Name	Class	Index Number

ANG MO KIO SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR EXPRESS

CHEMISTRY 6092 /01

31 August 2022 / Wednesday

Total Mark: 40

1 hour

Setters: Ms Tay Siew Peng

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST
Write in soft pencil.
Write your Name, Class and Index Number in the spaces on the Multiple Choice Answer Sheet.
Do not use staples, paper clips, glue or correction fluid/tape.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the Multiple Choice Answer Sheet.

Read the instructions on the Multiple Choice Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page **15**.
The use of an approved scientific calculator is expected, where appropriate.

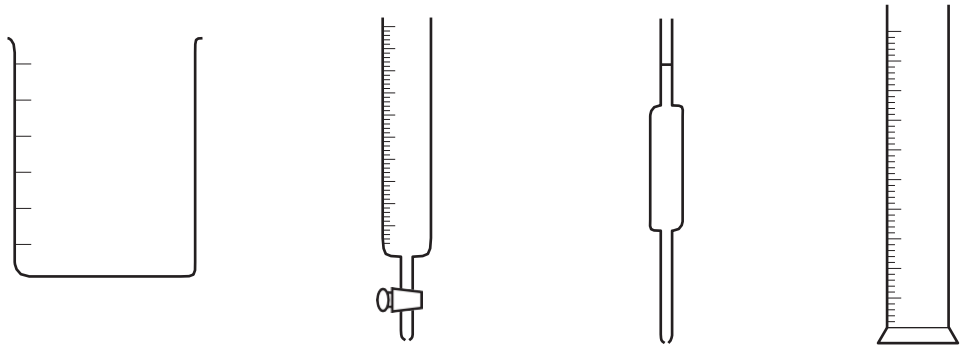
	For Examiner's use	
	TOTAL	

This document consists of **15** printed pages, including the cover page.

[Turn over]

1 A student has to measure 30.60 cm^3 of aqueous sodium bromide solution.
Which apparatus should the student select?

A **B** **C** **D**



2 Caffeine is a white solid that melts at 235 °C. A sample of impure caffeine is found to be contaminated with sugar.

Propanone is an organic solvent with a low boiling point. Caffeine and sugar have different solubilities in water and propanone.

substance	solubility in water	solubility in propanone
caffeine	moderate	high
sugar	high	insoluble

The following steps could be carried out to obtain pure caffeine from a mixture of caffeine and sugar.

I add excess water
II add excess propanone
III cool and crystallise
IV filter the mixture
V heat the filtrate

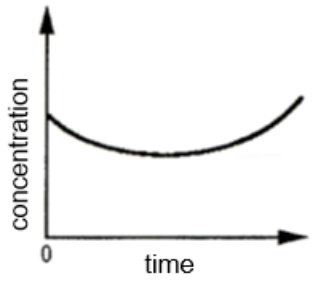
In what order should the steps be carried out?

A I, IV, III and V
B I, IV, V and III
C II, IV, III and V
D II, IV, V and III

3 Distillation is used to obtain water from a copper(II) sulfate solution.

Which graph shows the change in concentration of the copper(II) sulfate solution in the distillation flask?

A



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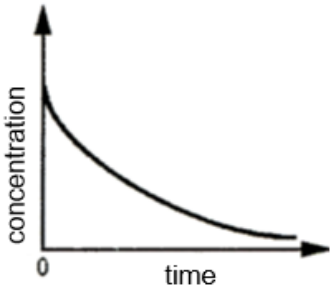

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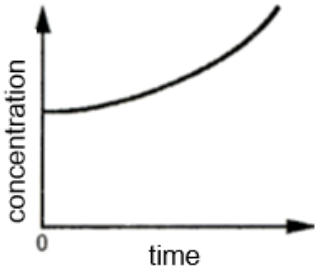

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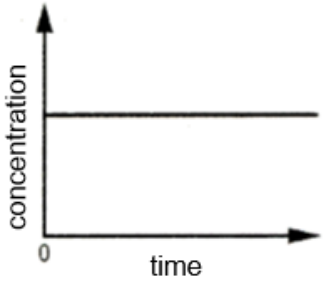


4 A new substance was discovered and a series of experiments were conducted on it.
Which observation suggests that the substance cannot be an element?

A It has a fixed boiling point.
B It dissolves in water to form a yellow-green solution.
C When heated strongly, a brown solid and a yellow gas are produced.
D When heated in air, it can form oxides with two different chemical formulae.

5 Three atoms are shown.

$^{32}_{16}X$ $^{33}_{16}Y$ $^{32}_{17}Z$

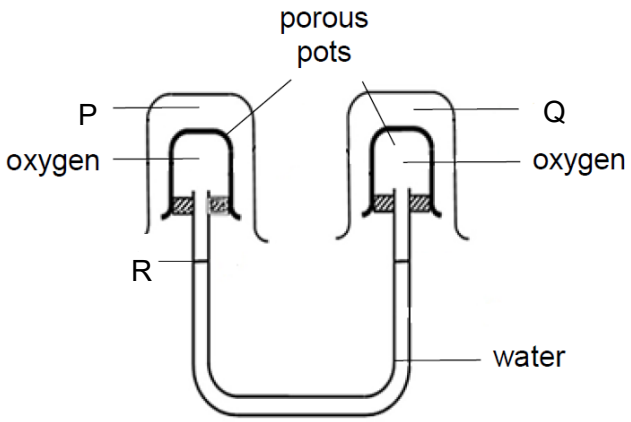
What can be deduced from the proton numbers and nucleon numbers of X, Y and Z?

A X and Y are the same element.
B X and Z are the same element.
C Y has more protons than X.
D Z has more neutrons than Y.

6 At what temperature does a dilute sodium chloride solution begin to boil?

A 98 °C
B 100 °C
C 103 °C
D 801 °C

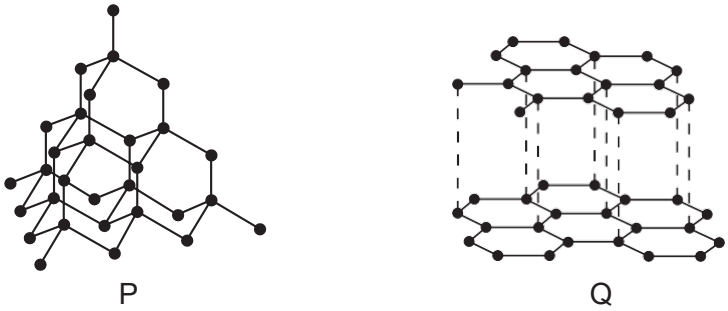
7 The diagram shown is set up using different gases in two beakers P and Q. The inverted smaller beakers both contain oxygen gas.



Which gases, when placed in beakers P and Q respectively, will cause the water level at R to rise initially?

	P	Q
A	ammonia	nitrogen
B	argon	oxygen
C	carbon dioxide	nitrogen
D	oxygen	carbon dioxide

8 The diagrams show the structures of two solids, P and Q.



Which row is correct?

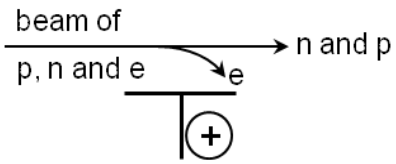
	has covalent bonding	conducts electricity
A	P only	P only
B	P only	Q only
C	both P and Q	P only
D	both P and Q	Q only

9 Zinc and zinc chloride are both conductors of electricity in their molten states. What particles cause the two substances to conduct electricity in molten state?

	zinc	zinc chloride
A	mobile electrons only	mobile electrons only
B	mobile electrons only	mobile ions only
C	mobile electrons and ions	mobile ions only
D	mobile electrons and ions	mobile electrons and ions

10 A beam of electron (e), neutron (n) and proton (p) is passed across a positively charged plate.
Which diagram correctly shows how the particles are affected by the plate?

A



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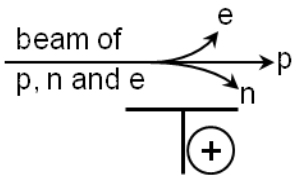

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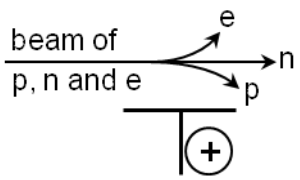

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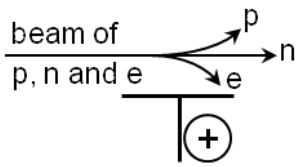


11 Element M has *n* protons and can form M^{2+} ions.
Element N has (*n* + 3) protons.

Which of the following correctly describes the type of compound and the chemical formula of compound formed between M and N?

	type of compound	chemical formula
A	covalent compound	MN_2
B	covalent compound	M_3N_2
C	ionic compound	MN_2
D	ionic compound	M_3N_2

12 The empirical formula of compound X is CH_2 and the relative molecular mass, M_r of X, is 70.

What is the molecular formula of X?

A CH_2
B C_2H_4
C C_5H_{10}
D C_nH_{2n}

13 Which compound contains both ionic bonds and covalent bonds?

A Al_2O_3
B NaCl
C SiO_2
D $ZnSO_4$

14 A chemist wants to make calcium nitrate. He starts with 8.00 g of pure calcium oxide and an excess of dilute nitric acid. He produces 12.65 g of pure anhydrous calcium nitrate.

What is the percentage yield of calcium nitrate?

[relative atomic masses, A_r: Ca, 40; N, 14; H, 1; O, 16]

A 54.0%
B 63.2%
C 67.1%
D 86.8%

15 Chlorine can be prepared from concentrated hydrochloric acid and potassium manganate(VII). The reaction is represented as:

$$2KMnO_4 + x\,HCl \rightarrow 2KCl + 2MnCl_2 + y\,H_2O + z\,Cl_2$$

What are the values of *x*, *y* and *z*?

	x	*y*	*z*
A	16	8	5
B	5	8	16
C	8	5	16
D	16	5	8

16 Sulfur dioxide can react with oxygen to form sulfur trioxide as shown.

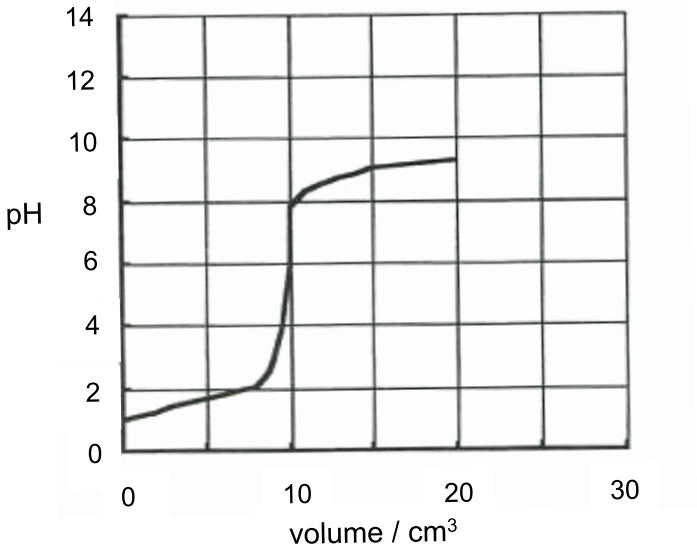
$$2SO_2\,(g) + O_2\,(g) \rightarrow 2SO_3\,(g)$$

If 200 cm^3 of sulfur dioxide is reacted with 200 cm^3 of oxygen, what is the volume of gases remaining after the reaction?

A 100 cm^3
B 200 cm^3
C 300 cm^3
D 400 cm^3

17 In an acid-base titration, a 0.10 mol/dm^3 alkali is added to 10 cm^3 of 0.10 mol/dm^3 dilute acid.

The graph below shows the change in pH during the titration.



Which of the following represents the titration shown in the graph?

A ethanoic acid and aqueous sodium hydroxide
B ethanoic acid and aqueous ammonia
C nitric acid and aqueous sodium hydroxide
D nitric acid and aqueous ammonia

18 The table gives information about three indicators.

indicator	colour at pH 1	pH at which indicator changes colour	colour at pH 12
thymol blue	red	3	yellow
congo red	blue	5	red
phenolphthalein	colourless	10	red

What colour would be obtained when each indicator is added separately to pure water?

	thymol blue	congo red	phenolphthalein
A	red	blue	red
B	yellow	blue	colourless
C	yellow	blue	red
D	yellow	red	colourless

19 Which substance has the greatest number of atoms?

A 33 g of CO_2
B 2 g of He
C 27 g of F_2
D 40 g of MgO

20 In which of the following reactions is dilute hydrochloric acid not behaving as an acid?

A $NH_3 + HCl \rightarrow NH_4Cl$
B $AgNO_3 + HCl \rightarrow AgCl + HNO_3$
C $CuCO_3 + 2HCl \rightarrow CuCl_2 + CO_2 + H_2O$
D $Mg + 2HCl \rightarrow MgCl_2 + H_2$

21 The labels fell off two bottles each containing a colourless solution, one of which was sodium carbonate solution and the other was sodium chloride solution.

Which of the following tests would allow the identification of the solutions?

A addition of dilute nitric acid
B addition of aqueous ammonia
C addition of sodium hydroxide solution
D addition of lead(II) nitrate solution

22 Which of the following reactants could be used to prepare a pure sample of sodium sulfate safely?

A sodium carbonate and sulfuric acid
B sodium and sulfuric acid
C sodium nitrate and zinc sulfate
D sodium and zinc sulfate

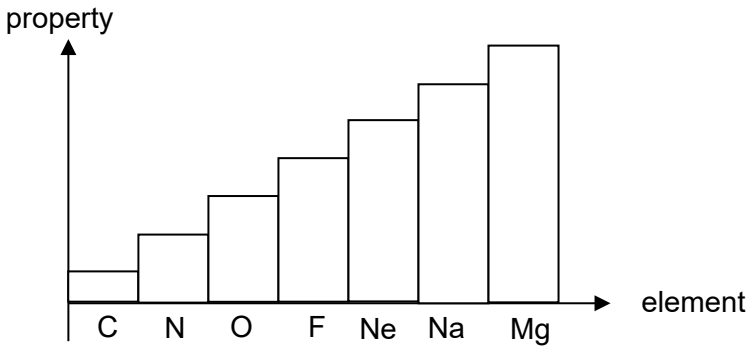
23 Which reaction is a redox reaction?

A $Ag^+ + Cl^- \rightarrow AgCl$
B $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$
C $H^+ + OH^- \rightarrow H_2O$
D $2SO_2 + O_2 \rightarrow 2SO_3$

24 Which statement about the elements lithium and rubidium is correct?

A Both lithium and rubidium are in the same period of the Periodic Table.
B Lithium reacts more rapidly in water than rubidium.
C Lithium floats on water but rubidium sinks.
D Lithium has a higher melting point than rubidium.

25 The graph shows how a property changes from carbon to magnesium in the Periodic Table.

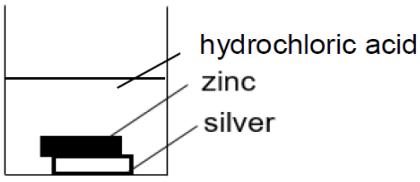


What could be the property?

A atomic number
B atomic radius
C group number
D number of neutrons

26 The diagrams below show four pieces of metal strips of equal size tied together in dilute hydrochloric acid solution. After five minutes, which beaker will contain the least number of zinc ions in the solution?

A



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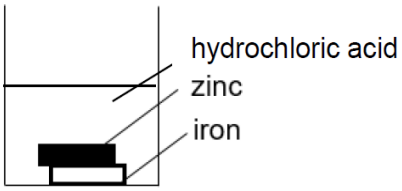

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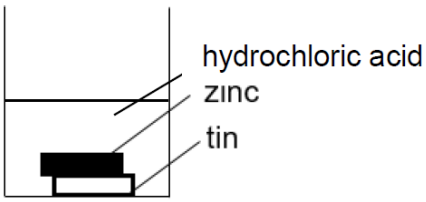
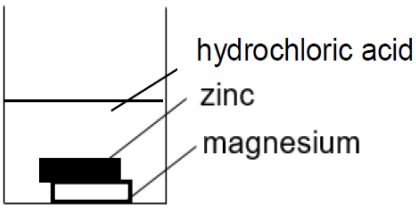


D



27 Which of the following is not a reason for recycling metals?

A Metal ores are a finite resource.
B Recycling metals increases the purity of the metals.
C Recycling reduces the cost of producing the metals.
D Recycling reduces the pollution of the atmosphere.

28 Which of the following acid produces the fastest initial speed of reaction when 10 cm^3 of each acid is used to react with excess magnesium carbonate? Assume that the rest of the experimental conditions are kept the same.

A 1.5 mol/dm^3 of hydrochloric acid
B 1.5 mol/dm^3 of sulfuric acid
C 2.0 mol/dm^3 of nitric acid
D 3.0 mol/dm^3 of ethanoic acid

29 Magnesium reacts with dilute sulfuric acid according to the equation below,

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4 + H_2$$

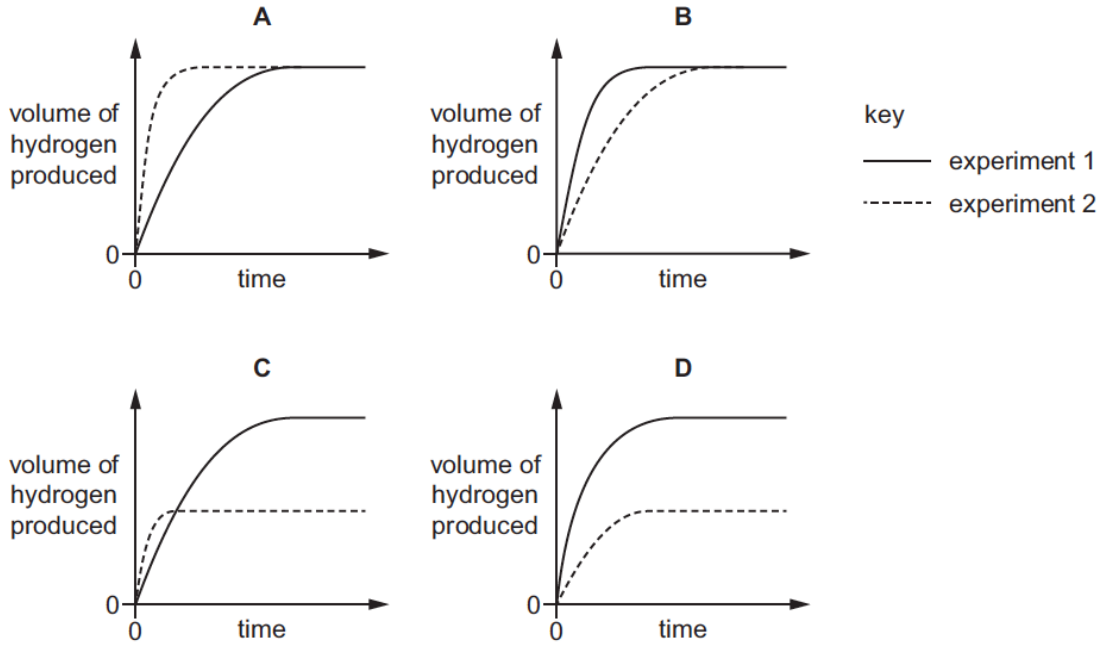
Two experiments are carried out at 25 °C

experiment 1 24.0 g of powdered magnesium is reacted with 100 cm^3 of 1.0 mol / dm^3 sulfuric acid.

experiment 2 24.0 g of powdered magnesium is reacted with 50 cm^3 of 2.0 mol / dm^3 sulfuric acid

During each experiment the volume of hydrogen produced is measured. The results are plotted on a graph.

Which graph is correct?



30 Consider the following reaction for which the heat of reaction is given:

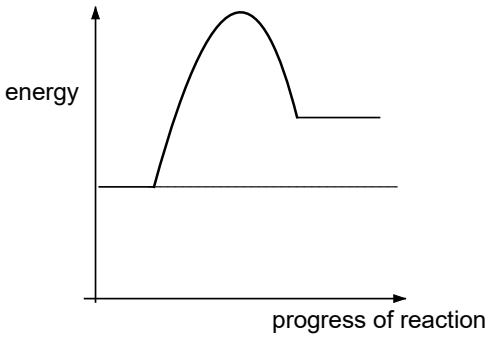
$$2N_2O_5\ (s) \rightarrow 2N_2\ (g) + 5O_2\ (g) \qquad \Delta H = -23\ kJ/mol$$

Which of the following statements about the statement is not correct?

A For 2 moles of N_2 (g) produced, 11.5 kJ of heat is released.
B For each mole of N_2O_5 (s) reacted, 11.5 kJ of heat is released.
C The energy of N_2O_5 is more than that of the products.
D The energy involved in bond forming is greater than that of bond breaking.

31 Which energy profile diagram shows the fastest endothermic reaction?

A



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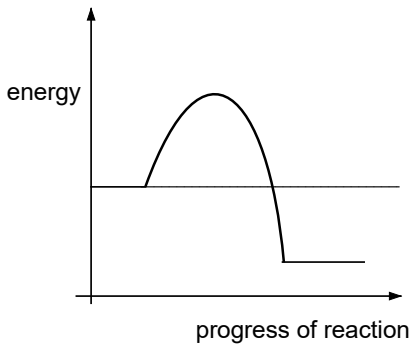

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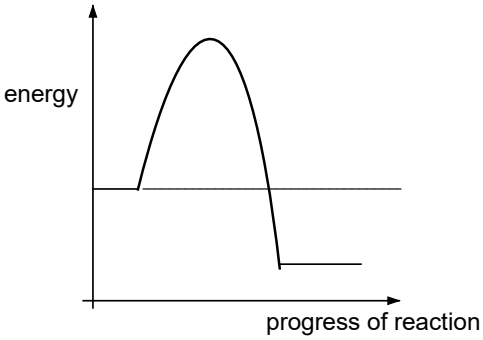

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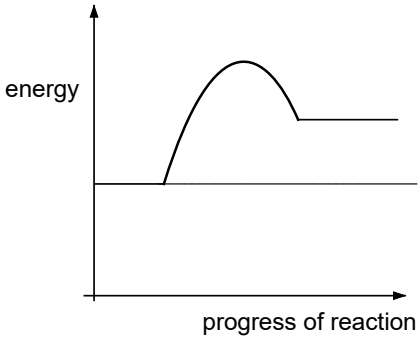
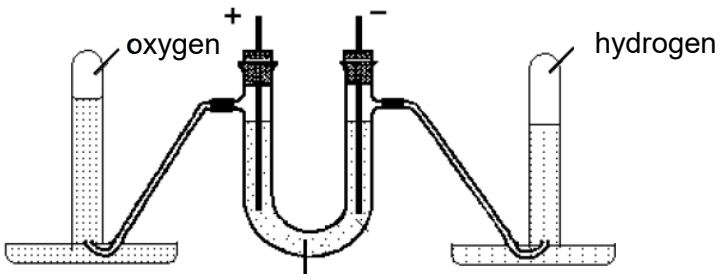


32 An experiment was carried out to electroplate an iron spoon with chromium metal.
Which row correctly states the cathode, the aqueous electrolyte used and the reaction taking place at the anode?

	cathode used	aqueous electrolyte used	reaction at anode
A	chromium	iron(III) nitrate	$Cr^{3+} + 3e^- \rightarrow Cr$
B	chromium	chromium(III) nitrate	$Cr \rightarrow Cr^{3+} + 3e^-$
C	spoon	chromium(III) nitrate	$Cr \rightarrow Cr^{3+} + 3e^-$
D	spoon	chromium(III) nitrate	$Cr^{3+} + 3e^- \rightarrow Cr$

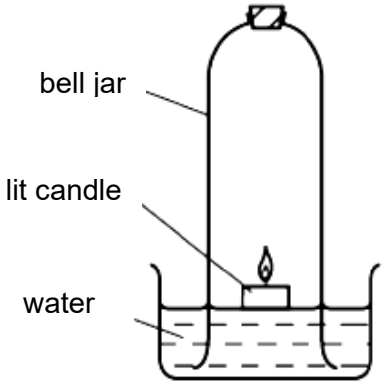
33 The diagram shows the electrolysis of dilute sodium chloride solution using inert electrodes.



Given that, at room temperature and pressure (r.t.p), *x* moles of electrons were passed in the circuit, which of the following statement is correct?
[1 mole of gas occupies 24dm^3 at r.t.p]

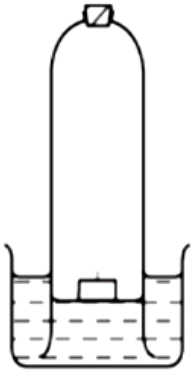
A 6*x* dm^3 of oxygen was collected at the anode.
B 6*x* dm^3 of hydrogen was collected at the cathode.
C 12*x* dm^3 of oxygen was collected at the cathode.
D 12*x* dm^3 of hydrogen was collected at the anode.

34 The diagram shows an experiment to determine the percentage of oxygen in air.



Which diagram shows the correct level of water after the candle stops burning?

A



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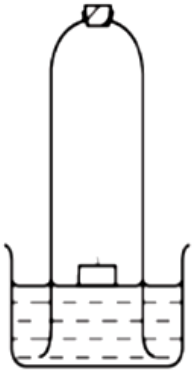

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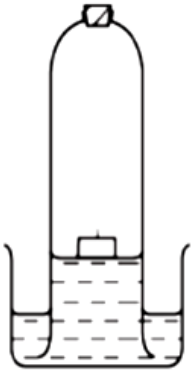

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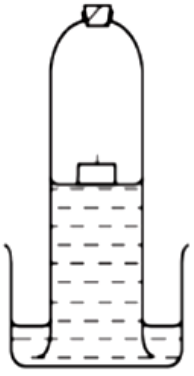


35 Ammonia is manufactured by the Haber process using an iron catalyst.

Which statement about the reaction is **not** correct?

A A high temperature will decrease the yield of the ammonia.
B It is not possible to obtain 100% of the yield.
C Nitrogen is reduced by hydrogen to form ammonia.
D The iron catalyst is used to increase the speed of reaction and yield of ammonia.

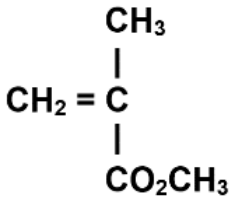
36 Which statement about the fractional distillation of petroleum is correct?

A At each level in the distillation column, only one compound is collected.
B The higher up the distillation column, the higher the temperature.
C The molecules collected at the bottom of the distillation column are the most flammable.
D The molecules reaching the top of the column have the smallest relative molecular masses.

37 Which of the following could not be produced when methane reacts with fluorine in the presence of ultraviolet light?

A fluoromethane
B hydrogen fluoride
C hydrogen
D tetrafluoromethane

38 Bone cement, used in artificial hip and knee replacements, is formed by the polymerisation of methyl methacrylate and the process is highly exothermic.



methyl methacrylate

Which statement about bone cement is true?

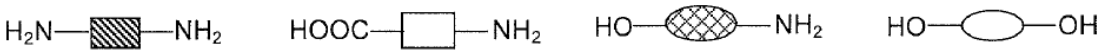
A Aqueous bromine is decolourised by bone cement.
B Less energy is released in the formation of C-C bond than the energy absorbed in the breaking of C=C bond.
C The empirical formula of bone cement is C_2H_4O.
D Water is formed in the polymerisation of methyl methacrylate.

39 The ester which gives the smell of fried chicken has the formula $C_3H_7COOC_2H_5$.

Which pair of reactants will produce this ester?

A ethanol and propanoic acid
B ethanol and butanoic acid
C propanol and ethanoic acid
D propanol and butanoic acid

40 The diagram shows four different monomers.



How many of the monomers can react with the monomer below to form a polymer?

A 1
B 2
C 3
D 4

End of Paper 1

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name: …… Index no: ……... Class: ……..….

Bukit Batok Secondary School

PRELIMINARY EXAMINATIONS 2022

SECONDARY 4 EXPRESS

CHEMISTRY 6092/01

Paper 1 Multiple Choice

24 Aug 2022
1105–1205

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions.
For each question there are four possible answers **A, B, C** and **D.**
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 16.

The use of an approved scientific calculator is expected, where appropriate.

1 An impure sample of X melts at around 90°C.

What is most likely to be the melting point of pure X?

A below 80°C
B between 85°C and 90°C
C between 90°C and 95°C
D cannot be determined

2 A student is given a mixture of oil, sand and copper(II) sulfate solution and is required to produce from the mixture, separate samples of oil, sand and copper(II) sulfate. The student is supplied with filtration apparatus(F), a separating funnel(S) and an evaporating dish(E).

Which is the correct order of the apparatus used to separate the mixture?

A E, F, then S
B F, E, then S
C F, S, then E
D S, F, then E

3 Which statements about kinetic particle theory are **incorrect**?

1. When a solid is heated, its particles melt.
2. All particles move at a constant speed.
3. Ethene particles move faster than carbon monoxide.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

4 Statements A to D refer to an imaginary element discovered in a meteoroid.

Which statement most strongly suggests that the element is a non-metal?

A It forms an acidic oxide.
B It is soluble in water.
C It is a conductor of electricity.
D It reacts vigorously with chlorine.

5 Two particles have the same number of protons and neutrons but different number of electrons.

What can be inferred about the two particles?

A They are an atom and an ion of different elements.
B They are an atom and an ion of the same element.
C They are an atom and an isotope of different elements.
D They are an atom and an isotope of the same element.

6 Elements D, E and G are atoms with proton numbers 3, 8 and 17 respectively.

What are the formulae of their hydrides formed?

	D	E	G
A	DH	HE_2	HG
B	DH	H_2E	HG
C	DH_2	HE_2	HG_7
D	DH_3	H_2E	H_7G

7 Which row shows the substance in the order of their melting points?

	highest →			lowest
A	chlorine	fluorine	potassium	diamond
B	diamond	potassium	chlorine	fluorine
C	diamond	potassium	fluorine	chlorine
D	potassium	diamond	chlorine	fluorine

8 Which statement explains why sodium chloride has a lower melting point than magnesium oxide?

A Sodium chloride is covalent but magnesium oxide is ionic.
B Sodium is more reactive than magnesium.
C The attraction between the ions in sodium chloride is weaker than that between the ions in magnesium oxide.
D The melting point of sodium is lower than that of magnesium.

9 Carbon disulfide is used in manufacturing polymers and fibres.

Which statement about carbon disulfide is correct?

A It has a high boiling point.
B It has a giant molecular structure.
C It is a simple covalent compound with single covalent bonds only.
D It is insoluble in water.

10 A carbohydrate has the formula $(CH_2O)_6$.
0.50 mole of this carbohydrate is burned in excess oxygen and the gas formed is collected.

What volume of gas, measured at room temperature and pressure, is collected?

A 12 dm^3 **B** 24 dm^3 **C** 72 dm^3 **D** 144 dm^3

11 The formula of an oxide of element Y is Y_2O_3.
16.0 g of the oxide contains 11.2 g of Y.

How many moles of Y does 11.2 g of the element contain?

A $\frac{4.8}{16} \times \frac{2}{3}$
B $\frac{4.8}{16} \times \frac{3}{2}$
C $\frac{8}{16} \times \frac{3}{2}$
D $\frac{8}{16} \times \frac{3}{2}$

12 The equations show the reactions involved in the formation of nitric acid, HNO_3, from nitrogen.

$$N_2 + O_2 \rightarrow 2NO$$
$$2NO + O_2 \rightarrow 2NO_2$$
$$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$$

How many moles of nitric acid are formed from 1.00 mole of nitrogen?

A 0.50 **B** 1.00 **C** 2.00 **D** 4.00

13 Bromopropane, C_3H_7Br, can be made from propanol using the reaction shown.

$$C_3H_7OH + HBr \rightarrow C_3H_7Br + H_2O$$

In an experiment, 8 g of propanol produced 10 g of bromopropane.

What is the percentage yield of bromopropane?

A 40.7% **B** 48.8% **C** 61.0% **D** 80.0%

14 In a volumetric experiment involving the addition of hydrochloric acid to 25.0 cm^3 of aqueous sodium hydroxide, it is necessary to determine when the reaction is just completed.

Which piece of apparatus could be used to determine the end-point of the reaction?

A electronic balance
B gas syringe
C stopwatch
D thermometer

15 A salt, S, is dissolved in water to give a green solution. On adding chlorine, the green solution turned yellow. On addition of aqueous sodium hydroxide, the green solution gave a green precipitate and the yellow solution gave a red-brown precipitate. On addition of dilute nitric acid followed by aqueous silver nitrate, the green solution gave a white precipitate.

What is the formula of S?

A $CuCl_2$ **B** $FeCl_2$ **C** $FeCl_3$ **D** $FeSO_4$

16 Which pair of reagents can be used to prepare an aqueous solution containing copper(II) chloride as the only salt?

A copper metal and dilute hydrochloric acid
B copper(II) nitrate and aqueous sodium chloride
C copper(II) oxide and dilute hydrochloric acid
D copper(II) sulfate and dilute hydrochloric acid

17 The following reactions are carried out.

reaction	result
ammonium chloride is warmed with sodium hydroxide solution	gas P is given off
ethanoic acid is added to an aqueous solution of ammonia	compound Q is formed
sulfuric acid is added to an ammonium carbonate	gas R is given off

What are P, Q and R?

	gas P	compound Q	gas R
A	ammonia	ammonium carbonate	carbon dioxide
B	ammonia	ammonium ethanoate	carbon dioxide
C	ammonia	ammonium ethanoate	ammonia
D	chlorine	ammonium ethanoate	ammonia

18 On bubbling carbon dioxide into an aqueous solution of X, a white precipitate, Y, is formed. This precipitate dissolves when more carbon dioxide is bubbled through, forming a colourless solution of Z.

What are the formulae of X, Y and Z?

	X	Y	Z
A	$CaCO_3$	$Ca(OH)_2$	$Ca(HCO_3)_2$
B	$CaCO_3$	$Ca(HCO_3)_2$	$Ca(OH)_2$
C	$Ca(OH)_2$	$CaCO_3$	$Ca(HCO_3)_2$
D	$Ca(OH)_2$	$Ca(HCO_3)_2$	$CaCO_3$

19 Elements X and Y are in Group VII of the Periodic Table.

X is a liquid at room temperature. Y is a gas at room temperature.

Which statement(s) is/are correct?

1. Atoms of X have more neutrons than atoms of Y.
2. X has a paler colour than Y.
3. X displaces Y from aqueous solutions of Y^- ions.

A 1 only **B** 2 only **C** 1 and 3 only **D** 1, 2 and 3

20 Which statement about groups and periods in the Periodic Table is correct?

A Atoms gain electrons more easily down Group I.
B Melting point increases across Period 2.
C The most unreactive group contains only non-metals.
D The strongest non-metal oxidising agent is at the bottom of a group.

21 W, X, Y and Z are elements in the Periodic Table.

- W and Z reacts readily with water.
- W has a lower melting point than Z.
- X has a common oxidation state of +1 and Y has a common oxidation state of −2.
- X is formed as an element at the negative electrode during electrolysis.

Which statement could be correct?

A W could be sodium and Z could be potassium.
B X is most likely to be hydrogen.
C Y is most likely to be in Group IV.
D Z burns in air to form an acidic oxide.

22 Which process does **not** involve either oxidation or reduction?

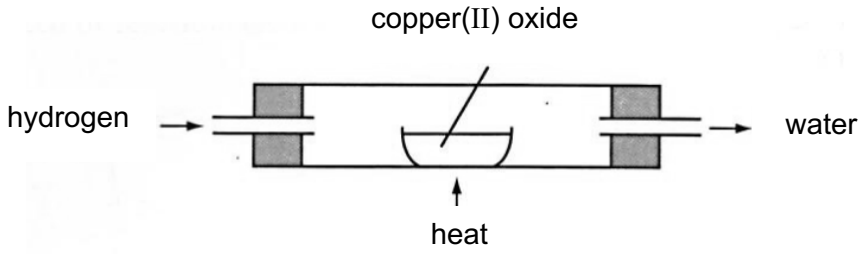
A formation of ammonium nitrate from ammonia and nitric acid
B formation of nitrogen monoxide from ammonia
C formation of sulfuric acid from sulfur
D formation of zinc from zinc sulfide

23 In which equations is manganese being oxidised?

1 $2Mn(OH)_2 + H_2O_2 \rightarrow Mn_2O_3 + 3H_2O$
2 $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$
3 $MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

A 1 only **B** 1 and 2 only **C** 2 and 3 only **D** 3 only

24 An experiment is set up as shown.



A student recorded these inferences.

1. Hydrogen is a reducing agent.
2. Hydrogen gains oxygen to form water.
3. Copper(II) oxide loses oxygen to form copper metal.
4. Copper(II) oxide gains hydrogen and is reduced.

Which of these inferences are **true**?

A 1 and 3 only
B 2 and 4 only
C 1, 2 and 3 only
D 1, 2 and 4 only

25 In the manufacture of iron by the blast furnace, which are the main gases that escape from the top of the blast furnace?

A carbon monoxide, carbon dioxide, hydrogen
B nitrogen, carbon dioxide, carbon monoxide
C nitrogen, oxygen, steam
D oxygen, carbon dioxide, sulfur dioxide

26 When heated, solid X gives off a gas. When this gas is bubbled through limewater, a white precipitate is formed.

The residue, after heating solid X, reacts with dilute acid and aqueous alkali.

What is X?

A iron(II) carbonate
B lead(II) carbonate
C magnesium carbonate
D sodium carbonate

27 Experiments were carried out to determine the reactivity of three metals, X, Y and Z. The results are tabulated below.

experiment	X	Y	Z
reaction with steam	no	yes	yes
reduction of metal oxide with carbon	yes	yes	no

Which metal is likely to be X, Y and Z?

	X	Y	Z
A	copper	zinc	magnesium
B	copper	magnesium	zinc
C	magnesium	zinc	copper
D	zinc	copper	magnesium

28 A coil of clean copper wire is suspended in a beaker of aqueous silver nitrate. Crystals of silver are deposited on the copper wire.

Which statement is **not** correct?

A The copper is oxidised.
B The solution turns blue.
C The total mass of the crystals of silver increases gradually.
D The total number of positive ions in the solution is unchanged.

29 The table gives information about five metals.

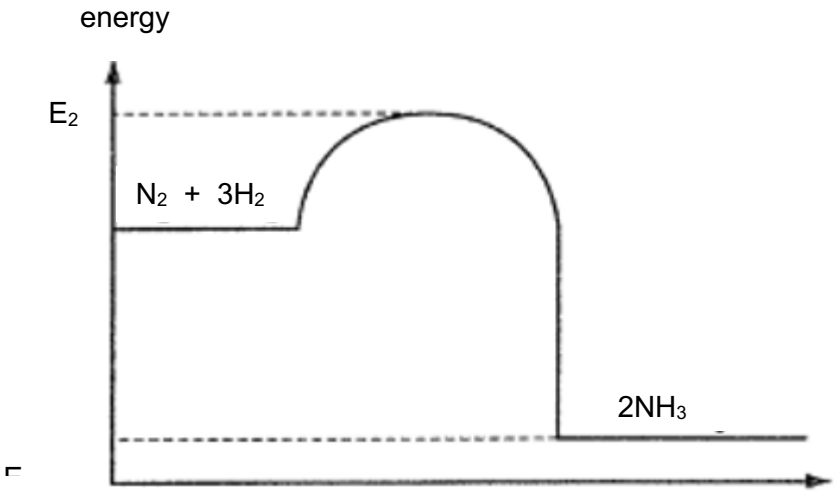
metal	% in earth's crust	cost per tonne / $
aluminium	8.1	750
copper	0.0007	1080
iron	5	300
tin	0.0002	9500
zinc	0.015	575

The general pattern suggests that the higher the percentage of metal in the earth's crust, the lower the cost.

Aluminium does **not** fit in this pattern. Why is this so?

A Collection and transportation of used aluminium for recycling cost money.
B Demand for the uses of aluminium is greater than other metals.
C Reduction of aluminium oxide using electricity is more expensive.
D The oxide layer for protecting aluminium has to be removed.

30 The energy profile diagram shows Haber process.



What does the energy change $E_2 - E_1$ represent?

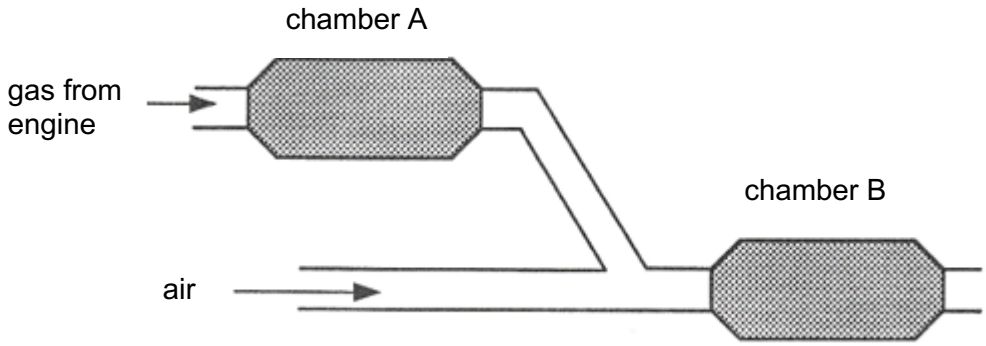
A activation energy of the forward reaction
B activation energy of the reverse reaction
C enthalpy change for the forward reaction
D enthalpy change for the reverse reaction

31 Ammonia is produced by the reaction of the elements hydrogen and nitrogen in the Haber process.

How is ammonia produced during the Haber process separated from the reaction mixture?

A cooling the mixture
B dissolving the other two gases
C filtering out the other two gases
D passing gaseous mixture through fused calcium oxide

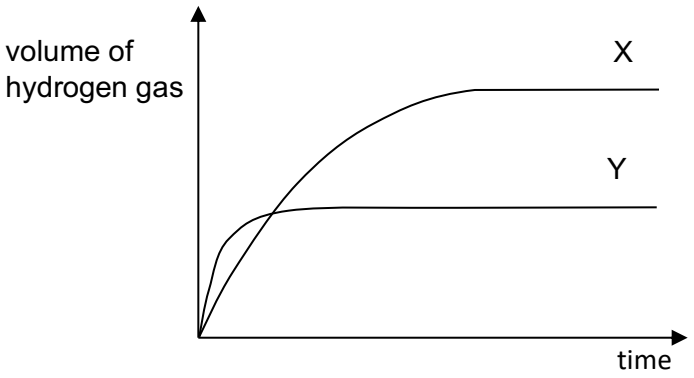
32 The diagram below shows a catalytic converter that is installed in a car in which the engine runs on petrol. It consists of a reductive chamber A and an oxidative chamber B.



Which equation represents the reaction that takes place in one of the chambers?

A $N_2 + O_2 \rightarrow N_2O_2$
B $2CO + O_2 \rightarrow 2CO_2$
C $CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$
D $2NO + O_2 \rightarrow 2NO_2$

33 Two experiments on the reaction between zinc and sulfuric acid are carried out and their results are given in the graph below.



If 4 g of zinc granules reacts with 100 cm^3 of 1.0 mol/dm^3 sulfuric acid to produce graph X, which of the following could give rise to graph Y?

A 2 g zinc granules in 100 cm^3 of 1.0 mol/dm^3 sulfuric acid
B 2 g zinc granules in 100 cm^3 of 2.0 mol/dm^3 sulfuric acid
C 4 g zinc granules in 50 $cm^3$of 2.0 mol/dm^3 sulfuric acid
D 4 g zinc granules in 25 cm^3 of 2.0 mol/dm^3 sulfuric acid

34 Why is nickel used in the hydrogenation of alkenes?

A It increases the yield of products.
B It lowers the activation energy of the reaction.
C It makes the reaction more exothermic.
D It prevents a reverse reaction from occurring.

35 Which of the following combinations of type of electrodes, electrolyte and products at the electrodes is correct when the solution is electrolysed?

	type of electrodes	electrolyte	product at the anode	product at the cathode
A	carbon	aqueous hydrochloric acid	oxygen	hydrogen
B	carbon	concentrated potassium chloride	chlorine	oxygen
C	copper	dilute copper(II) nitrate	copper	copper
D	platinum	concentrated sodium hydroxide	oxygen	sodium

36 A metal key is being electroplated with copper. The mass of the key is measured before and after the electroplating process.

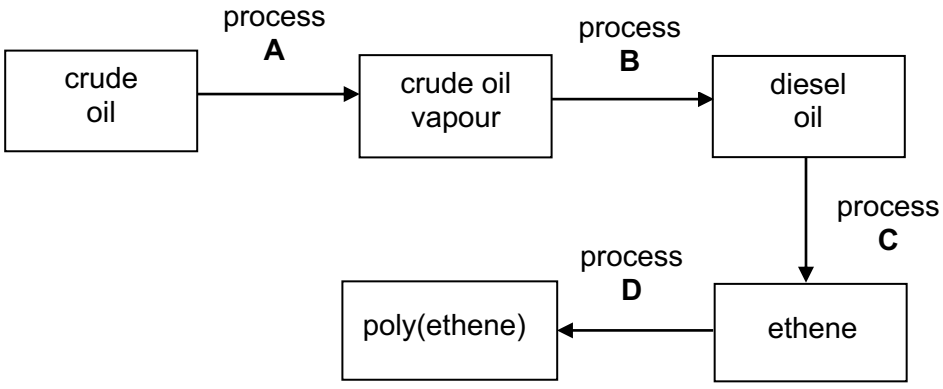
	mass of metal key / g
before electroplating	5.43
after electroplating	6.71

What is the number of moles of oxygen gas formed at the other electrode?

A 0.01 mol. **B** 0.02 mol. **C** 0.03 mol. **D** 0.04 mol.

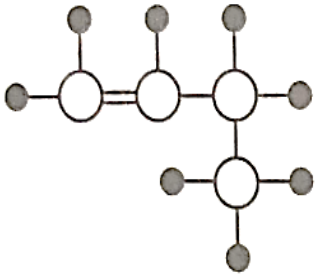
37 The flow chart outlines the manufacture of poly(ethene) from crude oil.

Which process involves cracking?

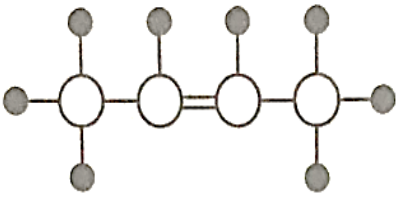


38 The molecular structures of three hydrocarbons are shown below:

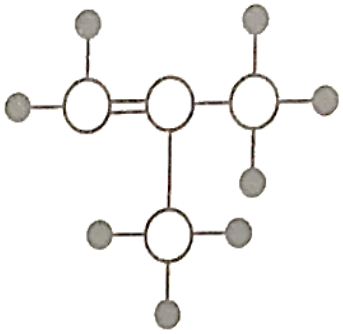
R



S



T



key = carbon

= hydrogen

Which statement about these hydrocarbons is correct?

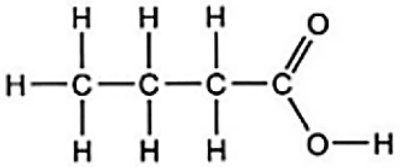
A All three hydrocarbons are isomers of propene.
B R is a branched alkene.
C S is but-1-ene.
D T is an isomer of butene.

39 The results of two tests on compound U are shown.

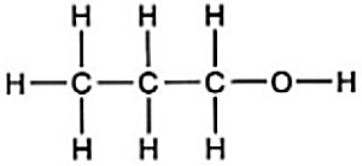
test	result
add aqueous bromine	turns colourless
add acidified potassium manganate(VII) solution	turns colourless

Which structure is U?

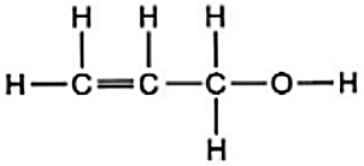
A



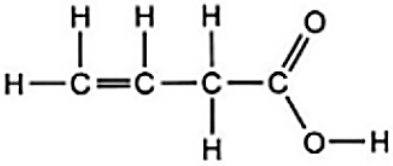
B



C



D



40 L has the formula $HOOC(CH_2)_4COOH$ and M has the formula $H_2N(CH_2)_6NH_2$.
When L is reacted with M, a macromolecule is formed.

Which statement about this macromolecule is correct?

A Double bonds in the monomers are broken during its formation.
B It is non-biodegradable.
C It has ester linkages.
D It represents the structure of Terylene.

End of Paper

DATA SHEET

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H Hydrogen 1										2 He Helium 4
3 Li Lithium 7	4 Be Beryllium 9											5 B Boron 11	6 C Carbon 12	7 N Nitrogen 14	8 O Oxygen 16	9 F Fluorine 19	10 Ne Neon 20
11 Na Sodium 23	12 Mg Magnesium 24											13 Al Aluminium 27	14 Si Silicon 28	15 P Phosphorus 31	16 S Sulfur 32	17 Cl Chlorine 35.5	18 Ar Argon 40
19 K Potassium 39	20 Ca Calcium 40	21 Sc Scandium 45	22 Ti Titanium 48	23 V Vanadium 51	24 Cr Chromium 52	25 Mn Manganese 55	26 Fe Iron 56	27 Co Cobalt 59	28 Ni Nickel 59	29 Cu Copper 64	30 Zn Zinc 65	31 Ga Gallium 70	32 Ge Germanium 73	33 As Arsenic 75	34 Se Selenium 79	35 Br Bromine 80	36 Kr Krypton 84
37 Rb Rubidium 85	38 Sr Strontium 88	39 Y Yttrium 89	40 Zr Zirconium 91	41 Nb Niobium 93	42 Mo Molybdenum 96	43 Tc Technetium -	44 Ru Ruthenium 101	45 Rh Rhodium 103	46 Pd Palladium 106	47 Ag Silver 108	48 Cd Cadmium 112	49 In Indium 115	50 Sn Tin 119	51 Sb Antimony 122	52 Te Tellurium 128	53 I Iodine 127	54 Xe Xenon 131
55 Cs Caesium 133	56 Ba Barium 137	57 – 71 lanthanoids	72 Hf Hafnium 178	73 Ta Tantalum 181	74 W Tungsten 184	75 Re Rhenium 186	76 Os Osmium 190	77 Ir Iridium 192	78 Pt Platinum 195	79 Au Gold 197	80 Hg Mercury 201	81 Tl Thallium 204	82 Pb Lead 207	83 Bi Bismuth 209	84 Po Polonium –	85 At Astatine –	86 Rn Radon –
87 Fr Francium –	88 Ra Radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db Dubnium –	106 Sg Seaborgium –	107 Bh Bohrium –	108 Hs Hassium –	109 Mt Meitnerium –	110 Ds Darmstadtium –	111 Rg Roentgenium –	112 Cn Copernicium –	–	114 Fl Flerovium –		116 Lv Livermorium –		

Key

proton (atomic) number

atomic symbol

lanthanoids	57 La Lanthanum 139	58 Ce Cerium 140	59 Pr Praseodymium 141	60 Nd Neodymium 144	61 Pm Promethium 147	62 Sm Samarium 150	63 Eu Europium 152	64 Gd Gadolinium 157	65 Tb Terbium 159	66 Dy Dysprosium 162	67 Ho Holmium 165	68 Er Erbium 167	69 Tm Thulium 169	70 Yb Ytterbium 173	71 Lu Lutetium 175
actinoids	89 Ac Actinium –	90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium –	94 Pu Plutonium –	95 Am Americium –	96 Cm Curium –	97 Bk Berkelium –	98 Cf Californium –	99 Es Einsteinium –	100 Fm Fermium –	101 Md Mendelevium –	102 No Nobelium –	103 Lr Lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

BEDOK SOUTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022

4EXP

CANDIDATE NAME			
CLASS		REGISTER NUMBER	

CHEMISTRY 6092/01

31st August 2022

Additional Materials: Optical Mark Sheet (OMS)

1 hour

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on this paper with a blue or black pen.

Write your name, register number, class and subject on the Optical Mark Sheet (OMS) provided.
Write in soft pencil on the OMS.
Do not use staples, paper clips, glue, or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OMS.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this paper.
The use of an approved scientific calculator is expected, where appropriate.

A copy of the Periodic Table is printed on page **13**.

For Examiner's Use	
Paper 1 (30%)	40

Setter: DL

1 An unknown white solid, X, melts between 161 °C and 163 °C. When chromatography is performed with water as the solvent, X produces only one spot on the chromatogram.

Which statement must be true about X?

A X is pure.

B X is impure.

C X can sublime.

D X is an ionic compound.

2 The boiling points of some substances found in air are given in the table.

Air is cooled to -190 °C so that some of the substances in it condense.

As the temperature is raised from -190 °C, which substance will undergo a change of physical state into a gas first?

	substance	boiling point / °C
A	argon	-186
B	oxygen	-183
C	nitrogen	-196
D	carbon dioxide	-78.5

3 Which statement correctly describes the rate and volume of hydrogen gas produced when 10 cm^3 of 1.00 mol/dm^3 of nitric acid and 10 cm^3 of 1.00 mol/dm^3 of ethanoic acid are reacted separately with excess magnesium until no visible reaction?

	volume of H_2 produced	rate of reaction
A	the same volume of H_2 would be obtained for both acids	The reaction with ethanoic acid would proceed at a slower rate
B	the volume of H_2 would be more when nitric acid is used	The reaction with ethanoic acid would proceed at a slower rate
C	the same volume of H_2 would be obtained for both acids	both reactions would proceed at the same rate
D	the volume of H_2 would be more when nitric acid is used	both reactions would proceed at the same rate

4 The rate of diffusion of different gases is measured at the same temperature and pressure.
Which two gases would diffuse at a different rate?

A N_2 and CO **B** C_2H_4 and N_2

C CO_2 and C_3H_8 **D** C_3H_6 and CO

5 The R_f values for the dyes, J – M, in four different solvents are shown in the table.

	solvent			
	water	organic solvent 1	organic solvent 2	organic solvent 3
dye J	0.3	0.5	0.7	0.6
dye K	0.0	0.2	0.6	0.7
dye L	0.2	0.1	0.4	0.8
dye M	0.5	0.2	0.6	0.9

Which solvent could be used to separate a mixture of all four dyes, J, K, L and M?

A water **B** organic solvent 1

C organic solvent 2 **D** organic solvent 3

6 An isotope of element X has 15 protons and 17 neutrons in its nucleus.
Which chemical symbol best represents the ion of X?

A $^{15}_{32}X^{3+}$ **B** $^{15}_{32}X^{3-}$ **C** $^{32}_{15}X^{3+}$ **D** $^{32}_{15}X^{3-}$

7 Three different experiments that involve colour changes are carried out

.

1 Universal Indicator solution is bubbled with ammonia gas.
2 Sulfur dioxide is tested with acidified potassium manganate(VII) solution.
3 Chlorine gas is bubbled into litmus solution.

Which row correctly identifies the experiments that correspond to the colour changes?

	purple to colourless	**green to blue**	**red to colourless**
A	2	1	3
B	2	3	1
C	3	1	2
D	1	2	3

8 Which of the following represents the most likely structural formula for the compound S_2Cl_2?

A S – Cl – Cl – S

B S – Cl – S – Cl

C Cl – S – S – Cl

D Cl = S – S = Cl

9 An imaginary element has two isotopes:

- The first isotope has 15 protons and a relative abundance of 80%
- The second isotope has 16 neutrons

If the relative atomic mass of the imaginary element is 30.2, determine the number of neutrons in the first isotope.

A 15 **B** 16 **C** 17 **D** 18

10 A book recorded the formula of a sample of rust as '$\mathbf{2Fe_2O_3.\frac{3}{2}H_2O}$'.

What is the percentage by mass of iron in this sample of rust?

A 29.9% **B** 32.3% **C** 59.9% **D** 64.6%

11 What is the volume of carbon dioxide gas (at room temperature and pressure) produced when 2.65 g sodium carbonate reacts with 100 cm^3 of 0.10 mol/dm^3 hydrochloric acid?

A 120 cm^3 **B** 240 cm^3 **C** 600 cm^3 **D** 1200 cm^3

12 In an electrolysis experiment, the same amount of charge deposited 6 g of titanium and 16 g of copper. The charge on the copper ion was 2+. [A_r: Ti, 48; Cu, 64]

What was the charge on the titanium ion?

A 1+ **B** 2+ **C** 3+ **D** 4+

13 How many different ions are present in aqueous iron(II) sulfate?

A 2 **B** 3 **C** 4 **D** 5

14 Which statement about ammonia is correct?

A It reacts with alkalis to form salts.

B It dissolves in water to form an acidic solution.

C It is formed when ammonium salts are heated with sulfuric acid.

D It decomposes on heating to a high temperature to form nitrogen and hydrogen.

15 Solid ammonium chloride decomposes on heating in a test tube to produce two gases.

Which change would be observed to a piece of moist red litmus paper?

A remains red

B turns blue and remains blue

C turns blue and then turns red

D turns blue and then bleached

16 Which reagent cannot be used to distinguish aluminium hydroxide from calcium hydroxide?

A $H_2SO_4(aq)$ **B** $HCl(aq)$

C $NaOH(aq)$ **D** $NH_4OH(aq)$

17 Salt X can be prepared by reacting together an acid and a metal or insoluble metal carbonate. A pure sample of salt X is then obtained by filtration, followed by crystallisation of the filtrate.

What is the identify of salt X?

A lead(II) sulfate **B** sodium chloride

C copper(II) sulfate **D** magnesium chloride

18 Chlorine is reacted with aqueous potassium bromide and a brown solution is formed.

Which statement about this reaction is correct?

A Bromide ions gain electrons.

B The oxidation state of chlorine decreases.

C Chlorine is reduced because it loses electrons.

D Bromine has a higher electron affinity than chlorine.

19 Lithium reacts with dilute nitric acid at a constant room temperature.

Which statement about the rate of this reaction is correct?

A It increases as the reaction proceeds.

B It decreases as the reaction proceeds.

C It remains the same as the reaction proceeds.

D It increases then remains the same as the reaction proceeds.

20 An aqueous solution of sodium hydroxide has a pH of 10.

Which substance could be added to the aqueous sodium hydroxide to increase the pH?

A H^+ ions **B** OH^- ions

C Na^+ ions **D** H_2O molecules

21 For which does 10 g of the metal have the most electrons in its sea of electrons'?

A aluminium (Al) **B** sodium (Na)

C lithium (Li) **D** magnesium (Mg)

22 Metal M can be obtained from its aqueous chloride by electrolysis and from its oxide by heating with carbon.

Which metal is M?

A sodium **B** silver

C lead **D** copper

23 Potassium reacts with water to form solution R and gas S. When solution R reacts with dilute nitric acid, salt T is formed.

What are the formulae of R, S and T?

	solution R	gas S	salt T
A	KOH	H_2	KNO_3
B	KOH	CO_2	K_2NO_3
C	POH	H_2	PNO_3
D	POH	CO_2	P_2NO_3

24 A substance $NaXO_4$ undergo a chemical reaction with hydrogen peroxide, according to the following equation:

$$2NaXO_4 + 3H_2O_2 \rightarrow 2XO_2 + 2NaOH + 2H_2O + 3O_2$$

What is the role of hydrogen peroxide in the above reaction?

A It acts as a catalyst. **B** It is an oxidising agent.

C It is a reducing agent. **D** It is a dehydrating agent.

25 Metal M forms a chloride M*Cl*.

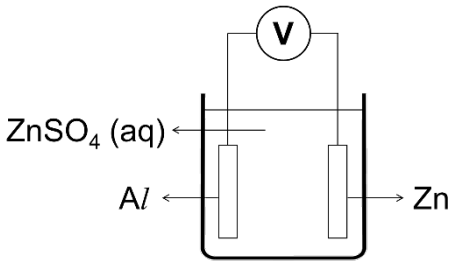
M is below copper in the reactive series.

If a concentrated aqueous solution of M*Cl* is electrolysed, which reaction will occur at the cathode and the anode?

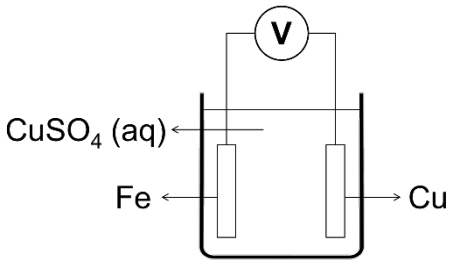
	cathode (negative electrode)	anode (positive electrode)
A	$M^+ + e^- \rightarrow M$	$2Cl^- \rightarrow Cl_2 + 2e^-$
B	$M^+ + e^- \rightarrow M$	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$
C	$2\ H^+ + 2e^- \rightarrow H_2$	$2Cl^- \rightarrow Cl_2 + 2e^-$
D	$2\ H^+ + 2e^- \rightarrow H_2$	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

26 In which diagram would the voltage measured be the highest?

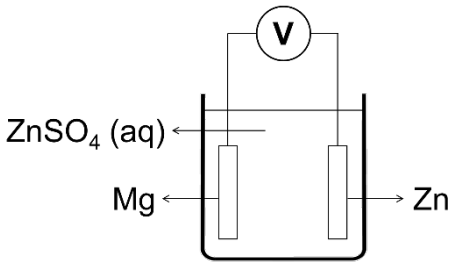
A



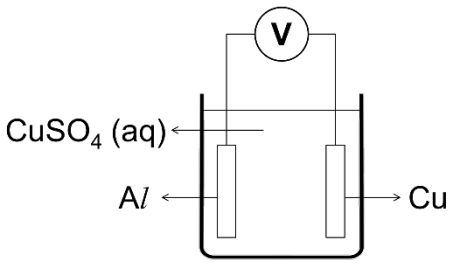
B



C

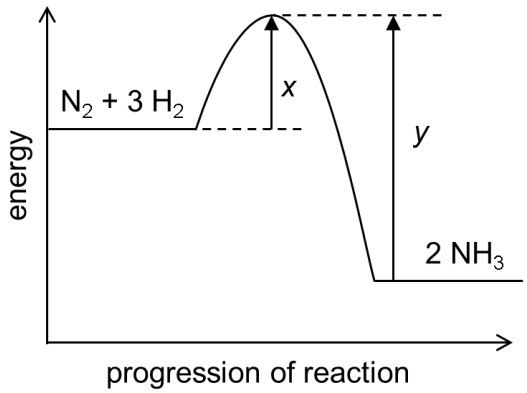


D



27 The equation and the energy profile for the reversible reaction in the Haber process are shown.

$$N_2 + 3\ H_2 \leftrightharpoons 2\ NH_3$$



Which statement about bond breaking and forming is correct?

A The energy released in forming bonds is labelled *x*.

B The energy released in breaking bonds is equal to *y*.

C The energy released in breaking bonds is less than the energy absorbed in forming bonds.

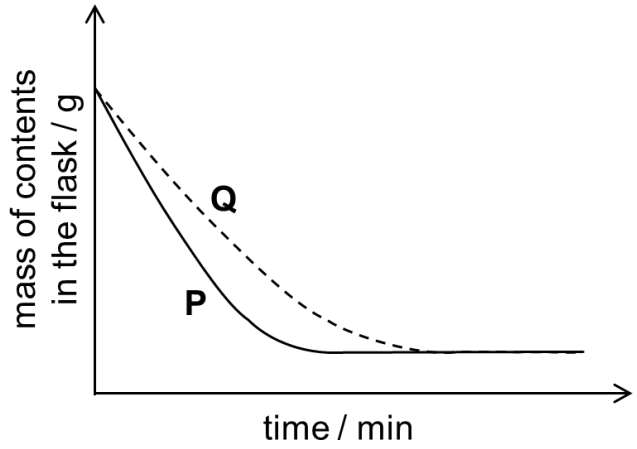
D The energy released in forming bonds is more than the energy absorbed in breaking bonds.

28 In experiment 1, one mole of ethane undergoes complete combustion to form carbon dioxide and water only. In experiment 2, one mole of propane is combusted completely instead.
How will the activation energy and enthalpy change of experiment 2 be different from experiment 1?

	activation energy	enthalpy change
A	unchanged	unchanged
B	increase	unchanged
C	unchanged	increase
D	increase	increase

29 Excess calcium carbonate powder was reacted with a fixed volume of dilute nitric acid in a conical flask placed on top of a mass balance. The mass of the contents in the flask was measured at regular time interval.

The data collected was used to plot graph P as shown below.



The experiment was modified in the following manner:

1. replacing the acid with ethanoic acid
2. use lumps of calcium carbonate
3. decrease the pressure on the system
4. increase the temperature of the acid

Which modification(s) will produce graph Q?

A 1 and 2 only **B** 3 and 4 only **C** 1, 2 and 3 **D** 2, 3 and 4

30 Which pair of gases are involved in the formation of acid rain?

A CO and CO_2 **B** CH_4 and NO_2

C NO_2 and CO **D** SO_2 and NO_2

40

31 Aqueous potassium iodide changes from colourless to brown when it is added to substance X.
What can be determined about substance X from this observation?

A Substance X is a reducing agent.

B Substance X is an oxidising agent.

C Substance X can only be aqueous bromine.

D Substance X contains Fe^{2+} ions which undergo oxidation.

32 Propene is used to make poly(propene).
Which fraction from petroleum is the main feedstock for the manufacture of propene?

A lubricating oils **B** paraffin

C bitumen **D** naphtha

33 What is added to polyunsaturated vegetable oils to form solid margarine?

A steam

B ethene

C hydrogen

D aqueous bromine

34 A sample of methane gas reacts with oxygen gas as shown by the equation below.

$$3CH_4(g) + 4O_2(g) \rightarrow C(s) + 2CO(g) + 6H_2O(l)$$

If 100 cm^3 of methane gas was mixed with 100 cm^3 of oxygen gas for this reaction, what is the volume of the resulting gaseous mixture at room temperature and pressure?

A 50 cm^3

B 75 cm^3

C 200 cm^3

D 225 cm^3

35 Which bond in a molecule of ethanoic acid is broken when it reacts with magnesium?

A the C-H bond

B the C-O bond

C the C=O bond

D the O-H bond

36 The equation for the cracking of an alkane is shown.

$$C_8H_{18} \rightarrow H_2 + X + Y$$

Compound X has three carbon atoms. Compound Y decolourises aqueous bromine.

What are the formulae of compounds X and Y?

	compound X	compound Y
A	C_3H_6	C_5H_{10}
B	C_3H_8	C_5H_{10}
C	C_3H_6	C_5H_{12}
D	C_3H_8	C_5H_{12}

37 X reacts with steam to form Y.
Y decolourises purple acidified potassium manganate(VII) to form Z.
If Z is butanoic acid, what is the formula of X?

A `C_4H_9OH **B** C_3H_7COOH

C C_4H_{10} **D** C_4H_8

38 Eleostearic acid is a fatty acid present in bitter gourd oil.
It has a molecular formula of $C_{17}H_{29}COOH$.
How many carbon-carbon double bonds are present in one molecule of the acid?

A `2 **B** 3

C 4 **D** 5

39 Which alcohol cannot be oxidised to produce a carboxylic acid containing a CH_3 group?

A ethanol

B butanol

C propanol

D methanol

40 Which reaction can vinegar undergo but is not typically observed for a mineral acid?

A `neutralisation with limewater **B** combustion with oxygen

C reaction with sodium metal **D** reaction with limestone

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name:	Register Number:	Class:

4E

BEDOK GREEN SECONDARY SCHOOL

4E

Preliminary Examination 2022

Chemistry **6092/1**

Paper 1 30 Aug 2022

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Write your name, register number and class on the multiple choice answer sheet provided.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D**. Choose the one you consider to be correct and record your choice in soft pencil on the optical mark sheet.

Read very carefully the instructions on the Multiple Choice Answer Sheet.

INFORMATION FOR CANDIDATES
Each correct answer will score one mark.
Any rough working should be done in this booklet.
A copy of the Periodic Table is on Page **16**.

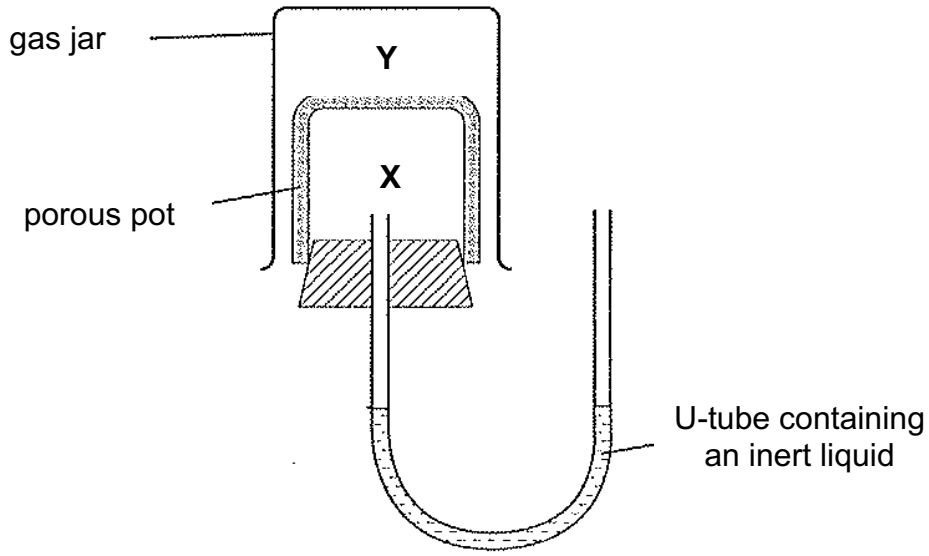
This document consists of **16** printed pages including the cover page.

[Turn Over

Section A: Multiple Choice Questions [40 marks]

Answer **all** questions on the Multiple Choice Answer Sheet.

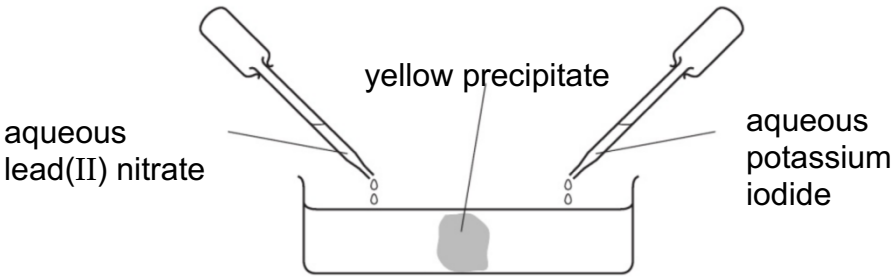
1 The apparatus consists of a porous pot containing a gas **X** which is surrounded by a gas **Y** in a gas jar.



Which of the following pairs of gases would cause an upward movement of the liquid in the right hand limb of the U-tube?

	gas **X**	gas **Y**
A	H_2	NH_3
B	NH_3	CO_2
C	O_2	H_2
D	O_2	CO_2

2 Aqueous lead(II) nitrate and aqueous potassium iodide are added to a dish containing water, as shown.

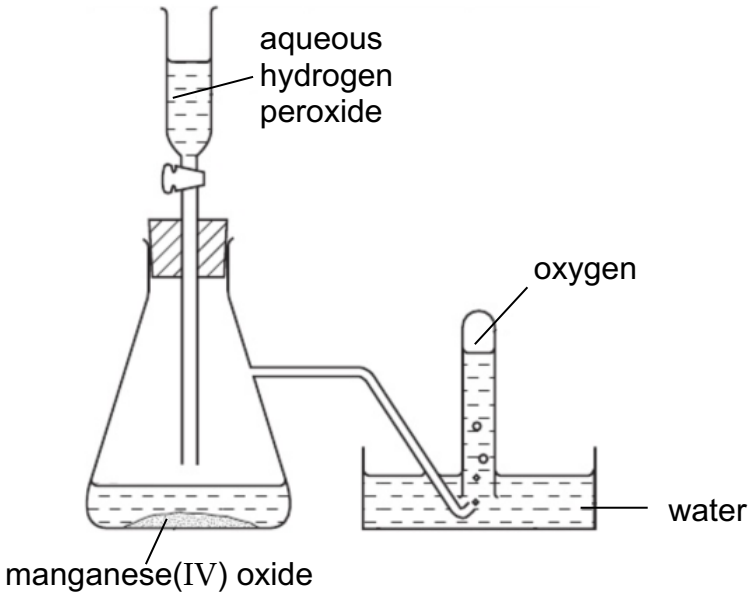


A yellow precipitate forms after a few minute.

Which process occurs **before** the precipitate forms?

A diffusion
B distillation
C precipitation
D neutralisation

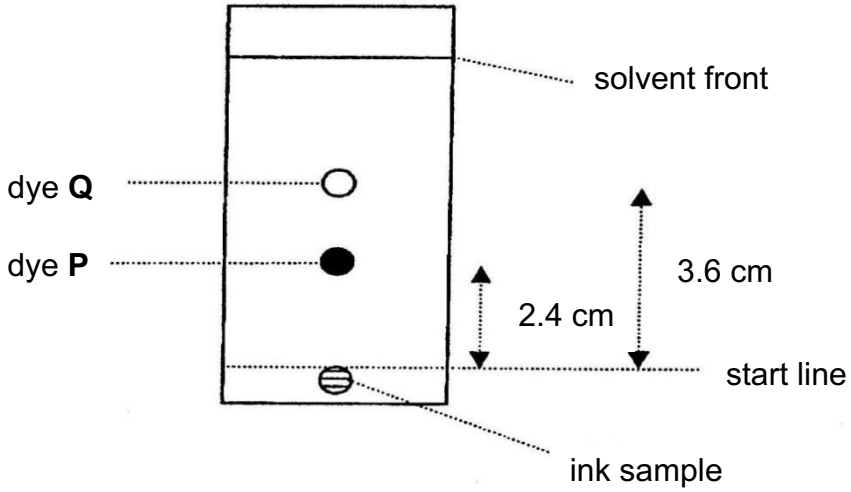
3 Oxygen was prepared from hydrogen peroxide and collected as shown in the diagram.



The first few tubes of gas were rejected because the gas was contaminated by

A nitrogen.
B hydrogen.
C water vapour.
D hydrogen peroxide.

4 The results of a paper chromatography experiment shown below were obtained.



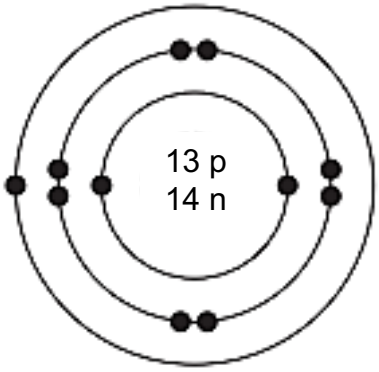
Given that the R_f value of dye **P** is 0.40, determine the R_f value of dye **Q**.

A 0.50
B 0.60
C 0.70
D 0.80

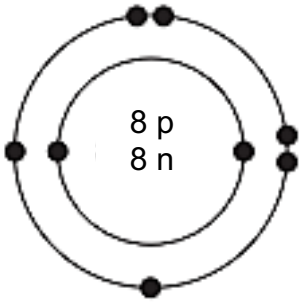
5 Which of the following properties **cannot** be used to test for the purity of a coloured liquid?

A filtration
B freezing point
C fractional distillation
D paper chromatography

6 The electronic structure of two atoms **P** and **Q** are shown below.



atom **P**



atom **Q**

When these two elements combine chemically, what will be the type of bonding and mass of one mole of the compound formed?

	type of bonding	mass of one mole of compound / g
A	ionic bonding	43
B	covalent bonding	70
C	ionic bonding	102
D	covalent bonding	113

7 An atom of element **X** has a proton number of 6 and nucleon number 16.

Which of the statements about **X** is correct?

A An oxide of **X** is likely to be basic.
B The formula of a molecule of **X** is likely to be $\mathbf{X_2}$.
C The formula of the compound formed by **X** and hydrogen is $\mathbf{XH_2}$.
D **X** is likely to form four covalent bonds and a giant covalent structure.

8 A metal consists of a lattice of positive ions in a 'sea' of electrons.

What changes, if any, take place to the 'sea' of electrons and positive ions in a metal wire when an electric current is passed through it?

	electrons	positive ions
A	replaced by new electrons	replaced by new electrons
B	replaced by new electrons	unchanged
C	unchanged	replaced by new electrons
D	unchanged	unchanged

9 Fibre glass can be considered to be a mixture of ionic oxides and giant covalent oxides.

Which of the following is **not** a constituent of fibre glass?

A MgO
B Na_2O
C P_4O_{10}
D SiO_2

10 Melamine is a plastic. It has an empirical formula of CH_2N_2.

If its relative molecular mass is 126, what is its molecular formula?

A CH_2N_2
B $C_2H_4N_4$
C $C_3H_6N_6$
D $C_4H_8N_8$

11 One mole of each of the following compounds is burnt in excess oxygen.

Which compound will produce two moles of carbon dioxide and two moles of steam only?

A C_2H_4
B C_3H_8
C C_2H_5OH
D C_2H_5COOH

12 The fertiliser ammonium nitrate is manufactured from ammonia by a two-stage process.

Stage 1: $NH_3 + 2O_2 \rightarrow HNO_3 + H_2O$

Stage 2: $HNO_3 + NH_3 \rightarrow NH_4NO_3$

What is the maximum mass of fertiliser that can be made if only 17 tonnes of ammonia is available?

A 34 tonnes
B 40 tonnes
C 80 tonnes
D 97 tonnes

13 68 g of impure hydrogen peroxide decomposes in the presence of manganese(IV) oxide to give 1.2 dm^3 of oxygen gas at room temperature and pressure.

$$2H_2O_2 \rightarrow O_2 + 2H_2O$$

What is the percentage purity of the hydrogen peroxide?

A 2.5%
B 5.0%
C 10.0%
D 15.0%

14 One mole of compound **X** gives three moles of ions in aqueous solution. **X** reacts with ammonium carbonate to give an acidic gas.

What is compound **X**?

A sulfuric acid
B ethanoic acid
C calcium hydroxide
D sodium hydroxide

15 In which pair of substances, does each have a giant molecular structure?

A methane, silica
B diamond, silica
C diamond, iodine
D iodine, methane

16 Which of the following salts is **incorrectly** matched with its method of preparation?

	salt	method of preparation
A	silver nitrate	add excess silver to warm dilute nitric acid
B	ammonium sulfate	titrate aqueous ammonia with dilute sulfuric acid
C	lead(II) chloride	mix aqueous lead(II) nitrate and dilute hydrochloric acid
D	iron(III) sulfate	add excess iron(III) oxide to warm dilute sulfuric acid

17 Which one of the following is **not** a redox reaction?

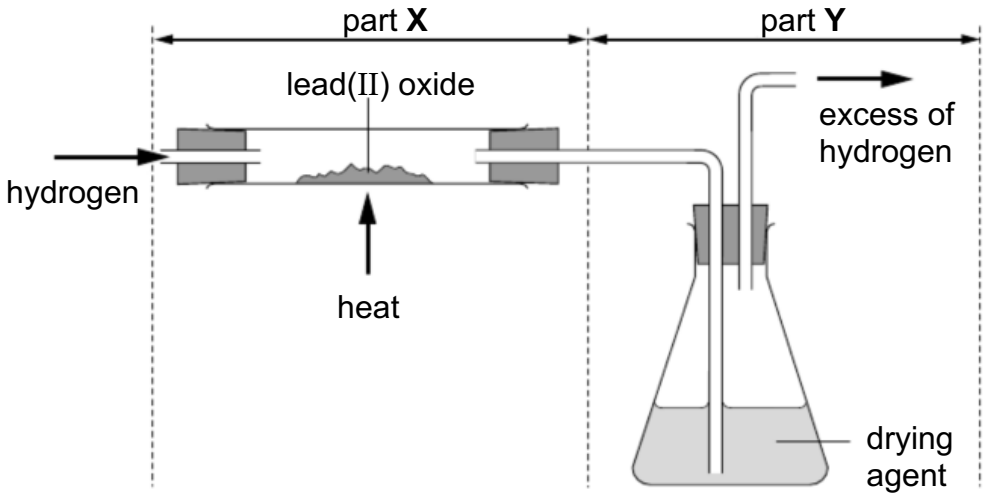
A $Mg + 2HCl \rightarrow MgCl_2 + H_2$
B $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$
C $Cu + 2H_2SO_4 \rightarrow CuSO_4 + 2H_2O + SO_2$
D $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

18 What is the role of hydrogen peroxide as shown in the reaction?

$$Ag_2O + H_2O_2 \rightarrow 2Ag + H_2O + O_2$$

A a catalyst
B a reducing agent
C an oxidising agent
D a dehydrating agent

19 Lead(II) oxide is reduced in the apparatus shown.



How do the masses of parts **X** and **Y** of the apparatus change?

	X	**Y**
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

20 A 25 cm^3 of phosphoric acid, H_3PO_4, contains 0.025 mole of the acid.
What is the hydrogen ion concentration in the solution?

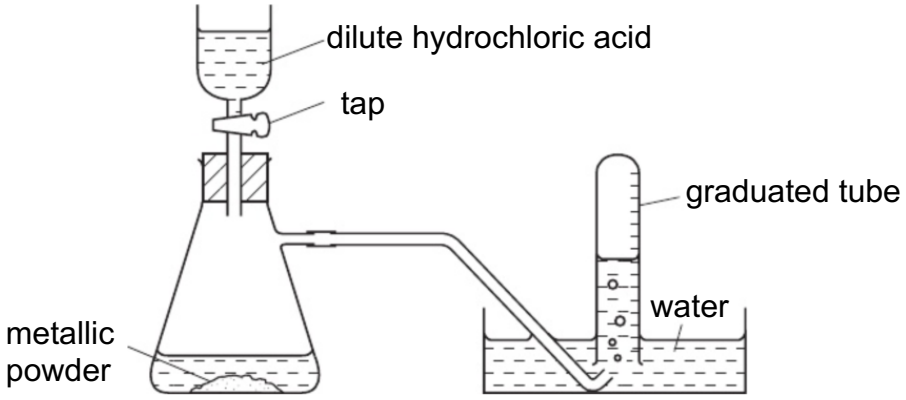
A 0.25 mol/dm^3
B 1.00 mol/dm^3
C 2.00 mol/dm^3
D 3.00 mol/dm^3

21 The carbonate of metal **X** is a white solid. It decomposes when heated. Carbon dioxide and a yellow solid oxide are formed.

What is metal **X**?

A iron
B lead
C copper
D sodium

22 The diagram shows apparatus for measuring the volume of hydrogen given off when an excess of dilute hydrochloric acid is added to powdered metal. The volume of gas is measured at room temperature and pressure.



The experiment is carried out three times, using the same mass of powder each time but with different powders:

- pure magnesium
- pure zinc
- a mixture of magnesium and zinc

Which powder gives the greatest volume of hydrogen and which the least volume?

	greatest volume of H_2	least volume of H_2
A	magnesium	zinc
B	magnesium	the mixture
C	zinc	magnesium
D	zinc	the mixture

23 The table shows the results of adding weighed pieces of nickel metal in salt solutions of metals **P**, **Q**, **R** and **S**.

solution	initial mass of nickel /g	mass of nickel after 15 minutes /g
P	6.0	5.0
Q	6.0	5.5
R	6.0	4.5
S	6.0	0.0

Which of the following statements is correct?

A **S** could be nickel(II) chloride solution.
B Metal **R** can displace the metal in solution **S**.
C The metal **R** is higher than nickel in the reactivity series.
D The metal **P** is higher than metal **Q** in the reactivity series.

24 Iron rusts when exposed to oxygen in the presence of water.

Which of these methods will **not** slow down the rate of rusting of an iron roof?

A painting it
B coating it with plastic
C galvanising it with zinc
D attaching strips of copper to it

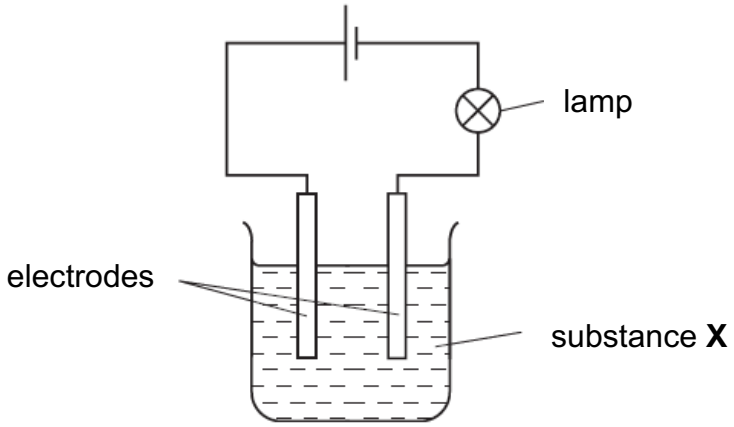
25 Three stages in making steel from iron ore are listed.

P carbon dioxide reacts with carbon
Q basic oxides and oxygen are added
R haematite is reduced

In which order do these stages occur?

A **P** → **Q** → **R**
B **P** → **R** → **Q**
C **Q** → **P** → **R**
D **R** → **Q** → **P**

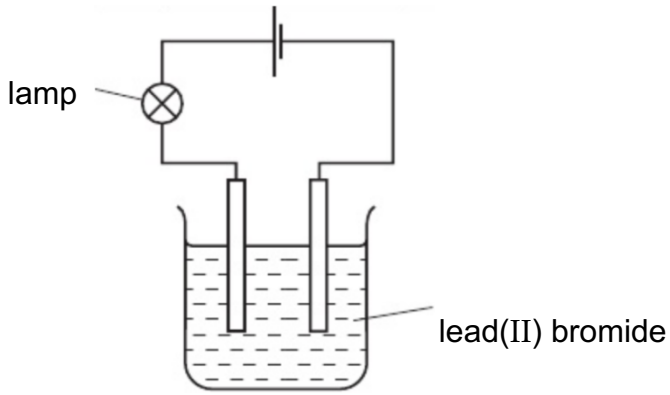
26 In the circuit below, the lamp lights up.



What could **X** be?

A liquid ethanol
B solid sodium chloride
C a solution of ethanol in water
D a solution of sodium chloride in water

27 The diagram shows the apparatus used to electrolyse lead(II) bromide using inert electrodes.



Why does the lamp light up only when the lead(II) bromide is melted?

A There are no ions in solid lead(II) bromide.
B Electrons flow through the lead(II) bromide when it is melted.
C The ions in lead(II) bromide are free to move only when the solid is melted.
D Bromine atoms in the lead(II) bromide are converted to ions when it is melted.

28 A molten compound is electrolysed. Two atoms of **X** are deposited at the negative electrode at the same time as three atoms of **Y** are deposited at the positive electrode.

These results show that:

X is a .....1.....;

Y is a .....2.....;

The formula of the compound is .....3..... .

How are gaps 1, 2 and 3 correctly completed?

	1	2	3
A	metal	non-metal	$\mathbf{X_3Y_2}$
B	metal	non-metal	$\mathbf{X_2Y_3}$
C	non-metal	metal	$\mathbf{X_3Y_2}$
D	non-metal	metal	$\mathbf{X_2Y_3}$

29 The results of three halogen displacement experiment are shown.

experiment	halogen added	halide solution		
		$\mathbf{X^-}$	$\mathbf{Y^-}$	$\mathbf{Z^-}$
1	$\mathbf{X_2}$	-	$\mathbf{Y_2}$ displaced	$\mathbf{Z_2}$ displaced
2	$\mathbf{Y_2}$	no reaction	-	no reaction
3	$\mathbf{Z_2}$	no reaction	$\mathbf{Y_2}$ displaced	-

What are halogen **X**, **Y**, **Z**?

	X	**Y**	**Z**
A	bromine	chlorine	iodine
B	bromine	iodine	chlorine
C	chlorine	bromine	iodine
D	chlorine	iodine	bromine

30 **R**, **S** and **T** are three elements in the same period of the Periodic Table.

- **R** forms an oxide which dissolves into aqueous sodium hydroxide only
- **S** forms an oxide which dissolves into dilute sulfuric acid only
- **T** forms an oxide which dissolves in both aqueous sodium hydroxide and dilute sulfuric acid

If **R**, **S** and **T** are placed in order of increasing number (lowest atomic number first), which order is correct?

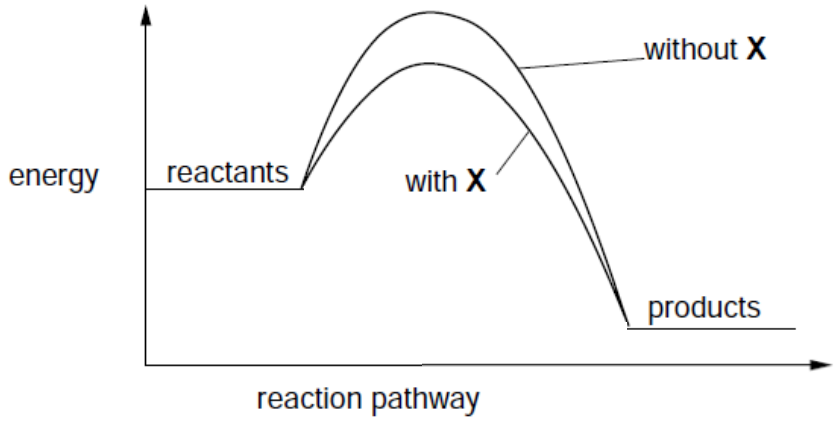
A **R**, **S**, **T**
B **S**, **T**, **R**
C **R**, **T**, **S**
D **T**, **S**, **R**

31 When solid **X** is dissolved in water, an endothermic change takes place. When 5 g of **X** are completely dissolved in 1000 cm^3 of water, a temperature change of 10°C occurs.

Which temperature change occurs when 5 g of **X** are completely dissolved in 500 cm^3 of water?

A a decrease of 5°C
B an increase of 5°C
C a decrease of 20°C
D an increase of 20°C

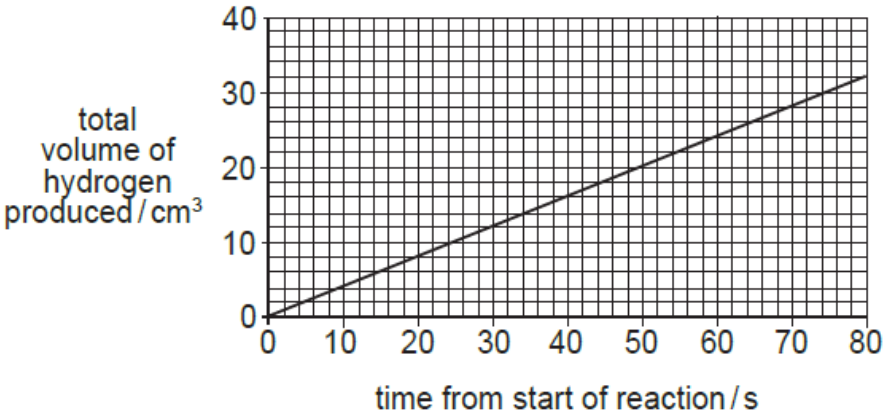
32 The energy profile diagrams show how adding a substance **X** to a reaction mixture changes the reaction pathway.



Which change is likely to be observed when **X** is added to the reaction mixture?

A The speed of reaction increases.
B The speed of reaction decreases.
C The reaction become less exothermic.
D The reaction become more exothermic.

33 Dilute hydrochloric acid was reacted with magnesium ribbon and the volume of hydrogen evolved was measured for the first 80 s.



What was the average rate of production of hydrogen?

A 0.4 cm^3/s
B 2.5 cm^3/s
C 4 cm^3/s
D 40 cm^3/s

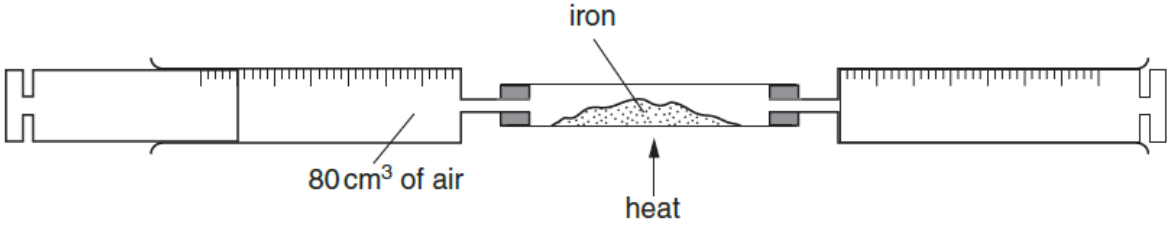
34 In the Haber process, nitrogen and hydrogen react to form ammonia.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92 \text{ kJ/mol}$$

Which factor decreases the speed of reaction?

A addition of a catalyst
B increasing the pressure
C increasing the temperature
D decreasing the temperature

35 An 80 cm^3 sample of air is trapped in a syringe. The air is slowly passed over heated iron in a tube until there is no further decrease in volume.



When cooled to the original temperature, which volume of gas remains?

A 16 cm^3
B 20 cm^3
C 64 cm^3
D 80 cm^3

36 Butane and methylpropane are isomers.
Which formula is different for the two isomers?

A general formula
B empirical formula
C structural formula
D molecular formula

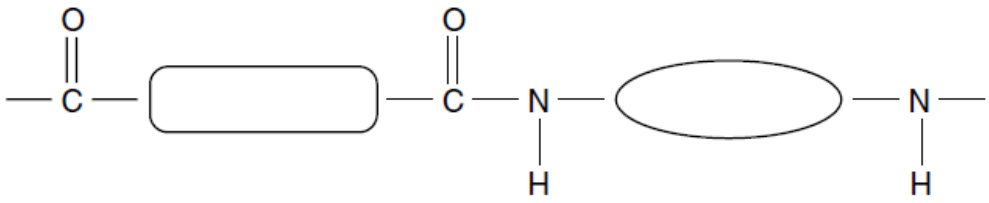
37 When 1 volume of gas **X** reacts with exactly 5 volume of oxygen it forms carbon dioxide and water only.

What is gas **X**?

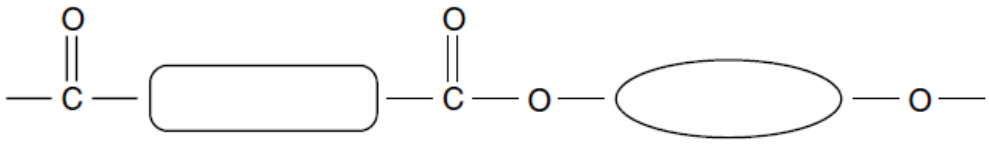
A methane
B ethane
C propane
D butane

38 The repeating units of two polymers, **X** and **Y**, are shown below.

X



Y



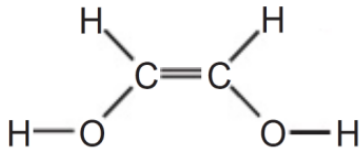
What are **X** and **Y**?

	X	Y
A	nylon	Terylene
B	starch	Terylene
C	protein	starch
D	nylon	protein

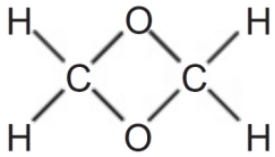
39 An aqueous solution of a compound of formula $C_2H_4O_2$ reacts with sodium carbonate, liberating carbon dioxide.

What is the structural formula of the compound?

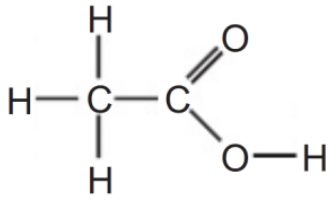
A



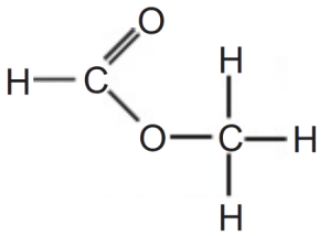
B



C



D



40 In the polymerisation of propene to poly(propene), there is **no** change in

A melting point.
B structural formula.
C molecular formula.
D percentage composition.

Name	Class				Index Number		

BROADRICK SECONDARY SCHOOL
SECONDARY 4 EXPRESS
PRELIMINARY EXAMINATION 2022

CHEMISTRY **6092/01**

Paper 1 Multiple Choice Sept 2022

Additional Materials: Multiple Choice Answer Sheet 1 hour

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paperclips, highlighters, glue or correction fluid.
Write your name, class and register number on top of this page and on any separate answer paper used.

There are **forty** questions on this paper. Answer **all** questions.
For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page **15**.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **15** printed pages including this cover page.

Setter : MR. LIANG ZW

[Turn over

1 In a titration, 25.0 cm^3 of aqueous sodium hydroxide is transferred into a conical flask. A few drops of indicator are added. Dilute hydrochloric acid is then added to the flask until the end-point is reached.

Which pieces of apparatus are used to measure volume in this experiment?

	to measure dilute hydrochloric acid	to measure aqueous sodium hydroxide
A	burette	beaker
B	burette	pipette
C	pipette	pipette
D	pipette	beaker

2 Which gas is **not** obtained industrially by fractional distillation?

A ammonia

B argon

C nitrogen

D oxygen

3 An impure sample of compound X has a melting point of 120 °C.

X is purified and its melting point is measured again.

Which row is correct?

	method of purifying X	melting point of pure X / °C
A	crystallisation	115
B	distillation	115
C	crystallisation	125
D	distillation	125

4 When dilute hydrochloric acid is added to a white powder, a gas is produced.

The solution remaining is tested separately with small volumes of both aqueous ammonia and aqueous sodium hydroxide.

A white precipitate is produced in both tests.

What is the white powder?

A aluminium oxide

B calcium oxide

C copper(II) carbonate

D zinc carbonate

5 Which statement explains why isotopes of the same element have the same chemical properties?

A They have the same electronic structure.

B They have the same relative mass.

C They have the same nucleon number.

D They have the same proton number.

6 An aqueous solution of a sulfate is made from a solid hydroxide, of a metal *M*, by the reaction:

$$M(OH)_2(s) + H_2SO_4(aq) \rightarrow MSO_4(aq) + 2H_2O(l)$$

For which hydroxide would the method **not** work?

A barium hydroxide

B copper(II) hydroxide

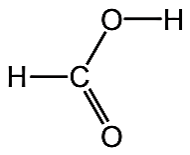
C iron(II) hydroxide

D magnesium hydroxide

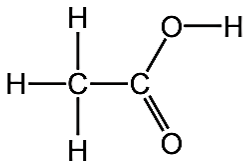
7 A covalent compound P has the empirical formula CH_2O.

Which structure represents P?

A



B



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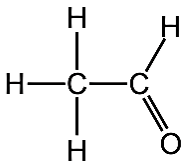

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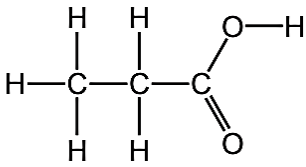


8 Which row explains why copper is a good conductor of electricity at room temperature?

	copper ions move freely	electrons move freely
A	no	no
B	no	yes
C	yes	no
D	yes	yes

9 What is the structure of sand?

A an ionic lattice

B a macromolecule

C a polymer

D a simple molecule

10 Pentane, C_5H_{12}, has a higher boiling point than propane, C_3H_8.

Which statement explains the difference in boiling point?

A Carbon-carbon single bonds are stronger than carbon-hydrogen bonds.

B Pentane has more covalent bonds to break.

C Pentane does not burn as easily as propane.

D The forces of attraction between pentane molecules are stronger than those between propane molecules.

11 Sodium nitride contains the nitride ion, N^{3-}.

Sodium nitride is unstable and decomposes into its elements.

What is the equation for the decomposition of sodium nitride?

A $2NaN_3 \rightarrow 2Na + 3N$

B $2Na_3N \rightarrow 6Na + N_2$

C $2NaN_3 \rightarrow Na_2 + 3N_2$

D $2Na_3N \rightarrow 6Na + 2N$

12 What is the mass of one mole of carbon-13?

A 0.013 g

B 0.026 g

C 1 g

D 13 g

13 The Haber process is a reversible reaction.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The reaction has a 30% yield of ammonia.

Which volume of ammonia gas, NH_3, measured at room temperature and pressure, is obtained by reacting 0.75 moles of hydrogen with excess nitrogen?

A 3600 cm^3

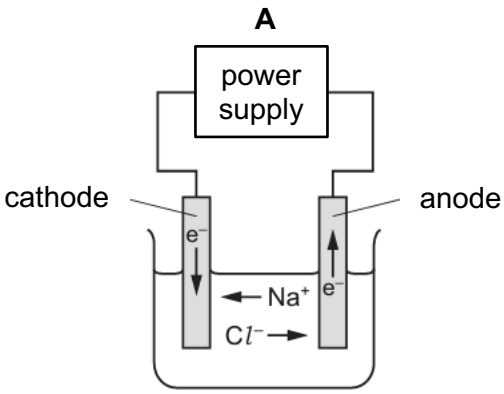
B 5400 cm^3

C 12000 cm^3

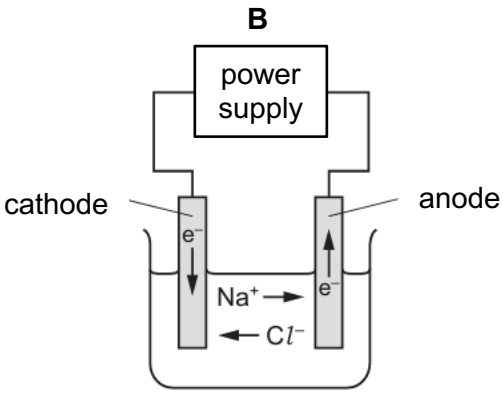
D 18000 cm^3

14 Which diagram shows the direction of movement of ions and electrons during the electrolysis of molten sodium chloride?

A



B



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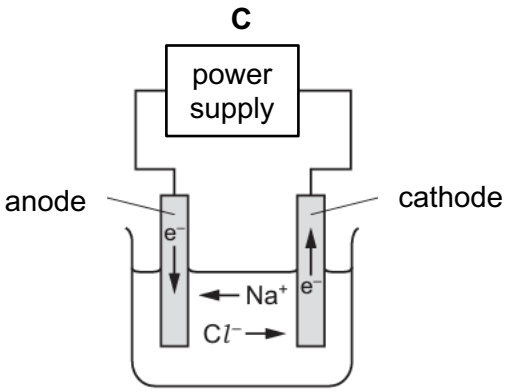
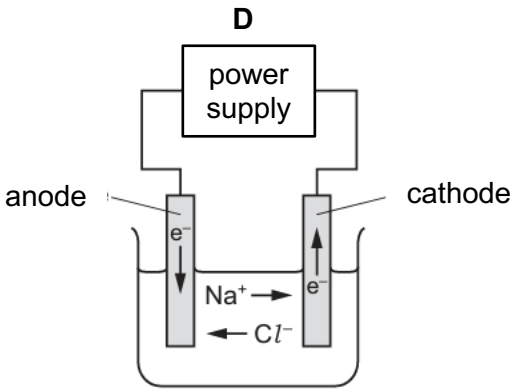
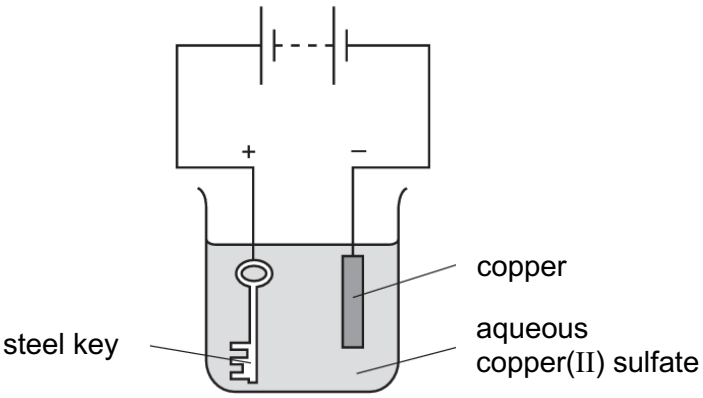


D



15 The apparatus shown is set up to plate a steel key with copper.



The key does **not** get coated with copper.

Which change needs to be made to plate the key?

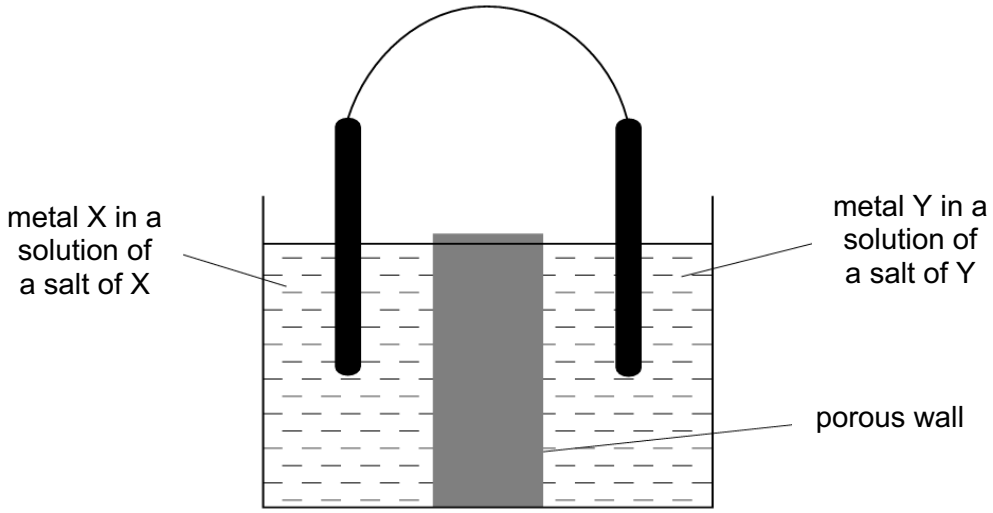
A increase the concentration of the aqueous copper(II) sulfate

B increase the voltage

C replace the solution with dilute sulfuric acid

D reverse the electrical connections

16 Which pair of metals X and Y will produce the highest voltage when used as electrodes in a simple cell?



	metal X	metal Y
A	copper	silver
B	magnesium	silver
C	magnesium	zinc
D	zinc	copper

17 Which row describes the changes that occur in an endothermic reaction?

	energy change	temperature
A	energy given out to the surroundings	decreases
B	energy given out to the surroundings	increases
C	energy taken in from the surroundings	decreases
D	energy taken in from the surroundings	increases

18 Which statement about fuels is correct?

A Heat energy is only produced by burning fuels.

B Hydrogen is used as a fuel although it is difficult to store.

C Methane is a good fuel because it produces only water when burned.

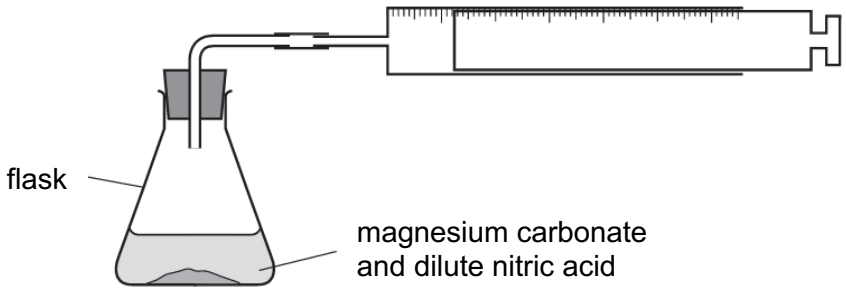
D Uranium is burned in air to produce energy.

19 Which statement about endothermic and exothermic reactions is correct?

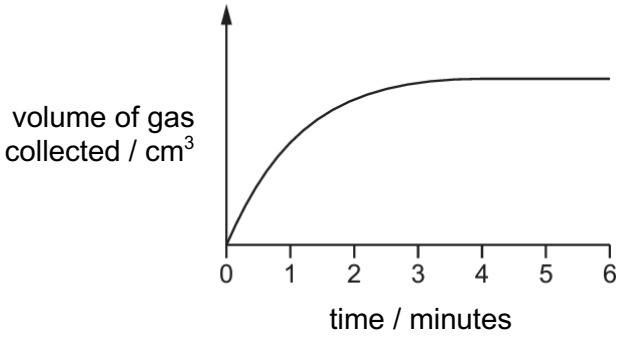
A In an endothermic reaction, less energy is absorbed in bond breaking than is released in bond forming.
B In an endothermic reaction, the activation energy is always higher than in an exothermic reaction.
C In an exothermic reaction, more energy is absorbed in bond breaking than is released in bond forming.
D In an exothermic reaction, the reactants are higher energy level than the products on an energy level diagram.

20 The apparatus shows a method of following the rate of the reaction between magnesium carbonate, $MgCO_3$, and dilute nitric acid, HNO_3.

$$MgCO_3(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2O(l) + CO_2(g)$$



The graph shows the volume of gas collected against time.



Three statements are made about the experiment.

1 The mass of the flask and its contents decreases as time increases.
2 The rate of the reaction decreases as time increases.
3 The reaction has finished after four minutes.

Which statements are correct?

A 1, 2 and 3
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only

21 How does increasing the concentration affect the reacting particles in a chemical reaction?

	increases the collision rate	increases the proportion of particles with the activation energy
A	✓	×
B	✓	✓
C	×	×
D	×	✓

22 Zinc oxide is an amphoteric oxide.

Which of the following substances will react with zinc oxide?

A acids and bases

B acids only

C bases only

D neither acids nor bases

23 When aqueous iron(III) chloride is added to aqueous potassium iodide, a chemical reaction occurs and iodine is formed.

Which statement is correct?

A Iodide ions are oxidised, they gain electrons in this reaction.

B Iodide ions are oxidised, they lose electrons in this reaction.

C Iron(III) chloride is oxidised in this reaction.

D Neither iodide ions nor iron(III) chloride is oxidised in this reaction.

24 In which reaction is the underlined substance behaving as an oxidising agent?

A $\underline{BaCl_2} + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

B $3CuO + \underline{2NH_3} \rightarrow 3Cu + N_2 + 3H_2O$

C $2FeCl_2 + \underline{Cl_2} \rightarrow 2FeCl_3$

D $O_2 + \underline{2SO_2} \rightarrow 2SO_3$

25 The oxide of an element X increases the rate of decomposition of hydrogen peroxide. At the end of the reaction the oxide of X is unchanged.

Which details are those of X?

	proton number	mass number
A	18	40
B	20	40
C	25	55
D	82	207

26 The proton number of indium, In, is 49.

What is the most likely formula for the oxide of indium?

A In_2O

B In_2O_3

C InO

D InO_2

27 Which statement(s) is/are true about all the noble gases?

1 The number of protons in their atoms equals the number of neutrons.

2 The number of protons in their atoms does not equal the number of electrons.

3 They all have eight electrons in their outer shell.

4 They do not react to form ionic compounds.

A 1, 2 and 3

B 1 and 3 only

C 3 only

D 4 only

28 Many metal carbonates decompose when they are heated.

Which row describes what happens when potassium carbonate, calcium carbonate and copper(II) carbonate are heated using a Bunsen burner?

	decomposes easily	decomposes with difficulty	does not decompose at Bunsen temperatures
A	calcium carbonate	copper(II) carbonate	potassium carbonate
B	copper(II) carbonate	calcium carbonate	potassium carbonate
C	copper(II) carbonate	potassium carbonate	calcium carbonate
D	potassium carbonate	calcium carbonate	copper(II) carbonate

29 Three correct statements about aluminium are listed.

1 Aluminium is the most common metal in the Earth's crust.
2 It is costly to extract aluminium from its ore, bauxite.
3 The world's supply of bauxite is limited.

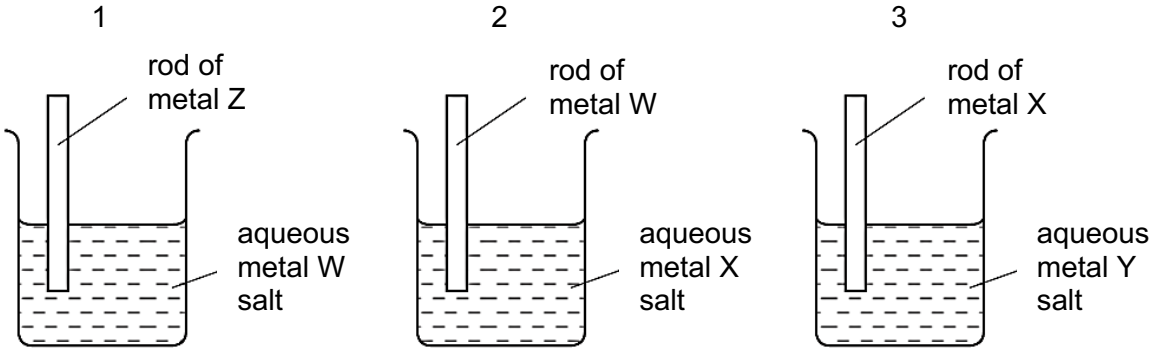
Which statement(s) explain why aluminium should be recycled?

A 1 and 2 only
B 2 and 3 only
C 3 only
D 1, 2 and 3

30 Which process, used to prevent iron from rusting, involves sacrificial protection?

A alloying
B electroplating
C galvanising
D painting

31 Three different beakers are set up as shown.



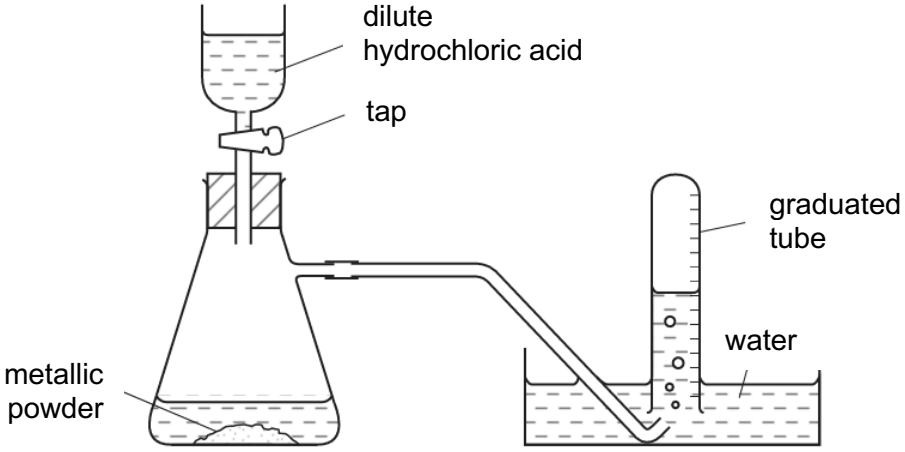
In beaker 1, metal W is displaced from solution.
In beaker 2, metal X is displaced from solution.
In beaker 3, metal Y is displaced from solution.

What is the order of decreasing reactivity of the four metals?

	most reactive → least reactive			
A	W	X	Y	Z
B	Y	X	W	Z
C	Z	W	X	Y
D	Z	X	W	Y

32 The diagram shows the experimental setup for measuring the volume of hydrogen given off when an excess of dilute hydrochloric acid is added to powdered metal.

The volume of gas is measured at room temperature and pressure.



The experiment is carried out three times, using the same mass of powder each time but with different powders:

- pure magnesium
- pure zinc
- a mixture of magnesium and zinc

Which powder gives the greatest volume of hydrogen and which the least volume in 5 minutes?

	greatest volume of H_2	least volume of H_2
A	magnesium	zinc
B	magnesium	the mixture
C	zinc	magnesium
D	zinc	the mixture

33 Ammonia is produced using the Haber process.

Which row shows the source of the raw materials and the optimum reaction conditions?

	source of nitrogen	source of hydrogen	temperature / °C	pressure / atm
A	air	hydrocarbons	200	450
B	hydrocarbons	air	450	200
C	air	hydrocarbons	450	200
D	air	hydrocarbons	450	450

34 The processes photosynthesis, respiration and fermentation all change the amount of carbon dioxide in the atmosphere.

Which process(es) increase(s) the amount of carbon dioxide in the atmosphere?

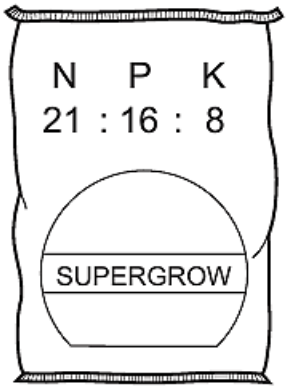
A photosynthesis and fermentation

B photosynthesis only

C respiration and fermentation

D respiration only

35 Which combination of chemical compounds can be used to produce the fertiliser shown?



A $(NH_4)_3PO_4$, KC*l*

B NH_4NO_3, $Ca_3(PO_4)_2$

C NH_4NO_3, $CO(NH_2)_2$

D NH_4NO_3, K_2SO_4, $(NH_4)_2SO_4$

36 The two statements are about the fractional distillation of crude oil. The statements may or may **not** be correct. They may or may **not** be linked.

statement 1 Fractional distillation is used to separate crude oil into useful fractions.

statement 2 The fractions with lower boiling points are found at the top of the fractionating column.

What is correct about these two statements?

A Both statements are correct and statement 2 explains statement 1.

B Both statements are correct but statement 2 does not explain statement 1.

C Statement 1 is correct but statement 2 is incorrect.

D Statement 1 is incorrect but statement 2 is correct.

37 Which statements about alcohols are correct?

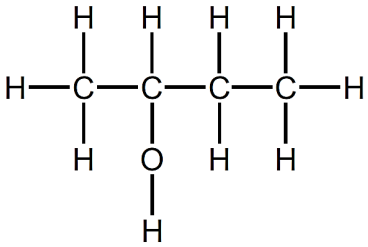
1 All alcohols contain the hydroxide ion, OH^-.

2 Ethanol can be formed from ethene using a reaction catalysed by yeast.

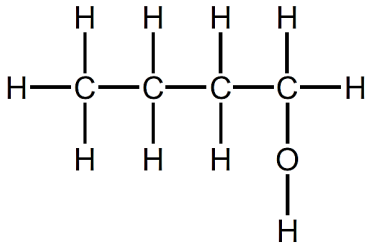
3 Methanol can be oxidised to methanoic acid.

4 The alcohols X and Y shown are isomers.

X



Y



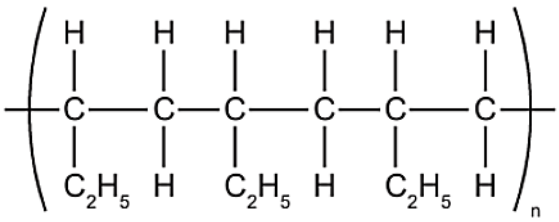
A 1, 2 and 3

B 3 only

C 2 and 4 only

D 3 and 4 only

38 The section of a polymer chain is shown.



Which molecule would produce this polymer and by which type of polymerisation?

	molecule	type of polymerisation
A	$CH_3–CH=CH–CH_3$	condensation
B	$CH_3–CH_2–CH=CH_2$	addition
C	$CH_3–CH_2–CH_2–CH=CH_2$	condensation
D	$CH_3–CH=CH–CH_3$	addition

39 The formula of an ester is $CH_3CH_2CH_2COOCH_2CH_2CH_3$.

Which acid and alcohol react together to make the ester?

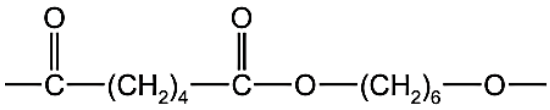
	acid	alcohol
A	butanoic acid	butanol
B	butanoic acid	propanol
C	propanoic acid	butanol
D	propanoic acid	propanol

40 P is a polymer that:

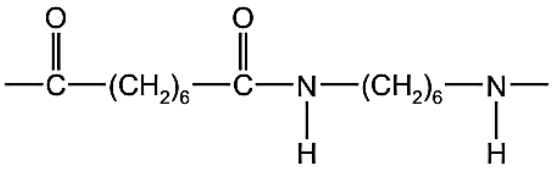
- has six carbon atoms in each of the monomers from which it is formed,
- is not a polyester,
- is formed using condensation polymerisation.

What is the partial structure of P?

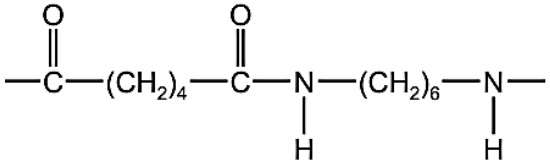
A



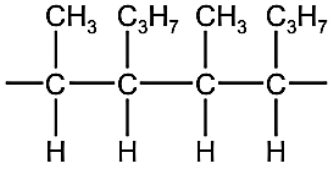
B



C



D



The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

BEATTY SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR EXPRESS

CANDIDATE NAME			
CLASS		REGISTER NUMBER	

CHEMISTRY

6092/01

Paper 1 Multiple Choice
Setter: Mr Yeo Chee Keong

31 August 2022
1 hour

Additional Materials:
Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

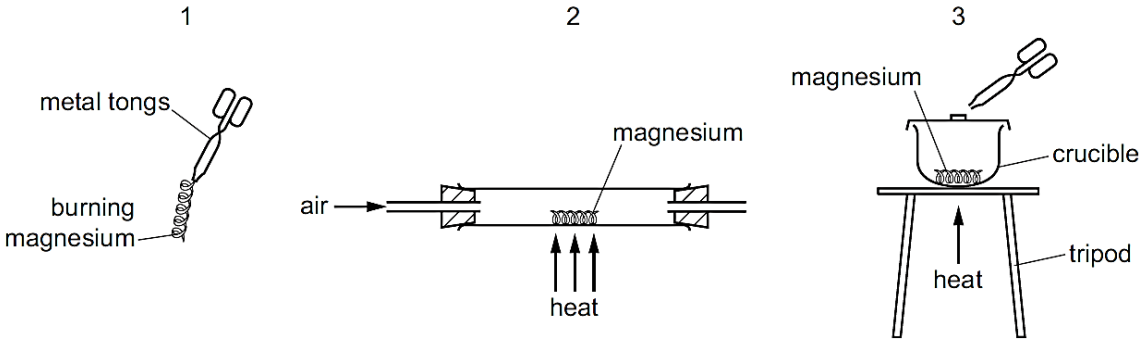
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and register number on the Multiple Choice Answer Sheet provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 15.
The use of an approved scientific calculator is expected, where appropriate.

1 Shermen investigates the change in mass during the combustion of magnesium. The diagrams show three set-ups for this investigation.



Which set-up(s) is/are suitable for this investigation?

A 3 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3 only

2 The table shows the observations made when different reagents are added to an aqueous solution of Z.

reagents added	observations
aqueous sodium hydroxide	green-white precipitate; green precipitate only in excess sodium hydroxide
dilute nitric acid followed by aqueous silver nitrate	yellow precipitate
dilute nitric acid followed by aqueous barium nitrate	no visible reaction

What are the ions present in solution Z?

A Al^{3+}, Fe^{2+}, I^-
B Al^{3+}, Fe^{3+}, SO_4^{2-}
C Pb^{2+}, Fe^{2+}, I^-
D Pb^{2+}, Fe^{3+}, Cl^-

3 A mixture of colourless amino acids is separated using chromatography.
The solvent used is propanol and the chromatogram is sprayed with a locating agent.

Which row describes the purpose of the propanol and the locating agent?

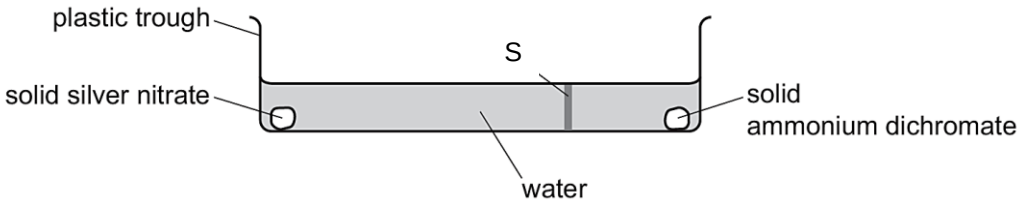
	purpose of propanol	purpose of locating agent
A	to make the individual amino acids visible	to prevent the amino acids moving any further
B	to move the amino acids up the chromatography paper	to make the individual amino acids visible
C	to move the amino acids up the chromatography paper	to prevent the amino acids moving any further
D	to prevent the amino acids moving too far up the paper	to make the individual amino acids visible

4 How many underlined substance(s) can be obtained by fractional distillation of the mixture?

- <u>hydrogen</u> from liquefied air
- <u>propene</u> from bitumen
- <u>ethanol</u> from water and ethanol mixture
- <u>ethyl ethanoate</u> from ethanol and ethanoic acid

A 1 **B** 2 **C** 3 **D** 4

5 Silver dichromate is a red solid that can be made by reacting silver nitrate solution with ammonium dichromate solution. The apparatus was set up as shown.

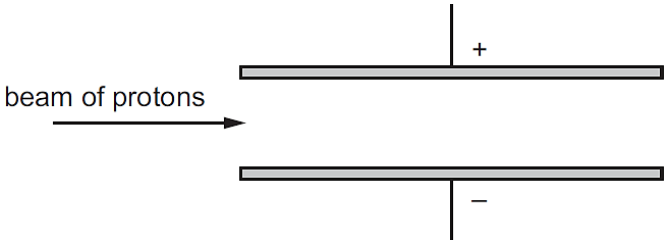


After five minutes, a red solid appeared along the line marked 'S' on the diagram.

What conclusion can be made from this experiment?

A Diffusion of silver nitrate occurs faster than the diffusion of ammonium dichromate.
B Silver ions have a lower relative molecular mass than dichromate ions.
C Solid silver nitrate is more soluble than solid ammonium dichromate.
D The red solid formed would dissolve to form a coloured solution.

6 A beam of protons was passed through an electrostatic field between two charged plates. The electrostatic field deflected the beam of protons. The lower the relative mass of the particle, the larger the deflection.



The experiment was repeated using a beam of electrons in place of the beam of protons.

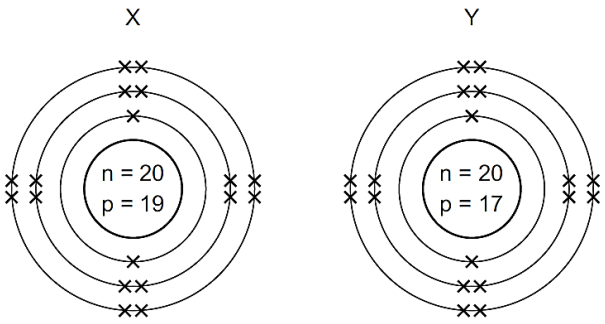
Which row correctly shows the amount and direction of the beam of electrons?

	amount of deflection of beam of electrons	direction of deflection of beam of electrons
A	deflected less than beam of protons	opposite direction to beam of protons
B	deflected less than beam of protons	same direction as beam of protons
C	deflected more than beam of protons	opposite direction to beam of protons
D	deflected more than beam of protons	same direction as beam of protons

7 Which ion contains the same number of both neutrons and electrons?

A $^{40}Ca^{2+}$ **B** $^{19}F^{-}$ **C** $^{24}Mg^{2+}$ **D** $^{32}S^{2-}$

8 The arrangements of the electrons in two ions formed from elements X and Y are shown.



Which equation represents the reaction between elements X and Y?

A $X_2 + 2Y \rightarrow 2X^+ + 2Y^-$
B $X_2 + 2Y \rightarrow 2X^- + 2Y^+$
C $2X + Y_2 \rightarrow 2X^+ + 2Y^-$
D $2X + Y_2 \rightarrow 2X^- + 2Y^+$

9 Magnesium oxide may be used for the lining of an electric furnace for making crockery.

Which properties of magnesium oxide help to explain this use?

	ionic bonding	electrical conductivity	solubility in water
A	no	yes	no
B	no	no	yes
C	yes	yes	yes
D	yes	no	no

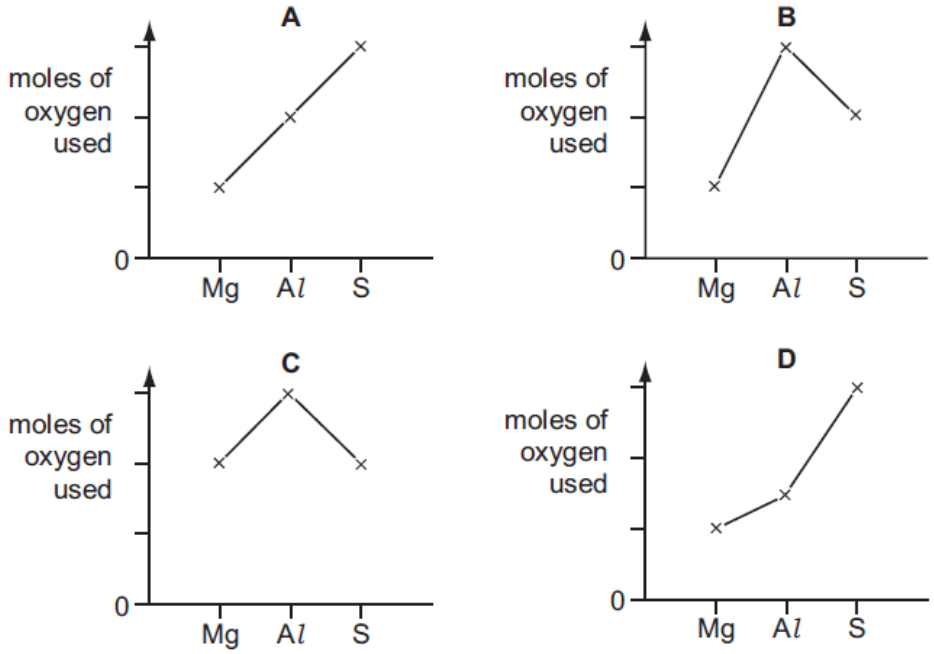
10 Both aluminium and graphite are good conductors of electricity and have high melting points.

Which row correctly shows the similarity and difference between aluminium and graphite?

	similarity	difference
A	good conductors of electricity due to mobile electrons	aluminium has a high melting point due to strong metallic bonds while graphite has a high melting point due to strong intermolecular forces
B	good conductors of electricity due to mobile electrons	aluminium has a high melting point due to strong metallic bonds while graphite has a high melting point due to strong covalent bonds
C	high melting point due to strong forces of attraction	aluminium conducts electricity due to positive cations while graphite conducts electricity due to mobile electrons
D	high melting point due to strong forces of attraction	aluminium conducts electricity due to sea of delocalised electrons while graphite conducts electricity due to oppositely charged ions

11 One mole of magnesium, aluminium and sulfur are each completely burned in excess of oxygen gas.

Which graph shows the number of moles of oxygen used for each element?



12 A sample of solid ammonium chloride decomposes on heating.

solid ammonium chloride → ammonia gas + hydrogen chloride gas

A total of 2.4×10^{21} molecules of gas is formed.

What is the volume of ammonia gas produced?

A 48 cm^3 **B** 96 cm^3 **C** 2.88×10^{25} cm^3 **D** 5.76×10^{25} cm^3

13 62 g of impure copper(II) carbonate undergoes thermal decomposition to produce 10 dm^3 of carbon dioxide gas.

What is the percentage purity of copper(II) carbonate?
[M_r: $CuCO_3$, 124]

A 16.1% **B** 50.0% **C** 83.3% **D** 92.0%

14 In an electrolysis experiment, the same amount of charge deposited 12 g of titanium and 32 g of copper. The charge on the copper ion was 2+.
[A_r: Ti, 48; Cu, 64]

What was the charge on the titanium ion?

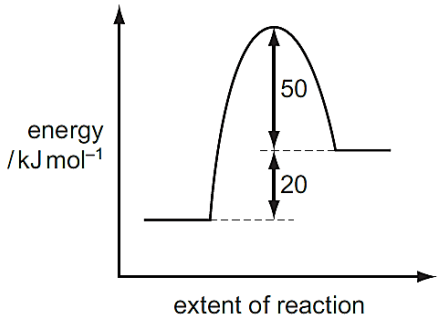
A 1+ **B** 2+ **C** 3+ **D** 4+

15 Concentrated aqueous sodium chloride is electrolysed using inert electrodes.

Which row correctly explains the change occurring during electrolysis?

	change occurring	explanation
A	oxygen is liberated at the positive electrode	OH^- ions loses electrons more easily than Cl^- ions
B	pH of the electrolyte increases	H^+ ions are discharged
C	products of electrolysis stay the same when molten sodium chloride electrolyte is used	Na^+ and Cl^- ions are present in both electrolytes
D	solid sodium is deposited at the negative electrode	Na^+ ions are discharged

16 The reaction pathway for a reversible reaction is shown.



Which statements about the reaction are correct?

1 The activation energy for the forward reaction is +70 kJ/mol.
2 The enthalpy change for the backward reaction is –50 kJ/mol.
3 The shape of the graph can be represented by the decomposition of silver salts in photographic films by light.
4 The shape of the graph can be represented by the dissolution of ammonium nitrate in water.

A 1 and 2 only
B 2 and 3 only
C 3 and 4 only
D 1 and 4 only

17 Qiyang investigates the effect of concentration on the rate of reaction between calcium carbonate and hydrochloric acid. He follows the method shown.

- Place 1 g of calcium carbonate in a conical flask.
- Add excess hydrochloric acid.
- Let the reaction continue until no more gas is produced.
- Repeat the experiment with different concentrations of hydrochloric acid.

Which essential step has been left out of the method if he is to work out the rate of the reaction?

A placing a rubber bung in the conical flask
B placing the experiment setup onto an electronic balance
C plotting a graph to calculate the gradient
D using a stopwatch to time the reaction

18 Magnesium reacts with dilute sulfuric acid.

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

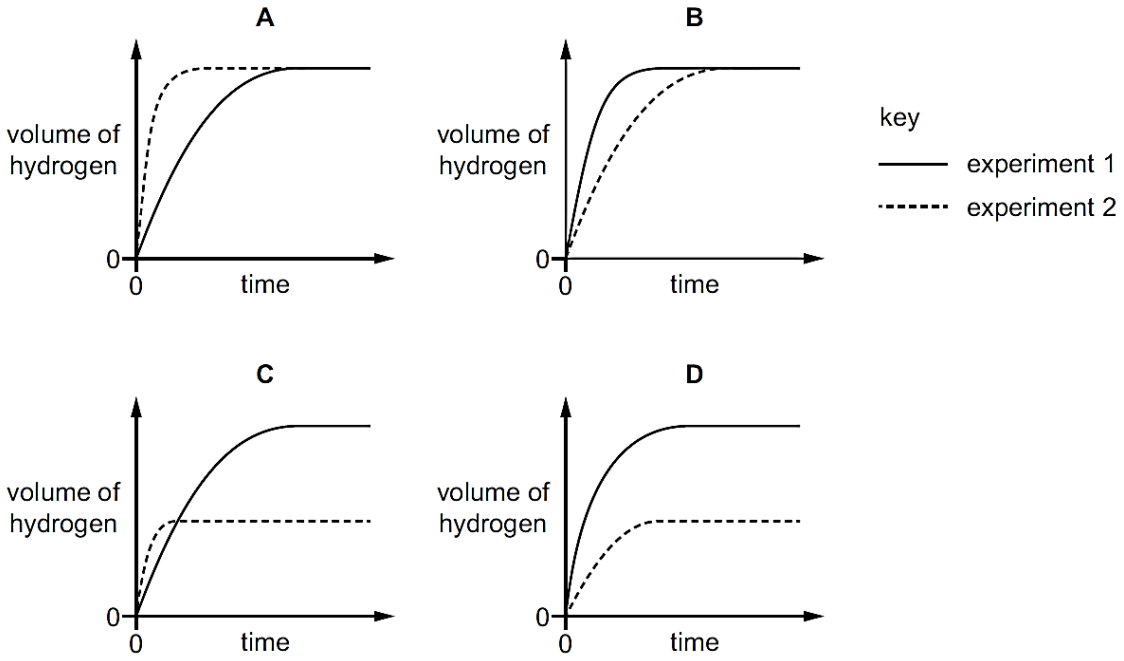
Two experiments were carried out.

experiment 1: 24.0 g of magnesium reacted with 100 cm^3 of 1.0 mol/dm^3 sulfuric acid.

experiment 2: 24.0 g of magnesium reacted with 50 cm^3 of 2.0 mol/dm^3 sulfuric acid.

In each experiment the volume of hydrogen was measured at various times. The results were plotted on a graph.

Which graph is correct?



19 Acidified MnO_4^- is often used in titrations to determine the concentrations of other solutions. One such reaction is represented by the ionic equation shown.

$$MnO_4^-(aq) + 8H^+(aq) + 5Fe^{2+}(aq) \rightarrow Mn^{2+}(aq) + 4H_2O(l) + 5Fe^{3+}(aq)$$

Which statement is correct?

A Eight moles of H^+ ions are oxidised by gaining 4 moles of oxygen atoms.
B Five moles of Fe^{2+} ions are oxidised by losing 5 moles of electrons.
C Manganese is oxidised in the process as the oxidation state increases.
D This is not a redox reaction as the number of hydrogen atoms remain unchanged.

20 The thermal decomposition of one mole of ammonium nitrate gives only two products: two moles of steam and one mole of an oxide of nitrogen, X.

What is the oxidation state of nitrogen in X?

A +1 **B** +2 **C** +3 **D** +4

21 Acids are used in many chemical reactions.

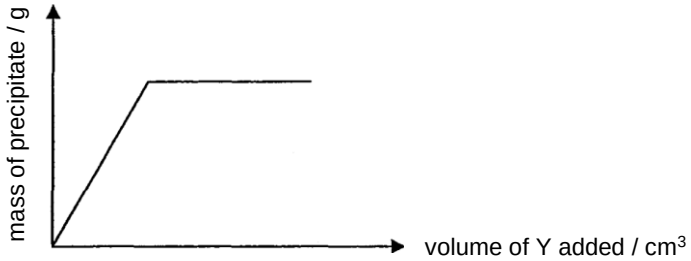
Which row correctly shows the role of acid in the reaction mixture?

	reaction mixture	role of acid
A	ethanoic acid, ethanol and concentrated sulfuric acid	catalyst
B	ethanol, potassium manganate(VII) and nitric acid	oxidising agent
C	lead(II) carbonate and phosphoric acid	precipitation
D	lead(II) nitrate and sulfuric acid	neutralisation

22 Which statement about oxides is correct?

A A solution of magnesium oxide has a pH less than 7.
B A solution of sulfur dioxide has a pH greater than 7.
C Magnesium oxide reacts with nitric acid to produce a salt.
D Sulfur dioxide reacts with hydrochloric acid to produce a salt.

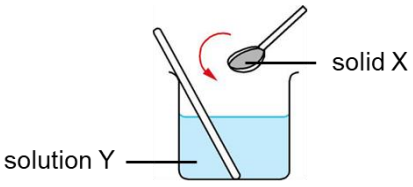
23 An aqueous solution of X was placed in a test tube and an aqueous solution of Y gradually added from a burette. The mass of the precipitate was obtained as shown.



Which pair of reagents are possible identities of X and Y?

A ammonia solution and zinc chloride
B calcium hydroxide and nitric acid
C magnesium carbonate and water
D sodium carbonate and barium nitrate

24 A student wishes to prepare a pure and dry sample of copper(II) nitrate using the method shown in the diagram.

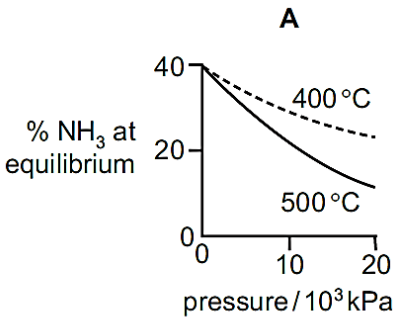


Which row correctly shows the identity of solid X and solution Y used?

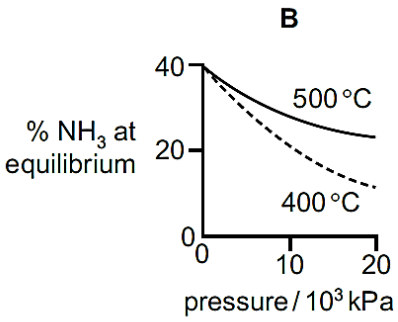
	solid X	solution Y
A	copper(II) chloride	excess nitric acid
B	copper(II) hydroxide	excess nitric acid
C	excess copper	nitric acid
D	excess copper(II) carbonate	nitric acid

25 Which diagram best represents the percentage of ammonia formed at different temperatures and pressures?

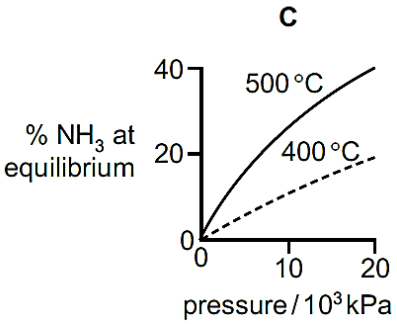
A



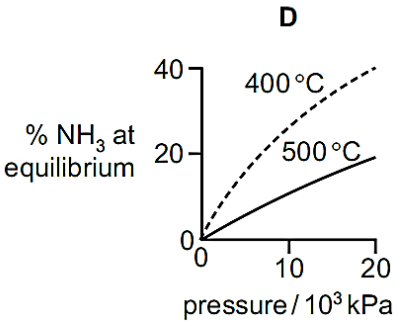
B



C



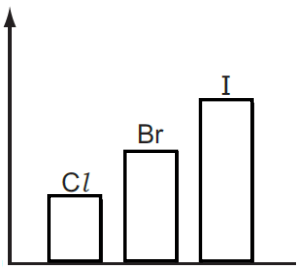
D



26 Which statement about the elements in the Periodic Table is correct?

A All the Group 0 elements cannot form compounds.
B Elements in Group V form ions with a charge of 5+.
C Elements in the same group react in a similar way because they all contain the same number of electrons.
D Germanium has a less metallic character than gallium.

27 Kendrick drew a bar chart representing the properties of some Group VII elements.

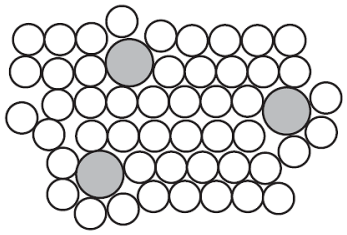


Which properties follow the trend observed in the bar chart?

1 colour intensity
2 melting point
3 oxidising ability
4 reactivity

A 1 and 2 only
B 2 and 3 only
C 3 and 4 only
D 1 and 4 only

28 The diagram shows the structure of an alloy.



Which statement about alloys is correct?

A All alloys contain iron atoms.
B Alloys can only be formed by mixing copper or iron with other metals.
C High carbon steel alloys are soft and easily shaped.
D There are forces of attraction between the positive ions and 'sea of electrons'.

29 Abby carried out some experiments to place four metals, P, Q, R, and S in order of reactivity. The results are as shown.

	metal P	metal Q	metal R	metal S
solution of P nitrate	–	×	×	×
solution of Q nitrate	✓	–	✓	✓
solution of R nitrate	✓	×	–	✓
solution of S nitrate	✓	×	×	–

Key ✓ shows a reaction happened
× shows no reaction happened
– shows the experiment was not performed

What is the correct order of reactivity of the four metals?

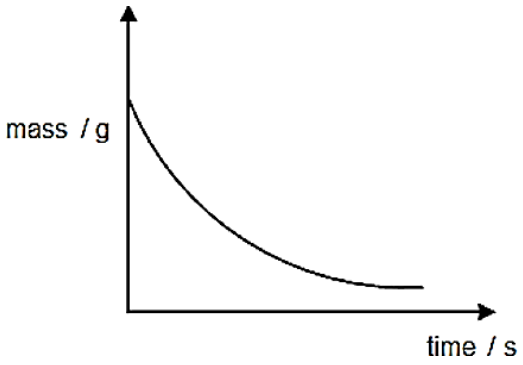
	most reactive →			least reactive
A	P	Q	R	S
B	P	S	R	Q
C	Q	R	S	P
D	Q	P	S	R

30 Metal X is more reactive than zinc but less reactive than sodium.

What would be the best method for obtaining metal X from its ore?

A electrolysis of an aqueous solution of a salt of X
B electrolysis of the molten oxide of X
C heating the oxide of X in hydrogen
D heating the oxide of X with powdered carbon

31 A known mass of unknown carbonate was placed in an open crucible and heated until there was no further change observed. The results are as shown.



Which carbonates will give the results as shown?

1 calcium carbonate
2 hydrated potassium carbonate
3 sodium carbonate
4 zinc carbonate

A 1 and 3 only
B 2 and 3 only
C 1 and 4 only
D 1, 2 and 4 only

32 A steel bicycle which had been left outdoors for several months was starting to rust.

What would **not** reduce the rate of corrosion?

A Add acid to the rust and paint the bicycle.
B Paint the bicycle and wipe the bicycle with an oily cloth.
C Store the bicycle in a dry shed.
D Wipe the bicycle with a clean, damp cloth and oil the bicycle.

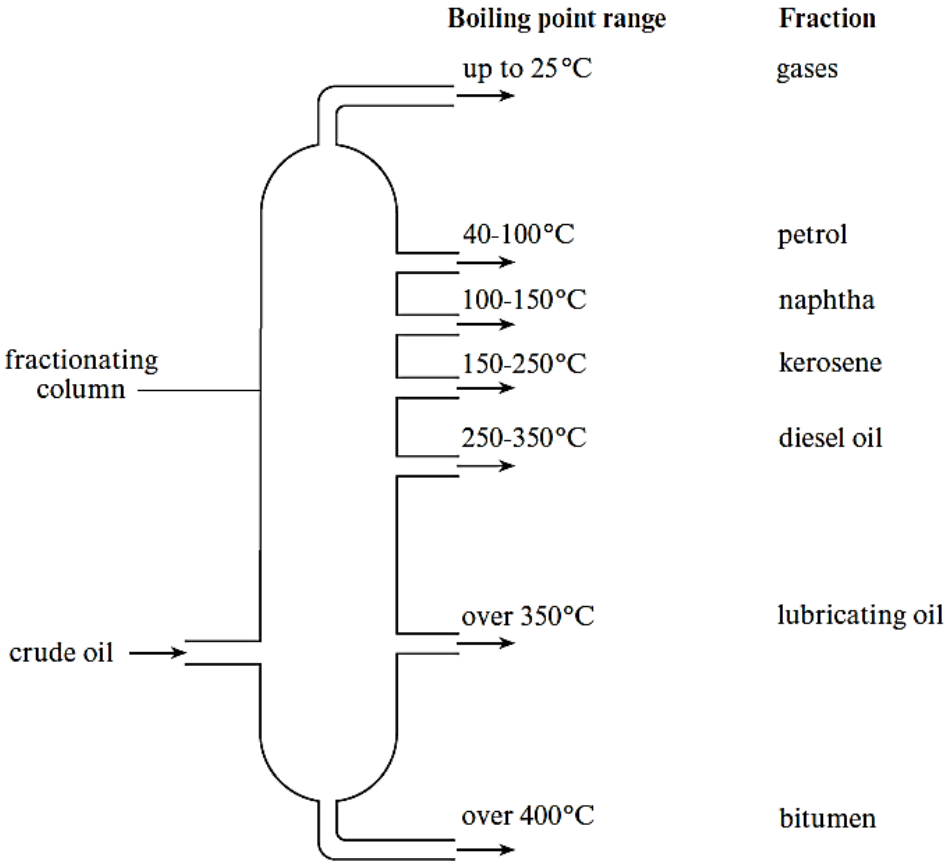
33 Four sources of air pollution are listed.

1 burning coal
2 internal combustion in car engines
3 incomplete combustion of carbon-containing fuels
4 adding lead compounds to petrol

Which sources produce acid rain?

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 3 and 4 only

34 Crude oil is separated into fractions in the fractionating column as shown.

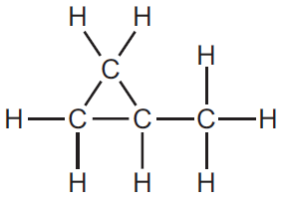


Which statements about the separation of crude oil are correct?

1 A mixture of octane and nonane can be found in the petrol fraction.
2 All the fractions belong to the same homologous series with an increasing boiling point down the column.
3 The molecular masses of the fractions increase down the column.

A 3 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

35 The diagram shows the structural formula of an organic compound.



Which statement about this compound is correct?

A It has a general formula of C_nH_{2n+2}.
B It is a saturated hydrocarbon.
C It is an isomer of butane.
D It is formed from the hydrogenation of butene.

36 Which equation represents the complete combustion of an organic molecule with a relative molecular mass of 32?

A $CH_3NH_3 + 3O_2 \rightarrow CO_2 + 3H_2O + NO$
B $2CH_4 + 4O_2 \rightarrow 2CO_2 + 4H_2O$
C $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$
D $2HCO_2H + O_2 \rightarrow 2CO_2 + 2H_2O$

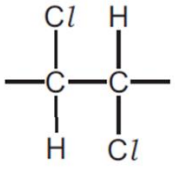
37 Which row correctly shows the products obtained by cracking of hydrocarbons?

	alkene	hydrogen	water
A	✓	✗	✗
B	✓	✓	✗
C	✓	✓	✓
D	✗	✓	✓

38 A mixture of the three isomers of $C_2H_2Cl_2$ is polymerised.

Three repeating units of the possible polymers are shown.

1



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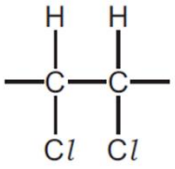

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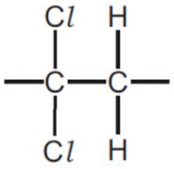


Which repeating units could be seen within the polymer chains?

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

39 Several reagents are listed below.

- aqueous bromine
- ethanol
- magnesium
- potassium manganate(VII)
- Universal Indicator

How many reagents can be used to physically distinguish separate beakers of propanol and propanoic acid?

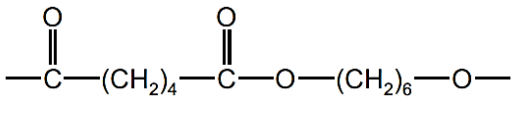
A 2 **B** 3 **C** 4 **D** 5

40 P is a polymer that

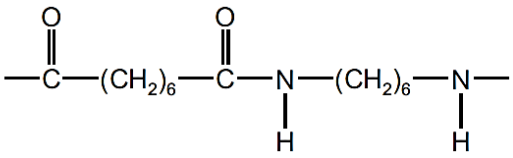
- has six carbon atoms in each of the monomers from which it was formed,
- has a similar structure to nylon,
- was formed from the loss of water molecules.

What is the partial structure of P?

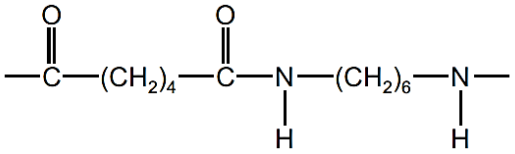
A



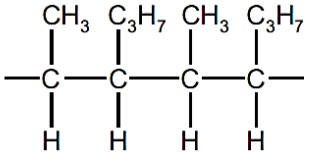
B



C



D



The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

CHRIST CHURCH SECONDARY SCHOOL
2022 PRELIMINARY EXAMINATION
FOUR EXPRESS

CANDIDATE NAME		CLASS	
CENTRE NUMBER	S	INDEX NUMBER	

CHEMISTRY 6092/01

Paper 1 **15 July 2022**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number, name and class on all the work you hand in.
Write in soft pencil on the Multiple Choice Answer Sheet
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Multiple Choice Answer Sheet.

Read the instructions on the answer sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 14.
The use of an approved scientific calculator is expected, where appropriate.

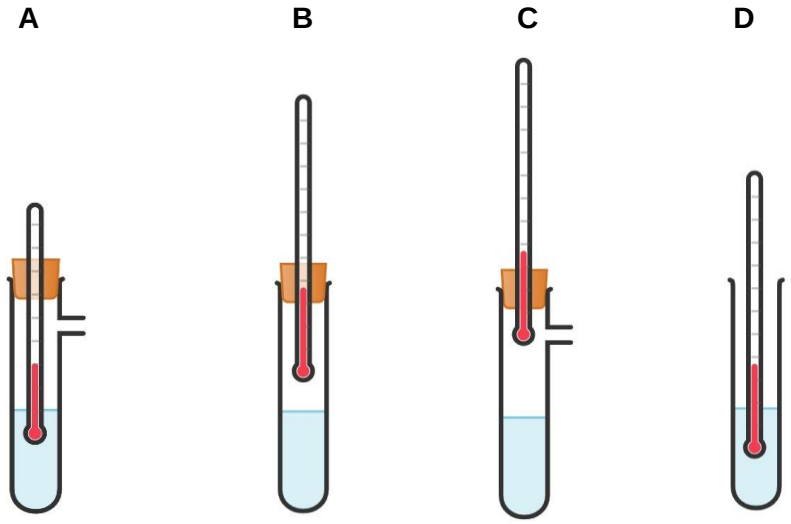
This document consists of **14** printed pages.

1 Which one of the following correctly describes the particles in a dilute sugar solution at room temperature?

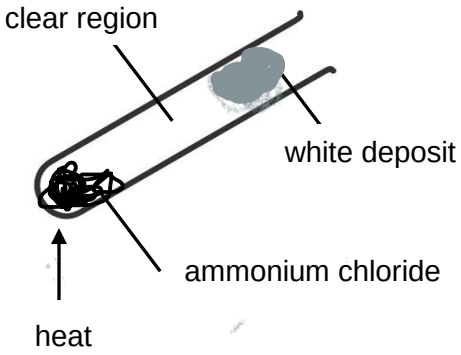
	sugar molecules	water molecules
A	widely separated, moving at random	close together, moving at random
B	widely separated, moving at random	close together, not moving
C	widely separated, not moving	widely separated, moving at random
D	close together, moving at random	widely separated, vibrating slightly

2 The tubes shown in the diagram all contain a dilute solution of a solid X dissolved in a liquid Y.

Which apparatus is most suitable for finding the boiling point of liquid Y?



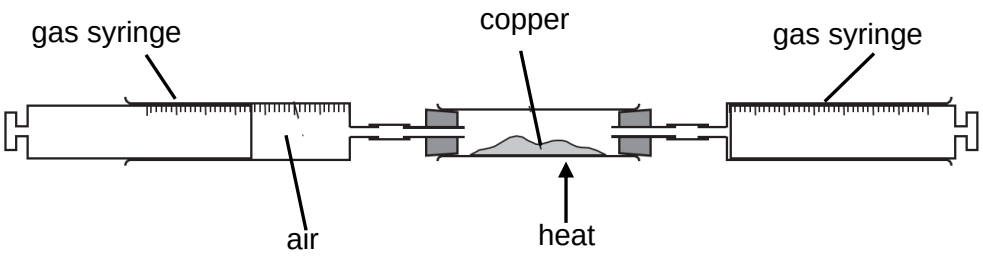
3 The diagram shows some ammonium chloride being heated.



What does the clear region between the ammonium chloride and the white deposit contain?

A ammonia and chlorine
B ammonia and hydrogen chloride
C ammonia and water vapour
D ammonium chloride vapour

4 The percentage of oxygen in the air is found by using the apparatus shown below. The air is passed over heated copper until there is no further decrease in volume.

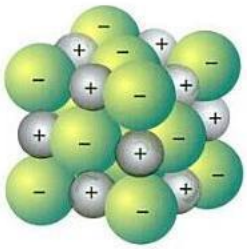


What precaution should be taken before the initial volume of air and final volume of gases remaining in the apparatus are found?

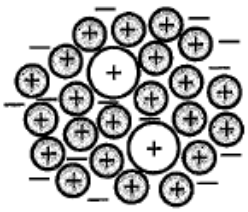
A The tube containing the copper should be removed.
B Both syringes should contain the same volume of air.
C All the copper should have reacted.
D The apparatus should be at room temperature.

5 Which of the following shows the structure of bronze?

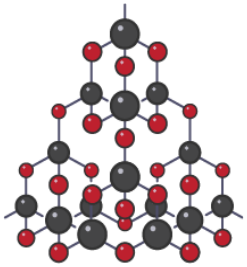
A



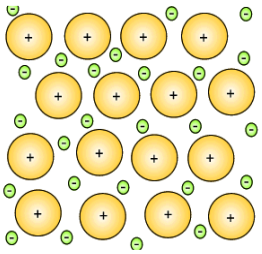
B



C



D



6 Naturally-occurring bromine has a relative atomic mass of 80 and consists entirely of two isotopes of relative atomic masses 79 and 81.

What can be deduced about naturally-occurring bromine from this information only?

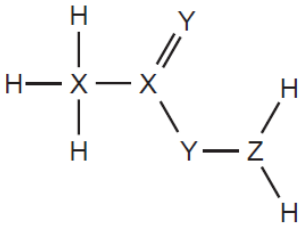
A Bromine is radioactive.
B Bromine has different oxidation states.
C Bromine isotopes have different number of protons.
D Bromine contains the two isotopes in equal proportions.

7 Silicon carbide is a shiny, hard, chemically inert material with a very high melting point. It can be used to sharpen knives and make crucibles.

Which type of structure explains these properties?

A a giant structure with covalent bonds between carbon and silicon atoms
B a giant structure containing metallic bonds
C a giant structure with covalent bonds between atoms and weak forces of attraction between the layers of atoms
D a simple molecular structure with covalent bonds between the carbon and silicon atoms

8 The diagram shows the structure of a covalent compound containing the element hydrogen, H, and the unknown elements X, Y and Z.



To which groups of the Periodic Table do these three elements, X, Y and Z, belong?

	X	Y	Z
A	1	5	6
B	4	5	1
C	4	6	5
D	5	1	4

9 What does a solution of hydrogen chloride and methylbenzene contain?

A methylbenzene ions, hydrogen ions and chloride ions
B methylbenzene ions and hydrogen chloride molecules
C methylbenzene molecules, hydrogen molecules and chlorine molecules
D methylbenzene molecules and hydrogen chloride molecules

10 Which one of the following substances

(i) is an element
(ii) also forms crystals composed of small molecules?

A carbon dioxide
B ice
C iodine
D graphite

11 The table below shows the results of experiments to measure the volume of sulfuric acid (column 1) needed to neutralise the mass of sodium hydroxide (column 2) dissolved in the volume of water (column 3).

experiment	column 1	column 2	column 3
	volume of sulfuric acid required / cm^3	mass of sodium hydroxide / g	volume of water required / cm^3
1	20	1	20
2	40	2	40
3	40	2	20
4	?	1	40

From the results, what volume of sulfuric acid is needed to neutralise the sodium hydroxide in experiment 4?

A 10 cm^3 **B** 20 cm^3
C 40 cm^3 **D** 80 cm^3

12 Dinitrogen tetroxide, N_2O_4 is a poisonous gas. It can be disposed of safely by reaction with sodium hydroxide. In the experiment, the concentration of aqueous sodium hydroxide used is 1.5 mol/dm^3.

$$N_2O_4(g) + 2NaOH(aq) \rightarrow NaNO_3(aq) + NaNO_2(aq) + H_2O(l)$$

What is the least volume of aqueous sodium hydroxide required to dispose of 300 cm^3 of N_2O_4 at room temperature and pressure?

A 10 cm^3 **B** 20 cm^3
C 120 cm^3 **D** 240 cm^3

13 An element X in found in Group VII of the Periodic Table.

Which of the following is a likely behaviour of element X?

A reacts vigorously with water
B forms a hydride of formula XH_7
C reduces hydrogen sulfide
D oxidises SO_3^{2-} to SO_4^{2-}

14 250 cm^3 of 3.00 mol/dm^3 dilute hydrochloric acid is added to 350 cm^3 of 2.00 mol/dm^3 dilute hydrochloric acid.

What is the concentration of the resulting solution?

A 1.45 mol/dm^3
B 2.42 mol/dm^3
C 2.50 mol/dm^3
D 8.33 mol/dm^3

15 The table below shows the results of heating the carbonates and nitrates of three metals to the same temperature.

metal	products of decomposition	
	metal carbonate	metal nitrate
W	no change	metal nitrite and oxygen
X	oxide and carbon dioxide	metal oxide, nitrogen dioxide and oxygen
Y	no change	metal oxide, nitrogen dioxide and oxygen

What is the order of these metals in the reactivity series likely to be?

	most reactive ⟶		least reactive
A	W	X	Y
B	W	Y	X
C	X	Y	W
D	Y	W	X

16 Nickel is between iron and lead in the reactivity series.

Which of the following can be deduced from this?

A Nickel can be obtained by moderate heating of nickel hydroxide.
B Nickel can displace hydrogen rapidly from hot water.
C Nickel can be displaced from an aqueous solution containing nickel ions.
D Nickel loses electrons more readily than iron

17 Which one of the following reactions could be represented by the ionic equation.
M is the symbol for a metallic element.

$$M(s) + 2H^+(aq) \longrightarrow M^{2+}(aq) + H_2(g)$$

A iron + dilute hydrochloric acid
B lead + dilute sulfuric acid
C iron + steam
D sodium + water

18 A sample of air was shaken with an alkaline solution of a compound called pyrogallol. The gases remaining did not support combustion.

Which one of the following pairs of gases was removed by pyrogallol?

A carbon dioxide and nitrogen
B oxygen and carbon dioxide
C oxygen and nitrogen
D water vapour and hydrogen

19 Which of the following gases is **least** common in air?

A hydrogen
B argon
C carbon dioxide
D nitrogen

20 In an experiment, 6 moles of magnesium ions were discharged in the electrolysis of molten magnesium chloride.

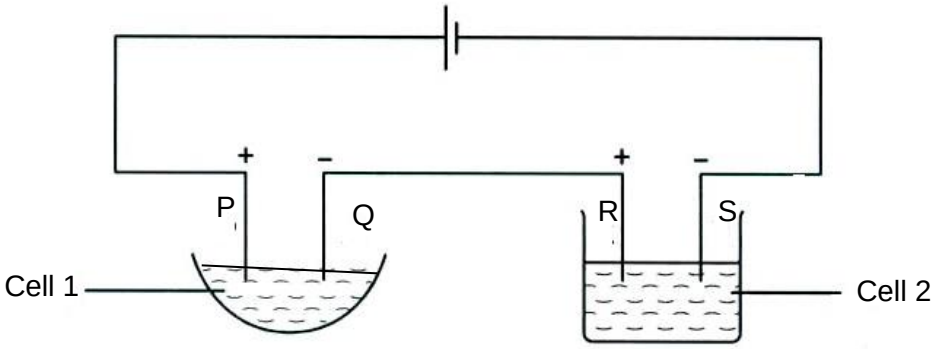
Which amount of metal would be discharged by the same amount of electricity in the following experiments?

A 3 moles of copper(II) ions in the electrolysis of aqueous copper(II) sulfate.
B 6 moles of zinc ions in the electrolysis of aqueous zinc chloride.
C 12 moles of calcium ions in the electrolysis of molten calcium fluoride.
D 12 moles of lithium ions in the electrolysis of molten lithium bromide.

21 Two electrolytic cells are connected as shown in the diagram.

Cell 1: P is a copper electrode while Q is a platinum electrode immersed in dilute copper(II) chloride solution.

Cell 2: R is a platinum electrode while S is a copper electrode immersed in concentrated copper(II) chloride solution.



Which of the following statement(s) describes the observations made after sometime?

1. There is a higher mass gain in Q than S.
2. Both P and R electrodes decrease in mass.
3. Both Cell 1 and 2 electrolytes fade in colour.

A 1 and 2
B 1 and 3
C 2 and 3
D none of the above

22 When sulfur dioxide is bubbled into aqueous bromine, the reddish brown colour fades.

Which of the following describes the role of sulfur dioxide in the above reaction?

A an acid
B an oxidising agent
C a reducing agent
D a catalyst

23 Which one of the following processes does **not** involve either oxidation or reduction?

A manufacture of iron from haematite
B manufacture of ammonium sulfate from ammonia and sulfuric acid
C manufacture of ammonia from nitrogen and hydrogen
D manufacture of zinc from zinc blende (ZnS)

24 Which one of the following statements is always true for all examples of combustion?

A One product is always carbon dioxide.
B It is an exothermic reaction.
C The combustion products have more energy than the original fuel and oxygen.
D No bonds are broken in the reaction.

25 When powdered metal M was placed in aqueous lead(II) nitrate, a grey precipitate was obtained. The temperature rose and some M remained unchanged.

Which of the following conclusions **cannot** be deduced from this information?

A The reaction is exothermic.
B M is more reactive than lead.
C M was in excess.
D M has the same valency as lead.

26 Hydrogen peroxide decomposes to form water and oxygen gas. In two separate experiments, manganese(VI) oxide was added to 50 cm^3 of aqueous hydrogen peroxide.

The measurements taken are shown in the table below.

experiment	mass of MnO_2 / g	tempertaure rise / ^oC	Total volume of O_2 produced / cm^3
1	0.1	5	50
2	0.2	x	y

What were the values of x and y?

	x	y
A	2.5	50
B	5.0	50
C	5.0	100
D	10.0	100

27 Sulfur dioxide is reacted with oxygen to produce sulfur trioxide. This reaction is catalysed by a metal oxide catalyst.

$$2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$$

What will become larger if the experiment is repeated using a better catalyst?

A The total volume of gas produced at the end of the reaction.
B The amount of hydrogen peroxide left over at the end of the reaction.
C The initial gradient of a graph of total volume of gas produced against time.
D The time needed to produce a particular volume of gas.

28 Four oxides are added separately to aqueous sodium hydroxide.

1. aluminium oxide
2. carbon dioxide
3. copper(II) oxide
4. magnesium oxide

Which oxides react with aqueous sodium hydroxide?

A 2 only
B 1 and 2 only
C 3 and 4 only
D 1, 3 and 4 only

29 The results of some tests on solid X are listed below.

1. Solid X produced water when it is gently heated alone.
2. When dissolved completely in water and added to aqueous ammonia, it gave a dirty-green precipitate.
3. When dissolved completely in water and added to silver nitrate solution, it gave a white precipitate.

From the above results, what is solid X?

A hydrated copper(II) sulfate
B anhydrous copper(II) chloride
C hydrated iron(II) chloride
D anhydrous iron(II) sulfate

30 Which of the following mixtures below will result in the ionic equation shown?

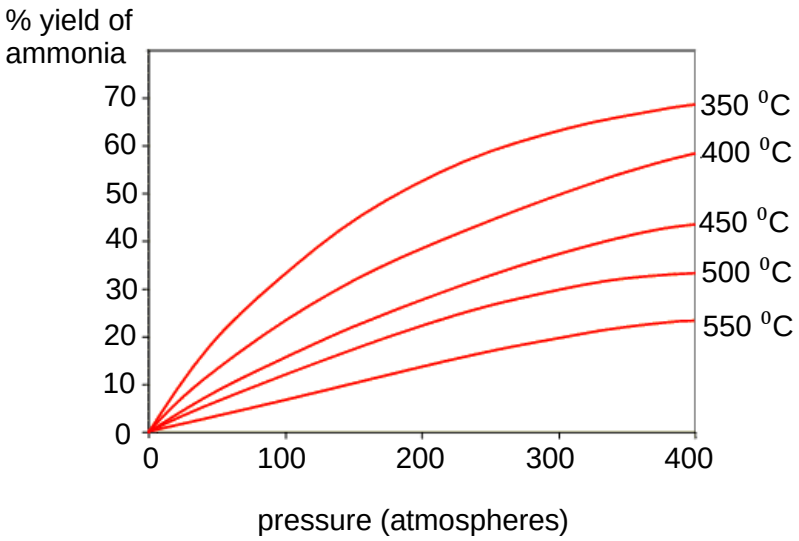
$$Pb^{2+}(aq) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s)$$

A aqueous lead(II) nitrate is added to dilute sulfuric acid
B lead(II) chloride is added to aqueous sodium sulfate
C lead(II) oxide is added to dilute sulfuric acid
D lead(II) sulfate is added to water

31 Nitrogen and hydrogen can react upon heating, according to the chemical equation.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The graph below shows the percentage yield of ammonia produced from 1 mole of nitrogen at different temperatures and pressures.



Which of the following statement(s) can be deduced from the information given above?

1. At 200 atmospheres, the number of moles of ammonia produced is greater at 450 ^{0}C than at 500 ^{0}C.
2. An increase in pressure increases the number of moles of ammonia produced at both 400 ^{0}C and at 350 ^{0}C.
3. The percentage yield of ammonia will most likely to be 33% at 500 ^{0}C and at 400 atmospheres.

A 1 only
B 1 and 2 only
C 2 and 3 only
D 1, 2 and 3

32 The following ionic equation shows a redox reaction.

$$BrO_3^{--} + 5\ Br^{--} + 6H^+ \longrightarrow 3Br_2 + 3H_2O$$

Which one of the following substances is the oxidising agent?

A BrO_3^{--}
B Br^{--}
C H^+
D H_2O

33 Which one of the following reagents can be used to distinguish between butane and butanol?

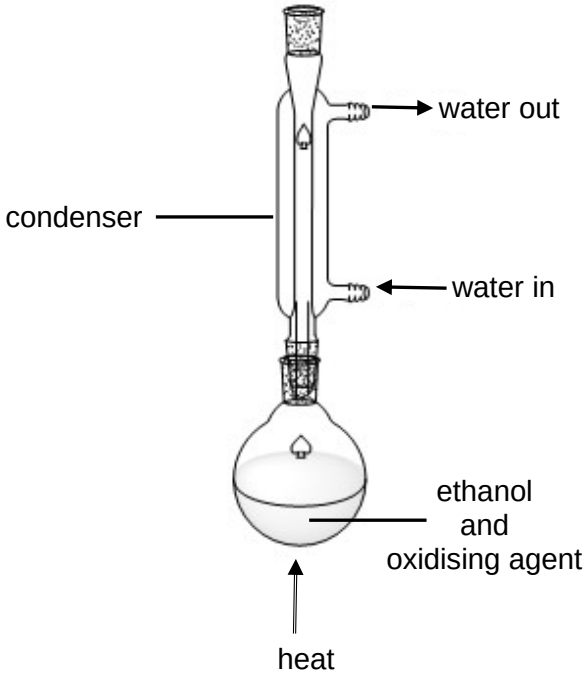
A concentrated sulfuric acid
B aqueous bromine
C phosphoric acid
D acidified potassium manganate(VII)

34 Ethanol is used in some after-shave lotions and deodorants.

Which pair of properties makes it suitable for these uses?

A It is flammable and mixes easily with water.
B It is flammable and vapourises easily.
C It is a good solvent and vapourises easily.
D It is colourless and mixes easily with water.

35 Ethanol was oxidised to ethanoic acid using the apparatus shown below.



What is the purpose of the condenser in the above set-up?

A prevent the conversion of the ethanol to ethene
B prevent the escape of any unchanged ethanol
C prevent the reforming of ethanol from ethanoic acid
D prevent the reaction of ethanoic acid with ethanol

36 Under suitable conditions, concentrated sulfuric acid dehydrates methanoic acid, H_2CO_2, to give carbon monoxide according to the equation below.

$$H_2CO_2 \longrightarrow CO + H_2O$$

Concentrated sulfuric acid also dehydrates $H_2C_2O_4$. In this case, what product(s), other than water, would you expect to be formed?

A carbon monoxide only
B carbon dioxide only
C carbon monoxide and hydrogen
D carbon dioxide and carbon monoxide

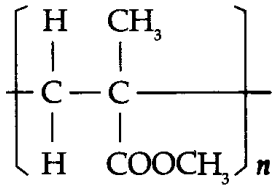
37 Which one of the following correctly describes both ethene and ethane?

A They are both unsaturated hydrocarbons.
B They both readily decolourise bromine water.
C They can both burn to produce carbon dioxide and water.
D They are both readily polymerised.

38 In which process do large molecules become smaller molecules?

A fermentation of sugars
B catalytic reaction between ethene and steam
C reaction between ethene and bromine
D polymerisation of ethene

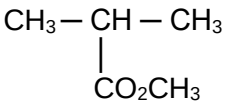
39 The polymer, perspex, has the structural formula.

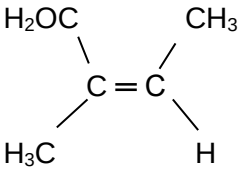


Which of the following structures is the monomer for the polymer?

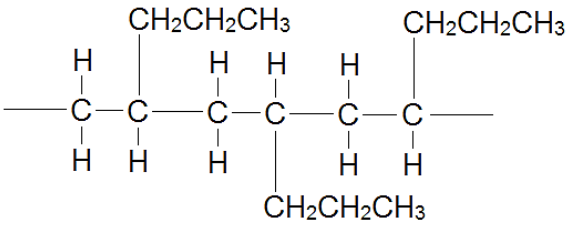
A $CH_2 = C(CH_3)CO_2CH_3$

B $CH_2 = CH - CO_2CH_3$

C 

D 

40 Engine oil is used to lubricate the car engine. Certain polymers are added to engine oil to improve its viscosity. A portion of the chain of one such polymer is shown below.



A molecule of this polymer contains 40 carbon atoms.
How many molecules of monomer are required to form one molecule of this polymer?

A 4
B 5
C 8
D 10

End of Paper

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name: _____ ( ) Class:_____

CHIJ KATONG CONVENT

PRELIMINARY EXAMINATIONS 2022

Secondary Four Express

CHEMISTRY

6092/01

Duration: 1 hour

Classes: 405 and 406

Additional Material: Optical Answer Sheet.

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid/ tape.
Write your name, class and index number in the spaces provided at the top of this page and on the Optical Answer Sheet.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in the question booklet.
A copy of the Periodic Table is printed on page 11.

At the end of the examination, hand in:

1. Optical Answer Sheet; and
2. Question booklet **separately**.

1 Hydrogen chloride gas (M_r = 36.5) is released at P in the apparatus shown.

The Universal Indicator paper turns red after 38 s.

Universal Indicator paper

The experiment is repeated under the same conditions using sulfur dioxide (M_r = 64).

Which shows the result for sulfur dioxide?

	Universal Indicator turns	time for Universal Indicator to change colour/ s
A	blue	26
B	blue	51
C	red	26
D	red	51

2 Substance M melts at –7.0 °C and is a brown liquid at room temperature.

At which temperature(s) will pure M boil?

A –77.0 °C
B –7.0 °C to 7.0 °C
C 48.0 °C to 65.0 °C
D 59.0 °C

3 A student is asked to measure the time taken for 0.4 g of magnesium carbonate to react completely with 20.0 cm^3 of dilute hydrochloric acid.

Which pieces of apparatus does the student need?

A electronic balance, burette, stopwatch
B electronic balance, pipette, stopwatch
C electronic balance, stopwatch, thermometer
D stopwatch, pipette, thermometer

4 R_f values are used to identify unknown substances using paper chromatography.

Which statements about R_f values are correct?

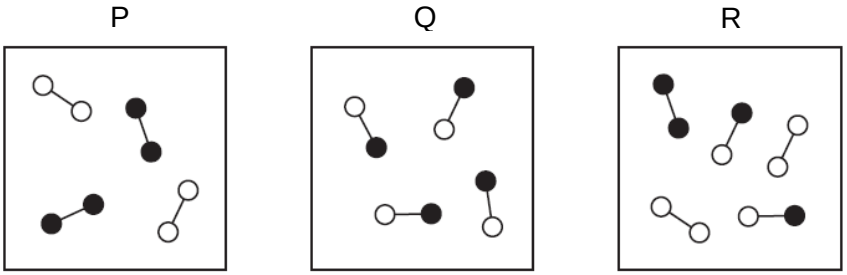
1 R_f values are always less than 1.0.
2 R_f value = distance travelled by solvent ÷ distance travelled by unknown substance.
3 The higher the R_f value, the further the unknown substance travels.
4 R_f values are not affected by the solubility of the unknown substance.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 3 and 4 only

5 Which physical property is used to separate the nitrogen and oxygen from air?

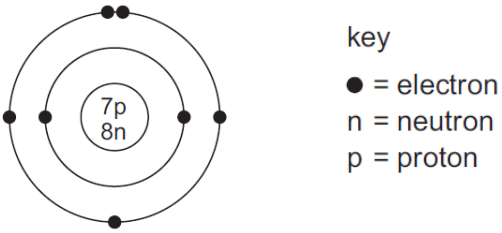
A boiling point
B density
C electrical conductivity
D molecular mass

6 Which statement about P, Q and R is correct?



A P contains two compounds and R contains a mixture.
B P contains two elements and Q contains a mixture.
C P contains two elements and Q contains one compound.
D Q contains two compounds and R contains a mixture.

7 The structure of an atom is shown.



Which element is the atom an isotope of?

A nitrogen
B oxygen
C phosphorus
D titanium

8 Which row describes the structure of the positive ion in sodium chloride?

	protons	electrons	neutrons
A	11	11	12
B	11	10	12
C	17	17	18
D	17	18	18

9 Which row describes what happens to the electrons when lithium and nitrogen atoms form ions?

	lithium atoms	nitrogen atoms
A	each lithium atom loses one electron to form a Li^+ ion	each nitrogen atom gains three electrons to form a N^{3-} ion
B	each lithium atom loses one electron to form a Li^- ion	each nitrogen atom loses three electrons to form a N^{3+} ion
C	each lithium atom gains one electron to form a Li^+ ion	each nitrogen atom gains five electrons to form a N^{5-} ion
D	each lithium atom gains one electron to form a Li^- ion	each nitrogen atom loses five electrons to form a N^{5+} ion

10 Which statement about metals is correct?

A Layers of positive ions can slide over one another making metals malleable.
B Metallic bonding consists of a lattice of negative ions in a sea of delocalised electrons.
C Metallic bonding consists of a lattice of positive ions in a sea of delocalised negative ions.
D Metals conduct electricity because positive ions are free to move.

11 Which statement is correct about the structures of both diamond and silicon(IV) oxide?

A Molecules of both diamond and silicon(IV) oxide are held together by weak intermolecular forces of attraction.
B The carbon in diamond and the silicon in silicon(IV) oxide each form four covalent bonds.
C They both contain atoms arranged in planes held together by weak intermolecular forces of attraction.
D They both contain ions that are free to move.

12 What is the total number of electrons in one molecule of ammonia, NH_3?

A 6
B 8
C 10
D 11

13 Four fertilisers are each supplied in 100 kg bags.

Which fertiliser supplies the greatest mass of nitrogen per 100 kg bag?

A ammonium nitrate, NH_4NO_3
B ammonium phosphate, $(NH_4)_3PO_4$
C ammonium sulfate, $(NH_4)_2SO_4$
D urea, $CO(NH_2)_2$

14 1 g of calcium carbonate is added to 50.0 cm^3 of 0.050 mol / dm^3 hydrochloric acid. The reaction is as shown.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

Which volume of carbon dioxide is produced in this reaction?

A 30 cm^3
B 60 cm^3
C 120 cm^3
D 240 cm^3

106

15 A tablet contains 0.080 g of ascorbic acid (*M*r = 176).

What is the concentration of ascorbic acid when one tablet is dissolved in 200 cm^3 of water?

A 0.0000909 mol / dm^3
B 0.000455 mol / dm^3
C 0.00227 mol / dm^3
D 0.0909 mol / dm^3

16 Which statement about amphoteric oxides is correct?

A They are made by combining an acidic oxide with a basic oxide.
B They react with water to give a solution of pH 7.
C They react with both acids and bases.
D They do not react with acids or bases.

17 Ethanoic acid is a weak acid. Hydrochloric acid is a strong acid.

1 Ethanoic acid molecules are partially dissociated into ions.
2 1.0 mol / dm^3 ethanoic acid has a higher pH than 1.0 mol / dm^3 hydrochloric acid.
3 Ethanoic acid is always more dilute than hydrochloric acid.
4 Ethanoic acid does not produce hydrogen ions.

Which statements are correct?

A 1 and 2 only
B 1 and 3 only
C 2 and 4 only
D 3 and 4 only

18 When blue-green crystals of nickel(II) sulfate are heated, water is produced and a yellow solid remains. When water is added to the yellow solid, the blue-green colour returns.

Which process describes these changes?

A combustion
B corrosion
C neutralisation
D reversible reaction

19 Lead(II) sulfate is prepared by mixing two substances, X and Y. When the reaction is complete, the mixture is filtered.

Which row shows the best way to prepare pure lead(II) sulfate?

	substance X	substance Y	method after filtration
A	aqueous lead(II) nitrate	aqueous sodium sulfate	crystallise the filtrate
B	aqueous lead(II) nitrate	aqueous sodium sulfate	wash and dry the residue
C	solid lead(II) carbonate	dilute sulfuric acid	crystallise the filtrate
D	solid lead(II) carbonate	dilute sulfuric acid	wash and dry the residue

20 The thermite reaction can be used to produce iron from iron(III) oxide. The equation for the reaction is shown.

$$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$$

Which statements about this reaction are correct?

1 Aluminium is the oxidising agent.
2 Aluminium oxidises iron(III) oxide.
3 Electrons are transferred from aluminium to iron(III) ions.
4 Iron in iron(III) oxide is reduced.

A 1 and 3 only
B 1 and 4 only
C 2 and 3 only
D 3 and 4 only

21 Which pair of compounds shows that transition elements have variable oxidation states?

A Cr_2O_3 and $CrBr_3$
B $CuSO_4$ and $CuCl_2$
C Fe_2O_3 and $FeCl_2$
D NiO and $NiCl_2$

22 Which statement about the uses of metals is not correct?

A Aluminium is used in aircraft because of its strength and good electrical conductivity.
B Copper is used in electrical wiring because of its good electrical conductivity.
C Stainless steel resists corrosion and is used to make cutlery.
D Transition elements are often used as catalysts.

23 Heating copper(II) carbonate produces copper(II) oxide and carbon dioxide. Heating the copper(II) oxide with carbon produces copper.

Which processes are involved in the conversion of copper(II) carbonate to copper?

A sublimation followed by oxidation
B sublimation followed by reduction
C thermal decomposition followed by oxidation
D thermal decomposition followed by reduction

24 Which statement about the hydrogen fuel cell is not correct?

A Chemical energy is converted into electrical energy.
B Hydrogen is oxidised.
C Reaction only involves bond formation.
D Water is the only product.

25 Which statement about the electrolysis of copper(II) sulfate solution using carbon electrodes is correct?

A A colourless gas is produced at the anode.
B A colourless gas is produced at the cathode.
C The colour of the electrolyte remains the same.
D The mass of both electrodes remains constant.

26 Elements in Group I of the Periodic Table react with water.

Which row describes the products formed in the reaction and the trend in reactivity of the elements?

	products	trend in reactivity
A	metal hydroxide and hydrogen	less reactive down the group
B	metal hydroxide and hydrogen	more reactive down the group
C	metal oxide and hydrogen	less reactive down the group
D	metal oxide and hydrogen	more reactive down the group

27 An inert gas E is used to fill weather balloons.

Which descriptions of E are correct?

	number of valence electrons in an atom of E	structure of gas E
A	2	diatomic molecules
B	2	monatomic atoms
C	8	diatomic molecules
D	8	monatomic atoms

28 Nitrogen reacts with hydrogen to produce ammonia.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

The reaction is exothermic. The bond energies are shown in the table.

bond	bond energy in kJ / mol
N≡N	945
H–H	436
N–H	390

Which shows the overall energy change for this reaction?

A –959 kJ / mol
B –87 kJ / mol
C 87 kJ / mol
D 959 kJ / mol

29 Which statements about endothermic reactions are correct?

1 The energy of the products is greater than the energy of the reactants.
2 The energy of the reactants is greater than the energy of the products.
3 The temperature of the surroundings increases during the reaction.
4 The temperature of the surroundings decreases during the reaction.

A 1 and 3 only
B 1 and 4 only
C 2 and 3 only
D 2 and 4 only

30 Which change in reaction conditions increases both the collision frequency and the proportion of molecules with sufficient energy to react?

A addition of a catalyst
B increasing the concentration of a reactants
C increasing the surface area of a reactants
D increasing the temperature of the reactants

31 The rate of reaction between magnesium ribbon and 2 mol / dm^3 hydrochloric acid at 25 °C to produce hydrogen gas is measured.

In another experiment, either the concentration or the temperature of hydrochloric acid is changed. All other conditions are kept the same.

Which conditions would increase the rate of reaction?

A 1 mol / dm^3 hydrochloric acid at 25 °C
B 2 mol / dm^3 hydrochloric acid at 10 °C
C 2 mol / dm^3 hydrochloric acid at 20 °C
D 3 mol / dm^3 hydrochloric acid at 25 °C

32 Which statements about the Haber process are correct?

1 An increase in pressure increases the speed of reaction.
2 An iron catalyst is used to increase the yield of ammonia.
3 A higher temperature of 450 °C is used to decrease the yield of ammonia.
4 A relatively low pressure of 250 atm is used because it is costly to maintain a high pressure.

A 1 and 4 only
B 1, 3 and 4 only
C 2 and 3 only
D 1, 2, 3 and 4

33 Oxides of nitrogen are formed in car engines and are a source of air pollution. To decrease this pollution, catalytic converters are fitted to car exhausts.

What happens to the oxides of nitrogen in the catalytic converter?

A combustion
B cracking
C oxidation
D reduction

34 Which statement/s about sulfur dioxide pollution is/ are correct?

1 It increases the pH of rivers.
2 It damages limestone buildings.
3 It causes respiratory problems.

A 1 only
B 2 only
C 1 and 3 only
D 2 and 3 only

35 Which chemical equation shows a correct reaction of methane?

A $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$
B $CH_4 + Cl_2 \rightarrow CH_4Cl_2$
C $CH_4 + Cl_2 \rightarrow CH_2Cl_2 + H_2$
D $2CH_4 + 2Cl_2 \rightarrow 2CH_3Cl + Cl_2 + H_2$

36 Which two compounds are molecules containing a double bond?

A ethane and ethanoic acid
B ethane and ethanol
C ethene and ethanoic acid
D ethene and ethanol

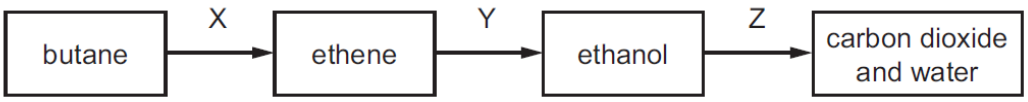
37 Ethanol can be formed using the two following methods.

1 fermentation
2 reaction between ethene and steam

Which row correctly shows the condition for the two methods?

	1	2
A	uses a catalyst	uses a catalyst
B	uses a catalyst	does not use a catalyst
C	does not use a catalyst	uses a catalyst
D	does not use a catalyst	does not use a catalyst

38 The diagram shows a reaction sequence.



Which row shows the processes X, Y and Z?

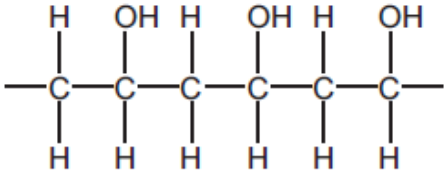
	X	Y	Z
A	cracking	fermentation	respiration
B	cracking	hydration	combustion
C	distillation	fermentation	respiration
D	distillation	hydration	combustion

39 Which reaction can be used to make ethanoic acid?

A oxidation of ethanol
B oxidation of ethene
C reduction of ethanol
D reduction of ethene

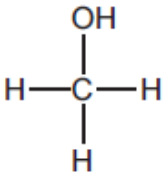
111

40 The structure of an addition polymer is shown.

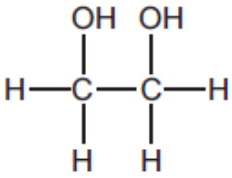


Which monomer is used to make this?

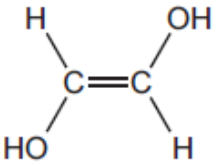
A



B



C



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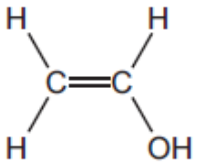

The Periodic Table of Elements

Group																	
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							1 H hydrogen 1										2 He helium 4
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Key

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The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

O

CONVENT OF THE HOLY INFANT JESUS SECONDARY
Preliminary Examination in preparation for
the General Certificate of Education Ordinary Level 2022

CANDIDATE NAME			
CLASS		REGISTER NUMBER	

CHEMISTRY 6092/01

Paper 1 Multiple Choice **14 September 2022**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and register number on the Multiple Choice Answer Sheet provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on the question paper.
A copy of the Periodic Table is printed on page 16.
The use of an approved scientific calculator is expected, where appropriate.

1 One of the instructions for an experiment reads as follows.

Quickly add 50 cm^3 of acid.

What is the best piece of apparatus to use?

A a burette **B** a conical flask

C a measuring cylinder **D** a pipette

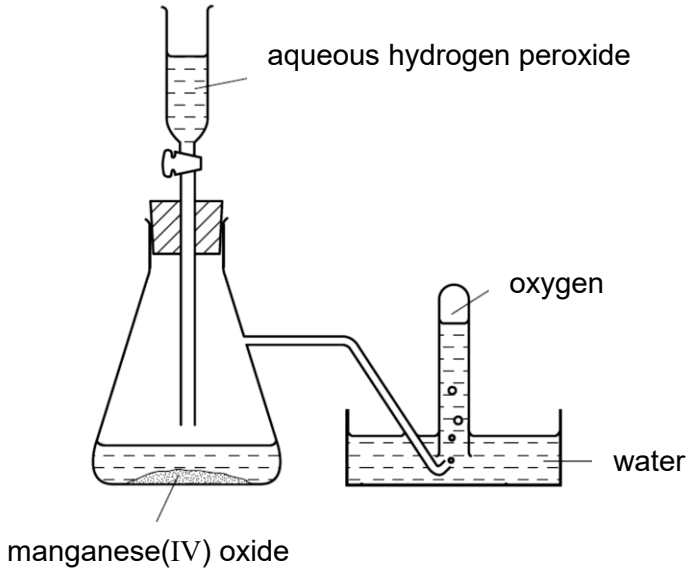
2 You have been given a liquid mixture of benzene (C_6H_6) and a dilute solution of sodium chloride in water. Benzene boils at 80 °C.

Which method should be used in the respective sequence to obtain samples of benzene and sodium chloride crystals?

	first method	second method
A	filtration	crystallisation
B	use a separating funnel	evaporation
C	distillation	filtration
D	evaporation	sublimation

3 Oxygen was prepared from hydrogen peroxide and collected as shown in the diagram.

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$



The first few tubes of gas were rejected because the gas was contaminated by

A water vapour. **B** hydrogen peroxide.

C hydrogen. **D** nitrogen.

4 What is the best method to separate a mixture of sodium chloride crystals and iodine crystals?

A sublimation **B** fractional distillation

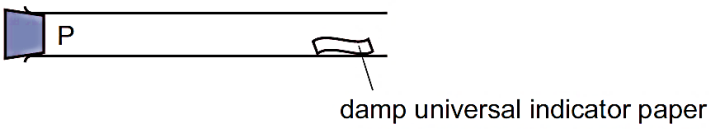
C filtration **D** crystallisation

5 An aqueous solution of zinc sulfate is tested by adding reagents.

Which observation is correct?

	reagent added to zinc sulfate	observations
A	acidified aqueous barium nitrate	forms a yellow precipitate
B	aqueous ammonia	forms white precipitate, insoluble in excess of the reagent
C	aqueous sodium hydroxide	forms a white precipitate, soluble in excess of the reagent
D	powdered copper	forms a grey precipitate

6 A gas is released at point P in the apparatus shown.



Which gas turns the damp universal indicator paper red **most** quickly?

A ammonia

B methane

C hydrogen chloride

D sulfur dioxide

7 Which statement about the atoms of all isotopes of chlorine is correct?

A They have different number of electrons in the outer shell.

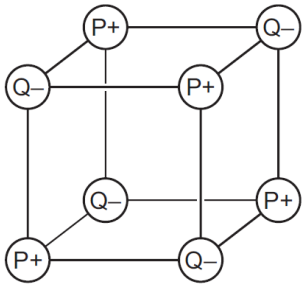
B They have the same mass.

C They have the same number of neutrons.

D They gain one electron to form ions.

8 Two elements, P and Q, are in the same period of the Periodic Table.

P and Q react together to form an ionic compound. Part of the lattice of this compound is shown.



Which statement is correct?

A An ion of P has more electrons than an ion of Q.

B An ion of P and ion of Q has different number of electron shells.

C An ion of Q has more protons than electrons.

D Element P is non-metallic.

9 Students are asked to state

- the number of electrons used to form covalent bonds in a molecule of methanoic acid,
- the electrical conductivity when the acid is dissolved in water.

Which row is correct?

	number of electrons	electrical conductivity in water
A	5	poor
B	6	good
C	8	poor
D	10	good

10 Which pair of statements about diamond and graphite is correct?

A They are allotropes of carbon. They are both macromolecules.

B They each conduct electricity. They can both be used as electrode.

C Diamond has covalent bonds. Graphite has ionic bonds.

D Diamond is hard with high melting point. Graphite is soft with low melting point.

11 These two statements are about metals, their properties and bonding.

statement 1 Metal conduct electricity when solid.

statement 2 In metals, a lattice of positive ions exists in a 'sea of electrons' which can move throughout the metal.

Which answer is correct?

A Both statements are correct and statement 2 explains statement 1.

B Both statements are correct but statement 2 does not explain statement 1.

C Statement 1 is correct but statement 2 is incorrect.

D Statement 2 is correct but statement 1 is incorrect.

12 40 cm^3 of the gaseous oxide of element Y requires 60 cm^3 of oxygen for complete combustion to produce 80 cm^3 of the gaseous oxide YO_2.

What is the molecular formula of the original oxide given that all gas volumes are measured at room temperature and pressure?

A YO **B** Y_2O **C** Y_2O_3 **D** Y_2O_5

13 N_2O_4 is a poisonous gas. It can be removed safely by reaction with aqueous sodium hydroxide.

$$N_2O_4(g) + 2NaOH(aq) \rightarrow NaNO_3(aq) + NaNO_2(aq) + H_2O(l)$$

What is the minimum volume of 0.8 mol/dm^3 aqueous sodium hydroxide needed remove 0.02 mol of N_2O_4?

A 12.5 cm^3 **B** 25.0 cm^3 **C** 50.0 cm^3 **D** 100.0 cm^3

[Turn over

14 Iron(II) oxide is produced by heating iron(II) carbonate.

$$FeCO_3(s) \rightarrow FeO(s) + CO_2(g)$$

What is the percentage yield of iron(II) oxide if 150 g of iron(II) carbonate produces 50 g of iron(II) oxide?

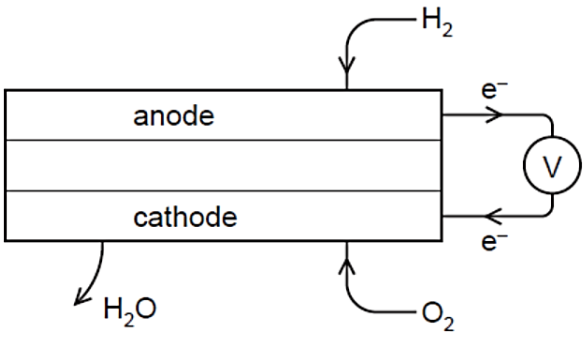
A $\dfrac{50 \times 116 \times 100}{150 \times 72}$

B $\dfrac{50 \times 150 \times 72}{116}$

C $\dfrac{50 \times 150 \times 72 \times 100}{116}$

D $\dfrac{50 \times 116}{150 \times 72}$

15 An alternative fuel for cars is hydrogen. Hydrogen can be used in a fuel cell as shown.



Which statement about the fuel cell is correct?

A Hydrogen gas is oxidised at the negative electrode to form water.

B Hydrogen gas is reduced at the positive electrode to form water.

C Oxygen gas is oxidised at the positive electrode to form water.

D Oxygen gas is reduced at the negative electrode to form water.

16 What is the ionic half-equation for the reaction that occurs at the cathode when molten lead(II) chloride is electrolysed?

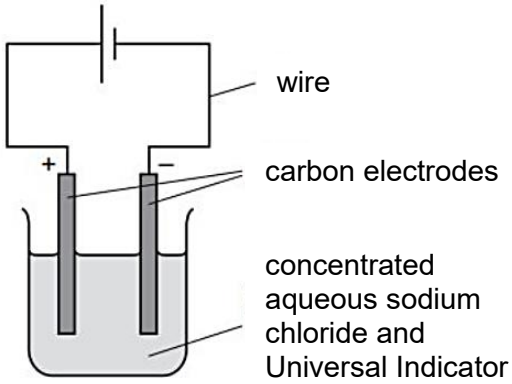
A $Pb^{2+} + 2e^- \rightarrow Pb$

B $2Cl^- \rightarrow Cl_2 + 2e^-$

C $Cl_2 + 2e^- \rightarrow 2Cl^-$

D $Pb \rightarrow Pb^{2+} + 2e^-$

17 A few drops of Universal Indicator were added to a beaker of concentrated aqueous sodium chloride and the solution was electrolysed using carbon electrodes.



What statement is correct?

A A grey solid is deposited at the anode.

B A yellowish-green gas is evolved at the cathode.

C The colour of Universal Indicator at the anode is colourless.

D The colour of Universal Indicator at the cathode is red.

18 A student wishes to use bond energies to calculate the enthalpy change for the reaction shown below.

$$(CH_3)_3CCl + (CH_3)_2NH \rightarrow (CH_3)_3CN(CH_3)_2 + HCl$$

Which inventory shows the most efficient means of doing the calculation to compute energies of bonds broken and formed?

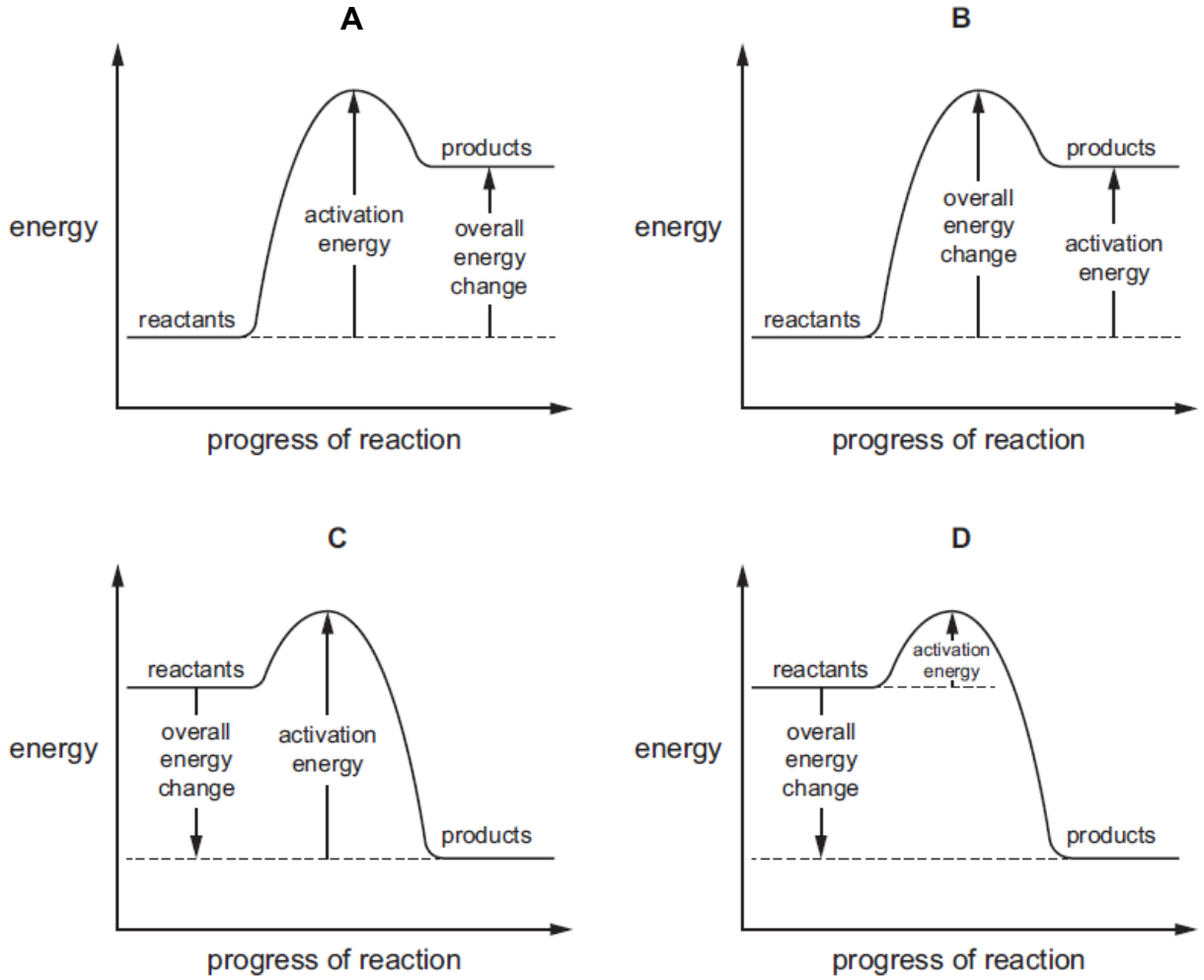
A bonds broken: 15 C—H, 3 C—C, 2 C—N, 1 C—C*l*, 1 N—H;
bonds formed: 15 C—H, 3 C—C, 2 C—N

B bonds broken: 1 C—C*l*, 1 N—H;
bonds formed: 1 C—N, 1 H—C*l*

C bonds broken: 14 C—H, 3 C—C, 2 C—N;
bonds formed: 14 C—H, 3 C—C, 2 C—N, 1 C—C*l*, 1 N—H

D bonds broken: 1 C—N, 1 H—C*l*;
bonds formed: 1 C—C*l*, 1 N—H

19 Which diagram is a correctly labelled energy level diagram for an endothermic reaction?



20 Magnesium reacts with dilute hydrochloric acid.

Which statement about the particles in the reaction is correct?

A Increasing the concentration of acid increases the collision rate but has no effect on the activation energy.

B Increasing the concentration of acid increases the collision rate and the activation energy.

C Increasing the temperature of the reaction increases the activation energy.

D Increasing the temperature of the reaction decreases the collision rate.

21 Ethanoic acid, nitric acid, propanoic acid and sulfuric acid each dissolve in water to form an acidic solution.

If Universal Indicator is placed in a 0.1 mol/dm^3 solution of each acid, which solution will produce a colour indicating the lowest pH?

A ethanoic acid

B nitric acid

C propanoic acid

D sulfuric acid

22 Dilute hydrochloric acid was added to substance X. No visible change was observed. However, the temperature of the mixture increased by 5 °C.

What could be substance X?

A copper(II) oxide

B magnesium metal

C calcium carbonate

D sodium hydroxide

23 An excess of aqueous sodium chloride was added to aqueous lead(II) nitrate and the mixture was filtered.

Which row shows the identity of the residue and the substances present in the filtrate?

	residue	substances in filtrate
A	lead(II) chloride	sodium nitrate and lead(II) nitrate
B	lead(II) chloride	sodium nitrate and sodium chloride
C	sodium nitrate	lead(II) chloride and lead(II) nitrate
D	sodium nitrate	lead(II) chloride and sodium chloride

24 The element vanadium, V, forms several oxides.

In which change is oxidation taking place?

A $VO_2 \rightarrow V_2O_3$

B $V_2O_5 \rightarrow VO_2$

C $V_2O_3 \rightarrow VO$

D $V_2O_3 \rightarrow V_2O_5$

[Turn over

25 In the Periodic Table, how does the metallic character of the elements vary from left to right across a period?

A It decreases.

B It increases.

C It increases then decreases.

D It stays the same.

26 The elements in a Group of the Periodic Table show the following trends.

1 The element with the lowest proton number has the lowest reactivity.

2 All the elements in the group form basic oxides.

3 The density of the elements increases down the group.

4 The melting point of the elements decreases down the group.

What is this Group?

A I **B** IV **C** VI **D** VII

27 Element X is a solid at room temperature and pressure. It needs to lose one electron per atom to attain the electronic structure of argon.

What is element X?

A bromine

B chlorine

C potassium

D sodium

28 When aqueous iodine is added to a solution of vanadium ions, V^{2+}, the V^{2+} ions each lose one electron.

Which property of transition elements is shown by this reaction?

A Transition elements are oxidising agent.

B Transition elements form a stable ion with a charge of 1+.

C Transition elements have variable oxidation states.

D Transition elements can act as catalyst.

29 Which row shows the correct indication of halogen which will react with potassium bromide to form bromine?

	chlorine	iodine
A	✓	✓
B	✓	×
C	×	✓
D	×	×

✓ = will react

× = will not react

Questions **30** and **31** concern the extraction of titanium.

Titanium (Ti) is extracted from the ore called rutile. Rutile is mainly made up of titanium oxide (TiO_2). Titanium is not very reactive so it should be possible to displace titanium from its oxide with carbon. However carbon reacts with titanium, making it very brittle.

Therefore, titanium is extracted by reacting titanium chloride ($TiCl_4$) with sodium. The sodium used for the reaction is obtained by electrolysis.

30 Which row in the table is the correct order of reactivity for carbon, sodium and titanium?

	most reactive ⟶ least reactive		
A	sodium	carbon	titanium
B	carbon	titanium	sodium
C	titanium	carbon	sodium
D	sodium	titanium	carbon

31 The equation for the reaction of titanium chloride with sodium is shown below.

$$TiCl_4 + 4Na \rightarrow Ti + 4NaCl$$

When 190 g of titanium chloride reacted with sodium, 48 g of titanium and 234 g of sodium chloride were produced.

How much sodium is required to produce 48 g of titanium?

A 23 g **B** 92 g **C** 190 g **D** 234 g

[Turn over

32 As extraction of aluminium by electrolysis is expensive, an increasing amount of aluminium is being recycled.

Another important reason to recycle aluminium is that

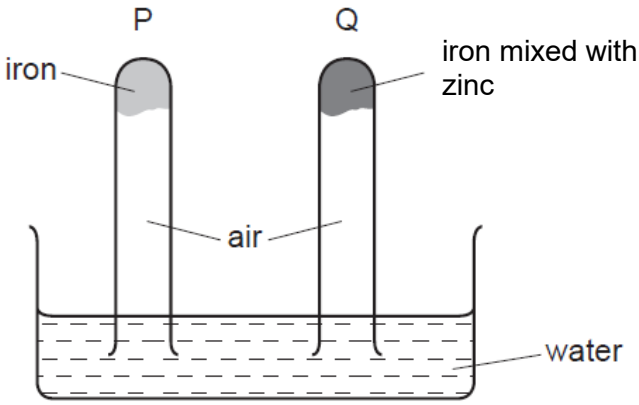
A it saves limited aluminium oxide reserves.

B the recycled aluminium is purer.

C aluminium scrap does not corrode easily.

D recycling aluminium does not use energy.

33 The diagram shows an experiment to investigate the rusting of iron.



What happens to the iron and water level in tube P and Q?

	P		Q	
	iron	water level	iron	water level
A	rusts	falls	rusts	no change
B	rusts	raises	does not rust	raises
C	rusts	no change	does not rust	falls
D	does not rust	raises	does not rust	no change

34 During the manufacture of iron by the blast furnace, which equation shows the reaction of an acidic substance with a basic substance?

A $C + O_2 \rightarrow CO_2$

B $CO_2 + C \rightarrow 2CO$

C $CaO + SiO_2 \rightarrow CaSiO_3$

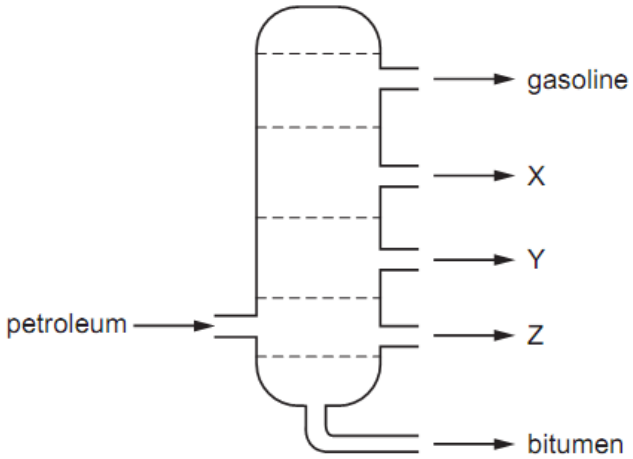
D $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

35 Pure air contains nitrogen, oxygen, and small amounts of other gases. The noble gases have been left out of the table.

Which row shows the composition of dry, unpolluted air?

	nitrogen / %	oxygen / %	other gases
A	21	78	small amount of carbon dioxide
B	21	78	small amount of carbon monoxide
C	78	21	small amount of carbon dioxide
D	78	21	small amount of carbon monoxide

36 The diagram shows the separation of petroleum into fractions.



Which statement about fraction X, Y and Z is correct?

A Fraction Y has the higher range of boiling points than Z.

B Fraction Y is less viscous than X.

C Fraction Z is less flammable than Y.

D Incomplete combustion of Z produces carbon dioxide and water.

37 The equation between a hydrocarbon, C_xH_8, and chlorine is shown.

$$C_xH_8 + 2Cl_2 \rightarrow C_xH_6Cl_2 + 2HCl$$

Which statement is correct?

A The reaction is an addition reaction.

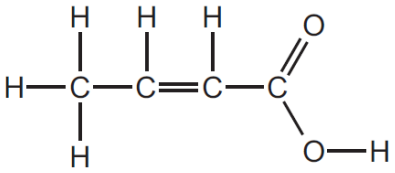
B UV light is required for the reaction to take place.

C High temperature and pressure is required for the reaction to take place.

D The molecular formula of the hydrocarbon is C_4H_8.

[Turn over

38 The structure of a compound is shown.



Which row shows the observation when the compound reacts with aqueous bromine, acidified potassium manganate(VII) and a piece of magnesium?

	aqueous bromine	warm with acidified potassium manganate(VII)	magnesium
A	colourless to brown	purple to colourless	no effervescence
B	brown to colourless	purple to colourless	effervescence
C	colourless to brown	remain purple	no effervescence
D	brown to colourless	remain purple	effervescence

39 What are formed when glucose is fermented?

A ethene and carbon dioxide

B ethene and oxygen

C ethanol and carbon dioxide

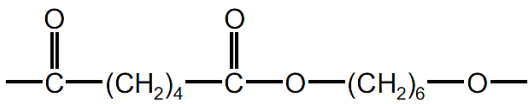
D ethanol and oxygen

40 Polymer Z

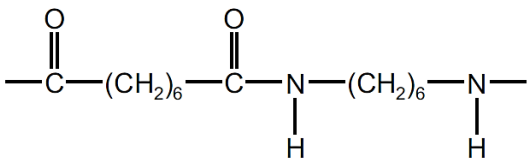
- has six carbon atoms in each of the monomers from which it is formed.
- is formed using condensation polymerisation.
- contains amide linkage.

Which is polymer Z?

A



B



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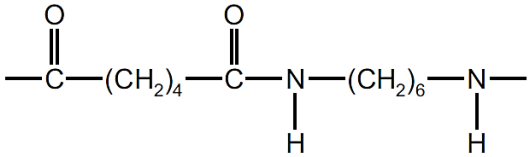

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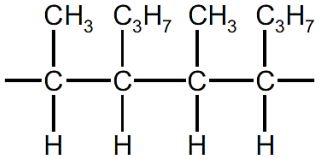

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

康 柏 中 学
COMPASSVALE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
CHEMISTRY 6092/01
Paper 1 Multiple Choice
Secondary Four Express

Name: _____ Duration: 1 h

Index No: _____ Date: 31 August 2022

Class: _____ Marks: _____ /40

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 15.
The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of **15** printed pages including this page. Setter: Miss Zhuang

1 The concentration of aqueous sodium carbonate can be found through an experiment involving a reaction with nitric acid of known concentration.

Which apparatus are needed for the experiment?

A burette, measuring cylinder, gas syringe

B burette, pipette, conical flask

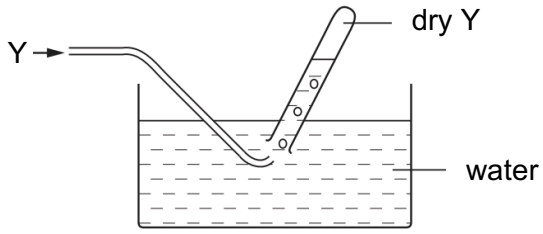
C burette, pipette, stopwatch

D electronic balance, measuring cylinder, gas syringe

2 Gas Y is a water-soluble, acidic gas which is less dense than air.

Which method is used to collect a dry sample of gas Y?

A



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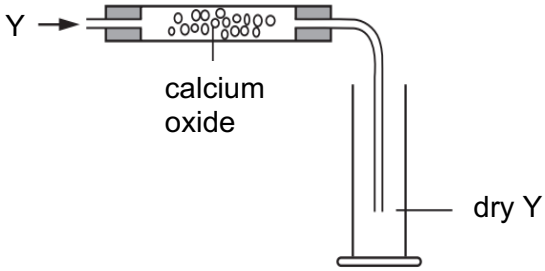

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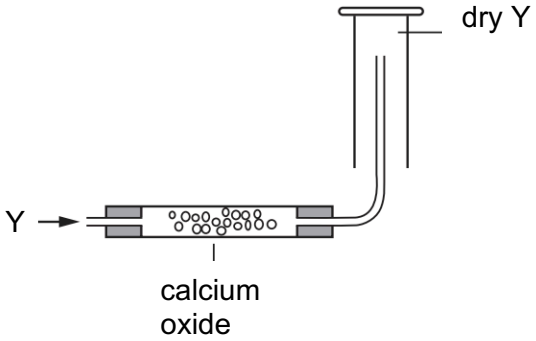

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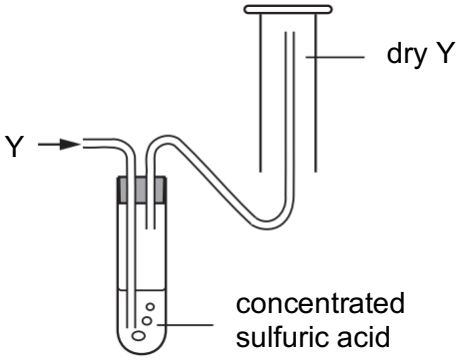
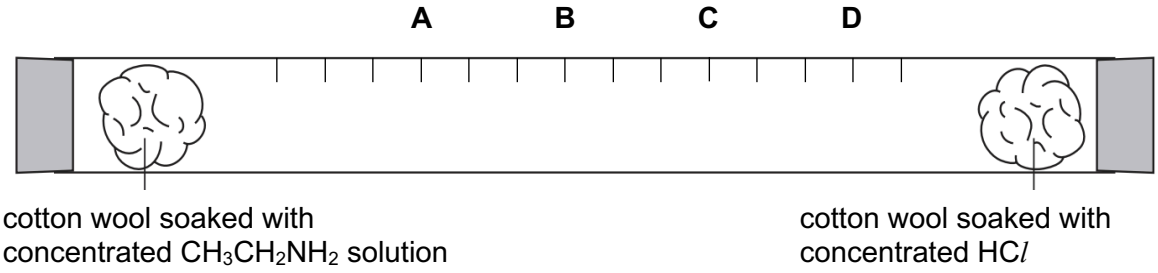


3 Ethylamine, $CH_3CH_2NH_2$ (M_r = 45), reacts with hydrogen chloride gas, HC*l* (M_r = 36.5) to form a white solid, ethylammonium chloride.

In an experiment, the following apparatus is set up.

Where will the white solid form?



4 Which statement about kinetic particle theory is correct?

A Energy is taken in when a liquid changes into solid state.

B Iodine particles are further apart in vapour state than in solid state.

C Particles have stronger attractive forces in gaseous state than in liquid state.

D When water boils, its particles lose kinetic energy.

5 When two elements react together, a compound is formed.

Which statement is correct?

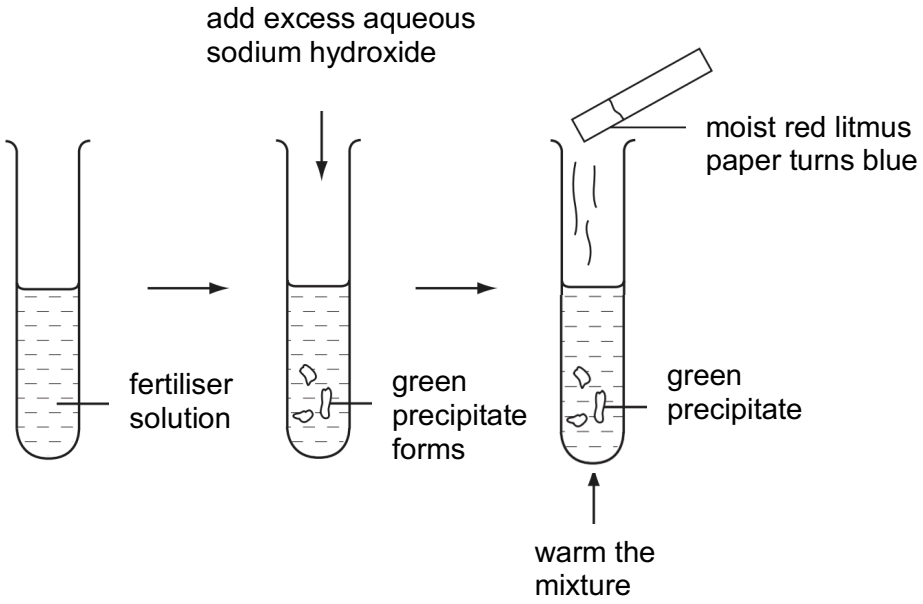
A Equal masses of the elements must be used.

B The compound formed can be easily separated into its elements.

C The compound formed will have a fixed melting point.

D The compound shows similar chemical properties to its constituent elements.

6 A solution of fertiliser was tested as shown.



Which ions are present in this fertiliser?

A Fe^{2+} and NH_4^+

B Fe^{2+} and NO_3^-

C Fe^{2+} and SO_4^{2-}

D NH_4^+ and NO_3^-

7 Which particle has the same number of neutrons and electrons?

A $^{19}_{9}F^-$ **B** $^{23}_{11}Na^+$ **C** $^{31}_{15}P$ **D** $^{32}_{16}S^{2-}$

8 Unnilpentium is an artificial element. One of its isotopes is $^{262}_{105}Unp$.

Which statement is correct?

A $^{262}_{105}Unp$ has a nucleon number of 105.

B Isotopes of unnilpentium have different chemical properties.

C The atom $^{262}_{106}Y$ is an isotope of $^{262}_{105}Unp$.

D The atom $^{260}_{105}X$ is an isotope of $^{262}_{105}Unp$.

9 Ammonium nitrate, NH_4NO_3, is a white crystalline salt that is commonly used in agriculture as a high-nitrogen fertilizer.

Three statements about ammonium nitrate are given.

statement 1 Forces of attraction between oppositely charged ions is present in ammonium nitrate.

statement 2 Molten ammonium nitrate can conduct electricity as there are delocalised electrons.

statement 3 There is covalent bonding in ammonium nitrate.

Which statements are correct?

A 1 only **B** 2 and 3 only **C** 2 only **D** 1 and 3 only

10 Which molecule has only six electrons used for bonding?

A C_2H_4 **B** C_2H_6 **C** H_2O **D** PCl_3

11 Elements P and Q form an ionic compound P_2Q.

In which group of the Periodic Table is P found and how is the bond between P and Q formed?

	group in which P is found	how the bond between P and Q is formed
A	I	Q atom gains two electrons from two P atoms
B	II	Q atom gains two electrons from one P atom
C	VI	P and Q shares two electrons
D	VI	P atom gains two Q atoms

12 The formula of china clay (aluminium silicate) was shown in an old book as $Al_2O_3.2SiO_2.2H_2O$.

It is shown in a modern book as $Al_2(OH)_xSi_2O_y$.

What are the values of x and y?

	x	y
A	2	4
B	2	5
C	4	3
D	4	5

13 One mole of each of the following compounds is burnt in excess oxygen.

Which compound would produce four moles of carbon dioxide and four moles of steam only?

A C_4H_{10}

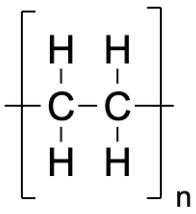
B C_4H_9OH

C $C_2H_5CO_2H$

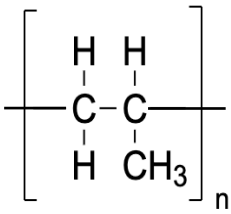
D $CH_3CH_2CO_2CH_3$

14 Which polymer has an empirical formula that is different from the rest?

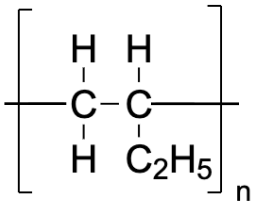
A



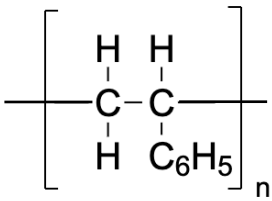
B



C



D



15 A washing powder contains sodium hydrogencarbonate, $NaHCO_3$ (M_r =84). In a titration, a solution containing 1.00 g of washing powder requires 7.15 cm^3 of 0.1 mol/dm^3 sulfuric acid for complete reaction.

$$2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2CO_2 + 2H_2O$$

Given that sodium hydrogencarbonate is the only ingredient that reacts with the acid, what is the percentage purity of sodium hydrogencarbonate in the washing powder?

A 3.0% **B** 6.0% **C** 12.0% **D** 24.0%

16 The pH of an aqueous solution of hydrochloric acid is 3.

What will be the pH of the solution after adding 15 g of sodium chloride?

A 2 **B** 3 **C** 7 **D** 9

17 Hydrazine, N_2H_4, is used as a rocket fuel since it reacts with oxygen to form gases that are environmentally friendly.

$$N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(g) \qquad \Delta H = -534 \text{ kJ/mol}$$

Despite its use as a rocket fuel, hydrazine does not burn readily in oxygen.

Which statement explains why hydrazine does **not** burn readily?

A Hydrazine is a liquid.

B The activation energy is too high.

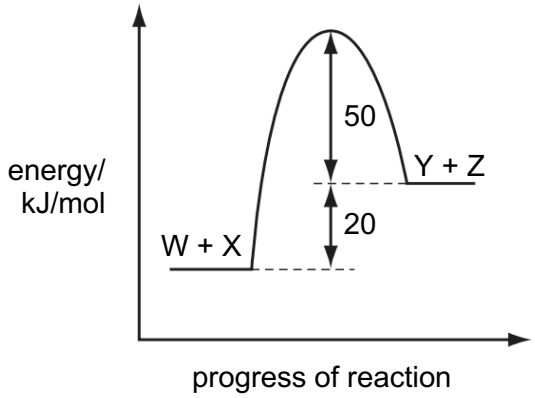
C The N≡N bond is very strong.

D The reaction is exothermic.

18 W and X reacts to form Y and Z in a reversible reaction.

$$W + X \rightleftharpoons Y + Z$$

The energy profile diagram for this reaction is shown.



Which statements are correct?

1 The enthalpy change for the backward reaction is +20 kJ/mol.

2 The forward reaction is endothermic.

3 The activation energy for the forward reaction is +70kJ/mol.

A 1 and 2 **B** 1 and 3 **C** 1, 2 and 3 **D** 2 and 3

19 An alloy reacts with dilute nitric acid to evolve a gas which extinguishes a lighted splint with a 'pop' sound. A red-brown solid residue remains, which turns into a black solid when heated in air.

Which two metals are present in this alloy?

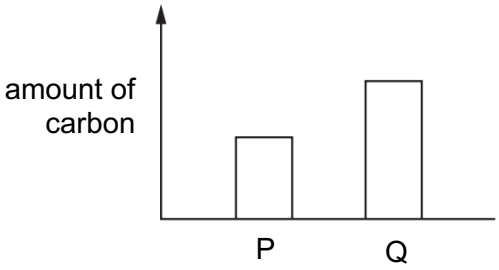
A iron and copper

B iron and aluminium

C silver and zinc

D silver and copper

20 The diagram compares the amount of carbon in two steels, P and Q.



Which row correctly compares the strength and brittleness of P and Q?

	strength	brittleness
A	Q > P	Q > P
B	Q > P	P > Q
C	P > Q	Q > P
D	P > Q	P > Q

21 Aluminum, caesium and zinc are three commonly used metals.

Caesium, Cs, is a metal that is above aluminum in the reactivity series.

Which row correctly shows the extraction of the three metals?

	aluminium	zinc	caesium
A	electrolysing A*l*C*l*$_3$(aq)	heating ZnO with coke	electrolysing CsC*l*(aq)
B	electrolysing A*l*C*l*$_3$(aq)	electrolysing ZnC*l*$_2$(aq)	electrolysing CsC*l*(*l*)
C	electrolysing A*l*$_2$O$_3$(*l*)	heating ZnO with coke	electrolysing CsC*l*(*l*)
D	heating A*l*$_2$O$_3$ with coke	electrolysing ZnC*l*$_2$(aq)	heating Cs$_2$O with coke

22 Old steel pipes corrode quickly in a damp atmosphere but aluminum cans do not.

Which statement correctly explains this?

A Aluminium cannot form variable oxidation states but iron can.

B Aluminium has a lower density than iron.

C Aluminium is above iron in the reactivity series.

D Aluminium is protected by its oxide layer.

23 Which process does **not** involve either oxidation or reduction?

A formation of ammonium chloride from ammonia and hydrochloric acid

B formation of nitrogen monoxide from ammonia

C formation of sulfuric acid from sulfur

D formation of zinc from zinc sulfide

24 Aqueous potassium iodide is used as a test reagent.

When it is added to an aqueous solution of compound Z, the colour of the test reagent changes from …….1…….. . This colour change shows that Z is …..2……. .

Which words correctly complete the sentence?

	1	2
A	brown to colourless	oxidised
B	brown to colourless	reduced
C	colourless to brown	oxidised
D	colourless to brown	reduced

25 River water in a chalky agricultural area is suspected to contain Ca^{2+}, Mg^{2+}, CO_3^{2-}, Cl^- and NO_3^- ions. During an investigation, the water is treated by adding a calculated quantity of calcium hydroxide.

What could be precipitated upon the addition of calcium hydroxide?

A $CaCl_2$ **B** $CaCO_3$ **C** $MgCl_2$ **D** $Mg(NO_3)_2$

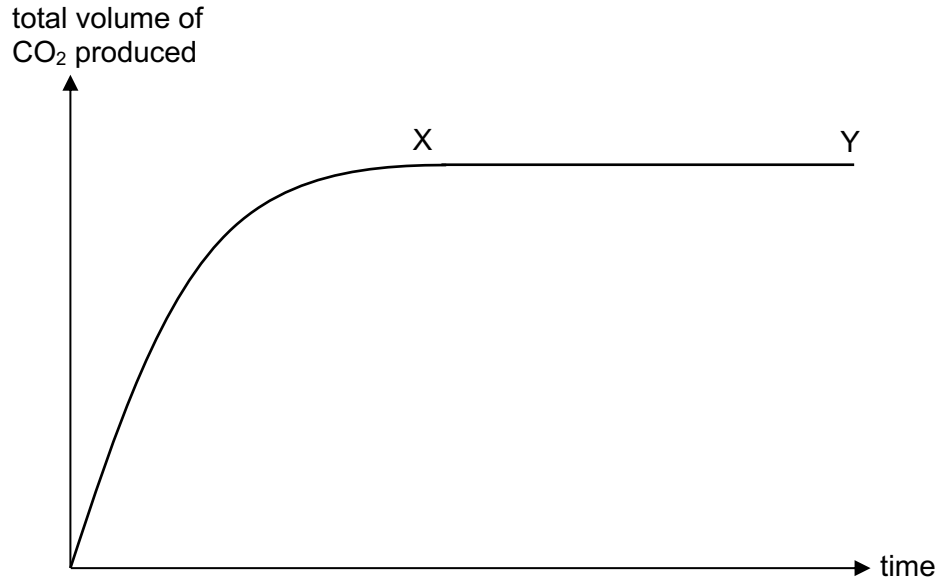
26 6.5 g of zinc foil was added to 20 cm^3 of 0.1 mol/dm^3 dilute sulfuric acid and the volume of hydrogen evolved was recorded at regular time intervals.

In a separate experiment, the same mass of zinc foil was added to 40 cm^3 of the same solution of dilute sulfuric acid.

How will the rate of reaction and total volume of hydrogen evolved in this second experiment compare to the first experiment?

	rate of reaction	total volume of hydrogen evolved
A	increases	increases
B	increases	no change
C	no change	no change
D	no change	increases

27 The graph shows how total volume of carbon dioxide produced by the reaction between nitric acid and excess sodium carbonate varied with time.



Which statement about section XY of the graph is correct?

A All the sodium carbonate has reacted.

B No more carbon dioxide is being produced.

C The concentration of the acid is decreasing.

D The speed of reaction is at a maximum.

28 Element X is a solid at room temperature.

X loses one electron per atom to obtain the electronic configuration of a noble gas and it is the least reactive element in its group.

What is element X?

A At **B** F **C** Fr **D** Li

29 Silver metal has some properties similar to Group I elements.

Which statement about silver is true?

A Silver can displace hydrogen from cold water.

B Silver is extracted from its ore by electrolysis.

C Silver reacts with chlorine to form silver chloride which is soluble in water.

D Silver reduces bromine to form silver bromide, AgBr.

30 Which oxide is **unlikely** to dissolve in aqueous sodium hydroxide?

A Al_2O_3 **B** CO_2 **C** SO_2 **D** MgO

31 Three different solutions were electrolysed using inert electrodes.

solution 1 dilute sodium chloride

solution 2 concentrated sodium chloride

solution 3 aqueous copper(II) sulfate

Which solutions produce hydrogen at the negative electrode?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 only **D** 2 and 3 only

32 Which of the following methods would **not** produce ammonia?

A adding sodium hydroxide followed by aluminium foil to zinc nitrate solution and heat it

B heating ammonium chloride with potassium hydroxide

C heating ammonium sulfate with dilute nitric acid

D heating concentrated aqueous ammonia

33 Which gas is present in the exhaust fumes of a car engine in a much greater amount than any other gas?

A carbon dioxide

B carbon monoxide

C nitrogen

D water vapour

34 Which statement about the fractions of crude oil is correct?

A Fractions containing bigger hydrocarbons are found nearer to the top of the fractionating column.

B Kerosene burns with a more smoky flame than diesel.

C Lubricating oil is more viscous than diesel.

D Petrol boils at a higher temperature range compared to kerosene.

35 Butene reacts with steam in the presence of sulfuric acid as shown in the equation.

$$CH_3CH_2CH{=}CH_2 + H_2O \rightarrow CH_3CH_2CH_2CH_2OH$$

What type of reaction is this?

A acid-base

B addition

C hydrolysis

D substitution

36 In the presence of ultraviolet light, ethane and chlorine react to give a mixture of products.

Which compound is a possible product of the reaction?

A CH_3Cl **B** $CH_2ClCHCl_2$ **C** $CH_2{=}CHCl$ **D** $CH_3CH_2CH_2Cl$

37 Which molecule **cannot** be obtained from the cracking of a molecule of nonane, $CH_3(CH_2)_7CH_3$?

A $CH_2{=}CHCH{=}CH_2$

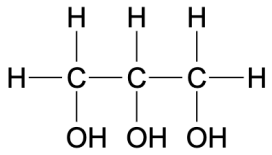
B $CH_3CH_2CH_2CH_2CH_2CH_3$

C $(CH_3CH_2CH_2)_3CH$

D H_2

38 Propane-1,2,3-triol is a raw material for many important industrial chemical processes.

The structure of propane-1,2,3-triol is shown.



Which statements about propane-1,2,3-triol are correct?

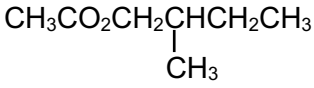
statement 1 It can be used as a solvent and a fuel.

statement 2 It reacts with acidified $KMnO_4$ to form carboxylic acids.

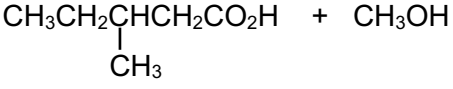
statement 3 It reacts with carboxylic acids to form compounds containing up to three ester groups.

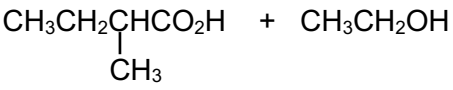
A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 1 only

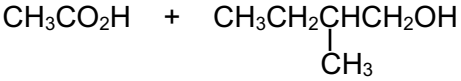
39 Molecule X has the following formula.

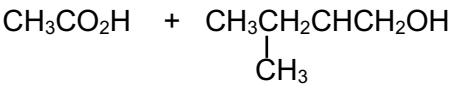


Which alcohol and acid can react together under suitable conditions to produce X?

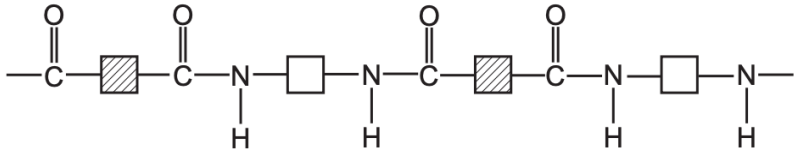
A 

B 

C 

D 

40 Polymer Y has the following structure.



Which is correct about polymer Y?

A It is a form of polyester.

B It is formed by addition polymerisation.

C It is produced when monomers containing carboxylic acid functional group reacts with monomers containing alcohol functional group.

D Water is eliminated in the polymerisation process to form Y.

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**Key** proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2022

CHEMISTRY
PAPER 1

Name: _____ ( ) Class: _____

SECONDARY FOUR EXPRESS **Thurs 15 Sep 2022**
6092/01 **1h**
0800 – 0900 h

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and the OTAS sheet.
Write in soft pencil.
An approved scientific calculator may be used.

There are **forty** questions in this section. Answer all questions. For each question, there are four possible answers, **A**, **B**, **C** or **D**. Choose the **one** you consider correct and record your choice in soft pencil on the OTAS sheet.

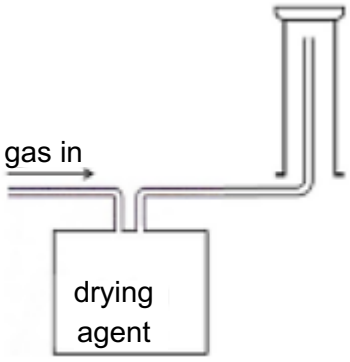
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 19.

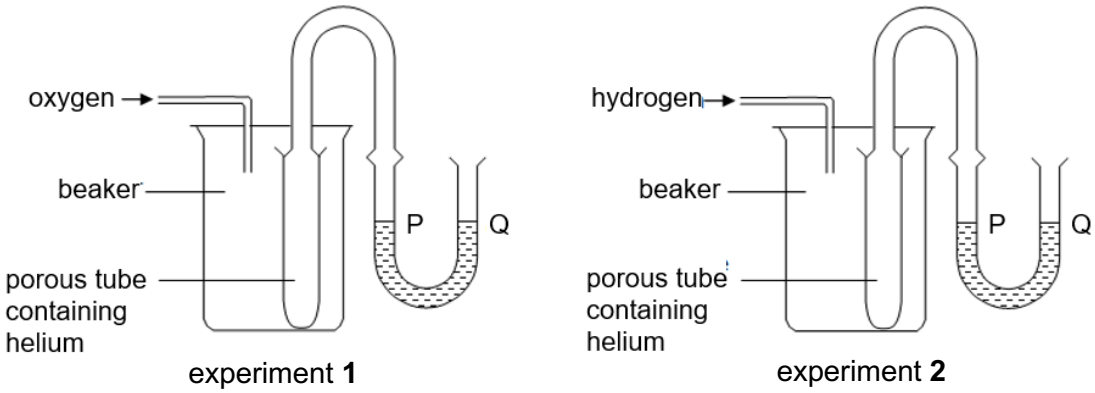
Name of setter: Ms Tian Yilin

1 Which option shows the correct drying agent and the corresponding gas that can be collected by the method shown in the set up?



	drying agent	gas collected
A	anhydrous calcium oxide	carbon dioxide
B	anhydrous calcium oxide	hydrogen
C	concentrated sulfuric acid	ammonia
D	concentrated sulfuric acid	chlorine

2 Two experiments, experiments **1** and **2**, are set up to demonstrate the diffusion of gases.

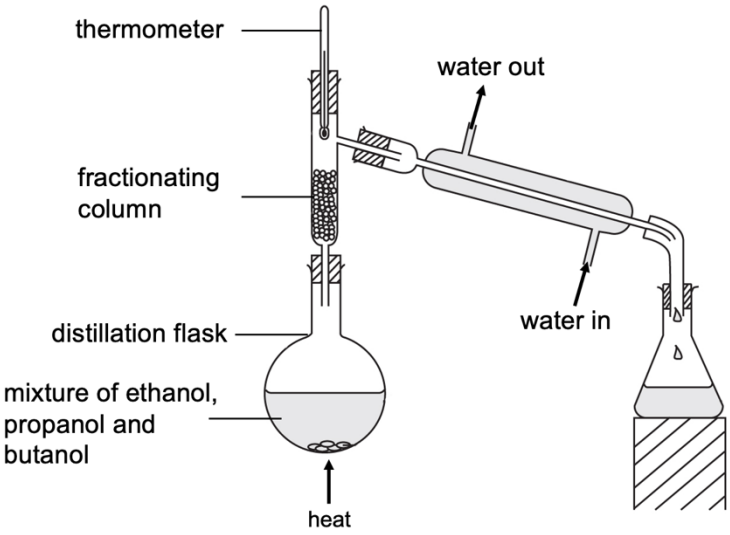


experiment **1** experiment **2**

What would happen to the water levels at P and Q in both experiments?

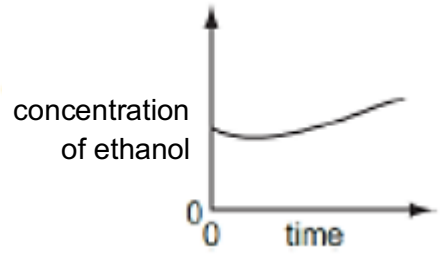
	experiment 1	experiment 2
A	P is higher than Q	P and Q remain the same
B	P is higher than Q	P is lower than Q
C	P and Q remain the same	P and Q remain the same
D	P and Q remain the same	P is higher than Q

3 The apparatus is used to separate a mixture of ethanol (boiling point 78 °C), propanol (boiling point 97 °C) and butanol (boiling point 118 °C).

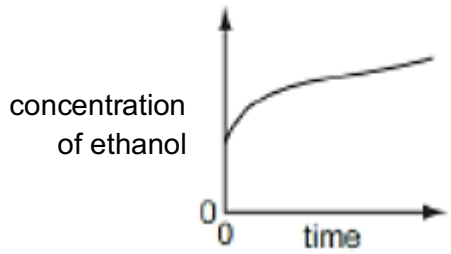


Which graph shows the change in concentration of ethanol in the distillation flask as the distillation proceeds?

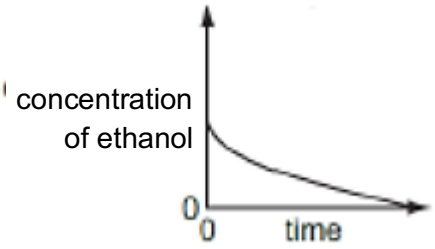
A



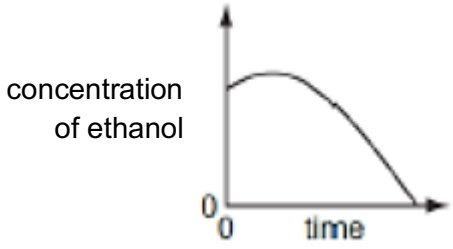
B



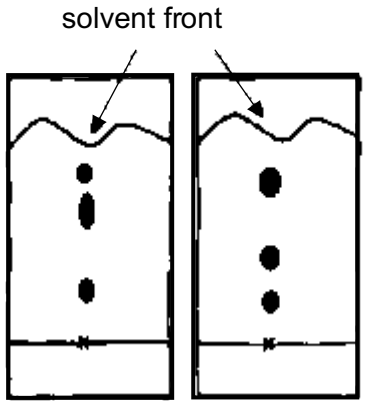
C



D



4 Two students carried out chromatography experiments to examine a urine sample. They used the same urine sample. The chromatograms obtained by the two students are shown in the diagrams.

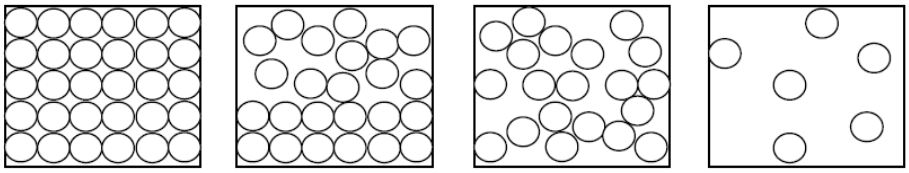


Why are the chromatograms different?

A One of the students used a larger amount of urine sample.
B One of the students did not use enough solvent.
C One of the students added another substance to the urine sample.
D The two students used different solvents.

5 The melting and boiling points of carbon tetrachloride are -23 °C and 76 °C respectively.

Which diagrams best represent the arrangement of carbon tetrachloride particles as a sample of it is cooled from 80 °C to -20 °C?



	arrangement at 80 °C	arrangement at -20 °C
A	1	2
B	4	4
C	3	3
D	4	3

6 Which of the following contains an element, a mixture and a compound?

A ozone, air, sulfur trioxide
B helium, distilled water, chromium
C diamond, limewater, carbon dioxide
D calcium carbonate, magnesium, oxygen

7 A scientist wants to carry out a series of tests on three test-tubes of different colourless solutions which are labelled **X**, **Y** and **Z**. To a portion of each solution, he adds silver nitrate solution followed by dilute nitric acid. His observations are shown below.

test-tube	**X**	**Y**	**Z**
add silver nitrate solution	no change observed	white ppt formed	white ppt formed
add dilute nitric acid	no change observed	effervescence	white ppt remained

Based on his observations, what are the possible identities of the anions present in each of the three test-tubes?

	test-tube X	**test-tube Y**	**test-tube Z**
A	NO_3^-	Br^-	Cl^-
B	NO_3^-	CO_3^{2-}	Cl^-
C	NO_3^-	CO_3^{2-}	SO_4^{2-}
D	NH_4^+	Br^-	SO_4^{2-}

8 An ion contains 8 protons, 7 neutrons and 9 electrons. What is its nucleon number?

A 8
B 15
C 17
D 24

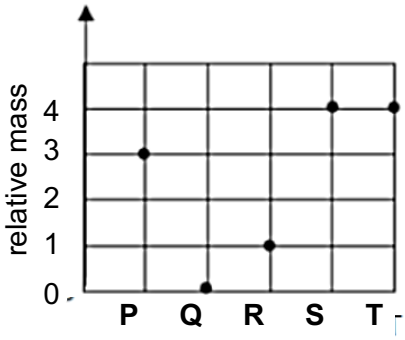
9 An imaginary element has two isotopes:

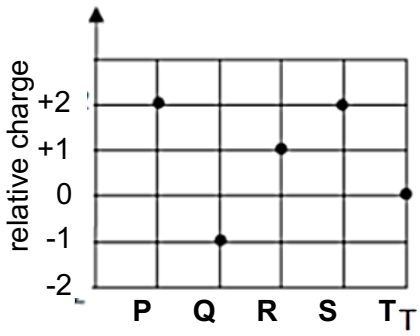
- The first isotope has 15 protons and a relative abundance of 80%.
- The second isotope has 16 neutrons.

If the relative atomic mass of the imaginary element is 30.2, determine the number of neutrons in the first isotope.

A 8
B 15
C 17
D 24

10 The relative mass and relative charge of particles **P**, **Q**, **R**, **S** and **T** are shown in two diagrams.





Which statement(s) is/are correct?

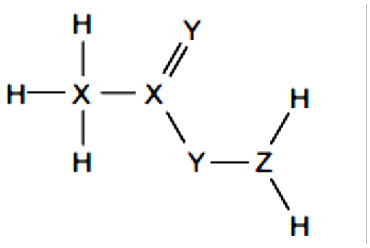
1 **Q** represents an electron.
2 **R** represents a hydrogen ion.
3 **T** represents the nucleus of a helium atom.
4 **P** and **S** represent the nuclei of isotopes.

A 1 only
B 3 only
C 1, 2 and 4
D 2, 3 and 4

11 Which substance contains both ionic and covalent bonds?

A ammonium chloride
B hydrogen chloride
C iron(III) oxide
D phosphorus trichloride

12 The diagram shows the structure of a covalent compound containing the element hydrogen, H, and the unknown elements **X**, **Y** and **Z**.

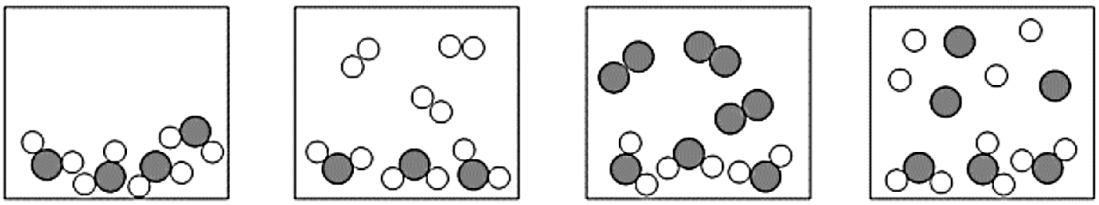


How many valence electrons do each of the three elements, **X**, **Y** and **Z** possess?

	X	**Y**	**Z**
A	4	5	6
B	4	6	5
C	4	5	1
D	5	1	4

13 24 cm^3 of hydrogen burns in 10 cm^3 of oxygen.

Which one of the following diagrams represents the molecules that remain in the reaction vessel?
(All volumes are measured at room temperature and pressure. The number of particles do not represent the actual amounts.)



A **B** **C** **D**

14 The extraction of iron in the blast furnace yields pig iron, impure iron. A student dissolves a 3.8 g sample of pig iron with an excess of sulfuric acid. 1.58 dm^3 of hydrogen gas was obtained at r.t.p.

Which calculation shows the percentage purity of iron in pig iron?

A $\frac{1.58}{24} \div \frac{3.8}{56} \times 100$

B $1.58 \times 24 \div \frac{3.8}{56} \times 100$

C $\frac{3.8}{56} \div (1.58 \times 24) \times 100$

D $\frac{3.8}{56} \div \frac{1.58}{24} \times 100$

15 0.10 mol of a compound contains 4.8 g of oxygen, 1.6 g of hydrogen and 9.6 g of carbon. What is the molecular formula of the compound?

A $C_7H_{12}O_4$
B $C_8H_{16}O_3$
C $C_{14}H_{24}O_8$
D $C_{16}H_{32}O_6$

16 What is the volume of 1.0 mol/dm^3 of hydrochloric acid that is required to react completely with 1.25 g of zinc carbonate?

A 10 cm^3
B 20 cm^3
C 100 cm^3
D 200 cm^3

17 Ethanoic acid (CH_3COOH) is an acid commonly found in vinegar. It reacts with sodium hydroxide to form the soluble salt sodium ethanoate (CH_3COONa) and water.

What is the ionic equation for this reaction?

A $H^+ (aq) + OH^- (aq) \rightarrow H_2O (l)$
B $CH_3COO^- (aq) + Na^+ (aq) \rightarrow CH_3COONa (aq)$
C $CH_3COOH (aq) + OH^- (aq) \rightarrow CH_3COO^- (aq) + H_2O (l)$
D $CH_3COOH (aq) + NaOH (aq) \rightarrow CH_3COONa (aq) + H_2O (l)$

18 Which statement(s) is/are true about dilute ethanoic acid and dilute hydrochloric acid?

1 Pure ethanoic acid is a stronger acid than 0.1 mol/dm^3 ethanoic acid.
2 1.0 mol/dm^3 ethanoic acid is a stronger acid than 0.1 mol/dm^3 ethanoic acid.
3 0.1 mol/dm^3 hydrochloric acid is a stronger acid than 0.1 mol/dm^3 ethanoic acid.
4 0.1 mol/dm^3 hydrochloric acid is a stronger acid than 1.0 mol/dm^3 ethanoic acid.

A 1, 2 and 3
B 2 and 3
C 3 only
D 3 and 4

19 Which equation suggests that the underlined oxide has amphoteric properties?

A $\underline{K_2O} + H_2O \rightarrow 2KOH$
B $\underline{P_2O_5} + 6NaOH \rightarrow 2Na_3PO_4 + 3H_2O$
C $\underline{Cl_2O} + 2LiOH \rightarrow 2LiClO + H_2O$
D $\underline{Ga_2O_3} + 2KOH \rightarrow 2KGaO_2 + H_2O$

20 An excess of substance **Y** was added bit by bit, with stirring to aqueous solution **Z**. The changes in the pH of the mixture is shown in the graph.

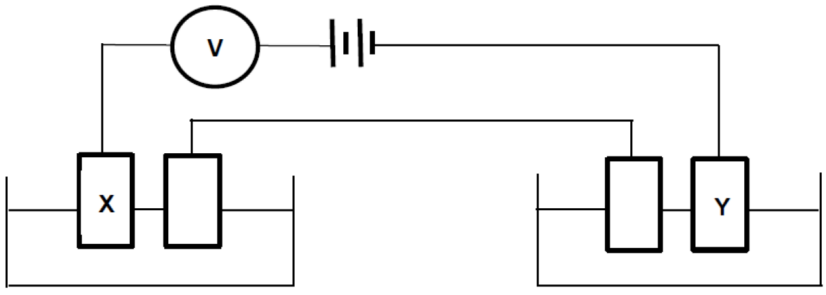
What could substance **Y** and **Z** be?

	substance Y	**substance Z**
A	potassium oxide	sulfuric acid
B	magnesium oxide	ethanoic acid
C	calcium oxide	ethanoic acid
D	zinc oxide	sulfuric acid

21 Which statement describes what happens in a hydrogen fuel cell?

A Electricity is used to produced water.
B Electricity and water are produced.
C Hydrogen is burnt to form steam.
D Oxygen is produced.

22 A student carried out an experiment involving the electrolysis of concentrated copper(II) chloride in cell **A** and concentrated sodium chloride in cell **B** using inert electrodes.

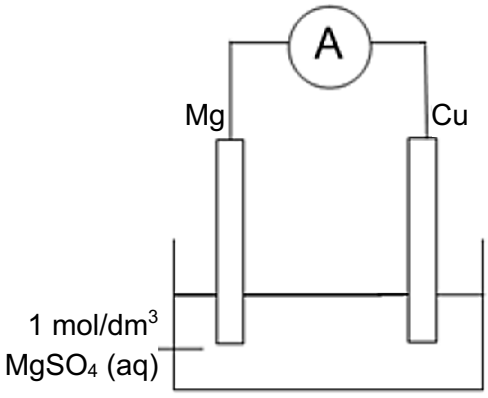


cell **A** cell **B**

What are the ionic equations that occurred at electrode **X** and **Y** at the start of the electrolysis?

	at electrode X	at electrode Y
A	$2Cl^- \rightarrow Cl_2 + 2e^-$	$2H^+ + 2e^- \rightarrow H_2$
B	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$	$2H^+ + 2e^- \rightarrow H_2$
C	$2Cl^- \rightarrow Cl_2 + 2e^-$	$Na^+ + e^- \rightarrow Na$
D	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$	$Na^+ + e^- \rightarrow Na$

23 The following is a simple cell set-up.

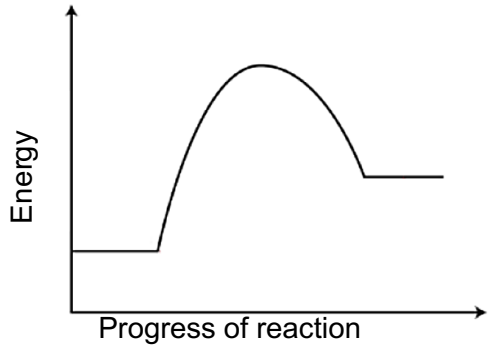


Which statements are correct?

1 Electrons flow from the copper electrode to the magnesium electrode.
2 The mass of the magnesium electrode decreases.
3 A deposit of magnesium will appear on the copper electrode.
4 Chemical energy is converted into electrical energy.

A 1 and 3 only
B 2 and 4 only
C 1, 2 and 4 only
D 2, 3 and 4 only

24 The energy profile diagram of a reaction is given.



Which reaction **cannot** be represented by this diagram?

A $H_2O\ (g) \rightarrow 2H\ (g) + O\ (g)$
B $6CO_2\ (g) + 6H_2O\ (l) \rightarrow C_6H_{12}O_6\ (s) + 6O_2\ (g)$
C $N\ (g) + 3H\ (g) \rightarrow NH_3\ (g)$
D $CuCO_3\ (s) \rightarrow CuO\ (s) + CO_2\ (g)$

25 The enthalpy changes for the complete combustion of three fuels are as shown:

Reaction	Enthalpy change/kJ per mole of fuel
$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$	–100
$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$	–75
$2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$	–170

What is the correct arrangement for the fuels from the least energy per gram of fuel to the most energy per gram of fuel?

	least	→	most
A	CH_4	C_3H_6	C_2H_5OH
B	C_3H_6	CH_4	C_2H_5OH
C	C_2H_5OH	CH_4	C_3H_6
D	C_2H_5OH	C_3H_6	CH_4

26 Which formulae contains nitrogen with an oxidation state of +5?

A NO_2
B N_2O_4
C NH_4^+
D HNO_3

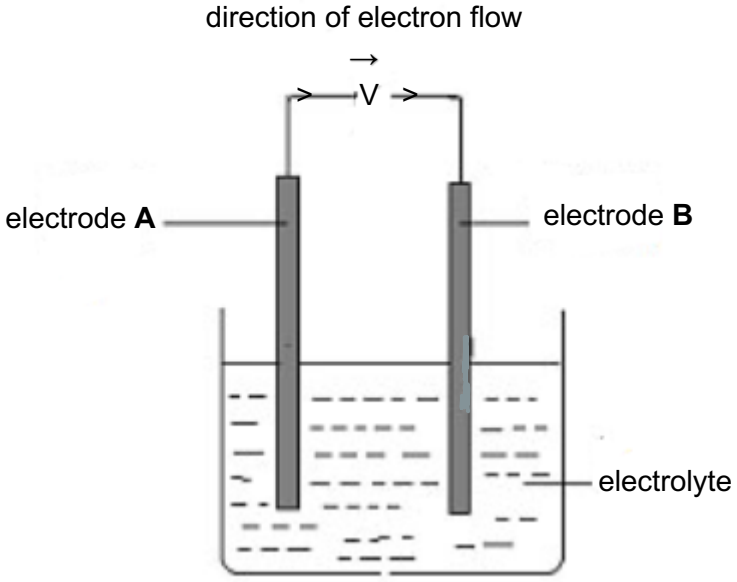
27 Which one of the following processes is **not** a redox reaction?

A rusting of iron nails
B combustion of methane
C decomposition of hydrogen peroxide into water and oxygen
D neutralisation of dilute hydrochloric acid by aqueous sodium hydroxide

28 Experiments were carried out to determine the positions of metals **X**, **Y** and **Z** in the reactivity series. The table shows the results.

Test	**Metal X**	**Metal Y**	**Metal Z**
Reaction between metal and hydrochloric acid	Effervescence	Effervescence	No visible observation
Heating the metal oxide with carbon	Metal oxide reduced	Metal oxide not reduced	Metal oxide reduced

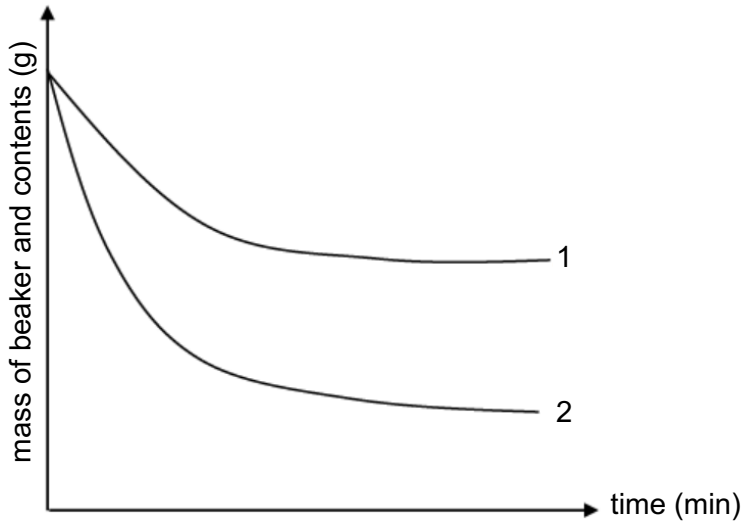
Two of these metals were used to form a simple cell as shown in the diagram.



Which pairs of metals used at electrodes **A** and **B** would produce the largest voltage in the direction of electron flow?

	electrode A	**electrode B**
A	metal **X**	metal **Z**
B	metal **Y**	metal **Z**
C	metal **Z**	metal **X**
D	metal **Z**	metal **Y**

29 Excess zinc was added to a beaker of dilute hydrochloric acid on a balance. A graph of the mass of the beaker and contents was plotted against time (curve 1).

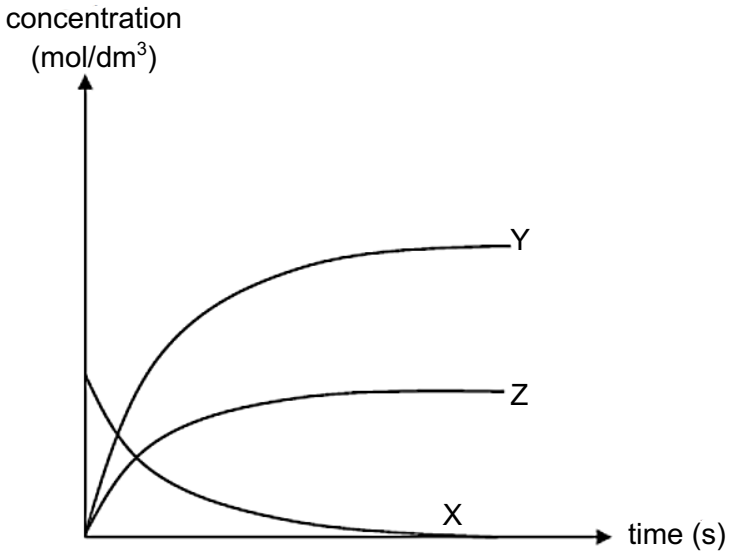


Which of the following changes to the experiment could give curve 2?

1 The same volume of a more concentrated solution of hydrochloric acid
2 An increase in pressure
3 The same mass of zinc but in smaller pieces

A 1 only
B 2 only
C 1 and 3 only
D 1, 2 and 3

30 The following graph shows the change in reactant and product concentrations with time during a chemical reaction.



Which equation represents the reaction?

A $X \rightarrow 2Y + Z$
B $X \rightarrow Y + 2Z$
C $Y + Z \rightarrow X$
D $2Y + Z \rightarrow X$

31 Which statement about transition elements is correct?

A All catalysts are transition elements or their compounds.
B All coloured compounds contain transition elements.
C Transitions elements conduct electricity because they have variable oxidation states.
D Transition elements have high melting points due to strong attraction between positive ions and a 'sea of electrons'.

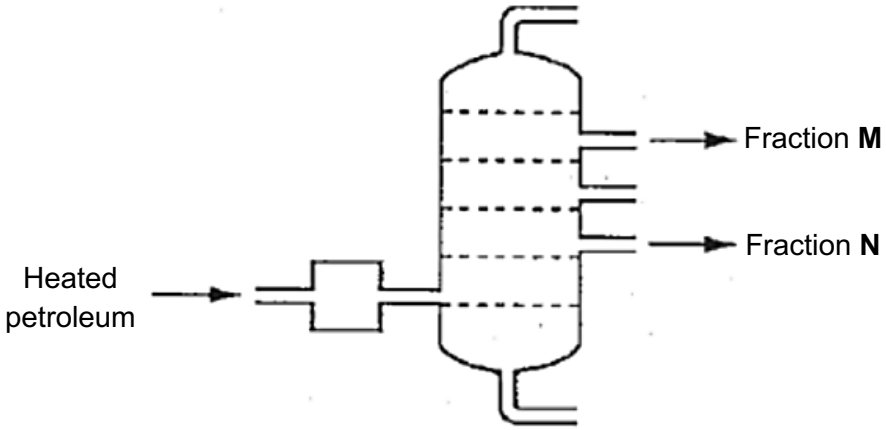
32 A newly discovered element, gistatine, is placed in Group VII of the Periodic Table. It has a relative atomic mass of 370. What property is gistatine likely to have?

A It forms a black compound with sodium.
B It is a dark green gas at room temperature.
C It is displaced by fluorine from potassium gistatide.
D It reacts with aqueous potassium iodide.

33 Which statement about groups in the Periodic Table is correct?

A All groups contain acidic and basic oxides.
B In Group VII, all the elements form halides with most metals.
C In Group I, all the elements form covalent compounds with hydrogen.
D All groups form either positively charged ions or negatively charged ions.

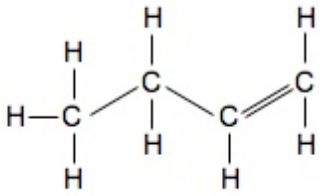
34 The diagram shows the fractional distillation of petroleum.



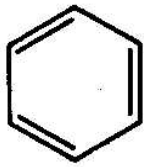
Which row about fractions **M** and **N** are correct?

	M burns more easily than N	**M has a higher boiling point than N**	**M is more viscous than N**
A	true	false	false
B	true	true	false
C	false	true	true
D	false	false	true

35 The diagram shows how the structural formula of butene can be simplified:

Usual structural formula of butene	Simplified version
	

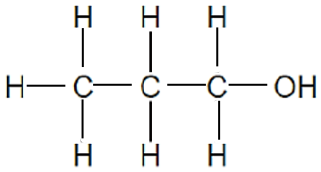
The simplified structural formula of benzene is shown:



What is the empirical formula of benzene?

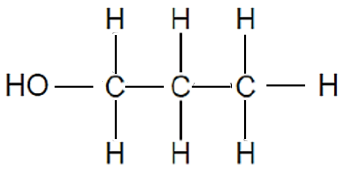
A CH
B CH_2
C CH_3
D CH_4

36 The following shows the structural formula of propan-1-ol.

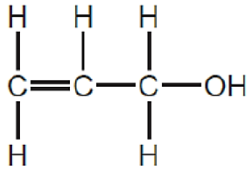


Which of the following is an isomer of propan-1-ol?

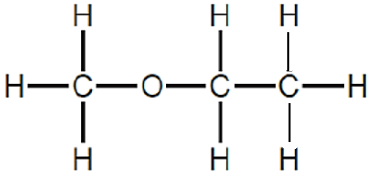
A



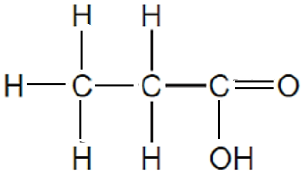
C



B

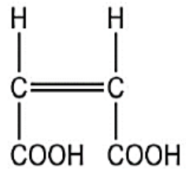


D

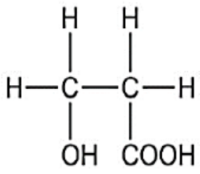


37 A student experiments with the properties of compounds **W**, **X**, **Y** and **Z**.

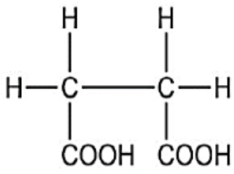
The compound reacts with steam to from a compound that further reacts with an alcohol to form a sweet-smelling compound.



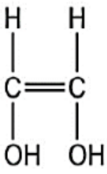
W



X



Y



Z

Which compound will give these reactions?

A **W**
B **X**
C **Y**
D **Z**

38 A student investigated the reactions of four vegetable oils **P**, **Q**, **R** and **S** with hydrogen gas. 100 cm^3 of hydrogen gas was passed through 1 g samples of each of the four vegetable oils in the presence of a suitable catalyst.

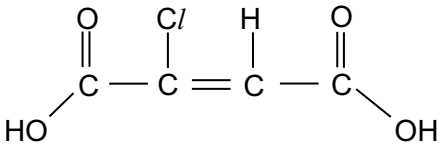
The volume of hydrogen remaining after each reaction was recorded.

vegetable oil	volume of hydrogen gas remaining/cm^3
P	0
Q	87
R	100
S	64

Which vegetable oil(s) is/are saturated?

A **P** only
B **R** only
C **P**, **Q** and **S**
D **Q**, **R** and **S**

39 The diagram shows the structural formula of chloromaleic acid.

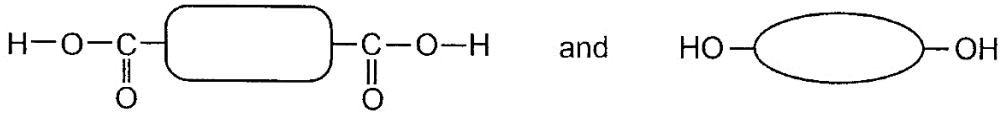


Which of the following statements about chloromaleic acid is/are true?

I It decolourises bromine solution in the absence of sunlight.
II It reacts with calcium carbonate with one of its products having the chemical formula $Ca_2C_2HO_4Cl$.
III One mole of choromaleic acid reacts with excess sodium metal to produce one mole of hydrogen gas.

A I only
B I and II only
C I and III only
D II and III only

40 A synthetic polymer is made by condensation polymerisation of the two monomers shown.



In the polymerisation of the two monomers to form the polymer, which of the following set correctly shows the changes in properties?

	boiling point	**percentage composition by mass**
A	change	no change
B	change	change
C	no change	change
D	no change	no change

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Class:	Candidate Name:	Candidate Index Number:

EDGEFIELD SECONDARY SCHOOL
2022 Preliminary Examination
Secondary 4 Express

O Syllabus

CHEMISTRY

Paper 1 Multiple choice **6092/01**

August 2022

Additional Materials: Multiple Choice Answer Sheet **1 hour**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your class, name and class register number in the above boxes.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate answer sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark.
A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 18.

The use of an approved scientific calculator is expected, where appropriate.

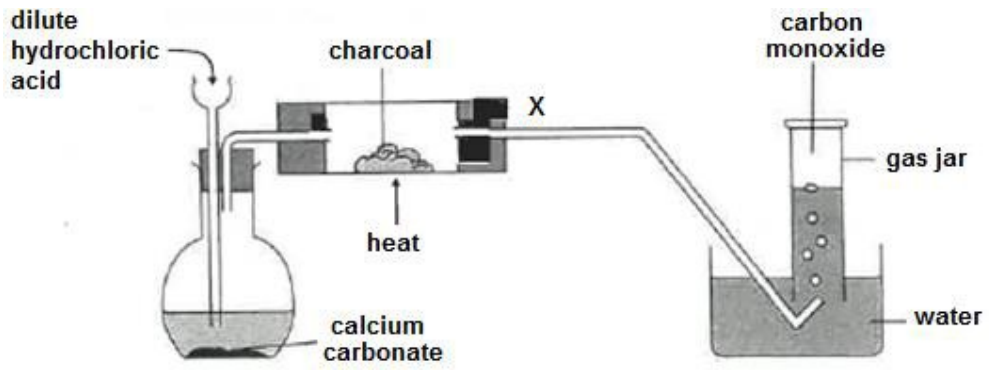
FOR EXAMINER'S USE	
TOTAL	**/ 40**

My target grade/mark: _____

_____
Parent's signature

This document consists of 18 printed pages.

1 The following diagram shows an experimental setup used by a student to prepare carbon monoxide from charcoal. What should the student do to obtain a purer yield of carbon monoxide?



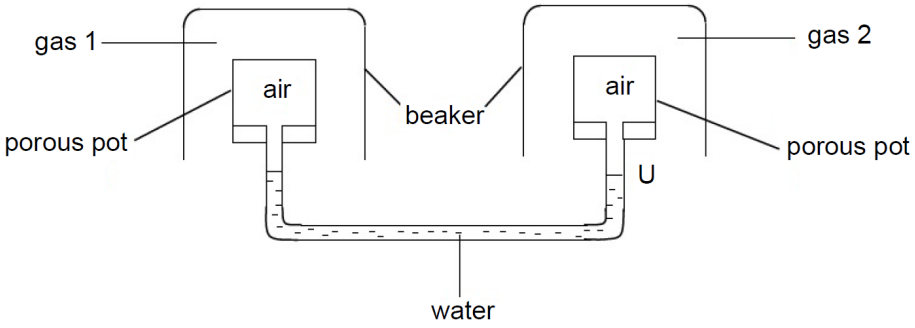
A Use dilute sulfuric acid instead of dilute hydrochloric acid so that hydrogen chloride gas will not be formed.
B Bubble the stream of gas from X into a flask containing drying agent before collection.
C Pass the stream of gas from X through a filtering system to remove soot produced from charcoal.
D Pass the stream of gas from X into a flask containing aqueous sodium hydroxide before collection.

2 How many of the molecules shown contain only one single covalent bond?

Cl_2 H_2 N_2 O_2 CO_2

A 1
B 2
C 3
D 4

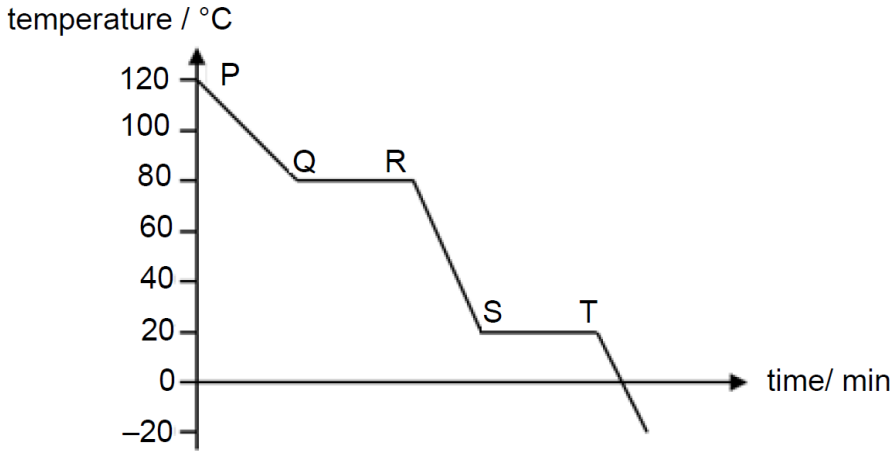
3 The apparatus is set up, using different gases in the two inverted beakers.



Which pair of gases would cause an upward movement of the water level at U?

	gas 1	gas 2
A	helium	carbon monoxide
B	helium	hydrogen
C	nitrogen	carbon monoxide
D	nitrogen	hydrogen

4 The graph shows the change in temperature with time when a substance at 120 °C is cooled to –20 °C.



Which statement correctly describes the change taking place between the points?

A The volume of vapour is decreasing from R to S.
B The particles release energy as they become closer together from Q to R.
C The particles absorb energy as they become more orderly from S to T.
D The energy of the particles remain constant from 20 °C to -20 °C.

5 The melting and boiling points of some gases in air are shown below.

gas	melting point/ °C	boiling point/ °C
oxygen	– 219	– 183
argon	– 189	– 186
nitrogen	– 210	– 196

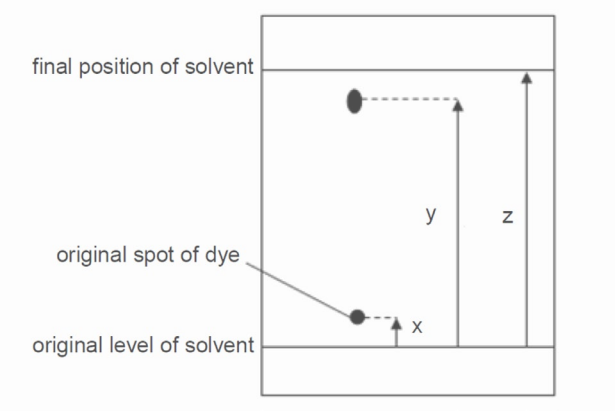
What temperature should the sample of air be decreased to in order to obtain only liquid oxygen?

A – 180 °C
B – 182 °C
C – 185 °C
D – 219 °C

6 Which of the following physical processes could be used to separate a mixture of hexane and water?

A filtration
B fractional distillation
C sublimation
D use of separating funnel

7 A student carried out a chromatography experiment. The diagram below shows the chromatogram obtained.



Which one of the following gives the R_f value of the dye?

A $\frac{y}{z}$
B $\frac{y-x}{z}$
C $\frac{y}{z-x}$
D $\frac{y-x}{z-x}$

8 Which substance is likely to be a pure compound?

A a colourless liquid which gives two fractions when distilled
B a white powder that dissolves in water
C a yellow liquid that boils at 115 °C
D green crystals that start to melt at 72 °C and completely melt at 75 °C

9 The descriptions of three substances are given as follows:

substance	description
X	It is made up of identical molecules which burns in excess air to form carbon dioxide and water.
Y	It is a gas which burns in excess air to form water only.
Z	Its solution can be separated into three dyes by paper chromatography.

Which of the following correctly classifies substances X, Y and Z?

	X	Y	Z
A	element	element	compound
B	compound	compound	mixture
C	compound	element	mixture
D	element	mixture	element

10 An element, Z, has *p* protons and *n* neutrons in the nucleus of its atoms. Element Z reacts with oxygen to form a basic oxide.

Which list gives the correct information about the ion of an isotope of Z?

	number of protons	number of neutrons	number of electrons
A	p	$n + 1$	$p + 1$
B	p	$n + 1$	$p - 1$
C	$p + 1$	n	$p + 1$
D	$p + 1$	n	$p - 1$

11 A hydrated salt, $MSO_4.nH_2O$ is formed when 0.2 mol of MSO_4 reacts with 36.0 g of water. What is the value of n?

A 2
B 4
C 5
D 10

12 When a few drops of aqueous ammonia are added to copper(II) sulfate solution, the reaction that takes place can be represented by the following ionic equation:

$$Cu^{2+}(aq) + 2OH^{-}(aq) \rightarrow Cu(OH)_2(s)$$

In excess aqueous ammonia, a soluble copper(II) complex ion is formed.
What would be observed when 20 cm^3 of 0.5 mol/dm^3 aqueous copper(II) sulfate was mixed with 30 cm^3 of 1.0 mol/dm^3 aqueous ammonia?

A pale blue solution
B dark blue solution
C blue precipitate in colourless solution
D colourless solution

13 At the start of a reaction, a 2.00 dm^3 solution contains 0.500 mol of ethanol. After 100 seconds, the concentration of the ethanol has decreased to 0.140 mol/dm^3. What is the decrease in the concentration of ethanol?

A 0.036 mol/dm^3
B 0.140 mol/dm^3
C 0.110 mol/dm^3
D 0.250 mol/dm^3

14 The shell of a quail egg makes up 2% of the mass of an average quail egg. An average quail egg has a mass of 15 g. Assuming the quail egg shell is made up of pure calcium carbonate, what is the volume of 1.0 mol/dm^3 hydrochloric acid that 10 quail eggs can neutralise?

A 0.0250 dm^3
B 0.0300 dm^3
C 0.0500 dm^3
D 0.0600 dm^3

15 Element **Y** exists as 3 stable isotopes and has a relative atomic mass of 65.0. Which of the following compositions of isotopes is correct?

A 32.1% ^{64}**Y**, 56.4% ^{66}**Y** and 11.5% ^{67}**Y**
B 54.6% ^{64}**Y**, 6.6% ^{66}**Y** and 38.8% ^{67}**Y**
C 56.3% ^{64}**Y**, 31.1% ^{66}**Y** and 12.6% ^{67}**Y**
D 50.3% ^{64}**Y**, 25.5% ^{66}**Y** and 24.2% ^{67}**Y**

16 Chloroform, also known as trichloromethane, is a colourless, sweet-smelling liquid which was once used as an anaesthetic. How many valence electrons are not involved in bonding?

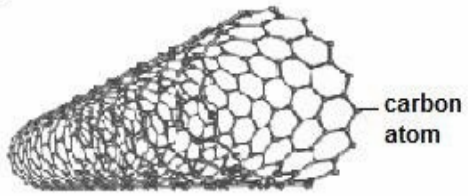
A 0
B 2
C 18
D 21

17 Which statement about one mole of a metal is always true?

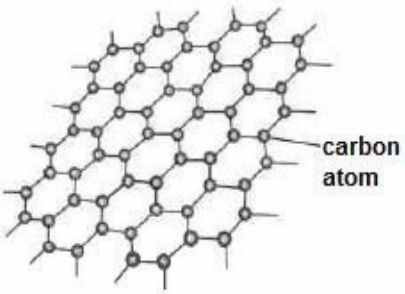
A It contains the same number of particles as 1/12 mole of ^{12}C.
B It has the same mass as one mole of hydrogen atoms.
C It contains the same number of particles as one mole of hydrogen atoms
D It contains the same mass as one mole of ^{12}C.

18 Carbon can form different structures as shown in the diagram below. Which of these structure(s) is/are able to conduct electricity?

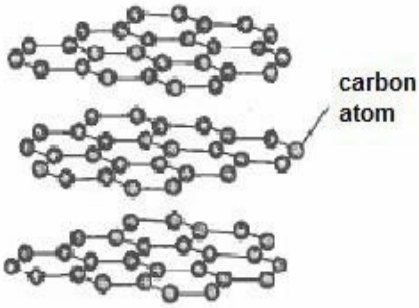
I



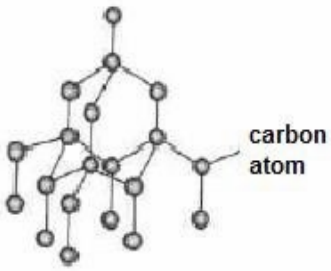
II



III



IV



A I and IV only
B II and III only
C I, II and III only
D III and IV only

19 Two separate tests were carried out on an unknown salt solution, **Z**. The results of the tests are shown in the table below.

	test	result
1	add aqueous ammonia	green precipitate formed which is insoluble in excess
2	add dilute nitric acid then aqueous silver nitrate	yellow precipitate formed

What is the identity of salt **Z**?

A Copper(II) chloride
B Iron(II) chloride
C Iron(II) iodide
D Iron(III) iodide

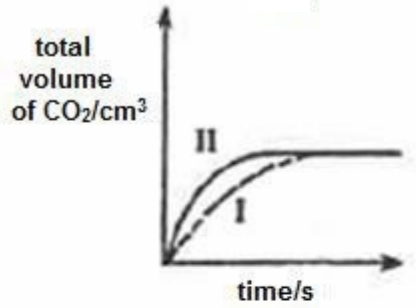
20 Ammonia is produced by the Haber process.

Which statement is **not** correct?

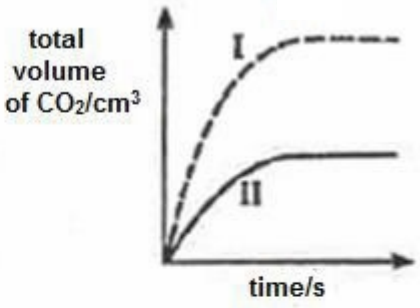
A An iron catalyst is used.
B Each hydrogen molecule reacts with three nitrogen molecules to form two molecules of ammonia.
C Hydrogen for the Haber process can be obtained by the cracking of crude oil.
D The reaction is reversible.

21 In two separate experiments, the reaction of calcium carbonate with an excess of dilute hydrochloric acid was investigated. The calcium carbonate used in Experiment I was more finely divided than that used in Experiment II. Assuming all other conditions were identical in both experiments, which of the following graphs best illustrates the results?

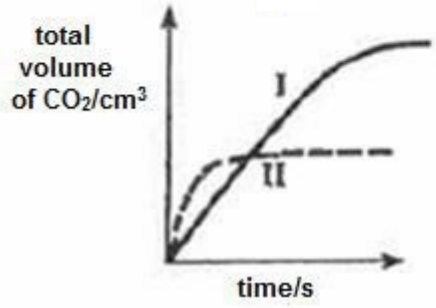
A



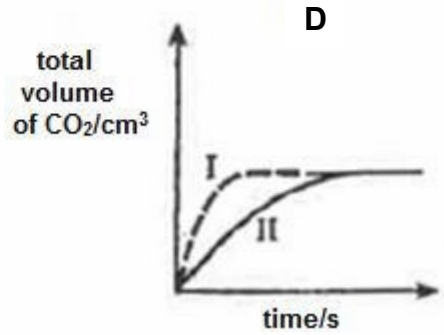
B



C



D



22 Metal Z and its compounds undergo the following reactions.

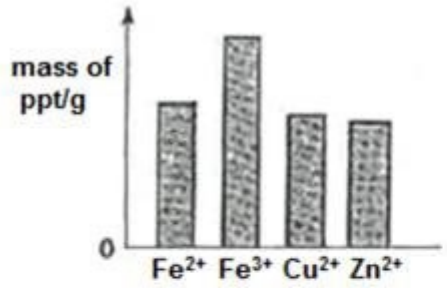
Reaction I: $Z + 2HCl \rightarrow ZCl_2 + H_2$
Reaction II: $ZCO_3 \rightarrow ZO + CO_2$
Reaction III: $ZO + CO \rightarrow Z + CO_2$

What could metal Z be?

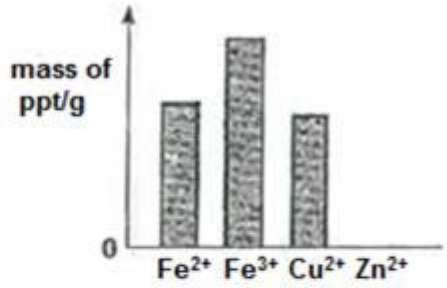
A Magnesium
B Copper
C Iron
D Calcium

23 Four separate solutions are prepared such that each solution contains 1 g of one of the ions Fe^{2+}, Fe^{3+}, Cu^{2+}, Zn^{2+}. Excess aqueous sodium hydroxide is added to each solution and the mass of any resulting precipitate is recorded. Which of the following diagrams, **A**, **B**, **C**, **D** illustrates the results?

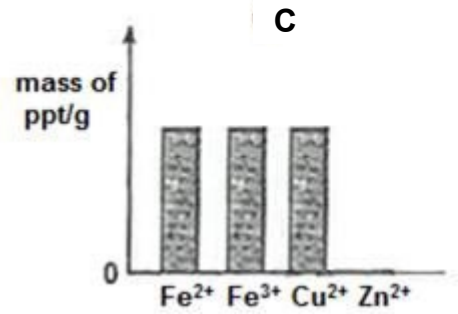
A



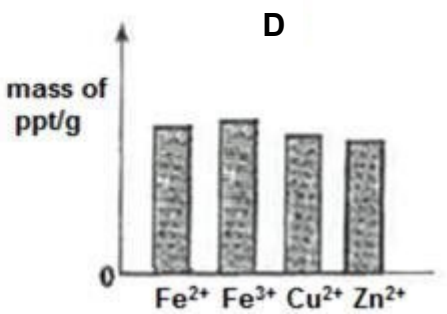
B



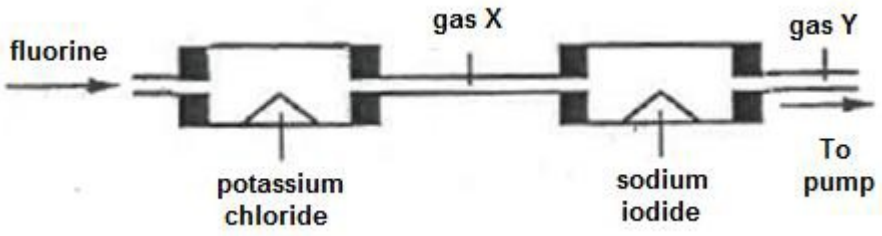
C



D

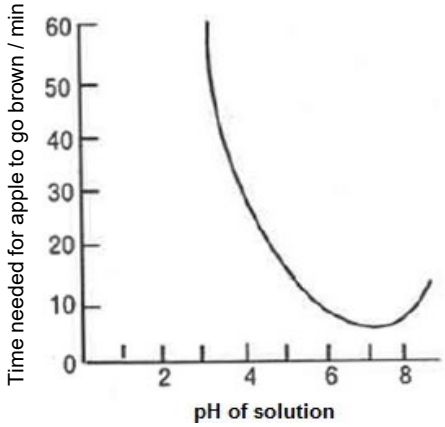


24 The reaction shown below was carried out. Which of the following gives the correct colour of gas X, sodium iodide and gas Y?



	gas X	sodium iodide	gas Y
A	Pale yellow	Brown	Violet
B	Greenish yellow	White	Violet
C	Pale yellow	Yellow	Brown
D	Greenish yellow	Brown	Brown

25 Pieces of apples usually go brown when they are left in air for a few minutes. To stop browning, cut apples are placed in special solutions. The graph below indicates how browning is affected by the pH of a solution.

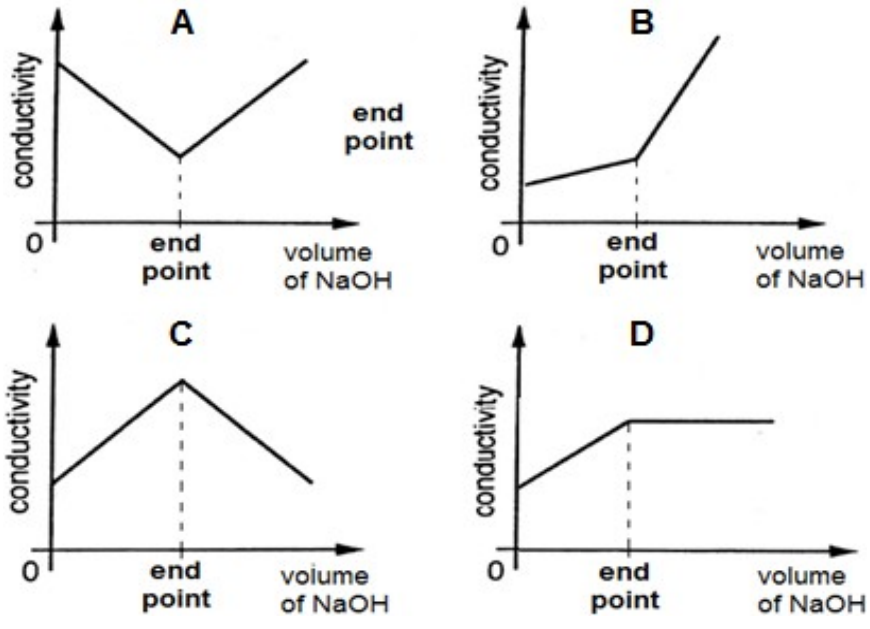


Which one of these solutions stops browning?

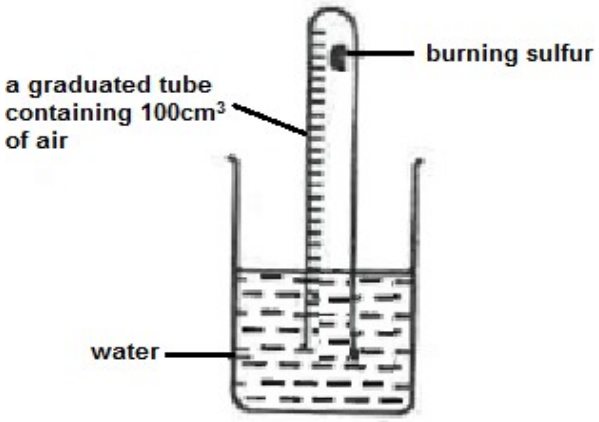
A sodium carbonate (pH 9)
B sodium chloride (pH 7)
C ethanoic acid (pH 4)
D sodium hydrogen sulfate (pH 2.5)

26 Aqueous sodium hydroxide is a strong alkali while dilute ethanoic acid is a weak acid. The reaction between the alkali and the acid causes a change in the electrical conductivity of the mixture.

Which of the following graph correctly shows the change in electrical conductivity when aqueous sodium hydroxide is added slowly to the dilute ethanoic acid until it is in excess?

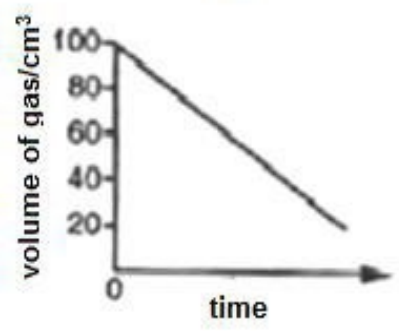


27 Sulfur burns in air to form a water-soluble solid oxide. A small lump of sulfur was burnt in the tube shown in the diagram below. The initial volume of air in the tube is 100 cm^3.

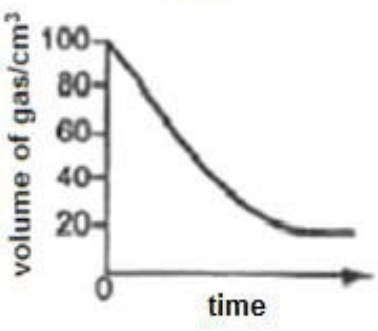


Which graph shows how the volume of gas remaining in the apparatus changes?

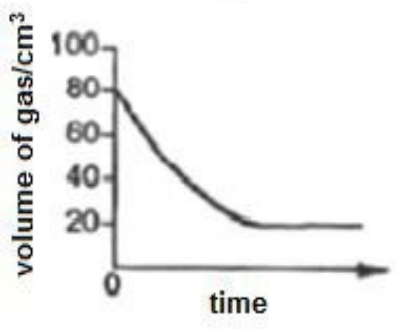
A



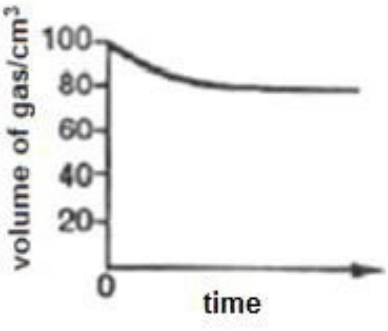
B



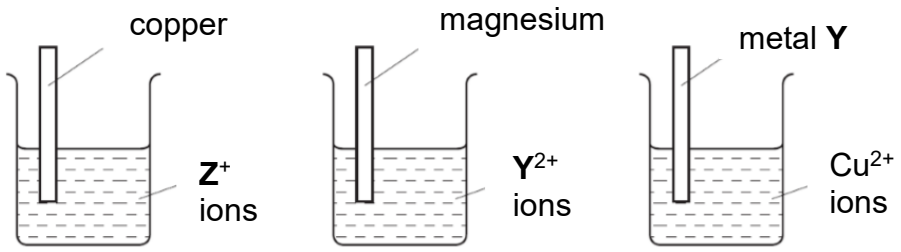
C



D



28 A student conducted three experiments to compare the reactivities of four different metals; copper, magnesium, metal **Y** and metal **Z**.



A deposit was observed on the metal strip for each experiment.
How many metals that were investigated will be able to react with aqueous hydrochloric acid?

A 1
B 2
C 3
D 4

29 Which electrolytic set-up results in no change in the concentration of the solution during electrolysis?

A aqueous sodium chloride solution between carbon electrodes
B copper(II) sulfate solution between copper electrodes
C copper(II) sulfate solution between platinum electrodes
D dilute sodium chloride solution between platinum electrodes

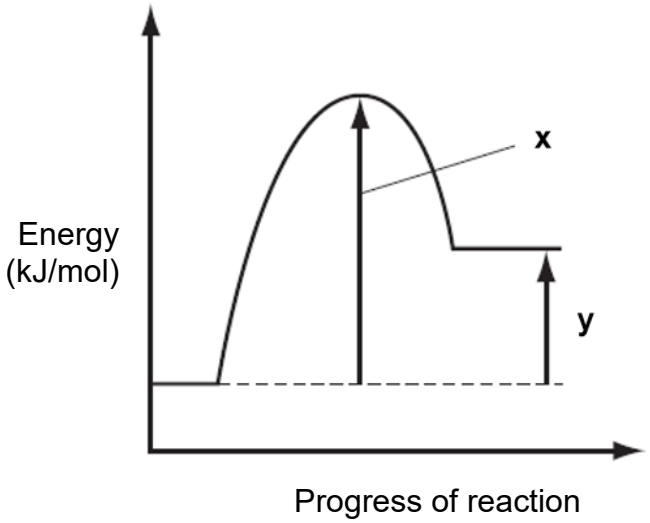
30 In an electrolysis, the same amount of charge deposited 54.0 g of silver and 14.9 g of tin.
If the charge on silver ion is 1+, what was the most likely charge of the tin ion?

A 1+
B 2+
C 3+
D 4+

31 Which statement describes what happens when hydrogen and oxygen are used in a fuel cell?

A Electricity is generated due to flow of electrons from cathode to anode.
B Hydrogen is burned to form steam.
C Hydrogen is oxidised by losing electrons at the anode.
D Oxygen is oxidised by gaining electrons from hydrogen.

32 The energy profile diagram for a chemical reaction is shown below.



Which statement about the energy profile diagram is correct?

A The overall enthalpy change is equal to **x** + **y**.
B The reaction is exothermic.
C The value of **x** would decrease in the presence of catalyst.
D The value of **y** would increase in the presence of catalyst.

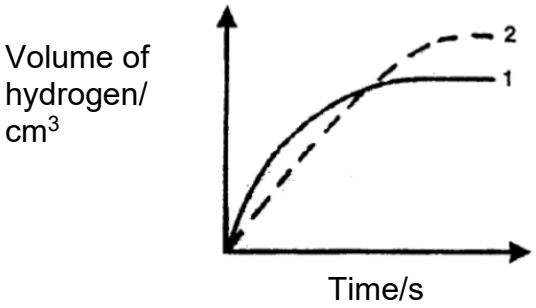
33 The scheme shows four stages, 1 to 4, in the conversion of solid candle wax, $C_{30}H_{62}$, into carbon dioxide and water

1	$C_{30}H_{62}(s) \rightarrow C_{30}H_{62}(l)$
2	$C_{30}H_{62}(l) \rightarrow C_{30}H_{62}(g)$
3	$C_{30}H_{62}(g) + 45.5O_2(g) \rightarrow 30CO_2(g) + 31H_2O(g)$
4	$30CO_2(g) + 31H_2O(g) \rightarrow 30CO_2(g) + 31H_2O(l)$

Which stages are exothermic?

A 1 and 2
B 1 and 4
C 2 and 3
D 3 and 4

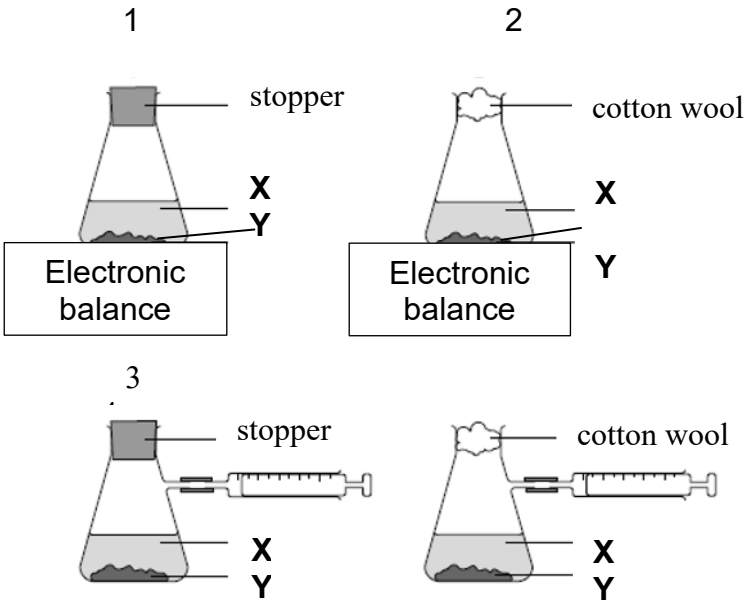
34 In the graph below, curve **1** was obtained by the reaction between 50.0 cm^3 of 1.00 mol/dm^3 sulfuric acid and excess zinc granules.



Which changes would produce curve **2**?

A increase the temperature by 10°C
B add the same mass of zinc powder instead of zinc granules
C use 100.0 cm^3 of 1.00 mol/dm^3 sulfuric acid instead of 50.0 cm^3 of 1.00 mol/dm^3 sulfuric acid
D use 100.0 cm^3 of 0.75 mol/dm^3 sulfuric acid instead of 50.0 cm^3 of 1.00 mol/dm^3 sulfuric acid

35 A liquid **X** reacts with solid **Y** to form a gas.



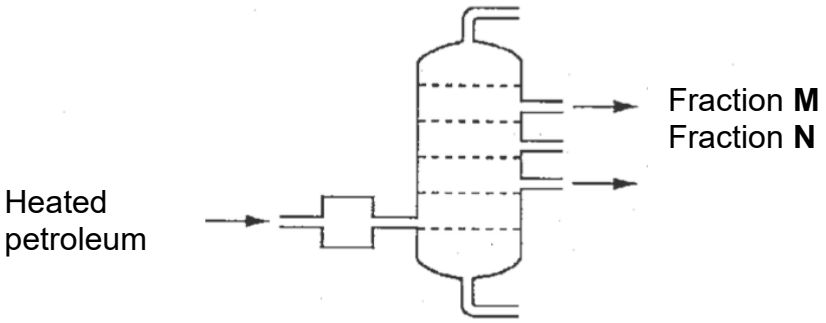
Which two diagrams show suitable methods for investigating the speed of the reaction?

A 1 and 3
B 1 and 4
C 2 and 3
D 2 and 4

36 Which pair of pollutants can cause the most damage to limestone buildings?

A carbon monoxide and oxygen
B chloroflurocarbons and ozone
C methane and sulfur dioxide
D nitrogen dioxide and sulfur dioxide

37 The diagram shows the fractional distillation of petroleum.



Which row about fraction **M** and **N** are correct?

	M burns more easily than **N**	**M** has a higher boiling point than **N**	**M** is more viscous than **N**
A	True	False	False
B	True	True	False
C	False	True	True
D	False	False	True

38 In the polymerisation of ethene to form poly(ethene), which does **not** change?

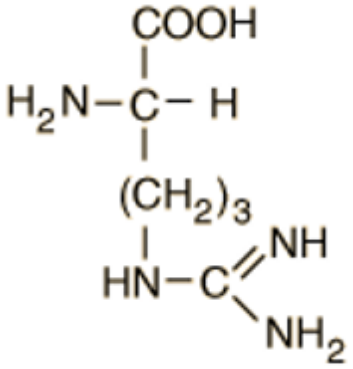
A boiling point
B density
C empirical formula
D molecular mass

39 The reaction between a carboxylic acid, $C_xH_yCO_2H$ and an alcohol, $C_nH_{2n+1}OH$, produces an ester.

How many hydrogen atoms does one molecule of the ester contain?

A y+ 2n
B y+2n+1
C y+2n+2
D y+2n+3

40 The full structural formula of the amino acid, Arginine, is shown below.



The following statements were made about the amino acid.

1 It undergoes addition polymerisation.
2 It forms a polymer with the same linkage as nylon.
3 It reacts with magnesium to form hydrogen gas.
4 It decolorises acidified potassium manganate(VII) solution readily.

Which statements are correct?

A 1 and 2
B 1 and 3
C 2 and 3
D 2 and 4

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

East Spring Secondary School

Towards Excellence and Success

Name: ..... ( )

Class: .....

Preliminary Examination 2022
Secondary 4 Express

CHEMISTRY **6092/01**
Paper 1 Multiple Choice

Tuesday **1 hour**
13 September 2022 **0800 – 0900**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class, index number on the Answer Sheet in the spaces provided.

There are forty questions on this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

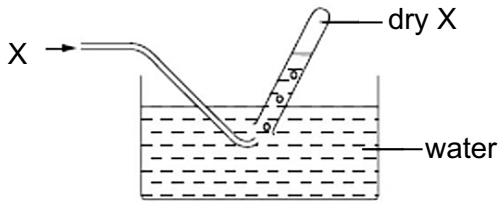
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 16.
The use of an approved scientific calculation is expected, where appropriate.

This question booklet consists of **16** printed pages including the cover page.

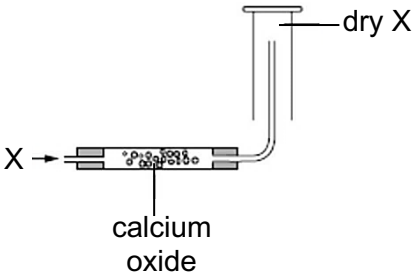
1 Gas X is very soluble in water, less dense than air, and turns moist red litmus paper blue.

Which method would be **most** suitable to collect a dry sample of the gas?

A



B



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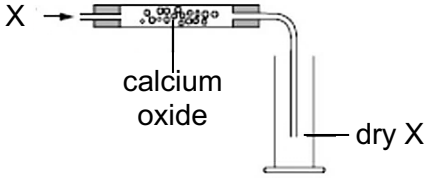

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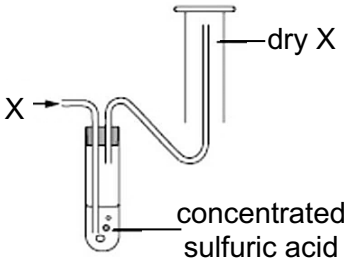


2 A gas, T, has the following properties:

1 a choking smell

2 turns damp blue litmus paper red, then bleaches it

3 does not decolourise acidified potassium manganate(VII)

What is T?

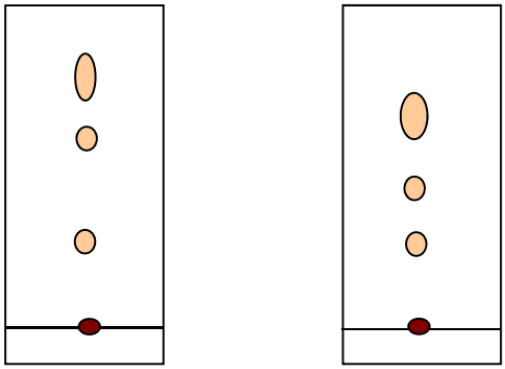
A ammonia

B chlorine

C carbon dioxide

D sulfur dioxide

3 Two students investigated the substances that produce the colour in a type of sweet. The solution obtained from the sweet was separated by paper chromatography.
The chromatograms obtained by the two students are shown below.



student 1 student 2

Why are the two chromatograms obtained different?

A The two students used different solvents.

B One of the students did not use enough solvent.

C The solvent for student 2 did not reach the top of the paper.

D The solvent moved up the paper at different speeds.

4 A student was provided with a solid mixture, M. The table below shows some information about the three substances found in mixture M.

substance	boiling point / °C	solubility in water
W	140	soluble
X	90	insoluble
Y	95	soluble

The student was told he could carry out some of the following steps to separate the three substances in mixture M.

1 filtration

2 fractional distillation

3 evaporation

4 addition of water

In which order should the student carry out the steps?

A 1, 2, 3 **B** 2, 1, 3

C 4, 1, 2 **D** 4, 3, 1

5 Deuterium, D, is an isotope of hydrogen.

Which statement about deuterium is **not** correct?

A An atom of deuterium contains one proton.

B It forms the ion D^+.

C It has the same density as hydrogen.

D It reacts with ethene to form the compound CH_2DCH_2D.

6 An ion, X^{2-}, has p nucleons and q electrons.

What does the nucleus of an atom of X contain?

	number of protons	number of neutrons
A	q − 2	p – q
B	q − 2	p – (q – 2)
C	q + 2	p – (q – 2)
D	q + 2	p – (q + 2)

7 Boron is a non-metallic element which is placed above aluminium in Group III of the Periodic Table.

It forms a compound with nitrogen known as boron nitride which has a structure similar to graphite.

A student made the following conclusions about boron nitride.

1 Boron nitride has a layered structure with weak attraction forces between the layers.

2 The empirical formula of boron nitride is BN.

3 The boron and nitrogen atoms are likely to be arranged alternately in a hexagonal pattern.

Which of the conclusions about boron nitride are correct?

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

8 In which molecule are all the outer electrons of the atoms involved in bonding?

A CH_3CH_3 **B** H_2O **C** HF **D** NH_3

9 When a covalent liquid boils, its molecules are spaced further apart.

Which property of the molecules affects the energy required to boil a covalent liquid the most?

A the reactivity of the molecules

B the shape of the molecules

C the strength of the covalent bonds between the atoms

D the strength of the forces of attraction between the molecules

10 20 cm^3 of propene gas reacts with 500 cm^3 of oxygen according to the equation shown below.

$$2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$$

What is the **total** volume of gas remaining at the end of the reaction?
(all volumes are measured at room temperature and pressure.)

A 120 cm^3 **B** 410 cm^3 **C** 470 cm^3 **D** 530 cm^3

11 An excess of dilute hydrochloric acid was added separately to the following.

1 2.4 g of magnesium

2 4.2 g of magnesium carbonate

3 2.0 g of magnesium oxide, then warmed

Which statement is correct?

A The number of moles of magnesium chloride formed would be the greatest in reaction 1.

B The number of moles of magnesium chloride formed would be the greatest in reaction 2.

C The number of moles of magnesium chloride formed would be the greatest in reaction 3.

D The number of moles of magnesium chloride formed would be the same for all three reactions.

12 When 20 g of a sample of impure calcium carbonate is heated, 6.6 g of carbon dioxide is obtained.

What is the percentage purity of the sample of calcium carbonate?

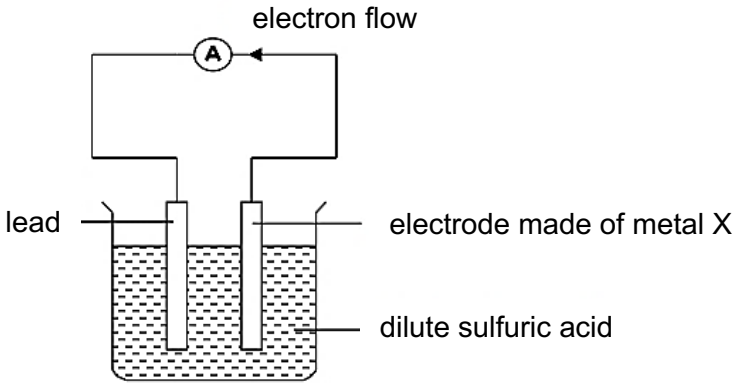
A 15% **B** 33% **C** 50% **D** 75%

13 Aqueous copper(II) sulfate is electrolysed using a positive copper electrode and a negative graphite electrode.

Which row is correct?

	at the positive electrode	at the negative electrode
A	electrode dissolves	copper deposited
B	hydrogen gas given off	oxygen gas given off
C	oxygen gas given off	copper deposited
D	electrode dissolves	hydrogen gas given off

14 In the set-up below, a lead electrode, an electrode made of metal X and dilute sulfuric acid are used to produce electrical energy.



With reference to the set-up, which of the following statements is correct?

A The lead electrode is the negative electrode.

B Metal X is below lead in the reactivity series.

C The mass of the lead electrode decreases.

D The mass of the metal X electrode decreases.

15 Which of the following statements best describes the mechanism of a hydrogen-oxygen fuel cell?

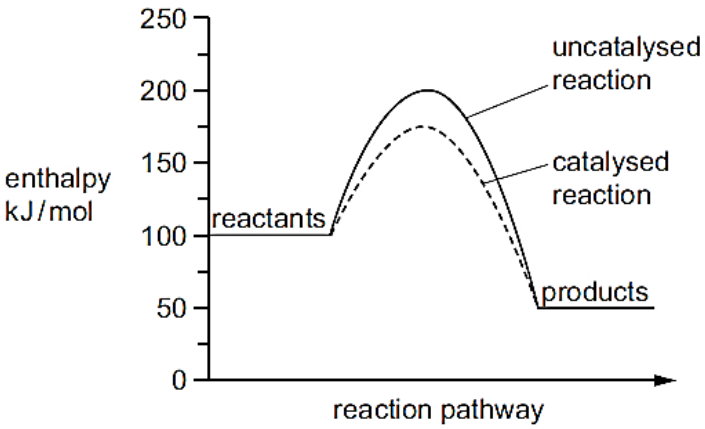
A Hydrogen and oxygen undergo redox reactions to generate electricity.

B Hydrogen ions react with hydroxide ions to generate electricity.

C Electricity is used to provide heat energy.

D Electricity is used to generate hydrogen and oxygen.

16 The energy diagram below represents a chemical reaction carried out with a catalyst and without a catalyst.



What is the enthalpy change for catalysed reaction?

A −150 kJ/mol **B** −50 kJ/mol **C** +50 kJ/mol **D** +100 kJ/mol

17 A student performs two experiments at room temperature.

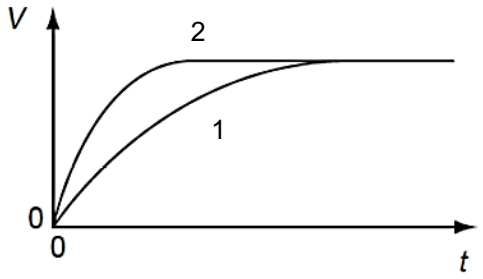
In experiment 1, 10 g of magnesium ribbon was reacted with excess 2.0 mol/dm^3 of dilute hydrochloric acid.

In experiment 2, 5 g of magnesium powder was reacted with excess 2.0 mol/dm^3 of dilute hydrochloric acid.

In both experiments, the volume of hydrogen, *V*, was plotted against time, *t*.

Which set of graphs is correct?

A



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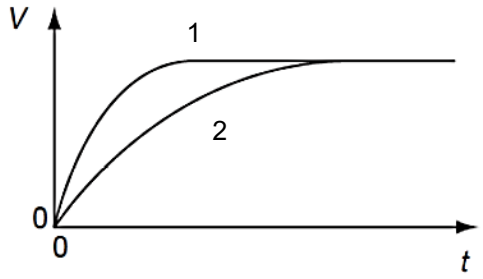

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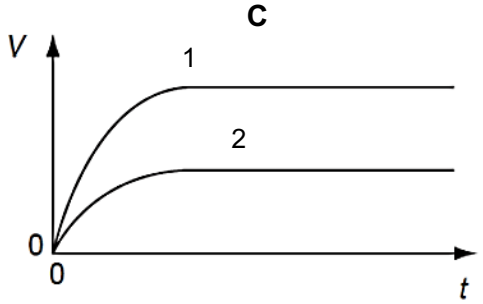

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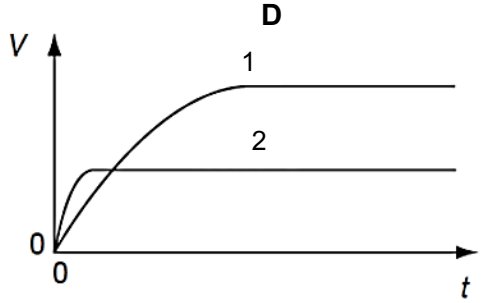


18 Which factor decreases the activation energy of a reaction?

A addition of a catalyst

B decrease in temperature

C increase in pressure

D increase in concentration of the reactants

19 Chemical Z is a powerful reducing agent.

Which statement about Z is correct?

A Z reacts with aqueous potassium iodide producing a brown solution and gains electrons in the process.

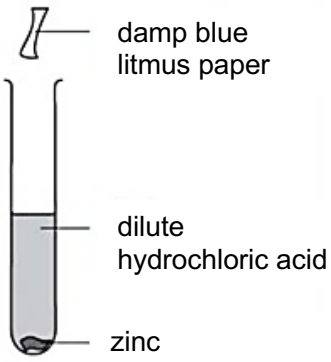
B Z reacts with aqueous potassium iodide producing a brown solution and loses electrons in the process.

C Z decolourises acidified potassium manganate(VII) and gains electrons in the process.

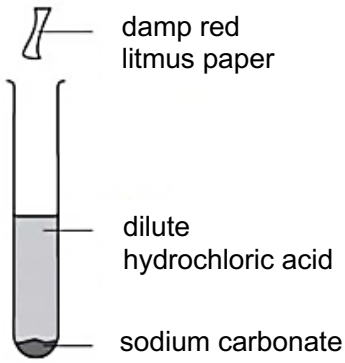
D Z decolourises acidified potassium manganate(VII) and loses electrons in the process.

20 The diagrams below show mixtures of chemicals that react to produce gases.
In which reaction will the litmus paper change colour?

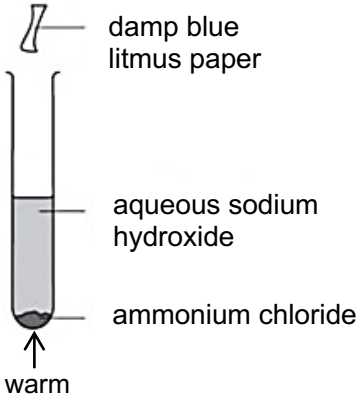
A



B



C



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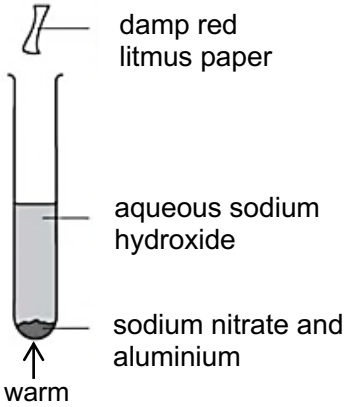


21 As part of the procedure to prepare a pure salt, a student carried out crystallisation.

Which of the following could the salt be?

A ammonium nitrate
B barium carbonate
C silver iodide
D calcium sulfate

22 Which oxide is insoluble in aqueous ammonia?

A NO_2 **B** P_4O_{10} **C** ZnO **D** FeO

23 Ammonia is manufactured industrially from nitrogen and hydrogen by the Haber process. The reaction can be represented by the following equation.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Which of the following statements are correct about the Haber process?

1 Nitrogen is oxidised to form ammonia.
2 Hydrogen is obtained from the cracking of crude oil.
3 Ammonia formed is condensed and obtained as a liquid.
4 An iron catalyst is used to increase the yield of ammonia.

A 1 and 2 only
B 2 and 3 only
C 1 and 4 only
D 3 and 4 only

24 Which of the following properties of the elements increases across the Periodic Table?

1 non-metallic character
2 number of electron shells
3 tendency to attract electrons

A 1 only
B 1 and 3
C 2 and 3
D 3 only

25 Caesium is a Group I metal.

Which reaction involving this element will **not** produce hydrogen gas?

A adding caesium to dilute nitric acid

B adding caesium to cold water

C electrolysing aqueous caesium chloride

D electrolysing molten caesium chloride

26 Two statements about noble gases are given:

1 Noble gases are reactive, monatomic gases.

2 All atoms of noble gases all have fully filled outer electron shells.

Which of the following is correct?

A Both statements are correct and statement 2 explains statement 1.

B Both statements are correct but statement 2 does not explain statement 1.

C Statement 1 is correct but statement 2 is incorrect.

D Statement 2 is correct but statement 1 is incorrect.

27 Which statement about alloys is correct?

A They can all be represented by a chemical formula.

B Their structures contain a 'sea' of electrons.

C They are good conductors of electricity as they have mobile ions.

D They are formed by chemically combining two metals.

28 Which of the following metals, when added to aqueous silver nitrate, will result in **all** the following observations made during the reaction?

- colourless, odourless gas produced
- a silvery metal formed
- colourless solution remains colourless

A calcium **B** copper **C** gold **D** iron

29 A metal is positioned between zinc and lead in the reactivity series.

Which method is most suitable for the extraction of the metal?

A electrolysis of its molten compound

B electrolysis of its salt solution

C reduction of its oxide using carbon

D reduction of its oxide using lead

30 An iron object is galvanised with zinc coating.

Which of the following statements describes what happens to the object and the zinc coating when the surface of the object is scratched?

	iron object	zinc coating
A	starts to rust	remains unchanged
B	starts to rust	continues to corrode
C	remains unchanged	continues to corrode
D	remains unchanged	remains unchanged

31 Which pollutants can be removed from the car exhaust by a catalytic converter?

1 carbon monoxide

2 oxides of nitrogen

3 unburnt hydrocarbons

4 sulfur dioxide

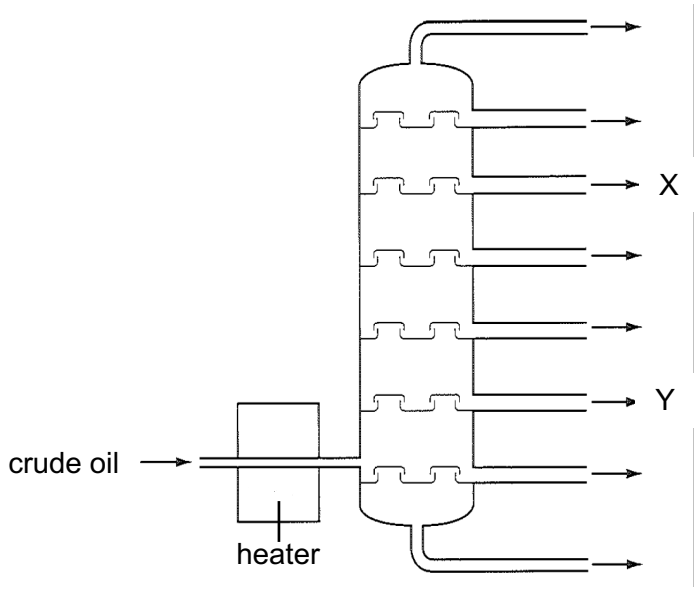
A 1 and 2

B 2 and 4

C 1, 2 and 3

D 1, 2, 3 and 4

32 Fractional distillation of crude oil occurs in a fractionating column. The positions at which fractions X and Y are collected are shown.



Which statement is correct?

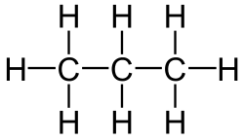
A X has a higher boiling point than Y.

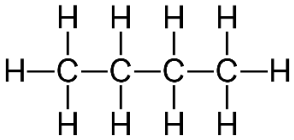
B X has longer chain molecules than Y.

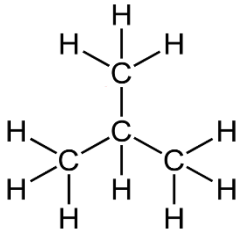
C X condenses at a lower temperature than Y.

D The temperature is highest at the top of the column.

33 The diagrams show the structures of three hydrocarbons.







Which statement is correct for all three compounds?

A They are isomers of each other.

B They have the same general formula.

C They have the same physical properties.

D They react with aqueous bromine.

34 When decane, $C_{10}H_{22}$, is cracked, only three compounds are formed.

The compounds are ethene, ethane and propene.

What is the ratio of the compounds formed?

	ethene	ethane	propene
A	1	1	1
B	1	1	2
C	1	2	1
D	2	1	1

35 One mole of polyunsaturated oil is converted completely to margarine. When the reaction is completed, the mass of the margarine is 8.0 g more than the mass of the vegetable oil.

How many carbon-carbon double bonds does the polyunsaturated vegetable oil contain?

A 1 **B** 2 **C** 4 **D** 8

36 Two gases, Q and R, have the following properties.

- Q dissolves in sodium hydroxide but R is insoluble
- R burns in excess oxygen to give Q and water only.
- R decolourises aqueous bromine.

What are the identities of Q and R?

	Q	R
A	carbon monoxide	ethene
B	carbon monoxide	ethane
C	carbon dioxide	ethene
D	carbon dioxide	ethane

37 Compound X has the following properties.

1 X can be made by a fermentation process.

2 X forms Y when added to acidified potassium manganate(VII).

3 X can react with Y to form Z and water.

Which homologous series do X, Y and Z belong to?

	X	Y	Z
A	alcohol	carboxylic acid	ester
B	alcohol	ester	carboxylic acid
C	carboxylic acid	alcohol	ester
D	carboxylic acid	ester	alcohol

38 Ethanol can be manufactured from either ethene or glucose. The table gives statements about the processes involved.

	process using ethene	process using glucose
1	reaction is faster at 300°C than at 200°C	reaction is faster at 100°C than at 30°C
2	produces pure ethanol	produces a dilute aqueous solution of ethanol
3	uses a catalyst	uses a catalyst
4	uses steam	produces carbon dioxide

In which rows are both statements correct?

A 1 and 4 only

B 2 and 4 only

C 1, 2 and 3 only

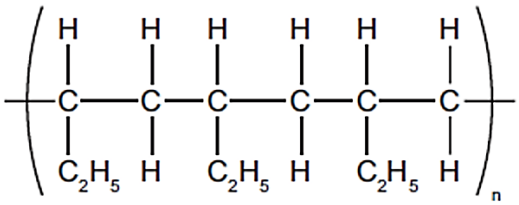
D 2, 3 and 4 only

39 Which alcohol would combine with propanoic acid to give the ester $C_2H_5CO_2C_2H_5$?

A methanol **B** ethanol

C propanol **D** butanol

40 A section of a polymer chain is shown below.



Which row correctly describes the molecule used to make this polymer, and the type of polymerisation involved?

	molecule	type of polymerisation
A	CH_3-CH=CH-CH_3	condensation
B	CH_3-CH_2-CH=CH_2	addition
C	CH_3-CH_2-CH_2-CH=CH_2	condensation
D	CH_3-CH=CH-CH_3	addition

End of Paper 1

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key atomic number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

	Class	Index No.
Candidate Name: ____________________		

FUHUA SECONDARY SCHOOL

Secondary Four Express

Preliminary Examination 2022

4E

CHEMISTRY 6092/01

Paper 1 Multiple Choice

31 August 2022
0800 – 0900
1 hour

Additional Material: Optical Mark Recognition (OMR)

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class, index number on the OMR and this question booklet.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OMR.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on this paper.
A copy of the Periodic Table is printed on page **14**.
The use of an approved scientific calculator is expected, where appropriate.

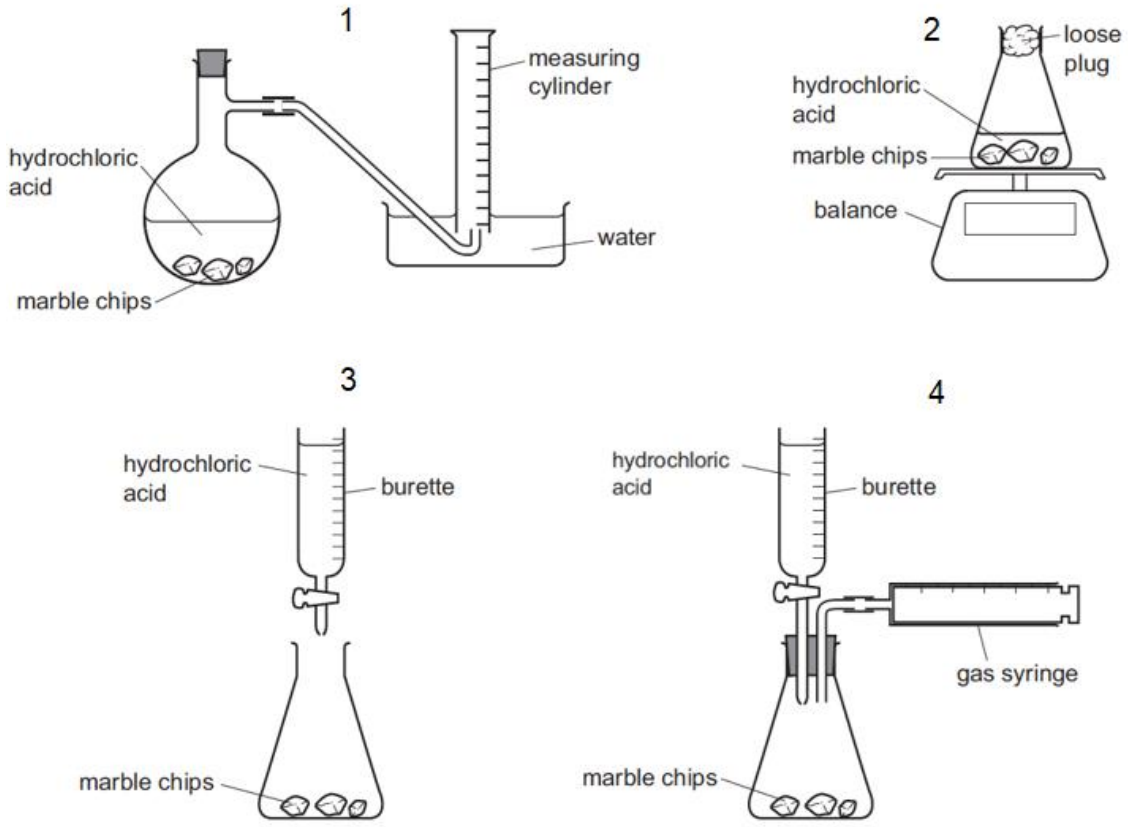
PARENT'S SIGNATURE	FOR EXAMINER'S USE	
		40

Setter: Mdm Hia Soo Ching

Vetters: Mr Elton Tan, Ms Choo Hui En, Ms Nur Hanis, Ms Veron Lee

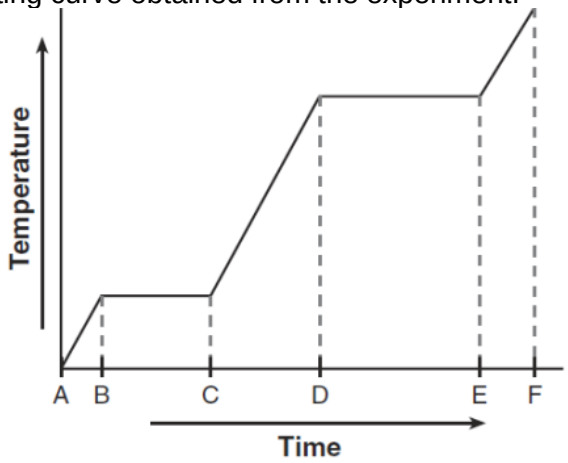
This question paper consists of 14 printed pages including this page.

1 A student follows the rate of the reaction between marble chips, $CaCO_3$, and dilute hydrochloric acid.
Which of the following set-ups can be used to measure the rate of reaction, together with a stopwatch?



A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 1, 2 and 4

2 A sample of a pure solid substance was heated until it turns completely gaseous. The graph below shows the heating curve obtained from the experiment.



Which of the following statements is **not** correct?

A At time interval AB, the average kinetic energy of the particles remains the same.
B At time interval BC, the solid and liquid states are in equilibrium.
C At time interval CD, heat is absorbed by the particles.
D At time interval EF, the particles are moving rapidly in any direction.

3 The table below shows information about elements flerovium, F*l*, and livermorium, Lv.

	F*l*	Lv
proton number	114	116
nucleon number	289	292

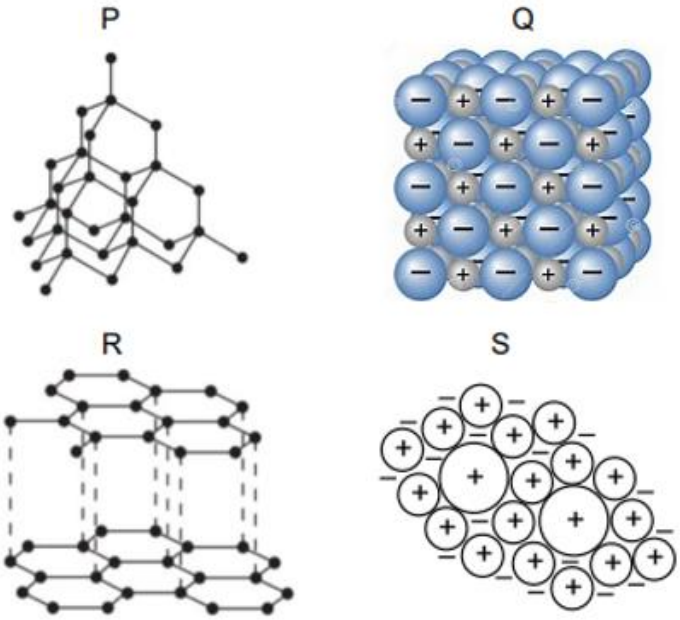
Which of the following statements about the elements is correct?

A A Lv^{2+} ion has the same number of electrons as a F*l* atom.
B A Fl^{2+} ion has the same number of protons as an atom of Lv.
C An atom of F*l* has two more electrons as an atom of Lv.
D An atom of Lv has one fewer neutron than an atom of F*l.*

4 Bromine crystals are obtained by freezing bromine at -223°C.
What will the bromine crystals contain?

A bromine atoms only
B bromine molecules only
C bromine ions and molecules
D bromine atoms and molecules

5 The diagrams below show the structures of substances P, Q, R and S.



Which of these structures conduct electricity because of mobile electrons?

A P and R **B** R and S **C** Q and S **D** Q, R and S

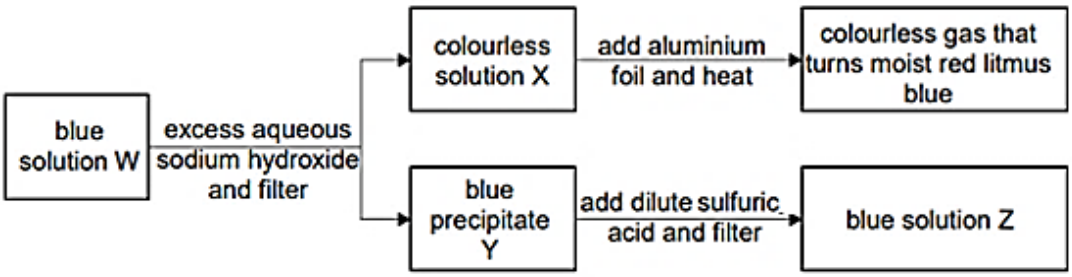
6 Which of the following contains 1 mole of ions when in aqueous state?

A 0.250 mol of CaO
B 0.250 mol of $(NH_4)_3PO_4$
C 0.500 mol of H_2SO_4
D 0.500 mol of CH_3COOH

7 Citric acid is widely used as a flavouring and preservative in food.
Which statement best describes the mixture formed when citric acid dissolves in ethanol?

A It turns blue litmus red.
B It contains covalent molecules only.
C It contains both covalent molecules and ions.
D It produces effervescence when added to carbonates.

8 The flowchart below shows the reaction that solution W undergoes.



What are the identities of W, X, Y and Z?

	W	X	Y	Z
A	$Cu(NO_3)_2$	$NaNO_3$	$Cu(OH)_2$	$CuSO_4$
B	$CuSO_4$	Na_2SO_4	$Cu(OH)_2$	$CuSO_4$
C	$Fe(NO_3)_2$	$NaNO_3$	$Fe(OH)_2$	$FeSO_4$
D	$(NH_4)_2SO_4$	NH_4OH	$Cu(OH)_2$	$CuSO_4$

9 The flowcharts show the reagents added into separate test tubes containing aqueous magnesium nitrate and aluminium nitrate.

$Mg(NO_3)_2$ —(aqueous sodium carbonate)→ P —(excess hydrochloric acid)→ Q —(aqueous sodium hydroxide)→ R

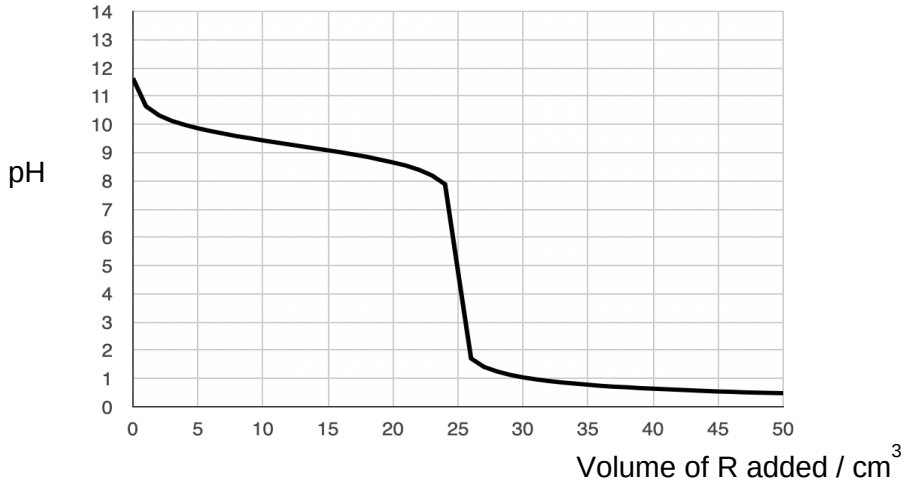
$Al(NO_3)_3$ —(aqueous sodium carbonate)→ S —(excess sulfuric acid)→ T —(aqueous ammonia)→ U

P, Q and R are magnesium compounds.
S, T and U are aluminium compounds.

How many of the compounds formed, P – U, will give a white precipitate in aqueous solutions?

A 2 **B** 3 **C** 4 **D** 5

10 Aqueous solution R is gradually added to aqueous solution S. The changes in pH are shown on the graph.



What are the identities of R and S?

	R	S
A	aqueous ammonia	ethanoic acid
B	ethanoic acid	sodium hydroxide
C	hydrochloric acid	aqueous ammonia
D	aqueous ammonia	hydrochloric acid

11 The consecutive reactions that may occur in a thunderstorm are as follows:

$N_2 + O_2 \rightarrow 2NO$

$2NO + O_2 \rightarrow 2NO_2$

$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$

How many moles of nitric acid are formed from 0.50 mol of nitrogen?

A 0.50 mol **B** 1.00 mol **C** 2.00 mol **D** 6.00 mol

12 A washing powder contains sodium hydrogencarbonate, $NaHCO_3$, as the active ingredient.

In a titration, a solution containing 1.00 g of washing powder was found to react completely with 2.86 cm^3 of 0.250 mol/dm^3 of dilute hydrochloric acid.

Assuming that sodium hydrogencarbonate is the only ingredient that reacts with the acid, what is the percentage by mass of sodium hydrogencarbonate in the washing powder?

A 3.0 % **B** 6.0 % **C** 12.0 % **D** 24.0 %

13 Brass, made of copper and zinc, is more suitable to make musical instruments as compared to pure copper.
Which statement best explains why brass is harder than pure copper?

A The zinc atoms have more valence electrons than copper atoms.
B The zinc atoms form strong metallic bonds with copper atoms in brass.
C The zinc atoms prevent the delocalised electrons from moving freely in the lattice
D The zinc atoms prevent layers of copper atoms from sliding over each other easily.

14 The table below refers to four metals and some of their compounds.

metal	action of heat on metal carbonate	effect of hydrogen on heated oxide	action of sulfuric acid on metal
P	decomposed	reduced	no reaction
Q	no reaction	no reaction	effervescence observed
R	decomposed	no reaction	effervescence observed
S	decomposed	reduced	effervescence observed

What is the order of reactivity in descending order?

A Q, S, R, P
B Q, R, S, P
C R, S, P, Q
D R, Q, P, S

15 Which of the following is **not** a redox reaction?

A $2Ag + Br_2 \rightarrow 2AgBr$
B $2CO + O_2 \rightarrow 2CO_2$
C $Na_2CO_3 + CuCl_2 \rightarrow 2NaCl + CuCO_3$
D $Fe + 2HCl \rightarrow FeCl_2 + H_2$

16 The table below shows the colour changes when a few drops of aqueous potassium iodide and acidified aqueous potassium manganate (VII) were added separately into four different solutions.

solution	potassium iodide	potassium manganate (VII)
1	colourless to brown	purple to colourless
2	colourless to brown	no change
3	no change	purple to colourless
4	no change	no change

Which of the following solutions is/are oxidising agent(s)?

A 1 only **B** 1 and 2 **C** 1 and 3 **D** 4 only

17 The pollutants released into the air from car exhausts and some power stations include oxides of the type XO and YO_2.
What are X and Y?

	X	Y
A	carbon	nitrogen
B	carbon	nitrogen and sulfur
C	carbon and nitrogen	carbon and nitrogen
D	carbon and nitrogen	carbon, nitrogen and sulfur

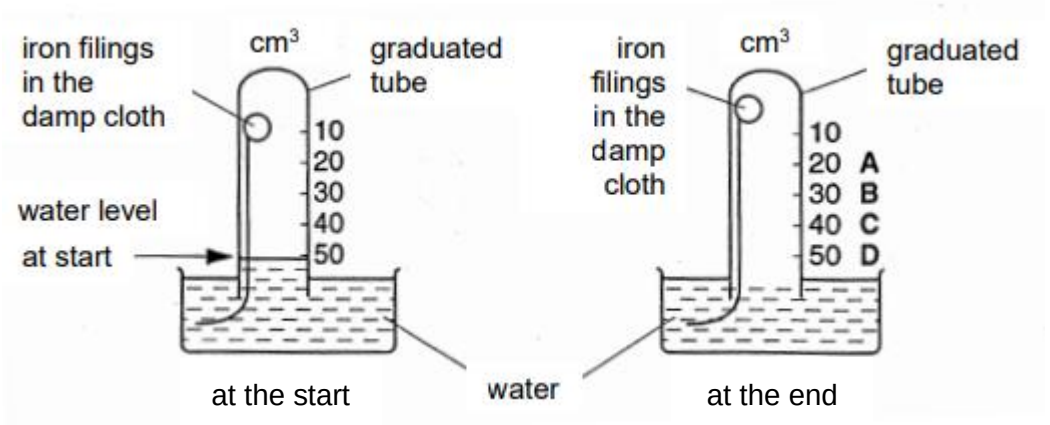
18 A car burning lead-free fuel has a catalytic converter fitted to its exhaust. On analysis, its exhaust gases are shown to contain small quantities of nitrogen oxides.

What modification(s) would result in lower exhaust concentrations of nitrogen oxides?

1 An increase in the surface area of the catalyst in the converter.
2 An increase in the percentage of oxygen going into the car.
3 A much higher temperature of combustion in the engine.

A 1 only **B** 2 and 3 **C** 1 and 2 **D** 1, 2 and 3

19 Iron filings are wrapped in a piece of damp cloth and left to rust in the apparatus as shown.



Which letter indicates the water level when rusting has been completed?

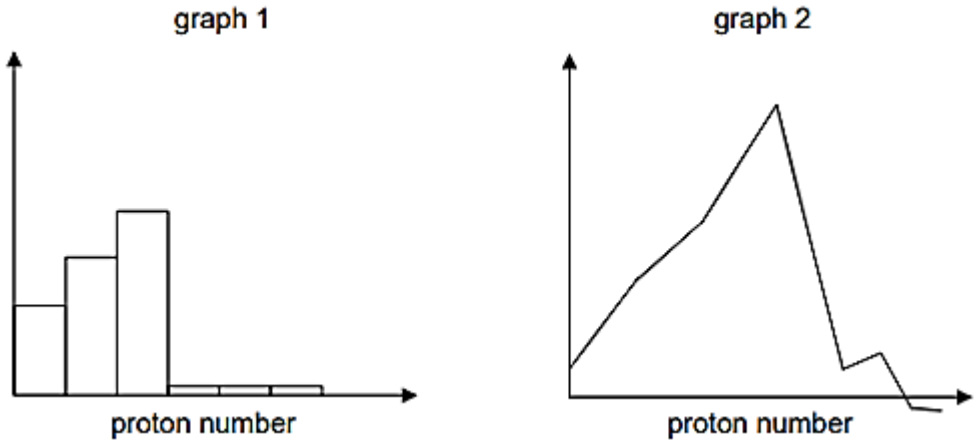
20 P, Q and R are elements found in Group VII of the Periodic Table. Three experiments were carried out to determine the reactivity of P, Q and R.
The three reactions are represented by the three equations shown below.

1 $R^-(aq) + Q_2(aq) \rightarrow$ no reaction
2 $P^-(aq) + R_2(aq) \rightarrow$ no reaction
3 $2Q^-(aq) + P_2(aq) \rightarrow Q_2(aq) + 2P^-(aq)$

Which statement about P, Q and R is correct?

A Q_2 is more reactive than P_2.
B R_2 has a lighter colour than Q_2.
C R_2 is a stronger oxidising agent than P_2.
D P_2 is a solid at room temperature and pressure.

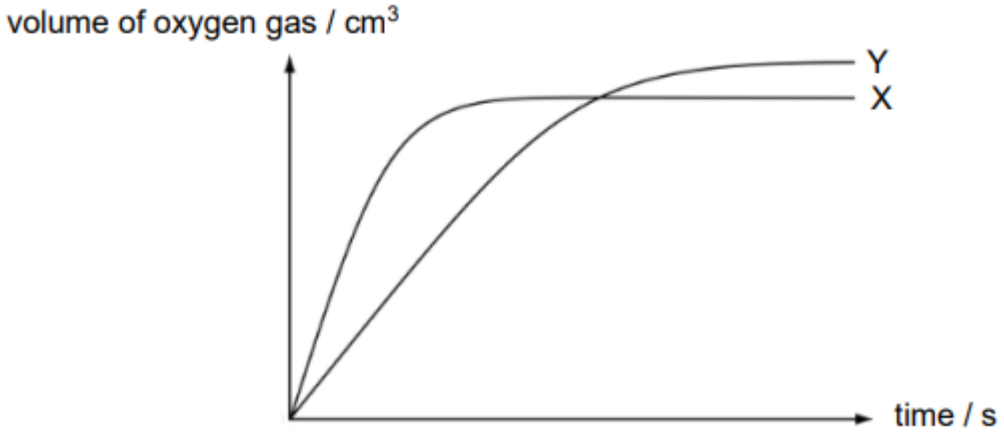
21 The graphs below show the trend in physical properties of the elements across Period 3.



Which physical property is represented by the y-axis of the graphs?

	graph 1	graph 2
A	electrical conductivity	melting point
B	charge on ion	atomic radius
C	number of valence electrons	melting point
D	metallic character	charge on ion

22 The diagram below shows curve X which was obtained by the decomposition of 100 cm^3 of 1.00 mol/dm^3 hydrogen peroxide using manganese (IV) oxide as catalyst.



Which of the following changes made to the original experiment would produce curve Y?

A Adding 10.0 cm^3 of water.
B Adding 10.0 cm^3 of 0.500 mol/dm^3 of hydrogen peroxide.
C Lowering the temperature of the solution by 10.0 °C.
D Reducing the mass of manganese (IV) oxide added.

23 Which of the following acids and the quantity stated will produce the fastest initial rate of reaction when 4.00 g of magnesium ribbon is added to it at room temperature and pressure?

A 15.0 cm^3 of 2.00 mol/dm^3 nitric acid
B 20.0 cm^3 of 1.00 mol/dm^3 hydrochloric acid
C 20.0 cm^3 of 1.50 mol/dm^3 sulfuric acid
D 30.0 cm^3 of 2.00 mol/dm^3 ethanoic acid

24 Hydrogen and chlorine react together to form hydrogen chloride.

$$H_2\,(g) + Cl_2\,(g) \rightarrow 2HCl\,(g) \quad \Delta H = -184\ kJ/mol$$

1 Increasing the pressure has no effect on the total volume of hydrogen chloride obtained.
2 48 dm^3 of hydrogen gas is mixed with 24 dm^3 of chlorine gas to produce 48 dm^3 of hydrogen chloride gas.
3 An increase in pressure will lead to higher frequency of collisions between H_2 and Cl_2 molecules.
4 A decrease in temperature of the mixture will lead to an increase in rate of reaction.

Which of the statements are correct?

A 1 and 3 **B** 2 and 3 **C** 1, 2 and 3 **D** 2, 3 and 4

25 Chlorodifluoromethane could be obtained from the following reaction:

$$C_2F_4 + 2HCl \rightarrow 2CHF_2Cl \quad \Delta H = -32\ kJ/mol$$

The bond energies of some of the bonds are given in the following table.

bond	bond energy kJ/mol
C–F	495
C–H	413
C–C	347
C=C	610
C–Cl	339

What is the bond energy of the H–Cl bond?

A 389 kJ/mol **B** 431 kJ/mol **C** 778 kJ/mol **D** 862 kJ/mol

26 Bismuth(III) oxychloride dissolves in concentrated hydrochloric acid to give a colourless solution of bismuth(III) chloride.

$$BiOCl\ (s) + 2HCl\ (aq) \rightarrow BiCl_3\ (aq) + H_2O\ (l); \quad \Delta H = -132\ kJ/mol$$

The activation energy for the forward reaction is 45 kJ/mol. Addition of water re-forms bismuth(III) oxychloride as a white precipitate.

What is the activation energy for the reverse reaction?

A – 45 kJ/mol **B** – 87 kJ/mol **C** 87 kJ/mol **D** 177 kJ/mol

27 Three electrolytic cells are set up using inert electrodes. The electrolytes used are listed below.

cell 1: concentrated aqueous potassium chloride
cell 2: dilute sulfuric acid
cell 3: dilute copper (II) chloride

In which of these cell(s) is/are gases formed at both electrodes?

A 2 only **B** 3 only **C** 1 and 2 **D** 2 and 3

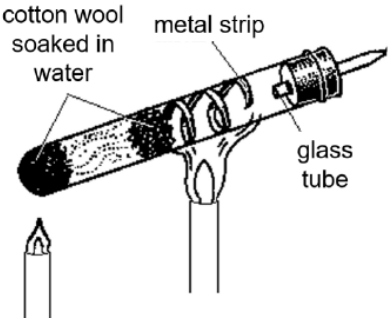
28 Three simple cells are set up using zinc metal and three other unknown metals, U, V and W, as electrodes.

cell	metals used	voltage / V	positive electrode
1	Zn, U	-0.45	Zn
2	Zn, V	+2.71	V
3	Zn, W	+1.11	W

What of the following lists the metals in order of decreasing reactivity?

A U, Zn, V, W
B U, Zn, W, V
C V, W, Zn, U
D V, Zn, W, U

29 In the experiment shown below, a strip of metal was heated in a glass tube. When a spark was created at the outlet of the glass tube, no flame was observed.



Which of the following could be the metal strip?

A calcium **B** lead **C** magnesium **D** zinc

30 Which of the following statements about the Haber Process is correct?

A The final yield is increased by operating at high temperature.
B The final yield is increased by operating at low pressure.
C The rate of reaction is increased by operating at low temperature.
D The rate of reaction is increased by operating at high pressure.

31 Which statement about a petroleum fraction is correct?

A It boils at a fixed temperature.
B Its molecules are all hydrocarbons.
C None of its molecules is found in other fractions,
D All its molecules contain the same number of carbon atoms.

32 Two compounds are thought to be isomers.
Possible similarities and differences are listed below. Which combination would confirm isomerism?

	similarity	difference
A	molecular mass	molecular structure
B	molecular structure	molecular mass
C	chemical properties	physical properties
D	physical properties	chemical properties

33 5 g of vegetable oil (M_r = 800) reacted completely with 900 cm^3 of hydrogen gas (measured at room temperature and pressure) to form margarine which is a saturated fat. How many carbon-carbon double covalent bonds are there in one molecule of the oil?

A 3 **B** 4 **C** 5 **D** 6

34 Which of the following molecules is **not** a substitution product formed when butane reacts with chlorine in the presence of sunlight?

A $C_4H_5Cl_4$
B C_4HCl_9
C $C_4H_2Cl_8$
D $C_4H_3Cl_7$

35 An alcohol, X, was fully oxidised to form a carboxylic acid.
Neutralisation of the acid with aluminium oxide gives a salt with the formula $(CH_3CO_2)_3Al$.

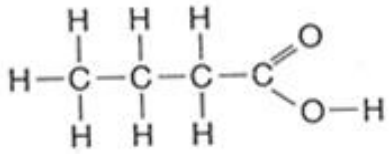
What was alcohol X?

A CH_3OH
B CH_3CH_2OH
C $CH_3CH_2CH_2OH$
D $CH_3CH_2CH_2CH_2CH_2CH_2OH$

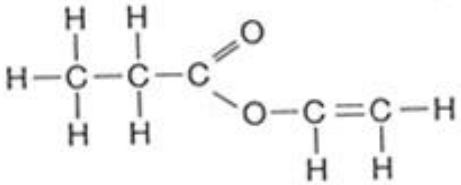
36 The table shows the results of tests carried out on compound P which has the molecular formula $C_4H_8O_2$.

test	observation
add bromine water	bromine water remains orange
add aqueous sodium carbonate	effervescence observed

1



2



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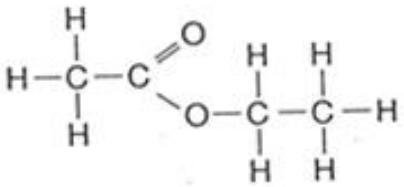
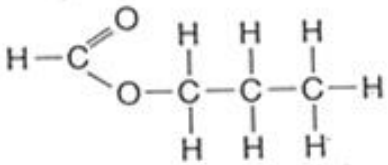


4



What could compound P be?

A 1 only **B** 3 only **C** 1 and 3 **D** 1 and 4

37 The structures of two isomers of butane are given below.

$CH_3CH_2CH=CH_2$ and $CH_3CH=CHCH_3$

How many statements about the two isomers are correct?

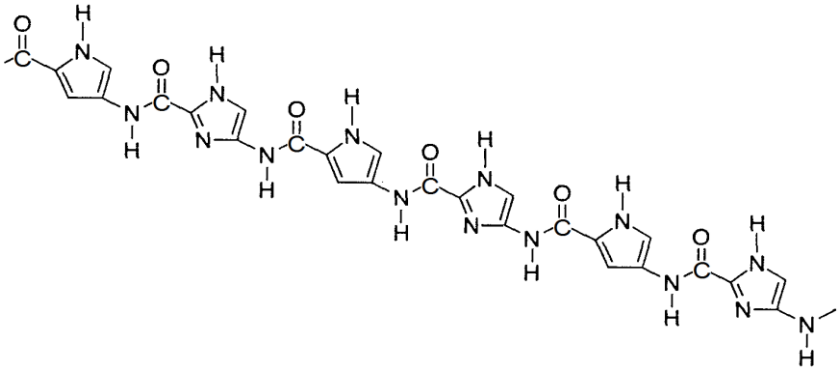
- Combustion of 10 g of each isomer will give the same volume of gases.
- Both will react with steam to give the same molecule.
- Both will react with hydrogen to give the same molecule.
- 1 mol of each isomer will react with 1 mol of bromine to give the same mass of products.

A 1 **B** 2 **C** 3 **D** 4

38 Petroleum can be separated into fractions by fractional distillation.
Which statement about this process is **not** correct?

A The lubricating oil fraction is a source of polishes and waxes.
B The fraction obtained at the top of the fractionating column has the highest boiling point.
C In a fractionating column, the bitumen fraction is obtained below the kerosene fraction.
D The molecules reaching the top of the column have the smallest relative molecular mass.

39 The structure below shows part of a polymer.



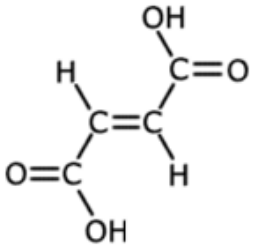
1 It is a nylon.
2 It is formed in an addition polymerisation reaction.
3 It is formed from two different types of monomers.
4 Each monomer has at least two different functional groups.

Which statements are correct?

A 1 and 4 **B** 2 and 3 **C** 1, 3 and 4 **D** 2, 3 and 4

40 The following diagrams show four monomers.

How many of these monomers would react with the molecule below to form a polymer?



A 1 **B** 2 **C** 3 **D** 4

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**Key** proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name: ( )	Class:

GREENDALE SECONDARY SCHOOL
Preliminary Examination 2022

CHEMISTRY **6092/01**

Paper 1 Multiple Choice **31 August 2022**
Secondary 4 Express **1 hour**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and register number on the Answer Sheet and on the Question Paper in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on this question paper.
A copy of the Periodic Table is printed on Page 18.
The use of an approved scientific calculator is expected, where appropriate.

1 A student put exactly 25.0 cm^3 of dilute hydrochloric acid into a conical flask.

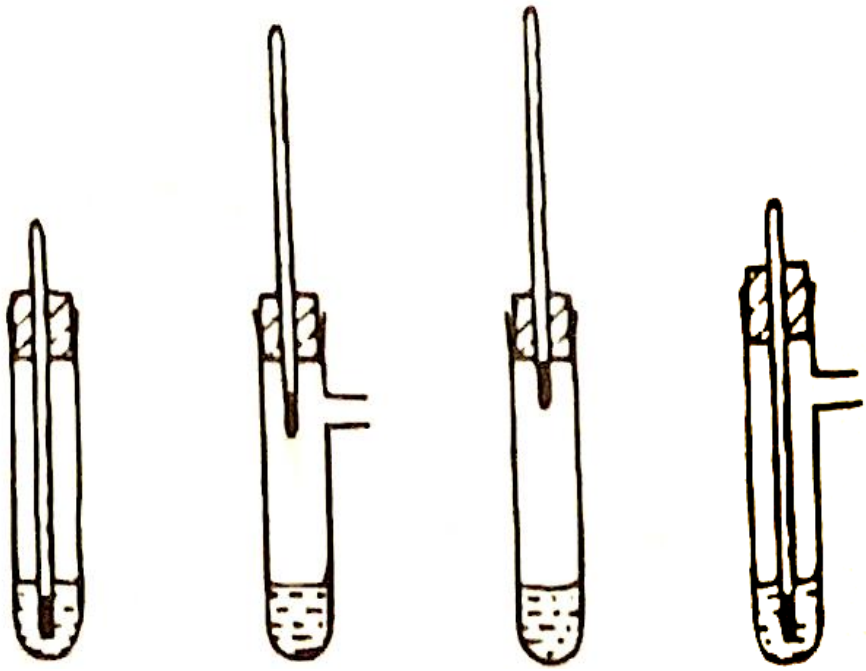
The student added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to use?

A balance, measuring cylinder, thermometer
B balance, pipette, stopwatch
C balance, pipette, thermometer
D burette, pipette, thermometer

2 The tubes shown all contain a dilute solution of a solid X dissolved into a liquid Y.

Which apparatus is most suitable for finding the boiling point of liquid Y?



A **B** **C** **D**

3 Which description of brass are correct?

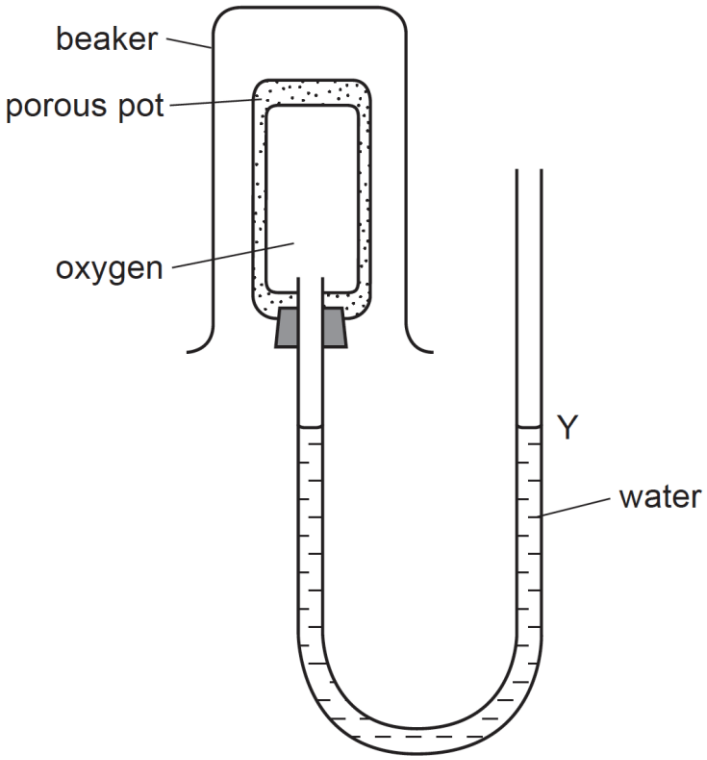
1 It is an alloy.
2 It is a mixture.
3 It is a non-metal.

A 1 only **B** 1 and 2 only **C** 2 and 3 only **D** 3 only

4 Which one of the following correctly describes the particles in a dilute sugar solution at room temperature?

	sugar molecules	water molecules
A	widely separated, moving at random	close together, moving at random
B	widely separated, moving at random	close together, not moving
C	close together, moving at random	widely separated, moving at random
D	close together, vibrating slightly	close together, moving at random

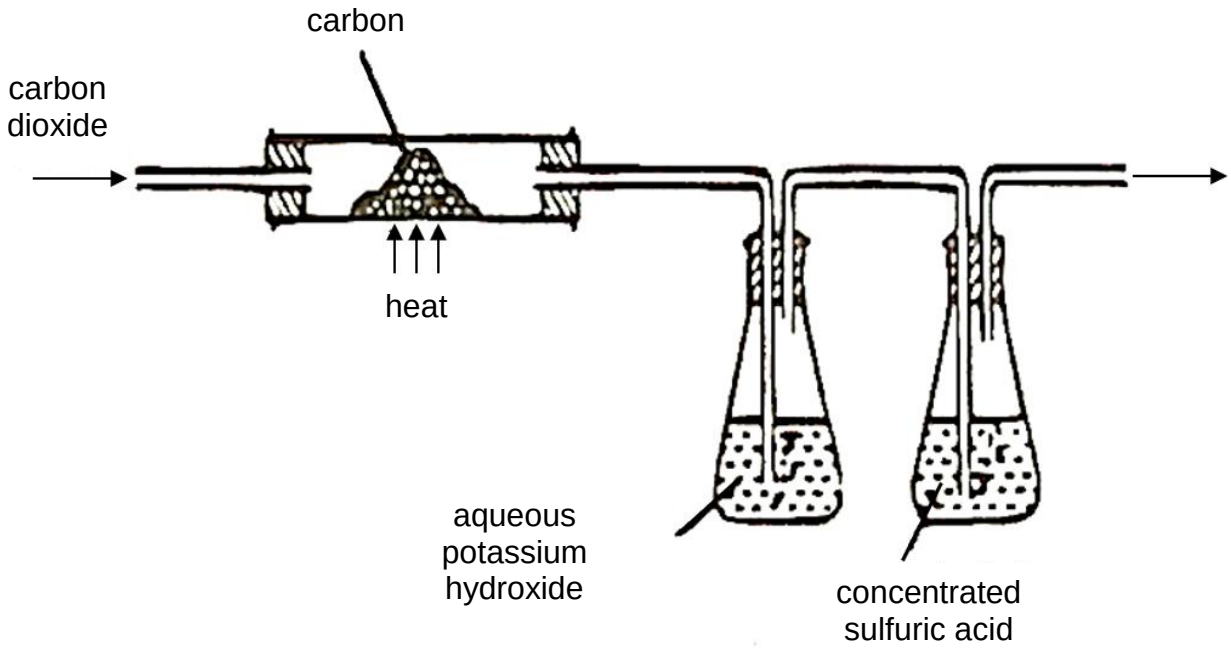
5 The diagram shows a diffusion experiment.



Which gas, when present in the beaker over the porous pot, will cause water level at Y to initially rise?

A CO_2
B Cl_2
C CH_4
D NO_2

6 The apparatus shown is used to prepare carbon monoxide.



What is the purpose of the aqueous potassium hydroxide?

A to absorb any oxygen formed
B to cool the carbon monoxide
C to dry carbon monoxide
D to remove traces of carbon dioxide

7 A bottle of copper(II) oxide has been contaminated with some solid sodium chloride.

How can the sodium chloride be removed from the copper(II) oxide?

A Place the mixture in a separating funnel.
B Heat the mixture and allow it to cool.
C Add aqueous silver nitrate to the mixture and filter.
D Add water to the mixture and filter.

8 A particle consists of three electrons, four protons and five neutrons.

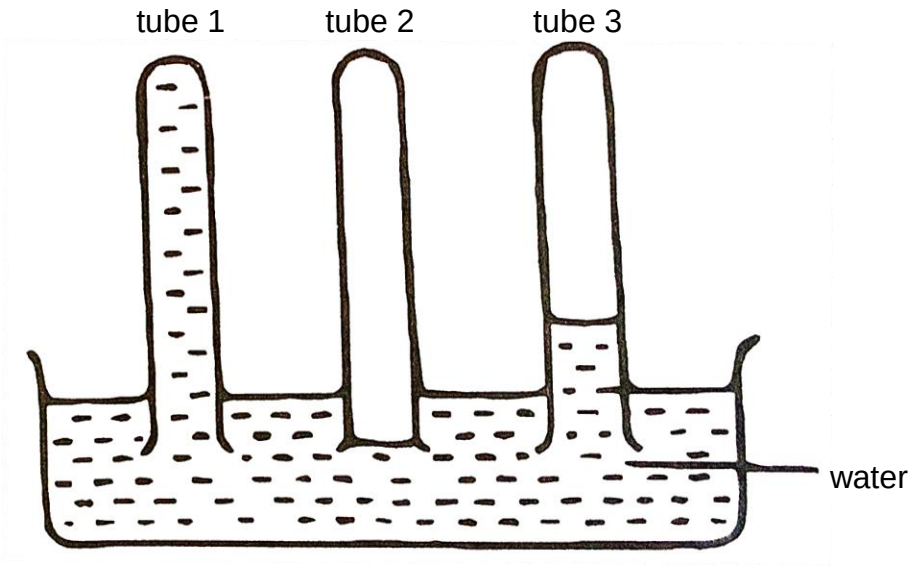
Which of the statement about the particle are correct?

1 The particle has an atomic number of 3.
2 The particle has a mass number of 7.
3 The particle has a charge of 1+.

A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 3 only

9 Three dry test-tubes were filled with different gases and placed in a trough of water.

After a short time, the water had risen in two of the tubes as shown.



Which gases could the tubes have contained?

	tube 1	tube 2	tube 3
A	ammonia	carbon dioxide	hydrogen
B	ammonia	hydrogen	carbon dioxide
C	carbon dioxide	ammonia	oxygen
D	oxygen	ammonia	carbon dioxide

10 The elements T, X and Y have consecutive, increasing atomic numbers.

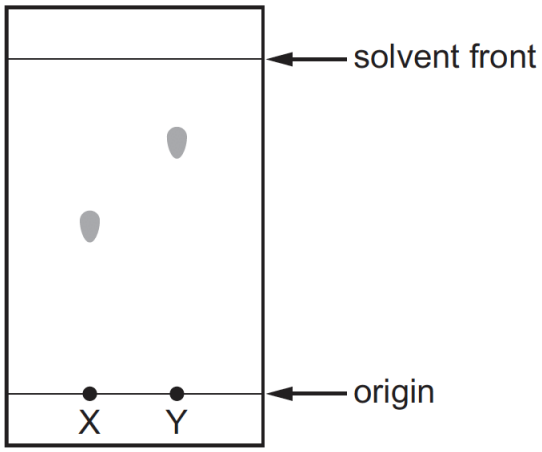
If element T is a noble gas, what will be the symbol for the ion of element Y in its compounds?

A Y^{+} **B** Y^{2+} **C** Y^{2-} **D** Y^{-}

11 What are the different forms for the same element in the same physical state called?

A allotropes **B** isomers **C** isotopes **D** polymers

12 The results of a paper chromatography experiment are shown.



X is an aqueous solution of a salt of a Group I element.

Y is an aqueous solution of a salt of a transition element.

Which row is correct?

	larger R_f value	requires a locating agent
A	X	X
B	X	Y
C	Y	X
D	Y	Y

13 Hydrogen gas is produced when sodium is added to water.

What is the volume of hydrogen gas, measured at r.t.p., produced when 18.4 g of sodium reacts with excess water?

A 9.6 dm^3 **B** 15.0 dm^3 **C** 19.2 dm^3 **D** 30.0 dm^3

14 Iron can be electroplated with zinc to make it resistant to corrosion.

Which row about electroplating iron with zinc is correct?

	positive electrode	negative electrode	electrolyte
A	iron	zinc	iron(II) nitrate
B	iron	zinc	zinc nitrate
C	zinc	iron	iron(II) nitrate
D	zinc	iron	zinc nitrate

15 Element P has an electronic configuration of 2.8.6.

Element R has an electronic configuration of 2.8.8.1.

What is likely to form if P and R combine?

A a covalent compound RP
B a covalent compound R_2P
C an ionic compound RP
D an ionic compound R_2P

16 One mole of compound Q gives three moles of ions in aqueous solution. Q reacts with ammonium carbonate to give an acidic gas.

What is compound Q?

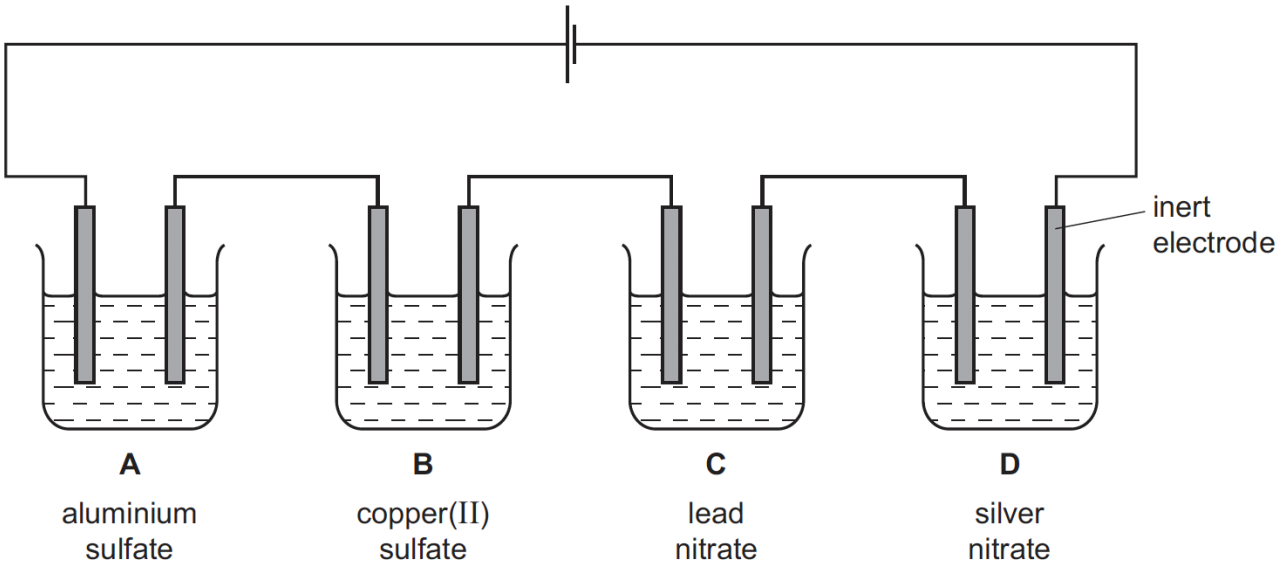
A calcium hydroxide
B nitric acid
C sodium hydroxide
D sulfuric acid

17 124 g of phosphorus vapour has the same volume as 71 g of chlorine gas at the same temperature and pressure.

What is the formula of a molecule of phosphorus?

A P_8 **B** P_4 **C** P_2 **D** P

18 When electrolysed using inert electrodes, which dilute solution would produce the greatest increase in mass of the negative electrode?
[A_r: A*l*, 27; Cu, 64; Pb, 207; Ag, 108]



19 Which of the following involves the largest number of electrons for complete discharge during electrolysis?

A 5 moles of OH^- ions
B 6 moles of Cu^{2+} ions
C 7 moles of O^{2-} ions
D 12 moles of Na^+ ions

20 High carbon steel is used in manufacturing processes.

Which properties does high carbon steel have?

1 It is brittle.
2 It is malleable.
3 It is soft.
4 It is strong.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

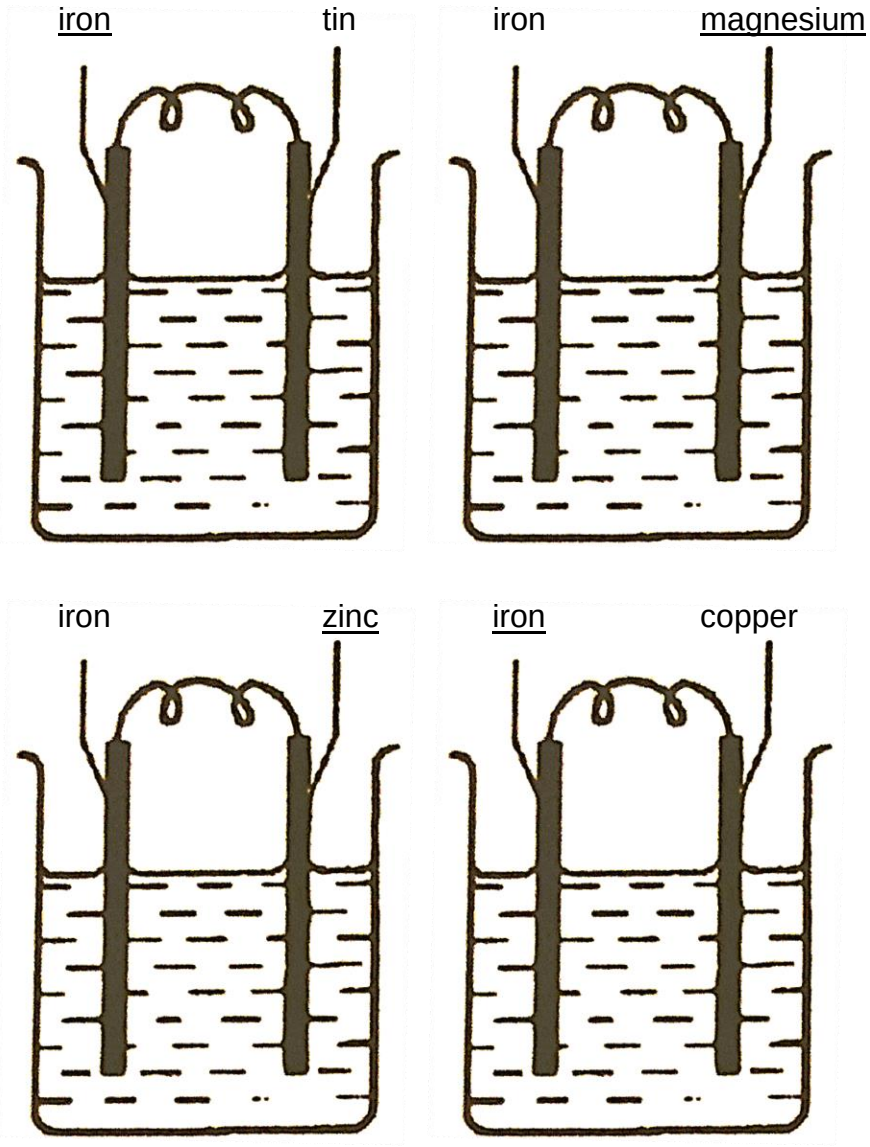
21 The table shows the energy released by the complete combustion of some compounds used as fuel.

compound	M_r	ΔH in kJ/mol
methane	16	– 880
ethanol	46	– 1380
propane	44	– 2200
heptane	100	– 4800

Which fuel produces the most energy when 1 g of the compound is completely burned?

A ethanol **B** heptane
C methane **D** propane

22 Four cells were set up using aqueous sodium chloride as the electrolyte.



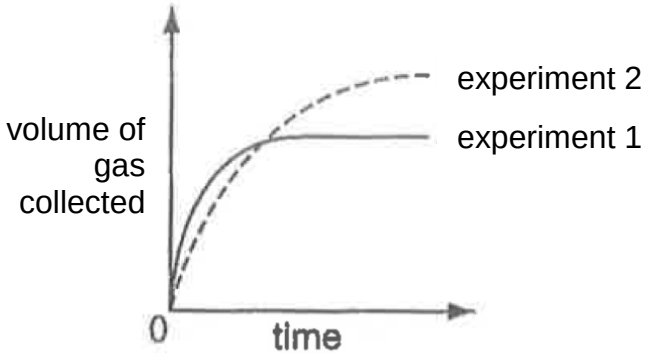
In each cell, only the underlined electrode dissolved. To establish the order of reactivity of the metals, it is necessary to set up two or more cells.

Which of the following pairs of cells are needed in addition to the four cells above?

	first cell electrodes	second cell electrodes
A	tin/copper	magnesium/zinc
B	tin/magnesium	zinc/copper
C	tin/zinc	magnesium/copper
D	tin/zinc	zinc/copper

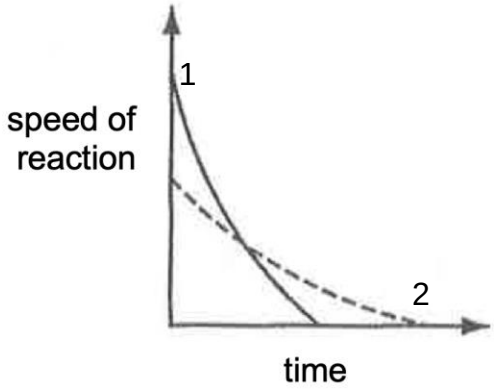
23 In two separate experiments, a substance was decomposed and the gas evolved was collected.

The graph shows the total volume of gas collected against time for each experiment.

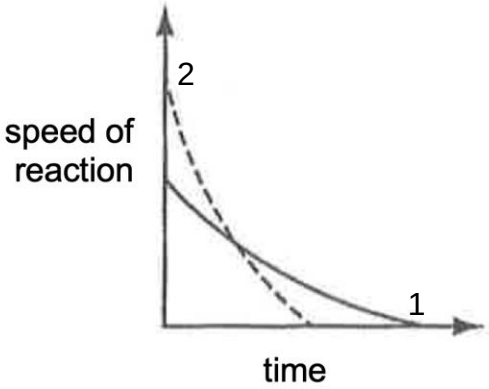


Which graph shows how the speed of reaction varied with time in each experiment?

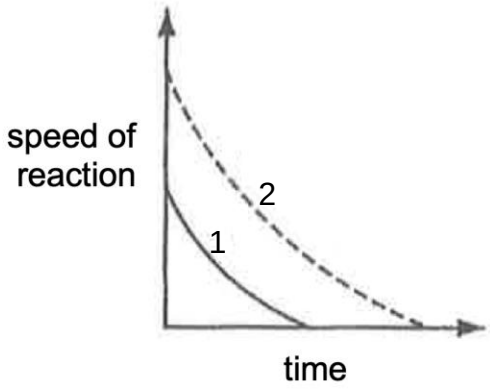
A



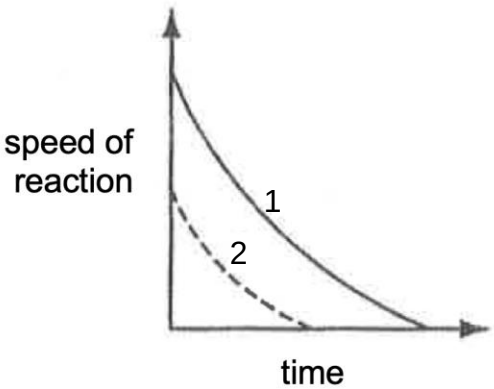
B



C



D



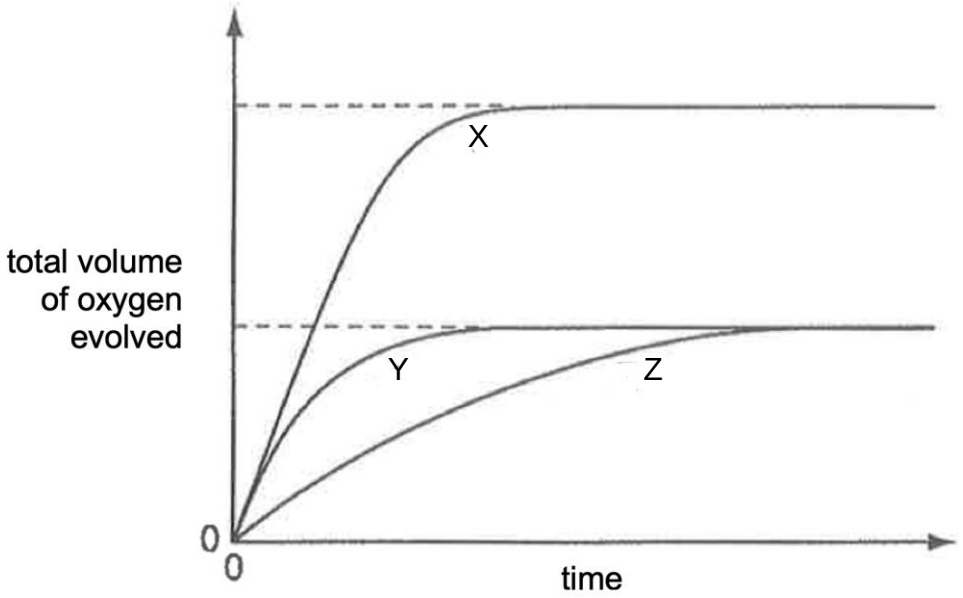
24 The hydrogen peroxide solution is catalytically decomposed by manganese(IV) oxide.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

To study the effect of the concentration of the solutions on the rate of reaction, the total volume of oxygen evolved was recorded against time.

Three experiments were performed using a fixed mass of catalyst but with

(i) 50 cm^3 of 2.0 mol/ dm^3 hydrogen peroxide.
(ii) 100 cm^3 of 1.0 mol/ dm^3 of hydrogen peroxide.
(iii) 100 cm^3 of 2.0 mol/dm^3 of hydrogen peroxide.



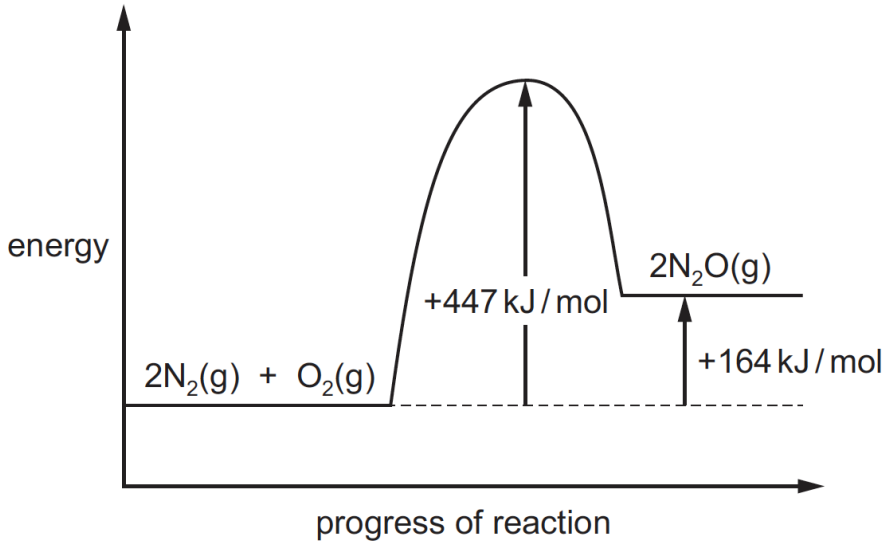
On the graph above, which of the curves, X, Y and Z relate to the solutions (i), (ii) and (iii)?

	(i)	(ii)	(iii)
A	X	Y	Z
B	X	Z	Y
C	Z	X	Y
D	Y	Z	X

25 Under certain conditions nitrogen reacts with oxygen to form dinitrogen monoxide.

$$2N_2(g) + O_2(g) \rightleftharpoons 2N_2O(g)$$

The energy profile diagram for the reaction is shown.



What is the activation energy for the reverse reaction?

A – 447 kJ/mol
B – 283 kJ/mol
C + 141.5 kJ/mol
D + 283 kJ/mol

26 The formation of liquid water from hydrogen and oxygen is thought to occur in three stages.

1 $2H_2(g) + O_2(g) \rightarrow 4H(g) + 2O(g)$

2 $4H(g) + 2O(g) \rightarrow 2H_2O(g)$

3 $2H_2O(g) \rightarrow 2H_2O(l)$

Which stages would be exothermic?

A 1, 2 and 3 **B** 1 and 2 **C** 1 and 3 **D** 2 and 3

27 Iron is extracted from iron ore in a blast furnace.

Which substances are fed into the top of the blast furnace?

1 coke
2 limestone
3 hot air

A 1, 2 and 3 **B** 1 and 2 **C** 1 and 3 **D** 2 and 3

28 Which noble gas is present in the largest percentage by volume in air?

A argon **B** helium
C krypton **D** neon

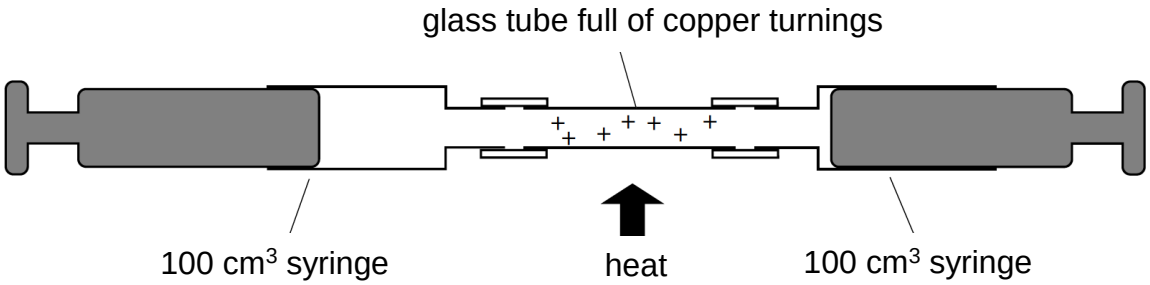
29 Which gas can be removed from the exhaust gases of a petrol-powered car by its catalytic converter?

A carbon monoxide **B** carbon dioxide
C nitrogen **D** steam

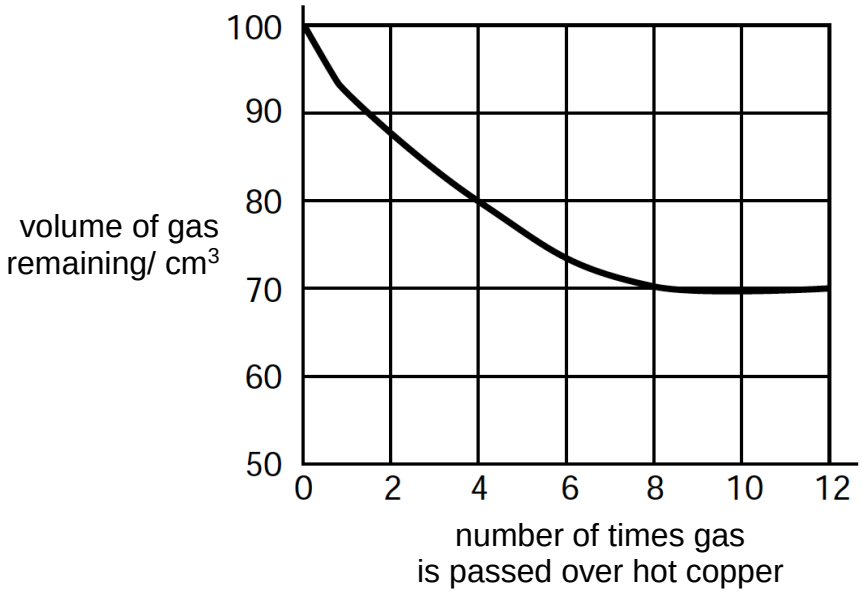
30 Which gas will react with ozone in the upper atmosphere of the Earth?

A CF_2Cl_2 **B** CH_4 **C** CO_2 **D** CF_4

31 A 100 cm^3 sample of bottled gas used for diving was placed in a gas syringe in the apparatus shown.



The gas was passed backward and forward over heated copper turnings. The results obtained were used to plot the graph.



What is the percentage of oxygen in the bottled gas?

A 20% **B** 30% **C** 70% **D** 80%

32 Which physical properties of the alkanes does **not** increase as relative molecular mass increases?

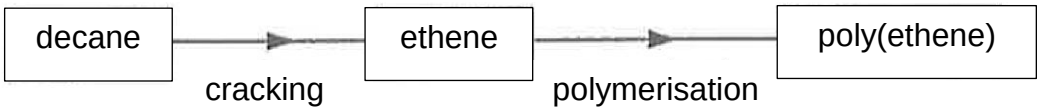
A boiling point
B flammability
C melting point
D viscosity

33 When 20 cm^3 of a gaseous alkene burns in an excess of oxygen, 60 cm^3 of carbon dioxide are formed. Both volumes are measured at r.t.p.

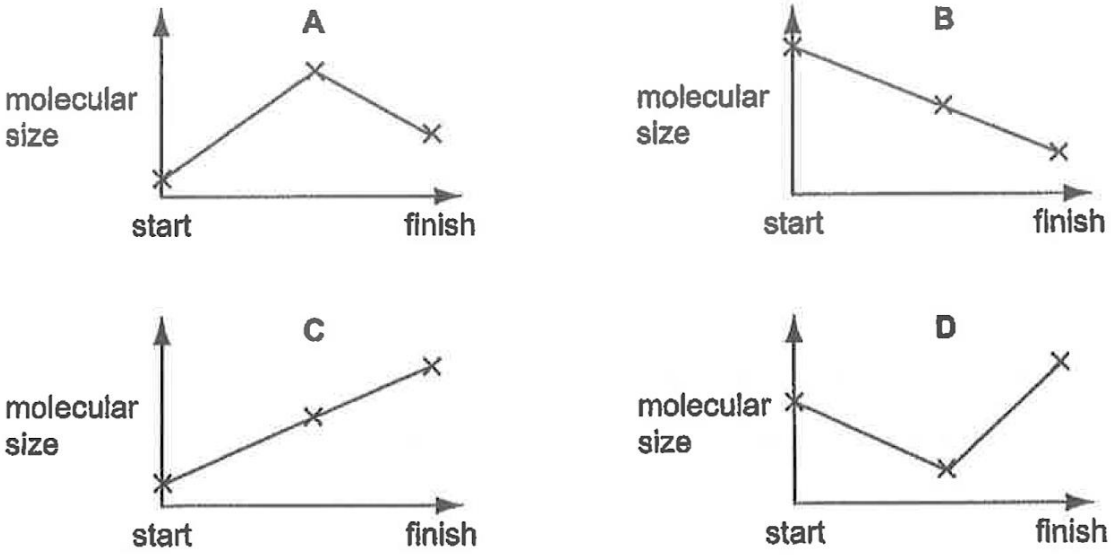
What is the formula of the alkene?

A C_3H_6 **B** C_3H_8 **C** C_6H_{12} **D** C_6H_{14}

34 Poly(ethene) can be manufactured by the process below.



Which diagram shows the change in molecular size during this process?



35 Which bond in a molecule of ethanoic acid is broken when it reacts with magnesium?

A the C — H bond
B the C — C bond
C the O — H bond
D the C = O bond

36 An alcohol contains 60% carbon by mass.

What is its formula?

A CH_3OH
B C_2H_5OH
C C_3H_7OH
D C_4H_9OH

37 Some synthetic products are said to be non-biodegradable.

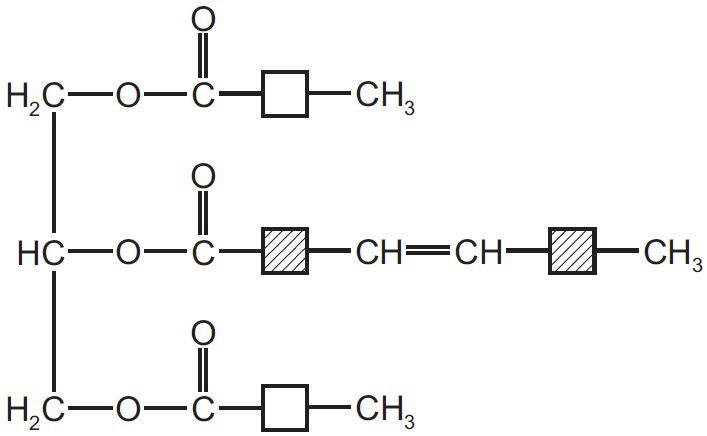
What does this term mean?

A cannot act as catalysts for biological process
B not harmful to living organisms
C not decomposed by strong heat
D not broken down by bacteria

38 What is the catalyst used in the preparation of ethyl ethanoate from ethanol and ethanoic acid?

A concentrated sulfuric acid **B** nickel
C phosphoric acid **D** yeast

39 The diagram shows a simplified structure of a fat.

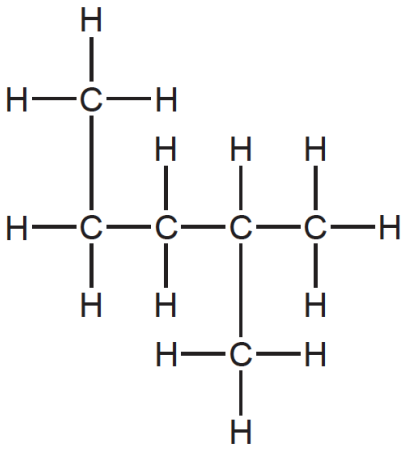


Which compounds in the table have functional groups that can be found in this fat?

	ethene	nylon	ethanoic acid
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✗
D	✗	✗	✗

40 Structures 1, 2, 3 and 4 are hydrocarbons.

1



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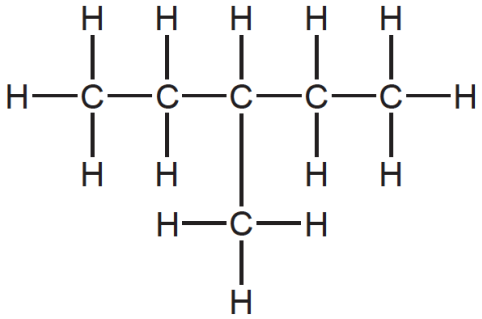

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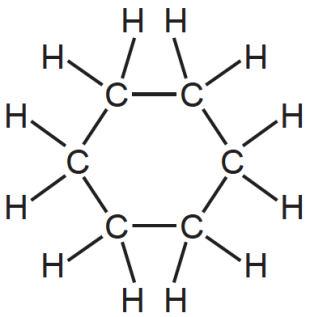

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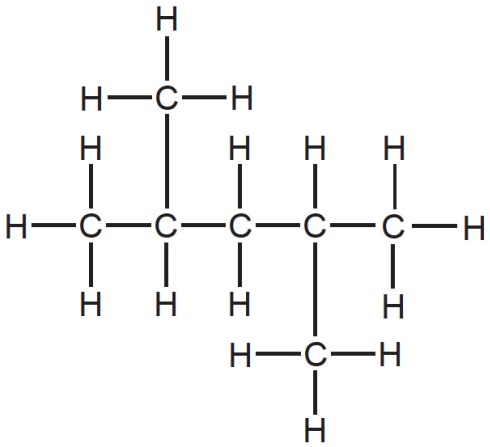


Which pair of structures are isomers?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

GUANGYANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
Secondary Four Express

CANDIDATE NAME	

CENTRE NUMBER					INDEX NUMBER					CLASS/ REG No.	/

CHEMISTRY

Paper 1 Multiple Choice

6092/01
31 August 2022
1 hour

Additional Materials: Multiple Choice Answer Sheet
Periodic Table

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, centre number, index number, class and register number in the spaces above.

There are **forty** questions on this paper. Answer all questions.
For each question there are four possible answers, **A, B, C** and **D**.

Read the instructions on the Answer Sheet carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of 16 printed pages, inclusive of this cover page

Y

PAPER 1 (40 MARKS)

This paper consists of 40 multiple-choice questions. For each question, there are four possible answers. Choose the best answer you consider correct and record your answer on the Answer Sheet provided.

1 Copper (II) nitrate is soluble in water. Copper (II) carbonate is insoluble in water.
A mixture of solid copper (II) nitrate and copper(II) carbonate is added to a beaker of water.
It is stirred until no more solid dissolves.
How can separate samples of copper (II) nitrate and copper (II) carbonate be obtained from the resulting mixture?

A crystallisation followed by distillation
B evaporation followed by distillation
C evaporation followed by filtration
D filtration followed by crystallisation

2 A mixture of three liquids is separated by fractional distillation.
Which statements are **correct**?

1 The mixture boils at constant temperature throughout the separation.
2 The temperature at which the mixture boils increases during the separation.
3 The liquid with the highest boiling point is collected first.
4 The liquid with the lowest boiling point is collected first.

A 1 and 3
B 1 and 4
C 2 and 3
D 2 and 4

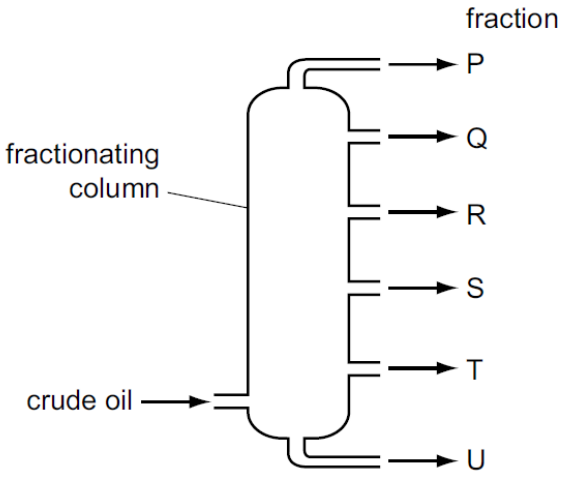
3 It is possible to produce Ar^{2+} ions from argon atoms in a laboratory.
Which statement is **correct**?

A Each argon atom gains two electrons and loses the electronic configuration of an inert gas.
B Each argon atom gains two electrons and obtains the electronic configuration of an inert gas.
C Each argon atom loses two electrons and loses the electronic configuration of an inert gas.
D Each argon atom loses two electrons and obtains the electronic configuration of an inert gas.

4 Two isotopes of chlorine are ^{35}Cl and ^{37}Cl.
Using these isotopes, how many different relative molecular masses are possible for the compound with molecular formula $C_2H_3Cl_3$?

A 2
B 3
C 4
D 5

5 The diagram below shows a fractionating column used in the separation of petroleum.



Which row explains why fraction R is collected above fraction S?

	boiling point of R	average molecular mass of R
A	greater than S	greater than S
B	greater than S	smaller than S
C	smaller than S	greater than S
D	smaller than S	smaller than S

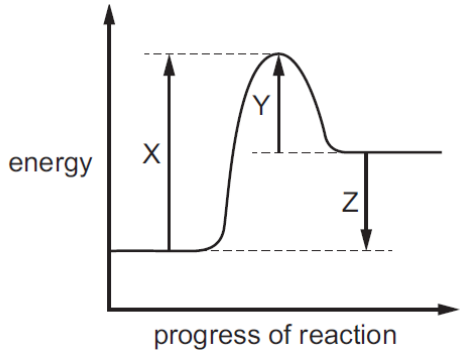
6 The table shows data for some particles. There are gaps represented by W, X, Y and Z.

particle	proton number	nucleon number	number of neutrons	number of electrons
Ar	18	40	W	18
K^+	19	39	20	X
Sc	21	Y	24	21
S^{2-}	16	32	16	Z

Which row shows the correct values for W, X, Y and Z?

	W	X	Y	Z
A	20	20	42	14
B	20	20	42	16
C	22	18	45	14
D	22	18	45	18

7 The energy profile diagram of a chemical reaction is shown below.



Which statement is **correct**?

A The reaction is exothermic.
B Y represents ΔH for the reaction.
C X represents the activation energy for the reaction.
D Z represents the energy given out as the reaction proceeds.

8 Three statements about the elements carbon, nitrogen and sulfur are shown below.

1 They are in groups next to each other in the Periodic Table.
2 Their neutron to proton ratios are all two to one.
3 They each form an acidic oxide.

Which statements are **correct**?

A 1, 2 and 3
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only

9 When K_2MnO_4 is dissolved in water, the following reaction occurs.

$$a MnO_4^{2-}(aq) + b H_2O(l) \rightarrow c MnO_4^{-}(aq) + d\ MnO_2(s) + e OH^{-}(aq)$$

What could be the values of *a* and *c* in the balanced chemical equation?

	a	*c*
A	2	1
B	3	1
C	3	2
D	4	3

10 Many elements and compounds contain covalent bonds.
Which statement about covalently bonded elements and compounds is **correct**?

A Aqueous solutions of covalent compounds always conduct electricity.
B Bonding in the nitrogen molecule involves three shared pairs of electrons.
C Double covalent bonds are present in ethene and in water.
D The formation of covalent bonds always produces atoms with eight electrons in their outer shells.

11 J is an aqueous solution.
On addition of aqueous sodium hydroxide to J a green precipitate is formed.
The resulting mixture is heated and no gas is formed.
Aluminium foil is added to the warmed mixture. A gas is formed that turns damp red litmus paper blue.
Which ions could be present in J?

A Fe^{3+} and NH_4^+
B Fe^{3+} and NO_3^-
C Fe^{2+} and NH_4^+
D Fe^{2+} and NO_3^-

12 An aqueous solution of zinc chloride is tested by adding reagents.
Which observation is **correct**?

	reagent added to zinc chloride (aq)	observations
A	acidified aqueous barium nitrate	forms a white precipitate
B	aqueous ammonia	forms a white precipitate, soluble in excess of the reagent
C	aqueous sodium hydroxide	forms a white precipitate, insoluble in excess of the reagent
D	powdered copper	forms a grey precipitate

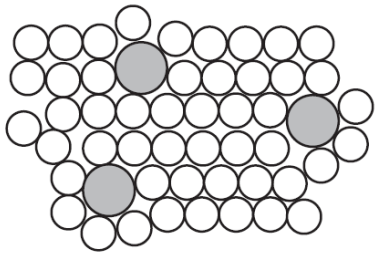
13 Which reaction is a redox reaction?

A $Mg + 2HCl \rightarrow MgCl_2 + H_2$
B $MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2O + CO_2$
C $MgO + 2HCl \rightarrow MgCl_2 + H_2O$
D $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$

14 One mole of an organic compound, **Q**, is completely burnt in oxygen and produces exactly three moles of water. Which compound is **Q**?

A butane, C_4H_{10}
B ethanol, C_2H_5OH
C propane, C_3H_8
D propanol, C_3H_7OH

15 The diagram below shows the structure of an alloy.



Which statement about alloys is **correct**?

A The alloy brass has a chemical formula.
B High carbon steel alloys are soft and easily shaped.
C Alloys can only be formed by mixing copper or iron with other metals.
D In an alloy there is attraction between positive ions and a 'sea of electrons'.

16 Calcium carbonate, $CaCO_3$, reacts with an acid, HA as shown below.

$$CaCO_3(s) + 2HA(aq) \rightarrow CaA_2(aq) + H_2O(l) + CO_2(g)$$

What is the minimum mass of acid required to react completely with 10 g of calcium carbonate?
[M_r: HA, 46; $CaCO_3$, 100]

A 4.6 g
B 9.2 g
C 10 g
D 20 g

17 When concentrated sulfuric acid reacts with sodium iodide the products include sulfur, iodine, hydrogen sulfide and sulfur dioxide.
Which statement is **correct**?

A Hydrogen sulfide is the product of a reduction reaction.
B Iodide ions are stronger oxidising agents than sulfate ions.
C Sulfur atoms from the sulfuric acid are both oxidised and reduced.
D Sulfur atoms from the sulfuric acid are oxidised to make sulfur dioxide.

18 Attaching pieces of magnesium to underground iron pipes can protect the iron from corrosion.
Which reaction protects the iron from corrosion?

A $Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$
B $Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$
C $Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$
D $Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$

19 The names and formulae of three nitrogen compounds are shown below.

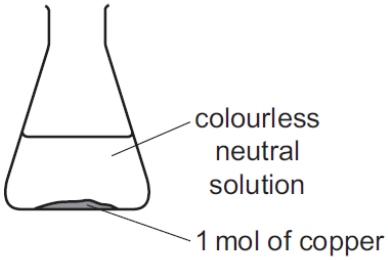
ammonia	hydrazine	hydroxylamine
NH_3	N_2H_4	NH_2OH

Which compound has the highest relative molecular mass, M_r, and in which compound is the percentage by mass of hydrogen the **greatest**?

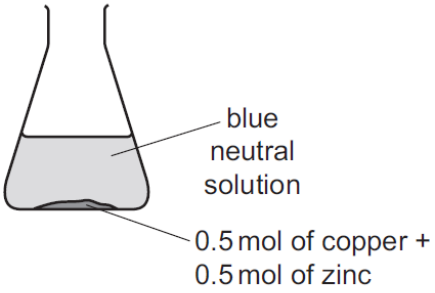
	highest M_r	greatest percentage by mass of hydrogen
A	N_2H_4	NH_3
B	N_2H_4	N_2H_4
C	NH_2OH	NH_3
D	NH_2OH	N_2H_4

20 In an experiment, 1 mol of powdered copper and 1 mol of powdered zinc are placed in a flask.
Dilute acid, containing 1 mol of acid, is added to the flask.
The flask is left until all the reactions, if any, are complete.
Which diagram shows the result of the experiment?

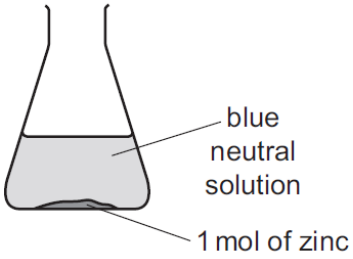
A



B



C



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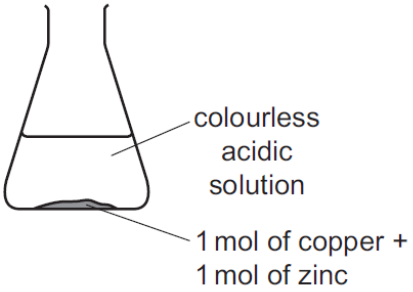


21 The diagram below shows the positions of elements L, M, Q, R and T in the Periodic Table. These letters are not the chemical symbols of the elements.

Which statement about the properties of these elements is **correc**t?

A L reacts more vigorously with water than does M.
B L, M and Q are all metals.
C T exists as diatomic molecules.
D T is more reactive than R.

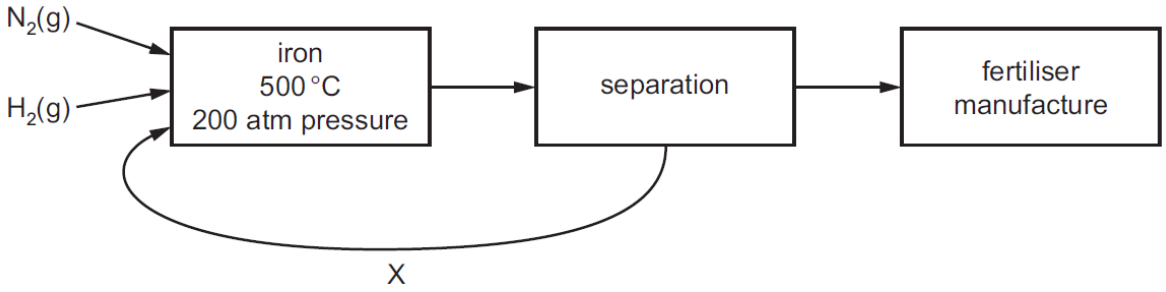
22 The section of the reactivity series shown includes a newly discovered metal, symbol X.

Ca
Mg
Fe
X
H
Cu

The only oxide of X has the formula XO. Which equation shows a reaction which occurs?

A $Cu\ (s) + X^{2+}\ (aq) \rightarrow Cu^{2+}\ (aq) + X\ (s)$
B $2X\ (s) + Cu^{2+}\ (aq) \rightarrow 2X^{+}\ (aq) + Cu\ (s)$
C $X\ (s) + Fe_2O_3\ (s) \rightarrow 2Fe\ (s) + 3XO\ (s)$
D $X\ (s) + 2HCl\ (aq) \rightarrow XCl_2\ (aq) + H_2\ (g)$

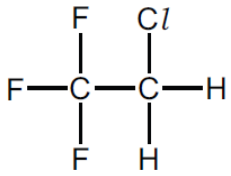
23 The diagram below shows the main stages in the manufacture of an ammonia-based fertiliser.



What is happening in the process labelled X?

A Unreacted hydrogen only is recycled.
B Unreacted hydrogen and nitrogen are recycled.
C The gases are cooled to cause ammonia to form a liquid.
D Ammonia is returned to the start of the process to shift the equilibrium towards the product.

24 CFC compounds were used as aerosol propellants. The structure of one CFC compound is shown.



Which element in this compound causes a depletion of ozone in the atmosphere?

A carbon
B chlorine
C fluorine
D hydrogen

25 Pollutant gases are released by the bacterial decay of vegetable matter.
The bacterial decay of vegetable matter is the main source of which gas?

A carbon monoxide
B methane
C nitrogen dioxide
D sulfur dioxide

26 The rate of a chemical reaction decreases as the temperature decreases because at a lower temperature:

1 a lower proportion of molecules have energy that exceeds the activation energy
2 the molecules are further apart
3 the frequency of successful collision is less.

Which reasons **correctly** explain this decrease?

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

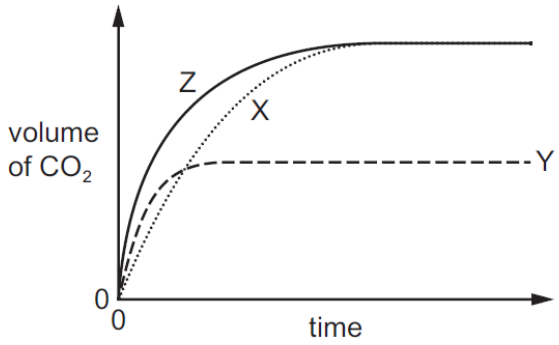
27 If a sample of ammonia is passed over heated iron, two gases, X and Y, are formed.
Gas X reacts with oxygen. Gas Y is unreactive.
Which statement is **correct**?

A Gas X reacts with oxygen to form water.
B Gas Y is a compound.
C The formation of the two gases from ammonia cannot be reversed.
D There is a triple covalent bond in one molecule of gas X.

28 The rate of the reaction between a metal carbonate and a dilute acid is followed by measuring the volume of carbon dioxide produced and plotting this against time.

The line labelled X shows the results of an experiment using 50 cm^3 of 1.0 mol / dm^3 hydrochloric acid and excess metal carbonate.

The experiment is repeated using different conditions and lines Y and Z are drawn to show the volumes of carbon dioxide produced against time.



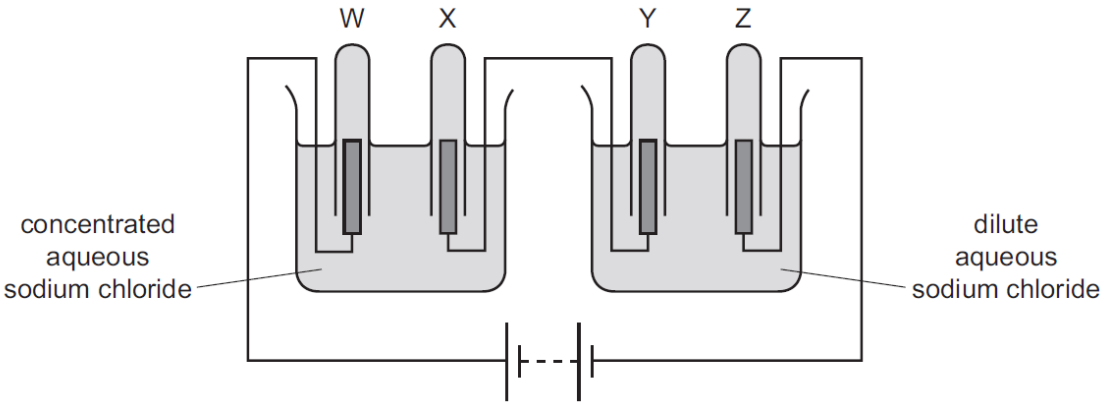
Which row shows the conditions that could give lines Y and Z?

	conditions for Y	conditions for Z
A	50 cm^3 of 0.5 mol / dm^3 hydrochloric acid at same temperature.	25 cm^3 of 2.0 mol / dm^3 hydrochloric acid at same temperature
B	50 cm^3 of 0.5 mol / dm^3 hydrochloric acid at same temperature with a catalyst.	12.5 cm^3 of 4.0 mol / dm^3 hydrochloric acid at same temperature.
C	50 cm^3 of 1.0 mol / dm^3 hydrochloric acid at a lower temperature.	50 cm^3 of 1.0 mol / dm^3 hydrochloric acid at a higher temperature.
D	50 cm^3 of 0.5 mol / dm^3 hydrochloric acid at a higher temperature.	50 cm^3 of 1.0 mol / dm^3 sulfuric acid at same temperature.

29 Magnesium can be produced by electrolysis of molten magnesium chloride, $MgCl_2$.
What are the equations for the reactions that occur at the positive electrode and at the negative electrode?

	positive electrode	negative electrode
A	$2Cl^- \rightarrow Cl_2 + 2e^-$	$2H^+ + 2e^- \rightarrow H_2$
B	$Cl_2 + 2e^- \rightarrow 2Cl^-$	$Mg^{2+} + 2e^- \rightarrow Mg$
C	$2Cl^- \rightarrow Cl_2 + 2e^-$	$Mg^{2+} + 2e^- \rightarrow Mg$
D	$2Cl^- \rightarrow Cl_2 + 2e^-$	$Mg^{2+} + 2e^- \rightarrow 2Mg$

30 The diagram below shows the electrolysis of concentrated and dilute aqueous sodium chloride using inert electrodes. Gases are produced and collected in each of the test-tubes W, X, Y and Z.

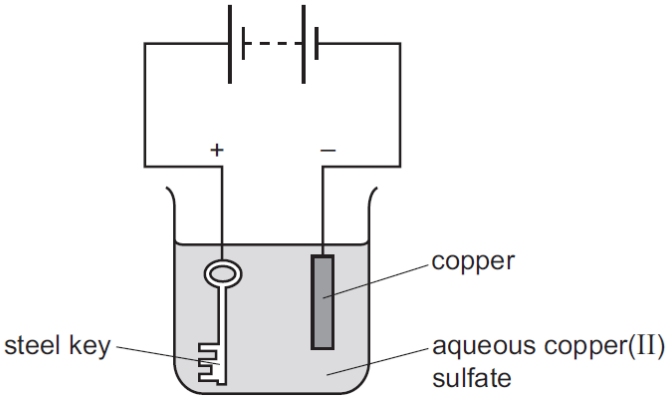


Which statements are **correct**?

1 Approximately equal volumes of gas are produced and collected in test-tubes W and X.
2 Approximately equal volumes of gas are produced and collected in test-tubes Y and Z.
3 Three different gases are produced in the experiment.

A 1, 2 and 3
B 1 and 2 only
C 2 and 3 only
D 1 and 3 only

31 The apparatus shown below is set up to plate a steel key with copper.



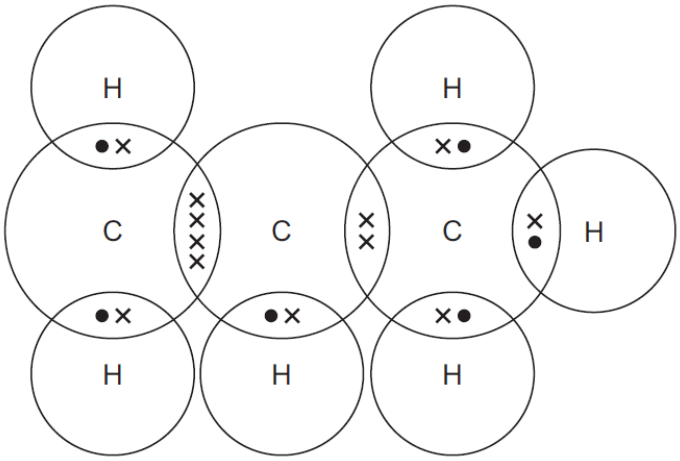
The key does not get coated with copper.
Which change needs to be made to plate the key?

A Increase the voltage.
B Reverse the electrical connections.
C Replace the solution with dilute sulfuric acid.
D Increase the concentration of the aqueous copper (II) sulfate.

32 A hydrocarbon, C_xH_y, undergoes an addition reaction with chlorine.
A second hydrocarbon, C_pH_q, undergoes a substitution reaction with chlorine.
If x = 4 and p = 6, what are the values of y and q?

	y	q
A	8	16
B	8	14
C	10	12
D	10	14

33 Compound X is shown in the dot-and-cross diagram below.



Which statement about compound X is **correct**?

A It is a saturated hydrocarbon.
B It is an isomer of butene.
C It will decolourise bromine water.
D Its chemical name is propane.

34 A solution of sodium hydroxide reacts with 3 mol of chlorine under certain conditions. The reaction produces 5 mol of sodium chloride and 1 mol of X, the only other chlorine-containing product.
What is the formula of compound X?

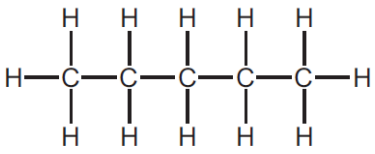
A NaC*l*O
B NaC*l*O_2
C NaC*l*O_3
D NaC*l*O_4

35 An ester is formed from a carboxylic acid and an alcohol.
How does the number of carbon, hydrogen and oxygen atoms in an ester differ from the total number of these atoms in the carboxylic acid and alcohol from which the ester is formed?

	carbon atoms	hydrogen atoms	oxygen atoms
A	fewer	fewer	fewer
B	fewer	same	fewer
C	same	fewer	fewer
D	same	same	same

36 The diagrams below show the structures of five hydrocarbons.

1



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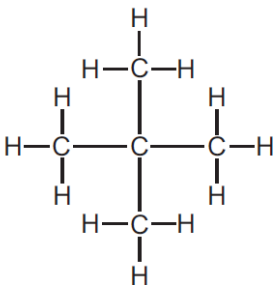

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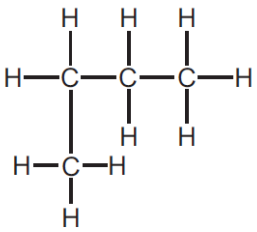

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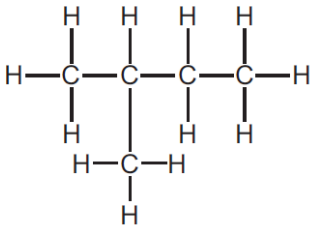

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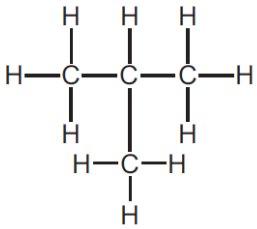


Which three hydrocarbons are isomers of each other?

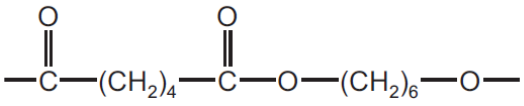
A 1, 2 and 4
B 2, 3 and 5
C 2, 3 and 4
D 3, 4 and 5

37 P is a polymer that:

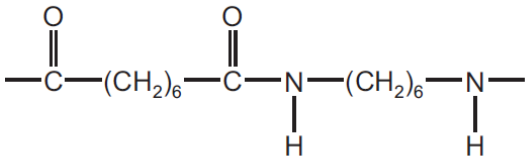
- has six carbon atoms in each of the monomers from which it is formed
- is **not** a polyester
- is formed using condensation polymerisation.

What is the partial structure of P?

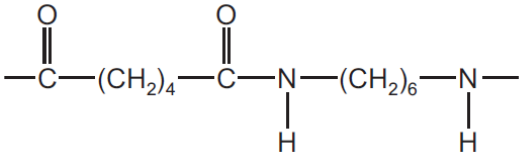
A



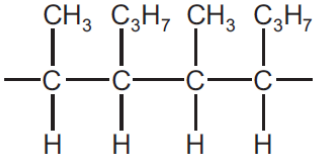
B



C

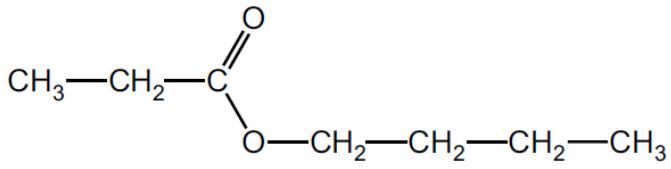


D

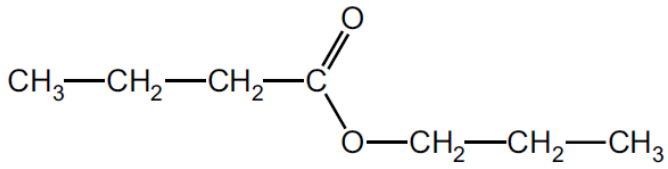


38 A carboxylic acid with molecular formula $C_4H_8O_2$ reacts with an alcohol with molecular formula
C_3H_8O to form an ester. What is the formula of the ester formed?

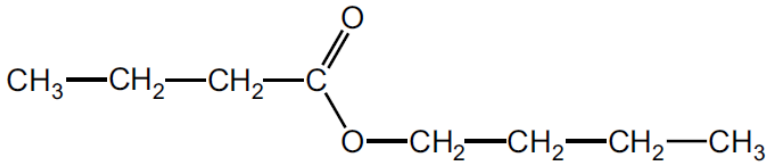
A



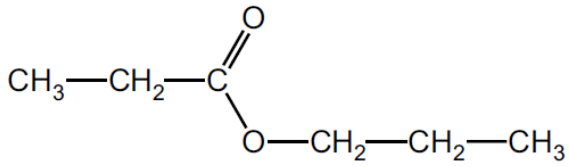
B



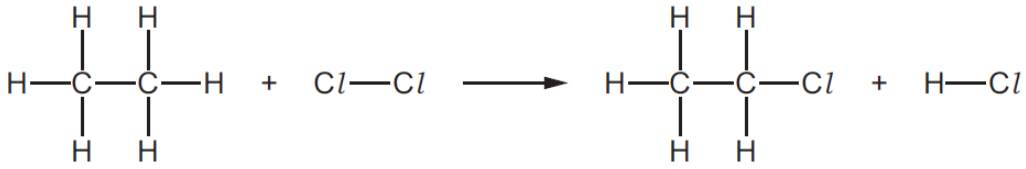
C



D



39 Chlorine reacts with ethane to produce chloroethane and hydrogen chloride.
The reaction is exothermic.



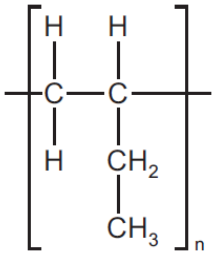
The bond energies are shown in the table.

bond	bond energy in kJ / mol
C–Cl	+340
C–C	+350
C–H	+410
Cl–Cl	+240
H–Cl	+430

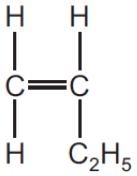
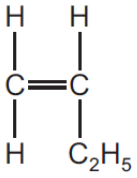
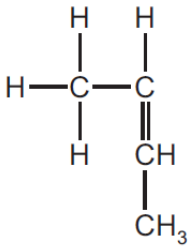
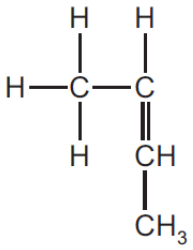
What is the energy change for the reaction?

A –1420 kJ / mol
B –120 kJ / mol
C +120 kJ / mol
D +1420 kJ / mol

40 The diagram below shows the repeat unit of a polymer.



Which row **correctly** identifies the monomer and type of polymerisation involved in making this polymer?

	monomer	type of polymerisation
A		addition
B		condensation
C		addition
D		condensation

End of Paper

Setter: Ms Kim

O

JURONG SECONDARY SCHOOL
2022 GRADUATION EXAMINATION 2
SECONDARY 4 EXPRESS

CANDIDATE NAME	

CLASS		INDEX NUMBER	

CHEMISTRY **6092/01**
PAPER 1 29 August 2022
1 hour

Additional Materials: Multiple Choice Answer Sheet.

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions.
For each question, there are four possible answers **A**, **B**, **C**, and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

A copy of the Periodic Table is to be found on page 19.
The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use	
TOTAL [40 marks]	

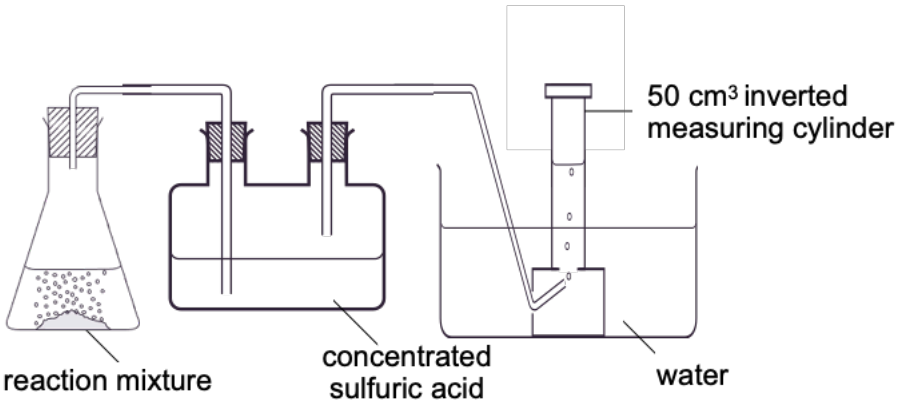
This document consists of 19 printed pages including this page.

[Turn over]

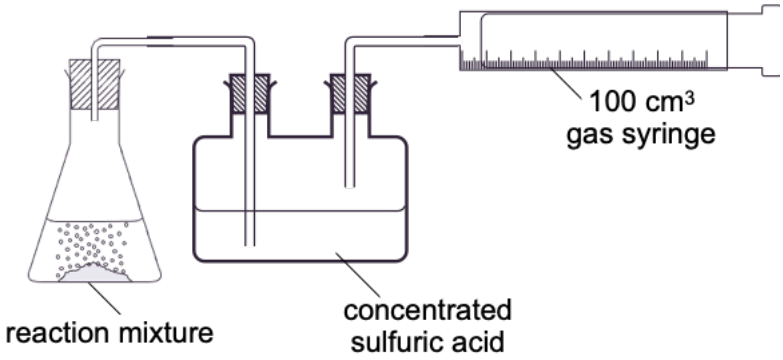
1 An experiment is designed to collect a dry sample of carbon dioxide produced when an excess dilute acid is added to 0.35 g of calcium carbonate.

Which apparatus set-up is most suitable for this experiment?

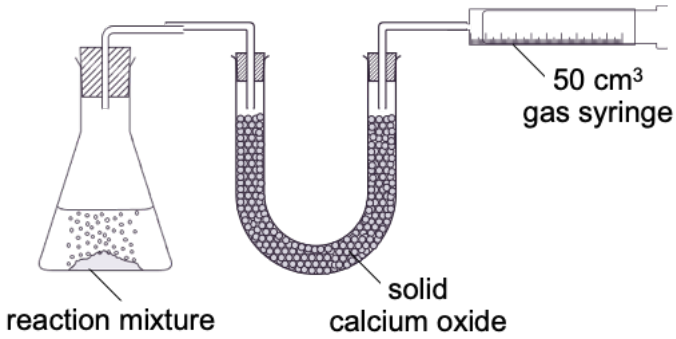
A



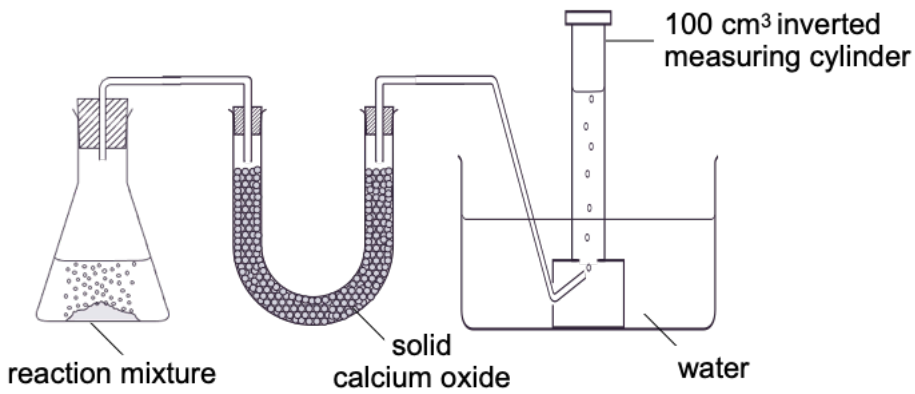
B



C



D



2 The melting and boiling points of some substances are given in the table.

Which substance may be condensed using a water-cooled condenser?

	substance	melting point / °C	boiling point / °C
A	ammonia	–78	–33
B	ethylamine	–81	16.6
C	methane	–182.5	–162
D	pentane	–130	36

3 The following shows some common cations.

1 Ca^{2+}

2 Cu^{2+}

3 Fe^{3+}

4 Pb^{2+}

Which cations will produce a precipitate when mixed with excess aqueous ammonia?

A 1 and 2 only

B 2 and 3 only

C 3 and 4 only

D all of the above

4 Which statement explains why carbon monoxide and ethene diffuse at the same rate?

A They are both gases at room temperature.

B They both contain the element carbon.

C They both react with oxygen.

D They have the same relative molecular mass.

5 Two naturally occurring isotopes of uranium can be represented as $^{235}_{92}U$ and $^{238}_{92}U$.

Which statement is true?

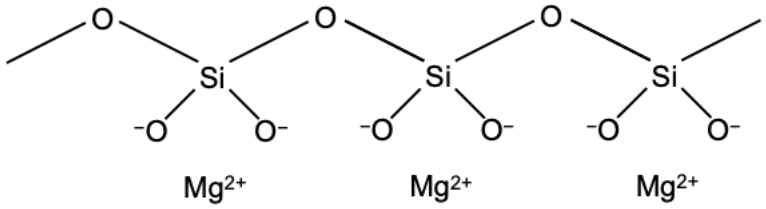
A $^{238}_{92}U$ has 92 electrons and 146 neutrons.

B $^{235}_{92}U$ has 92 protons and 144 neutrons.

C $^{235}_{92}U$ has the same number of neutrons as the $^{238}_{92}U$ atom.

D $^{235}_{92}U$ has fewer electrons than the $^{238}_{92}U$ atom.

6 The diagram below shows a simplified structure for asbestos.



What are the bonds present in asbestos?

A covalent and ionic bonds

B covalent and metallic bonds

C covalent bonds and intermolecular forces of attraction

D ionic bonds

7 The following shows some simple covalent compounds.

1 CO_2

2 CH_4

3 NH_3

Which contains valence electrons that are **not** used for bonding?

A 1 only

B 1 and 2

C 1 and 3

D 3 only

8 Which statements about metals are correct?

1 Metals form only basic oxides.
2 Metals conduct thermal energy.
3 Metals are lustrous and ductile.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

9 5.0 g of an oxide of bismuth contains 4.48 g of bismuth.

What is the molecular formula of this oxide?

A BiO
B Bi_2O_3
C Bi_3O_4
D Bi_4O_3

10 Which compound does **not** have the empirical formula CH_2O?

A ethanoic acid, CH_3CO_2H
B ethanol, CH_3CH_2OH
C glucose, $C_6H_{12}O_6$
D methyl methanoate, HCO_2CH_3

11 Hydrogen reacts with oxygen to form steam according to the equation below.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$$

Which statement is correct?

A 1 mol of steam is formed if 1 mol of oxygen reacts completely in excess hydrogen.
B 4 g of hydrogen completely reacts with 16 g of oxygen.
C 16 g of oxygen would produce 18 g of steam.
D 36 g of steam is formed if 2 g of hydrogen reacts completely in excess oxygen.

12 The formula of a metal carbonate is M_2CO_3. 0.69 g of the carbonate requires 50 cm^3 of 0.20 mol/dm^3 hydrochloric acid for complete reaction.

The equation for the reaction is shown.

$$M_2CO_3 + 2HCl \rightarrow 2MCl + CO_2 + H_2O$$

What is the relative atomic mass of metal M?

A 19

B 23

C 39

D 78

13 The list shows the electrolytes in three electrolytic cells with inert electrodes.

1 aqueous sodium chloride solution

2 concentrated sodium chloride solution

3 concentrated hydrochloric acid

4 dilute hydrochloric acid

In which cells will chlorine gas be **first** produced?

A 1 and 3

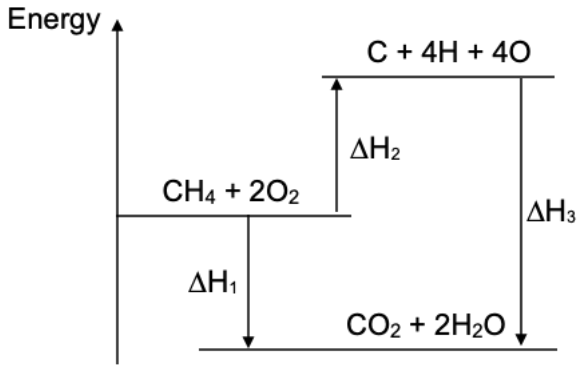
B 1 and 4

C 2 and 3

D 2 and 4

14 Methane burns in oxygen to form carbon dioxide and water.

The following energy level diagram represents this reaction.



Which row correctly identifies the energy involved in respective bond breaking and bond forming processes?

	energy involved in bond breaking only	energy involved in bond forming only
A	ΔH_1	ΔH_2
B	ΔH_1 and ΔH_3	ΔH_2
C	ΔH_2	ΔH_1 and ΔH_3
D	ΔH_2	ΔH_3

15 Zinc reacts with dilute hydrochloric acid at a constant temperature of 25 °C.

Which statement about the rate of this reaction is correct?

A It decreases and the reaction stops within 2 seconds.

B It decreases then increases as the reaction proceeds.

C It increases at the start then decreases as the reaction proceeds.

D It remains the same as the reaction proceeds.

16 Ilmenite is a mineral containing iron(II) titanate, $FeTiO_3$. It is the main source of titanium dioxide which is used mainly in paints, sunscreens and cosmetics.

The equation shows the reaction to obtain titanium dioxide from ilmenite.

$$FeTiO_3 + 2H^+ \rightarrow Fe^{2+} + TiO_2 + H_2O$$

Which statement about this reaction is correct?

A Ilmenite is the reducing agent in this reaction because it has been reduced.

B The acid used in the reaction has been oxidised because it gained oxygen.

C This is not a redox reaction.

D Titanium in ilmenite has been reduced because it has gained electrons.

17 Aluminium, magnesium and sulfur are elements from Period 3 of the Periodic Table.

Which row shows the nature of the oxides formed by these three elements?

	aluminium	magnesium	sulfur
A	amphoteric	basic	neutral
B	amphoteric	basic	acidic
C	basic	amphoteric	acidic
D	basic	amphoteric	neutral

18 When compound X is added to ammonium nitrate solution, a gas with a pungent smell is produced. The gas turns damp red litmus paper blue.

What could compound X be?

A potassium oxide

B magnesium carbonate

C sodium nitrate

D zinc sulfate

19 The table shows the solubility of some mercury(I) salts.

salt	solubility in water
HgC*l*	very slightly soluble in water
Hg_2CO_3, Hg_2SO_4	insoluble
$HgNO_3$	soluble

Which is most suitable in making a sample of mercury(I) chloride?

A Add dilute hydrochloric acid to aqueous mercury(I) nitrate and filter.

B Add excess mercury(I) carbonate to cold dilute hydrochloric acid and filter.

C Heat mercury(I) sulfate with dilute hydrochloric acid, cool and filter.

D Heat liquid mercury with dilute hydrochloric acid, cool and filter.

20 The decomposition of sulfur trioxide to sulfur dioxide is a reversible reaction.

$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$$

This reaction is endothermic in the forward direction and the heat absorbed is 196 kJ/mol.
The activation energy for the forward reaction is 271 kJ/mol.

What is the activation energy of the **reverse** reaction?

A 75 kJ/mol

B 121 kJ/mol

C 196 kJ/mol

D 271 kJ/mol

21 Element Y is in the second period of the Periodic Table.
An atom of element Z has six more protons than an atom of element Y.

Which statement must be correct?

A Elements Y and Z are in the same period.

B Elements Y and Z have the same number of electrons in the first shell.

C Element Z has six more electrons in its outer shell than element Y.

D The nucleon number of element Z is six more than that of element Y.

22 Which statement about noble gases is **not** correct?

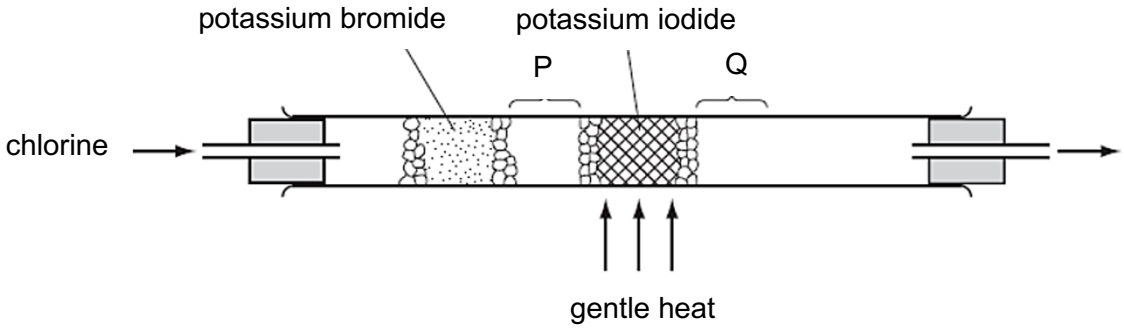
A They all have eight valence electrons.

B They are all gases at room temperature and pressure.

C They are electrically neutral.

D They are monatomic.

23 Chlorine gas was passed through a tube as shown. After a short time, coloured substances were seen at P and Q.

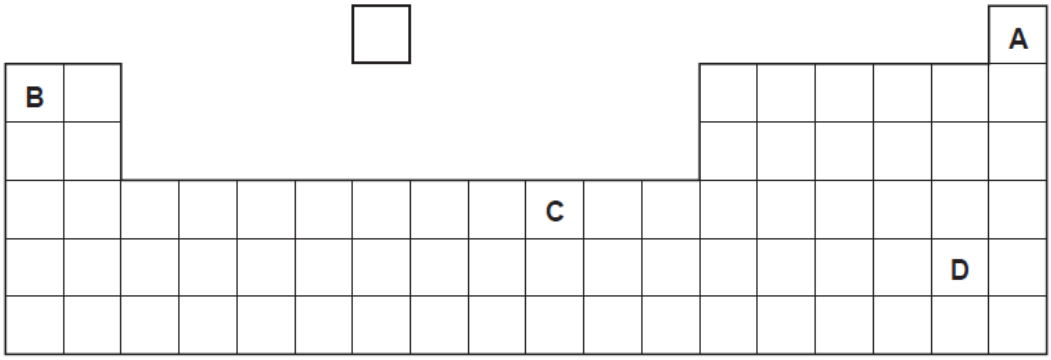


What are the observations at P and Q?

	at P	at Q
A	yellow-green gas	violet vapour
B	red-brown vapour	red-brown vapour
C	red-brown vapour	violet vapour
D	violet vapour	red-brown vapour

24 Element Z ignites spontaneously in air to form two oxides with formula ZO and Z_2O_3.

Where is this element most likely found in the Periodic Table?



25 Bronze is a copper-based alloy that is typically harder than its constituent elements of copper and tin. Trace amounts of other metals may also be present in the alloy.

Which difference between the elements explains the hardness?

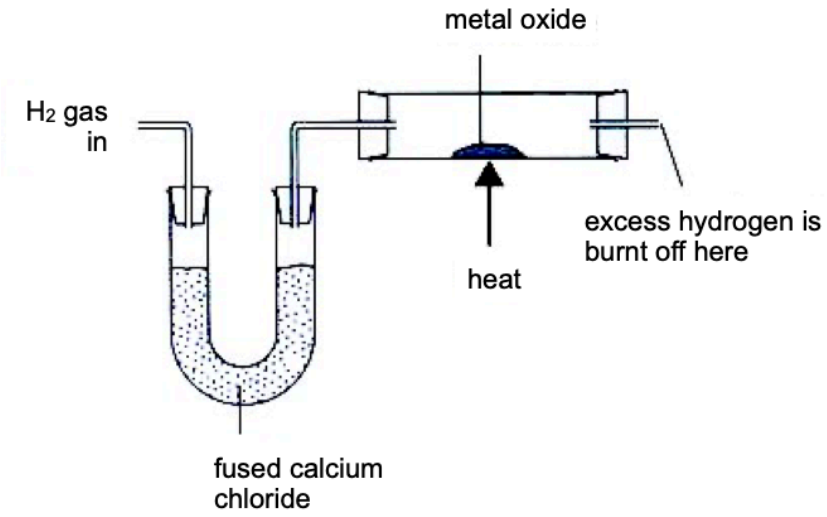
A atomic size

B density

C proton number

D relative atomic mass

26 A yellow coloured metal oxide was placed into a glass tube and heated strongly while hydrogen gas was passed over it.



The metal oxide dissolved partially when excess dilute sulfuric acid was added to it.

What is the identity of the metal oxide?

A copper(II) oxide

B lead(II) oxide

C potassium oxide

D iron(II) oxide

27 The table below shows the temperature at which thermal decomposition occurs for some metal carbonates.

metal carbonate	temperature / °C
copper(II) carbonate	220
iron(II) carbonate	?
magnesium carbonate	402
zinc carbonate	300

What is the temperature at which iron(II) carbonate undergoes thermal decomposition?

A 200

B 280

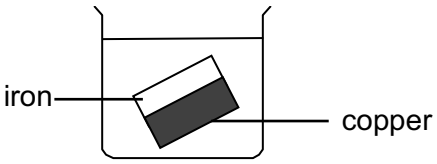
C 320

D 480

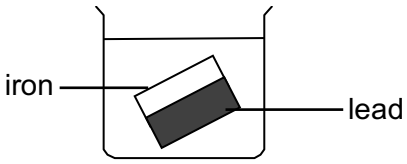
28 Each beaker contains two strips of metals fastened together and immersed in hydrochloric acid. All the strips are of the same size.

After 5 minutes, which beaker contains the **least** amount of iron ions?

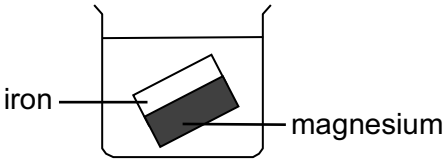
A



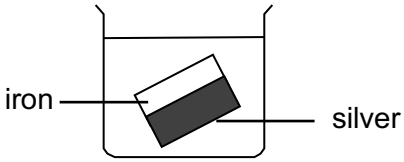
B



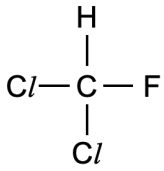
C



D



29 Freon-12 is a chlorofluorocarbon. The full structural formula of Freon-12 is shown.



Which statement about Freon-12 is correct?

A It is a very reactive compound.

B It reacts with water to form acid rain.

C Its fluorine atom is responsible for global warming.

D Its chlorine atom is responsible for the depletion of the ozone layer.

30 Which statements about air pollutants are correct?

1 Carbon monoxide is responsible for the production of acid rain.

2 Oxides of nitrogen are produced in car exhausts.

3 Sulfur dioxide can be produced by the combustion of coal.

4 Methane is produced from the incomplete combustion of fossil fuels.

A 1 and 2 only

B 2 and 3 only

C 2, 3 and 4 only

D all of the above

31 An excess of iron(II) chloride is added to acidified potassium manganate(VII).

Which statements are correct for this reaction?

1 iron(II) is reduced to iron(III)

2 manganate(VII) ions are oxidised to manganese(II) ions

3 potassium manganate(VII) is an oxidising agent

4 the purple colour disappears

A 1 and 2

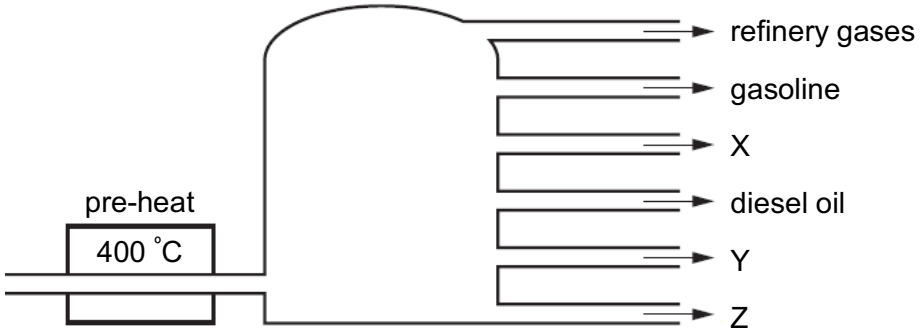
B 1 and 4

C 2 and 3

D 3 and 4

32 In an oil refinery, petroleum is separated into useful fractions.

The diagram shows some of these fractions.

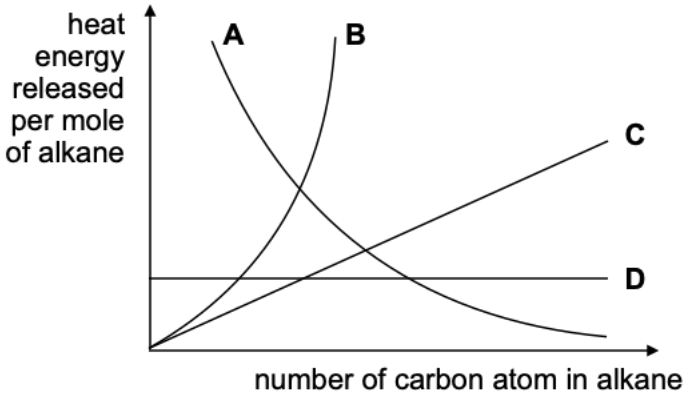


What are fractions X, Y and Z?

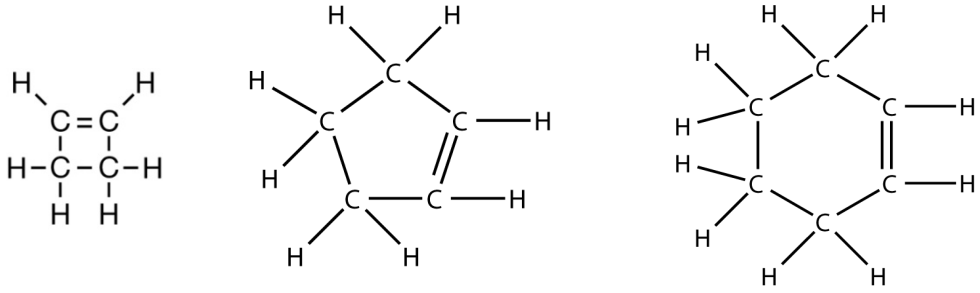
	X	Y	Z
A	lubricating oil	bitumen	paraffin
B	lubricating oil	paraffin	bitumen
C	paraffin	bitumen	lubricating oil
D	paraffin	lubricating oil	bitumen

33 The complete combustion of alkanes to produce carbon dioxide and water is an important exothermic reaction.

Which graph shows the relationship between the heat energy released per mole of alkane and the number of carbon atoms in the alkane?



34 Three members of the cycloalkene homologous series are:



The general formula for this homologous series is

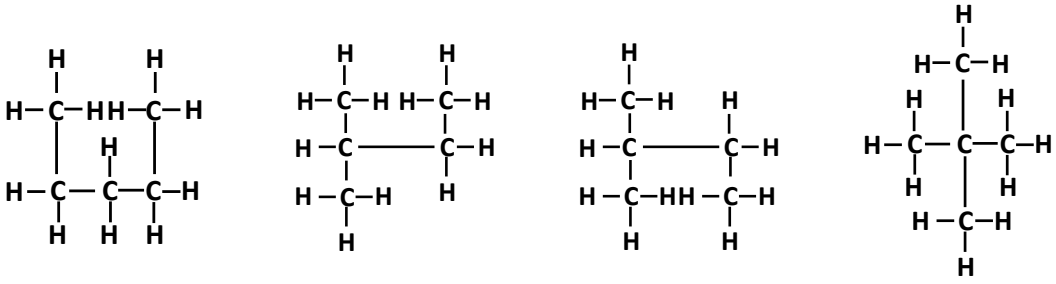
A C_nH_{2n-2}

B C_nH_{2n-1}

C C_nH_{2n}

D C_nH_{2n+2}

35 Four structural formulae are shown below.



1 2 3 4

Which structural formulae represents the same compound?

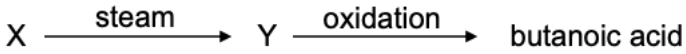
A 1 and 4 only

B 1, 2 and 4 only

C 2 and 3 only

D 2 and 4 only

36 Butanoic acid is produced via a two-step process as shown.



Which statements are correct for this process?

1 X is a saturated hydrocarbon.

2 Phosphoric(V) acid is used as a catalyst in synthesising Y from X.

3 The formula for Y is C_4H_9OH.

A 1 only

B 1 and 2

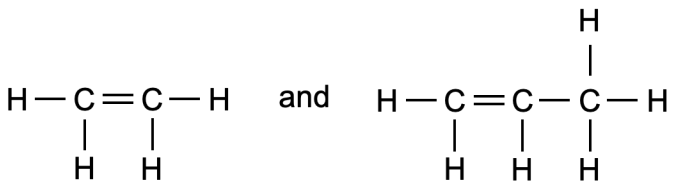
C 2 only

D 2 and 3

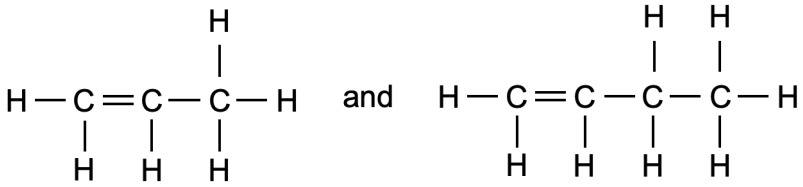
37 Addition of hydrogen to alkenes produces alkanes.

Which pair of alkenes will give the same product on addition of hydrogen?

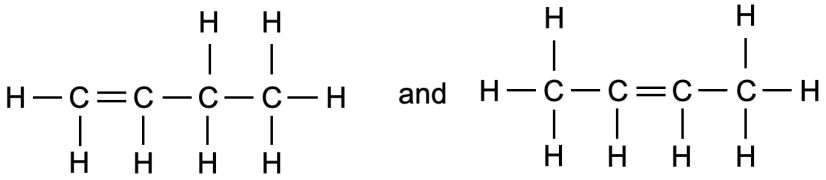
A



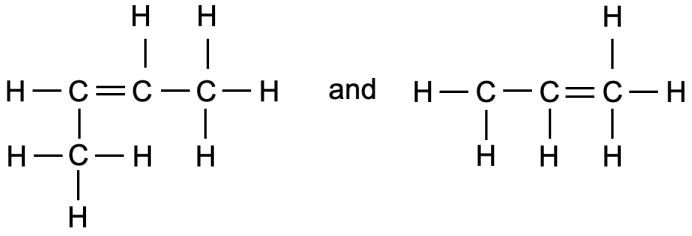
B



C



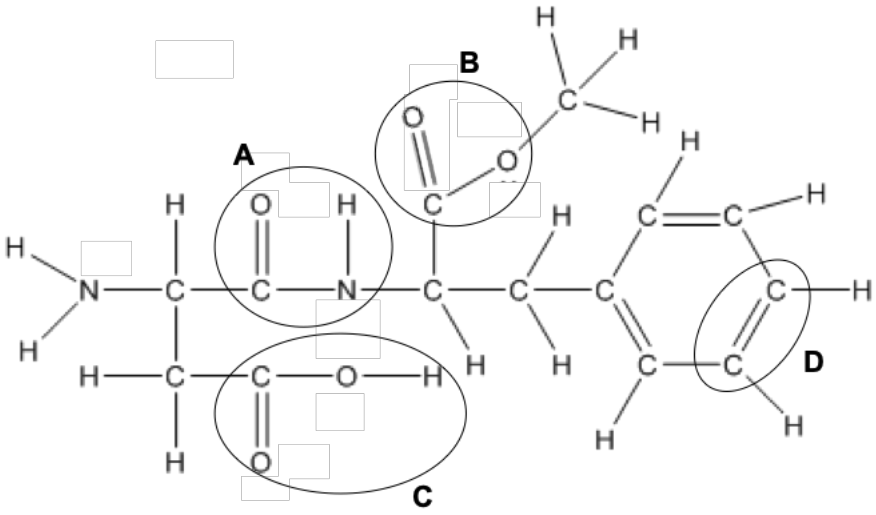
D



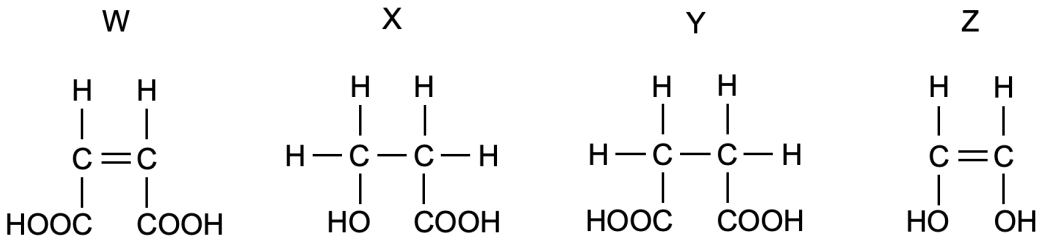
38 Aspartame is a widely used artificial sweetener and a popular sugar substitute in low-calorie food and drinks, including diet sodas.

The structural formula of aspartame is shown.

Which part of the structure shows the functional group that accounts for its sweet smell?



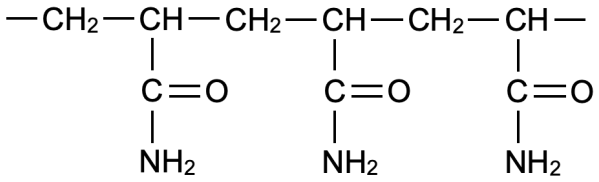
39 Four organic compounds, W, X, Y and Z are shown below.



What are the reactions of compounds W, X, Y and Z?

	decolourise aqueous bromine	reacts with carboxylic acid	has pH less than 7
A	X and Y	W, X and Y	W, X, Y and Z
B	X and Y	X and Z	X and Z
C	W and Z	W, X and Y	X and Z
D	W and Z	X and Z	W, X and Y

40 Polyacrylamide is used to manufacture soft contact lenses. Part of the polymer is shown below.



1 It contains amide linkages.

2 The molecular formula of its monomer is C_3H_5NO.

3 It is an addition polymer.

Which statements about polyacrylamide are correct?

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

END OF PAPER

THE PERIODIC TABLE OF ELEMENTS

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium 209	85 At astatine 210	86 Rn radon 222
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) numbers
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 162	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinum –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

O

JURONGVILLE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
Secondary 4 Express

STUDENT NAME			
CLASS		INDEX NUMBER	

CHEMISTRY

6092/01

Paper 1 Multiple Choice

26 August 2022

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number in the spaces on all the work you hand in.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the Multiple Choice Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 15.
The use of an approved scientific calculator is expected, where appropriate.

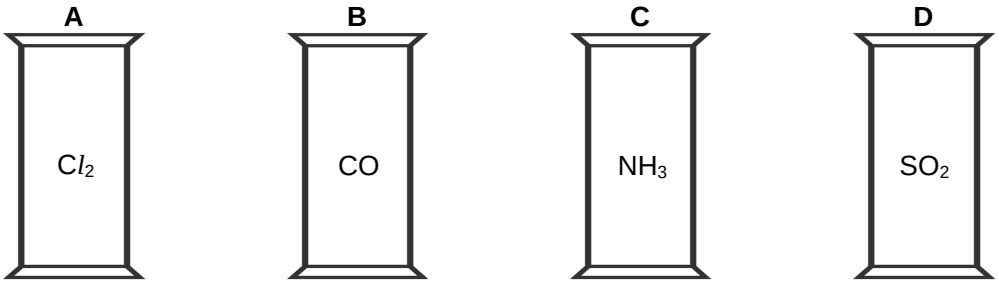
DO NOT OPEN THE BOOKLET UNTIL YOU ARE TOLD TO DO SO

Setter: Mrs Wong Yan Pure

1 Four identical gas jars are filled with different gases.

The lids are taken off the gas jars and they are left open to the air for a few hours.

Which gas jar will first contain the most air in it?



2 A pale green solution X gives a green precipitate with excess aqueous sodium hydroxide.

An alkaline gas is only given off when the mixture is warmed with powdered aluminium.

Which ions does X contain?

A ammonium and copper(II) ions

B ammonium and iron(II) ions

C copper(II) and nitrate ions

D iron(II) and nitrate ions

3 Which apparatus **cannot** be used to measure the rate of neutralisation between solid sodium carbonate and aqueous hydrochloric acid?

A electronic balance

B gas syringe

C stopwatch

D thermometer

4 An analysis is carried out on a plant extract containing some coloured pigments.

In Fig. 4.1, a small amount of plant extract is dotted on a chromatography paper and separated using solvent A.

After drying the chromatography paper, the chromatography paper is subjected to another separation using solvent B, as shown in Fig. 4.2.

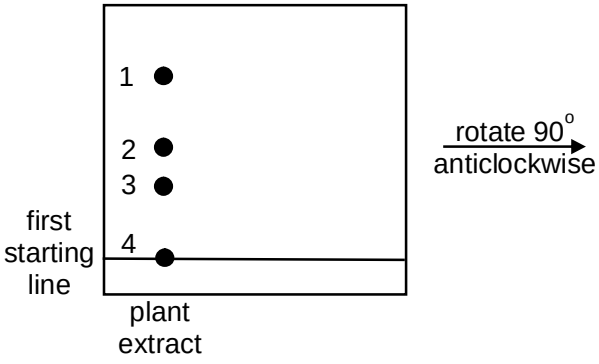


Fig. 4.1

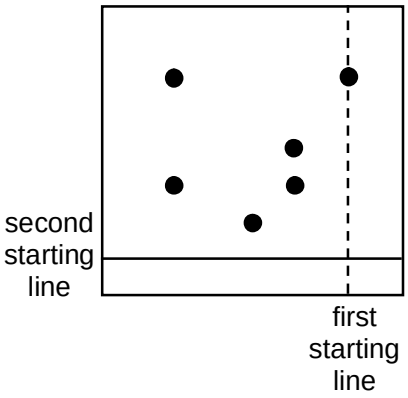


Fig. 4.2

Which statement is **not** true?

A Pigment 2 is less soluble in solvent A than in solvent B.

B Pigment 4 is most likely a pure substance.

C Pigments 1 and 3 have a same substance.

D The components in pigment 1 have different solubilities in solvent B.

5 An ion X^+ contains 23 nucleons and 10 electrons.

What does the nucleus of the ion X^+ contain?

	protons	neutrons
A	9	14
B	10	13
C	11	11
D	11	12

6 A covalent compound has the following structural formula.

$$X - Y \equiv Z$$

Which row shows the possible electronic structures of the atoms X, Y and Z?

	X	Y	Z
A	1	2,2	2,5
B	1	2,4	2,3
C	2,8,7	2,2	2,3
D	2,8,7	2,4	2,5

7 Peeling onions often cause tearing of the eyes due to the release of a sulfide compound.

Peeling them under running water reduces the problem.

Which statements are true of the sulfide compound?

1 It has a low boiling point.

2 It has small and light ions with weak bonding.

3 It is a covalent compound with weak covalent bonds.

4 It is soluble in water.

A 1 and 2 only **B** 1 and 4 only

C 2 and 3 only **D** 3 and 4 only

8 The strongest ionic crystal lattices are generally observed to consist of highly charged ions combined in a 1 : 1 ratio.

Which two elements are likely to form crystals with the highest melting point?

A aluminium and oxygen **B** calcium and fluorine

C lithium and fluorine **D** magnesium and oxygen

9 Sulfur vapour with a mass of 128 g has the same volume as 16 g of oxygen at the same temperature and pressure.

What is the formula of a molecule of sulfur vapour?

A S_2 **B** S_4

C S_6 **D** S_8

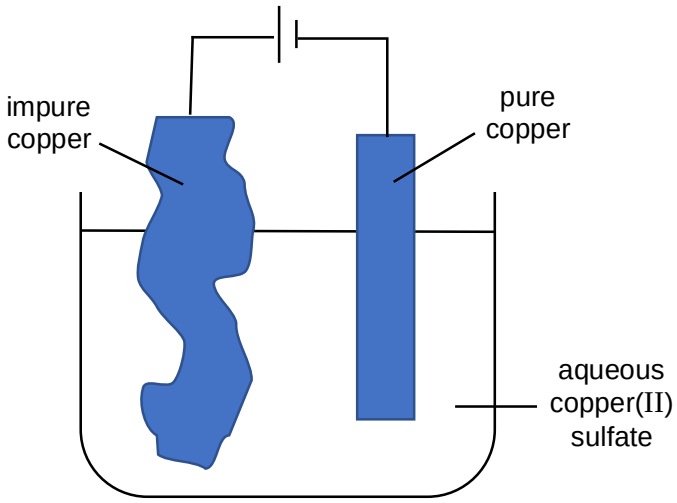
10 75 cm^3 of 0.200 mol / dm^3 of sodium hydroxide is added to 25 cm^3 of 0.200 mol / dm^3 sulfuric acid.

What is the concentration of the excess sodium hydroxide in the resultant solution?

A 0.005 mol / dm^3 **B** 0.010 mol / dm^3

C 0.030 mol / dm^3 **D** 0.050 mol / dm^3

11 A student carried out an electrolytic purification of copper as shown.



The table shows the information about this electrolytic purification.

mass of	before electrolytic purification / g	after electrolytic purification / g
anode	100	10
cathode	10	80

What was the percentage impurity of the impure copper anode?

A 10.0 % **B** 20.0 %

C 30.0 % **D** 90.0 %

12 When gold plating an orchid, a coating containing fine metal or carbon particles is first painted onto the orchid.

Why is this coating applied?

A It allows the gold to form a tough alloy on the orchid's surface.

B It gives the orchid a conductive surface so that it can act as the anode.

C It gives the orchid a conductive surface so that it can act as the cathode.

D It gives the orchid a sticky surface so that the gold plating will not fall off.

13 Which observation will be made when dilute sulfuric acid is electrolysed using graphite electrodes?

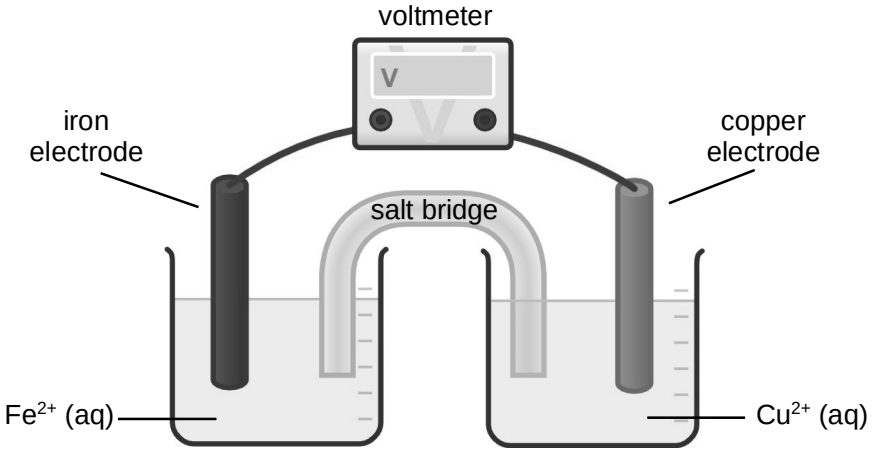
A No gas is evolved at both the cathode and anode.

B The gas evolved at the anode extinguishes a lighted splint with a 'pop' sound.

C The gas evolved at the cathode is less dense than air.

D The gas evolved at the cathode relights a glowing splint.

14 The figure shows the set-up of a simple cell involving iron and copper electrodes immersed in their respective electrolytes.



Which statement is **not** true for the experiment?

A The colour intensity of copper(II) solution decreases over time.

B The electrons flow from left to right through the salt bridge.

C There is a decrease in the mass of iron electrode.

D There is an increase in the mass of copper electrode.

15 The table shows the energy released by the complete combustion of some compounds used as fuels.

compound	formula	M_r	ΔH / kJ / mol
methane	CH_4	16	–880
ethanol	C_2H_5OH	46	–1380
propane	C_3H_8	44	–220
heptane	C_7H_{16}	100	–4800

Which fuel produces the most energy when 1 g of the compound is completely burnt?

A methane **B** ethanol

C propane **D** heptane

16 The equations for three reactions are given.

reaction 1 $H_2 \rightarrow 2H$

reaction 2 $2H + O \rightarrow H_2O$

reaction 3 $HCl \rightarrow H + Cl$

Which of these reactions are endothermic?

A reaction 1 only

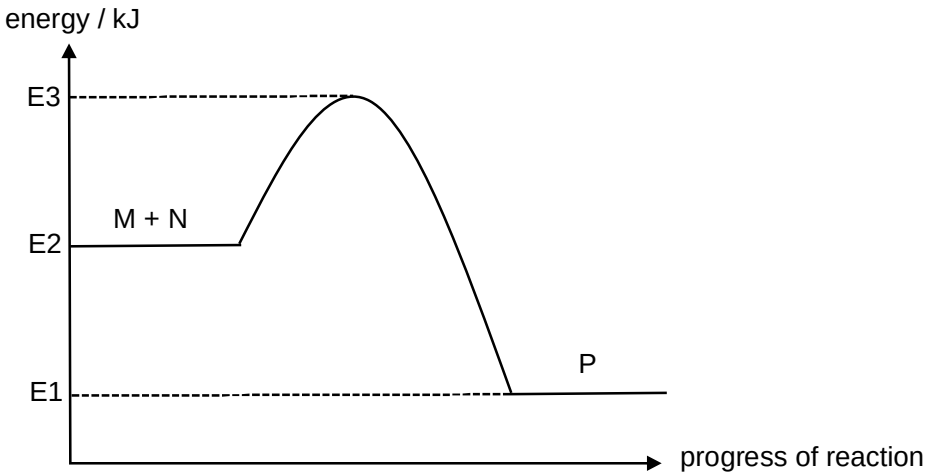
B reactions 1 and 2 only

C reactions 1 and 3 only

D reactions 2 and 3 only

17 The energy profile diagram for the following reaction is shown.

$M + N \rightleftharpoons P \qquad \Delta H = -108 \text{ kJ / mol}$



Which equation represents the activation energy of the forward reaction?

A E1 + E2

B E2 – E1

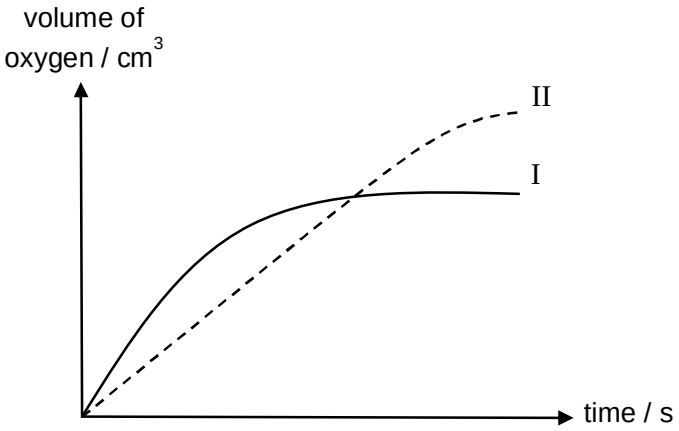
C E3 – E1

D E3 – E2

[Turn over

18 Curve I is obtained by the decomposition of 50 cm^3 of 1 mol / dm^3 aqueous hydrogen peroxide, catalysed by manganese(IV) oxide.

$$2H_2O_2(aq) \rightarrow O_2(g) + 2H_2O(l)$$



Which change will produce curve II?

A adding 60 cm^3 of 1 mol / dm^3 aqueous hydrogen peroxide

B adding 100 cm^3 of 0.1 mol / dm^3 aqueous hydrogen peroxide

C lowering the temperature

D using 75 cm^3 of 0.5 mol / dm^3 aqueous hydrogen peroxide instead

19 Which observation is that of a redox reaction?

A Aqueous potassium iodide turns brown when chlorine gas is bubbled into it.

B Blue precipitate is formed when aqueous ammonia is added to copper(II) nitrate solution.

C Bubbles of gas are observed when an acid reacted with solid magnesium carbonate.

D Solution turned blue when copper(II) sulfate crystals are added to hydrochloric acid.

20 When acidified aqueous hydrogen peroxide is added to aqueous potassium manganate(VII), the reaction takes place:

$$2MnO_4^-(aq) + 5H_2O_2(aq) + 6H^+(aq) \rightarrow 2Mn^{2+}(aq) + 5O_2(g) + 8H_2O(l)$$

Which statement about the reaction is correct?

A Hydrogen peroxide acts as an oxidising agent.

B The oxidation number of manganese changes from +7 to +2.

C The potassium manganate(VII) is oxidised.

D The potassium manganate(VII) solution turns green.

21 Which salt can only be prepared by titration method?

A aluminium sulfate **B** ammonium sulfate

C copper(II) sulfate **D** iron(II) sulfate

22 Freshly distilled water has a pH of 7.0.

After it was left standing for a short time, the pH was observed to have dropped below 7.0.

Which of the equations best explains the phenomenon?

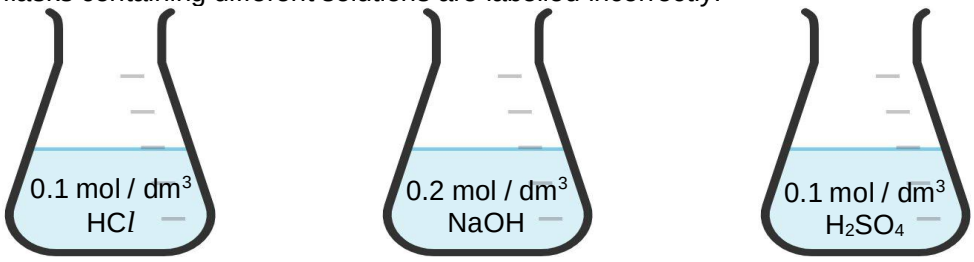
A $HCl(aq) \rightleftharpoons H^+(aq) + Cl^-(aq)$

B $H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq)$

C $H_2O(l) + CO_2(g) \rightleftharpoons 2H^+(aq) + CO_3^{2-}(aq)$

D $H_2O(l) + NH_3(g) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

23 Three flasks containing different solutions are labelled incorrectly.



In order to identify the solutions, a student mixes two of the solutions at one time and recording the change in temperature.

Which row shows an **incorrect** explanation to the student's observation?

	observation	explanation
A	There is no change in temperature when two solutions are mixed.	The solutions could be hydrochloric acid and sodium hydroxide respectively.
B	There is no change in temperature when two solutions are mixed.	The solutions could be hydrochloric acid and sulfuric acid respectively.
C	There is temperature rise when two solutions are mixed.	The solutions could be hydrochloric acid and sodium hydroxide respectively.
D	There is temperature rise when two solutions are mixed.	The solutions could be sulfuric acid and sodium hydroxide respectively.

24 Germanium, Ge, is in the same group of the Periodic Table as carbon.

Which formula would **not** belong to a compound of germanium?

A $NaGeO_3$ **B** Na_4Ge

C GeH_4 **D** GeO_2

25 Which statement is **false** about the Periodic Table?

A Group VII elements are coloured.

B The atomic radii of elements increases down the group.

C The density of alkali metals decreases down the group.

D The metallic nature of the elements increases down the group.

26 Which element is most likely to be a transition metal?

	density / g / cm^3	melting point / ^oC	number of chlorides
A	0.07	–259	1
B	3.10	–7	2
C	2.07	113	1
D	8.92	1083	2

27 Metal P can reduce steam to hydrogen, but metal Q cannot reduce steam.

Based on this information, which action will cause a reaction to occur?

A heating a mixture of metal Q and oxide of metal P

B heating carbonate of Q strongly

C passing hydrogen over the heated oxide of metal P

D passing steam over the heated oxide of metal P

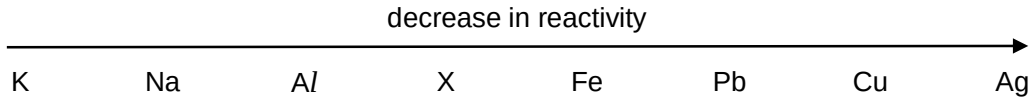
28 Alloys are usually harder than the metals that they are made of.

Which difference would explain the hardness of alloys?

A atomic sizes **B** densities

C electrical conductivities **D** relative atomic masses

29 The position of metal X in the reactivity series is shown.



What method **cannot** be used to extract X from its ore?

A electrolysis of its aqueous sulfate

B electrolysis of its molten oxide

C reduction of its oxide by heating with coke

D reduction of its sulfide by heating with coke

30 The metal chromium liberates hydrogen from dilute hydrochloric acid, but does not react with cold water.

When a piece of chromium is placed in lead(II) nitrate solution, grey solid is formed.

Which row shows the reactivity of calcium, chromium, lead and platinum in decreasing order?

A calcium, chromium, lead, platinum

B calcium, lead, chromium, platinum

C chromium, calcium, lead, platinum

D platinum, lead, chromium, calcium

31 Why is a tin-plated iron sheet less resistant to rusting than a galvanised iron sheet?

A Iron is less reactive than zinc but more reactive than tin.

B Tin does not adhere to iron as well as zinc.

C Zinc forms a layer that protects the iron surface but tin does not.

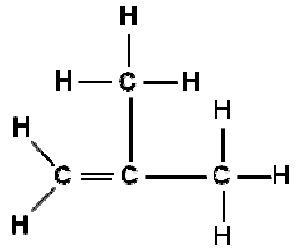
D Zinc is more scratch-resistant as compared to tin.

32 Which gas can be removed from the exhaust gases of a petrol-powered car by its catalytic convertor?

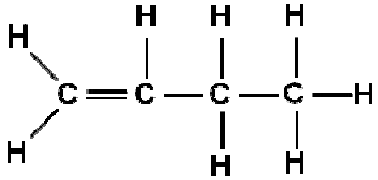
A carbon dioxide **B** carbon monoxide

C nitrogen **D** steam

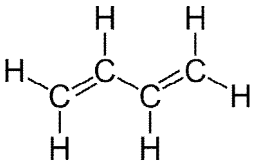
33 Structures of three hydrocarbons are shown.



hydrocarbon 1



hydrocarbon 2



hydrocarbon 3

Which statements about these hydrocarbons are correct?

1 On complete combustion of one mole of each hydrocarbon, they give the same volume of carbon dioxide.

2 They all form addition compounds with bromine.

3 They are all isomers of the same hydrocarbon.

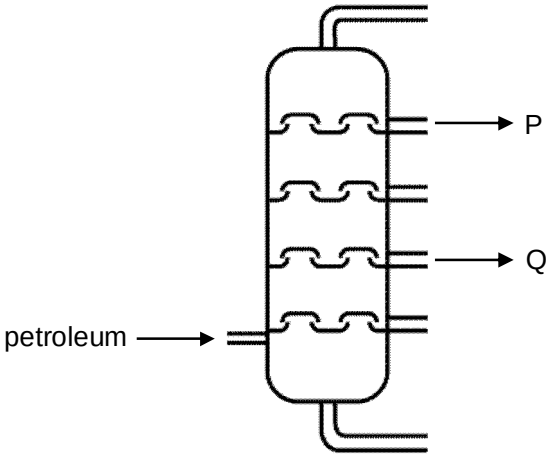
A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

34 The diagram shows the separation of crude oil into fractions.



Which statement about fractions P and Q is correct?

A P and Q are mainly alkenes.

B P and Q boil at a fixed temperature.

C P can be cracked to meet the higher demands of Q.

D P has a lower boiling point and a higher flammability than Q.

35 A food chemist wants to create the odour of pineapples in a product.

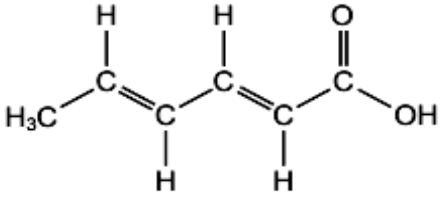
An ester with this odour has the formula $C_3H_7COOC_2H_5$.

Which pair of reactants would produce this ester?

A CH_3COOH and C_3H_7OH **B** C_2H_5COOH and C_2H_5OH

C C_2H_5COOH and C_3H_7OH **D** C_3H_7COOH and C_2H_5OH

36 Sorbic acid is used as a food preservative as it kills fungi and moulds that would possibly grow on food.



Sorbic acid will react with

- bromine in an organic solvent.
- Hydrogen at 200 °C in the presence of nickel catalyst.

How many moles of bromine and hydrogen will be incorporated into one mole of sorbic acid in these reactions?

	moles of bromine	moles of hydrogen
A	2	2
B	2	3
C	2.5	2
D	2.5	3

37 Which property does **not** change when ethene is polymerised to form poly(ethene)?

A boiling point **B** melting point

C molecular formula **D** percentage composition of carbon

38 Propene reacts with steam at 300 ^{o}C in the presence of phosphoric acid as a catalyst to produce a colourless liquid P.

On warming, liquid P with acidified potassium manganate(VII) solution, a colourless liquid Q is produced.

Identify liquids P and Q.

	P	Q
A	propane	butanol
B	propanol	butanoic acid
C	propanol	propanoic acid
D	propyl ethanoate	water

39 Polyunsaturated fats are considered healthy fats as they may reduce your risk of heart disease, especially when substituted for saturated fats.

An example of a polyunsaturated fat is C_6H_9COOH.

How many double covalent bonds are present in one molecule of the acid?

A 1 **B** 2

C 3 **D** 4

40 In which reaction is water produced?

A manufacture of ethanol from ethene

B manufacture of margarine from vegetable oils

C manufacture of poly(ethene) from ethene

D manufacture of Terylene from an alcohol and a carboxylic acid

End of Paper

THE PERIODIC TABLE OF ELEMENTS

Group																	
I	II											III	IV	V	VI	VII	0
							1 **H** hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) numbers atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 A*l* aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 C*l* chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 T*l* thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium 209	85 At astatine 210	86 Rn radon 222
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 F*l* flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 162	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinum –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

LOYANG VIEW SECONDARY SCHOOL

Preliminary Examination 2022
Secondary Four Express

CANDIDATE NAME : .....

CLASS : ..... **INDEX NUMBER** : .....

CHEMISTRY 6092/01

Paper 1 Multiple Choice **12 September 2022**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are forty questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 17.
The use of an approved scientific calculator is expected, where appropriate.

Setter: Ms Imma Wong

This paper consists of **17** printed pages.

1 Which group of substances consists of mixtures only?

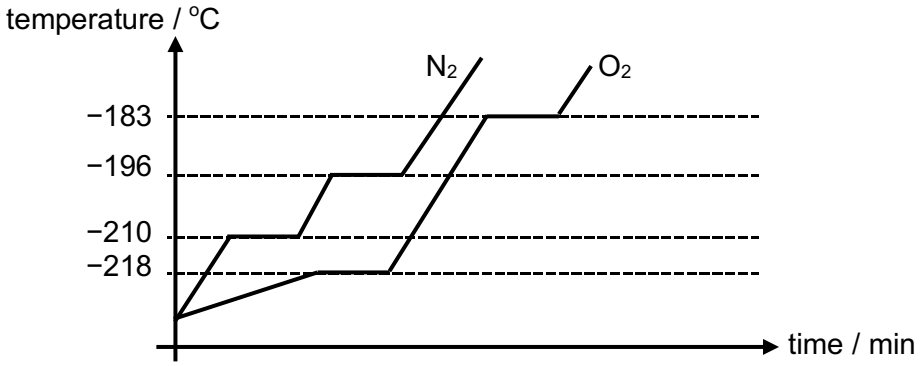
A air, petroleum and steel

B nylon, glucose and ethanol

C limestone, seawater and ozone

D haematite, brass and sodium chloride

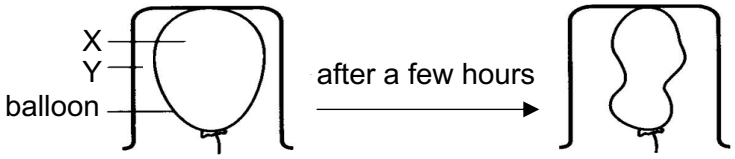
2 The graph (not drawn to scale) shows how the temperature of oxygen and nitrogen changes when they are heated.



At which temperature will there be two different states of matter in a mixture of oxygen and nitrogen under similar conditions?

A −180 °C **B** −200 °C **C** −215 °C **D** −220 °C

3 A balloon filled with gas X is placed inside a beaker that is filled with gas Y as shown. The balloon shrinks in size after a few hours.



Which could be the identities of gases X and Y?

	X	Y
A	nitrogen	ammonia
B	ammonia	argon
C	argon	oxygen
D	oxygen	nitrogen

4 An element J has a nucleon number of 45. The ion, J^{3+}, contains 18 electrons.

How many neutrons are there in an atom of J?

A 18 **B** 21 **C** 24 **D** 45

5 Which statement describes the arrangement and movement of particles of sodium hydroxide in water?

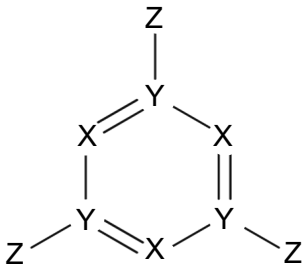
A Ions are closely packed and does not move.

B Ions are widely spaced and move randomly.

C Molecules are widely spaced and move randomly.

D Molecules are closely packed and move randomly.

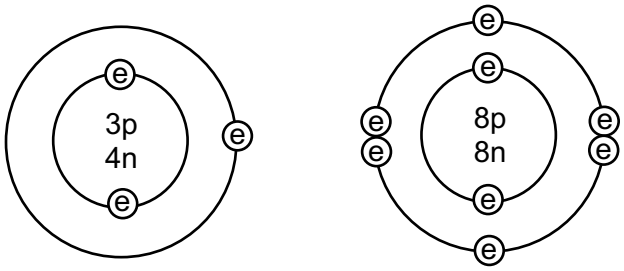
6 A stable molecule containing atoms of elements X, Y and Z has the structure shown.



What could elements X, Y and Z be?

	X	Y	Z
A	carbon	sulfur	hydrogen
B	nitrogen	silicon	sulfur
C	nitrogen	silicon	hydrogen
D	silicon	sulfur	chlorine

7 The structures of atoms of elements L and M are shown.

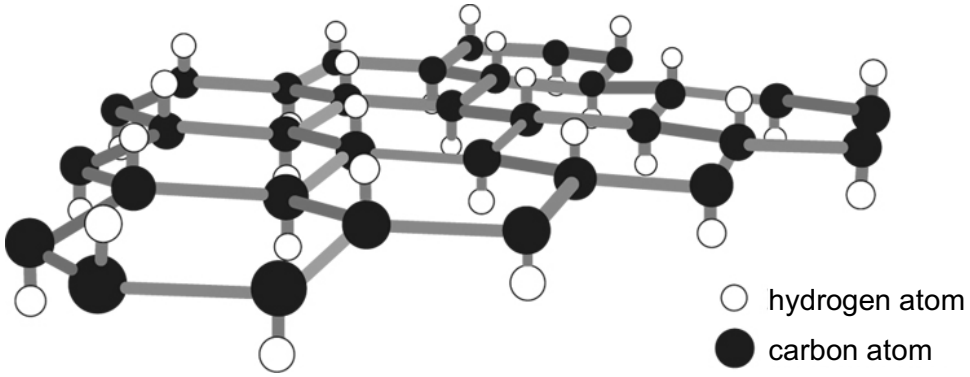


L M

What is the mass of 1 mole of the compound formed by L and M?

A 11 g **B** 12 g **C** 23 g **D** 30 g

8 Graphane, an allotrope of carbon has a similar structure to graphite, except that it has one hydrogen atom attached to each carbon as shown in the diagram.



Which of the properties listed below are properties of graphane?

1 It has a giant molecular structure.
2 It has a high melting point.
3 It is 'slippery' in nature.
4 It conducts electricity in the solid state.

A 1, 2 and 3

B 1, 2 and 4

C 1, 3 and 4

D 2, 3 and 4

9 Naphthalene is the main ingredient of mothballs. It contains 93.75 % of carbon and 6.25 % of hydrogen.

If the relative molecular mass of naphthalene is 128, what is its molecular formula?

[relative atomic masses, A_r : H, 1; C, 12]

A CH **B** C_5H_4 **C** $C_{10}H_8$ **D** $C_{10}H_{10}$

10 A pure hydrocarbon is used to heat homes.

When 10 cm^3 of the hydrocarbon is burned in 70 cm^3 of oxygen, the final gaseous mixture contains 30 cm^3 of carbon dioxide and 20 cm^3 of unreacted oxygen. All gaseous volumes are measured under identical conditions.

What is the chemical formula of the hydrocarbon?

[relative atomic masses, A_r : H, 1; C, 12; O, 16]

A C_2H_6 **B** C_3H_6 **C** C_3H_8 **D** C_4H_{10}

11 The equation for the reduction of iron ore in the blast furnace is shown.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

When 90 tonnes of the iron ore were reduced, 56 tonnes of molten iron were produced.

What is the percentage purity of the iron ore used?

[relative atomic masses, A_r : C, 12; O, 16; Fe, 56]

A 11.1 % **B** 42.2 % **C** 56.3 % **D** 88.9 %

12 What is the ionic equation for the reaction between sodium carbonate and sulfuric acid?

A $H^+ + OH^- \rightarrow H_2O$

B $2Na^+ + SO_4^{2-} \rightarrow Na_2SO_4$

C $CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$

D $2CO_3^{2-} + 2H^+ \rightarrow 2CO_2 + H_2O$

13 The colour changes of a recently discovered indicator is shown in the table.

pH	colour
0 – 3.5	red
3.5 – 5	green
5 - 14	purple

Which pair of substances could be distinguished by the new indicator?

A hydrochloric acid and ethanoic acid

B aqueous sodium chloride and water

C aqueous ammonia and aqueous sodium hydroxide

D aqueous potassium nitrate and aqueous potassium hydroxide

14 Which statement about oxides is true?

A Nitrogen dioxide is a neutral oxide.

B Zinc oxide dissolves readily in water to form an alkaline solution.

C Copper(II) oxide reacts with dilute sulfuric acid to give a blue solution.

D Carbon monoxide reacts with aqueous sodium hydroxide to form a salt and water.

15 A student recorded the following observations when he mixed two substances:

"no effervescence, solution changes colour, no precipitate forms"

Which two substances could have been used?

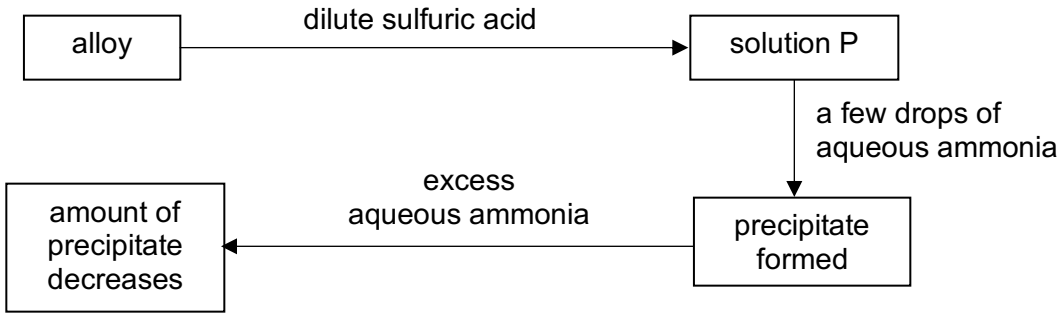
A dilute nitric acid and lead(II) carbonate

B dilute hydrochloric acid and iron(II) oxide

C aqueous sodium hydroxide and dilute sulfuric acid

D aqueous potassium chloride and aqueous silver nitrate

16 A sample of an alloy containing two metals was subjected to the following tests.



What are the two metals present in the alloy?

A iron and zinc

B iron and lead

C iron and copper

D copper and zinc

17 Which salts are best prepared by adding excess acid to an insoluble base?

A magnesium chloride, zinc sulfate, lead(II) nitrate

B sodium chloride, copper(II) nitrate, calcium sulfate

C copper(II) carbonate, barium sulfate, silver chloride

D sodium chloride, ammonium nitrate, potassium sulfate

18 Hydrogen peroxide was added to separate test tubes containing aqueous potassium iodide and aqueous acidified potassium manganate(VII). The iodide ions were oxidised and the manganate(VII) ions are reduced.

What are the colour changes seen?

	potassium iodide	**acidified potassium manganate(VII)**
A	brown to colourless	purple to colourless
B	brown to colourless	colourless to purple
C	colourless to brown	purple to colourless
D	colourless to brown	colourless to purple

19 A mineral, Jarosite, has the molecular formula $KFe_3(OH)_6(SO_4)_2$.

What is the oxidation state of iron in Jarosite?

A +2 **B** −2 **C** +3 **D** −3

20 A part of the Periodic Table is shown below. P, Q, R, S and T do not represent the actual symbols of the elements.

		Group							
		I	II	III	IV	V	VI	VII	0
	1								P
period	2	Q			R			S	
	3							T	

Which statement is correct?

A T is a strong oxidising agent.

B R forms an ionic compound with S.

C P has eight electrons in its outermost shell.

D The metallic character of the elements in period 2 increases from Q to S.

21 Rubidium, Rb, is an element in the same group of the Periodic Table as lithium, sodium and potassium.

Which statement about rubidium is correct?

A It forms an insoluble hydroxide.

B Its melting point is lower than lithium.

C It reacts slowly with water at room temperature.

D It can be produced during the electrolysis of aqueous rubidium chloride.

22 Excess zinc is added into a solution containing magnesium nitrate and copper(II) chloride. After the reaction, the mixture is filtered.

Which cations would be present in the filtrate?

1 Cu^{2+}
2 Mg^{2+}
3 Zn^{2+}

A 1 and 2 only

B 1 and 3 only

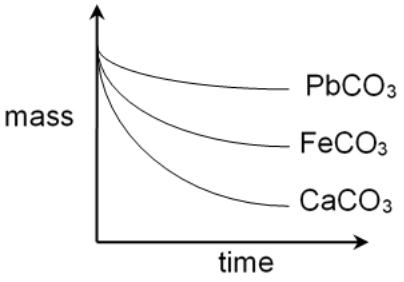
C 2 and 3 only

D 1, 2 and 3

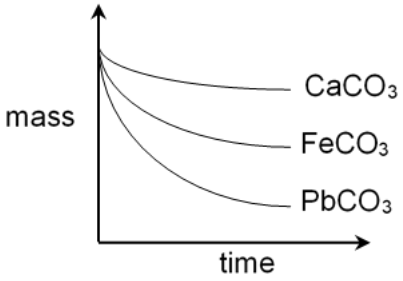
23 Equal masses of three different metal carbonates were placed in separate open crucibles and heated for two minutes.

Which graph shows what happens to the mass of the crucible and its contents?

A



B



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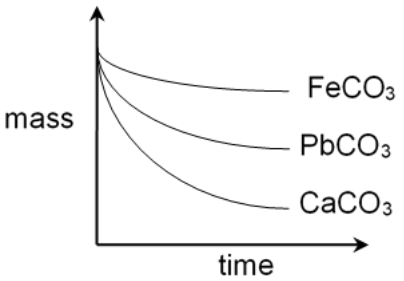
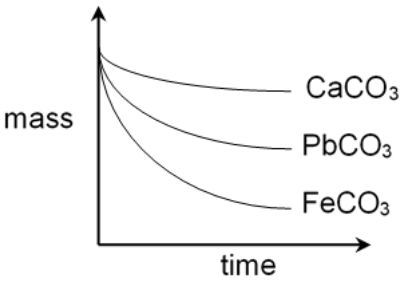
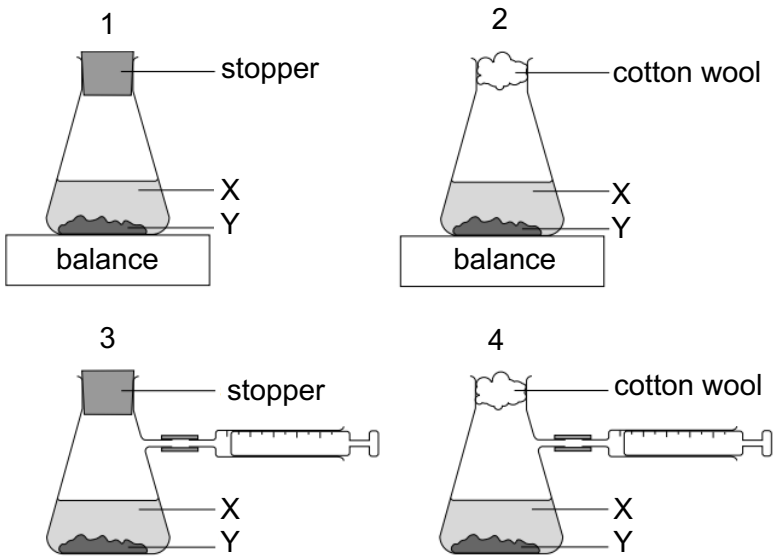


D



24 A liquid X reacts with solid Y to form a gas.

Which two diagrams show suitable methods for investigating the speed of the reaction?



A 1 and 3

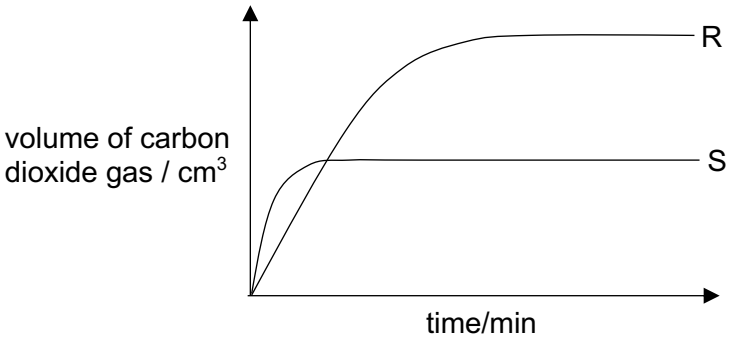
B 1 and 4

C 2 and 3

D 2 and 4

25 A student investigates the rate of reaction between copper(II) carbonate and excess nitric acid. The volume of carbon dioxide gas given off in the reaction is measured over time.

The graph shows the results of two experiments, R and S.



Which change in conditions would cause the difference between R and S?

A A catalyst is added in S only.

B The temperature of the solution in R is lower than in S.

C Half the volume of a more concentrated nitric acid is used in S than in R.

D Twice the mass of less finely powdered copper(II) carbonate used in R than in S.

26 A reaction takes place in two stages:

Stage 1
$S_2O_8^{2-}(aq) + 2I^-(aq) + 2Fe^{2+}(aq) \rightarrow 2SO_4^{2-}(aq) + 2I^-(aq) + 2Fe^{3+}(aq)$

Stage 2
$2SO_4^{2-}(aq) + 2I^-(aq) + 2Fe^{3+}(aq) \rightarrow 2SO_4^{2-}(aq) + I_2(aq) + 2Fe^{2+}(aq)$

Which ion is the catalyst in the reaction?

A Fe^{2+} **B** Fe^{3+} **C** I^- **D** SO_4^{2-}

27 Which statements about the Haber process are correct?

1 The catalyst used is a transition metal.
2 Unreacted nitrogen and hydrogen are circulated back into the system.
3 Both reactants are obtained from the fractional distillation of liquefied air.
4 The reaction is reversible and the yield achieved is only about 10 – 15%.

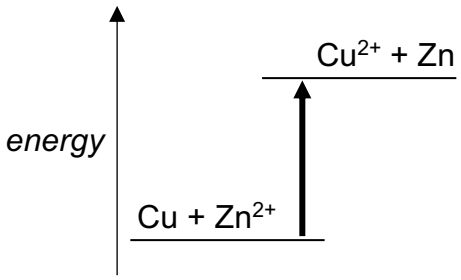
A 1 and 2 only **B** 2 and 4 only

C 1, 2 and 4 only **D** 1, 3 and 4 only

28 The reaction between zinc and aqueous copper(II) nitrate is exothermic.

Which energy level diagram represents the reaction?

A



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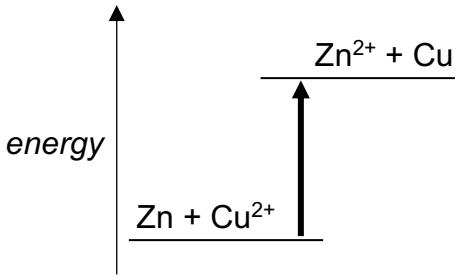
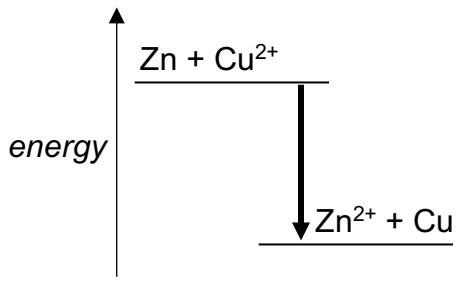


C



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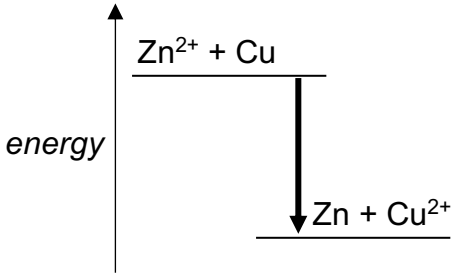


29 Which combination of electrode, electrolyte and products are correct?

	electrode	electrolyte	product at the anode	product at the cathode
A	carbon	concentrated hydrochloric acid	chlorine	hydrogen
B	carbon	concentrated sulfuric acid	sulfur	hydrogen
C	copper	aqueous copper(II) sulfate	oxygen	copper
D	platinum	aqueous copper(II) sulfate	hydrogen	copper

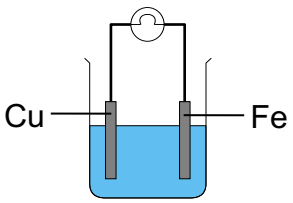
30 During the electrolysis of an aqueous solution of a cerium salt, 70 g of cerium is deposited at the cathode by 2 moles of electrons.

What is the formula of the cerium ion?
[relative atomic mass, A_r: Ce, 140]

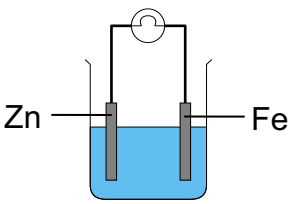
A Ce^{+} **B** Ce^{2+} **C** Ce^{3+} **D** Ce^{4+}

31 In which cell will the light bulb be the dimmest?

A



B



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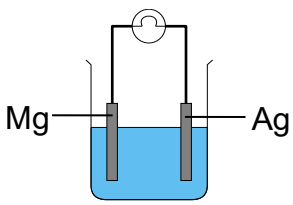
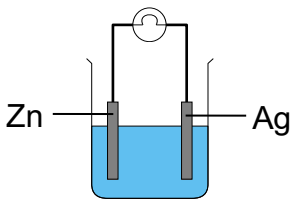


D



32 Waste gases from a coal-burning power station are passed through powdered calcium carbonate to reduce atmospheric pollution.

Which waste gas will not be removed by the powdered calcium carbonate?

A carbon dioxide
B carbon monoxide
C phosphorus(V) oxide
D sulfur dioxide

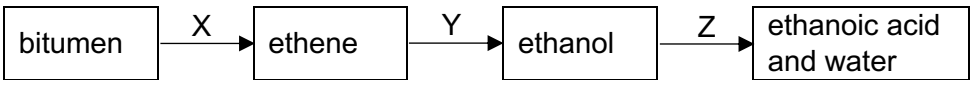
33 Four environmental problems are listed.

1 acid rain
2 depletion of the ozone layer
3 presence of greenhouse gases
4 incomplete combustion of carbon compounds

Which atmospheric pollutant is responsible for each problem?

	1	2	3	4
A	chlorofluorocarbons	sulfur dioxide	carbon dioxide	carbon monoxide
B	carbon dioxide	carbon monoxide	sulfur dioxide	chlorofluorocarbons
C	sulfur dioxide	carbon dioxide	chlorofluorocarbons	carbon monoxide
D	sulfur dioxide	chlorofluorocarbons	carbon dioxide	carbon monoxide

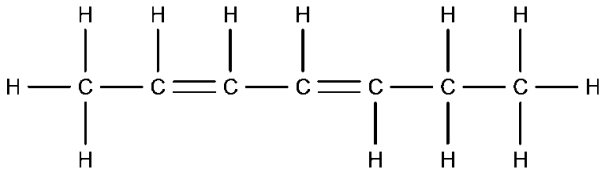
34 The diagram below shows a reaction sequence.



Which processes describe the above reactions?

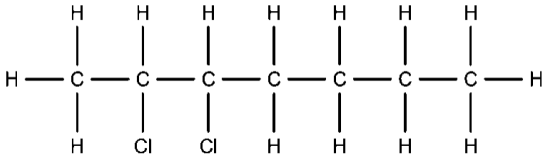
	X	Y	Z
A	cracking	fermentation	combustion
B	cracking	hydration	oxidation
C	distillation	fermentation	oxidation
D	distillation	hydration	combustion

35 The hydrocarbon shown is heated with hydrogen chloride gas under catalysed conditions.

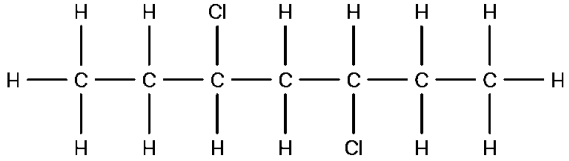


What compound could be formed during the reaction?

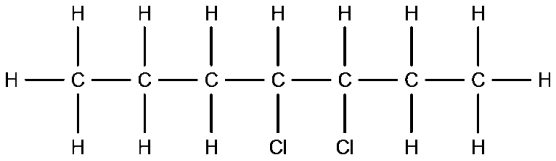
A



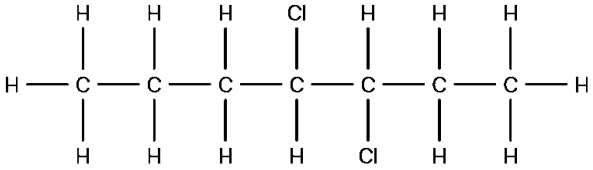
B



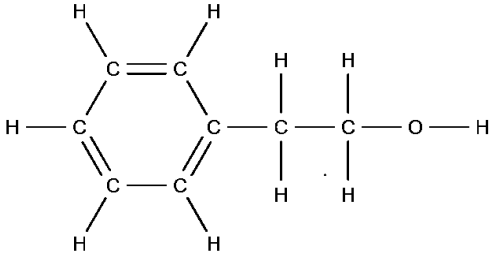
C



D



36 One substance responsible for the fragrance of roses is 2-phenylethanol.
The structure of the molecule is shown below.



Which statement about this molecule is incorrect?

A It is an unsaturated molecule.

B It can decolourise aqueous bromine at room temperature.

C It can undergo condensation polymerisation to form a polyester.

D It can be oxidised by acidified potassium manganate(VII) solution.

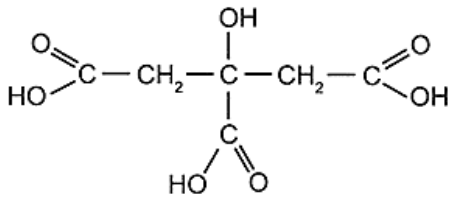
37 Propanal is a member of a homologous series called the alkanals.
The chemical formula of propanal is CH_3CH_2CHO.

What is the general formula of alkanals?

A $C_nH_{3n}CO$ **B** $C_nH_{2n}CHO$

C $C_nH_{2n+1}CHO$ **D** $C_nH_{2n+1}CH_2OH$

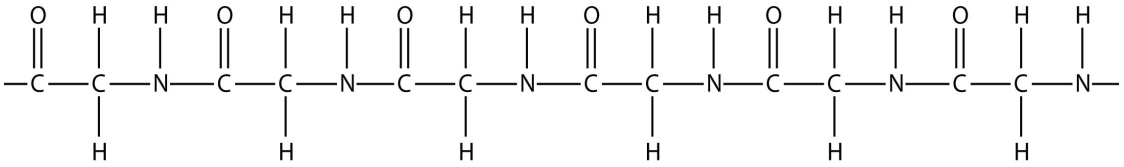
38 The structure of citric acid is shown.



How many moles of sodium hydroxide is needed to neutralise one mole of citric acid?

A 1 **B** 2 **C** 3 **D** 4

39 A section of a polymer is shown.



Which statement explains why this polymer should not be disposed by burning?

A It produces pollutants that can form acid rain.

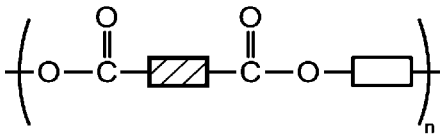
B The polymer does not burn well even at high temperature.

C It is highly flammable and may cause an explosion during burning.

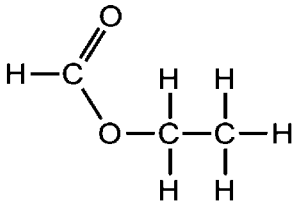
D It produces pollutants such as carbon dioxide and carbon monoxide.

40 Which compound cannot be prepared by reacting a carboxylic acid and an alcohol?

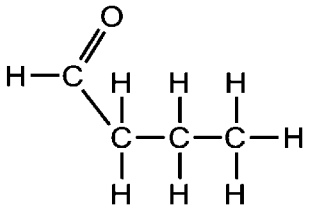
A



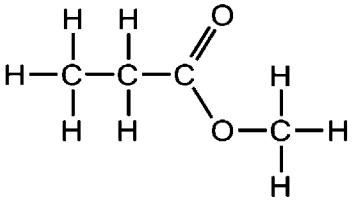
B



C



D



The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Class/ Index Number /	Centre Number/ 'O' Level Index Number /	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR

CHEMISTRY **6092/01**
Paper 1 Multiple Choice **30 August 2022**
1 hour

Additional Materials:
Optical Test Answer Sheet (OTAS) – 1 sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your class, index number, Centre number, O level index number and name in the spaces at the top of this page.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your answer in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

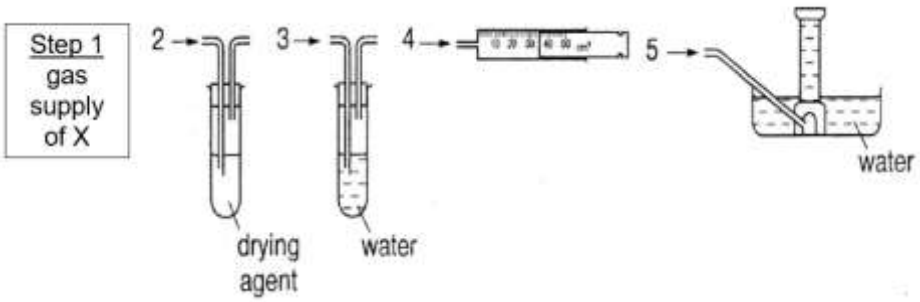
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this question booklet.
A copy of the Periodic Table is printed on page 16.
The use of an approved scientific calculator is expected, where appropriate.

The total number of marks for this paper is 40.

At the end of the examination, hand in the following separately:
(1) Optical Test Answer Sheet (OTAS)
(2) Question Paper

This document consists of 16 printed pages.

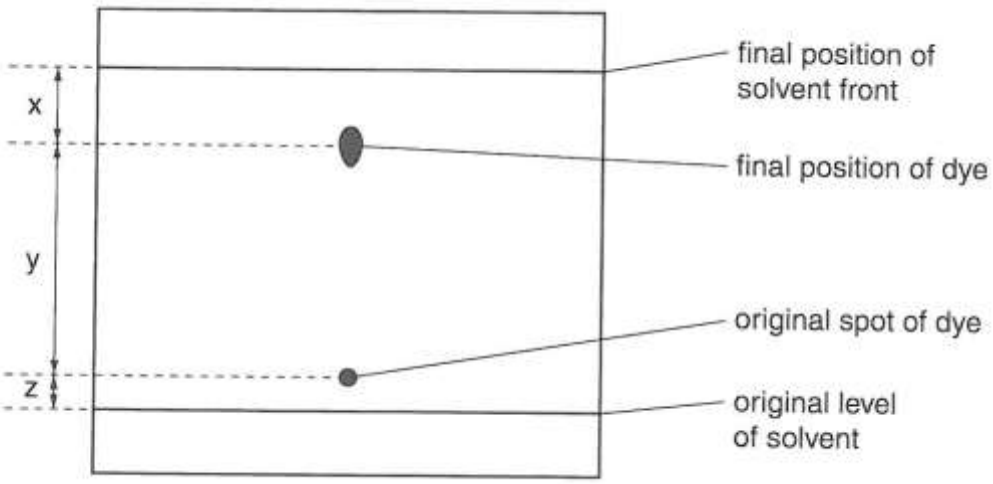
1 A gas X is insoluble in water and less dense than air. An impure supply of moist gas X contains a water-soluble impurity.



In which order should the pieces of apparatus shown be joined together after Step 1 to collect a pure, dry sample of X?

A 2,3,4 **B** 2,3,5 **C** 3,2,5 **D** 3,2,4

2 The diagram shows a chromatogram obtained when a single dye is analysed.
Three measurements, x, y and z are shown.



How is the R_f value of the dye calculated?

A $\frac{x}{x+y}$ **B** $\frac{y}{x+y}$ **C** $\frac{x}{x+y+z}$ **D** $\frac{y}{x+y+z}$

3 Solid samples of ammonium chloride, lead(II) chloride and sodium chloride were accidentally mixed together. Which of the following sequences outlines the best method to obtain the pure dry sample for each substance?

A dissolving, filtration, sublimation, crystallisation

B dissolving, fractional distillation, filtration, evaporation

C sublimation, dissolving, filtration, evaporation

D sublimation, filtration, evaporation, crystallisation

4 When heated steadily, an impure solid R melted over a range of 121 °C to 126 °C. Which of the following could be the melting point of R?

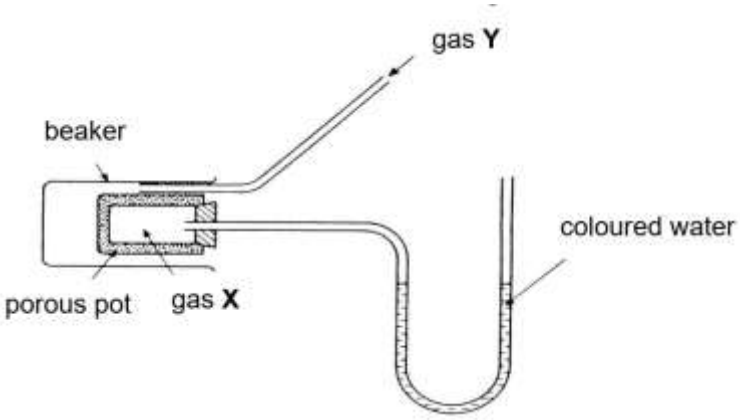
A 120 °C

B 121 °C

C 125 °C

D 128 °C

5 The apparatus below is used to show the diffusion of gases. Which pair of gases X and Y would cause no movement of the water?



	X	Y
A	CO	NO_2
B	CO_2	C_2H_6
C	N_2	C_2H_4
D	C_2H_4	C_2H_6

6 Benzene, C_6H_6, melts at 5.5 °C and boils at 80.1 °C.

Which statement best describes the changes in benzene as benzene is heated from room temperature to 90 °C?

A Benzene molecules lose energy and eventually, they move about freely.

B Benzene molecules gain energy and eventually, they vibrate and slide past one another.

C Benzene molecules lose energy and eventually, they vibrate about their fixed positions.

D Benzene molecules gain energy and eventually, they move about freely.

7 A new substance was discovered and a series of experiments were conducted on it. Which observation suggests that the substance **cannot** be an element?

A It had a fixed melting point.

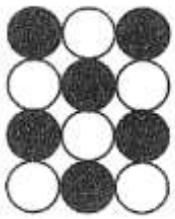
B Electrolysis of the molten substance gives two products.

C It dissolved in water to give a colourless solution.

D When heated in air, it could form two oxides.

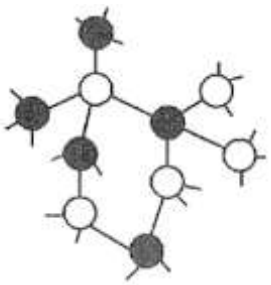
8 Which diagram best shows the structure of an alloy?

A



B

C



D

9 Three atoms M, E and T have mass numbers of 235, 238 and 239 respectively. M has 92 protons; E has 92 neutrons and T has 147 neutrons. Which of these atoms are isotopes?

A M, E and T

B M and E

C M and T

D E and T

10 Two particles having the same number of protons and neutrons but different numbers of electrons could be

A an atom and a molecule of the same element.

B an atom and an ion of the same element.

C ions of two different elements.

D an atom and an ion of different elements.

11 The table below shows information for five elements.
The symbols used here do not represent the actual chemical symbols of the elements.

element	P	Q	R	S	T
mass number	16	24	27	39	88
number of neutrons	8	12	14	20	50

Which two elements are in the same Group of the Periodic Table?

A P and R **B** P and S

C Q and S **D** Q and T

12 When a sulfur atom becomes a sulfide ion, the following changes could take place:

I the atomic number of sulfur increases by 2

II the atom gains 2 electrons

III the mass number of sulfur increases by 2

IV the ion formed has a 2+ charge

Which of the following options is correct?

A I, II and IV only

B I and II only

C II and IV only

D II only

13 The table below gives the number of protons, neutrons and electrons in particles I, J, K, L and M.
The symbols used here do not represent the actual chemical symbols of the elements.

particle	protons	neutrons	electrons
I	8	8	10
J	17	18	17
K	12	12	12
L	11	12	10
M	7	7	7

Which of the particles will form an ionic compound with I and what is the corresponding formula of the compound formed.

	particle	formula of compound
A	J	J_2I
B	K	KI
C	L	L_2I
D	M	MI_2

14 The table below shows the electrical conductivity of four substances:

substance	electrical conductivity
W	does not conduct under any condition
X	conducts when dissolved in water
Y	conducts when molten
Z	conducts when solid and when molten

Which of the following correctly identifies W, X, Y and Z?

	W	X	Y	Z
A	CH_3OH	NH_3	Al_2O_3	Au
B	NH_3	Al_2O_3	CH_3OH	Au
C	NH_3	CH_3OH	Al_2O_3	Au
D	Al_2O_3	NH_3	Au	CH_3OH

15 Excess aqueous lead(II) nitrate is added to aqueous potassium iodide. The precipitate formed is removed by filtration.
What ions are present in the filtrate?

A Pb^{2+} and I^-

B K^+ , NO_3^- , H^+ and OH^-

C K^+ , Pb^{2+} , NO_3^- , H^+ and OH^-

D K^+ , Pb^{2+} , I^- , NO_3^- , H^+ and OH^-

16 The melting point of aluminium oxide is much higher than melting point of calcium oxide. Which statement explains this?

A A calcium ion has a smaller charge than an aluminium ion.

B A calcium ion has more protons than an aluminium ion.

C A calcium ion has more shells of electrons than an aluminium ion.

D Calcium is more reactive than aluminium.

17 The formula of thalium sulfate is Tl_2SO_4 and that of ammonium vanadate is NH_4VO_3. Which of the following represents the formula of thalium vanadate?

A Tl_2VO_3

B $TlVO_4$

C $Tl(VO_3)_2$

D $TlVO_3$

18 Monosodium glutamate, commonly called MSG, is a popular seasoning and flavour enhancer. If the relative molecular mass of MSG is 169, and the formula of MSG is known to be $C_5H_8XO_4Na$, what is the element X in the compound?

A Chlorine

B Nitrogen

C Silicon

D Sulfur

19 A compound contains 0.291 g of carbon, 0.0484 g of hydrogen, 0.230 g of fluorine and 0.430 g of chlorine. The empirical formula of this compound is

A CHFCl

B C_2H_2FCl

C C_2H_4FCl

D CH_4FCl

20 8 g of a sample of X_2O_3 contains 0.1 mole of element X.
What is the mass of X in the sample?

A 1.6 g

B 2.4 g

C 5.6 g

D 11.2 g

21 Molecules of hydrogen(H_2) and chlorine(Cl_2) are produced when hydrogen chloride(HCl) decomposes. The equation for the decomposition is:

$$2HCl\ (g) \rightarrow H_2\ (g)\ +\ Cl_2\ (g)$$

Hydrogen chloride was added to a container which already contained some hydrogen. After the hydrogen chloride has decomposed for some time, the volumes of hydrogen chloride, hydrogen and chlorine in the container were determined. The volumes measured in cm^3 at room conditions, before and after the reaction are shown in the table.

	HCl	H_2	Cl_2
Before	200	20	0
After	X	100	80

What is the value of X?

A 0

B 20

C 40

D 160

22 Which element in the table is most likely to be a transition metal?

element	melting point(°C)	density(g/cm^3)	number of chlorides known
A	-7	3.10	3
B	113	2.07	1
C	1083	9.92	2
D	1521	1.12	1

23 Some properties of Group I elements are given.

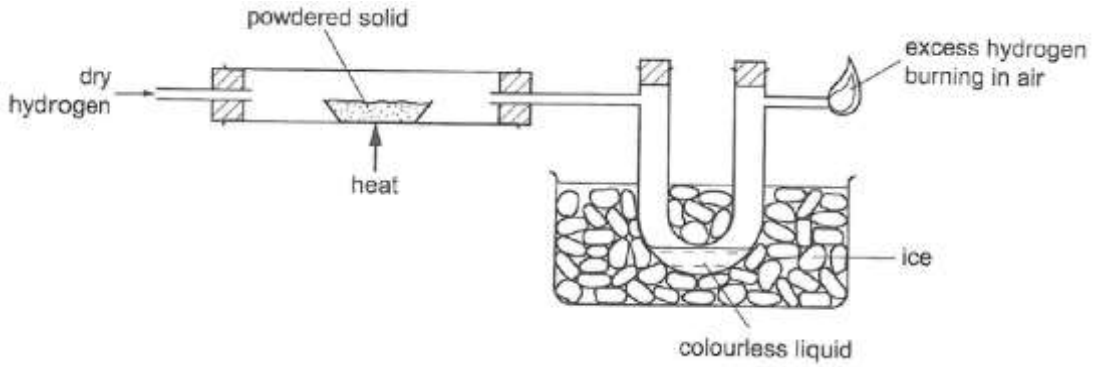
I reducing power
II density
III melting point

For which properties does the following order of elements apply?

(lowest) potassium < rubidium < caesium (highest)

A II only
B I and II only
C I and III only
D I, II and III

24 Dry hydrogen gas is passed over a powdered solid and then through a cooled U-tube before the excess of hydrogen is burned in air.



The U-tube contains a colourless liquid.
Which test could be used to show that the liquid is pure water?

A It turns anhydrous copper(II) sulfate blue.
B It freezes exactly at 0 °C.
C It turns cobalt(II) chloride paper pink.
D When it reacts with sodium, hydrogen is formed.

25 Which reaction(s) produces hydrogen gas?

reaction 1:	potassium with water
reaction 2:	zinc with steam
reaction 3:	copper with dilute hydrochloric acid

A 1 only
B 1 and 2 only
C 2 and 3 only
D All of the above

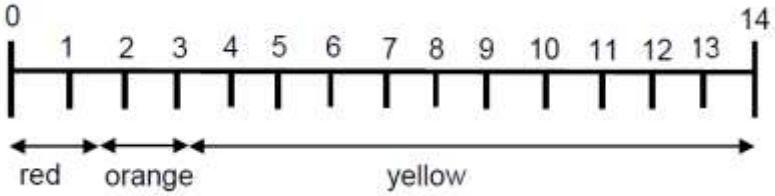
26 Four statements about the recycling of metals are listed.

1 More energy is required to mine and extract a metal than to recycle it.
2 The recycling of metals involves transport, separation and reprocessing.
3 Some metals are present in Earth's crust in very small quantities.
4 People in the future will need metals.

Which statements give valid reasons in recycling of metals.

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 1, 3 and 4

27 The colours of an indicator X in solutions of different pH are shown below :



Which pair of solutions cannot be differentiated by using indicator X?

A aqueous solutions of ammonia and sulfuric acid at the same concentration
B aqueous solutions of ammonia and sodium chloride at the same concentration
C aqueous solutions of hydrogen chloride and ethanoic acid at the same concentration
D aqueous solutions of sodium hydroxide and ethanoic acid at the same concentration

28 An unknown sample of a mixture of two solids was heated strongly in a boiling tube. The gaseous products produced were collected in dry test tubes.

The following were observations of the gaseous products:

1 colourless and odourless

2 rekindles a glowing splint

3 volume of the gases collected in the test-tube decreased when the test-tube of gaseous products was inverted over aqueous sodium hydroxide

What could be the gaseous products collected on heating the mixture of the two solids?

A ammonia and oxygen

B nitrogen and oxygen

C carbon dioxide and oxygen

D all of the above

29 The table gives information about the solubilities of the hydroxides, carbonates, and sulfates of calcium, sodium and zinc.

	hydroxide	carbonate	sulfate
calcium	slightly soluble	insoluble	slightly soluble
sodium	soluble	soluble	soluble
zinc	insoluble	insoluble	soluble

What is the best way of making zinc carbonate?

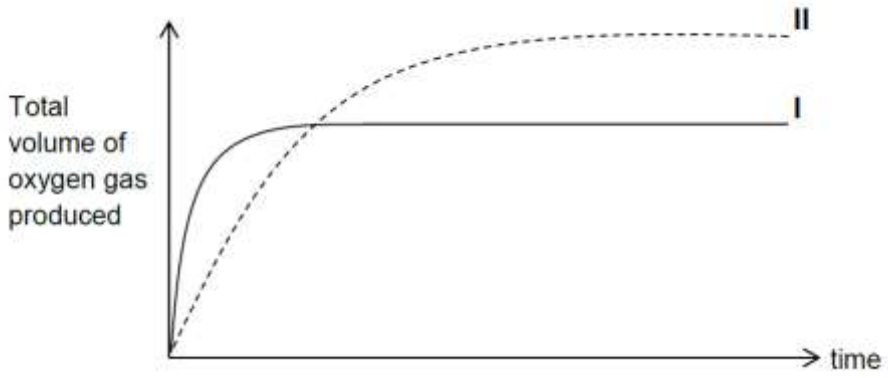
A Add aqueous sodium hydroxide to solid zinc hydroxide and then bubble in carbon dioxide gas.

B Add water to a mixture of solid zinc sulfate and solid calcium carbonate.

C Add water to solid zinc sulfate and then add in aqueous sodium carbonate.

D Add solid calcium hydroxide to aqueous zinc sulfate and then bubble in carbon dioxide gas.

30 Curve I in the diagram below was obtained from the decomposition of 100 cm^3 of 1 mol/dm^3 hydrogen peroxide solution, catalysed by manganese(IV) oxide.



This can be represented by the equation

$$2H_2O_2(aq) \rightarrow 2H_2O\ (l) + O_2(g)$$

With reference to the graph above, which alteration to the conditions would produce curve II?

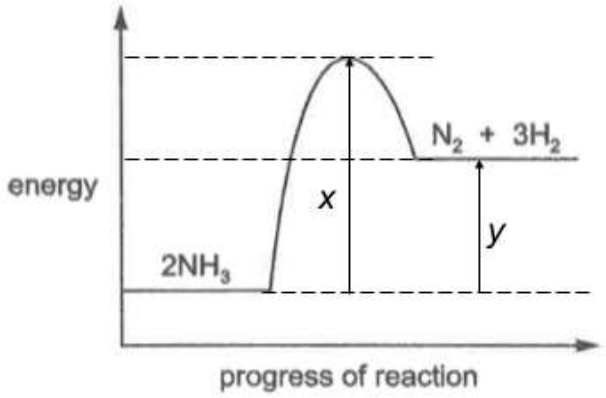
A using less manganese (IV) oxide

B lowering temperature

C adding some 0.1 mol/dm^3 hydrogen peroxide solution

D using a better catalyst

31 The energy profile diagram for the reversible reaction $2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$ is shown.



What is the activation energy of the reverse reaction?

A x **B** y **C** (x + y) **D** (x – y)

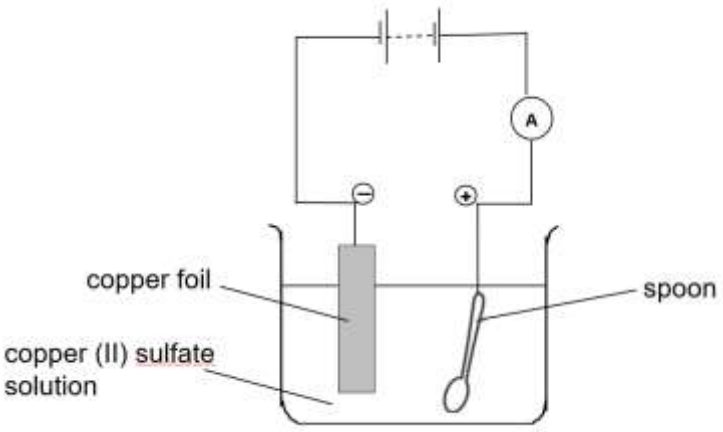
32 In which equation is the sign of the energy change, ΔH, shown correctly?

	equation	ΔH
A	$I_2(g) \rightarrow I_2(s)$	negative
B	$C(s) + O_2(g) \rightarrow CO_2(g)$	positive
C	$CO_2(g) \rightarrow C(g) + 2O(g)$	negative
D	$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$	positive

33 Rubidium is above sodium in the reactivity series.
What is formed when concentrated aqueous rubidium chloride is electrolysed?

	products	
	negative electrode	positive electrode
A	chlorine	hydrogen
B	hydrogen	rubidium
C	hydrogen	chlorine
D	rubidium	chlorine

34 The apparatus shown below was set up to copper plate the metal spoon.



The electroplating did **not** work.
What was the mistake in the apparatus?

A A variable resistor should be included in the electrical circuit.

B Dilute sulfuric acid should be used as the electrolyte.

C The copper electrode should all be in the solution.

D The spoon should be the negative electrode.

35 Which statement is true about the hydrogen-oxygen fuel cell?

A Hydrogen gas is oxidised at the negative electrode to form water.

B Hydrogen gas is reduced at the negative electrode to form water.

C Oxygen gas is oxidised at the negative electrode to form hydroxide ions.

D Oxygen gas is reduced at the negative electrode to form hydroxide ions.

36 One of the fractions obtained by the fractional distillation of petroleum oil contains molecules with 1 to 4 carbon atoms in them. Which of the following molecules can be found in this fraction?

A ethane, ethanol, butane

B ethane, propanol, methanoic acid

C ethane, propene, pentane

D methane, ethane, propane

37 Which physical property of the alkanes does not increase as relative molecular mass increases?

A viscosity

B solubility

C melting point

D boiling point

38 The reaction between a hydrocarbon C_xH_{10} and chlorine can be represented as follows.

$$C_xH_{10}\,(g) + 2Cl_2\,(g) \rightarrow C_xH_8Cl_2\,(g) + 2HCl\,(g)$$

Which of the following is a correct statement?

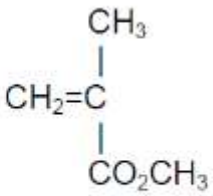
A It is an addition reaction.

B The molecular formula of the hydrocarbon is C_5H_{10}.

C Ultraviolet light is an essential condition for the reaction to take place.

D High temperature, high pressure and a catalyst are required in the reaction.

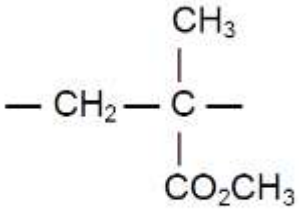
39 In an artificial hip joint, bone cement is used to attach the poly(ethene) cup for the joint to the pelvic girdle. Bone cement is formed by the polymerisation of methyl 2-methyl propenoate and the process is highly exothermic.



methyl 2-methylpropenoate

Which of the following are correct statements about this polymerisation?

1 The repeat unit of the polymer is



2 Less energy is released in forming the C – C bonds than absorbed in breaking a C = C bond.

3 The formation of the cement occurs by additional polymerisation.

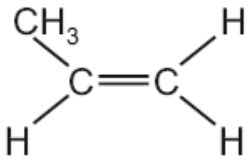
A 1 and 2 only

B 2 and 3 only

C 1 and 3 only

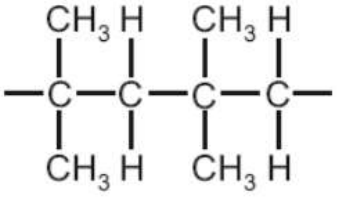
D 1, 2 and 3 only

40 The diagram shows the structure of a small molecule.

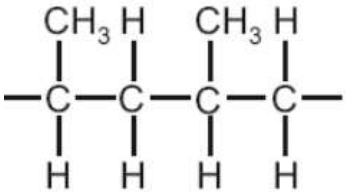


Which chain-like molecule is formed when these small molecules link together?

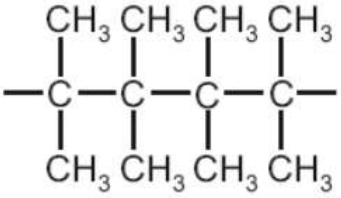
A



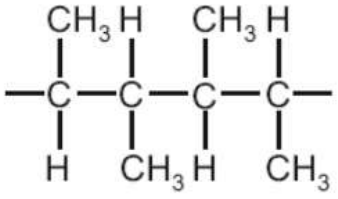
B



C



D



End of Paper

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number / atomic symbol / name / relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Answer **all** questions. Choose the one you consider correct and record your choice with a **soft pencil** on a separate Answer Sheet.

1 Which piece of apparatus could be used to determine the end-point of the reaction between hydrochloric acid and potassium hydroxide?

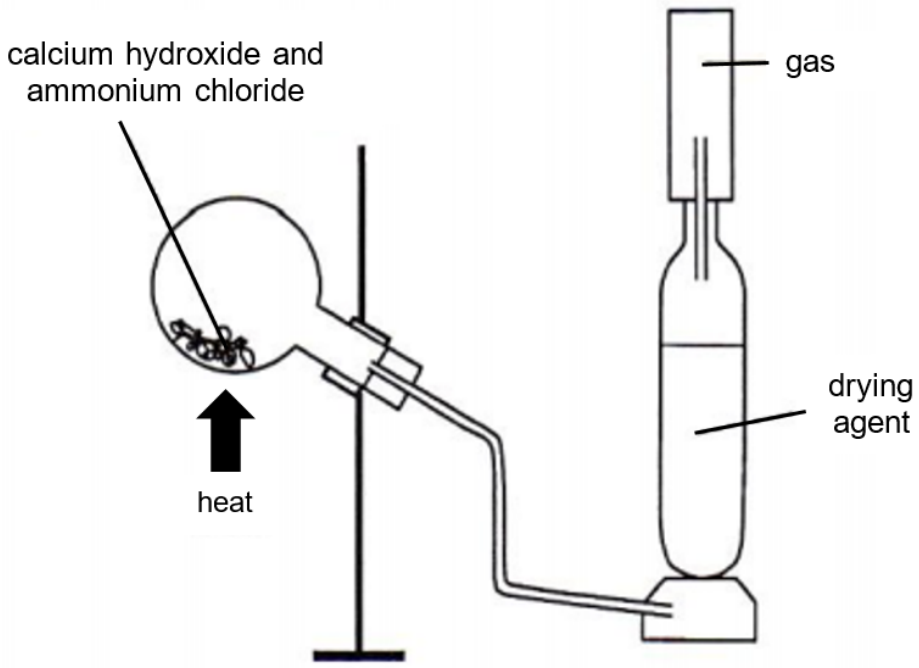
A electronic balance

B gas syringe

C stopwatch

D thermometer

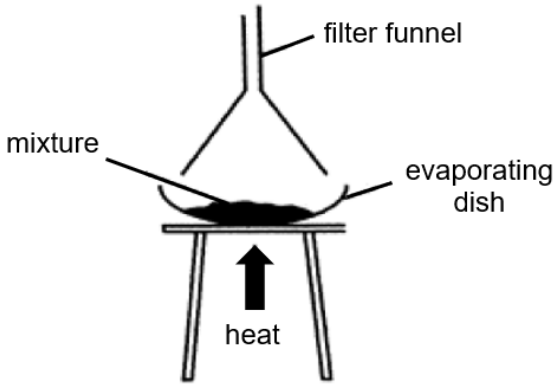
2 A student sets up the following apparatus to collect a gas.



What is the possible identity of the gas and drying agent?

	gas	drying agent
A	ammonia	concentrated sulfuric acid
B	ammonia	calcium oxide
C	hydrogen chloride	calcium oxide
D	hydrogen chloride	concentrated sulfuric acid

3 A student uses the following experimental set-up to separate mixtures.



Which mixture can be separated into its components using this set-up?

A ammonium chloride and iodine

B copper(II) sulfate and sodium chloride

C copper(II) sulfate and sugar

D sodium chloride and ammonium chloride

4 Some properties of substances P, Q, R and S are given in the table.

substance	percentage composition by mass	electrical conductivity when solid	effect of heat
P	fixed	yes	solid burns brightly to form an oxide
Q	fixed	no	solid decomposes to form simpler substances
R	varies	no	liquid burns to form carbon dioxide and water
S	varies	yes	solid melts

Which classification of the substances as an element, a mixture or a compound is correct?

	element	mixture	compound
A	P	R	Q, S
B	S	Q, R	P
C	R	S	Q, P
D	P	R, S	Q

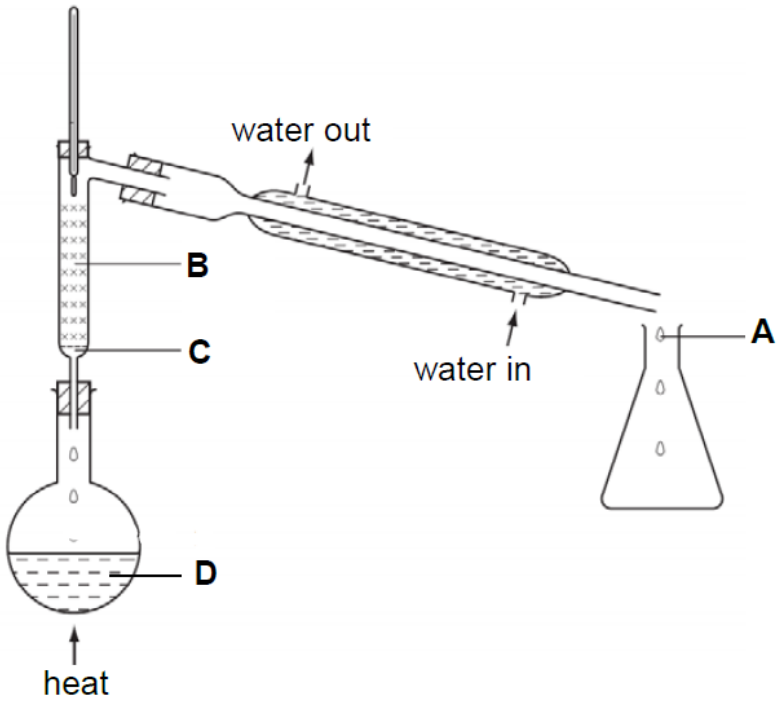
5 An unknown substance melts at -210 °C and boils at -196 °C.

Which row correctly describes the arrangement and movement of the particles of this substance at -204 °C?

	arrangement	movement
A	closely packed in a disorderly manner	sliding past one another
B	closely packed in a disorderly manner	vibrating about fixed positions
C	closely packed in an orderly manner	sliding past one another
D	closely packed in an orderly manner	vibrating about fixed positions

6 A mixture containing an equal volume of two miscible liquids is heated as shown.

When the mixture starts boiling and the thermometer first registers a steady reading, at which position, **A**, **B**, **C**, or **D**, will there be the highest proportion of liquid with the higher boiling point?



7 Paper chromatography is carried out on three different mixtures of dyes, using the same solvent. Each mixture contains at least one of the dyes W, X, Y and Z.

The R_f values of the dyes in the three mixtures are shown.

dye	R_f values from mixture 1	R_f values from mixture 2	R_f values from mixture 3
W	0.14	0.14	0.14
X	0.00	0.00	0.00
Y	0.50	0.50	0.50
Z	0.82	0.82	0.00

Which conclusion is correct?

A Dye W is nearest to the solvent front and is present only in mixture 1 and mixture 3.

B Dye X has travelled furthest up the chromatography paper.

C Dye Y is the only dye present in all three mixtures.

D Dye Z is nearest the solvent front and is found in only two of the mixtures.

8 The table shows information about two particles, L and M.

particle	number of protons	number of neutrons	electronic structure
L	11	12	2.8
M	19	20	2.8.8

Which statement about L and M is correct?

A Both are atoms of noble gases.

B Both are isotopes of the same element.

C Both are negative ions.

D Both are positive ions.

9 When testing for a chloride ion using silver nitrate, the solution must be acidified with dilute nitric acid.

What is the purpose of the nitric acid?

A to act as a catalyst

B to oxidise the chloride ion

C to prevent decomposition of any silver chloride formed

D to prevent precipitation of silver carbonate

10 Rubidium has a relative atomic mass of 85.5. It consists of only two isotopes with different percentage abundance.

isotope	percentage abundance
rubidium-85	?
rubidium-87	

What is the percentage abundance of rubidium-85 that occurs naturally?

A 25 %

B 45 %

C 50 %

D 75 %

11 An oxide compound contains 18.5 % by mass of calcium and 51.9 % by mass of iron.

What is its empirical formula?

A $CaFe_2O_4$

B $CaFe_2O$

C Ca_2FeO_2

D $Ca_2Fe_4O_8$

12 Which statement **best** explains why graphite is a suitable material to make pencil leads?

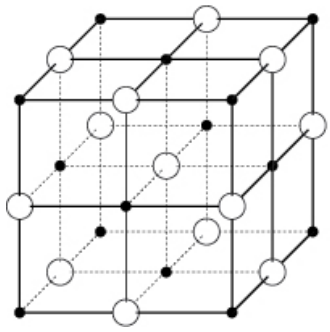
A The atoms can slide past one another easily.

B The delocalised electrons are free and mobile.

C The intermolecular forces of attraction between hexagonal layers of carbon atoms are easy to overcome.

D The strong covalent bonds between carbon atoms are difficult to overcome.

13 The diagram shows the arrangement of the ions in an ionic crystal.



Which compound **cannot** have this arrangement of its ions?

A calcium chloride, $CaCl_2$

B copper(II) sulfate, $CuSO_4$

C lithium fluoride, LiF

D magnesium oxide, MgO

14 Aqueous sodium hydroxide reacts with the solution of a metal chloride, GCl_n, to form a precipitate of the metal hydroxide.

$$GCl_n + nNaOH \rightarrow G(OH)_n + nNaCl$$

15 cm^3 of 0.500 mol/dm^3 sodium hydroxide required 20 cm^3 of 0.125 mol/dm^3 GCl_n solution for the reaction to complete.

What is the formula of the metal chloride?

A GCl

B GCl_2

C GCl_3

D GCl_4

15 200 cm^3 of ammonia burns in 120 cm^3 of oxygen according to the following equation.

$$4NH_3(g) + 3O_2(g) \rightarrow 2N_2(g) + 6H_2O(g)$$

What volume of nitrogen will be obtained, at room temperature and pressure?

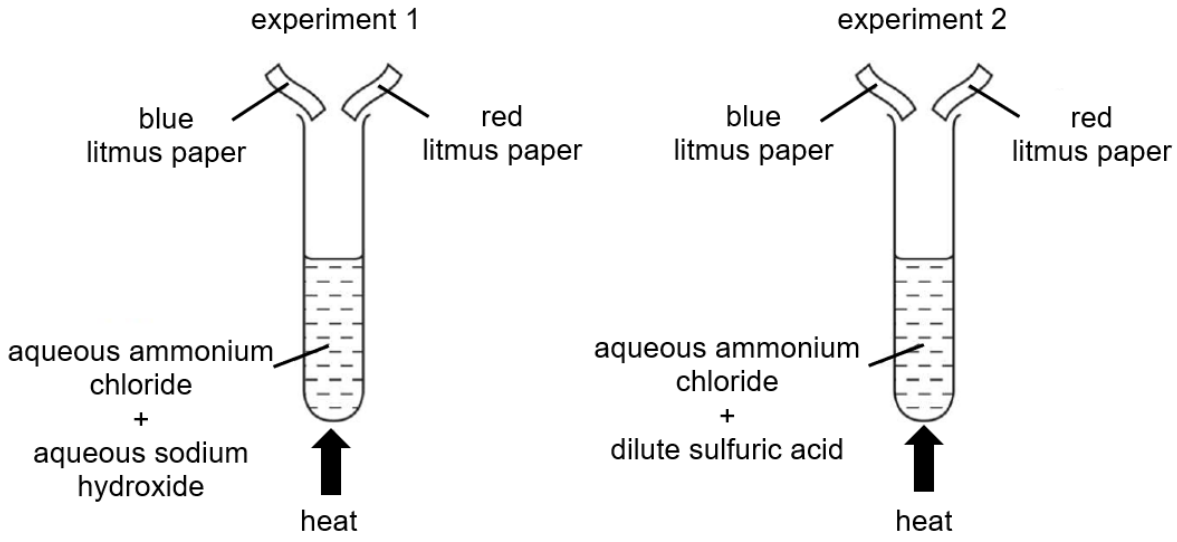
A 80 cm^3

B 100 cm^3

C 240 cm^3

D 320 cm^3

16 The diagram shows two experiments.



What will happen to the pieces of litmus paper?

	experiment 1	experiment 2
A	blue → red	both pieces bleach
B	blue → red	no change
C	red → blue	both pieces bleach
D	red → blue	no change

17 A sample of magnesium hydroxide, $Mg(OH)_2$, is made by adding an excess of aqueous sodium hydroxide to an aqueous solution containing 1.20 g magnesium sulfate, $MgSO_4$.

The mass of magnesium hydroxide formed is 0.26 g.

What is the percentage yield of magnesium hydroxide?

A 10.5 %

B 21.7 %

C 44.8 %

D 61.9 %

18 Which substance reacts with water to form a soluble compound and an insoluble gas?

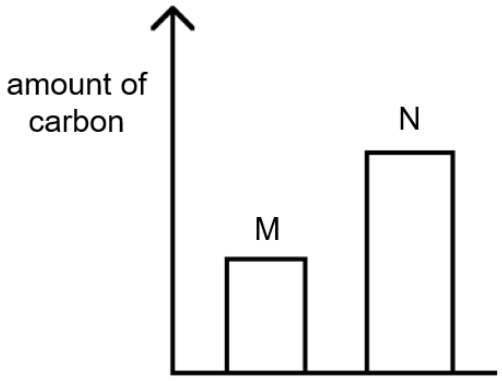
A ammonium sulfate

B caesium

C copper

D magnesium carbonate

19 Two steel bars from different manufacturers, M and N, has different amount of carbon.



Which statement shows the correct comparison of hardness and brittleness between the steel bars?

A M is harder and more brittle than N.

B M is harder than N, but N is more brittle than M.

C N is harder than M, but M is more brittle than N.

D N is harder and more brittle than M.

20 Elements H, J, L are in the same period in the Periodic Table.

The oxide of H dissolves in water to form a solution with a pH 12.5. The oxide of J forms a solution with a pH less than 4.5. The oxide of L is soluble in both aqueous potassium hydroxide and dilute nitric acid.

Which option shows the position of the elements in order of increasing atomic number?

A H, J, L

B H, L, J

C J, L, H

D L, J, H

21 Which element is most likely to be a transition metal?

element	melting point °C	density in g/cm^3	number of chlorides formed
A	-7	3.10	2
B	113	2.07	1
C	1521	1.12	1
D	1083	8.92	2

22 Which process does **not** involve either oxidation or reduction?

A formation of ammonium sulfate from ammonia and sulfuric acid

B formation of nitrogen monoxide from ammonia

C formation of sulfuric acid from sulfur

D formation of zinc from zinc blende, ZnS

23 Which reagent can be used to convert MnO_4^- ions to Mn^{2+} ions?

A acidified potassium manganate(VII)

B acidified potassium dichromate(VI)

C aqueous potassium iodide

D chlorine gas

24 W, X, Y and Z are metals. When the metals are heated with an oxide of another metal, the following results are obtained.

oxide of Z + W → oxide of W + Z

oxide of X + W → no reaction

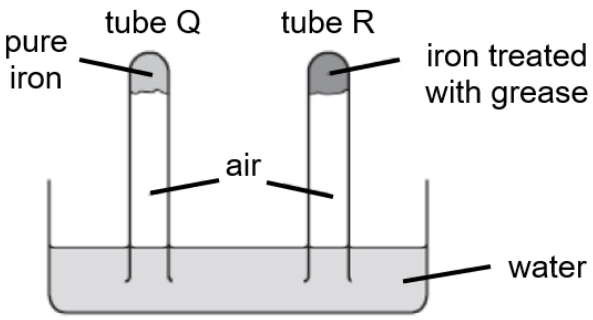
oxide of Z + Y → oxide of Y + Z

oxide of W + Y → no reaction

What is the correct arrangement of metals W, X, Y and Z in order of decreasing reactivity?

	most reactive	→		least reactive
A	X	W	Y	Z
B	Y	X	W	Z
C	W	X	Y	Z
D	Z	Y	W	X

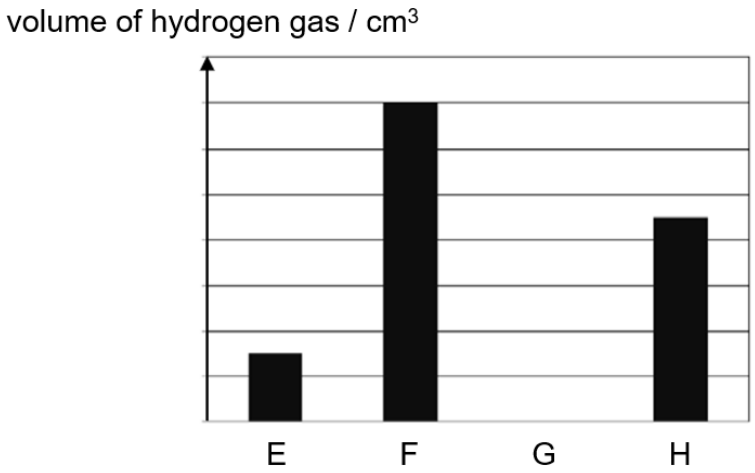
25 An experiment to investigate the effect of treating iron with grease is shown.



After seven days, what would happen to the water levels in tubes Q and R?

	tube Q	tube R
A	falls	no change
B	no change	rises
C	rises	no change
D	rises	rises

26 The bar chart below shows the volume of hydrogen gas collected in 1 min when equal masses of metals E, F, G and H are added to excess dilute nitric acid.



The carbonates of these metals were then heated.

Which row correctly shows the temperature required to decompose the carbonates of these metals in increasing order?

	increasing temperature →			
A	F	E	H	G
B	F	H	E	G
C	G	E	F	H
D	G	E	H	F

27 Ammonia is produced by the Haber process.

$$N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g) \qquad \Delta H = -92\ kJ/mol$$

Which statement about the Haber process is **not** correct?

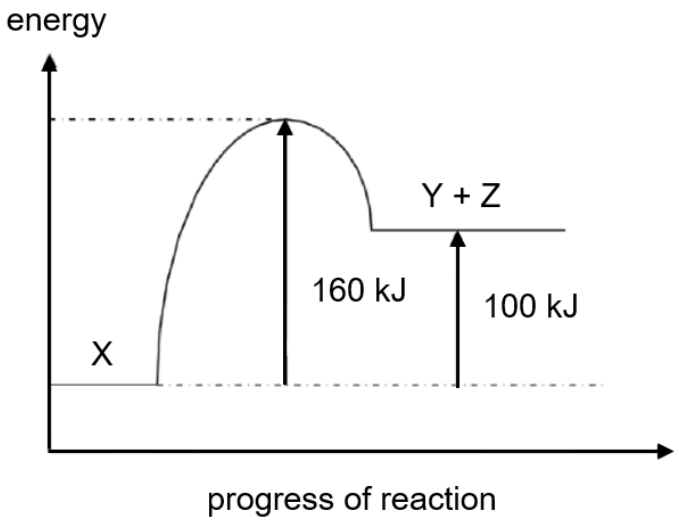
A An iron catalyst is used.

B Decreasing the temperature leads to an increase in the yield of ammonia.

C The hydrogen used is obtained from the fractional distillation of air.

D The yield of the reaction is always lower than 100 % as the reaction is reversible.

28 The diagram shows the energy profile for the decomposition of X to form products Y and Z.



What will be the activation energy for the reverse reaction?

A -160 kJ

B -60 kJ

C 60 kJ

D 160 kJ

29 The reaction between hydrogen and chlorine is represented by the equation shown.

$$H_2 + Cl_2 \rightleftharpoons 2HCl \qquad \Delta H = -184 \text{ kJ/mol}$$

The H–H bond energy is 436 kJ/mol and the C*l*–C*l* bond energy is 242 kJ/mol.

What is the H–Cl bond energy?

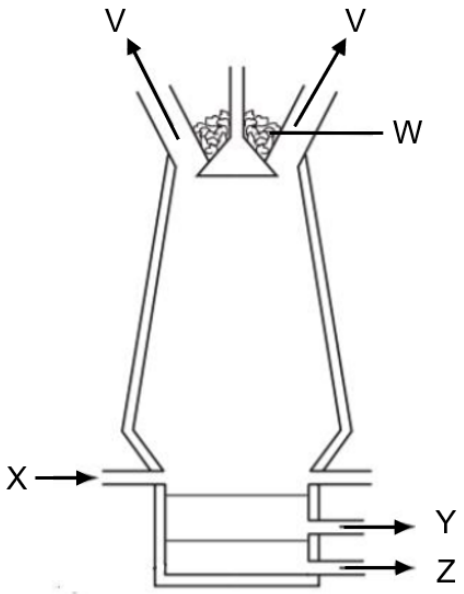
A 247 kJ/mol

B 431 kJ/mol

C 494 kJ/mol

D 862 kJ/mol

30 The diagram shows a blast furnace used in the extraction of iron.



Some statements about the extraction of iron are given.

I Air enters from X and waste gases escape from V.
II Haematite, limestone and coke are added to the furnace at W.
III Molten iron and slag is collected at Y and Z respectively.
IV Nitrogen is one of the main waste gases in the blast furnace.

Which statements about the extraction of iron in the blast furnace are correct?

A I and II only

B II and III only

C I, II and III only

D I, II and IV only

31 Magnesium reacts with dilute hydrochloric acid at a constant temperature of 25 °C.

Which statement about the rate of this reaction is correct?

A It decreases as the reaction proceeds.

B It decreases then increases as the reaction proceeds.

C It increases as the reaction proceeds.

D It remains the same as the reaction proceeds.

32 A metal fork is to be electroplated with nickel.

Which row correctly describes the set-up for this process?

	anode	cathode	electrolyte
A	metal fork	nickel	nickel(II) nitrate
B	metal fork	nickel	sulfuric acid
C	nickel	metal fork	nickel(II) nitrate
D	nickel	metal fork	sulfuric acid

33 Which pairs of statements correctly describe the differences between the conduction of electricity during electrolysis and the conduction of electricity by metals?

	conduction during electrolysis	conduction by metals
1	current is due to the movement of both positive and negative ions	current is due to the movement of electrons
2	charged particles move towards both electrodes	charged particles move in one direction only
3	results in a chemical change	does not result in a chemical change

A 1, 2 and 3 are correct

B 1 and 2 only are correct

C 2 and 3 only are correct

D 1 only is correct

34 Which atmospheric pollutants, emitted by internal combustion of engines, are reacted together to convert them to less harmful products?

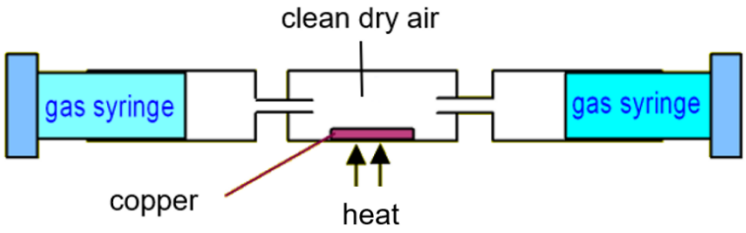
A carbon monoxide and nitrogen dioxide

B carbon monoxide and unburned hydrocarbons

C nitrogen dioxide and sulfur dioxide

D sulfur dioxide and unburned hydrocarbons

35 A sample of clean, dry air is passed over hot copper until all the oxygen in the air reacts with the copper. The volume of air decreases by 60 cm^3.



What is the approximate initial volume of the sample of air?

A 75 cm^3

B 120 cm^3

C 300 cm^3

D 600 cm^3

36 In an electrolysis experiment, the same amount of electrons deposited 3.90 g of zinc and 2.36 g of cobalt. The charge on the zinc ion was 2+.

[A_r: Co, 59; Zn, 65]

What is the charge of cobalt ion?

A 1+

B 2+

C 3+

D 4+

37 Which of the following could **not** be produced when methane reacts with fluorine in the presence of ultraviolet light?

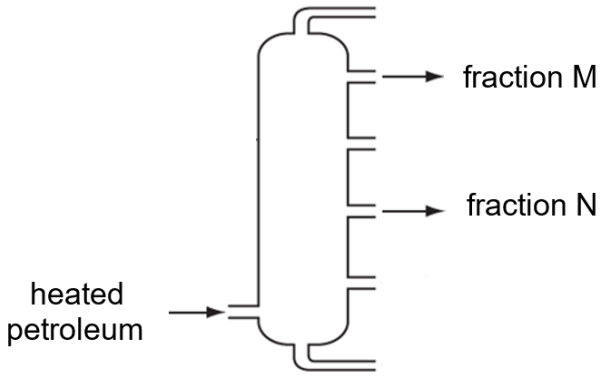
A fluoromethane

B hydrogen

C hydrogen fluoride

D tetrafluoromethane

38 The diagram shows the fractional distillation of petroleum.



Which row about fraction M and N is correct?

	M burns more easily than N	M has a higher boiling point than N	M is more viscous than N
A	true	false	false
B	true	true	false
C	false	true	true
D	false	false	true

39 Which statement about vegetable oil and the margarine made from it is correct?

A Both are liquids at room temperature and pressure.

B Both occur naturally.

C Margarine has a higher melting point.

D Vegetable oil has fewer carbon-carbon double bonds than margarine.

40 If one mole of each alcohol is burnt in excess oxygen, which alcohol will provide CO_2 and H_2O in a mole ratio of 3:4?

A CH_3OH

B C_2H_5OH

C C_3H_7OH

D C_4H_9OH

End of Paper 1

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

O

NORTHBROOKS SECONDARY SCHOOL
Preliminary Examination 2022
Secondary 4 Express

NORTHBROOKS

CANDIDATE NAME				
CLASS		INDEX NUMBER		

CHEMISTRY **6092/01**

Paper 1 **13 September 2022**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the Multiple Choice Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

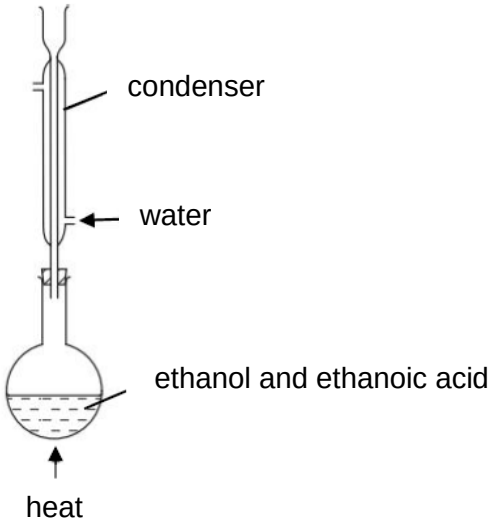
A copy of the Periodic Table is printed on page 18.

The use of an approved scientific calculator is expected, where appropriate.

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.

This document consists of 18 printed pages.

1 Ethanol and ethanoic acid can react to give ethyl ethanoate using the set-up below.



What is the function of the condenser in this set-up?

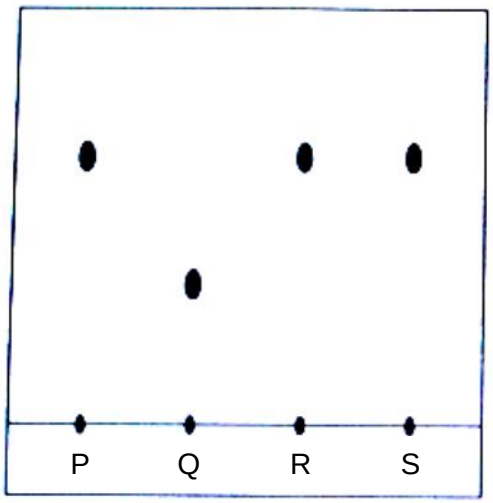
A To separate ethyl ethanoate from the ethanol and ethanoic acid

B To lower the temperature to prevent decomposition of ethyl ethanoate

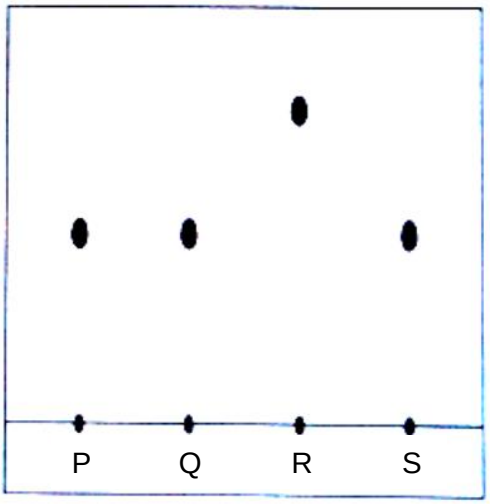
C To reduce the chances of the ethanol escaping from the reaction mixture

D To allow the ethanol to react with the oxygen in the air

2 An unknown sample, P, was tested using paper chromatography, together with three pigments, Q, R and S, using both water and ethanol as solvents.



using water



using ethanol

Which of the three pigments, Q, R or S, is P likely to be?

A Q only

B S only

C R and S only

D Q, R and S

3 A solid is thought to be pure hexanoic acid.

Which is the best way to test its purity?

A conduct paper chromatography

B determine its melting point

C measure its pH

D weigh it, burn it in oxygen, then weigh the products

4 Which of the following consists of an element, a compound and a mixture in the correct order?

A air, diamond, water

B helium, argon, sodium chloride

C limestone, zinc, lead

D sodium, carbon dioxide, salt water

5 Which statement about an atom is correct?

A Each element always has the same number of electrons and neutrons.

B Each element always has the same number of protons and neutrons.

C The nucleon number can be equal to the proton number.

D The nucleon number can be lesser than the number of electrons.

6 Antimony oxide has the formula Sb_2O_3 while potassium phosphate has the formula K_3PO_4.

What is the formula of antimony phosphate?

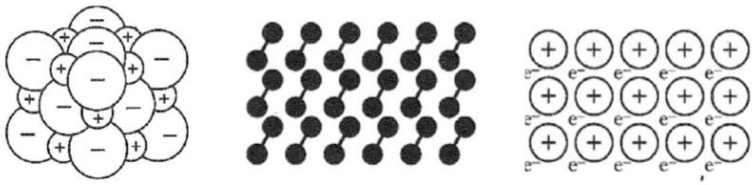
A $SbPO_4$

B Sb_2PO_4

C $Sb_2(PO_4)_3$

D Sb_3PO_4

7 The structures of three substances P, Q and R are shown below.



P Q R

Which statements are correct?

1 P and R can conduct electricity in the molten state.

2 P and R are compounds while Q is an element.

3 P and R have giant structures while Q has a simple structure.

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

8 In the molecules CH_3OH, NH_3 and HF, which atoms use all of their outer shell electrons in bonding?

A C and H

B C and F

C N and H

D H and O

9 Which sulfide shows the greatest mass of sulfur in a 6 g sample?

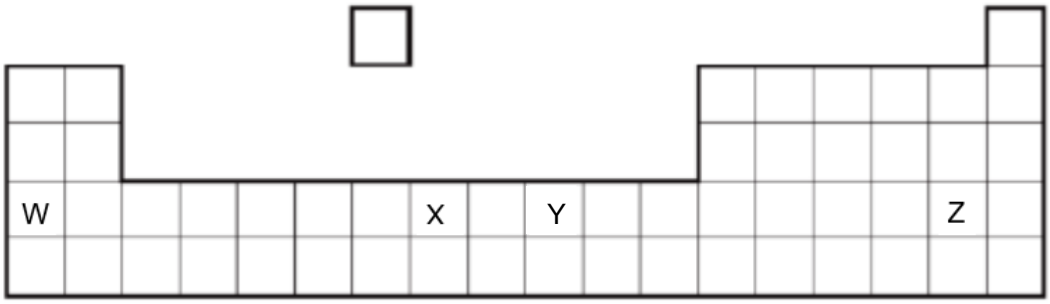
A Ag_2S

B FeS_2

C PbS

D SeS_2

10 Part of the Periodic Table is shown below.



1 Elements W, X and Y have high melting points.

2 Y is less reactive than W.

3 Z can form both ionic and covalent compounds.

4 X and Y form compounds that are coloured.

Which of the following statements are correct?

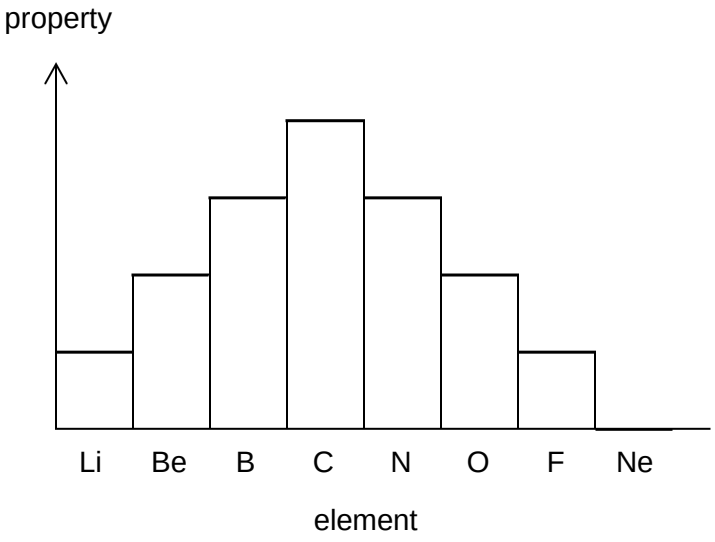
A 2 and 3 only

B 1, 2 and 3

C 1, 2 and 4

D 2, 3 and 4

11 The bar chart shows the period of elements from lithium to neon.



What information can be found from this bar chart?

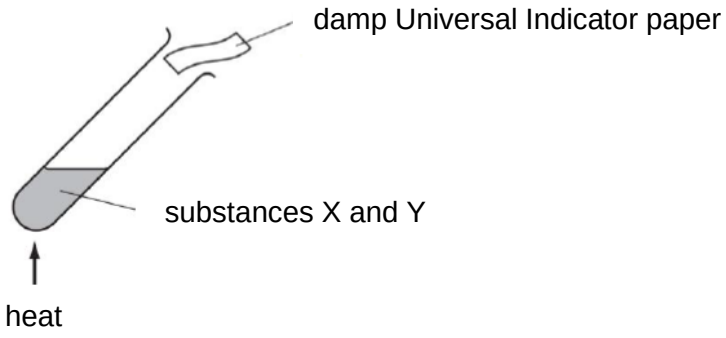
A the mass number

B the proton number

C the number of electrons used in bonding

D the number of shells which contain electrons

12 Two substances, X and Y are mixed and heated.



The damp Universal Indicator paper turns blue during the experiment.

What are substances X and Y?

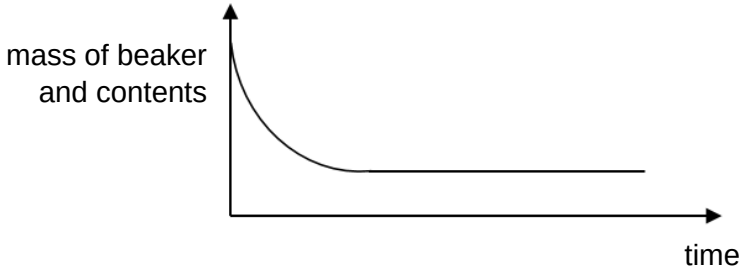
A barium hydroxide and ammonium chloride

B barium hydroxide and hydrochloric acid

C hydrochloric acid and ammonium nitrate

D hydrochloric acid and barium nitrate

13 Two solutions were mixed in a beaker and the mass of the beaker and contents was then recorded at various times. The graph below shows the results.



What could be the two solutions?

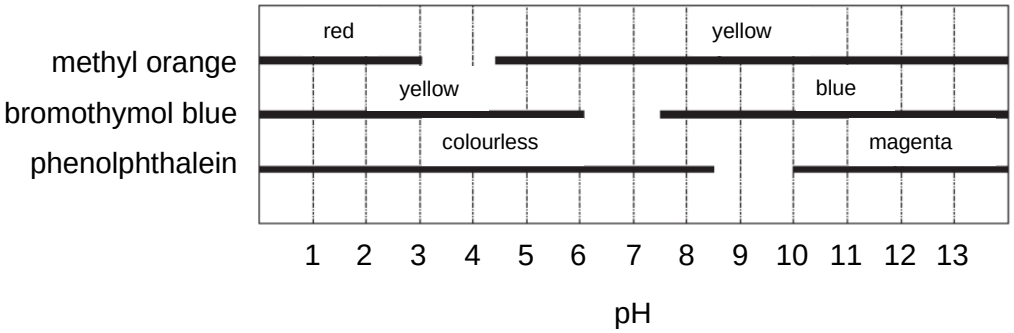
A aqueous copper(II) sulfate and aqueous ammonia

B aqueous copper(II) sulfate and dilute hydrochloric acid

C aqueous sodium hydroxide and zinc sulfate

D aqueous sodium carbonate and dilute nitric acid

14 The graph below shows the colour ranges of the acid-base indicators, methyl orange, bromothymol blue and phenolphthalein.



A solution, when placed in the three indicators separately, is yellow in methyl orange, blue in bromothymol blue and colourless in phenolphthalein.

What is the pH range of the solution?

A 2.5 to 3.5

B 4.5 to 5.5

C 7.5 to 8.5

D 9.5 to 10.5

15 The table shows the solubility of some lead salts in water.

salt	solubility in water
$PbCl_2$	slightly soluble in cold water, soluble in hot water
$PbCO_3$, $PbSO_4$	insoluble

What will be the best method for making a sample of lead(II) chloride?

A Add dilute hydrochloric acid to aqueous lead(II) nitrate, filter.

B Heat lead(II) sulfate with dilute hydrochloric acid, cool, filter.

C Heat excess powdered lead with hydrochloric acid, cool, filter.

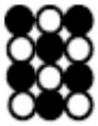
D Shake excess lead(II) carbonate with cold dilute hydrochloric acid, filter.

16 Which of the diagrams shows the structure of an alloy?

A

B

C



D

17 W, X, Y and Z are four metals which form cations W^+, X^{2+}, Y^+ and Z^{2+}.

The following are information on some of the reactions that the metals undergo.

$$X^{2+}(aq) + W(s) \rightarrow \text{no reaction}$$

$$Z^{2+}(aq) + 2W(s) \rightarrow 2W^{+}(aq) + Z(s)$$

$$Y_2CO_3(s) \xrightarrow{\text{heat}} \text{no reaction}$$

$$X_2CO_3(s) \xrightarrow{\text{heat}} XO(s) + CO_2(g)$$

What is the order of decreasing reactivity of the metals?

A X, W, Z, Y

B X, Y, Z, W

C Y, X, W, Z

D Z, W, X, Y

18 The table below shows the reactivity of four metals and their compounds.

metal	addition of dilute sulfuric acid to the metal	heating hydrogen with the metal oxide	adding metal to the aqueous sulfate of metal J
G	effervescence	metal G formed	no reaction
H	no reaction	metal H formed	no reaction
I	effervescence	no reaction	metal J formed
J	effervescence	no reaction	no reaction

What is the order of thermal stability of the metal carbonates from the most to the least thermal stable?

A H, G, J, I

B H, J, G, I

C I, G, H, J

D I, J, G, H

19 Scrap iron is often recycled.

Which reason for recycling is **not** correct?

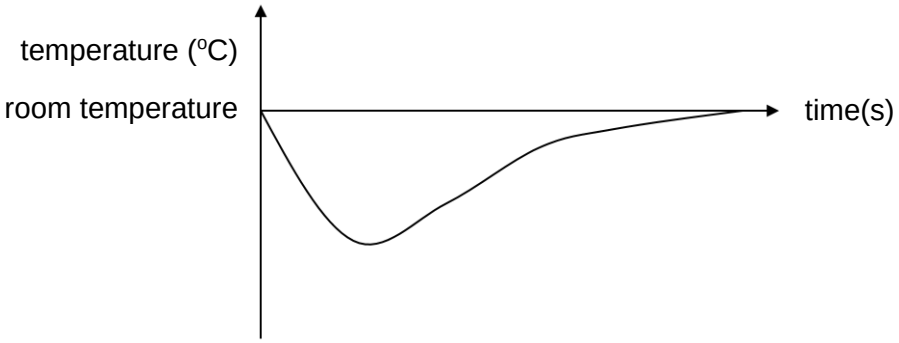
A It conserves the amount of iron ore.

B It reduces the amount of pollution due to extraction of iron from its ore.

C It reduces the amount of waste taken to landfill sites.

D It reduces the need to separate and collect the scrap iron from waste.

20 The graph below shows the change in temperature recorded during a chemical reaction.



What could this reaction be?

A burning magnesium ribbon in the presence of air

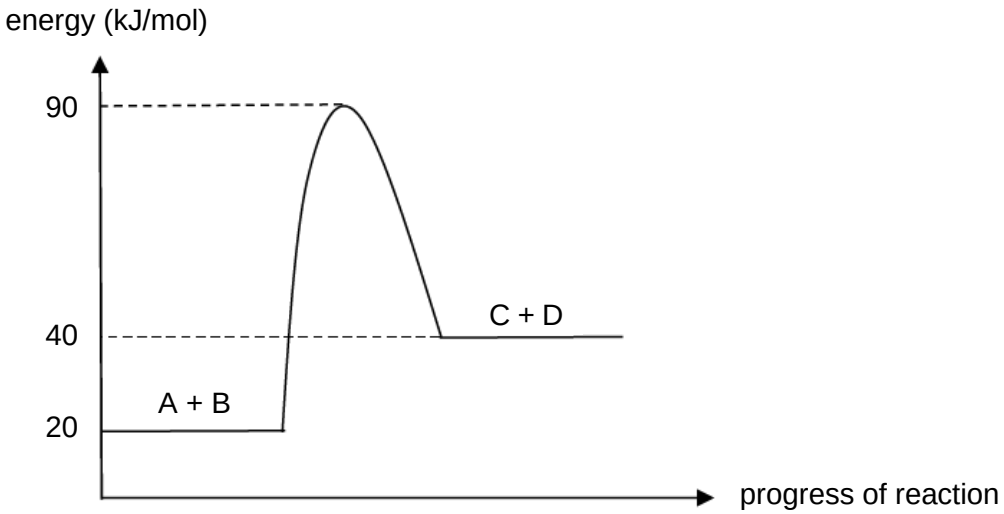
B combustion of petrol in the engines of vehicles

C dissolving ammonium chloride in water

D neutralisation of hydrochloric acid with sodium hydroxide

21 The energy profile diagram of a reversible reaction is shown below.

$$A + B \rightleftharpoons C + D$$



Which statement is correct about the energy profile diagram?

A Activation energy of the backward reaction is given by –50 kJ/mol.

B Activation energy of the forward reaction is given by +70 kJ/mol.

C Enthalpy change of the backward reaction is given by +20 kJ/mol.

D Enthalpy change of the forward reaction is given by +50 kJ/mol.

22 In the reaction between calcium carbonate and ethanoic acid, the following changes could be made to the conditions.

1 Increase the concentration of ethanoic acid

2 Increase the particle size of calcium carbonate

3 Increase the temperature of the system

4 Increase the pressure of the system

Which changes would increase the rate of reaction?

A 1 and 2 only

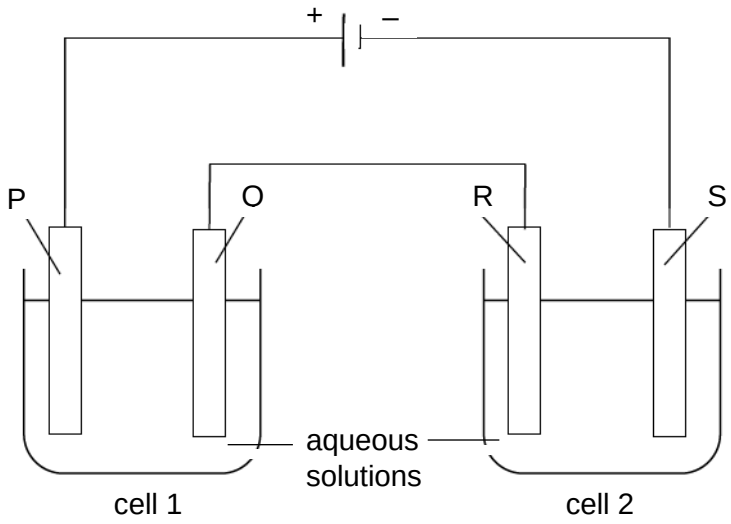
B 1 and 3 only

C 2 and 3 only

D 1, 2, 3 and 4

23 In the diagram below, each cell contains an aqueous solution of a single salt and all the four electrodes are platinum.

Electrode Q and S increase in mass during the electrolysis and no gas is given off at Q or S.



Which statement best explains why the increase in mass of Q is greater than the increase in mass of S over the same period of time?

A The cation of the solution in cell 1 is different from the cation of the solution in cell 2.

B The anion of the solution in cell 1 is different from the anion of the solution in cell 2.

C The current flowing in cell 1 is greater than the current flowing in cell 2.

D The loss in mass of electrode P is less than the loss in mass of electrode R.

24 Which statement is true for both simple and electrolytic cells?

	simple cell	electrolytic cell
A	It converts electrical energy into chemical energy.	It converts chemical energy into electrical energy.
B	Oxidation occurs at the negative electrode.	Oxidation occurs at the positive electrode.
C	Mass of the anode will decrease.	Mass of the anode will increase.
D	Electrons flow from the anode to the cathode.	Electrons flow from the cathode to the anode.

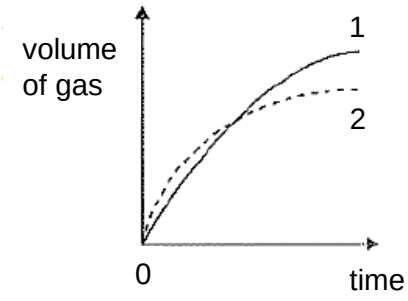
25 Two experiments are carried out to measure the volume of carbon dioxide produced when different concentrations of hydrochloric acid are added to excess calcium carbonate.

experiment	acid
1	50 cm^3 of 0.20 mol/dm^3 hydrochloric acid
2	20 cm^3 of 0.50 mol/dm^3 hydrochloric acid

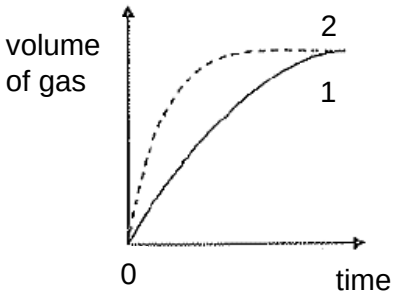
A graph of volume of carbon dioxide against time is plotted for both experiments.

Which graph best shows the results for these experiments?

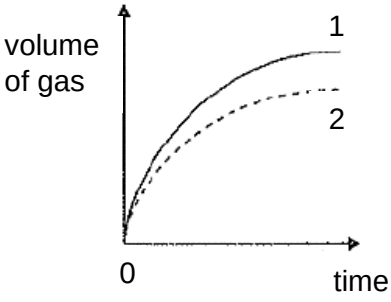
A



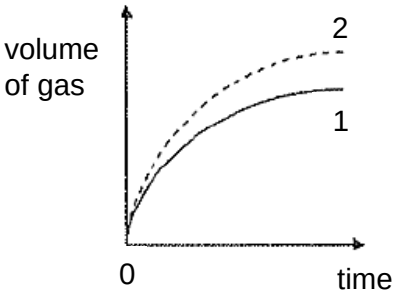
B



C



D



26 In which reaction is the pressure **least** likely to affect the rate of reaction?

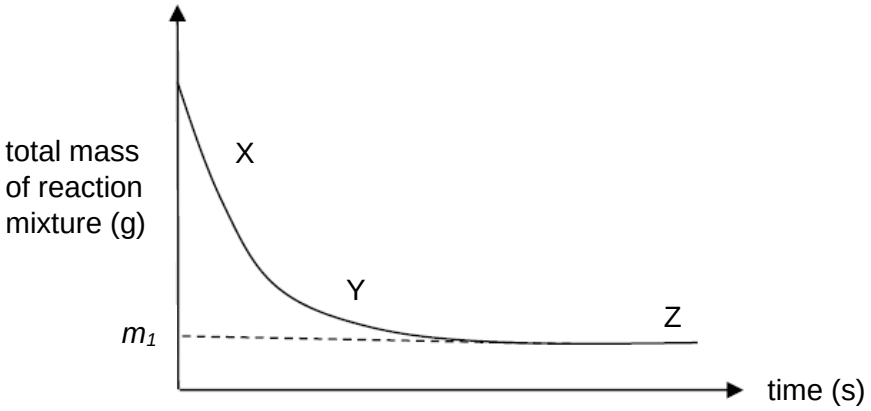
A $N_2\,(g) + 3H_2\,(g) \rightarrow 2NH_3\,(g)$

B $2SO_2\,(g) + O_2\,(g) \rightarrow 2SO_3\,(g)$

C $Fe_2O_3\,(s) + 3CO\,(g) \rightarrow 2Fe\,(l) + 3CO_2\,(g)$

D $Mg\,(s) + H_2SO_4\,(aq) \rightarrow MgSO_4\,(aq) + H_2\,(g)$

27 When an excess copper(II) carbonate is added to dilute sulfuric acid, the total mass of the reaction mixture is measured over a period of time as shown in the graph below.



Which statement about the curve is correct?

A All copper(II) carbonate has reacted at Z.

B The change from X to Y is due to the insoluble layer of salt formed.

C The concentration of the acid at Y is lower than at X.

D The mass of carbon dioxide produced is m_1 g.

28 Disproportionation is a reaction in which the same element is both oxidised and reduced.

Which reaction is an example of disproportionation?

A $2H_2O_2 \rightarrow 2H_2O + O_2$

B $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

C $H_2SO_3 + H_2O_2 \rightarrow H_2SO_4 + H_2O$

D $Cu + 2H_2SO_4 \rightarrow CuSO_4 + 2H_2O + SO_2$

29 The Haber process is a reversible reaction as some of the ammonia formed is unstable and it decomposes readily back into its reactants.

Which method is used to prevent this from happening?

A adding water to dissolve ammonia

B cooling the mixture to liquefy ammonia

C filter the mixture to remove ammonia

D fractional distil the mixture to separate ammonia gas

30 To reduce atmospheric pollution, waste gases from coal-burning power stations are passed through powdered calcium carbonate.

Which of the following gas will **not** be removed by the powdered calcium carbonate?

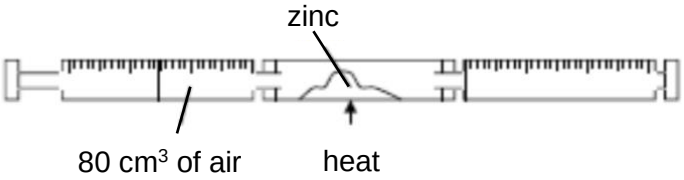
A carbon monoxide

B nitrogen dioxide

C phosphorous(V) oxide

D sulfur dioxide

31 An 80 cm^3 sample of air is trapped in a gas syringe. The air is slowly passed over heated zinc in a tube until there is no further change in the volume of air.



What is the approximate final volume of air in the gas syringe?

A 16 cm^3

B 40 cm^3

C 56 cm^3

D 64 cm^3

32 What is the volume of air required for a mixture of 20 cm^3 of methane and 40 cm^3 of carbon monoxide to burn completely?

A 60 cm^3

B 80 cm^3

C 300 cm^3

D 400 cm^3

33 Which atmospheric pollutants, emitted by internal combustion engines, are reacted together to convert them into less harmful products?

A nitrogen dioxide and sulfur dioxide

B nitrogen dioxide and carbon monoxide

C unburnt hydrocarbons and carbon monoxide

D unburnt hydrocarbons and carbon dioxide

34 When crude oil is fractionally distilled, which compounds leave from the bottom of the fractionating column?

A The compounds that are the least flammable.

B The compounds that are the least viscous.

C The compounds with the lowest relative molecular mass.

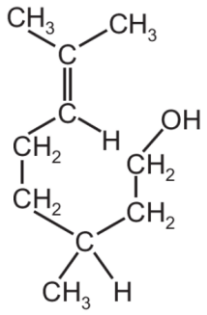
D The compounds with the lowest boiling points.

35 When dodecane, $C_{12}H_{26}$, is cracked, only three hydrocarbons are formed. The hydrocarbons are ethene, propane and propene.

What is the ratio of the hydrocarbons formed?

	ethene	propane	propene
A	1	1	1
B	1	1	3
C	1	3	1
D	3	1	1

36 Citronellol is found in rose oil. The structure of citronellol is shown.



Which statement about citronellol is **not** correct?

A Citronellol reacts with sodium hydroxide to produce salt and water.

B Citronellol turns purple acidified potassium manganate(VII) colourless.

C Citronellol reacts with hydrogen in the presence of a catalyst.

D Citronellol forms a polymer with the same empirical formula.

37 The chemical equation for a reaction is shown below.

$$CH_3COOH + Br_2 \leftrightharpoons CH_2BrCOOH + HBr$$

What is this reaction also known as?

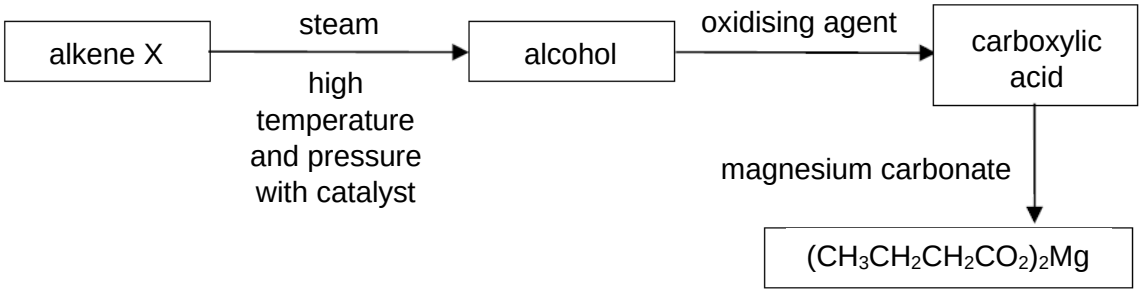
A addition reaction

B condensation reaction

C esterification reaction

D substitution reaction

38 A reaction scheme for an alkene X is given. The alkene underwent a series of reactions to obtain the salt, $(CH_3CH_2CH_2CO_2)_2Mg$.



What is alkene X?

A $CH_3CH=CH_2$

B $CH_3CH=CHCH_3$

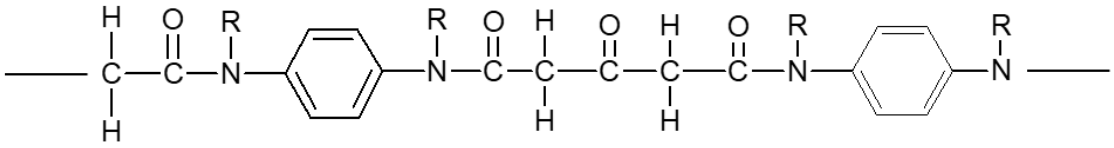
C $CH_3CH_2CH=CH_2$

D $CH_3CH_2CH_2CH=CH_2$

39 How does the number of carbon, hydrogen and oxygen atoms in an ester differ from the total number of carbon, hydrogen and oxygen atoms in the alcohol and carboxylic acid from which the ester was derived?

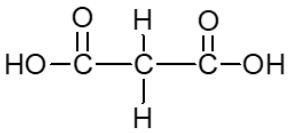
	carbon atoms	hydrogen atoms	oxygen atoms
A	same	same	same
B	less	same	less
C	same	less	less
D	less	less	less

40 A section of a polymer is shown below.

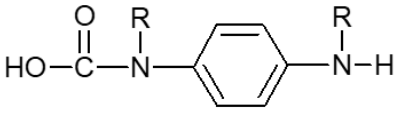


Which of the following shows a monomer involved in the formation of the above polymer?

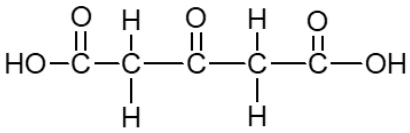
A



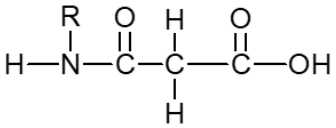
B



C



D



End of Paper

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

NAME:		INDEX NO:		CLASS:	

NORTHLAND SECONDARY SCHOOL
PRELIMINARY EXAMINATION
Secondary Four Express

CHEMISTRY 6092/01

Paper 1 Multiple Choice **31 August 2022**

Additional Materials: Multiple Choice Answer Sheet **1 hour**

READ THESE INSTRUCTIONS

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your class, index number and name on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions in this section. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

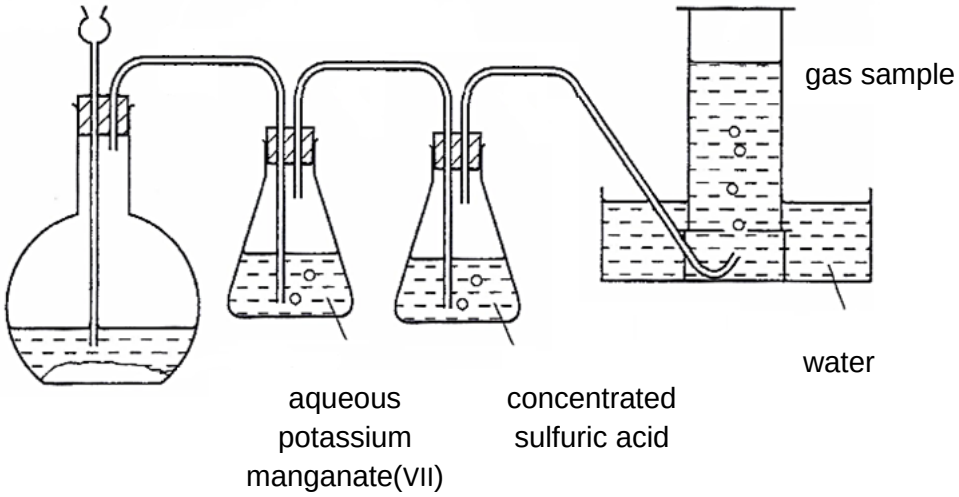
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 19.
The use of an approved scientific calculator is expected, where appropriate.

SECTION	FOR EXAMINER'S USE
TOTAL	40

Setter: Mdm Kumari **Vetter: Mdm Nilasari**

This document consists of **19** printed pages including the cover page and **1** blank page.

1 The diagram shows apparatus used to obtain a gas sample from a mixture of nitrogen, carbon monoxide, carbon dioxide and ammonia.



Which gases would be present in the gas sample?

A carbon monoxide and ammonia only
B carbon monoxide and carbon dioxide only
C nitrogen and ammonia only
D nitrogen and carbon dioxide only

2 A student is given 750 cm^3 of a saturated solution containing a sodium salt S and 550 cm^3 of a saturated solution containing a potassium salt P. Both salts do not decompose on heating.

Which apparatus must she use to enable her to determine which salt is more soluble?

1 2 3 4 5 6

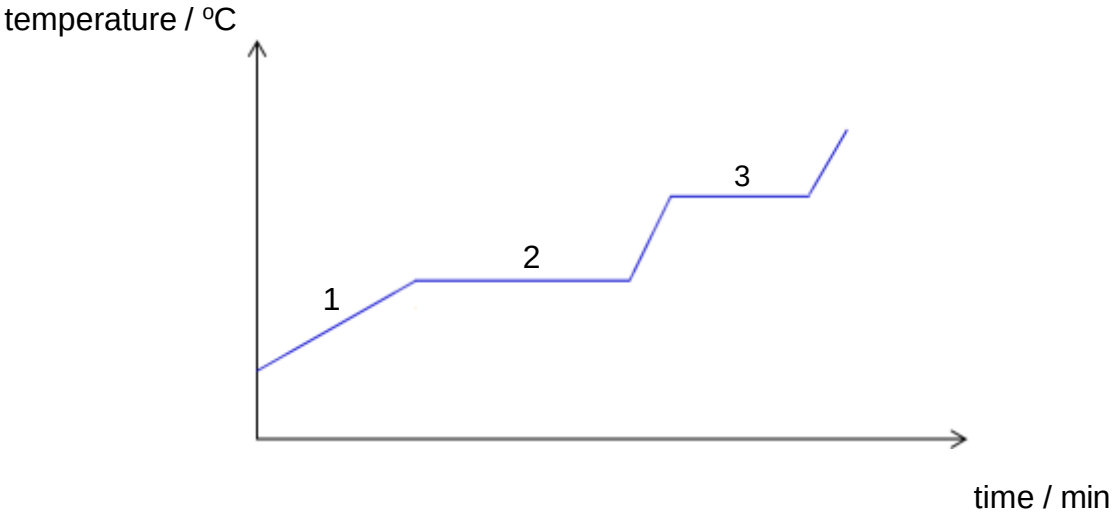
A 1, 4 and 6

B 1, 5 and 6

C 1, 2, 3 and 4

D 2, 4, 5 and 6

3 The graph shows the changes in temperature when a mixture containing equal volumes of X (boiling point 78 °C) and Y (boiling point 108 °C) is heated and separated by fractional distillation.

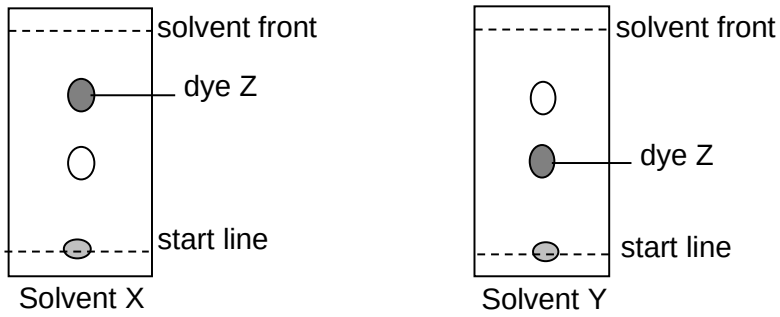


Which section(s) describe(s) the concentration of vapours X and Y correctly?

section	concentration of vapours
1	equal X and Y in the distilling flask
2	more X than Y in the condenser
3	more X than Y in the condenser

A 2 only
B 1 and 2 only
C 2 and 3 only
D 1, 2 and 3

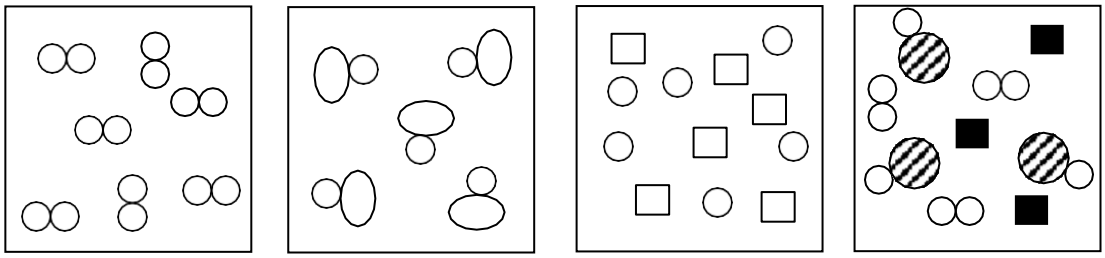
4 In a paper chromatography experiment involving some food colouring, two different solvents X and Y were used on separate samples of the colouring. The two chromatograms are shown.



Which statement can be deduced from the results?

A Dye Z is equally soluble in solvent X and solvent Y.
B Dye Z is more soluble in solvent Y than solvent X.
C The distance dye Z travels depends on the amount of colouring used.
D The distance dye Z travels depends on the solvent used.

5 Four substances 1 to 4 can be represented by the diagrams.



A student described them as follows:

Substance	Description
1	Mixture of elements
2	Molecules of a compound
3	Molecules of an element
4	Mixture of elements and compounds

Which substance(s) has/have been correctly described by the student?

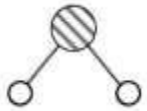
A 1 only
B 4 only
C 2 and 4 only
D 1, 2 and 3 only

6 Element J exists mostly as the isotope ^{51}J, which makes up 77.8% of a sample of the element. The other known isotope is ^{54}J.

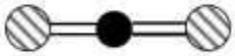
What is the relative atomic mass of element J?

A 51.7
B 51.9
C 52.5
D 53.4

7 The structural diagrams of two molecules, X_2Y and ZY_2, are shown.



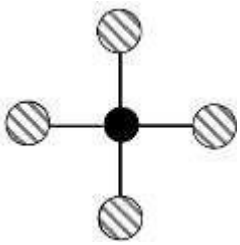
X_2Y



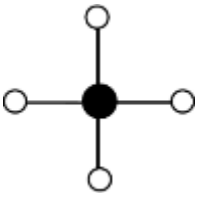
ZY_2

Which diagram represents a molecule of a compound formed between X and Z?

A



B



C

D

8 Which substance could be graphite?

	melting point / °C	boiling point / °C	Electrical conductivity when solid
A	-52	-2	poor
B	98	883	good
C	648	1294	poor
D	3652	4827	good

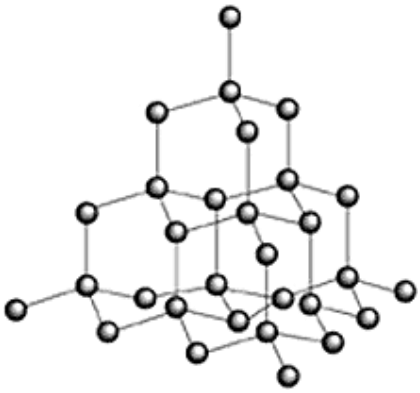
9 The table gives the proton and nucleon numbers of atoms P, Q, R and S.

atom	proton number	nucleon number
P	6	14
Q	7	14
R	16	32
S	20	40

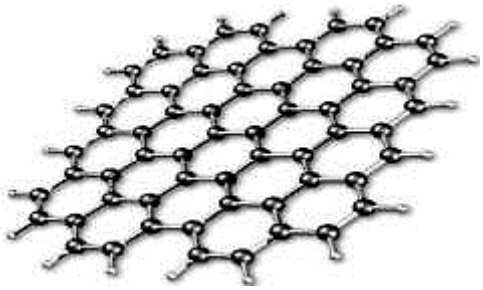
Which statement is true?

A Atom P and atom Q are isotopes of the same element.
B Atom P and atom R will combine to form a covalent compound.
C Atom Q and atom S will form an ionic compound with the formula S_2Q_3.
D Atom S can form a diatomic molecule.

10 The diagrams show the structures of diamond and graphene, made up of carbon atoms in different arrangements



diamond



graphene

Which row shows the correct properties of diamond and graphene?

	diamond	graphene
A	good electrical conductor	poor electrical conductor
B	poor electrical conductor	poor electrical conductor
C	high melting point	high melting point
D	low melting point	high melting point

11 Chlorobutane, C_4H_9Cl, can be made from butanol using the reaction shown.

$$C_4H_9OH + HCl \longrightarrow C_4H_9Cl + H_2O$$

In an experiment, 20 g of butanol produced 24 g of chlorobutane.

What is the percentage yield of chlorobutane?
[M_r of C_4H_9OH: 74; M_r of C_4H_9Cl: 92.5]

A 19.5 %
B 48.0 %
C 55.3 %
D 96.0 %

12 *x* cm^3 of gaseous hydrogen chloride, measured at room temperature and pressure, was dissolved in water to make 200 cm^3 of hydrochloric acid. 20.0 cm^3 of the hydrochloric acid prepared required 30.0 cm^3 of 0.1 mol/dm^3 sodium hydroxide for complete neutralisation.

What is the value of *x*?

A 0.110 cm^3
B 1.10 cm^3
C 72.0 cm^3
D 720 cm^3

13 Tin is extracted from its ore, SnO_2, by reducing it with carbon in a furnace. The equation for the reaction is shown.

$$SnO_2 + 2C \rightarrow Sn + 2CO_2$$

What is the percentage purity of tin ore if 600 g of the tin ore is reduced to produce 82 g of tin?

[A_r of Sn: 119, M_r of SnO_2: 151]

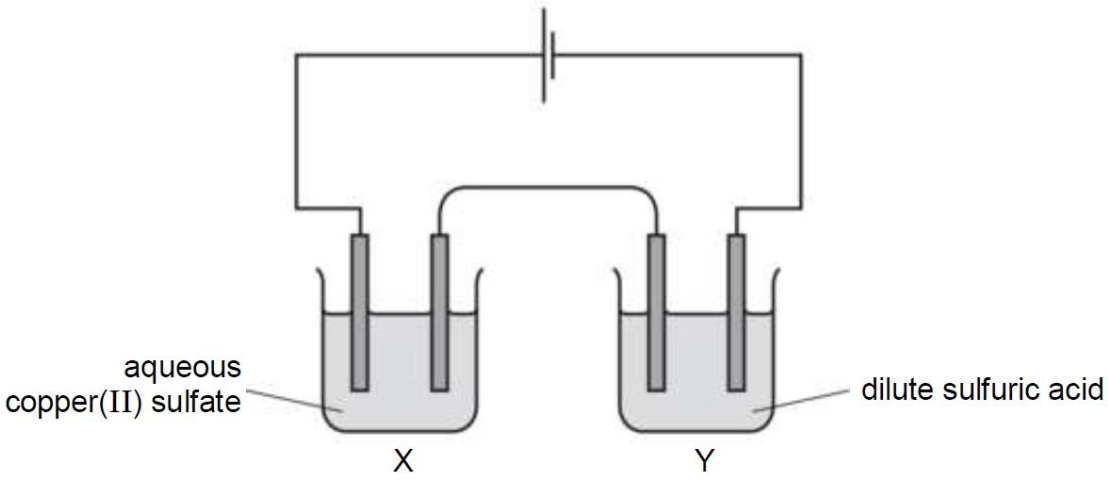
A $\frac{82}{119} \times \frac{151}{600} \times 100$

B $\frac{82}{119} \times \frac{600}{151} \times 100$

C $\frac{119}{82} \times \frac{151}{600} \times 100$

D $\frac{119}{82} \times \frac{600}{151} \times 100$

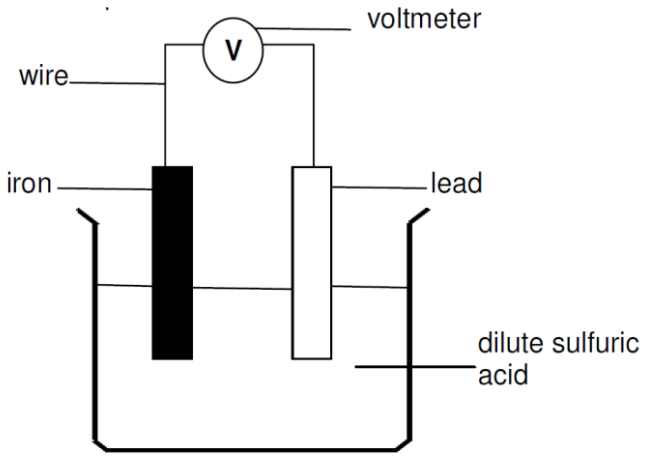
14 The diagram shows an electrolysis experiment using inert electrodes.



Which row indicates the concentration of the electrolytes in X and Y after some time?

	X	Y
A	changes	changes
B	changes	unchanged
C	unchanged	changes
D	unchanged	unchanged

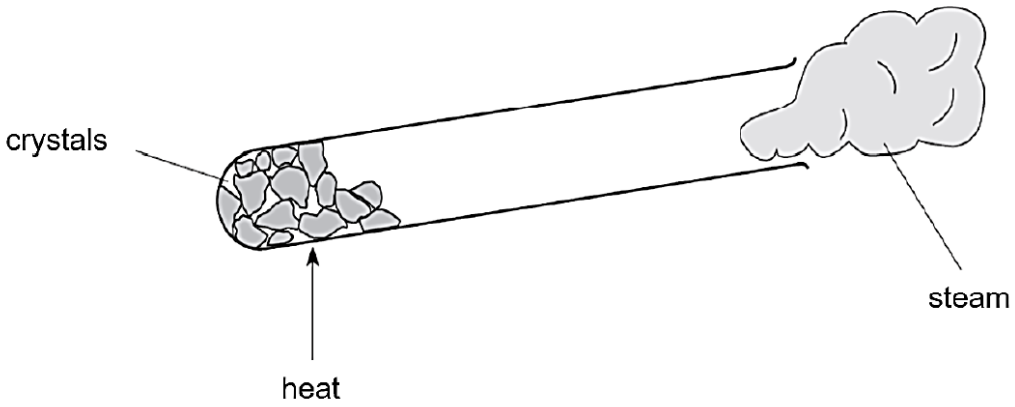
15 The diagram shows a simple cell.



Which half-equations best represent the reactions occurring at the positive and the negative electrode?

	negative electrode	positive electrode
A	$Fe \longrightarrow Fe^{2+} + 2e^-$	$Pb^{2+} + 2e^- \longrightarrow Pb$
B	$Fe \longrightarrow Fe^{2+} + 2e^-$	$2H^+ + 2e^- \longrightarrow H_2$
C	$2H^+ + 2e^- \longrightarrow H_2$	$Fe \longrightarrow Fe^{2+} + 2e^-$
D	$Pb^{2+} + 2e^- \longrightarrow Pb$	$2H^+ + 2e^- \longrightarrow H_2$

16 The diagram shows crystals of copper(II) sulfate, $CuSO_4.5H_2O$, being heated.

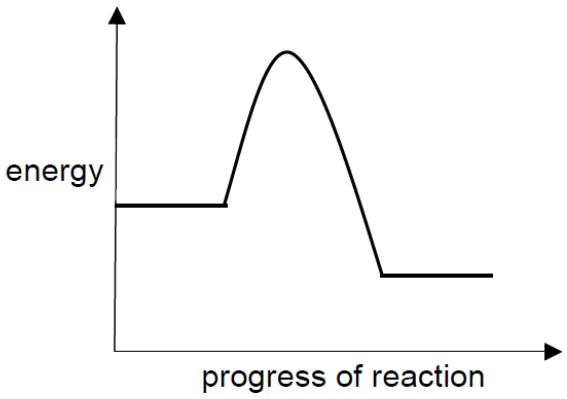


The copper(II) sulfate crystals were noted to have changed colour during the heating.

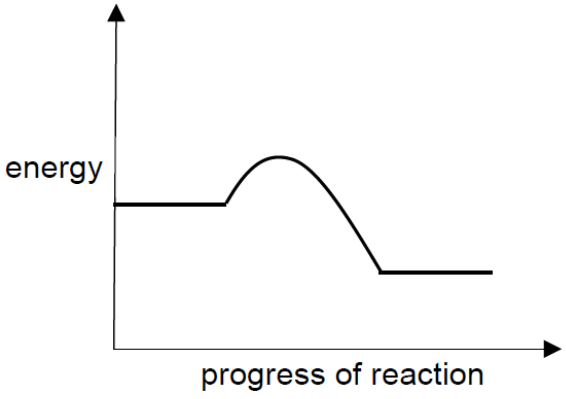
Which two terms best describe the changes observed in the above diagram?

A endothermic and dehydration
B endothermic and hydration
C exothermic and dehydration
D exothermic and hydration

17 The diagrams show the energy profile diagrams of the same chemical reaction carried out under 2 different conditions.



Reaction 1



Reaction 2

Which statement is true?

A Reaction 1 is exothermic and took place at a slower rate.
B Reaction 1 is exothermic while reaction in Reaction 2 is endothermic.
C Reaction 1 took place at a higher temperature and a faster rate than Reaction 2
D Reaction 2 is endothermic and the concentrations of the reactants were lower.

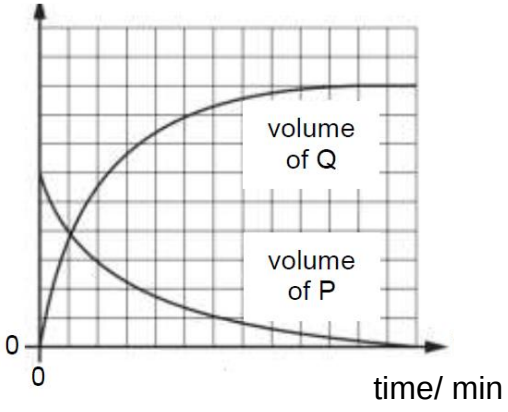
18 Gas P decomposes to form gas Q as shown in the equation.

$$xP \rightarrow yQ$$

Two experiments are conducted to investigate how different temperatures affect the rate of decomposition of gas P. The results of the experiments are shown.

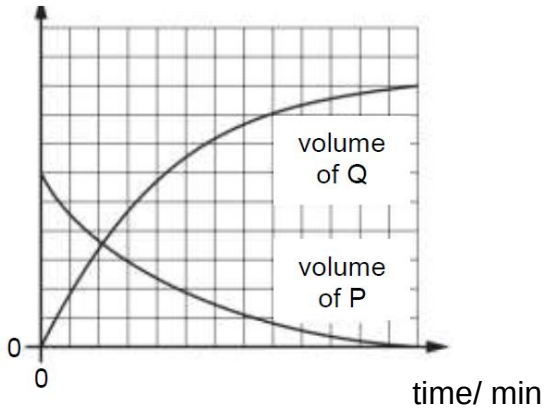
temperature T_1

Volume of gas/ cm^3



temperature T_2

Volume of gas/ cm^3

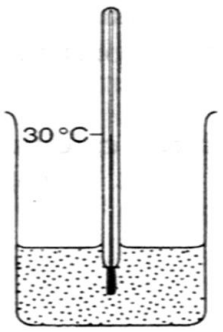


Whichof the followingw is correct?

	x	*y*	temperature
A	2	3	T_1 is higher than T_2
B	2	3	T_2 is higher than T_1
C	3	2	T_1 is higher than T_2
D	3	2	T_2 is higher than T_1

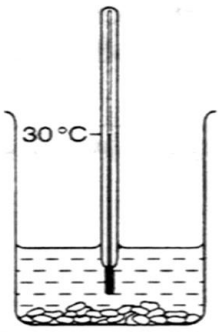
19 The thermometer shows the temperature at the start of the reaction in each beaker.

Which beaker shows the fastest rate of reaction?



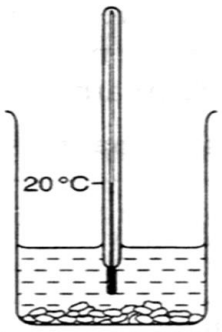
1 g of marble powder in 200 cm^3 of 3 mol/dm^3 HC*l*

A



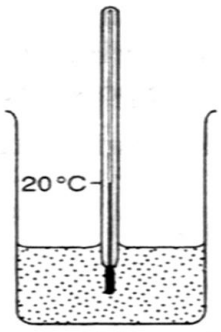
1 g of marble chips in 200 cm^3 of 2 mol/dm^3 HC*l*

B



1 g of marble chips in 200 cm^3 of 2 mol/dm^3 HC*l*

C



1 g of marble powder in 200 cm^3 of 1 mol/dm^3 HC*l*

D

20 A reaction can be represented by the following equation.

$3Na_2SO_3 + Cr_2O_7^{2-} + 8H+ \rightarrow 3Na_2SO_4 + 2Cr^{3+} + 4H_2O$

Which statement about the reaction is **incorrect?**

A Na_2SO_3 is acting as a reducing agent.
B The oxidation state of chromium is increased from -2 to +3.
C The oxidation state of sulfur is increased from +4 to +6.
D The reaction takes place in an acidic medium.

21 Which equation shows the greatest change in oxidation number for nitrogen?

A $2NO + O_2 \rightarrow 2NO_2$
B $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$
C $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
D $4NH_3 + 6NO \rightarrow 5N_2 + 6H_2O$

22 Industrial ammonia is obtained by the Haber process.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92$ kJ/mol

Which statement about the process is **incorrect**?

A High pressure favours the production of ammonia but is difficult to maintain.
B The hydrogen needed is obtained mainly by cracking of petroleum oil.
C The industrial catalyst used is finely divided iron.
D The reaction is endothermic, hence a temperature of 450 ^oC is used.

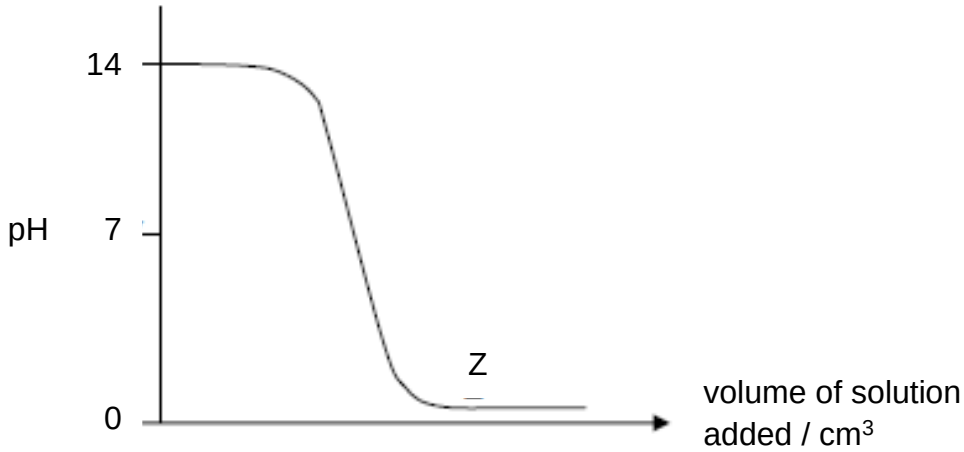
23 When performing an experiment, a student made the following observations.

1 The solution changes colour.
2 No bubbles of gas are formed.
3 No precipitate is formed.

Which pair of chemicals could the student have added together to obtain the above observations?

A aqueous calcium nitrate and aqueous ammonia
B aqueous lead(II) nitrate and aqueous magnesium chloride
C dilute nitric acid and barium carbonate
D dilute nitric acid and copper(II) oxide

24 The graph shows how the pH changes in a reaction between an acid and an alkali.



Which statements could be deduced from the graph?

1 An acid is added to a fixed volume of an alkali.
2 Only salt and water are present at part Z of the graph.
3 Neutralisation occurs at about pH 7.

A 1 and 2
B 1 and 3
C 2 and 3
D all of the above

25 When dilute sulfuric acid and potassium hydroxide react, potassium hydrogen sulfate, $KHSO_4$, is formed first.

$$H_2SO_4(aq) + KOH(aq) \rightarrow KHSO_4(aq) + H_2O(l)$$

Aqueous potassium hydrogen sulfate dissociates into ions.

$$KHSO_4(aq) \rightarrow K^+(aq) + H^+(aq) + SO_4^{2-}(aq)$$

If more potassium hydroxide is added, potassium sulfate can be formed.

$$KHSO_4(aq) + KOH(aq) \rightarrow K_2SO_4(aq) + H_2O(l)$$

Which results for these two salts, when tested with blue litmus paper and lead(II) nitrate solution are correct?

	salt	effect on blue litmus	addition of lead(II) nitrate solution
A	$KHSO_4$ K_2SO_4	no effect no effect	no precipitate no precipitate
B	$KHSO_4$ K_2SO_4	turns red no effect	white precipitate white precipitate
C	$KHSO_4$ K_2SO_4	no effect turns red	no precipitate no precipitate
D	$KHSO_4$ K_2SO_4	turns red turns red	white precipitate white precipitate

26 Which is the best way to prepare barium sulfate, starting from barium carbonate?

A Add dilute sulfuric acid to barium carbonate and then filter.
B Add excess aqueous sodium sulfate to barium carbonate and then filter.
C Add excess nitric acid to barium carbonate followed by dilute sulfuric acid and filter.
D Heat barium carbonate and then react the barium oxide with dilute sulfuric acid, then filter.

27 The diagram shows the positions of elements R ,S, T, U and V in the Periodic Table.

Which statement is correct?

A T forms an ionic compound with U.
B The metallic character of Period 2 elements increases from S to U.
C The valence shell of an atom of R has an octet structure.
D V is a stronger reducing agent than S.

28 Which statement about the alkali metals is correct?

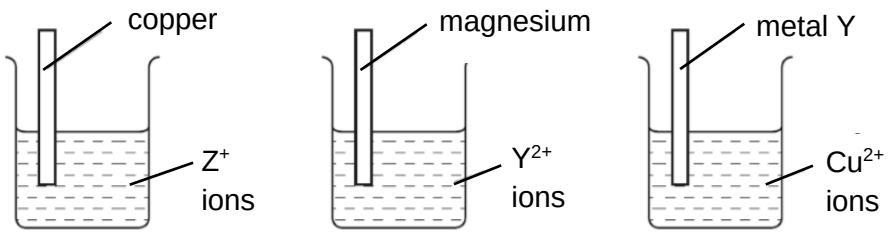
A Their melting points decrease on descending the group
B Their reactivities decrease on descending the group.
C They form covalent bonds with Group VII elements.
D They form oxides on reacting with water.

29 An inert gas X is used to fill weather balloons.

Which descriptions of X are correct?

	number of valence electron(s) in atoms of X	structure of gas X
A	2	single atoms
B	2	diatomic molecules
C	8	single atoms
D	8	diatomic molecules

30 A student conducted three experiments to compare the reactivities of four different metals: copper, magnesium, metal Y and metal Z.

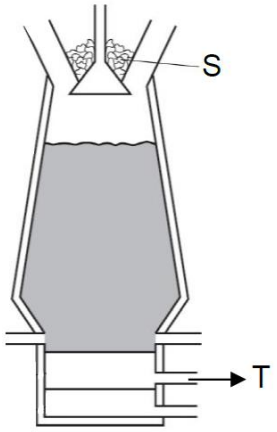


A deposit was observed on the metal strip for each experiment.

How many metal(s) that are investigated will be able to react with aqueous hydrochloric acid?

A 1
B 2
C 3
D 4

31 The diagram shows a blast furnace used to extract iron from haematite.



Which statement about the method of extraction is correct?

A Acidic impurities like sand are removed as slag which floats at T.
B Haematite, coke, hot air and limestone are added into the furnace through S.
C Haematite is oxidised to iron by the carbon monoxide which forms inside the furnace.
D Limestone reduces haematite to iron and carbon dioxide.

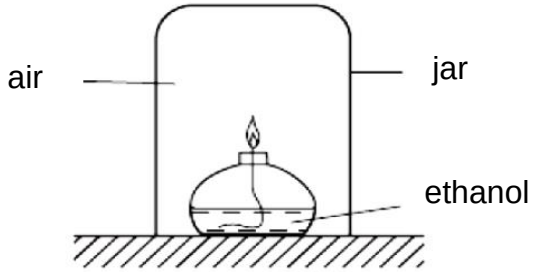
32 The diagram shows a boat made from iron.

Some magnesium blocks are attached to the iron below the water line.

How does the magnesium stop the iron boat from rusting?

A Magnesium corrodes in preference to the iron.
B Magnesium forms an alloy with the iron.
C Magnesium prevents oxygen in the water from reacting with iron.
D Magnesium reacts to form a protective coating of magnesium oxide on the iron.

33 The diagram shows ethanol burning in a sealed jar.



The mass of one gas in the jar does not change.

Which gas is it?

A carbon dioxide
B nitrogen
C oxygen
D water

34 The following are statements about air pollutants.

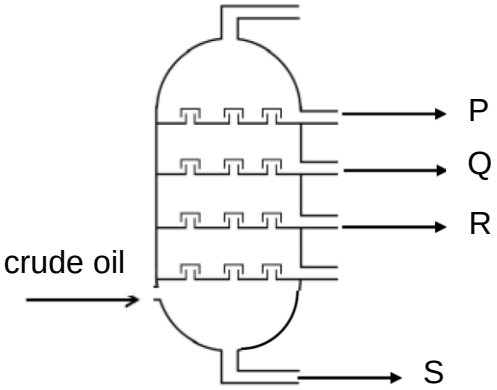
1 Carbon monoxide is responsible for the production of acid rain.
2 Oxides of nitrogen are present in car exhausts.
3 Sulfur dioxide can be produced by the combustion of fossil fuels.
4 Methane causes global warming.

Which statements are correct?

A 1 and 2 only
B 3 and 4 only
C 2, 3 and 4 only
D 1, 2, 3 and 4

Refer to the diagram to answer Questions **35** and **36**.

35 The diagram shows a fractionating column used for the refining of crude oil.



Which statements about the fractions P, Q, R and S are correct?

1 Fraction P has the lowest viscosity.
2 Fraction P is more flammable than fraction Q.
3 Fraction S has a smaller range of boiling points than fraction R.
4 All four fractions contain a mixture of hydrocarbons.

A 1 and 2 only
B 2 and 3 only
C 1 and 4 only
D 1, 2 and 4 only

36 Which fraction is used for paving roads?

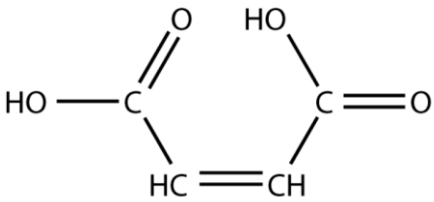
A Fraction P
B Fraction Q
C Fraction R
D Fraction S

37 0.4 mol of a polyunsaturated hydrocarbon was reacted with excess iodine until there was no further reaction. It was found that the product had an increase of 305 g.

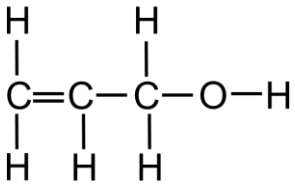
How many carbon-carbon double bonds did the hydrocarbon contain?

A 2
B 3
C 4
D 5

38 The structures of butenedioic acid and propenol are shown.



butenedioic acid



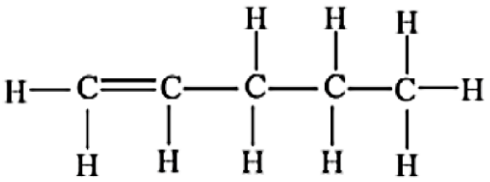
propenol

How many substance(s) can be used to distinguish between the two compounds?

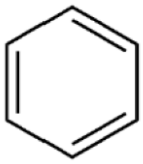
- aqueous bromine
- copper(II) carbonate
- acidified potassium manganate(VII) solution

A 0
B 1
C 2
D 3

39 The diagram shows the structural formula of pentene together with a simplified version that most chemists use.

structural formula of pentene	simplified version
	

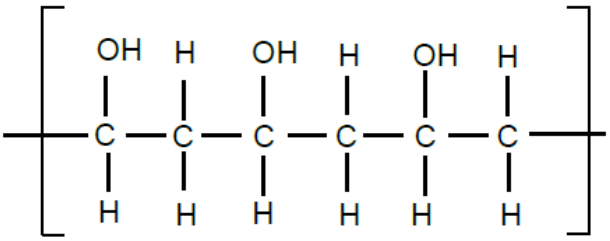
Benzene is a colourless and highly flammable hydrocarbon that is responsible for the aroma around petrol stations due to a sweet smell the liquid gives out. The simplified version of the structure of benzene is shown.



What is the empirical formula of benzene?

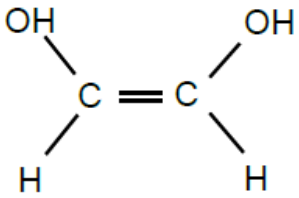
A CH
B CH_2
C C_2H
D C_2H_3

40 Polyethenol is a new plastic, which is water soluble. This plastic is useful in hospitals for keeping soiled laundry and thereby preventing infection. The dirty laundry is then placed in the wash and the bag dissolves letting the washing out. The structure of polyethenol is shown.

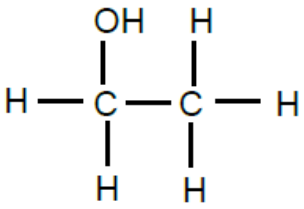


What is the monomer unit for this polymer?

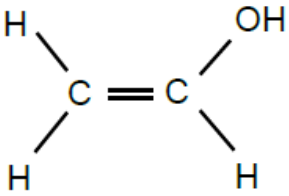
A



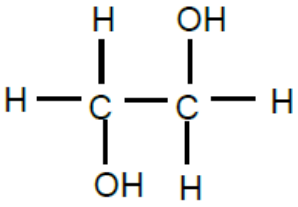
B



C



D



The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lantharum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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Class	Centre/Index Number	Name

南洋女子中學校

Nanyang Girls' High School

Preliminary Examination 2022
Secondary 4

CHEMISTRY **6092/01**

Paper 1 Multiple Choice

1 hour

Friday 26 August **1200 – 1300**

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue, correction fluid or tape.

Write your name, register number and class in the spaces at the top of this page and on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 15.

The use of an approved scientific calculator is expected, where appropriate.

This document consists of **15** printed pages and **1** blank page.

1 Which apparatus would be most suitable for measuring 24.5 cm^3 of a liquid?

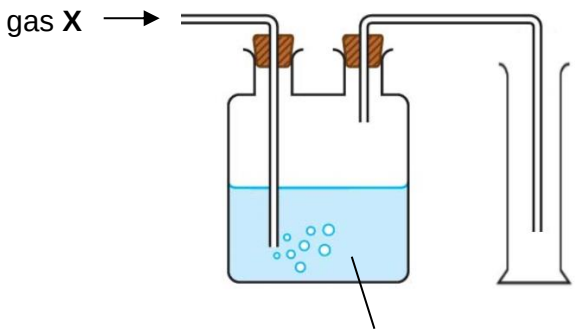
A burette

B measuring cylinder

C pipette

D syringe

2 The diagram shows an experimental setup to produce and collect a dry sample of gas **X**.



Which of the following is most likely to be gas **X**?

A ammonia gas

B hydrogen gas

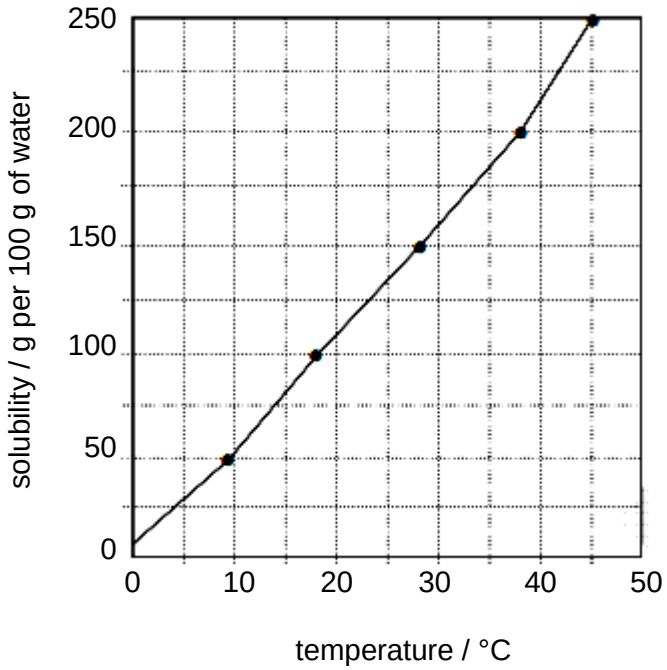
C hydrogen chloride gas

D steam

3 Which is not correctly matched with the apparatus needed for each separation?

	separation	apparatus
A	oil from a mixture of oil and water	separating funnel
B	salt from a mixture of salt and sand	filter paper, filter funnel, evaporating dish, retort stand, Bunsen burner
C	blue dye from black ink	filter paper, beaker, lid
D	water from seawater	thermometer, fractionating column, condenser

4 The graph shows the solubility curve of potassium nitrate in water.



Potassium nitrate solid was dissolved in 400 g of water at 45°C to obtain a saturated solution.

Upon cooling the solution to room temperature (25°C), what is the maximum approximate mass of crystals that can be obtained?

A 113 g **B** 138 g **C** 452 g **D** 552 g

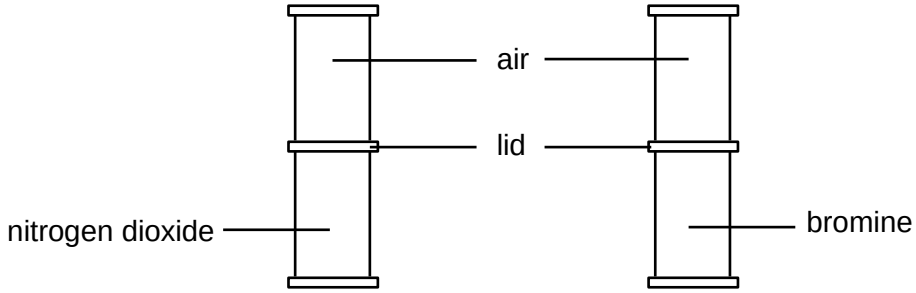
5 Which of the following tests would be able to distinguish between sulfur dioxide and carbon dioxide gas?

1 Bubble the gas into a test tube containing aqueous acidified $KMnO_4$.
2 Bubble the gas into a test tube containing limewater.
3 Place a damp blue litmus paper over the gas.
4 Place a lighted splint over the gas.

A 1 only **B** 1 and 2 **C** 1 and 3 **D** 2 and 4

[Turn over

6 A student carried out an experiment, at room temperature, involving two gas jars filled with equal volumes of nitrogen dioxide gas and bromine gas respectively. The gas jars are sealed with a lid and placed below another gas jar containing air.



The student removed the lids at the same time and observed that the gas jar containing nitrogen dioxide gas fills up the other gas jar more quickly than the gas jar containing bromine gas.

What could be the possible explanation to the difference in the rate of diffusion?

A Bromine has a higher boiling point than nitrogen dioxide.

B Nitrogen dioxide has greater kinetic energy than bromine gas.

C Nitrogen dioxide has smaller molecular mass than bromine gas.

D There are more atoms in a molecule of nitrogen dioxide than in a bromine molecule.

7 An element from the Periodic Table has the following properties.

- It has x number of protons and x+1 number of neutrons.
- It forms an ion with x+3 number of electrons.

Which element is this most likely to be?

A aluminium

B boron

C nitrogen

D phosphorus

8 Some properties of substance Y are listed.

- It has a high melting point.
- It does not conduct electricity in solid state.
- When fluorine gas is bubbled into its solution, a brown solution is obtained.

Which of the following is a possible identity of Y?

A calcium chloride

B graphite

C potassium iodide

D sodium

9 Epsom salts contain magnesium sulfate and are often used as a natural remedy for muscle aches, inflammation, and stress.

A student wrote down some statements about magnesium sulfate.

1 It is made up of a giant lattice structure.

2 Strong electrostatic forces of attraction exist between Mg^{2+}, S^{2-} and O^{2-} ions.

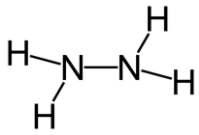
3 There is both ionic and covalent bonding present.

4 The ratio of positive to negative ions is 1:2.

Which of the above statements are correct?

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 1, 3 and 4

10 Dihydrogen tetrahydride has the following structure.



What is the total number of valence electrons not involved in bonding?

A 2

B 4

C 6

D 8

11 Which of the following enables a metal to conduct electricity?

A atoms

B electrons

C ions

D protons

12 Vanillin is the main chemical compound present in vanilla bean extract. It contains 63.16 % of carbon, 5.26 % of hydrogen and 31.58 % of oxygen by mass.

What is the empirical formula of vanillin?

A C_3H_3O

B $C_5H_5O_2$

C $C_8H_8O_3$

D $C_8H_8O_6$

13 Four moles of sulfur dioxide reacted with three moles of oxygen gas according to the following equation at room temperature and pressure.

$$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$$

What is the total volume of gas in the reaction mixture after the reaction is complete?

A 48.0 dm^3 **B** 72.0 dm^3 **C** 96.0 dm^3 **D** 120 dm^3

14 When 12.4 g of copper(II) carbonate, $CuCO_3$, was heated, 20 cm^3 of carbon dioxide gas, measured at room temperature and pressure, was released.

What was the percentage yield of carbon dioxide?

A 0.833 % **B** 4.17% **C** 41.7 % **D** 83.3 %

15 Three electrochemical cells are set up using zinc metal and three other unknown metals P, Q and R as electrodes.

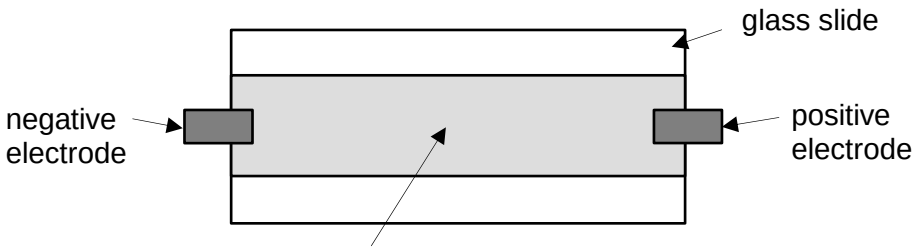
The results of the experiment are shown in the table below.

metal tested	voltmeter reading / V	direction of electron flow
P	0.200	zinc to metal P
Q	0.500	metal Q to zinc
R	1.100	zinc to metal R

Which of the following shows the three unknown metals in increasing order of reactivity?

A P, Q, R **B** Q, P, R **C** R, P, Q **D** R, Q, P

16 A piece of blue litmus paper was soaked in dilute aqueous potassium bromide and supported on a glass slide. The paper was connected to an electrical supply as shown in the diagram.



Which of the following shows the correct observations near each electrode after some time?

	negative electrode	positive electrode
A	remain blue	turn red
B	remain blue	turn red and then bleached
C	turn red	remain blue
D	turn red and then bleached	remain blue

17 Which of the following would involve overall energy being released?

A action of light on silver bromide

B conversion of water to steam

C rusting of iron

D thermal decomposition of calcium carbonate

18 When 17.75 g of Cl_2 is reacted with excess H_2, 45.5 kJ of energy is given out according to the following equation.

$$H_2 + Cl_2 \rightarrow 2HCl$$

What is the enthalpy change, ΔH, for the reaction?

A +91

B −91

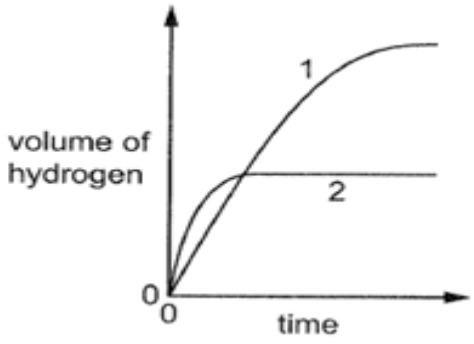
C +182

D −182

19 100 cm^3 of 1 mol/dm^3 dilute hydrochloric acid reacted with an excess of magnesium ribbon to produce hydrogen gas according to the equation below.

The volume of hydrogen gas produced was recorded against time in experiment 1.

$$2HCl + Mg \rightarrow MgCl_2 + H_2$$



What could be the quantities of acid and metal used in experiment 2?

	quantity of acid used	metal used
A	100 cm^3 of 1 mol/dm^3 HCl	Mg powder
B	100 cm^3 of 2 mol/dm^3 HCl	Mg ribbon
C	50 cm^3 of 1 mol/dm^3 HCl	Mg powder
D	50 cm^3 of 1 mol/dm^3 HCl	Mg ribbon

20 The rate of a reaction increases when the temperature is increased.

Which of the following statements best explain why this is so?

1 The activation energy decreases.
2 There are more particles with energy equal to or greater than the activation energy.
3 The frequency of effective collisions between particles increases.
4 The particles in the reaction mixture expand and have a greater surface area to collide.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

21 Which of the following will **not** have their rate of reaction affected by a change in pressure?

A $H_2(g) + O_2(g) \rightarrow H_2O_2(l)$

B $I_2(s) + Cl_2(g) \rightarrow 2ICl(l)$

C $N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(l)$

D $Na_2CO_3(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + H_2O(l) + CO_2(g)$

22 Small portions of aqueous acidified potassium manganate(VII) and aqueous potassium iodide were added separately to four solutions **A** to **D**. The original colour of these solutions was colourless.

The final colours of the solutions are shown in the table below.

Which solution acts as both an oxidising and a reducing agent?

	aqueous acidified potassium manganate(VII)	aqueous potassium iodide
A	colourless	colourless
B	colourless	brown
C	purple	colourless
D	purple	brown

23 The Ostwald process involves the manufacture of nitric acid. Ammonia is first manufactured from nitrogen gas before being used as a raw material for the Ostwald process.

A summary of the manufacturing process is shown below.

$$N_2 \xrightarrow{\textbf{A}} NH_3 \xrightarrow{\textbf{B}} NO \xrightarrow{\textbf{C}} NO_2 \xrightarrow{\textbf{D}} HNO_3$$

Which stage above shows the greatest change in the oxidation state of nitrogen?

24 In which row are the oxides correctly identified?

	acidic	amphoteric
A	nitrogen monoxide, carbon monoxide	phosphorus oxide, selenium oxide
B	nitrogen dioxide, silicon dioxide	aluminium oxide, calcium oxide
C	phosphorus oxide, carbon dioxide	lead(II) oxide, zinc oxide
D	sulfur dioxide, manganese oxide	nitrogen monoxide, lithium oxide

25 When excess calcium carbonate was reacted with dilute hydrochloric acid, the reaction gradually became slower and eventually stopped.

Which statement best explains this observation?

A An insoluble layer of calcium chloride is formed.

B As carbon dioxide is produced, it forms a white precipitate with calcium carbonate.

C Calcium carbonate was used up completely.

D There were no more hydrogen ions present in the reaction mixture.

26 Which substances produce an insoluble salt when aqueous solutions of them are mixed?

A barium chloride and aluminium nitrate

B calcium nitrate and potassium chloride

C lead(II) nitrate and zinc chloride

D sodium carbonate and ammonium sulfate

27 Which statement about the Haber process is correct?

A Hydrogen used is obtained from fractional distillation of air.

B Iron is used as a catalyst.

C Nitrogen used is obtained from nitrates in the soil.

D The reaction takes place at room temperature and pressure.

28 T and U are two elements located in Period 4 of the Periodic Table.

Which statement best proves that element U is located on the right side of element T?

A T is less reactive than U.

B T loses electrons more easily than U.

C T forms an acidic oxide while U forms a basic oxide.

D T has two unpaired valence electrons while U has four unpaired valence electrons.

29 Which statements about rubidium is correct?

A It reacts with water to form an oxide.

B It reacts with water to produce a colourless and pungent gas that turns red litmus blue.

C It reacts with chlorine explosively to form a giant molecular structure.

D It is a stronger reducing agent than potassium.

30 Which of the following show a decreasing trend down the group VII elements?

A atomic radius

B colour intensity

C melting and boiling point

D reactivity

31 Some properties of silver and its compounds are stated below.

1 Silver can form compounds like Ag_2O and AgF_2.

2 Silver has a high melting point of 962°C.

3 Silver is an important catalyst in the production of formaldehyde.

4 Silver reacts with chlorine to form a white crystalline solid of silver chloride.

Which of the above statements do not agree with the typical properties of transition metals?

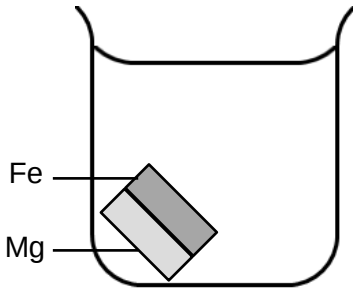
A 2 only **B** 4 only **C** 1 and 3 **D** 2 and 4

32 Four beakers of dilute sodium chloride solution were set up as shown.

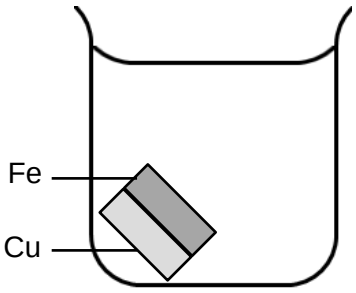
In each beaker, a piece of iron was attached on one side by another piece of metal.

In which beaker would the iron take the shortest time to rust?

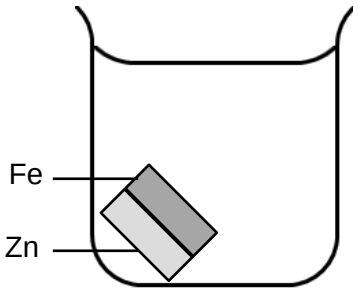
A



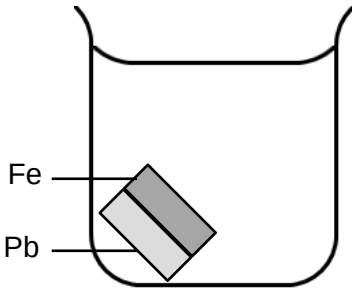
B



C



D



33 When heated strongly, metal X turns red hot and reacts slowly with steam.
Metal Y reacts slowly with dilute sulfuric acid and stops reacting halfway through the reaction.
Metal Z reacts very slowly with cold water but reacts violently with steam.

Which method of metal extraction from its ores is most likely to be used?

	electrolysis of molten ore	reduction by carbon
A	Z	X and Y
B	Y	X and Z
C	X and Z	Y
D	Y and Z	X

34 Which statements about the extraction of iron from haematite is correct?

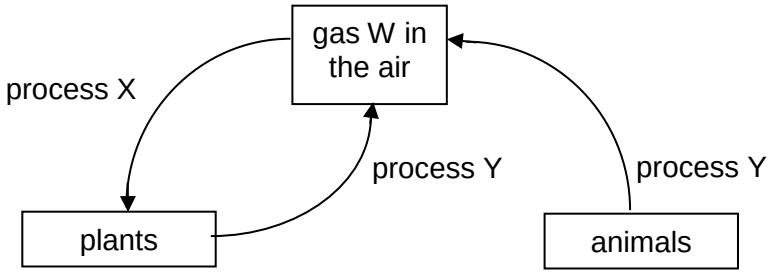
A At the bottom of the furnace, molten slag floats on top of molten iron.

B At the top of the furnace, hot waste gases such as oxygen escape.

C Carbon monoxide acts as the oxidising agent in the process.

D The other raw materials used are coke and quicklime.

35 The diagram below shows part of the carbon cycle.



What is the correct combination of the identity of gas W and processes X and Y?

	gas W	process X	process Y
A	carbon dioxide	photosynthesis	respiration
B	carbon dioxide	respiration	photosynthesis
C	carbon monoxide	photosynthesis	respiration
D	carbon monoxide	respiration	photosynthesis

36 When fossil fuels are burnt incompletely in a motor car, which gases can be found in its exhaust gases?

I carbon monoxide
II carbon dioxide
III sulfur dioxide
IV nitrogen

A **I** only **B** **I** and **II** **C** **I**, **II** and **III** **D** all of the above

37 Which formula below best represents a straight-chain hydrocarbon that contains only single covalent bonds?

A C_6H_6 **B** C_6H_{12} **C** C_6H_{14} **D** C_6H_5OH

38 Catalytic cracking is a process where long chain alkanes are broken into smaller, more useful molecules.

Which of the following equations correctly represents catalytic cracking?

A $C_{16}H_{32} \rightarrow 2C_3H_6 + 2C_5H_{10}$

B $C_{16}H_{32} \rightarrow 16C + 16H_2$

C $C_{16}H_{34} \rightarrow 4C_4H_8 + H_2$

D $C_{16}H_{34} \rightarrow 2C_2H_4 + 2C_6H_6 + 7H_2$

39 Which statements about alcohols are correct?

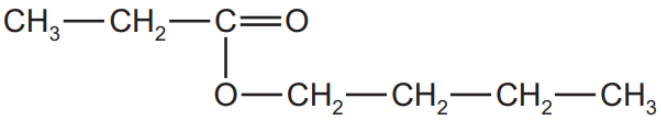
1 Alcohols decolourise aqueous acidified potassium manganate(VII).
2 All alcohols contain the hydroxide ion, OH^-.
3 Ethanol can be formed from ethene using a reaction catalysed by yeast.
4 Propanol can be oxidised to propanoic acid.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

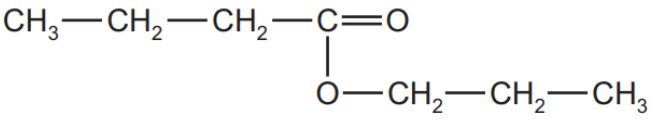
40 A carboxylic acid of molecular formula $C_4H_8O_2$ reacts with an alcohol of molecular formula C_3H_8O to form an ester.

What could be the formula of the ester formed?

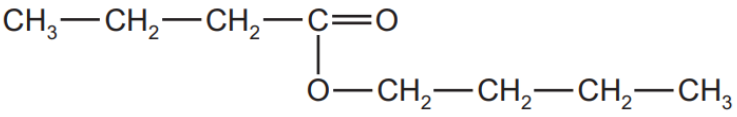
A



B



C



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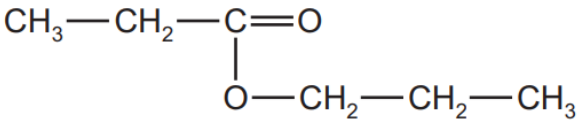


End of paper

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**Key** proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 A*l* aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 C*l* chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 T*l* thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 F*l* flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Class	Register Number

Candidate Name _____

PEIRCE SECONDARY SCHOOL

Department of Science

GCE 'O' Level Preliminary Examination I for Secondary Four Express

CHEMISTRY **6092**

Wednesday **9 May 2018** **0900 – 1000**

Time: **1 hour**

INSTRUCTIONS TO CANDIDATES

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, Index number on the Answer Sheet in the spaces provided.

There are forty questions in this paper. Answer all questions. For each question, there are four possible answers, A, B, C and D. Choose the one you consider correct and record your choice in soft pencil on the separate answer sheet.

INFORMATION FOR CANDIDATES
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page **19**.

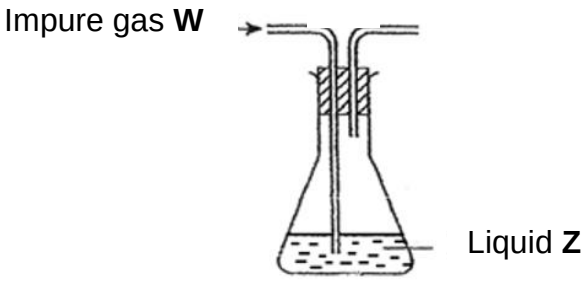
This paper consists of **15** printed pages.

Setter: Mr Ashwin Selvarajan

1 Gas **W** is contaminated with another gas. The impure gas can be removed using liquid **Z**.

Which apparatus is most suitable for the collection of pure gas **W**?

A



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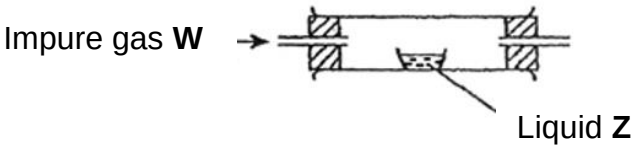

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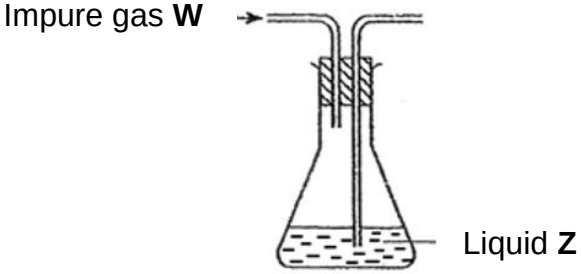

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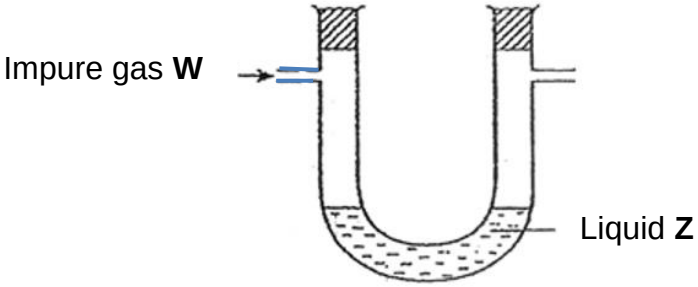
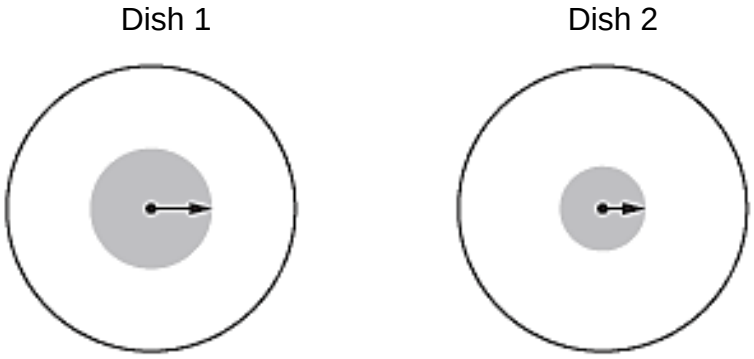


2 Small crystals of red cobalt(II) nitrate and blue copper(II) sulfate were placed at the centers of separate petri dishes filled with agar jelly. They were left to stand under the same physical conditions.
After some time, the colour of each substance has spread out as shown.



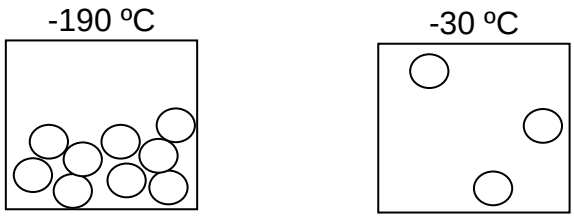
The lengths of the arrows indicate the relative distances travelled by particles of each substance. Which statement is correct?

A Diffusion is faster in dish 1 because the mass of the particles is greater.
B Diffusion is faster in dish 2 because the mass of the particles is smaller.
C Diffusion is slower in dish 1 because the mass of the particles is smaller.
D Diffusion is slower in dish 2 because the mass of the particles is greater.

3 A scientist wishes to separate a mixture of iodine, magnesium chloride and lead(II) chloride. Which of the following is the most appropriate sequence of techniques for the scientist to use?

	Step 1	Step 2	Step 3
A	sublimation	dissolution and filtration	crystallisation
B	sublimation	fractional distillation	dissolution and filtration
C	dissolution and filtration	crystallisation	sublimation
D	dissolution and filtration	fractional distillation	crystallisation

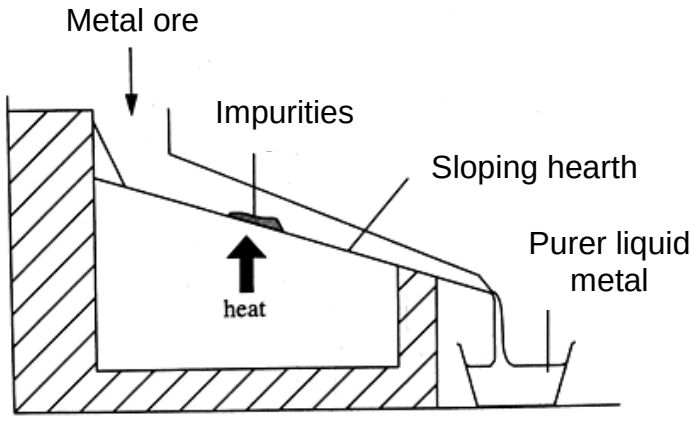
4 The following diagrams show the arrangement of particles of a substance at two different temperatures.



Which substance could the diagrams represent?

Substance	Melting point / ^{0}C	Boiling point / ^{0}C
A	−210	−50
B	−210	−10
C	−100	−50
D	−100	−10

5 Liquation is an old method of separating a metal from its ore and is shown in the following diagram.



Tin ore, containing iron and lead and other impurities, can be refined to a purer form using this method. The impure tin ore is added from the top of the furnace, which has a sloping hearth. The pure liquid tin is collected at the bottom of the furnace, while the impurities are left behind.

What can you deduce about the properties of tin from the method?

A It is an inert metal.
B It is less reactive than iron and lead.
C It is more reactive than iron and lead.
D It has a melting point and boiling point lower than those of iron and lead.

6 Indium (In) with a relative atomic mass of 114.9 consists of two naturally occurring isotopes. One of these isotopes is In-115, with 95.7% abundance.

Given that there are 49 protons in an atom of indium, calculate the nucleon number of the second naturally occurring isotope in indium.

A 49
B 64
C 113
D 114

7 Four particles **W**, **X**, **Y** and **Z** have the composition shown in the table below.

particle	number of electrons	atomic number	mass number
W	10	10	20
X	11	11	23
Y	10	11	23
Z	19	19	39

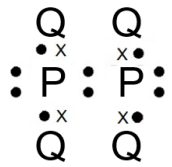
There are three statements below with regards to particles **W**, **X**, **Y** and **Z**.

1 Particle **X** gives away one electron to form particle **Y**.
2 Particle **W** and particle **Y** are isotopes.
3 Substance made of particle **Z** has a lower melting point than substance **X**

Which of the following statements are correct?

A 1 and 2
B 1 and 3
C 2 and 3
D 1, 2 and 3

8 The diagram below shows the arrangement of outermost electrons for element **P** when it reacts with element **Q** to form a compound.



To which groups of the Periodic Table do element **P** and element **Q** belong?

	element **P**	element **Q**
A	Group V	Group VI
B	Group V	Group VII
C	Group VI	Group I
D	Group VI	Group VII

9 The table provides some information of three particles.

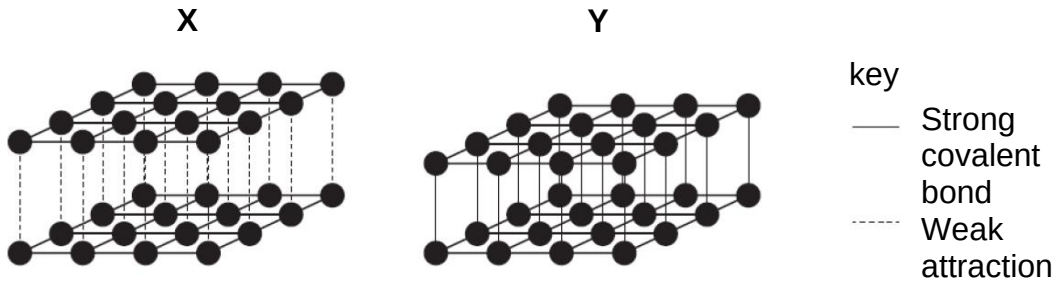
charge of particle	number of electrons	number of neutrons	nucleon number
0	18	**X**	40
1+	18	20	**Y**
Z	10	8	16

What are the values of **X**, **Y** and **Z**?

	X	**Y**	**Z**
A	18	37	2-
B	18	39	2+
C	22	39	2-
D	22	37	2+

10 Substances with giant covalent structures can be used as lubricants or as cutting tools for hard materials.

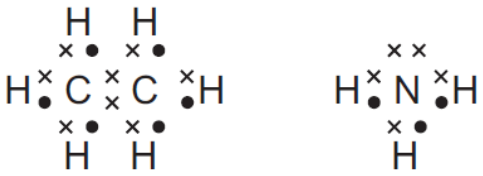
The diagram shows how the atoms are arranged in two giant covalent structures, **X** and **Y**.



Which statement is correct?

A Only X is used as a cutting tool and only Y is used as a lubricant.
B Only X is used as a lubricant and only Y is used a cutting tool.
C X and Y are both used as a cutting tool.
D X and Y are both used as lubricants.

11 Ethane, C_2H_6, and ammonia, NH_3, are covalent compounds.
The "dot-and-cross" diagrams of these compounds are shown.



Which statements are correct?

1 A molecule of ethane contains twice as many hydrogen atoms as a molecule of ammonia.
2 An unreacted nitrogen atom has five outer electrons.
3 In a molecule of ethane, the bond between the carbon atoms is formed by sharing two electrons, one from each carbon atom.

A 1, 2 and 3
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only

12 The active component of tobacco, nicotine, found in cigarette smoke is thought to increase the chances of a person developing lung cancer.

The percentage composition of nicotine is 74.0% carbon, 8.7% hydrogen and 17.3% nitrogen. The relative molecular mass of nicotine is 162.

What is the molecular formula of nicotine?

A C_3H_2N
B C_5H_7N
C $C_9H_6N_3$
D $C_{10}H_{14}N_2$

13 68 g of hydrogen peroxide is dissolved in water to form an aqueous solution. The solution is heated and decomposes in the presence of manganese(IV) oxide to give 2.4 dm^3 of oxygen gas as follows.

$$2H_2O_2 \rightarrow O_2 + 2H_2O$$

What is the percentage purity of the hydrogen peroxide? (All gases are measured at room temperature and pressure.)

A 2.5%
B 5.0%
C 10.0%
D 100.0%

14 Dinitrogen tetraoxide, N_2O_4, is a poisonous gas. It can be disposed off safely by reaction with sodium hydroxide. In the experiment, the concentration of aqueous sodium hydroxide used is 1.5 mol/dm^3.

N_2O_4 (g) + 2NaOH (aq) → $NaNO_3$ (aq) + $NaNO_2$ (aq) + H_2O (*l*)

Which of the following is the least volume of aqueous sodium hydroxide required to dispose off 300 cm^3 of N_2O_4 at room temperature and pressure?

A 10 cm^3
B 20 cm^3
C 120 cm^3
D 240 cm^3

15 Which pairs of statements correctly describe the differences between the conduction of electricity during electrolysis and the the conduction of electricity by metals?

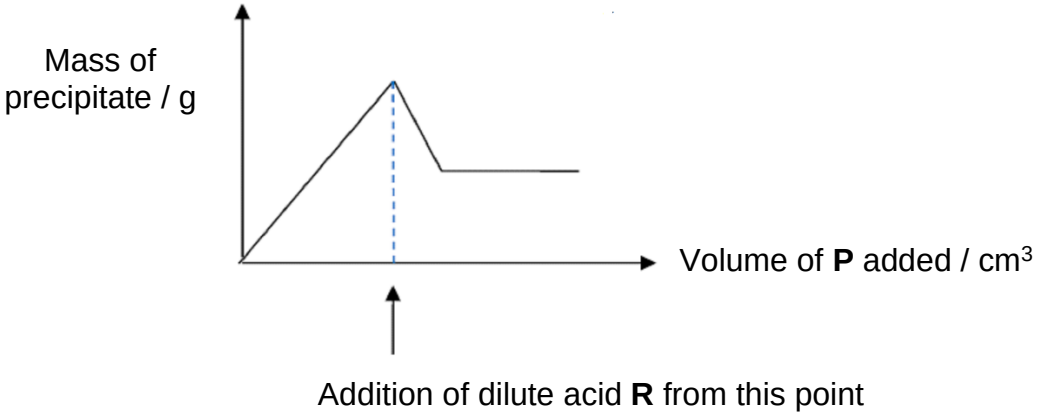
	conduction during electrolysis	conduction by metals
1	The current is due to the movement of both positive and negative ions.	The current is due to the movement of electrons.
2	Charged particles move towards both electrodes.	Charged particles move in one direction only.
3	It results in a chemical change.	It does not result in a chemical change.

A 1, 2 and 3 are correct
B 1 and 2 are correct
C 2 and 3 are correct
D 1 is correct

16 Which is the best way to prepare maximum yield of barium sulfate, starting from barium carbonate?

A Add dilute sulfuric acid to barium carbonate and then filter.
B Add excess aqueous sodium sulfate to barium carbonate and then filter.
C Add barium carbonate to nitric acid followed by dilute sulfuric acid and filter.
D Heat barium carbonate and then react the barium oxide with dilute sulfuric acid, then filter.

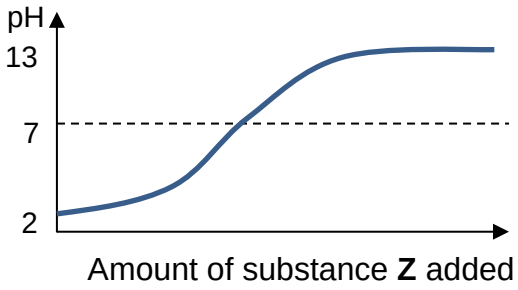
17 In a qualitative analysis, reagent **P** is added gradually to solution **Q**, followed by the addition of a dilute acid **R**.



The graph shows how the mass of the precipitate changes as the reagents are added. Which of the following entries is correct?

	P	anions in **Q**	**R**
A	aqueous silver nitrate	Cl^- and CO_3^{2-}	dilute nitric acid
B	aqueous silver nitrate	Cl^-	dilute nitric acid
C	aqueous barium chloride	Cl^- and CO_3^{2-}	dilute hydrochloric acid
D	aqueous barium chloride	CO_3^{2-}	dilute hydrochloric acid

18 An excess of substance **Z** was added slowly, with stirring, to aqueous solution **P**. The changes in the pH of the mixture are shown in the graph below.



What could substances **P** and **Z** be?

	substance **Z**	substance **P**
A	aluminium oxide	sulfuric acid
B	magnesium oxide	ethanoic acid
C	potassium oxide	sulfuric acid
D	zinc oxide	ethanoic acid

19 When dilute sulfuric acid and aqueous sodium hydroxide react, sodium hydrogen sulfate, $NaHSO_4$, is first formed.

$$H_2SO_4(aq) + NaOH(aq) \rightarrow NaHSO_4(aq) + H_2O(l)$$

Aqueous sodium hydrogen sulfate dissociates into ions.

$$NaHSO_4(aq) \rightarrow Na^+(aq) + H^+(aq) + SO_4^{2-}(aq)$$

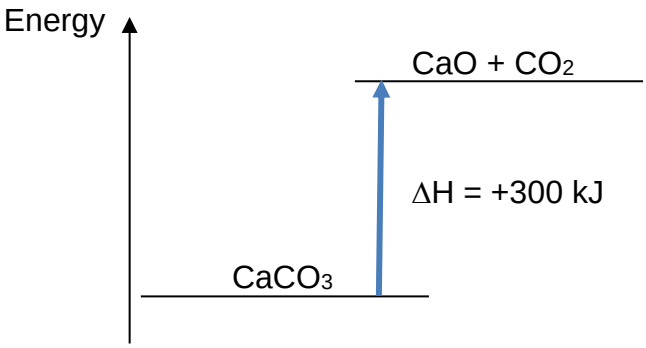
If more sodium hydroxide is added, sodium sulfate, Na_2SO_4, can be formed.

$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

Which results for these two salts, when tested with Universal Indicator and barium nitrate solution are correct?

		pH	addition of barium nitrate solution
A	$NaHSO_4$	>7	no reaction
	Na_2SO_4	7	no reaction
B	$NaHSO_4$	>7	white precipitate
	Na_2SO_4	7	white precipitate
C	$NaHSO_4$	<7	no reaction
	Na_2SO_4	7	no reaction
D	$NaHSO_4$	<7	white precipitate
	Na_2SO_4	7	white precipitate

20 The energy level diagram for the decomposition of calcium carbonate is shown below.



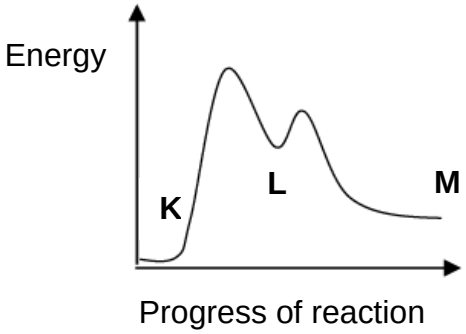
Which of the following can be deduced from the above energy level diagram when 1 mole of calcium carbonate is decomposed?

A The formation of bonds in the products uses 300 kJ of energy.
B 300 kJ of energy is lost to the surrounding due to bond breaking.
C The activation energy of the reaction must be more than 300 kJ.
D The amount of energy released for bond formation is more than the amount absorbed for bonds breaking.

21 In the conversion of compound **K** to compound **M**, it was found that the use of a catalyst caused the reaction to proceed through the formation of an intermediate compound **L**.

The following graph shows the energy profile diagram for the reactions.

Step 1: Compound **K** → Compound **L**
Step 2: Compound **L** → Compound **M**



Which of the following can be deduced from the diagram?

A Both Steps 1 and 2 are endothermic.
B The overall reaction to convert **K** to **M** is exothermic.
C Step 1 has a lower activation energy as compared to Step 2.
D Step 1 requires more energy for bond breaking than Step 2.

22 Iron rusts easily, hence steel structures should be treated to slow down the rusting process.

Which row incorrectly describes how each method protects iron from rusting and its main disadvantage?

	method	how it protects	disadvantage
A	painting steel	provides a barrier between the iron and the atmosphere	paint scrapes off easily, exposing iron to the atmosphere
B	alloying steel with chromium to make stainless steel	chromium reacts with oxygen in the air to form a barrier of chromium oxide which prevents iron from rusting	production of stainless steel is costly
C	storing steel objects in a dry place	absence of water prevents iron from rusting quickly	difficult to keep storage place dry at all times
D	coating steel plates with zinc	zinc is more reactive than iron, and provides a barrier between iron and the atmosphere	when coating of zinc is scratched, iron will corrode in place of zinc, making it rust more quickly

23 The list shows the position of metal **X** in the reactivity series of metals.

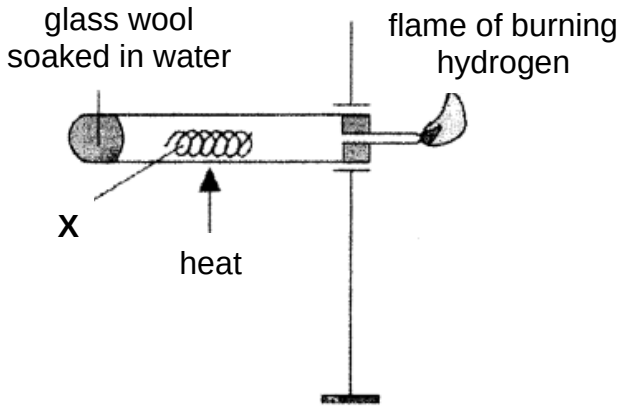
Na Al Fe **X** Cu Ag

Which method(s) could be used to extract metal **X**?

1 electrolysis of the solid metal oxide
2 heating the metal oxide with copper
3 heating the metal oxide with carbon

A 1, 2 and 3
B 1 and 3
C 2 and 3
D 3

24 A substance **X** is heated in the setup shown in the diagram. A flame is produced.



What is substance **X** most likely to be?

A **X** is a metal above hydrogen in the reactivity series.
B **X** is a metal below hydrogen in the reactivity series.
C **X** is an oxide of a metal that is above hydrogen in the reactivity series.
D **X** is an oxide of a metal that is below hydrogen in the reactivity series.

25 About 40 % of all steel and iron is produced by recycling.
Which statements are correct reasons for recycling iron?

I	Iron, when obtained by a recycling process, produces less carbon dioxide than the blast furnace process.
II	Recycling iron allows land to be used for other purposes e.g. housing
III	Scrap steel, if not recycled, would cause environmental problems due to its disposal by landfill.

A **I** and **II**
B **I** and **III**
C **II** and **III**
D **I**, **II** and **III**

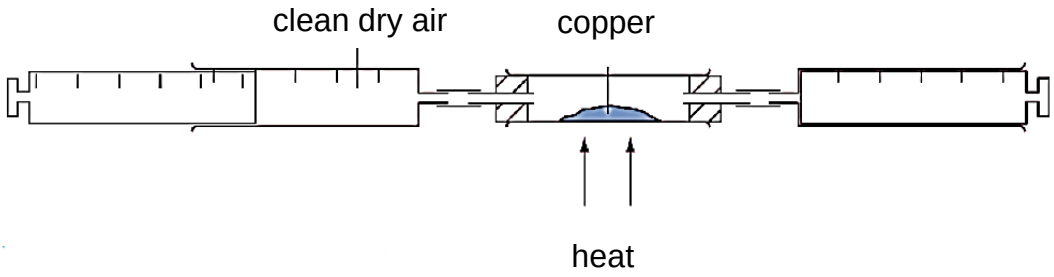
26 Ammonia is manufactured by the Haber Process. The equation for the Haber process is given below.

$$N_2\,(g) + 3\,H_2\,(g) \rightleftharpoons 2\,NH_3\,(g) \quad \Delta H = -92\ kJ/mol$$

Which statement about the Haber Process is true?

A Hydrogen used is obtained from the hydrogenation of alkenes.
B Nitrogen used is obtained from the fractional distillation of crude oil.
C The reaction is exothermic as energy is absorbed to break the strong N≡N bonds.
D The yield of the reaction is always lower than 100% as the reaction is reversible.

27 A sample of clean, dry air is passed over hot copper until there is no further change to the volume of air.

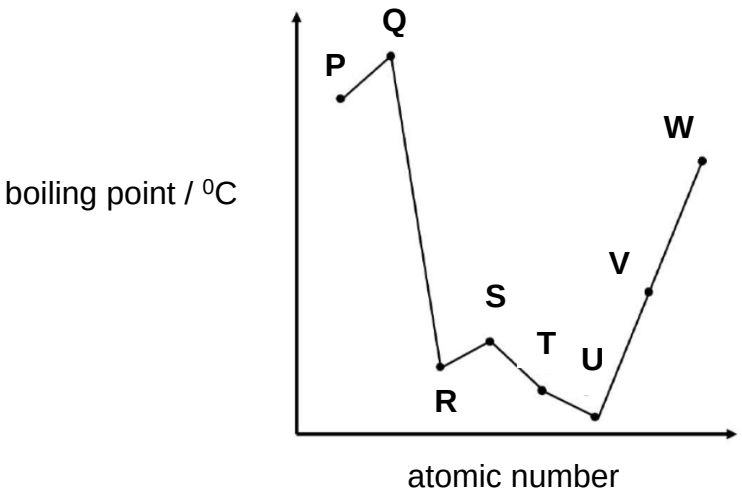


The volume of air decreased by 14.5 cm^3.

What was the starting volume of the sample of air?

A 18.4 cm^3
B 53.9 cm^3
C 69.0 cm^3
D 85.5 cm^3

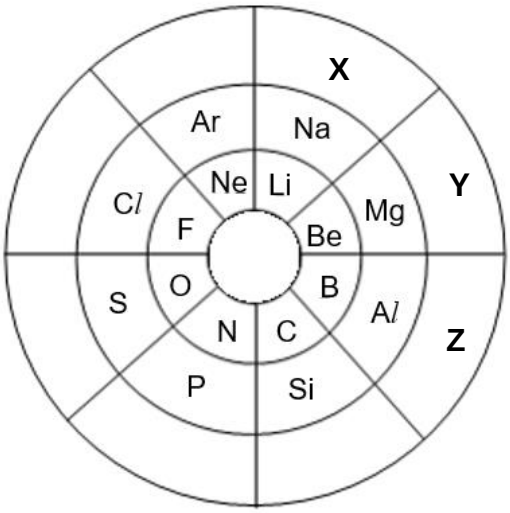
28 The graph below shows the variation in boiling points for eight consecutive elements in Periods 3 and 4 of the Periodic Table with atomic numbers less than or equal to 20.



What can be deduced from the above?

A Element **P** is a Group I element.
B Element **S** has a metallic lattice structure.
C Element **U** exists as diatomic molecules.
D Element **V** is a strong reducing agent.

29 Dimitri Mendeleev, a chemist, organised the elements using a system called the Periodic Table. A student suggested another way of arranging the elements as shown below.



Which of the following statements is correct?

A An atom of **X** contains three valence electrons.
B Elements **X** and **Y** belong to the same group.
C Element **X** contains more electrons than element **Z**.
D Elements **X**, **Y** and **Z** belong to the same period.

30 The carbonates of four metals **P**, **Q**, **R** and **S** are heated to the same temperature. The results of the experiments are shown in the table below.

carbonates of	products of thermal decomposition
P	metal oxide and carbon dioxide
Q	no visible change
R	metal and carbon dioxide
S	metal oxide and carbon dioxide

When metal **S** reacts with steam, a bright white glow is observed. However, metal **P** is not affected by steam. What is the correct order of reactivity of the four metals?

	most reactive ⟶			**least reactive**
A	**P**	**S**	**R**	**Q**
B	**Q**	**P**	**S**	**R**
C	**Q**	**S**	**P**	**R**
D	**R**	**P**	**S**	**Q**

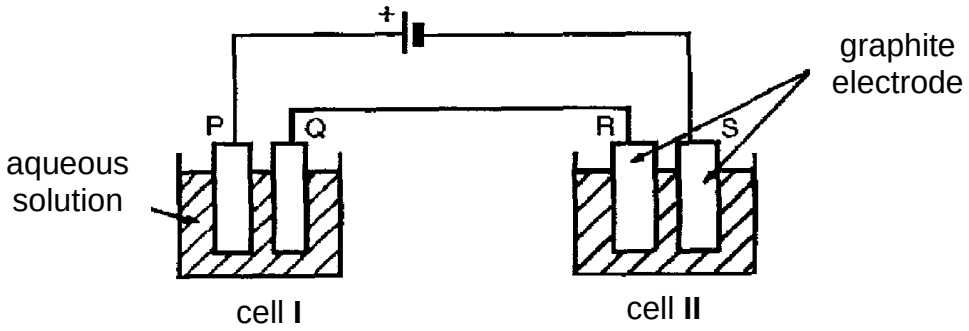
31 In an electrolysis experiment, the same amount of charge deposited 38.4 g of copper and 10.4 g of chromium. The charge on the copper ion was 2+.

What is the charge of Chromium?

[A_r: Cr, 52; Cu, 64]

A 2+
B 3+
C 4+
D 6+

32 In the diagram below each cell contains an aqueous solution of a single salt and all four electrodes are graphites. Electrodes **Q** and **S** increase in mass during the electrolysis but no gas is given off at **Q** or **S**.



If an increase in mass of **Q** is greater than the increase of mass of **S** in the same time, which of the following statements is necessarily true?

A The cation discharged in Cell **I** is different from the cation discharged in Cell **II**.
B The anion of the solute in Cell **I** is different from the anion of the solute in Cell **II**.
C The solution in Cell **I** is more concentrated than the solution in Cell **II**.
D The loss of mass of electrode P is less than the loss of mass of electrode **R**.

33 Study the reaction below:

$2KMnO_4\,(aq) + 5SO_2\,(g) + 2H_2O\,(l) \rightarrow K_2SO_4\,(aq) + 2MnSO_4\,(aq) + 2H_2SO_4\,(aq)$

Which is the correct pair of oxidising and reducing agents and the corresponding observation in this reaction?

	oxidising agent	reducing agent	observations
A	SO_2	$KMnO_4$	colourless solution turns purple
B	$KMnO_4$	SO_2	purple solution decolourises
C	$KMnO_4$	H_2O	purple solution decolourises
D	H_2SO_4	$MnSO_4$	colourless solution turns purple

34 When crude oil is fractionally distilled, which compounds leave from the bottom of the fractionating column?

A The compounds that are least flammable.
B The compound that are the least viscous.
C The compounds with the lowest relative molecular mass.
D The compounds with the lowest boiling points.

35 Ethanol can be manufactured from ethene or from glucose. The table gives statements about the processes involved.

	process using ethene	process using glucose
1	reaction is faster at 300 °C than at 200 °C	reaction is faster at 100 °C than at 30 °C
2	produces pure ethanol	produces a dilute aqueous solution of ethanol
3	uses a catalyst	uses a catalyst
4	uses steam	produces carbon dioxide

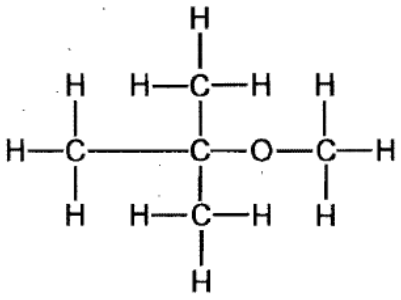
In which rows are both statements correct?

A 1 and 4
B 2 and 4
C 1, 2 and 3
D 2, 3 and 4

36 An ester with molecular formula $C_6H_{12}O_2$ undergoes hydrolysis to form an alcohol **G** and an acid **H**. Alcohol **G** can be oxidised to acid **H** by warming with acidified potassium manganate(*VII*). The formula of the ester is

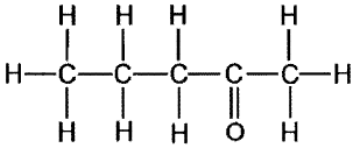
A $HCOOC_5H_{11}$
B $CH_3COOC_4H_9$
C $C_2H_5COOC_3H_7$
D $C_3H_7COOC_2H_5$

37 The structural formula of compound **X** is shown.

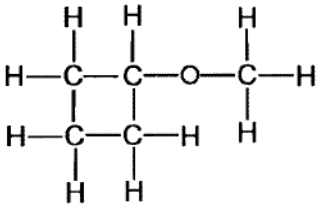


Which of the following compounds is an isomer of compound **X**?

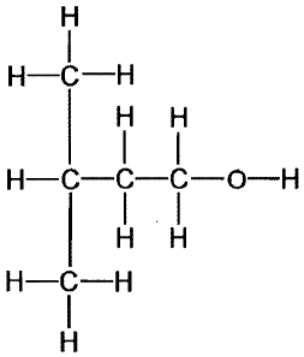
A



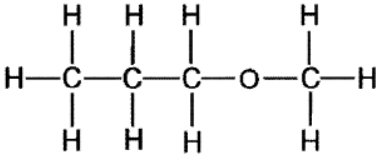
B



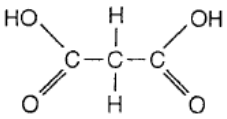
C



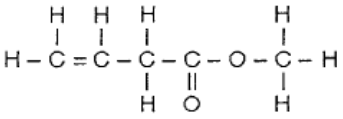
D



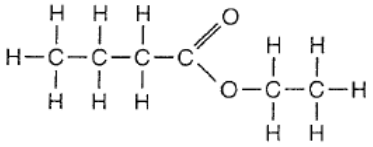
38 Which of the following tests can be used to distinguish the following organic compounds, I, II and III separately from each other?



I



II



III

test	1	Adding aqueous bromine.
	2	Adding powdered magnesium.
	3	Warming with acidified potassium manganate(VII).

A 1 only

B 2 only

C 1 and 2

D 1, 2 and 3

39 A pure fat molecule has a relative molecular mass of 300.

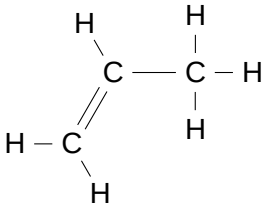
75 g of the fat reacts with 120 g aqueous bromine.

How many double bonds are there in each fat molecule?

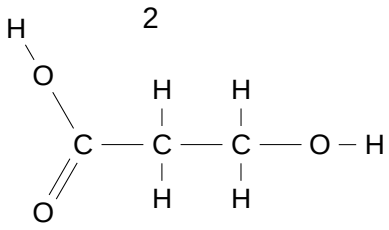
A 2
B 3
C 4
D 6

40 Which of the following compounds would undergo polymerisation on their own?

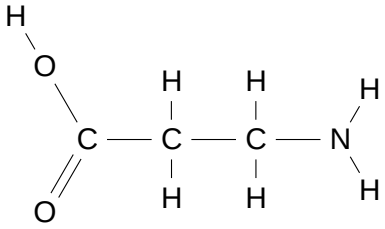
1



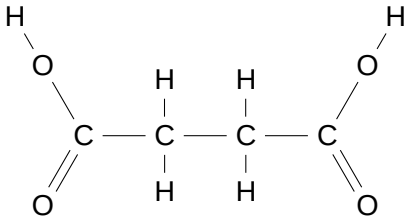
2



3



4



A 1 and 2
B 2 and 3
C 1, 2 and 3
D 1, 2, 3 and 4

– The End –

EXP

PUNGGOL SECONDARY SCHOOL
SECONDARY 4
EXPRESS
PRELIMINARY EXAMINATION

QUESTION & ANSWER BOOKLET

NAME			
CLASS		INDEX NUMBER	

Chemistry **6092**

Paper 1 **30 August 2022**

Additional materials: MCQ answer Sheet **1 hour**

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on all the work you hand in.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D.**

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet. A copy of the Periodic Table is printed on page 18.

The use of an approved scientific calculator is expected, where appropriate.

For Examiner's use	
Section A	/40
-	-
-	-
Total	/40

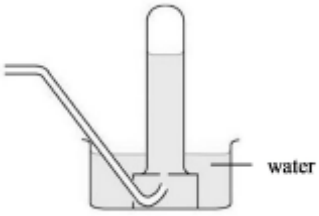
Parent's Signature

This paper consists of **18** printed pages and **0** blank page.

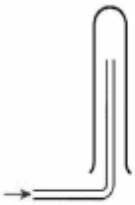
1 A student is preparing a gas in the laboratory that is soluble in water and less dense than air.

What is the most suitable method for collecting the gas?

A



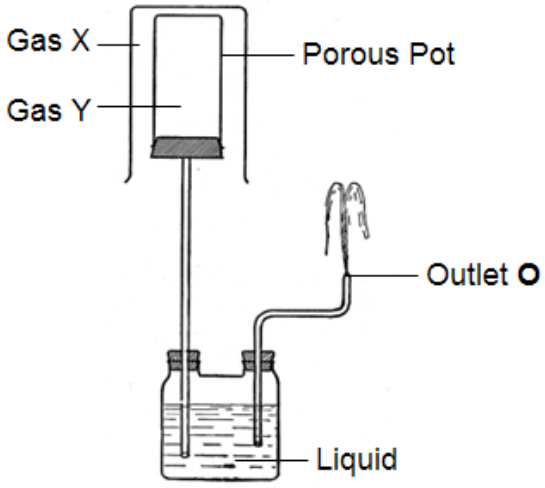
B



C

D

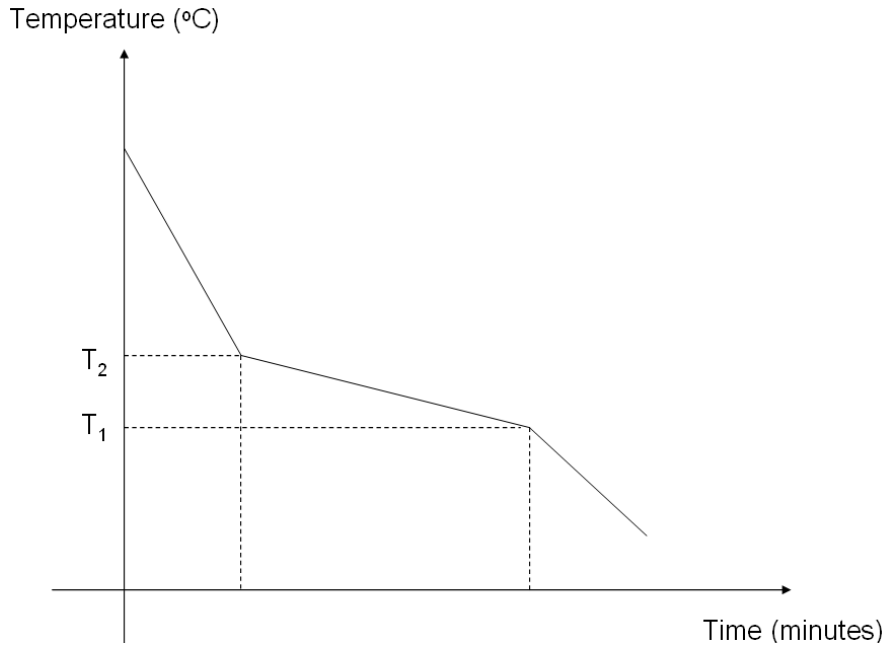
2 The diagram shows a beaker full of gas **X** inverted over a porous pot containing gas **Y**. A known liquid is used in the container. None of the gases provided below is soluble in the liquid.



Which pair of gases will lead to the liquid spilling out at the outlet **O**?

	Gas **X**	Gas **Y**
A	chlorine	hydrogen
B	argon	neon
C	flourine	helium
D	neon	flourine

3 The diagram below shows the cooling curve for an unknown substance. The substance changes from liquid to solid.



1 The particles in the substance below temperature T_1 vibrate about their fixed position.
2 The substance could be a sample of crude oil.
3 The freezing point is the average of T_1 and T_2.

Which statement(s) is/are correct?

A 1, 2 and 3
B 1 and 2 only
C 1 only
D 2 only

4 A salt, **R**, on warming with excess aqueous sodium hydroxide, evolved a gas that turned damp red litmus paper blue. When no more gas was evolved, a piece of aluminium foil was added, and a further evolution of the same gas occurred.

What could be **R**?

A ammonium nitrate
B ammonium sulfate
C zinc nitrate
D zinc sulfate

5 An ion Y^{2+} contains 19 neutrons and 18 electrons. Which of the following shows the proton number and nucleon number of **Y**?

	proton number	nucleon number
A	16	35
B	18	37
C	19	38
D	20	39

6 The electronic configuration of **X** is 2,8,4.

X reacts with an element **Y** from Group VII to form a compound.

Which of the following best describes the compound formed?

	type of bonding	formula of compound
A	ionic	$\mathbf{XY_4}$
B	ionic	$\mathbf{X_4Y}$
C	covalent	$\mathbf{XY_4}$
D	covalent	$\mathbf{X_4Y}$

7 The boiling points of beryllium oxide and sodium oxide are shown below.

	boiling point / ^oC
beryllium oxide	3900
sodium oxide	1950

Beryllium oxide does not conduct electricity in both solid and molten states.

Which of the following best explain the difference in boiling points between the two compounds?

A Electrostatic forces of attraction between the oppositively charged ions in beryllium oxide is stronger.
B Metallic bonds in beryllium oxide are stronger.
C Covalent bonds in beryllium oxide are stronger.
D Intermolecular forces of attraction in beryllium oxide is stronger.

8 Which structure **does not** contain atoms bonded to other atoms by four covalent bonds?

A graphite
B silicon dioxide
C poly(propene)
D carbon tetrachloride

9 Some of the medicinal tablets contain calcium. When the calcium in these tablets reacts with oxygen, it forms calcium oxide.

A sample of 100.0 g of calcium tablets yields 28.0 g of calcium oxide.

What is the percentage by mass of calcium in the tablet?

A 10.0%
B 15.0%
C 20.0%
D 25.0%

10 4.00 g of a metal oxide, **Y**O_2, is heated with carbon. 3.15 g of metal **Y** is obtained.

$$\mathbf{Y}O_2 + C \rightarrow \mathbf{Y} + CO_2$$

What is the identity of **Y**?

A $^{59}_{27}\mathrm{Co}$
B $^{91}_{40}\mathrm{Zr}$
C $^{115}_{49}\mathrm{In}$
D $^{119}_{50}\mathrm{Sn}$

11 Which statement about the electrolysis of molten sodium chloride is correct?

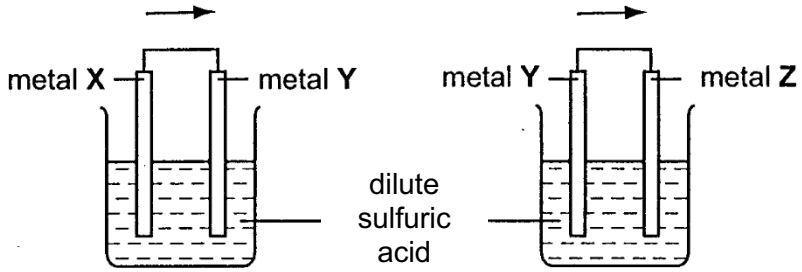
A A gas that bleaches damp litmus paper is produced at the anode.
B A gas that relights a glowing splint is produced at the anode.
C Sodium metal is deposited at the anode.
D A gas that extinguishes a lighted splint is produced at the cathode.

12 Inert electrodes are used in the electrolysis of an aqueous solution containing both copper(II) sulfate and zinc sulfate.

What will be produced at the cathode?

A copper
B zinc
C hydrogen
D oxygen

13 Two cells were set up as shown in the diagram. The arrows show the direction of electron flow in the external circuits.



Which set of metals would give the electron flow in the directions shown?

	metal **X**	metal **Y**	metal **Z**
A	iron	zinc	copper
B	copper	iron	zinc
C	zinc	iron	copper
D	zinc	copper	iron

14 The enthalpy change of combustion of four different fuels are shown below.

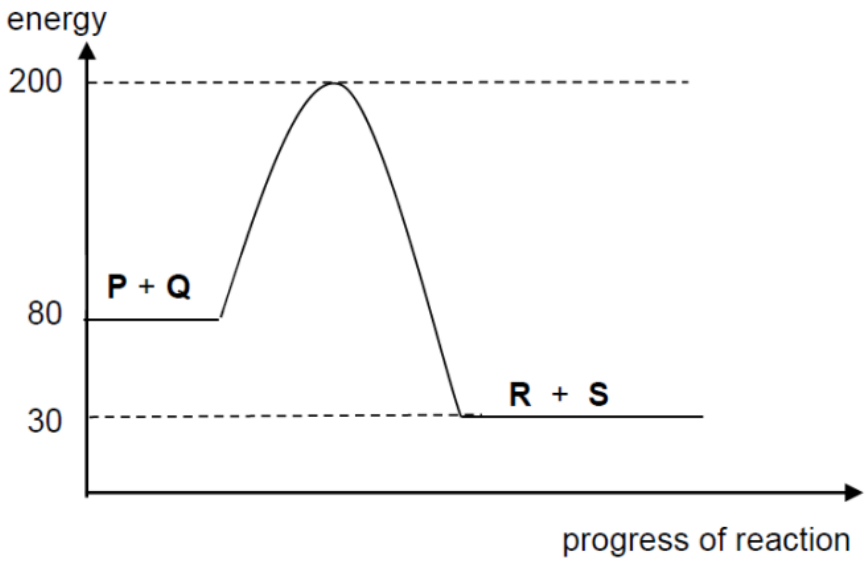
Reaction	**Enthalpy change/kJ**
$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$	−3120
$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$	−1367
$2C_4H_8 + 12O_2 \rightarrow 8CO_2 + 8H_2O$	−5432
$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$	−5756

Which fuel releases the most energy **per gram** of fuel?

A C_2H_6
B C_2H_5OH
C C_4H_8
D C_4H_{10}

15 The diagram below shows the energy profile diagram of a reversible reaction.

P + Q ⇌ R + S



What is the ethalpy change of reaction, ΔH and activation energy, E_a for the **reverse** reaction?

	ΔH in kJ / mol	E_a in kJ / mol
A	− 50	120
B	+ 50	120
C	− 50	170
D	+ 50	170

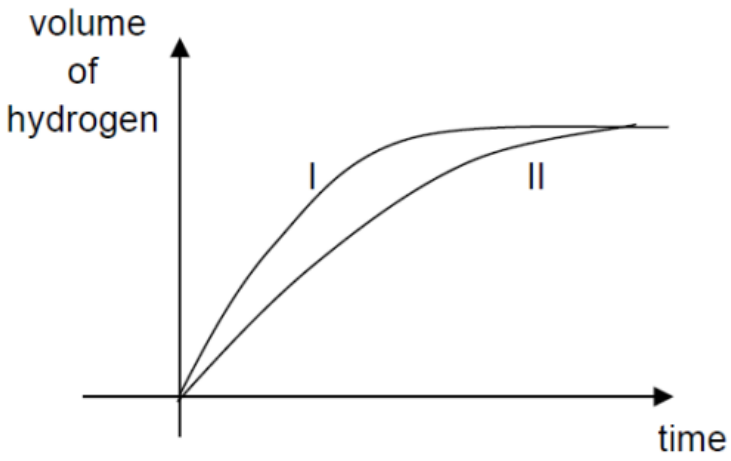
16 In the reaction between magnesium and sulfuric acid, the following changes could be made to the conditions.

1 increase concentration of the acid
2 increase in particle size of magnesium
3 increase in pressure on the system
4 increase in temperature of the system

Which changes will increase the rate of reaction?

A 1, 2 and 4
B 1 and 4 only
C 1, 3 and 4 only
D 2 and 4 only

17 In the graph, curve **I** was obtained when 1 g of granulated zinc was reacted with an excess of 0.1 mol/dm^3 nitric acid at 50°C.



Which of the following changes would give curve **II**?

A increasing the temperature
B using 1 g of powdered zinc
C adding 25 cm^3 of 0.025 mol/dm^3 of nitric acid to the original acid
D reducing the pressure of the reacting mixture

18 In which of the following reactions is the underlined substance oxidised?

A $\underline{Cl_2} + 2I^- \rightarrow I_2 + 2Cl^-$
B $3CuO + 2\underline{NH_3} \rightarrow N_2 + 3H_2O + 3Cu$
C $MgCO_3 + 2\underline{H^+} \rightarrow Mg^{2+} + CO_2 + H_2O$
D $\underline{Pb^{2+}} + SO_4^{2-} \rightarrow PbSO_4$

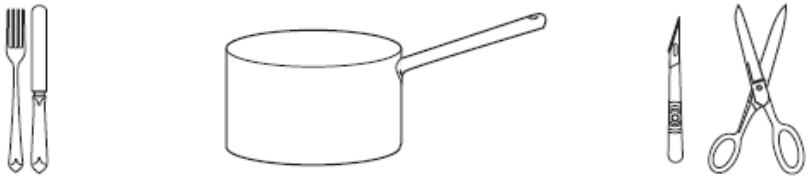
19 The table below shows the results of adding weighed pieces of nickel metal in salt solutions of metals **P**, **Q**, **R** and **S**.

solution	initial mass of nickel/ g	mass of nickel after 10 minutes/ g
P	5.0	4.0
Q	5.0	4.5
R	5.0	3.5
S	5.0	0.0

Which of the following statements is correct?

A Metal **S** can displace the metal in solution **R**.
B Metal **S** is below nickel in the reactivity series.
C Metal **R** is above nickel in the reactivity series
D Metal **P** is above metal **Q** in the reactivity series.

20 The diagram shows three types of item.

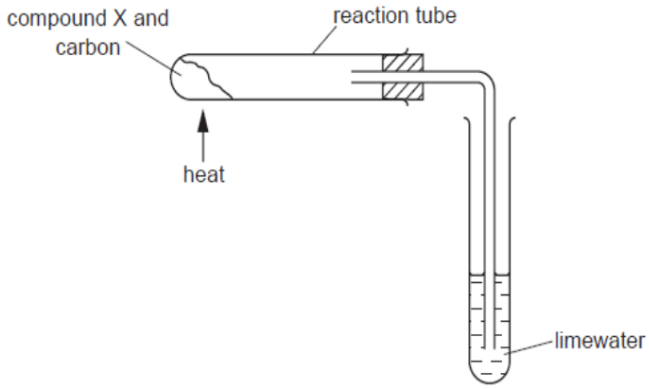


cutlery | cooking pan | instruments used in hospitals

Which method of rust prevention can be used for all three types of item?

A coating with paint
B galvanising
C using alloy such as stainless steel
D coating with grease

21 Compound **X** is heated with carbon using the apparatus shown.



No precipitate is formed in limewater after heating for some time.

What could be **X**?

A calcium oxide
B zinc oxide
C lead(II) oxide
D copper(II) oxide

22 The table below refers to four metals and some of their compounds.

Metal	Action of heat on metal carbonate	Effect of hydrogen on heated oxide	Action of dilute hydrochloric acid on metal
P	Decompose	Reduced	No reaction
Q	No reaction	No reaction	Hydrogen evolved
R	Decompose	No reaction	Hydrogen evolved
S	Decompose	Reduced	Hydrogen evolved

Which one of the following is the order of reactivity of the four metals?

	more reactive		→	less reactive	
A	**Q**	**R**		**S**	**P**
B	**Q**	**S**		**R**	**P**
C	**R**	**S**		**P**	**Q**
D	**R**	**Q**		**P**	**S**

23 Ammonia is produced by the reaction of the elements, hydrogen and nitrogen, in the Haber Process. One of these elements is obtained from air.

The ammonia formed can react with substance **X** to form a salt.

Ammonia can be displaced from this salt by reacting with substance **Y**.

Which row correctly shows the element obtained from air and the type of substances of **X** and **Y**?

	Element obtained from air	**X**	**Y**
A	hydrogen	acid	base
B	hydrogen	base	acid
C	nitrogen	acid	base
D	nitrogen	base	acid

24 Hydrazine has the formula H_2NNH_2. It has properties similar to those of ammonia.

1 It dissolves in water to produce hydroxide ions.
2 It is a covalent compound.
3 It reacts with hydrochloric acid to form a compound with the formula $Cl H_3NNH_3Cl$.

Which of the following correctly describe the properties of hydrazine?

A 1 only
B 1 and 2 only
C 1 and 3 only
D 1, 2 and 3

25 What does the term *strong acid* mean in relation to nitric acid?

A Each molecule of nitric acid can produce one hydrogen ion.
B It is fully ionised in aqueous solution.
C Its aqueous solution has a pH lower than 7.
D All nitrates are soluble in water.

26 The formulae of some oxides are shown below.

Na_2O MgO ZnO SO_2 CO

Which one of the following in the table gives the correct number of each type of oxide?

	number of each type of oxide		
	acidic	amphoteric	basic
A	1	1	2
B	2	0	3
C	2	1	2
D	1	1	3

27 Which equation describes the most suitable reaction for making copper(II) sulfate?

A $Cu + H_2SO_4 \rightarrow CuSO_4 + H_2$
B $Cu(NO_3)_2 + H_2SO_4 \rightarrow CuSO_4 + 2HNO_3$
C $Cu(NO_3)_2 + Na_2SO_4 \rightarrow CuSO_4 + 2NaNO_3$
D $CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$

28 **R**, **S** and **T** are in period 3 of the Periodic Table.

The oxide of **R** reacts with water to form a solution with a pH less than 7 and contributes to acid rain.

S reacts violently with cold water to produce a gas which extinguishes lighted splint with a 'pop' sound.

Oxide of **T** is soluble in both hydrochloric acid and aqueous sodium hydroxide.

Which statement is **incorrect**?

A **R** has more protons than **S**.
B Carbonate of **S** does not decompose on heating.
C **T** has lower electricity conductivity than **S**.
D **R** forms two oxides. One oxide of **R** decolourises purple potassium manganate(VII) solution.

29 Elements **U** and **V** are in Group VII of the Periodic Table**.**

U is a liquid at room temperature and **V** is a solid at room temperature.

Which statement is correct?

A **V** has lighter colour than **U**.
B **U** reacts with aqueous sodium chloride to form chlorine.
C **V** is a solid and can act as a catalyst.
D **U** displaces astatine from an aqueous solution of At^- ions.

30 The following reactions takes place in the presence of an ion of the element **X**.

Step 1 : $2\mathbf{X}^{2+} + S_2O_8^{2-} \rightarrow 2\mathbf{X}^{3+} + 2SO_4^{2-}$

Step 2 : $2\mathbf{X}^{3+} + 2I^- \rightarrow 2\mathbf{X}^{2+} + I_2$

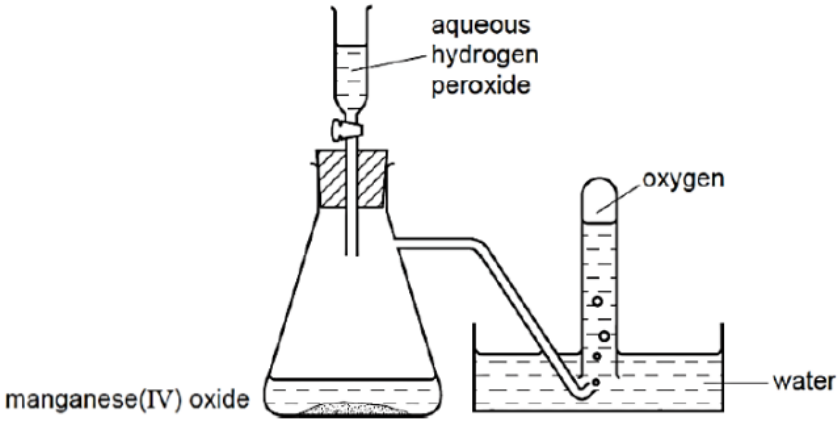
1 1 mol of $S_2O_8^{2-}$ produces 0.5 mol of I_2.
2 Compounds of **X** are coloured.
3 Oxide of **X** is basic.

Which statement(s) is/are correct?

A 1, 2 and 3
B 1 and 3 only
C 2 and 3 only
D 2 only

31 Oxygen gas was prepared from hydrogen peroxide and collected as shown.

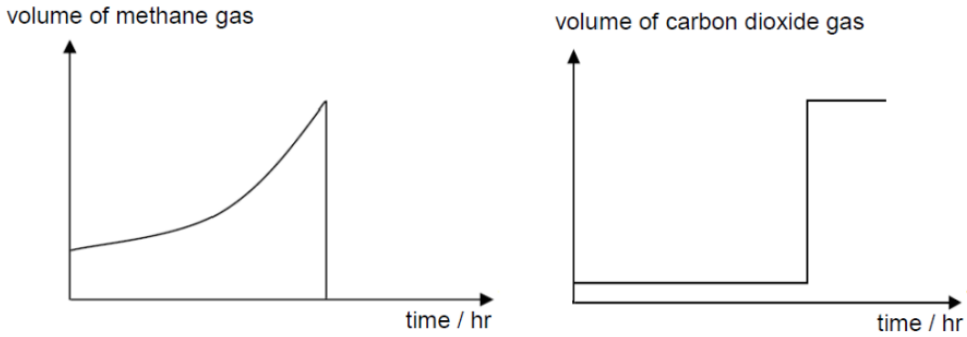
$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$



Which substance contaminated the first few tubes of oxygen collected?

A H_2
B H_2O
C H_2O_2
D N_2

32 The graphs below show how the volume of methane and carbon dioxide in the air inside a coal mine change with time.



What is likely to have caused the sudden change shown in the graphs?

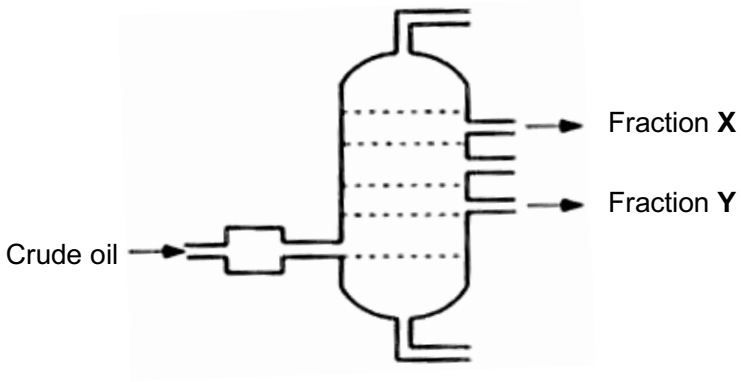
A A mixture of methane and air exploded.
B The coal mine was ventilated by having fresh air blown in.
C The temperature in the mine was lowered in the night.
D Methane reacts with carbon dioxide inside the coal mine.

33 An atmospheric pollutant can be removed by the process of reduction.

Which pollutant is removed by this process?

A carbon monoxide in a catalytic convertor
B sulfur dioxide by reaction with calcium oxide
C nitrogen monoxide in a catalytic converter
D sulfur dioxide from flue gases by reaction with calcium carbonate

34 The diagram shows the fractional distillation of crude oil.



Which of the following statements about fractions **X** and **Y** is correct?

A **X** is less flammable than **Y**.
B **X** has a higher boiling point than **Y**.
C **X** is less viscous than **Y**.
D Both **X** and **Y** can be used for making road surfaces.

35 Which manufacturing process does **not** require the use of catalyst?

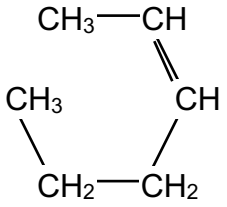
A Extraction of iron in blast furnace
B Manufacturing of margarine from vegetable oil
C Manufacturing of ammonia
D Production of petrol from long-chain hydrocarbon in cracking

36 During combustion, 10 cm^3 of the vapour of a hydrocarbon **R** produces 60 cm^3 of carbon dioxide measured under room temperature and pressure.

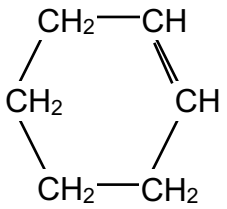
When **R** reacts with hydrogen over a nickel catalyst, a compound of relative molecular mass 84 is formed.

What is the formula of **R**?

A $(CH_3)_2CHCH_2CH_2CH_3$
B $CH_3CH_2CH_2COOCH_2CH_3$
C



D



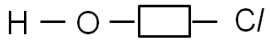
37 Which of these equations does **not** represent an addition reaction?

A $CH_4 + Br_2 \rightarrow CH_3Br + HBr$
B $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$
C $n\ C_2H_4 \rightarrow (—CH_2 – CH_2—)_n$
D $C_3H_6 + H_2O \rightarrow C_3H_7OH$

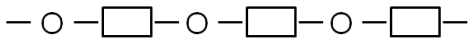
38 Which compound can be oxidised to ethanoic acid?

A CH_3OH
B C_2H_5OH
C C_3H_7OH
D C_4H_8

39 The following monomer undergoes condensation polymerisation to produce a polymer.



Three repeat units of this polymer are shown below.

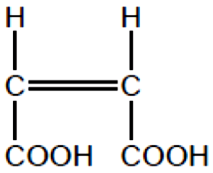


Which compound is formed each time a monomer is added to the polymer?

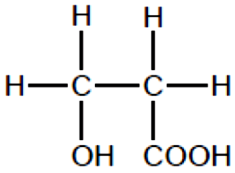
A Cl_2
B H_2
C HCl
D H_2O

40 The structures of 4 compounds **W**, **X**, **Y** and **Z** are shown below.

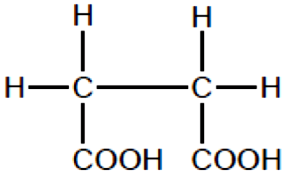
W



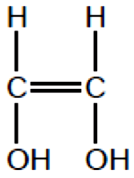
X



Y



Z



Which row correctly describes the reactions of the compounds?

	decolourises aqueous bromine	has a pH of less than 7	reacts with a carboxylic acid to form an ester
A	**W** and **Z**	**W**, **X** and **Y**	**X** and **Z**
B	**W** and **Z**	**X** and **Z**	**X**
C	**X** and **Y**	**W**, **X** and **Y**	**X** and **Z**
D	**X** and **Y**	**X** and **Z**	**X**

End of paper

The Periodic Table of Elements

Group																	
I	**II**											**III**	**IV**	**V**	**VI**	**VII**	**0**
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 A*l* aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 C*l* chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 T*l* thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 F*l* flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name: _____

Register No.	Class

'Perseverance Yields Success'

Ping Yi Secondary School

PRELIMINARY EXAMINATION 2022

Secondary 4 Express

Chemistry

6092/01

Paper 1 Multiple Choice **1 hour**

Additional materials: Multiple Choice Answer Sheet

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your name, class and register number in the spaces at the top of this page.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

There are **forty** questions in this paper. Answer **all** questions.
For each question, there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on Optical Answer Sheet (OAS).

Read the instructions on the answer sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Data Sheet is printed on page 17.
A copy of the Periodic Table is printed on page 18.

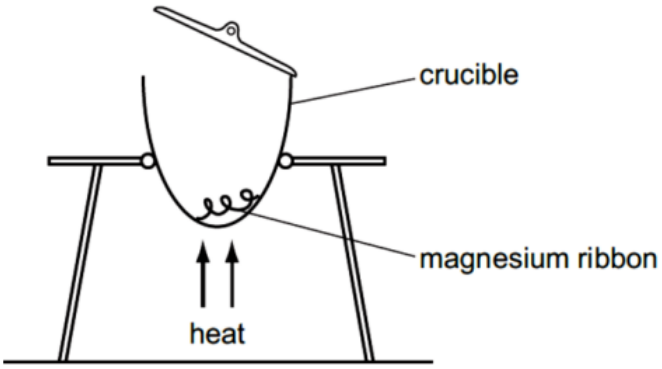
Expected Grade	□ **A1**	□ **A2**	□ **B3**	□ **B4**	□ **C5**
Teacher's Comment					
Student's Comment					
Parent's Comment and Signature					

This document consists of **18** printed pages including this cover page and inserts.

[Turn over

Answer all the questions in the answer sheet provided.

1 The diagram shows an experiment to find the formula of magnesium oxide.



Which piece of apparatus would be needed in addition to those shown above?

A burette
B electronic balance
C measuring cylinder
D thermometer

2 Which of the following substances may be condensed using a water condenser?

	substance	melting point / °C	boiling point / °C
A	ammonia	-78	-33
B	butane	-135	-0.5
C	hydrogen chloride	-115	-85
D	pentane	-130	36

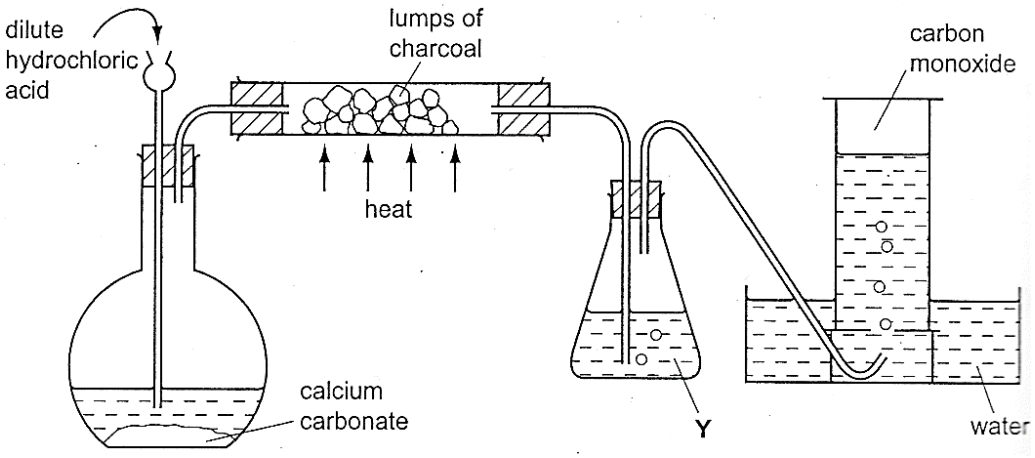
3 Which of the following correctly describes the particles in a dilute sugar solution at room temperature?

	sugar molecules	water molecules
A	close together, moving at random	close together, moving at random
B	widely separated, not moving	widely separated, moving at random
C	widely separated, moving at random	close together, moving at random
D	widely separated, moving at random	close together, not moving

4 At which temperature does a concentrated aqueous solution of sodium chloride begin to boil?

A 93 ºC **B** 99 ºC **C** 100 ºC **D** 104 ºC

5 The diagram shows the apparatus used to obtain carbon monoxide.



What is the main purpose of Y?

A to dry the gas
B to prevent water from being sucked back into the hot carbon
C to remove carbon dioxide from the gas
D to remove hydrogen chloride from the gas

6 The nucleon number and proton number of an atom of X and an atom of Y are shown.

	X	Y
proton number	19	17
nucleon number	39	37

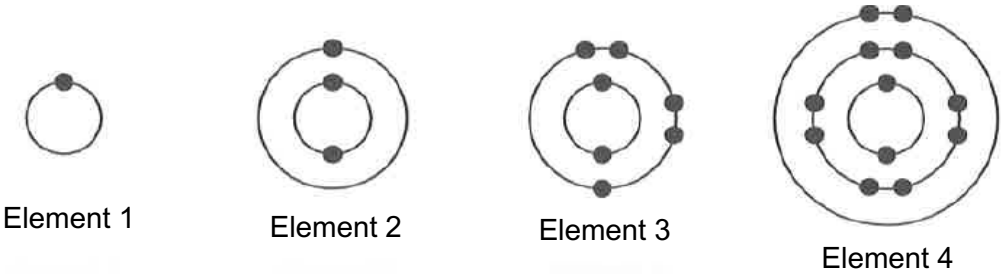
The following statements are made on X and Y.

1 An ion of X has more electrons than an ion of Y.
2 Both ions have the same number of valence electrons.
3 Both ions have the same number of neutrons.
4 Both react together to form a covalent compound XY.

Which statement(s) is/are correct?

A 1 only **B** 1 and 2 only **C** 2 and 3 only **D** 3 and 4 only

7 The diagrams show the electronic structures of four elements.



Element 1 Element 2 Element 3 Element 4

The following statements are made on the four elements.

1 Elements 1 and 2 are good electrical conductors.
2 Elements 2 and 4 have very high melting points.
3 Element 2 is more reactive than element 4.
4 Element 4 has a giant lattice structure.

Which statement(s) is/are true about the four elements?

A 1 only **B** 2 and 3 only **C** 2 and 4 only **D** 3 and 4 only

8 Carbon disulfide is a simple covalent compound used in manufacturing polymers. Which of these statements would you predict to be true about carbon disulfide?

A It has a low boiling point and conducts electricity when molten.
B It has a low boiling point and is soluble in organic solvents.
C It is a crystalline solid at room temperature and conducts electricity when molten.
D It is a crystalline solid at room temperature and is soluble in organic solvents.

9 In which pair of covalent molecules does oxygen form at least one double bond on both molecules?

A CO_2 and C_2H_5OH
B CO_2 and O_2
C H_2O and C_2H_5OH
D H_2O and O_2

10 The formula of thallium carbonate is Tl_2CO_3 and that of sodium chlorite is $NaClO_2$.
What is the formula of thallium chlorite?

A $TlClO_2$ **B** Tl_2ClO_2 **C** $Tl(ClO_2)_2$ **D** $Tl_2(ClO_2)_3$

11 Which molecule has the least number of electrons involved in covalent bonds?

A C_2H_2 **B** C_2H_4 **C** H_2S **D** N_2

12 Which statement best explains why graphite is often employed as a dry lubricant in hot machines?

A Each carbon atom uses only three out of four valence electrons for bonding.
B The carbon atoms in each layer are held by weak covalent bonds.
C The carbon atoms in graphite are connected in a tetrahedral arrangement.
D The different layers of carbon atoms are held by weak intermolecular forces of attraction.

13 Silicon carbide has a structure similar to diamond. Boron nitride has a structure similar to graphite. Bronze is a mixture of metals.

Which statements about silicon carbide, boron nitride and bronze are correct?

1 All are bonded covalently.
2 All are insoluble in water.
3 All except silicon carbide conduct electricity when solid.
4 Bronze has low melting point.

A 1 and 2 **B** 2 and 3 **C** 2 and 4 **D** 3 and 4

14 In an experiment, excess hydrochloric acid was added to 0.5 g of chalk and 100 cm^3 of carbon dioxide was produced at room temperature and pressure.

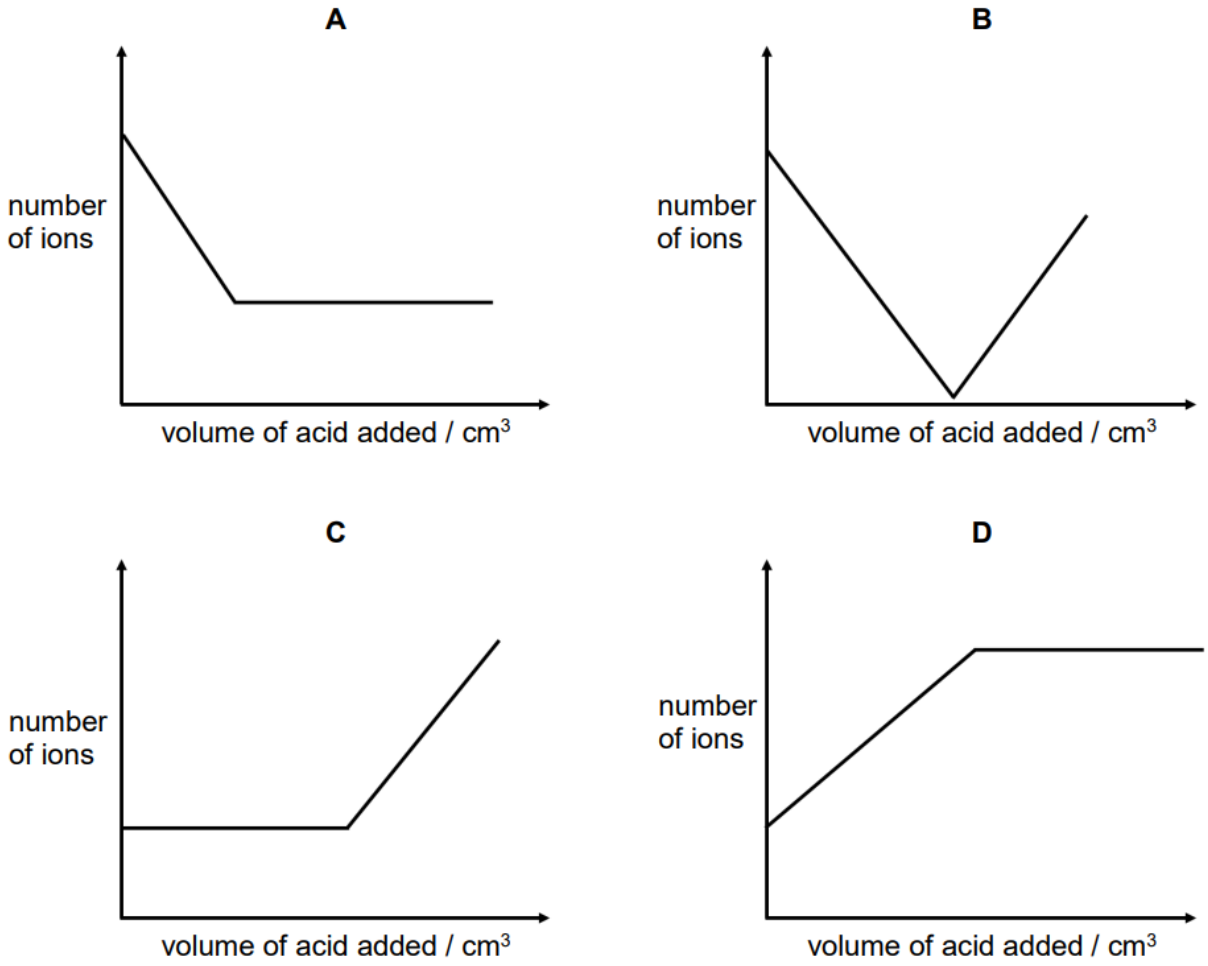
What is the percentage purity of calcium carbonate in the sample of chalk?

A 1.20 % **B** 2.20 % **C** 41.7 % **D** 83.3 %

15 In which reaction does the smallest percentage change in volume occur?

A $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$
B $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$
C $2H_2S(g) + SO_2(g) \rightarrow 3S(s) + 2H_2O(l)$
D $4NH_3(g) + 3O_2(g) \rightarrow 2N_2(g) + 6H_2O(l)$

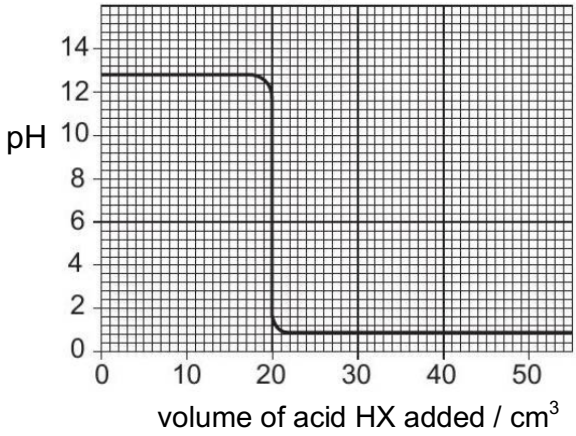
16 Dilute sulfuric acid was added to aqueous barium hydroxide until the acid was in excess.
Which graph shows the variation in the total number of ions in the solution?



17 49.2 g of hydrated magnesium sulfate is heated and cooled repeatedly until it reaches a constant mass of 24.0 g. Assuming only water of crystallisation is lost when hydrated magnesium sulfate is heated, what is the formula of the hydrated magnesium sulfate?

A $MgSO_4.3H_2O$
B $MgSO_4.5H_2O$
C $MgSO_4.7H_2O$
D $MgSO_4.10H_2O$

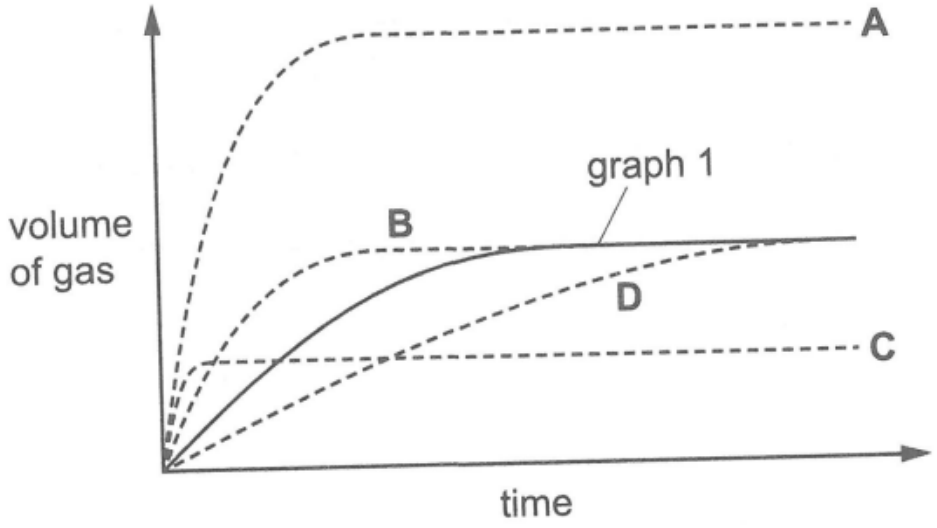
18 A pH probe measures the pH changes during a titration experiment. In the experiment, an unknown acid, HX of concentration 0.1 mol/dm^3, was added from a burette to 25.0 cm^3 of dilute sodium hydroxide. The graph shows the results of the experiment.



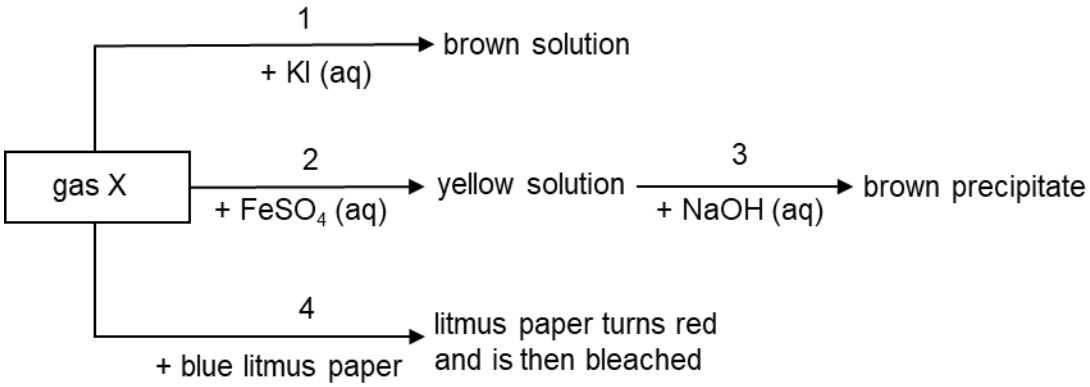
Which statement about the results obtained from the experiment is incorrect?

A Concentration of alkali used is less than 0.1 mol / dm^3.
B Formula of salt formed is NaX.
C HX is a strong acid.
D Neutralisation only occurs when 20.0 cm^3 of HX is added to sodium hydroxide.

19 A sample of 0.5 g of magnesium ribbon is reacted with an excess of 1.0 mol/dm^3 hydrochloric acid.
The volume of hydrogen gas produce over time is measured.
The results are plotted to give graph 1.
Which graph would be produced when 1.0 g of magnesium ribbon is reacted with an excess of 1.0 mol/dm^3 of hydrochloric acid under the same conditions?



20 The scheme below shows reactions of a gas X.



Which statement is incorrect?

A Gas X is chlorine.
B In stage 1, iodide ion is oxidised as it gains electrons to form iodine.
C In stage 2, iron(II) sulfate acts as a reducing agent.
D The brown precipitate formed in stage 3 is iron(III) hydroxide.

21 Metals are found naturally as the metal or as metal compounds.
The metal compounds can be reduced to the metal using carbon as a reducing agent or by electrolysis.
Which row is correct?

	can be found as the metal	obtained by reduction using carbon	obtained by electrolysis
A	Mg	Fe, Zn	Na, K
B	Ag	Na, Zn	Fe, K
C	Ag	Fe, Zn	Mg, Na
D	Mg	Fe, K	Ag, Na

22 Iron is extracted from iron ore in the Blast Furnace.

The equations show some reactions that happen in the Blast Furnace.

1 $C + O_2 \rightarrow CO_2$
2 $CO_2 + C \rightarrow 2CO$
3 $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
4 $CaCO_3 \rightarrow CaO + CO_2$
5 $SiO_2 + CaO \rightarrow CaSiO_3$

Which two equations show elements in compounds being reduced?

A 1 and 2 **B** 2 and 3 **C** 3 and 4 **D** 4 and 5

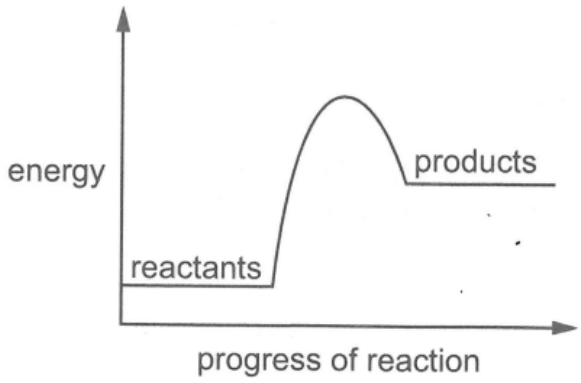
23 Elements W, X, Y and Z are in the same period but different groups of the Periodic Table.

W reacts with oxygen to form W_2O, a basic oxide.
X reacts with oxygen to form XO_2, an acidic oxide.
Y is an oxide which reacts with both an acid and a base.
Z reacts with W to form an ionic compound of formula WZ.

What is the order of these four elements across the Periodic Table?

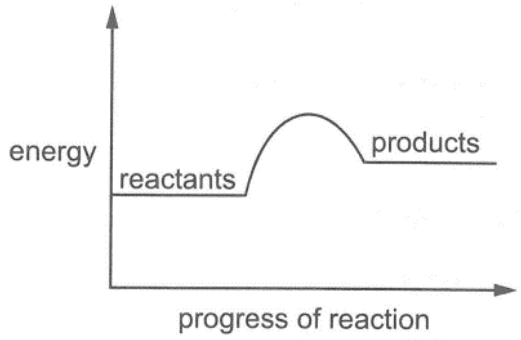
A WXYZ **B** WYXZ **C** WYZX **D** ZWYX

24 The energy profile diagram for a reaction is shown.

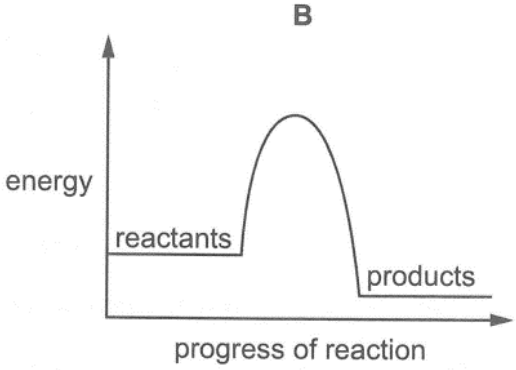


A catalyst was added and no other reaction condition was changed.
Which energy profile diagram is correct for the catalysed reaction?

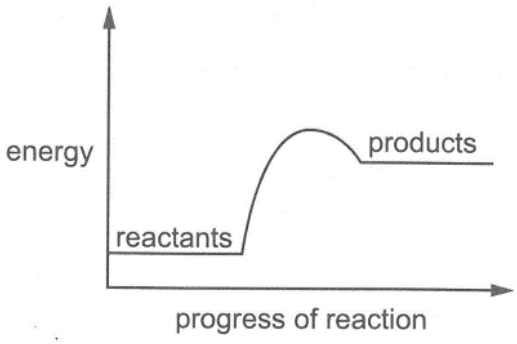
A



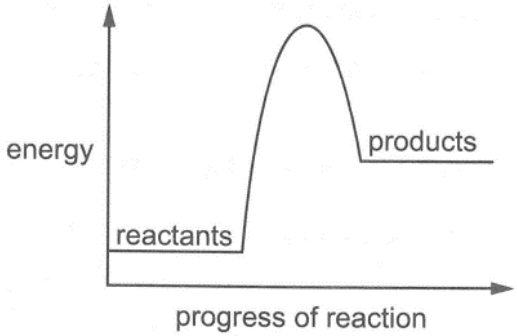
B



C



D



25 The scheme shows four stages 1 to 4, in the conversion of solid candle wax, $C_{30}H_{62}$, into carbon dioxide and water.

1 $C_{30}H_{62}(s) \rightarrow C_{30}H_{62}(l)$

2 $C_{30}H_{62}(l) \rightarrow C_{30}H_{62}(g)$

3 $C_{30}H_{62}(g) + 45.5O_2(g) \rightarrow 30CO_2(g) + 31H_2O(g)$

4 $30CO_2(g) + 31H_2O(g) \rightarrow 30CO_2(g) + 31H_2O(l)$

Which stages are exothermic?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

26 A catalytic converter in a car exhaust system changes pollutants into less harmful products.

Which change does not occur in a catalytic converter?

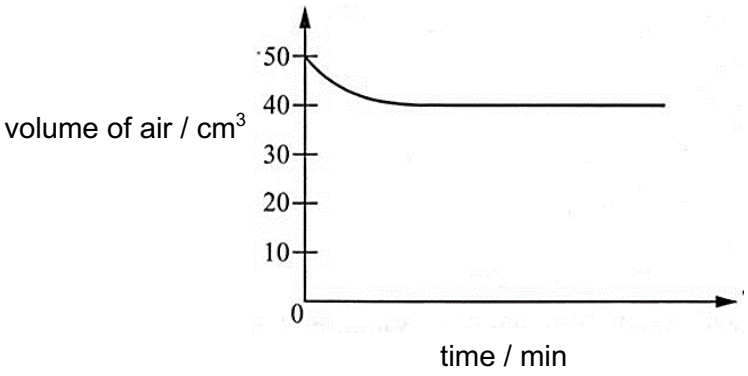
A carbon dioxide → carbon

B carbon monoxide → carbon dioxide

C nitrogen oxides → nitrogen

D unburned hydrocarbons → carbon dioxide and water

27 The graph below shows the change in the volume of air in a vessel.



Which of the following reactions is likely to cause this change?

A $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

B $2H_2O_2 \rightarrow 2H_2O + O_2$

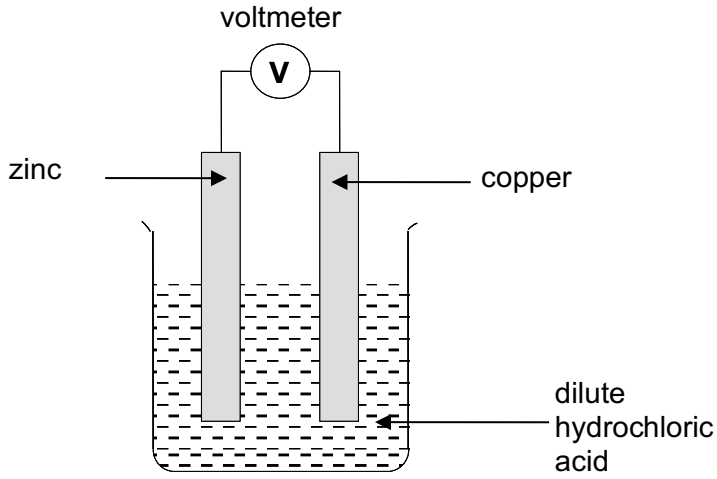
C $2Mg + O_2 \rightarrow 2MgO$

D $N_2 + 3H_2 \rightarrow 2NH_3$

28 An article to be copper-plated is made the cathode of a cell. What would be the most suitable materials for the anode and the electrolyte?

	anode	electrolyte
A	carbon	aqueous copper (II) sulfate
B	copper	aqueous copper (II) sulfate
C	copper	sulfuric acid
D	platinum	sulfuric acid

29 The diagram shows a set-up of a simple cell.



Which of the following describes the reaction at the cathode?

A $2Cl^- \rightarrow Cl_2 + 2e^-$

B $Cu \rightarrow Cu^{2+} + 2e^-$

C $2H^+ + 2e^- \rightarrow H_2$

D $4OH^- \rightarrow 2H_2O + O_2 + 2e^-$

30 Two metals and an electrolyte can be used to produce electrical energy. A voltage is set up between the metals. One of the metals used is zinc.

The table shows the voltage produced by some cells when different metals are used.

metal tested	voltage / V	direction of electron flow
P	0.2	zinc to metal P
Q	0.5	metal Q to zinc
R	1.1	zinc to metal R

Arrange the three metals according to their reactivity in the reactivity series, starting with the least reactive metal.

A P, Q, R **B** P, R, Q **C** Q, P, R **D** R, P, Q

31 During the electrolysis of dilute aqueous hydrochloric acid, 9.6 cm^3 of hydrogen gas is collected at the cathode at room temperature and pressure.

Which statement about the electrolysis is correct?

A 4.8 cm^3 of chlorine gas is collected at the anode.
B 4.8 cm^3 of oxygen gas is collected at the anode.
C 9.6 cm^3 of chlorine gas is collected at the anode.
D 9.6 cm^3 of oxygen gas is collected at the anode.

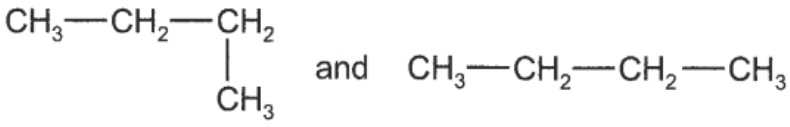
32 The boiling point of a covalent compound is determined by the strength of the intermolecular forces between its molecules.
Which covalent compound has the strongest forces of attraction between its molecules?

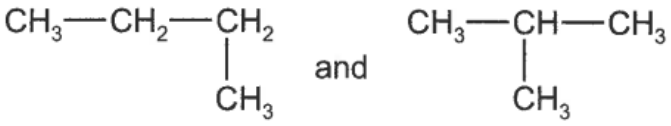
A butane **B** ethane **C** methane **D** propane

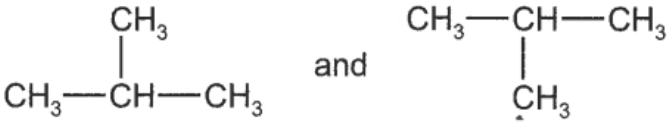
33 What will propanol, C_3H_7OH, form on complete oxidation?

A CH_3CO_2H **B** $C_2H_5CO_2H$ **C** $C_3H_7CO_2H$ **D** $C_4H_9CO_2H$

34 Which diagram(s) represent(s) the two isomers of butane, C_4H_{10}?

1 

2 

3 

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

35 Which bond in a molecule of ethanoic acid is broken when it reacts with magnesium?

A the C-H bond
B the C-C bond
C the O-H bond
D the C=O bond

36 Which alcohol and acid can be reacted together to make the ester, $CH_3CH_2CH_2CO_2CH_3$?

A C_4H_9OH and HCO_2H
B C_3H_7OH and CH_3CO_2H
C C_2H_5OH and $C_2H_5CO_2H$
D CH_3OH and $C_3H_7CO_2H$

37 The equation for the cracking of alkane is shown.

$$C_{10}H_{22} \rightarrow C_4H_{10} + X + Y$$

X decolourises aqueous bromine.

What is the formula of X and Y?

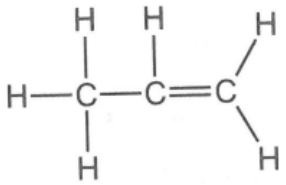
	compound X	compound Y
A	C_2H_4	C_4H_8
B	C_2H_4	C_4H_{10}
C	C_2H_6	C_4H_8
D	C_2H_6	C_4H_8

38 Compound Z

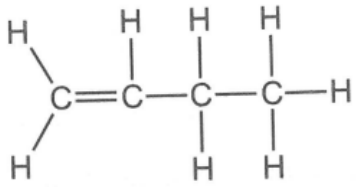
- has an empirical formula of CH_2,
- has an M_r of 56,
- reacts with steam to form two alcohols that have different structural formulae.

What is compound Z?

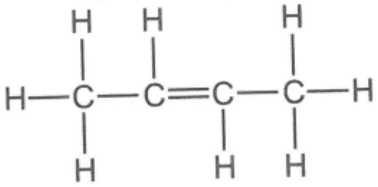
A



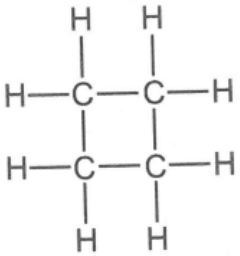
B



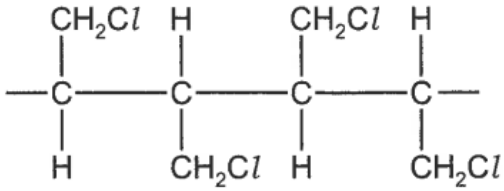
C



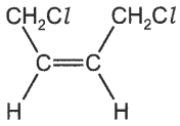
D

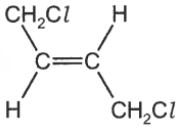


39 The diagram shows the partial structure of a polymer.



Which statement about this polymer is correct?

A It could be made by the addition polymerisation of 

B It could be made from the condensation polymerisation of 

C Its monomer has the empirical formula $C_4H_6Cl_2$.

D Its monomer could be made by the reaction of an alkane with chlorine.

40 Two compounds, X and Y, react together to form the polymer nylon.

compound X	compound Y
$H_2N\text{-}(CH_2)_6\text{-}NH_2$	$HOOC\text{-}(CH_2)_4\text{-}COOH$

What is the formula of the partial structure which repeats within the polymer?

A $C_{10}H_{22}N_2O_2$
B $C_{12}H_{22}N_2O_2$
C $C_{10}H_{20}N_2O_4$
D $C_{12}H_{20}N_2O_4$

END OF PAPER

DATA SHEET

Colours of some common metal hydroxides

aluminium hydroxide	white
calcium hydroxide	white
copper (II) hydroxide	light blue
iron (II) hydroxide	green
iron (III) hydroxide	red-brown
lead (II) hydroxide	white
zinc hydroxide	white

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name: …….. ( ) Class: Sec 4A

Queenstown Secondary School

Preliminary Examination 2022
Secondary Four Express
Chemistry
6092/01

31 August 2022
Wednesday

Time: 1200 – 1300h
Duration: 1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

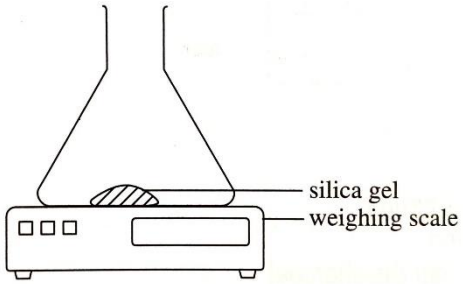
Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 17.
The use of an approved scientific calculator is expected, where appropriate.

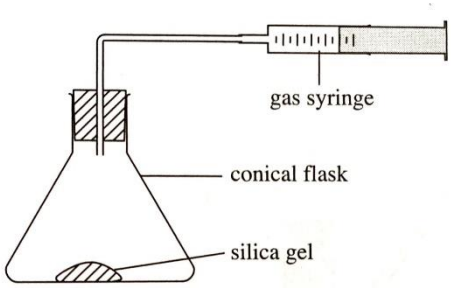
1 Silica gel is a solid which can absorb water vapour from the air. It can be used to limit the growth of mould on leather goods and electronic equipment.

Which of the following methods can be used to study the rate of absorption of water vapour in silica gel?

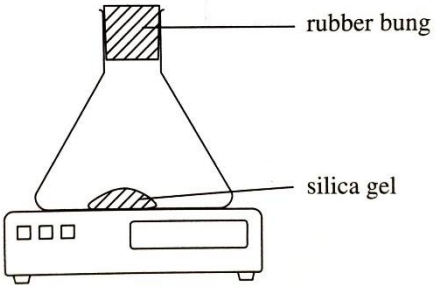
A



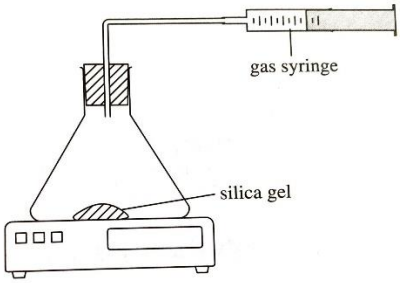
C



B



D



2 A liquid mixture contains methylbenzene and dilute aqueous copper(II) sulfate with different densities. Methylbenzene has a boiling point of 111°C and is insoluble in water.

Which of the following steps can be used to obtain a liquid sample of methylbenzene and solid sample of copper(II) sulfate?

	step 1	step 2
A	fractional distillation	crystallisation
B	simple distillation	evaporation
C	use a separating funnel	crystallisation
D	use a separating funnel	evaporation

3 During the test for chloride ion using aqueous silver nitrate, the solution must be acidified with dilute nitric acid.

What is the purpose of adding dilute nitric acid?

A To oxidise the chloride ion.

B To increase the speed of reaction.

C To prevent the precipitation of other ions.

D To prevent the decomposition of silver chloride formed.

4 In an experiment, 4.0 cm^3 of 1.0 mol/dm^3 aqueous copper(II) sulfate and 8.0 cm^3 of 1.0 mol/dm^3 aqueous barium nitrate are mixed.

$$CuSO_4\ (aq) + Ba(NO_3)_2\ (aq) \rightarrow Cu(NO_3)_2\ (aq) + BaSO_4\ (s)$$

What does the reaction vessel contain once the reaction is complete?

A a colourless solution only

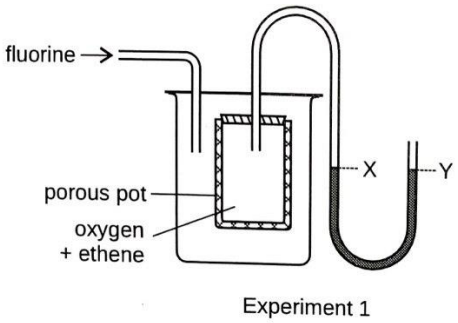
B a white precipitate and a blue solution

C a blue precipitate and a colourless solution

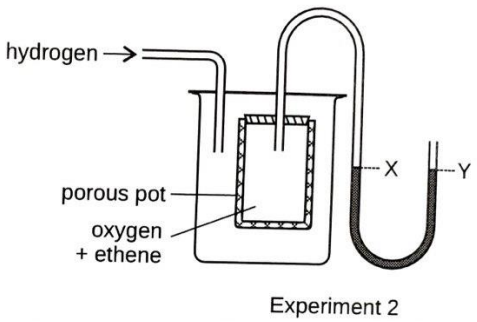
D a white precipitate and a colourless solution

5 Two experimental set ups used to demonstrate diffusion of gases are shown in the diagrams below. The gases in each porous pot are ethene, C_2H_4, and oxygen, O_2.

In the first experiment, the gas introduced into the beaker is fluorine, F_2, while in the second experiment, it is hydrogen, H_2.



Experiment 1



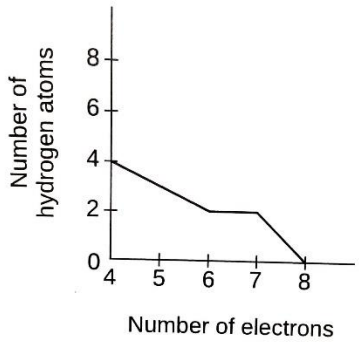
Experiment 2

What changes, if any, to the water levels X and Y would you expect to see in both experiments?

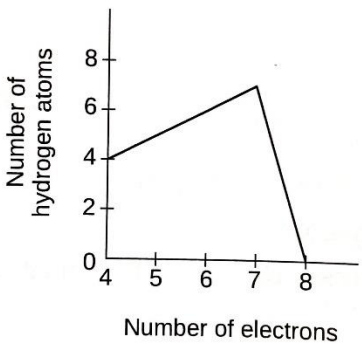
	experiment 1	experiment 2
A	Y is higher than X	Y is higher than X
B	X is higher than Y	Y is higher than X
C	X and Y remain the same	X is higher than Y
D	X and Y remain the same	X and Y remain the same

6 Which of the following diagrams below **best** represents the relationship between the number of electrons in the valence shell of an atom and the number of hydrogen atoms which the atom is most likely to combine?

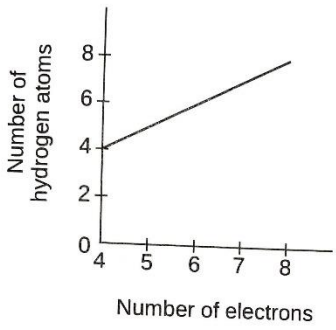
A



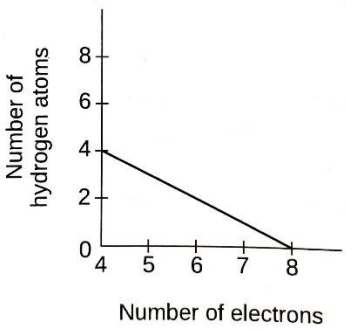
C



B



D

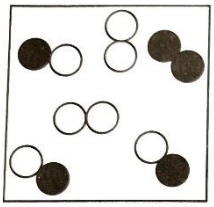


7 An element exists as 2 kinds of isotopes, P and Q. There are 80% of isotope P with a relative atomic mass of 45. If the relative atomic mass of the element is 47, what is the relative atomic mass of isotope Q?

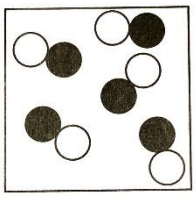
A 48 **B** 52 **C** 55 **D** 60

8 Which diagram represents the reaction between hydrogen and iodine that is not yet complete?

A

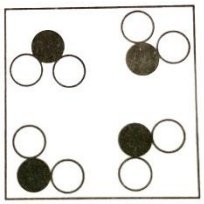


B



C

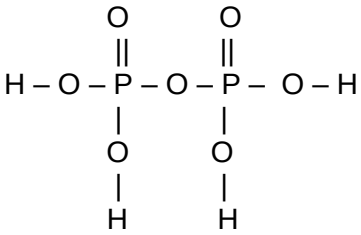
D



9 A compound G contains oxygen and one other element.
Which property of G indicates that the bonds in G are ionic?

A It is soluble in water.
B It reacts with alkalis.
C It has a low melting and boiling point.
D It conducts electricity in the molten and aqueous states only.

10 The structural formula shows the bonding in pyrophosphoric acid.



What is the total number of bonding electrons for both phosphorus atoms in the formula?

A 10 **B** 15 **C** 20 **D** 30

11 Which substance in the table below could be methanol?

substance	melting point /°C	boiling point /°C	electrical conductivity	
			in the liquid state	in aqueous state
A	−114	−85	nil	good
B	−98	65	nil	nil
C	180	218	nil	nil
D	420	970	good	good

12 Solid silver metal, aqueous magnesium nitrate, solid graphite and molten sodium chloride conduct electricity.

Which two of the substances conduct electricity as they contain mobile electrons?

A solid silver metal and solid graphite
B solid graphite and molten sodium chloride
C solid silver metal and aqueous magnesium nitrate
D aqueous magnesium nitrate and molten sodium chloride

13 40 cm^3 of an aqueous 0.5 mol/dm^3 solution of the hydroxide of metal X, exactly neutralises 80 cm^3 of 0.25 mol/dm^3 dilute sulfuric acid.

What is the formula for the sulfate of X?

A XSO_4 **B** X_2SO_4 **C** $X(SO_4)_4$ **D** $X_2(SO_4)_3$

14 A 400 g of sample of hydrated potassium sulfide crystals, $K_2S.xH_2O$, was heated to remove the water of crystallisation. The mass of solid that remained after heating was 220 g.

How many moles of water are present in 1 mole of this compound?

A 5 **B** 7 **C** 10 **D** 12

15 Methane burns completely in oxygen according to the equation.

$$CH_4\ (g) + 2O_2\ (g) \rightarrow CO_2\ (g) + 2H_2O\ (g)$$

In an experiment, 40 cm^3 of methane and 60 cm^3 of oxygen are allowed to react in a closed vessel. The water vapour formed is allowed to condense. What is the volume of the resultant gaseous mixture when measured at room temperature and pressure?

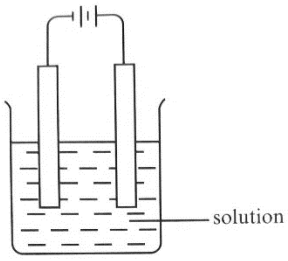
A 20 cm^3 **B** 40 cm^3 **C** 60 cm^3 **D** 100 cm^3

16 On adding 50 g of impure limestone, $CaCO_3$ (M_r = 100), to excess hydrochloric acid, 6.0 dm^3 of CO_2 was evolved at room temperature and puressure.

What is the purity of the limestone?

A 25% **B** 50% **C** 75% **D** 100%

17 Four different solutions were electrolysed in separate experiments.

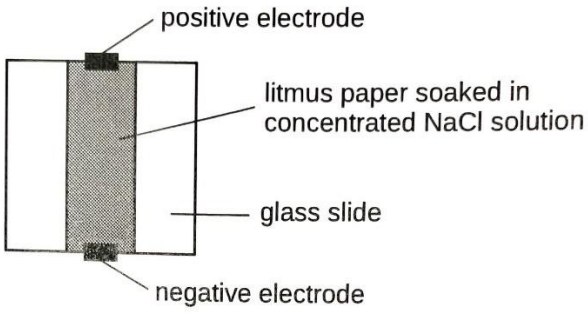


In three of the experiments, element A was formed at the cathode. In which of the following is the formation of A **not** represented by the equation shown below.

$$A^{2+} + 2e^- \rightarrow A$$

A aqueous copper(II) sulfate with inert electrodes
B aqueous copper(II) sulfate with copper electrodes
C molten magnesium sulfate with inert electrodes
D concentrated aqueous magnesium bromide with inert electrodes

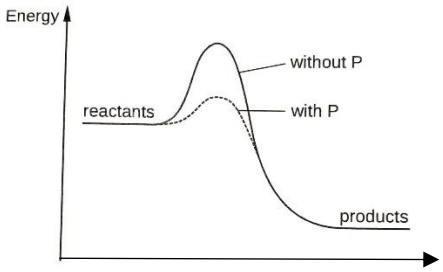
18 A piece of litmus paper was soaked in concentrated sodium chloride solution and supported on a glass slide and is connected to a power source as shown.



Which one of the following shows the correct observations near the positive electrode and negative electrode after the current has flowed for some time?

	positive electrode	negative electrode
A	bleached	blue
B	bleached	no change
C	no change	bleached
D	no change	red

19 A substance P is added to a reaction mixture.
The energy profile diagram shows the effect of P on the reaction pathway.



Which of the following observations are expected to occur when P is added to the reaction mixture?

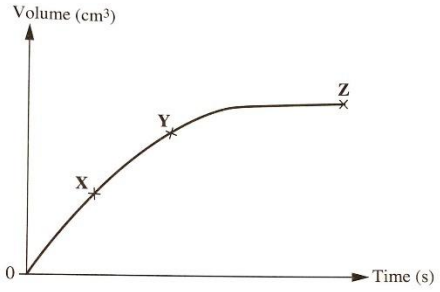
1 The speed of reaction increases.
2 The enthalpy of the reaction remains unchanged.
3 The reaction can take place at a lower activation energy pathway.

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 1, 2 and 3

20 Which statement about the hydrogen-oxygen fuel cell is **incorrect**?

A It produces electricity, water and heat.
B Hydrogen and oxygen are used as the main reactants.
C The net reaction produces water and hydrogen gas only.
D It is made up of an electrolyte between the anode and cathode.

21 The graph shows the volume of carbon dioxide given off plotted against time when a sample of calcium carbonate reacts with 100 cm^3 of 1 mol/dm^3 excess hydrochloric acid.



Which of the following statements is correct?

A The reaction has completely stopped only at point Z.
B The time taken for the reaction to reach completion increases when 100 cm^3 of 1 mol/dm^3 ethanoic acid is used instead.
C More vigorous bubbling is observed at point Y than at point X.
D The total volume of carbon dioxide evolved is greater if the sample of calcium carbonate is in powdered form.

22 Which equation does **not** represent a redox reaction?

A $Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$
B $Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$
C $2Li + F_2 \rightarrow 2LiF$
D $Cu^{2+} + Ca \rightarrow Ca^{2+} + Cu$

23 When hydrogen peroxide is added to aqueous iron(II) chloride, the pale green solution turns brown.

Which of the following statements **best** describes this observation?

A Iron(II) oxide is formed.

B Iron(III) hydroxide is formed.

C Hydrogen peroxide is acting as a reducing agent.

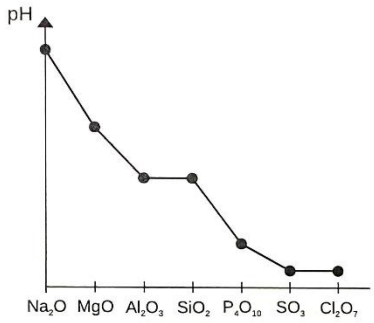
D Fe^{2+} ions are oxidised to Fe^{3+} ions by hydrogen peroxide.

24 The pH of a dilute solution of hydrochloric acid is approximately 2.
When 10 g of solid sodium chloride is added to it, what will its pH be?

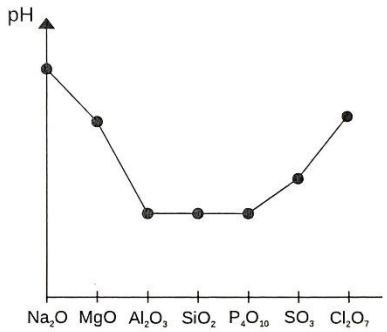
A 2 **B** 4 **C** 7 **D** 9

25 The oxides of the elements sodium to chlorine are added to water separately.
Which one of the following diagrams **best** represents the pH of the solutions produced?

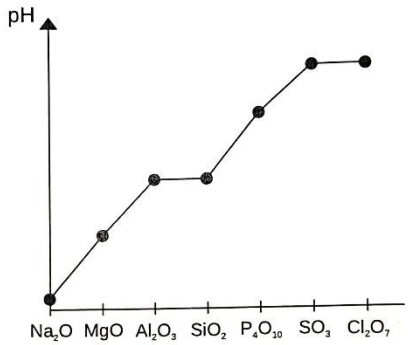
A



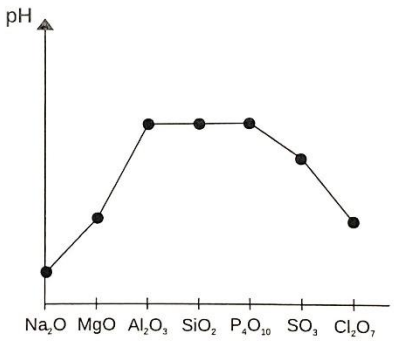
C



B



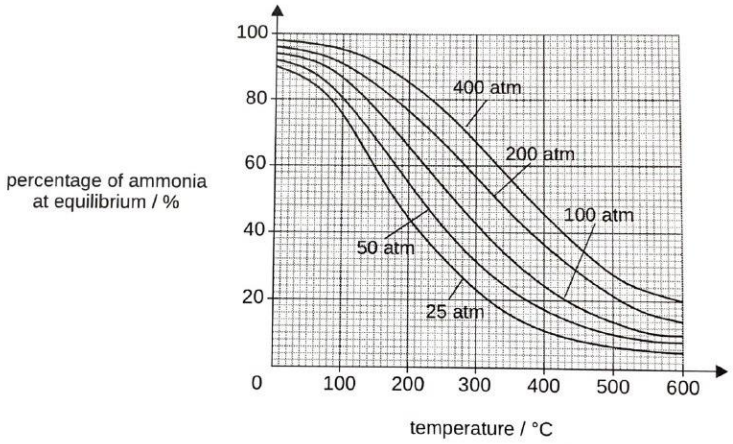
D



26 A sample of lead(II) chloride was contaminated with a small amount of lead(II) oxide. Which of the following correctly shows the steps to be taken to obtain pure and dry lead(II) chloride?

A Add dilute nitric acid, filter, evaporate filtrate to dryness.
B Add water, filter, evaporate filtrate to dryness and dry between filter paper.
C Add dilute nitric acid, filter, rinse residue and dry between filter paper.
D Add water, evaporate solution until saturated and perform crystallisation.

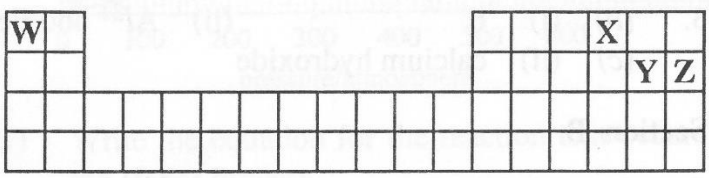
27 The graph gives the information about the percentage of ammonia present in the equilibrium mixture at different temperatures and pressure.



Which of the following statements about the Haber process is correct?

A Hydrogen is obtained from the air by fractional distillation.
B Decreasing pressure decreases the yield of the reaction.
C Decreasing temperature decreases the yield of the reaction.
D The reaction between hydrogen and nitrogen to form ammonia is irreversible.

28 The elements with the code letters W, X, Y and Z are placed in the Periodic Table as shown.



Which one of the following is a correct statement regarding W, X, Y and Z?

A The atomic numbers increase in the order W, X, Y and Z.

B W and X are solids, but Y and Z are gases under room conditions.

C The valency of W and Y is one, but the valency of X and Z is two.

D W is in Group I, X in Group V, Y in Group VI and Z in Group VII.

29 Which statement about Group I elements is true?

A They form covalent bonds with halogens.

B They form oxides when reacted with water.

C Their boiling points increase on descending the group.

D Their reactivity increases on descending the group.

30 Astatine is found in Group VII of the Periodic Table.
Which of the following is **not** a property of astatine?

A Astatine is a solid at room temperature.

B Astatine reacts by gaining one electron to form astatide ion.

C Astatine can displace iodide ions from aqueous solutions.

D Astatine can react with Group I elements to form an ionic compound.

31 Copper(II) carbonate, magnesium carbonate and iron(II) carbonate decompose when heated. The temperature at which decomposition takes place depends upon the position of the metal in the reactivity series.

What is the correct order for this decomposition?

	highest temperature	→	lowest temperature
A	magnesium carbonate	copper(II) carbonate	iron(II) carbonate
B	magnesium carbonate	iron(II) carbonate	copper(II) carbonate
C	copper(II) carbonate	iron(II) carbonate	magnesium carbonate
D	iron(II) carbonate	magnesium carbonate	copper(II) carbonate

32 A student was investigating an unknown metal X and he made the following observations in the report.

- A clean piece of X did not displace any lead when dropped into lead(II) nitrate solution.
- When a strip of lead is dipped into copper(II) nitrate solution, it became covered with a pink substance.
- A clean piece of X is dipped into copper(II) nitrate solution, it became covered with a pink substance.

Which of the following shows the correct arrangement of the three metals in order of increasing reactivity concluded by the student?

A Pb, X, Cu **B** X, Pb, Cu **C** Cu, Pb, X **D** Cu, X, Pb

33 Which reaction is **not** a step in the production of iron from haematite in the blast furnace?

A Carbon burning in air to produce carbon dioxide.
B Carbon dioxide reacting with iron(III) oxide to produce iron.
C Calcium oxide reacting with silicon dioxide to form slag.
D Calcium carbonate decomposed to form calcium oxide and carbon dioxide.

34 Which of the processes does **not** increase the amount of carbon in the atmosphere in the carbon cycle?

A combustion
B respiration
C photosynthesis
D decay of organic matter

35 The following list shows the environmental problems in our modern world.

1 global warming

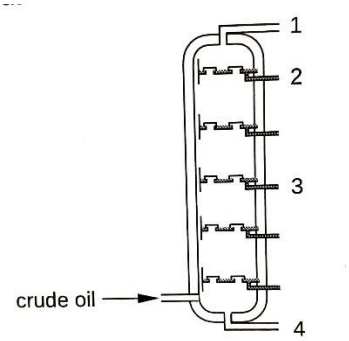
2 destruction of the ozone layer

3 rivers and lakes turning acidic

Which of the following sets correctly matches the air pollutants to the environmental problems?

	1	2	3
A	sulfur dioxide	methane	chlorofluorocarbons
B	methane	sulfur dioxide	chlorofluorocarbons
C	methane	chlorofluorocarbons	sulfur dioxide
D	chlorofluorocarbons	sulfur dioxide	methane

36 The diagram shows the fractional distillation of crude oil.



Which statement about the fractions is correct?

A Fraction 1 has the lowest flammability.

B Fraction 2 has the highest viscosity.

C Fraction 3 can undergo catalytic cracking to form fraction 2.

D Fraction 4 is used as a fuel in heavy vehicles such as trucks and lorries.

37 An alkane has formula $C_{10}H_{22}$.

Which of the following is **not** true about the cracking of this alkane?

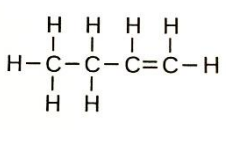
A The product of cracking can be all smaller alkanes only.

B A catalyst and high temperature are needed for cracking to occur.

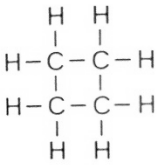
C Hydrogen produced from cracking is one of the raw materials for the Haber process.

D Cracking produces smaller molecules to meet the supply and demand for smaller hydrocarbons.

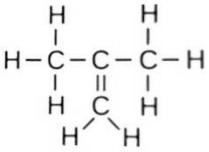
38 Which of the following are isomers of butene, C_4H_8?



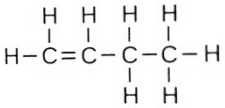
1



2



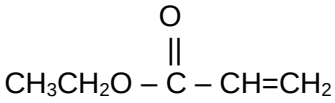
3



4

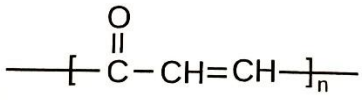
A 1 and 3 only **B** 1 and 4 only **C** 1, 3 and 4 **D** 2, 3 and 4

39 The molecular structure shows an 'acrylic ester' which can be used to make the sticky substance of adhesive tape called poly(acrylate).

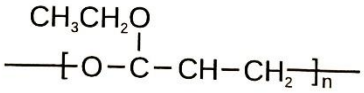


Which of the following represents the formula of poly(acrylate) which can be made from this monomer?

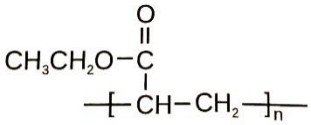
A



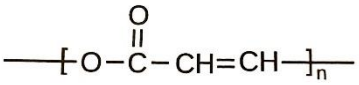
C



B



D



40 An organic compound X has the empirical formula CH_2O and a relative molecular mass of 60. It reacts with ethanol in the presence of concentrated sulfuric acid to give a sweet-smelling liquid.

Wat is the chemical formula of X?

A $C_2H_5COCH_2OH$ **B** $C_2H_5COOCH_3$ **C** C_2H_5OH **D** CH_3COOH

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

NAME:	NO:	CLASS:

RIVERSIDE SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2022

SUBJECT	: CHEMISTRY
PAPER	: 6092/01
LEVEL/STREAM	: 4 Express
DURATION	: 1 Hour

READ THESE INSTRUCTIONS FIRST

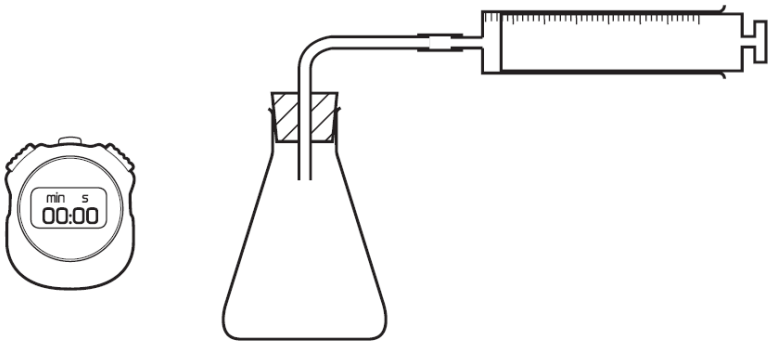
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, register number and class on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C**, and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this question paper.
A copy of the Periodic Table is printed on page 18.
The use of an approved scientific calculator is expected, where appropriate.

1 The apparatus shown can be used to find the rate of some chemical reactions.



The rate of which reaction can be followed using these apparatus?

A $Cu + H_2SO_4$

B $NaOH + CuSO_4$

C $Mg(HCO_3)_2 + HCl$

D $NaOH + HCl$

2 The melting and boiling points of four substances are shown in the table.

Which substance will be condensed if passed through a water condenser at room temperature?

	hydrocarbon	melting point/ °C	boiling point/ °C
A	butane	-135	0
B	carbon dioxide	-78.5	-78.5
C	pentane	-130	38
D	propane	-190	-45

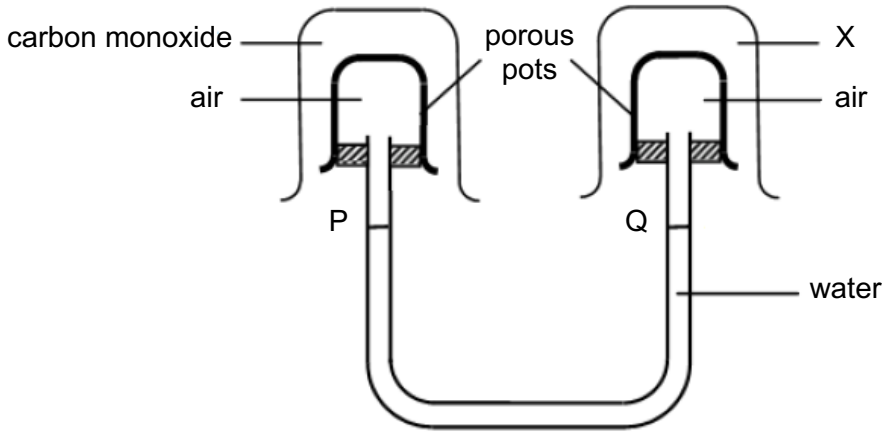
3 An acid, X, was added to a solution of the nitrate of metal Y.

A white precipitate was formed.

What are X and Y?

	X	Y
A	dilute hydrochloric acid	calcium
B	dilute hydrochloric acid	zinc
C	dilute sulfuric acid	aluminium
D	dilute sulfuric acid	barium

4 This experiment was set up to investigate the movement of gaseous substances.



The water level at P moved down initially.

What is substance X?

A helium

B methane

C nitrogen

D nitrogen oxide

5 A radioactive isotope of carbon has more nucleons than the non-radioactive isotope, $^{12}_{6}C$.

Which row is correct for an atom of a radioactive isotope of carbon?

	protons	neutrons	electrons
A	6	6	6
B	6	8	6
C	12	6	6
D	12	12	12

6 Substance T has the properties described below.

- conducts electricity when molten
- melting point higher than 600 °C
- highly soluble in water

What is substance T?

A ammonia

B copper(II) oxide

C magnesium chloride

D zinc

7 When solid iodine is heated, it sublimes and changes into a purple gas.

Which statement describes the process?

A Attractive forces between iodine molecules are overcome.

B Covalent bonds between iodine molecules are broken.

C Intermolecular forces between iodine atoms are overcome.

D Ionic bonds between the iodine atoms are weakened.

8 Which molecule has the **largest** number of electrons involved in covalent bonds?

A carbon dioxide

B ethene

C methanol

D nitrogen

9 Which substance is a metal?

	conduct electricity		physical state of product formed on reaction with oxygen
	when solid	when liquid	
A	✓	✓	solid
B	✓	✓	gas
C	✗	✓	no reaction
D	✗	✗	solid

10 The formula for hydrated sodium carbonate is $Na_2CO_3.xH_2O$. It contains 62.9% water of crystallisation by mass.

Which other information is needed to determine the value of *x*?

A atomic numbers of carbon, oxygen and sodium

B atomic numbers of carbon, oxygen, sodium and hydrogen

C relative atomic masses of carbon, oxygen and sodium

D relative atomic masses of carbon, oxygen, sodium and hydrogen

11 A 25.0 cm^3 sample of dilute sulfuric acid contains 0.05 moles of the acid.

What is the concentration of hydrogen ion in the solution?

A 1.0 mol/dm^3

B 2.0 mol/dm^3

C 4.0 mol/dm^3

D 8.0 mol/dm^3

12 126 g of potassium manganate(VII), $KMnO_4$, is needed for the complete oxidation of 46 g of ethanol, C_2H_5OH, under acidic conditions.

How many moles of ethanol can be completely oxidised by one mole of potassium manganate(VII) under these conditions?

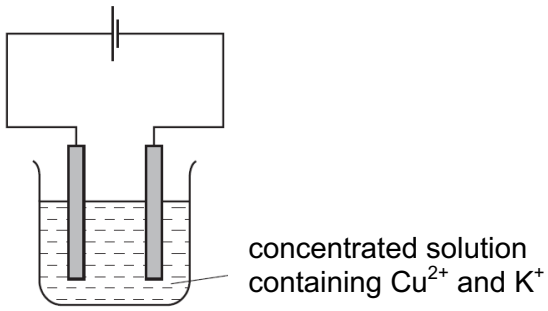
A 0.37

B 0.80

C 1.00

D 1.25

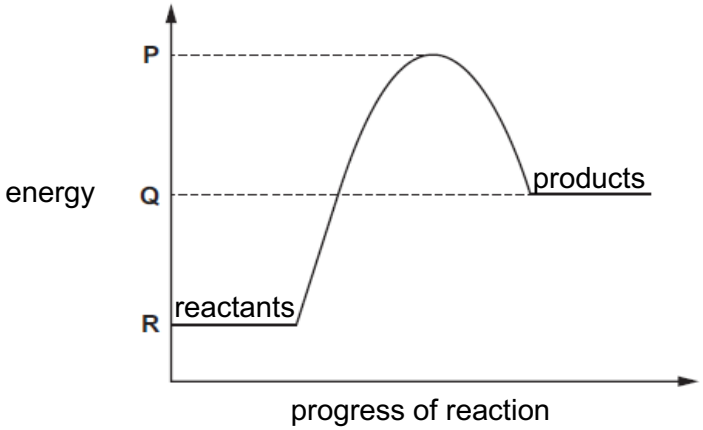
13 The diagram shows the electrolysis of a concentrated aqueous solution containing both copper(II) ions and potassium ions.



Which metal is deposited at the negative electrode and why?

	metal deposited	reason
A	copper	copper is less reactive than hydrogen
B	copper	copper is more reactive than hydrogen
C	potassium	potassium is less reactive than hydrogen
D	potassium	potassium is more reactive than copper

14 The energy profile diagram for the **forward** reaction of a reversible reaction is shown.



For the **reverse** reaction, which statement is correct?

A It is endothermic and the activation energy is P – Q.

B It is endothermic and the activation energy is P – R.

C It is exothermic and the activation energy is P – Q.

D It is exothermic and the activation energy is P – R.

15 0.24 g of magnesium ribbon was allowed to react at 25 ^{o}C with 20 cm^3 of 1.0 mol/dm^3 dilute hydrochloric acid.

Which factor would **not** result in an increase in the initial rate of the reaction?

A carrying out the reaction at 30 ^{o}C

B using 40 cm^3 of 1.0 mol/dm^3 dilute hydrochloric acid

C using a catalyst

D using powdered magnesium

16 At the start of a reaction, 1.00 dm^3 of a solution contains 0.300 mol of ethanol.

After 100 seconds, the concentration of the ethanol decreased to 0.297 mol/dm^3.

What is the rate of reaction over the first 100 seconds?

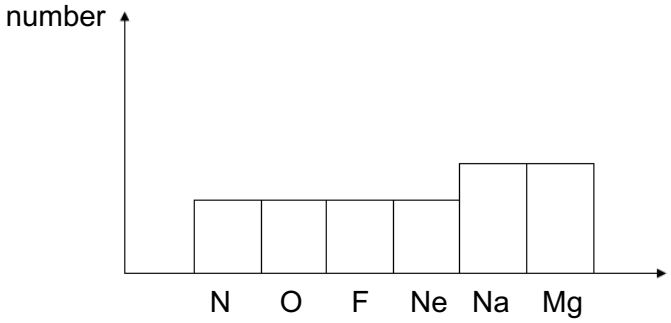
A 2.96×10^{-3} mol/dm^3 / s

B 3.00×10^{-5} mol/dm^3 / s

C 4.00×10^{-5} mol/dm^3 / s

D 8.00×10^{-5} mol/dm^3 / s

17 The chart shows the variation for a specific 'number' related to the elements, nitrogen to magnesium.



According to the trend, what is this 'number'?

A the number of electron shells

B the number of protons and neutrons

C the number of valence electrons

D the oxidation number

18 Oxidising strength is a relative term used to denote how certain elements oxidise other elements with respect to each other.

Which list represents the halogen in decreasing order of oxidising strength?

	decreasing oxidising strength →		
A	chlorine	bromine	iodine
B	chlorine	iodine	bromine
C	iodine	bromine	chlorine
D	iodine	chlorine	bromine

19 The list gives four oxides.

1 carbon dioxide

2 copper(II) oxide

3 magnesium oxide

4 zinc oxide

Which pair of oxides can react with sodium hydroxide?

A 1 and 2

B 1 and 4

C 2 and 4

D 3 and 4

20 Salt P is prepared by reacting aqueous metal carbonate and dilute acid.

Which is salt P?

A copper(II) chloride

B silver chloride

C sodium nitrate

D zinc sulfate

21 The reaction in the Haber process is represented as

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92 \text{ kJ}$$

Which statement about the Haber process is **incorrect**?

A 92 kJ of heat is given off when 2 mol of ammonia are formed.

B Iron is used as catalyst.

C The process is carried out at a high pressure of 250 atm.

D When 2 mol of N_2 and 6 mol of H_2 are used, 4 mol of NH_3 are collected.

22 The list gives four pairs of compounds.

1 ammonium nitrate and calcium hydroxide

2 ammonium nitrate and calcium nitrate

3 ammonium sulfate and calcium carbonate

4 ammonium sulfate and calcium oxide

Which pairs will produce ammonia when warmed together?

A 1 and 2 only

B 1 and 4 only

C 2 and 4 only

D 3 and 4 only

23 The table shows data for atoms or ions of the elements P, Q, R and S. The letters do not represent the chemical symbols of the elements.

	number of electrons	number of protons
P	11	11
Q	10	13
R	18	17
S	18	18

Which statement is correct?

A P and S are inert.

B Q and R form a compound with a formula QR_3.

C P combines with oxygen to form acidic oxides.

D R and S have different number of valence electrons.

24 Which statement(s) is/are true about **all** the noble gases?

1 The number of protons in their atoms equals the number of neutrons.

2 They all have eight electrons in their outer shell.

3 They do not react to form ionic compounds.

A 1, 2 and 3 only

B 1 and 2 only

C 2 only

D 3 only

25 Which element in the table is likely to be a transition metal?

	melting point	colour of chloride	variable oxidation state	use as catalyst
A	high	blue	yes	yes
B	low	green	no	yes
C	high	white	yes	no
D	low	white	no	no

26 Properties of an element and its compounds can be predicted from the position of the element in the Periodic Table.

What property **cannot** be predicted in this way?

A The catalytic property of the element or its compound.

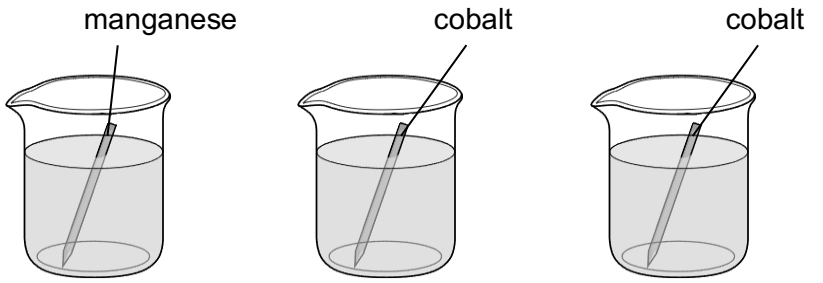
B The nature of the oxide of the element.

C The number of isotopes the element has.

D The reactivity of the element.

27 Three experiments to compare the reactivity of three metals are shown in the diagram.

Arrange them from least reactive to most reactive.

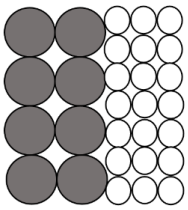


	tin sulfate solution	tin sulfate solution	manganese sulfate solution
result:	tin deposited on manganese	tin deposited on cobalt	no reaction

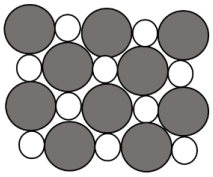
	least reactive → most reactive		
A	cobalt	tin	manganese
B	tin	cobalt	manganese
C	manganese	cobalt	tin
D	manganese	tin	cobalt

28 Which diagram best represents an alloy?

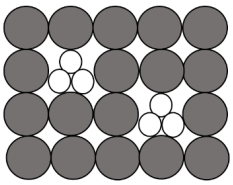
A



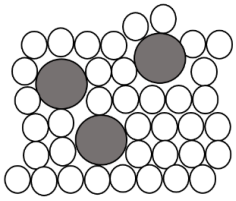
B



C



D



29 A block of magnesium is attached to an underground steel pipe.

Which will happen if a block of lead is used instead of magnesium?

A All of the lead will be oxidised.

B Iron in steel will be oxidised to form Fe^{3+}.

C The steel will corrode as it gets reduced.

D The steel will produce green deposits.

30 The metal beryllium does not react with cold water.

It reacts with dilute hydrochloric acid but cannot be extracted from its ore by using carbon.

Where should it be placed in the reactivity series?

magnesium

A

zinc

B

iron

C

copper

D

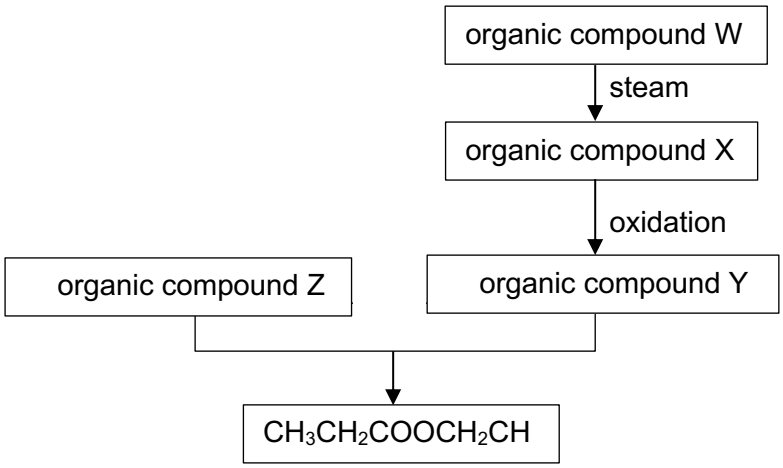
31 Which row correctly compares carbon dioxide and water vapour?

	both formed during respiration	both present in unpolluted air
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

32 Which molecule is **not** formed when pentane reacts with chlorine in the presence of sunlight?

A $C_5H_6Cl_6$ **B** $C_5H_{10}Cl_2$ **C** $C_5H_5Cl_4$ **D** $C_5H_4Cl_8$

33 An odour of pineapple comes from the organic compound, $CH_3CHCOOCH_2CH_3$.
It can be made using the reaction scheme below.



Which row correctly identifies X and Z?

	X	Z
A	CH_3CH_2OH	CH_3CH_2OH
B	CH_3CH_2COOH	CH_3CH_2OH
C	CH_3CH_2OH	CH_3CH_2COOH
D	$CH_3CH_2CH_2OH$	CH_3CH_2OH

34 Which pair of substances are possible products when 1 mole of C_8H_{18} undergoes cracking in the presence of aluminium oxide and silicon dioxide?

1 2 mole of C_4H_8 only

2 1 mole of C_2H_4 and 1 mole of C_6H_{14}

3 1 mole of C_3H_6 and 2 mole of H_2

4 3 mole of CO_2 and 4 mole of H_2O

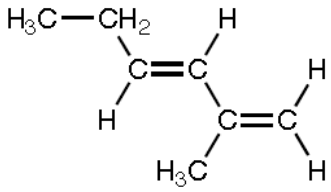
A 1, 3 and 4 only

B 1 and 4 only

C 1 only

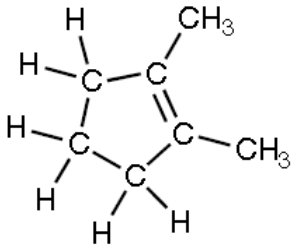
D 2 only

35 The diagram shows a long-chain molecule.

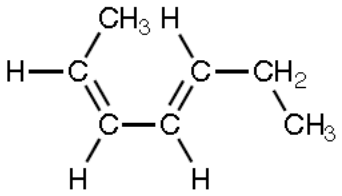


Which structure is **not** an isomer of the molecule?

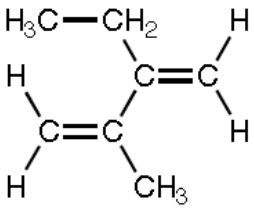
A



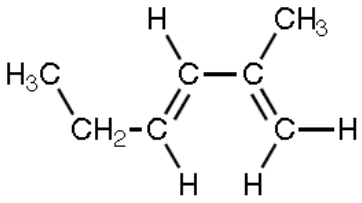
B



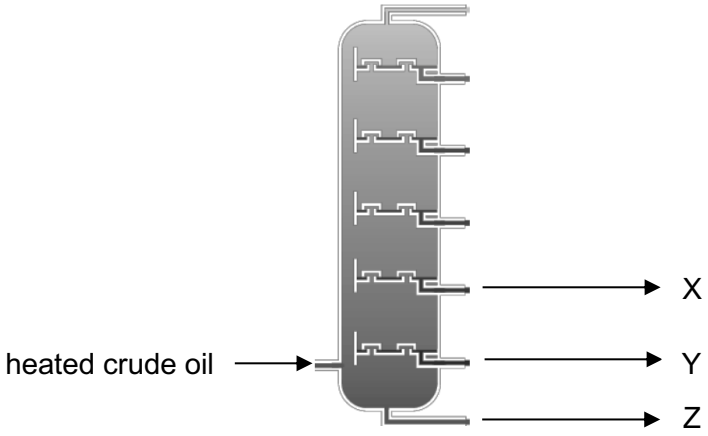
C



D



36 The diagram below shows the fractional distillation of crude oil.



Which statement is correct?

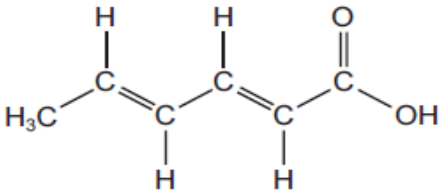
A Fraction X is used as fuel for cooking.

B Fractions X, Y and Z are each obtained as mixture of hydrocarbons.

C Fraction Y is more flammable than fraction X.

D Fraction Z has the lowest boiling point of the three fractions.

37 Sorbic acid is used as a food preservative because it kills fungi and moulds.



sorbic acid

Which are the reaction(s) that sorbic acid can undergo?

1 decolourises bromine in an organic solvent

2 reacts with aqueous sodium carbonate to produce carbon dioxide

3 reacts with hydrogen in the presence of a nickel catalyst

A 1 only

B 1 and 2 only

C 1 and 3 only

D all of the above

38 Three beakers contain the following acid solutions.

beaker A 50 cm^3 1.00 mol/dm^3 dilute hydrochloric acid

beaker B 50 cm^3 1.00 mol/dm^3 dilute sulfuric acid

beaker C 50 cm^3 1.00 mol/dm^3 ethanoic acid

A 10 cm length of magnesium is added to each beaker. The magnesium reacted completely in each case.

Each reaction produced 100% yield of the products.

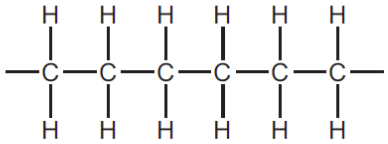
It was observed that 100 cm^3 hydrogen gas was formed when the magnesium reacted with dilute hydrochloric acid.

Which row shows the correct observations when beakers B and C were compared with beaker A?

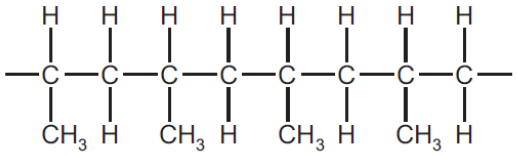
	speed of reaction		volume of hydrogen formed at the end of the reaction	
	beaker B	beaker C	beaker B	beaker C
A	faster	slower	more	less
B	faster	slower	same	same
C	slower	faster	more	less
D	slower	faster	same	same

39 What is the partial structure of the polymer formed by the polymerisation of propene, $CH_3CH=CH_2$?

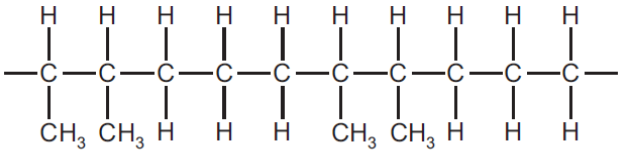
A



B



C



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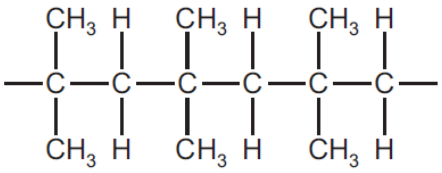


40 Which bond is present in both nylon and *Terylene*?

A C – O

B C = O

C N – C

D N – H

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name:		Index Number:		Class:	

ST. ANTHONY'S CANOSSIAN SECONDARY SCHOOL
Preliminary Examination 2022
Secondary 4 Express

CHEMISTRY **6092/01**

Paper 1
Setter: MRS ESTHER BOO

15 September 2022

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark.
A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page **20**
The use of an approved scientific calculator is expected, where appropriate.

40

Parent's signature:

This document consists of **20** printed pages

[Turn over

1 A student plans two experiments.

Experiment 1: find the concentration of a solution of sodium hydroxide by titration with dilute hydrochloric acid.

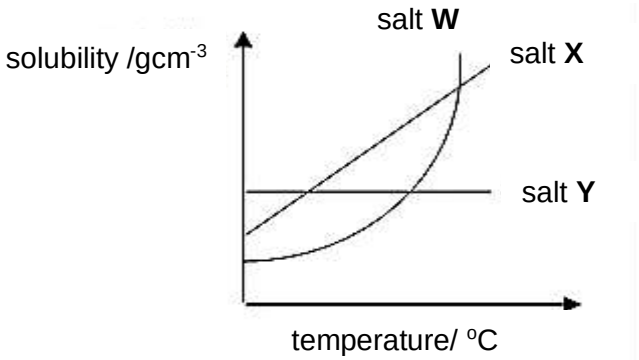
Experiment 2: find the rate of the reaction between pieces of calcium carbonate and dilute hydrochloric acid by measuring the volume of gas given off every minute.

What apparatus is needed for both experiments?

	experiment 1	experiment 2
A	electronic balance, measuring cylinder, thermometer	gas syringe, stopwatch
B	burette, pipette	electronic balance, measuring cylinder, thermometer
C	burette, pipette	gas syringe, stopwatch
D	gas syringe, stopwatch	burette, pipette

2 The solubility curves of three salts are shown.

Which salt(s) **cannot** be prepared by crystallisation?



A **W** only

B **Y** only

C **W** and **X**

D **X** and **Y**

[Turn over

3 Which test is used to show that a sample of water is pure?

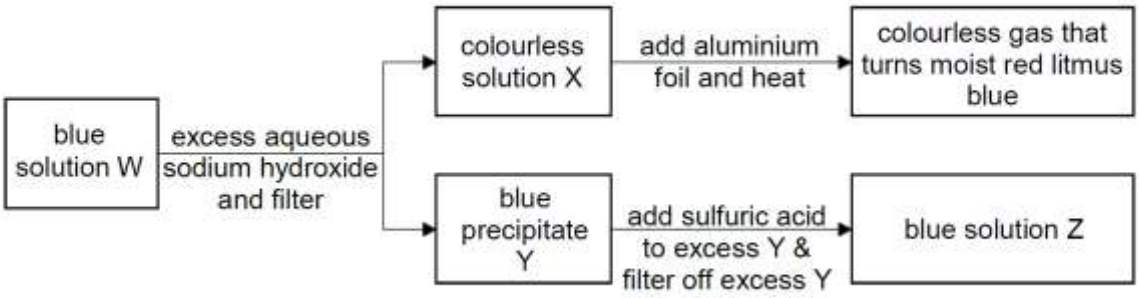
A evaporate the water to see if there is any solid left behind

B heat the water to check its boiling point

C test with anhydrous cobalt(II) chloride

D use universal indicator paper to check its pH

4 The flow chart below shows some reactions that blue solution W undergoes.



What are the identities of W, X, Y and Z?

	W	X	Y	Z
A	$Cu(NO_3)_2$	$NaNO_3$	$Cu(OH)_2$	$CuSO_4$
B	$CuSO_4$	Na_2SO_4	$Cu(OH)_2$	$CuSO_4$
C	$Fe(NO_3)_2$	$NaNO_3$	$Fe(OH)_2$	$FeSO_4$
D	$(NH_4)_2SO_4$	$NH_3(aq)$	$Cu(OH)_2$	$CuSO_4$

5 Which of the following solutions when mixed, would **not** produce a precipitate?

A aqueous ammonia with aqueous sodium chloride

B aqueous copper(II) sulfate with lithium carbonate solution

C aqueous zinc nitrate with aqueous ammonia

D aqueous silver nitrate solution with aqueous potassium iodide

6 A student tested a solution by adding aqueous sodium hydroxide. A precipitate was not seen because the reagent was added too quickly.

What could **not** have been present in the solution?

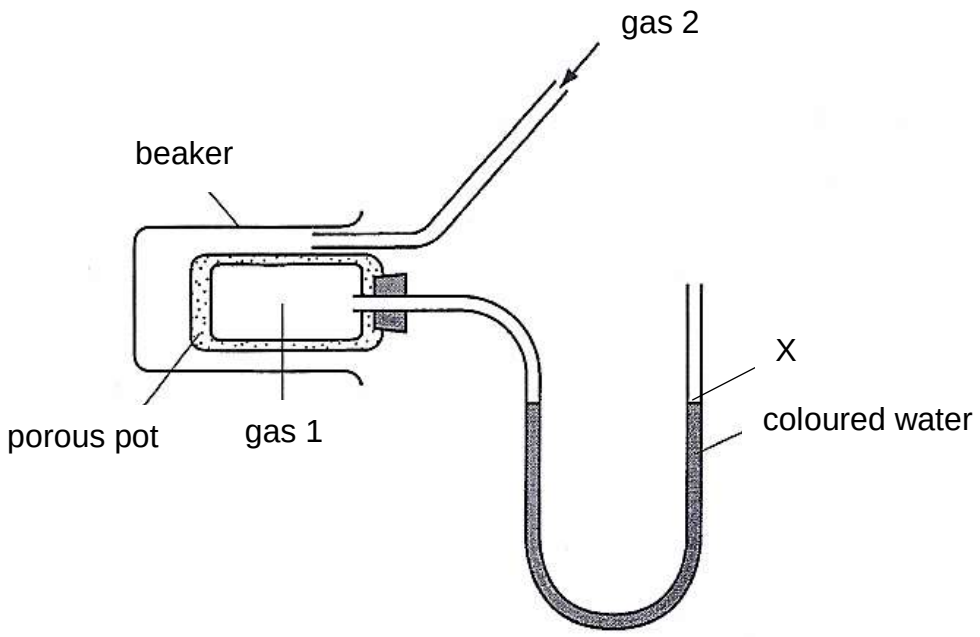
A Al^{3+}

B Ca^{2+}

C Pb^{2+}

D Zn^{2+}

7 The apparatus is used to show the diffusion of gases.



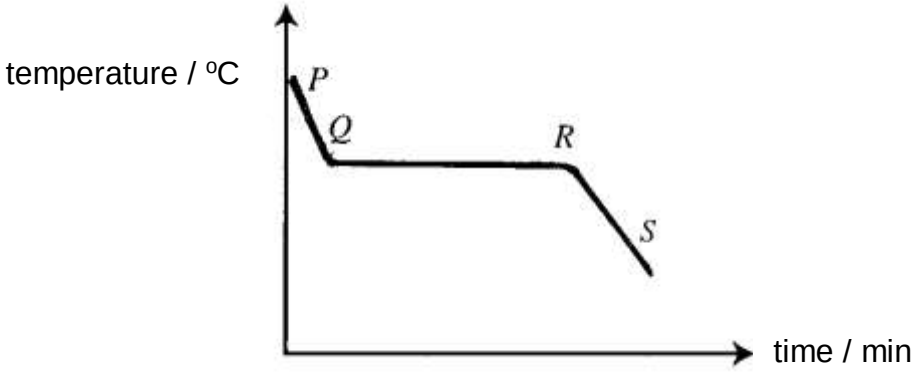
Which pair of gases 1 and 2 would cause the level of coloured water to rise at X?

	gas 1	gas 2
A	H_2	C_2H_6
B	CH_4	CO_2
C	C_2H_4	CO
D	NO_2	N_2

[Turn over

8 A sample of solid X is heated until it is completely melted.

The graph shows how its temperature varies with time as molten X is cooled.



Which of the following statements are true about the particles in X?

1. They are closer to each other at stage RS than at stage PQ.
2. The forces of attraction are stronger at stage P than at stage S.
3. The arrangement is more orderly at stage RS than at stage PQ.
4. Their total energy content at stage QR is lower than at stage RS.

A 1 and 2 are correct

B 1 and 3 are correct

C 2 and 3 are correct

D 2 and 4 are correct

9 Carbon-12 and carbon-14 are two isotopes of carbon. Measuring the amount of carbon-14 in a sample from a dead plant or animal can be used to calculate the age of the animal or plant.

Which statement about the isotopes is correct?

A Carbon-14 has gained two electrons to form carbon-12.

B Carbon-14 has lost two electrons to form carbon-12.

C Carbon-14 has two more neutrons than carbon-12.

D Carbon-14 has two more protons than carbon-12.

10 Which statement correctly describes both chlorine atoms and chloride ions?

A They are chemically identical.

B They have the same melting and boiling point.

C They have the same number of electrons in the valence shell.

D They have the same number of protons.

11 Which row correctly describe the properties of a mixture of iron and sulfur, and the compound iron(II) sulfide, FeS?

	mixture of iron and sulfur	compound iron(II) sulfide
1	iron and sulfur mix without chemically reacting	iron and sulfur combine in a chemical reaction to form iron(II) sulfide
2	the ratio of iron to sulfur in mixtures can vary	the ratio of iron to sulfur in iron(II) sulfide is always the same
3	the mixtures do not have the properties of iron or sulfur	iron(II) sulfide has the properties of iron and sulfur

A 1 only

B 1 and 2 only

C 2 and 3 only

D 3 only

12 The table shows four elements W, X, Y and Z with their atomic numbers.

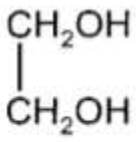
element	W	X	Y	Z
atomic number	6	8	11	17

Which row shows the formulae of the compounds formed from the four elements?

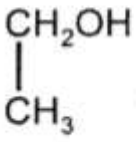
	formula of ionic compound formed	formula of covalent compound formed
A	WX	YZ
B	YW	WZ_4
C	YZ	ZW
D	Y_2X	WX_2

13 Which compound contains only eight covalent bonds?

A

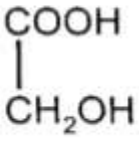


B



C

D



14 The complex ion $[Ag(NH_3)_x]^+$ consists of 76% of silver by mass.

What is the value of x?

A 1

B 2

C 3

D 4

15 The formula of a nitride of element **X** is $\mathbf{X}_3N_2$.
23.8 g of $\mathbf{X}_3N_2$ contains 4.5 g of **X**.

How many moles are there in 4.5 g of **X**?

A $\frac{19.3}{14} \times \frac{2}{3}$

B $\frac{19.3}{14} \times \frac{3}{2}$

C $\frac{23.8}{14} \times \frac{2}{3}$

D $\frac{23.8}{14} \times \frac{3}{2}$

16 20.0 cm^3 of ethyne, C_2H_2, is reacted with 60.0 cm^3 of oxygen.

The equation for the reaction is

$$2C_2H_2\,(g) + 5O_2\,(g) \rightarrow 4CO_2\,(g) + 2H_2O\,(l)$$

What is the total volume of gas remaining at the end of the reaction? (all volumes are measured at room temperature and pressure)

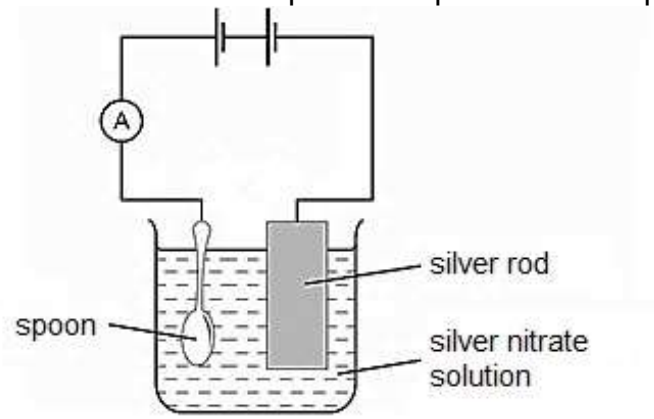
A 40.0 cm^3

B 50.0 cm^3

C 60.0 cm^3

D 70.0 cm^3

17 The apparatus shown below was set up to silver plate a metal spoon.



The experiment did **not** work.

What was the mistake in the set-up?

A The spoon should be at the negative electrode.

B Silver nitrate solution is not a suitable electrolyte.

C The silver rod should be completely immersed in the solution.

D The spoon must be made into an electrode by applying graphite paste.

18 In an experiment, a quantity of electricity plated 0.12 mole of copper metal onto a paper clip, from Cu^{2+}. The same quantity of electricity plated 0.08 mole of gold onto a ring.

What is the charge of the gold ions?

A +1

B +2

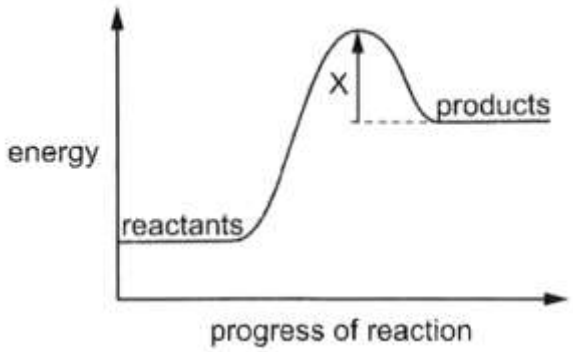
C +3

D +4

19 Which statement is true for both electrochemical cells and electrolytic cells?

	electrochemical cell	electrolytic cell
A	It converts electrical energy into chemical energy.	It converts chemical energy into electrical energy.
B	Oxidation occurs at positive electrode.	Oxidation occurs at negative electrode.
C	Forced flow of electrons from anode to cathode by an external generator.	Spontaneous flow of electrons from anode to cathode.
D	Anode gets used up.	Electrodes may not undergo any changes.

20 The energy profile diagram shows the energy changes that occur as a reaction takes place.



From the diagram, which statement about this reaction is correct?

A The energy change when breaking bonds is greater than the energy change when making bonds.

B The equation for this reaction could be $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$.

C The reaction has a negative ΔH value.

D X is the activation energy for the reaction.

21 Ammonium chloride dissolves in water according to the equation below.

$$NH_4Cl\ (s) \rightarrow NH_4Cl\ (aq) \qquad \Delta H = +15.0\ kJ/mol$$

When 0.2 moles of ammonium chloride dissolves in 50.0 cm^3 of water,

1. the concentration of the solution is 4.0 mol/dm^3.
2. the energy level of NH_4Cl increases.
3. the heat liberated is 3.0 kJ.
4. the temperature of water falls.

Which of the above statements are correct?

A 1, 2 and 3

B 1, 2 and 4

C 1, 3 and 4

D 2, 3 and 4

[Turn over

22 A student is exploring the various ways to measure the rate of the following reaction by measuring the changes in different variables of the reaction:

$$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 3C_2O_4^{2-}(aq) \rightarrow 2Cr^{3+}(aq) + 6CO_2(g) + 7H_2O(l)$$

Which of the following methods of monitoring the rate of reaction are suitable?

1. volume of gas produced
2. pH of the reaction mixture
3. mass of the reaction mixture
4. amount of precipitate formed
5. intensity of the orange colour of the reaction mixture

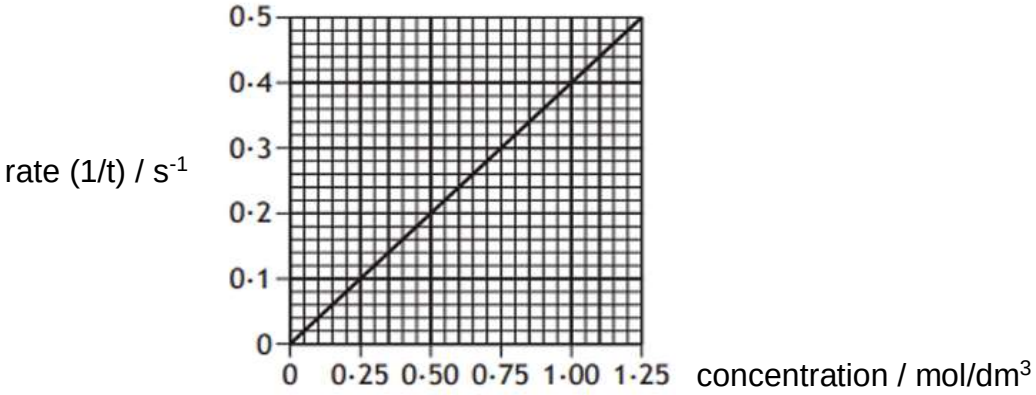
A 1, 2 and 3 only

B 1, 3 and 5 only

C 1, 2, 3 and 5 only

D 2, 3, 4 and 5 only

23 The graph shows how the rate of a reaction varies with the concentration of one of the reactants.



What is the reaction time, in seconds, when the concentration of the reactant was 0.50 mol/dm^3?

A 0.2 s

B 0.5 s

C 2.0 s

D 5.0 s

[Turn over

24 In which reaction is vanadium reduced?

A V to V_2O_5

B V^{3+} to VO^{2+}

C VO_3^- to VO^{2+}

D VO^{2+} to VO_2^+

25 X, Y and Z represent different halogens.

The table shows the results of nine experiments in which aqueous solutions of X_2, Y_2 and Z_2 were separately added to separate aqueous solutions containing X^-, Y^- and Z^- ions.

	$X^-(aq)$	$Y^-(aq)$	$Z^-(aq)$
$X_2(aq)$	no reaction	no reaction	no reaction
$Y_2(aq)$	X_2 formed	no reaction	Z_2 formed
$Z_2(aq)$	X_2 formed	no reaction	no reaction

Which row contains the halogens X_2, Y_2 and Z_2 in order of their decreasing strength as oxidising agents?

	strongest	→	weakest
A	X_2	Y_2	Z_2
B	Y_2	X_2	Z_2
C	Y_2	Z_2	X_2
D	Z_2	Y_2	X_2

26 Which oxide is insoluble in aqueous ammonia?

A FeO

B NO_2

C P_4O_{10}

D ZnO

27 Some statements about acids are given.

1. A 1 mol/dm^3 solution of a strong acid will have a higher pH than a 1 mol/dm^3 solution of a weak acid.
2. pH gives a measure of the H^+ concentration in a solution.
3. Universal indicator turns blue when placed in a solution of pH 5.
4. When acids react with metals, hydrogen ions gain electrons.

Which statements about acids are correct?

A 1, 2 and 3
B 1 and 2 only
C 1 and 4 only
D 2 and 4 only

28 A sample of potassium oxide, K_2O is dissolved in 250 cm^3 of distilled water. 25.0cm^3 of the solution is neutralised by 15.0 cm^3 of 2.00 mol/dm^3 of dilute sulfuric acid.

What is the mass of potassium oxide dissolved in 250 cm^3 of distilled water?

A 2.82 g
B 5.64 g
C 28.2 g
D 56.4 g

29 Which of the following pairs of elements react most vigorously together?

A copper and oxygen
B magnesium and chlorine
C potassium and fluorine
D sodium and bromine

30 Rubidium, Rb, is an element in the same group of the Periodic Table as lithium, sodium and potassium.

1. It reacts explosively with cold water.
2. It forms a soluble carbonate salt.
3. It forms a carbonate with a formula of $RbCO_3$.
4. It can be extracted *via* electrolysis of concentrated aqueous RbC*l*.

Which statements about rubidium are likely to be **wrong**?

A 1 and 2

B 1 and 3

C 2 and 3

D 3 and 4

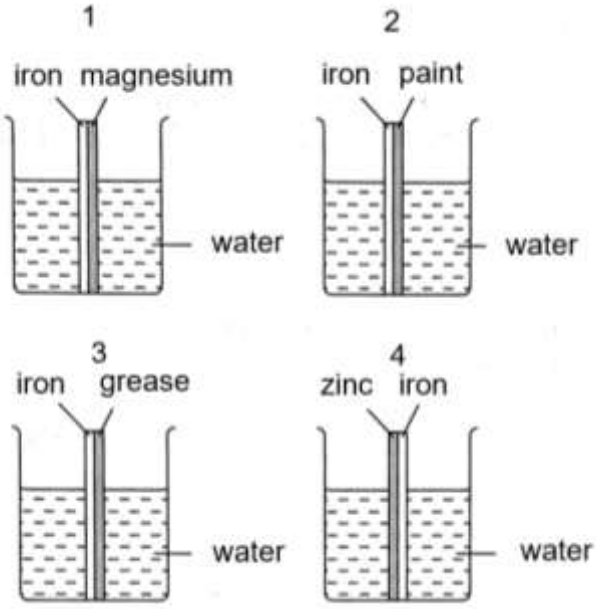
31 A student carried out an experiment to find the order of reactivity of five metals. They were tested with cold water, hot water and steam. The results were recorded in the following table.

metal	cold water	hot water	steam
V	no reaction	reacts slowly	vigorous reaction
W	no reaction	no reaction	slow reaction
X	reacts slowly	vigorous reaction	not attempted
Y	no reaction	no reaction	no reaction
Z	vigorous reaction	explosive reaction	not attempted

What is the order of reactivity of these metals?

	more reactive		→		less reactive
A	V	W	Y	X	Z
B	W	X	Z	V	Y
C	Z	X	V	W	Y
D	Z	X	Y	W	V

32 The following experiments were set up.



In which beaker(s) would the iron be less likely to rust after two days?

A 1 and 3 only

B 1 and 4 only

C 2 and 3 only

D all of the above

33 The table below shows the results obtained when solid carbonates of three metals, **W**, **X** and **Y**, are warmed.

	result
carbonate of **W**	A gas is given off. Solid changes colour from green to black
carbonate of **X**	A gas is given off. Solid does not change in colour.
carbonate of **Y**	A gas is not given off. Solid does not change in colour.

Which statements are correct?

1 Metal **Y** is loses electrons more readily than metal **X**.

2 Metal **W** is a transition metal.

3 If dilute nitric acid is added to all three carbonates, carbon dioxide is given off only for the carbonates of **W** and **X** but not for the carbonate of **Y**.

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

34 The equations below are for two of the reactions which occur in catalytic converters.

$$2C_8H_{18}\,(g) + 50NO\,(g) \longrightarrow 16CO_2\,(g) + 25N_2\,(g) + 18H_2O\,(g)$$

$$2CO\,(g) + 2NO\,(g) \longrightarrow 2CO_2\,(g) + N_2\,(g)$$

Which statement is correct for both reactions?

A Carbon dioxide is formed by the reduction of a carbon containing compound.

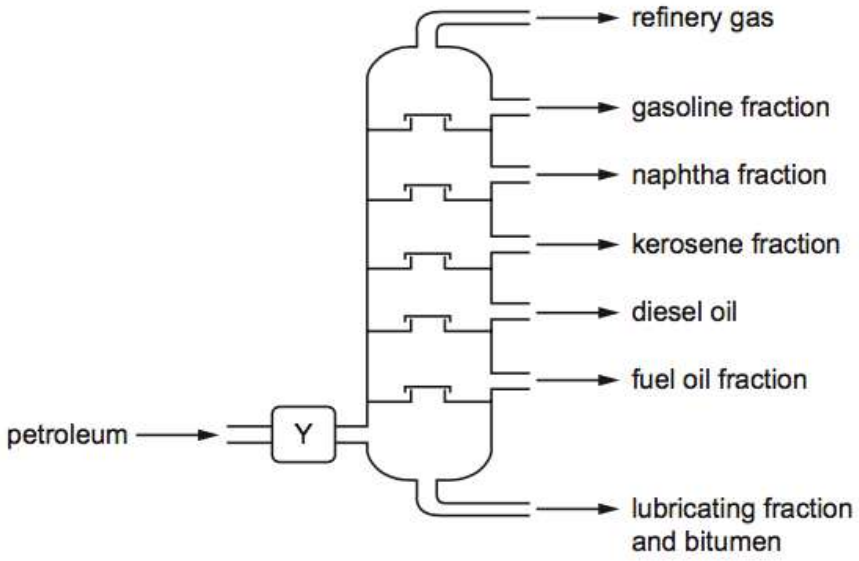
B Nitrogen is produced by the oxidation of nitrogen monoxide.

C Nitrogen monoxide is a reducing agent.

D The reactions are redox reactions.

[Turn over

35 The fractional distillation of petroleum is shown.



Which process happens at **Y**?

A burning

B condensation

C cracking

D vapourisation

36 In which process(es) will carbon dioxide be produced?

1 respiration by animals
2 formation of ethanoic acid from ethanol
3 photosynthesis by plants
4 combustion of methane

A 1 and 2 only

B 1 and 4 only

C 1, 3 and 4 only

D 4 only

37 The compound C_6H_{10} is a member of a hydrocarbon homologous series.
Which one of the following is the first member of this series?

A C_2H_2

B C_2H_3

C C_2H_4

D C_2H_6

38 Three chemical reactions are shown.

1 catalytic addition of steam to ethene

2 combustion of ethanol

3 fermentation of glucose

In which of the reactions does the relative molecular mass of the carbon-containing compound decrease?

A 1 and 2

B 1 only

C 2 and 3

D 3 only

39 A liquid can react separately with sodium carbonate, potassium hydroxide and propanol.

What is the liquid?

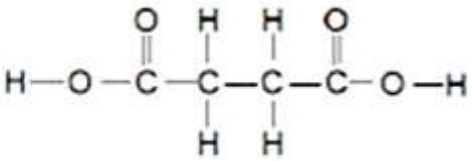
A aqueous ammonia

B dilute hydrochloric acid

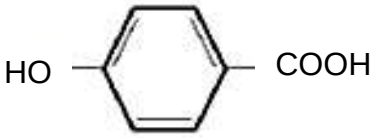
C ethanoic acid

D ethyl ethanoate

40 Which statement about the two compounds is **not** true?



X



Y

A X and Y react together to form a polyester.

B Both X and Y can react with magnesium metal.

C Y undergoes condensation polymerisation by reacting with itself.

D Y turns aqueous acidified potassium manganate(VII) from purple to colourless.

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

SINGAPORE CHINESE GIRLS' SCHOOL
Preliminary Examination
Secondary Four

CANDIDATE NAME							
CLASS	4			REGISTER NUMBER			
CENTRE NUMBER					INDEX NUMBER			

Chemistry

6092/01

Paper 1 Theory

Wednesday **31 August 2022** **1 hour**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction tape/fluid.
Write your name, class and index number on the Question Paper and Answer Sheet in the spaces provided.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C, D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

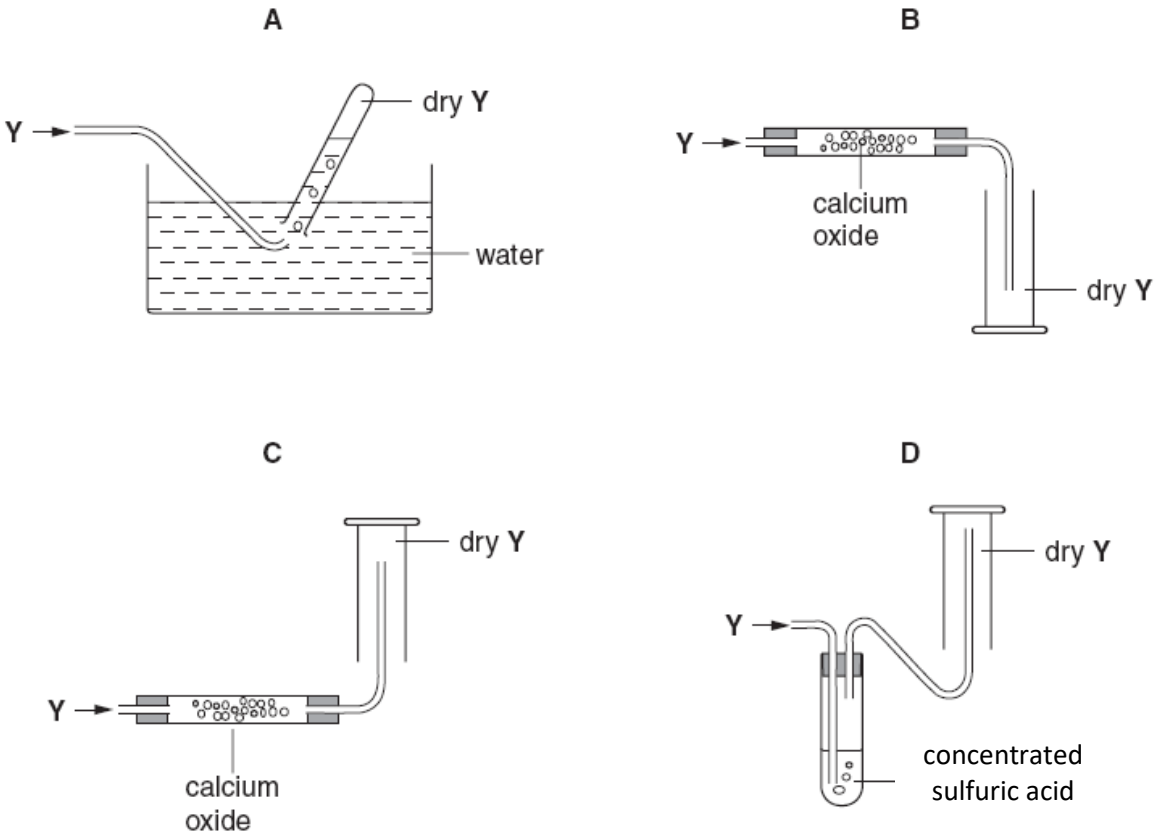
Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 15.
The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of 15 printed pages and 1 blank page.

1. A gas **Y**, is less dense than air, very soluble in water and is alkaline.

Which method is used to collect a dry sample of the gas?



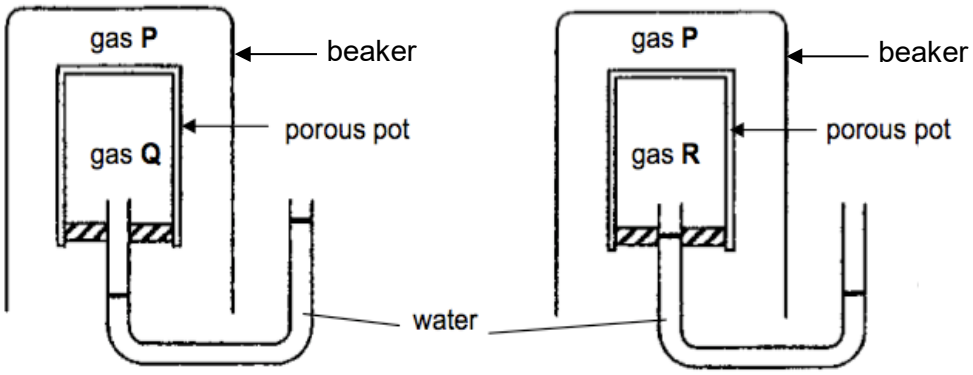
2. The following measurements are made on a sample pure water: its boiling point, its freezing point, and its pH.

Sodium chloride is now dissolved in the water and the measurements repeated.

How do the measurements change?

	boiling point	**freezing point**	**pH**
A	higher	lower	no change
B	higher	higher	increases
C	lower	higher	no change
D	lower	lower	decreases

3. The apparatus can be used to show the diffusion of gases. Two beakers containing gas **P** were placed over two porous pots containing gases **Q** and **R** respectively. The results are shown below.



What is the correct order of the relative molecular mass of gases **P**, **Q** and **R**?

	Lowest M_r	⟶	Highest M_r
A	**R**	**P**	**Q**
B	**R**	**Q**	**P**
C	**Q**	**P**	**R**
D	**P**	**Q**	**R**

4. A particle contains 31 protons, 40 neutrons and 28 electrons. Which symbol is correct for this particle?

A $^{59}_{28}Ni^{3+}$ **B** $^{71}_{31}Ga^{3+}$ **C** $^{70}_{31}Ga$ **D** $^{59}_{28}Ni^{3-}$

5. How many electrons in total are shared between the atoms in a molecule of ethene, C_2H_4, and in a molecule of water, H_2O?

	ethene	water
A	6	2
B	10	4
C	12	4
D	14	8

6. Which element forms a positive ion with the same electronic configuration as an atom of neon?

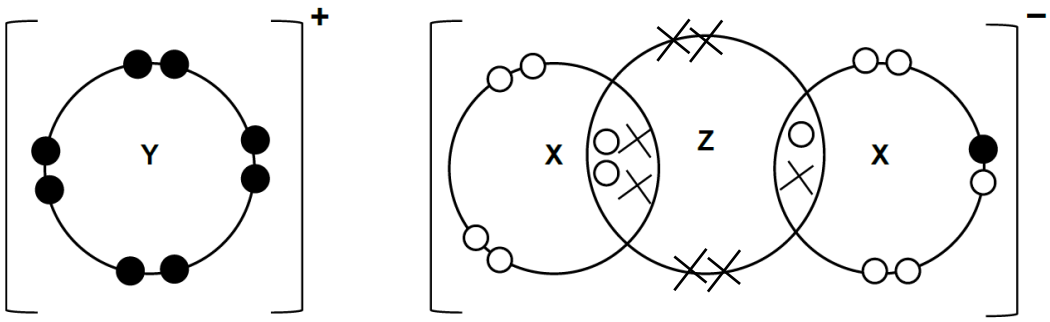
A chlorine

B magnesium

C lithium

D oxygen

7. **X, Y** and **Z** are 3 different elements in the Periodic Table. The "dot and cross" diagram of the compound formed from **X, Y** and **Z** is shown below. Only the valence electrons are shown.



Which statements are correct?

I Element **Y** could be lithium.

II Element **X** belongs to Group VII of the Periodic Table.

III Elements **X** and **Z** are bonded together by covalent bonds.

IV There are more electrons than protons in $\mathbf{ZX_2^-}$.

A **I** and **II** only

B **III** and **IV** only

C **I**, **III** and **IV** only

D **II**, **III** and **IV** only

8. Substance **X** has a high melting point. It is insoluble in water and organic solvents. It is used as a lubricant and is a conductor of electricity.

What is **X**?

A copper

B graphite

C potassium chloride

D hydrogen chloride

9. What is the ionic equation, including state symbols for the reaction between zinc carbonate and hydrochloric acid?

A $ZnCO_3(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2O(l) + CO_2(g)$

B $CO_3^{2-}(aq) + 2H^+(aq) \rightarrow H_2O(l) + CO_2(g)$

C $Zn_2CO_3(s) + 2H^+(aq) \rightarrow 2Zn^+(s) + H_2O(l) + CO_2(g)$

D $Zn^{2+}(aq) + CO_3^{2-}(aq) + 2H^+(aq) \rightarrow Zn(s) + H_2O(l) + CO_2(g)$

10. Which quantity contains the least number of atoms?

A 0.6 moles of oxygen gas

B 0.75 moles of lithium

C 0.25 moles of ammonia

D 0.25 moles of methane

11. Brass is a mixture of copper and zinc. A sample of brass has a mass of 24.0 g. When reacted with excess dilute sulfuric acid, 1.85 dm^3 of hydrogen was collected.

What is the percentage of copper in the sample of brass?

A 20.9% **B** 41.8 % **C** 58.2 % **D** 79.1 %

12. In leaded petrol there is an additive composed of lead, carbon and hydrogen only. This compound contains 29.7 % carbon and 6.19 % hydrogen by mass.

What is the value of *x* in the empirical formula PbC_8H_x?

A 5 **B** 6 **C** 16 **D** 20

13. How much sulfuric acid is required to neutralize 100 cm^3 of 1.0 mol/dm^3 sodium hydroxide?

A 50 cm^3 of 0.5 mol/dm^3 sulfuric acid

B 100 cm^3 of 1.0 mol/dm^3 sulfuric acid

C 50 cm^3 of 1.0 mol/dm^3 sulfuric acid

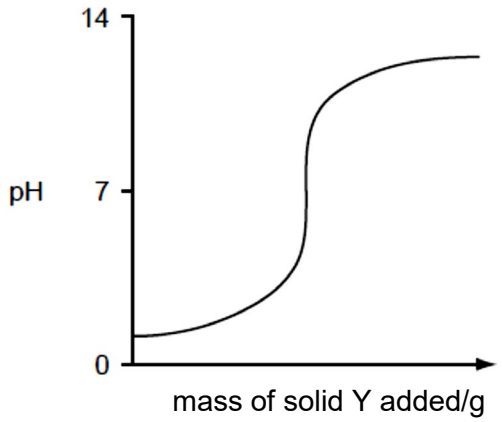
D 100 cm^3 of 2.0 mol/dm^3 sulfuric acid

14. In an experiment, 1 cm^3 of gaseous hydrocarbon **X** required 4 cm^3 of oxygen for complete combustion to produce 3 cm^3 of carbon dioxide. All gas volumes are measured at room temperature and pressure.

Which formula represents **X**?

A C_2H_4 **B** C_3H_4 **C** C_3H_8 **D** C_4H_8

15. Solid **Y** was added bit by bit with stirring to an aqueous solution of **Z**. The changes in pH of the mixture are shown in the graph.



Identify **Y** and **Z**.

	Y	**Z**
A	soluble metal oxide	hydrochloric acid
B	soluble metal oxide	ethanoic acid
C	insoluble metal oxide	nitric acid
D	insoluble metal oxide	aqueous ammonia

16. A precipitate of lead(II) hydroxide dissolves in aqueous sodium hydroxide to form a colourless solution. Which property of lead(II) hydroxide can be deduced from the reaction?

A Lead(II) hydroxide is a reducing agent.

B Lead(II) hydroxide is basic.

C Lead(II) hydroxide is soluble in water.

D Lead(II) hydroxide is amphoteric.

17. The table below shows the properties of five salts, and how they can be prepared.

Which one is magnesium bromide?

	colour	**solubility in water**	**methods to prepare salt**
A	white	soluble	insoluble base and acid
B	brown	soluble	titration
C	white	insoluble	precipitation
D	brown	insoluble	metal and acid

18. Which is a property of the hydroxide ion?

A It combines with hydrogen to form water.

B It readily breaks down into hydrogen ions and oxide ions.

C It is formed when ammonia dissolves in water.

D It turns methyl orange red.

19. Which statements about sulfuric acid are correct?

I A blue precipitate is formed when copper(II) hydroxide is added.

II 1.0 mol of sulfuric acid contains 2.0 mol of hydrogen ions.

III Sulfuric acid turns Universal Indicator yellow.

IV Effervescence of a colourless gas is seen when calcium is added.

A **I** and **III** **B** **II** and **III** **C** **I** and **IV** **D** **II and IV**

20. Which substances would react with copper?

I Dilute hydrochloric acid
II Oxygen
III Aqueous silver nitrate
IV Cold water

A **I** and **II** only
B **II** and **III** only
C **III** and **IV** only
D All of the above

21. Which substance could be zinc?

	conducts electricity		state of product formed when heated with oxygen
	when solid	when liquid	
A	✓	✓	**solid**
B	×	✓	**no reaction**
C	✓	×	**solid**
D	×	×	**gas**

22. Metal **M** will displace iron from aqueous iron(II) sulfate solution but not calcium from calcium nitrate. **M** is extracted from its oxide by electrolysis. **M** reacts with water.

What could **M** be?

A magnesium
B zinc
C sodium
D aluminium

23. Magnesium, on the left of Period 3 of the Periodic Table, is more metallic than chlorine on the right of this Period. This is because magnesium has

A fewer electrons.
B fewer protons.
C fewer full shells of electrons.
D fewer outermost electrons.

24. Crystals of iodine are heated gently. Which option correctly describes the formula of the particles present, the colour of the vapour produced and the bonds broken in the process?

	formula of particles	colour of vapour	bonds broken
A	I^-	purple	covalent bonds between atoms
B	I^-	brown	covalent bonds between molecules
C	I_2	purple	Van der Waal's forces between molecules
D	I_2	brown	Van der Waal's forces between atoms

25. An element has all four of the properties shown.

- solid at room temperature
- variable oxidation states
- forms coloured compounds
- high conductivity

What could this element be?

A strontium

B zinc

C graphite

D cobalt

26. When ammonia is converted into nitric acid on a commercial scale, the following reactions can occur.

In which reaction does the greatest change in oxidation number of the nitrogen occur?

	reaction
A	$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
B	$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$
C	$2NO + O_2 \rightarrow 2NO_2$
D	$4NH_3 + 6NO \rightarrow 5N_2 + 6H_2O$

27. In which reaction is sulfur dioxide acting as an oxidizing agent?

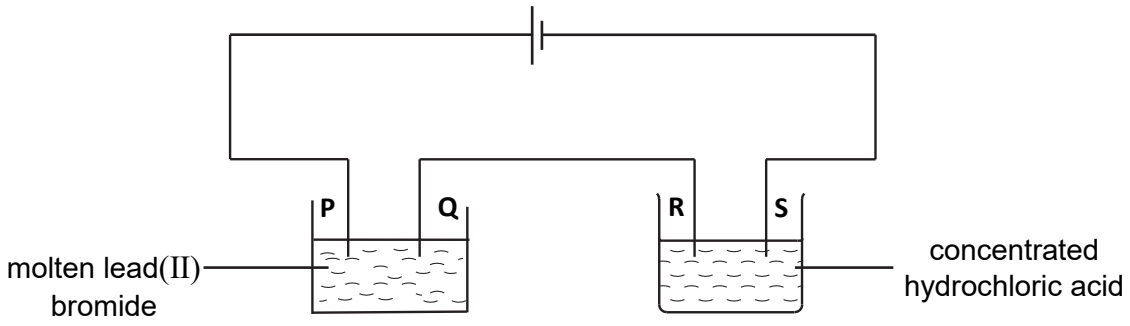
A $SO_2 + 2H_2O + Cl_2 \rightarrow H_2SO_4 + 2HCl$

B $SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

C $2SO_2 + O_2 \rightarrow 2SO_3$

D $SO_2 + 2H_2S \rightarrow 2H_2O + 3S$

28. An electrolytic circuit is set up, using inert electrodes **P**, **Q**, **R** and **S**.



At which of the electrodes is a Group VII element produced?

A **P** only **B** **P** and **R** **C** **Q** only **D** **Q** and **S**

29. A current is passed through each of the following electrolytes using inert electrodes. Which one will produce a neutral solution at the end of the electrolysis?

A Aqueous sodium sulfate

B Concentrated potassium chloride solution

C Dilute sulfuric acid

D Aqueous copper(II) nitrate solution

30. The table shows the energy released by the complete combustion of some compounds used as fuels.

Which fuel produces the most energy when 1 g of the compound is completely burned?

	compound	**M_r**	**ΔH in kJ/mol**
A	methane	16	-880
B	ethanol	46	-1380
C	propane	44	-2200
D	heptane	100	-4800

31. Which change(s) is/are exothermic?

I $CH_4\,(g) + 2O_2\,(g) \rightarrow CO_2\,(g) + 2H_2O\,(g)$

II $H\,(g) + Cl\,(g) \rightarrow HCl\,(g)$

III $H_2O\,(s) \rightarrow H_2O\,(l)$

A **I** only **B** **I** and **II** only **C** **II** and **III** only **D** **I**, **II** and **III** only

32. The usual conditions of the Haber Process are 250 atm, 450°C and an iron catalyst.

Which change in conditions will give the reactants more energy?

A Addition of more catalyst

B A decrease in pressure

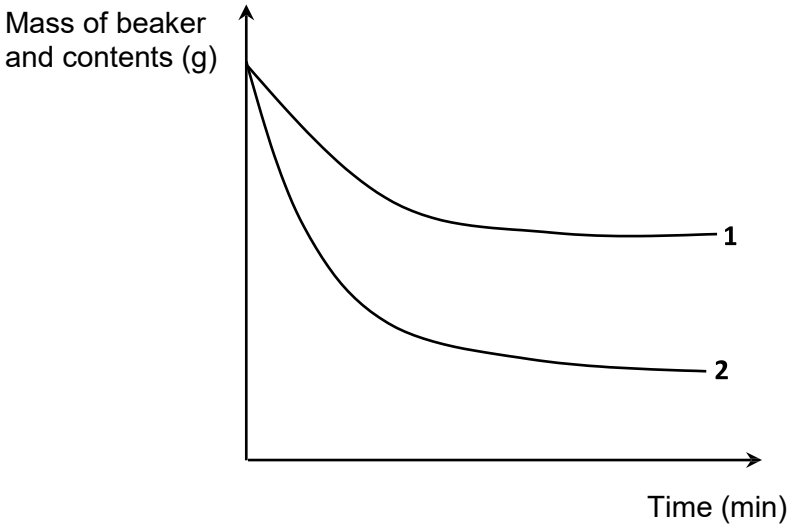
C An increase in concentration of the reactants

D An increase in temperature

33. Excess magnesium was added to a beaker of dilute hydrochloric acid on an electronic balance.

A graph of the mass of the beaker and contents was plotted against time (curve **1**).

What change(s) in the experiment could give curve **2**?



I The same mass of magnesium but in smaller pieces.

II The same volume of a more concentrated solution of hydrochloric acid.

III A lower temperature.

A **I** only.

B **II** only.

C **I** and **II** only.

D **II** and **III** only.

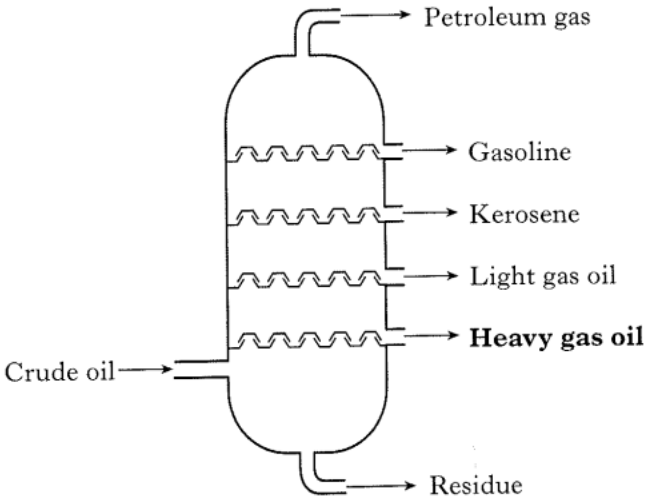
34 Mohr's salt is a pale green crystalline solid which is soluble in water. It is a 'double sulfate' which contains two cations, one of which is Fe^{2+}.

The identity of the second cation was determined by heating solid Mohr's salt with aqueous sodium hydroxide. The gas evolved turned moist red litmus blue. A grey-green solid residue was also formed.

What are the identities of the gas and the solid residue?

	gas	residue
A	H_2	$(NH_4)_2SO_4$
B	NH_3	$FeSO_4$
C	NH_3	$Fe(OH)_2$
D	SO_2	$Fe(OH)_2$

35. Heavy gas oil produced by fractional distillation of crude oil has a high viscosity. Which other properties does it also have?



A Low boiling point and high flammability

B High boiling point and low flammability

C Low boiling point and low flammability

D High boiling point and high flammability

36. $C_{10}H_{22}$ was cracked into a shorter alkane with 6 carbon atoms and an alkene. What would be the molecular formula of the alkene?

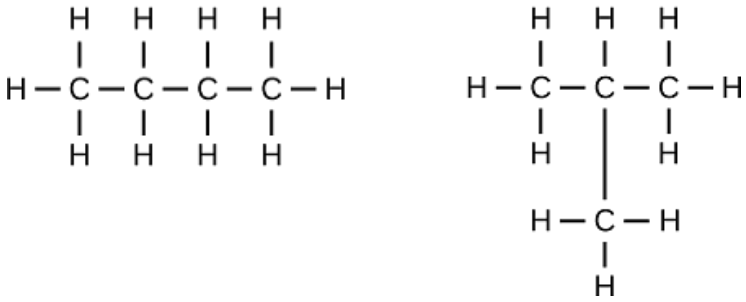
A C_6H_{14} **B** C_6H_{12} **C** C_4H_8 **D** C_4H_{10}

37. Under certain conditions, 1 mole of ethane reacts with chlorine.

Which is **not** a possible product of this reaction?

A $C_2H_4Cl_2$ **B** $C_2H_2Cl_4$ **C** $C_2H_2Cl_2$ **D** C_2Cl_6

38. The diagram shows two compounds.



It can be predicted from their formulae that the compounds have the same

A composition by mass.

B boiling point.

C structural formula.

D density

39. Which substance is formed when propan-1-ol, C_3H_7OH, is reacted with acidified potassium manganate(VII)?

A C_3H_8 **B** C_3H_7OK **C** C_3H_7COOH **D** C_2H_5COOH

40. With which substance will ethene react to form more than one product?

A bromine

B steam

C hydrogen

D oxygen

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

ST JOSEPH'S INSTITUTION
PRELIMINARY EXAMINATION 2022
(YEAR 4)

CANDIDATE NAME			
CLASS		INDEX NUMBER	

CHEMISTRY **6092/01**

Paper 1 **31 August 2022**

Additional Materials: **1 hour**
Multiple Choice Answer Sheet **(08:00 – 09:00)**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this Question paper.
A copy of the Periodic Table is printed on page 2 of this question paper.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **18** printed pages including this cover page.

The Periodic Table of Elements

Group																	
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19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
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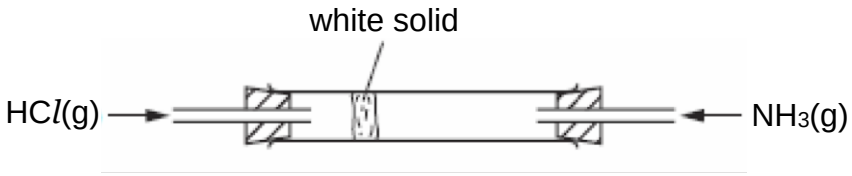
The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

1 Two gases, ammonia and hydrogen chloride, are allowed to enter the apparatus as shown below.



After some time, a white solid is formed on the inside of the tube.

Which statements explain why a white solid is formed in the position shown?

1 Ammonia and hydrogen chloride react to form solid ammonium chloride.

2 Ammonia diffuses faster than hydrogen chloride.

3 Ammonia has a higher relative molecular mass than hydrogen chloride.

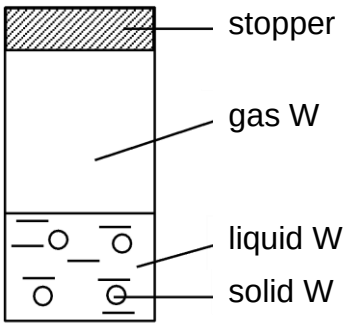
A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3

2 The gas jar contains compound W which is present in the solid, liquid and gaseous states.



Which of the following statements is correct?

A A gaseous W molecule has a lower mass than a liquid W molecule.

B Liquid W molecules move slower than solid W molecules.

C When W changes from gas to liquid, energy is absorbed.

D When W changes from liquid to solid, energy is released.

3 A student plans two experiments.

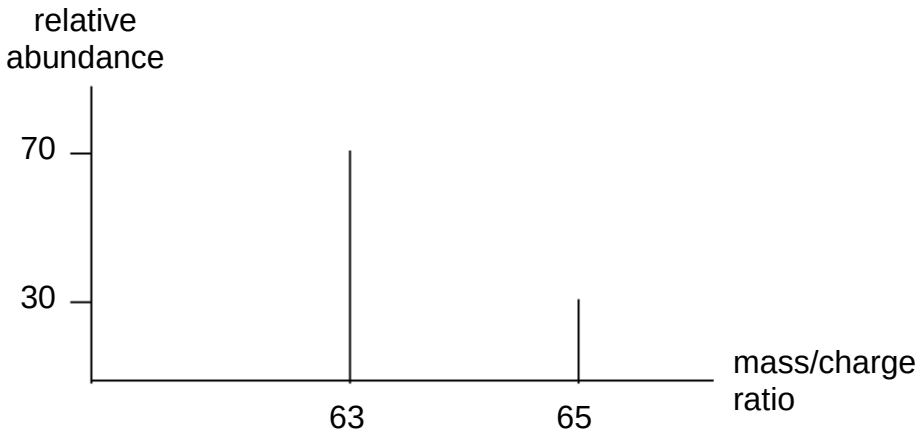
Experiment 1: To find the concentration of aqueous sodium hydroxide by titration with dilute hydrochloric acid

Experiment 2: To find the rate of the reaction between calcium carbonate and dilute hydrochloric acid by measuring the volume of gas given off every minute

What are the other apparatus needed in addition to a conical flask?

	experiment 1	experiment 2
A	burette, pipette	electronic balance, measuring cylinder, thermometer
B	burette, pipette	measuring cylinder, gas syringe, stopwatch
C	electronic balance, measuring cylinder, thermometer	measuring cylinder, gas syringe, stopwatch
D	measuring cylinder, gas syringe, stopwatch	burette, pipette

4 A sample of Y was analysed and found to contain only two isotopes, Y-63 and Y-65. The graph below shows the relative abundances of the two isotopes.



What is the relative atomic mass of Y?

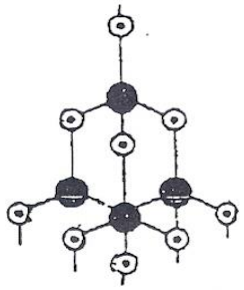
A 63.2

B 63.4

C 63.6

D 64.0

5 Silicon carbide has the following structure shown below.



Which statement is true for silicon carbide?

A It has a high boiling point because of the strong intermolecular forces of attraction.

B It has a high melting point because it has a giant ionic lattice structure.

C It is a hard solid because its atoms are bonded in a giant network.

D It is a soft solid because the layers of atoms can slide over one another.

6 The physical properties of substances X, Y and Z are shown below.

substance	X	Y	Z
melting point / °C	801	2852	3550
boiling point / °C	1413	3600	4827
electrical conductivity of solid	poor	poor	good

What could be the identities of X, Y and Z?

	X	Y	Z
A	MgO	NaC*l*	C (graphite)
B	MgO	NaC*l*	SiO_2
C	NaC*l*	MgO	C (graphite)
D	NaC*l*	MgO	SiO_2

7 Ethene is a colourless gas while polyethene is a solid at room temperature and pressure.

Which statement best explains this observation?

A The covalent bonds in ethene are stronger than the covalent bonds in polyethene.

B The covalent bonds in polyethene are stronger than the covalent bonds in ethene.

C The intermolecular forces of attraction in polyethene are stronger than the intermolecular forces of attraction in ethene.

D The intermolecular forces of attraction in polyethene are weaker than the intermolecular forces of attraction in ethene.

8 The elements X, Y and Z form the covalent compound with the structural formula shown below.

$$X - Y \equiv Z$$

Which of the following shows the possible electronic configurations of the atoms of X, Y and Z?

	X	Y	Z
A	1	2, 2	2, 5
B	1	2, 4	2, 3
C	2, 8, 7	2, 2	2, 3
D	2, 8, 7	2, 4	2, 5

9 Four oxides are added separately to aqueous sodium hydroxide.

1 aluminium oxide

2 carbon dioxide

3 copper(II) oxide

4 magnesium oxide

Which oxides react with aqueous sodium hydroxide?

A 2 only

B 1 and 2 only

C 3 and 4 only

D 1, 3 and 4 only

10 The pH of an aqueous solution of hydrochloric acid is 2.

What will be the pH of the acid after the addition of 10 g of sodium chloride?

A 1

B 2

C 7

D 9

11 Which pair of substances can be used to prepare a sample of lead(II) chloride when added to water and mixed?

A lead and hydrochloric acid

B lead(II) carbonate and hydrochloric acid

C lead(II) nitrate and potassium chloride

D lead(II) sulfate and potassium chloride

12 Which method is most suitable for the laboratory preparation of copper(II) chloride?

A react copper with chlorine gas

B react copper(II) carbonate with excess dilute hydrochloric acid

C react excess copper with concentrated hydrochloric acid

D react excess copper(II) oxide with dilute hydrochloric acid

13 Excess aqueous silver nitrate is added to aqueous barium chloride, and the precipitate formed is removed by filtration.

What are the possible ions present in the filtrate?

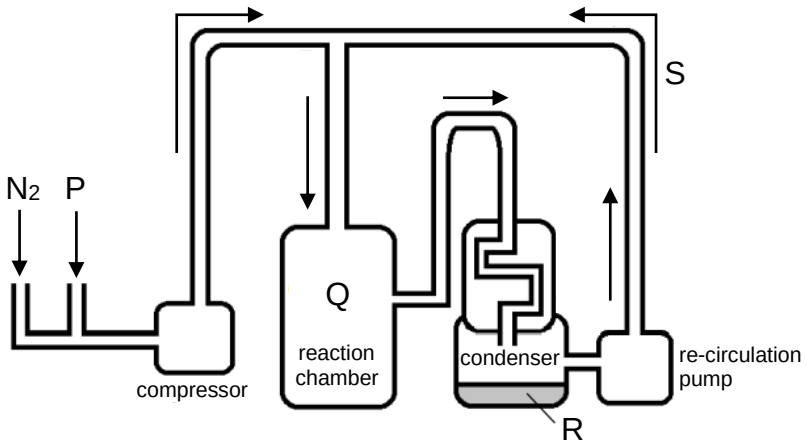
A Ag^+ and NO_3^-

B Ba^{2+} and NO_3^-

C Ag^+, Ba^{2+} and NO_3^-

D Ba^{2+}, Cl^- and NO_3^-

14 The diagram below shows a simplified diagram of the Haber Process. P, Q, R and S refer to the different substances present in different parts of the Haber Process.



Some statements about P, Q, R and S are shown.

1 P is obtained from the fractional distillation of liquid air.

2 Q is formed under reaction conditions of 450 °C and 250 atm.

3 R is an essential element used to make fertilisers.

4 S is a mixture of two compounds.

Which of the above statements are true?

A 2 only

B 2 and 3 only

C 1, 3 and 4 only

D 2, 3 and 4 only

15 The table below shows the concentration of polluting gases in four different industrial cities in parts of pollutant per billion parts of air (ppb).

city	concentration of ozone / ppb	concentration of sulfur dioxide / ppb	concentration of nitrogen dioxide / ppb
W	11	38	40
X	21	45	14
Y	23	17	46
Z	30	32	33

In which city are limestone buildings under the greatest threat from pollution?

A W **B** X **C** Y **D** Z

16 Which of the following changes does not take place in a catalytic converter?

A carbon monoxide → carbon dioxide

B oxides of nitrogen → nitrogen

C oxides of nitrogen → nitrogen monoxide

D unburnt hydrocarbons → carbon dioxide and water

17 Tobacco is a harmful substance which is found in cigarettes. The active component in tobacco is nicotine, which is dangerous and highly addictive.

Analysis of a sample of nicotine showed that it contains 74.0 % carbon, 8.7 % hydrogen and 17.3 % nitrogen.

Determine the molecular formula of nicotine if its relative molecular mass is 162.

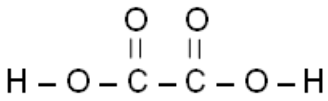
A C_5H_7N

B C_6H_9N

C $C_{10}H_{14}N_2$

D $C_{12}H_{18}N_2$

18 The structure of oxalic acid is shown below.



25.0 cm^3 of oxalic acid reacts completely with 15.0 cm^3 of 2.50 mol/dm^3 aqueous sodium hydroxide.

Determine the concentration of oxalic acid.

A 0.667 mol/dm^3

B 0.750 mol/dm^3

C 1.33 mol/dm^3

D 1.50 mol/dm^3

19 Bones contain a complex mixture of calcium salts, proteins and other materials. When a bone is strongly heated in a current of air, the only residue is calcium oxide.

A 50.0 g sample of bone was heated strongly and 14.0 g of calcium oxide was obtained. What was the percentage by mass of calcium in the bone?

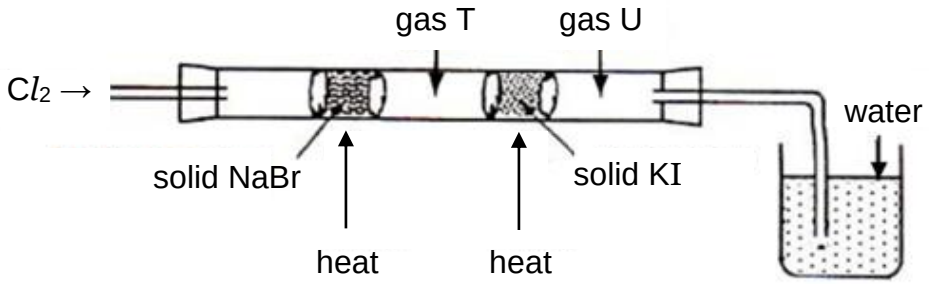
A 20.0 %

B 28.0 %

C 35.7 %

D 80.0 %

20 The diagram below shows a set-up used to investigate the reactivity of halogens.



A small amount of chlorine gas was pumped into the glass tube. What will be the colours observed for gas T, gas U and in the water?

	gas T	gas U	water
A	brown	reddish brown	colourless
B	greenish yellow	violet	yellow
C	reddish brown	brown	brown
D	reddish brown	violet	brown

21 Magnesium and chlorine are found in Period 3 of the Periodic Table.

Which of the following statements best explains why magnesium has more metallic character than chlorine?

A Magnesium has fewer electrons than chlorine.

B Magnesium has fewer number of electron shells than chlorine.

C Magnesium has fewer protons than chlorine.

D Magnesium has fewer valence electrons than chlorine.

22 The table below shows some information about the chlorides of some elements in Period 3 of the Periodic Table.

element	formula of main chloride	bonding present in chloride	pH of resulting solution when dissolved in water
sodium	NaC*l*	metallic	7
magnesium	MgCl_2	metallic	7
aluminium	A*l*Cl_3	covalent	3
phosphorus	PCl_3	covalent	2
sulfur	$S_2C l_2$	covalent	2

What is the bonding present in the chloride of silicon and the pH value of the resulting solution when the chloride is dissolved in water?

	bonding present in chloride	pH of resulting solution when dissolved in water
A	covalent	2
B	covalent	7
C	metallic	2
D	metallic	7

23 Which reactions are not redox reactions?

1 chlorine gas reacting with aqueous potassium iodide

2 dilute hydrochloric acid reacting with magnesium carbonate

3 dilute sulfuric acid reacting with aqueous sodium hydroxide

A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3

24 The oxide of titanium, TiO_2, is used as a 'whitener' in toothpaste. It is obtained from the ore iron(II) titanate, $FeTiO_3$.

What is the change in the oxidation number of titanium from $FeTiO_3$ to TiO_2?

A +3 to +2

B +3 to +4

C +6 to +4

D no change

25 A metal reacts vigorously with cold water.

Which statements about the metal are correct?

1 It is above hydrogen in the reactivity series.

2 It is below calcium in the reactivity series.

3 It reacts with aqueous zinc nitrate.

4 Its oxide can be reduced with carbon.

A 1 and 3 only

B 2 and 4 only

C 1, 2 and 3 only

D 1, 3 and 4 only

26 Which of the following statements are correct?

1 Aluminium alloys are used to manufacture aircraft bodies as they are strong.

2 Copper is used for cooking utensils as it is a good conductor of electricity.

3 Mild steel is used to make car bodies because it is ductile.

4 Stainless steel is used to make cutlery as it is resistant to corrosion.

A 4 only

B 1 and 4 only

C 1, 2 and 4 only

D 1, 3 and 4 only

27 Which statement about the blast furnace is not correct?

A Haematite is the ore which contains iron(III) oxide.

B Most carbon monoxide is formed from the incomplete combustion of coke.

C Nitrogen from hot air is released as a waste gas.

D The decomposition of limestone forms a product to remove silicon dioxide.

28 The formation of nitrogen dioxide from nitric oxide (NO) and oxygen is an exothermic reaction.

$$2NO + O_2 \rightarrow 2NO_2$$

What can be deduced from this information?

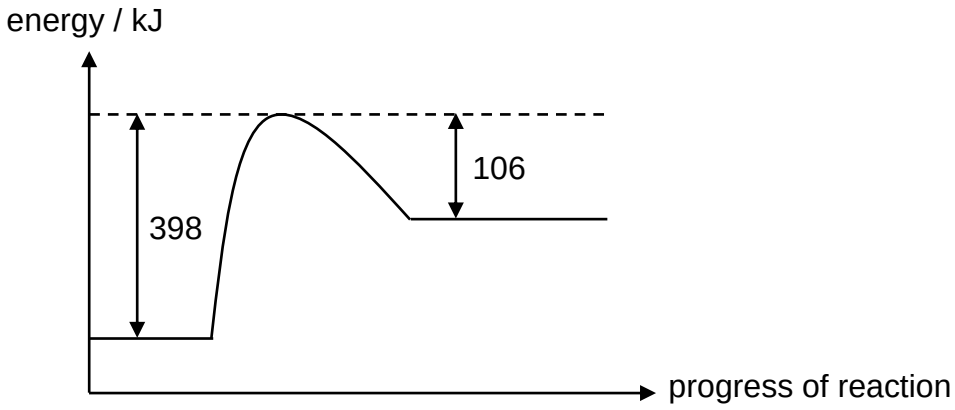
A The breaking of O=O bonds absorbs a lot of energy.

B The number of bonds broken is less than the number of bonds formed.

C The product possesses less energy than the reactants.

D The total energy change in bond breaking is greater than that in bond forming.

29 The diagram below shows the energy profile for a reaction.



Which statement about the reaction is correct?

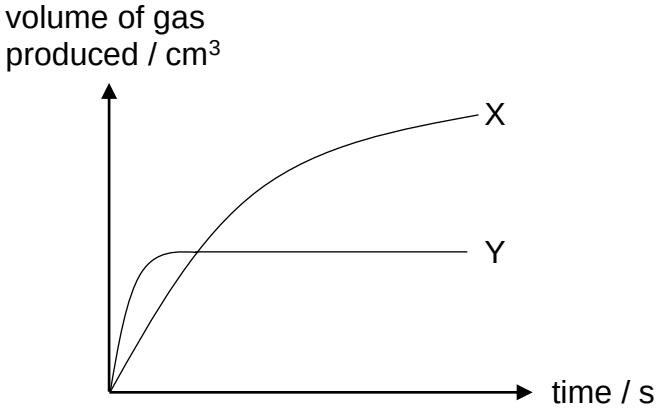
A The reaction is endothermic and the enthalpy change of reaction is +398 kJ.

B The reaction is endothermic and the enthalpy change of reaction is +292 kJ.

C The reaction is exothermic and the enthalpy change of reaction is -106 kJ.

D The reaction is exothermic and the enthalpy change of reaction is -292 kJ.

30 In the graph below, curve X represents the results of the reaction between 1.0 g of granulated zinc and excess sulfuric acid at 30 °C.



Which change will produce curve Y?

A Using 0.5 g of granulated zinc at 20 °C

B Using 0.5 g of powdered zinc at 30 °C

C Using 1.0 g of granulated zinc at 40 °C

D Using 1.0 g of powdered zinc at 40 °C

31 Powdered manganese(IV) oxide acts as a catalyst in the decomposition of aqueous hydrogen peroxide.

Which of the following statements explains why the rate of production of oxygen decreases during the reaction?

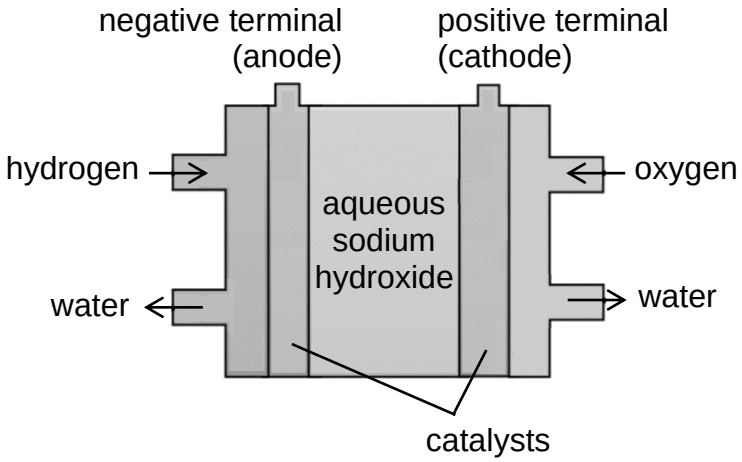
A The concentration of aqueous hydrogen peroxide decreases.

B The mass of manganese(IV) oxide decreases.

C The surface area of manganese(IV) oxide decreases.

D The temperature of aqueous hydrogen peroxide decreases.

32 The diagram below shows a hydrogen-oxygen fuel cell used to generate electricity.



Which half-equation represents the reaction that takes place at the positive terminal of the fuel cell?

A $H_2(g) + 2OH^-(aq) \rightarrow 2H_2O(l) + 2e$

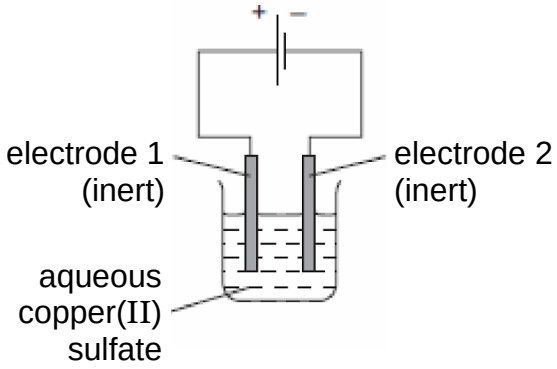
B $O_2(g) + 2H_2O(l) + 4e \rightarrow 4OH^-(aq)$

C $2H_2O(l) + 2e \rightarrow H_2(g) + 2OH^-(aq)$

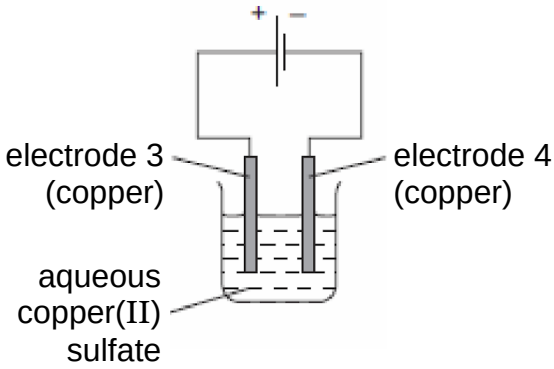
D $4OH^-(aq) \rightarrow O_2(g) + 2H_2O(l) + 4e$

33 The diagrams below show two different experiments for the electrolysis of aqueous copper(II) sulfate.

In experiment 1, both electrodes are inert. In experiment 2, both electrodes are made of copper.



Experiment 1



Experiment 2

At which electrodes can effervescence be observed?

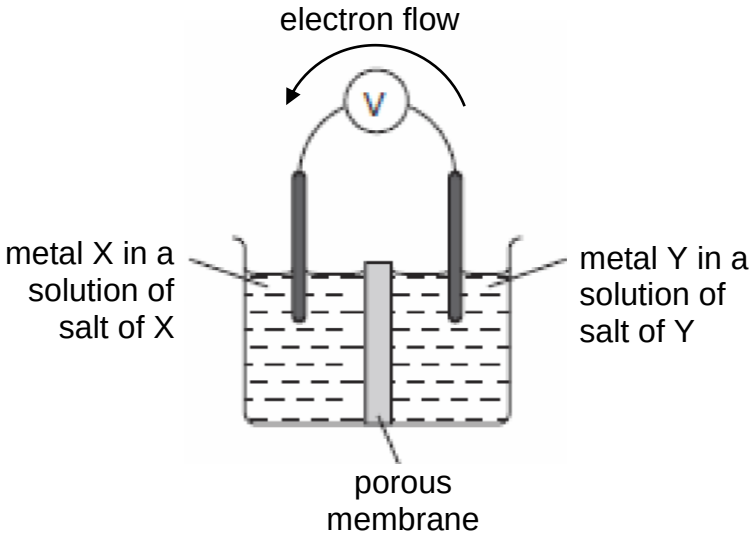
A 1 only

B 1 and 2 only

C 2 and 4 only

D 1, 2 and 4 only

34 Which pair of metals X and Y will produce the highest voltage when used as electrodes in a simple cell?

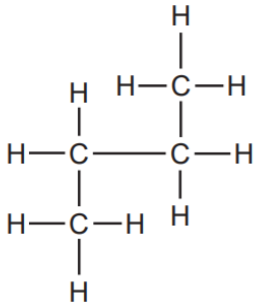


	metal X	metal Y
A	copper	magnesium
B	copper	zinc
C	magnesium	silver
D	magnesium	zinc

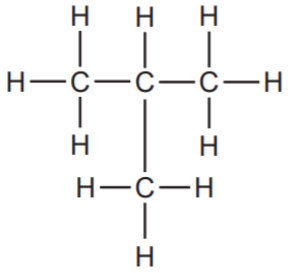
35 Which petroleum fraction is correctly matched to its use?

	fraction	use
A	bitumen	making waxes and polishes
B	gasoline	fuel for lorries
C	naphtha	lubricant for machinery
D	paraffin	fuel for aircraft

36 Four hydrocarbon structures are shown below.



1



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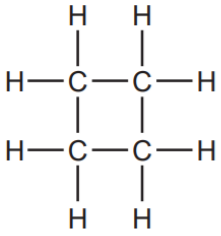

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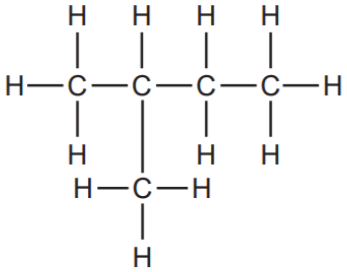


4

Which hydrocarbons are isomers of each other?

A 1 and 2 only

B 3 and 4 only

C 1, 2 and 3 only

D 1, 2 and 4 only

37 Some statements about propane and butane are shown below.

- Both are unsaturated hydrocarbons.
- Both reacts with chlorine in the presence of ultraviolet light.
- Butane has a lower boiling point than propane.
- Propane burns with a smokier flame than butane.

How many statements are correct?

A 1 **B** 2 **C** 3 **D** 4

38 Ethanol can be produced by using the two methods shown below.

Method 1: catalytic addition of steam to ethene
Method 2: fermentation

Which statements about the production of ethanol are correct?

1 Both methods give a high yield of ethanol.
2 Method 1 requires high temperature and pressure.
3 Method 2 occurs in the presence of oxygen at room temperature.
4 Method 2 requires yeast and glucose.

A 1 and 2 only
B 2 and 4 only
C 3 and 4 only
D 1, 2 and 4 only

39 Which straight chain hydrocarbon can form a polymer by addition polymerisation?

A C_6H_{14}
B C_7H_{14}
C C_8H_{18}
D C_9H_{20}

40 The diagrams below show four monomers.

How many of these monomers will react with the molecule below to form a polymer?

A 1
B 2
C 3
D 4

- End of Paper -

Name and Index Number: ( )	Class:

SENG KANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION

CHEMISTRY 6092/01

Secondary 4 Express

30 August 2022

Paper 1 Multiple Choice

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in soft pencil on the Multiple Choice Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this question paper.
The use of an approved scientific calculator is expected, where appropriate.

A copy of the Periodic Table is printed on page 18.

Parent's / Guardian's Signature: ……..

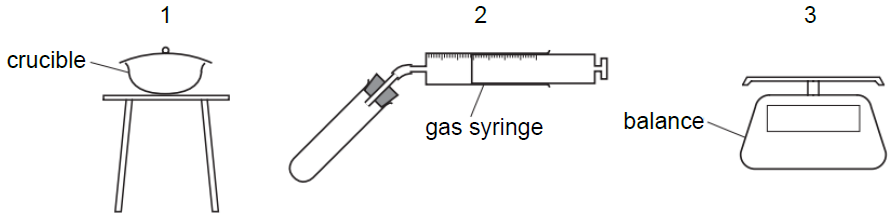
This document consists of **17** printed pages and **1** blank page.

Do not turn over the page until you are told to do so.

[Turn over

1 The formula of magnesium oxide can be investigated from heating magnesium with oxygen to form magnesium oxide.

Which apparatus are used for this investigation?



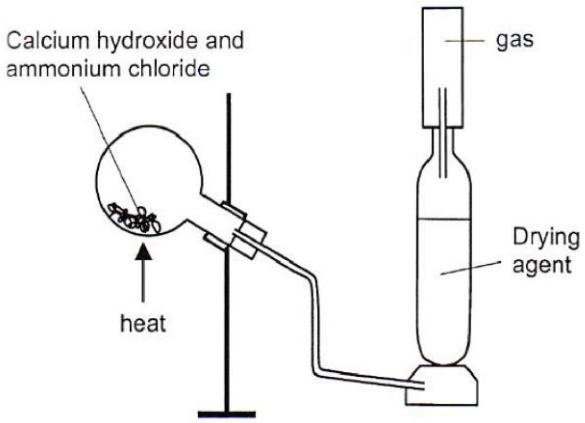
A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

2 A student set up the apparatus as shown.



What is the gas that will be collected from the set-up and which drying agent that should be used?

	name of gas	drying agent
A	ammonia	concentrated sulfuric acid
B	ammonia	calcium oxide
C	hydrogen chloride	calcium oxide
D	hydrogen chloride	concentrated sulfuric acid

3 Which statement about methods of purification and analysis is correct?

A A liquid that boils over a range of temperatures may still be 100% pure.

B An insoluble substance may be separated from water by crystallisation.

C Chromatography may only be used to separate coloured substances.

D Liquid air can be fractionally distilled, giving oxygen as one of the products.

4 Mary performed paper chromatography on a dye and obtained only one spot with an R_f value of 0.68.

Which statement is true about her chromatogram?

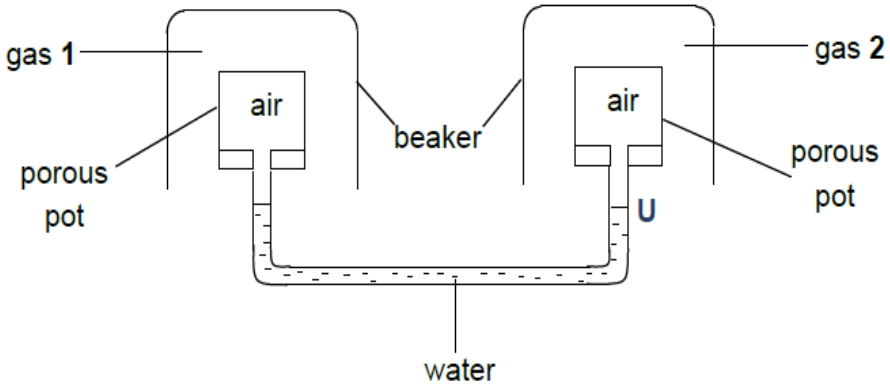
A Changing the solvent will not affect the R_f value.

B Using a more concentrated dye solution will increase the R_f value.

C The dye is likely to be a pure substance.

D The spot is closer to the starting line than it is to the solvent front.

5 The apparatus is set up, using different gases in two inverted beakers.



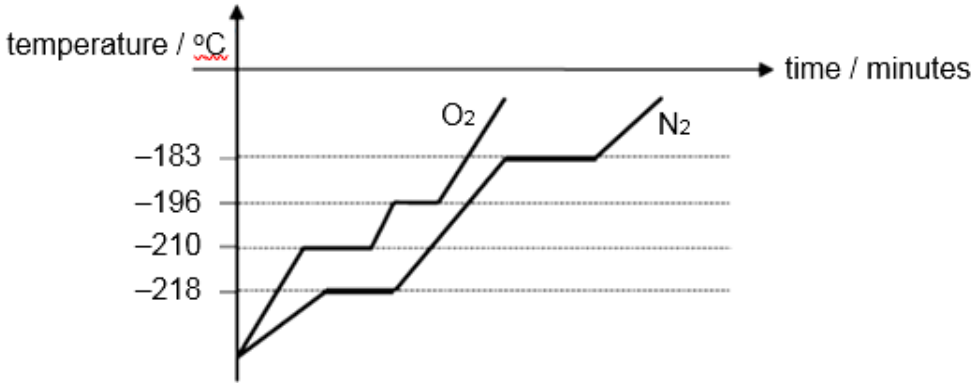
Which pair of gases would cause an upward movement of the water level at **U**?

	gas 1	gas 2
A	hydrogen	carbon dioxide
B	carbon dioxide	hydrogen
C	nitrogen	hydrogen
D	carbon dioxide	nitrogen

6 In which of the following substances are the particles closest to each other?

A dry ice
B lithium fluoride solution
C hydrogen gas
D molten aluminium

7 The graphs (not drawn to scale) show the heating curves of oxygen and nitrogen over a period of time.



Which statement about a mixture of oxygen and nitrogen is correct?

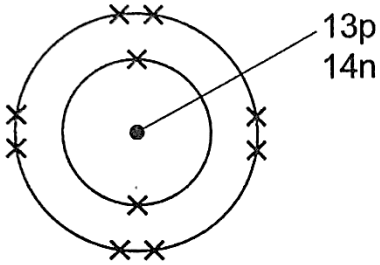
A At –185 °C, both oxygen and nitrogen molecules move rapidly in all directions.
B At –190 °C, both oxygen and nitrogen exist as a liquid.
C At –200 °C, both oxygen and nitrogen exist in the same state.
D At –215 °C, both nitrogen and oxygen molecules are vibrating about fixed positions.

8 An element with proton number 12 has a relative atomic mass of 24.4 and it is known that this element consists of two isotopes with 12 and 14 neutrons respectively.

What is the ratio of the percentage abundance of the lighter isotope to the heavier isotope?

A 1 : 2
B 1 : 4
C 2 : 1
D 4 : 1

9 The diagram shows a structure of an ion.



p = proton
n = neutron
× = electron

What is the correct position in the Periodic Table of the element from which this ion was formed?

	period	group
A	2	III
B	2	0
C	3	III
D	3	0

10 The proton numbers of elements X, Y and Z are 6, 8 and 12 respectively.

Which row shows the correct formula of the compounds formed between the elements?

	formula of compound formed		
A	Z_2Y	XY	ZX_2
B	ZY	XY_2	ZX_2
C	ZY	XY_2	Z_2X
D	Z_2Y	XY	Z_2X

11 Capsaicin, which is found in chilli and pepper, causes the spicy burning sensation in the mouth.

It has the molecular formula $C_{18}H_{27}NO_3$ and has a melting point of 65 °C.

Which of the following statements best explains why drinking water is ineffective in removing the burning sensation caused by capsaicin?

A Capsaicin has a giant molecular structure and is soluble in water.

B Capsaicin has a giant molecular structure and is not very soluble in water.

C Capsaicin has a simple molecular structure and is soluble in water.

D Capsaicin has a simple molecular structure and is not very soluble in water.

12 In the lattice structure of ionic compounds, the coordination number of each ion is the number of neighbouring ions of opposite charge.

The table shows the ions present and the coordination number of the ions in some ionic compounds. Taking sodium chloride for instance, each sodium ion is surrounded by 6 chloride ions, while each chloride ion is surrounded by 6 sodium ions. Hence, the coordination number for both the sodium ions and chloride ions is 6.

ionic compound	ion present		coordination number of		formula
	cation	anion	cation	anion	
sodium chloride	Na^+	Cl^-	6	6	NaCl
titanium (IV) oxide	Ti^{4+}	O^{2-}	6	3	TiO_2
unknown compound	Q	R	4	8	?

What is the formula of the unknown compound?

A QR_2

B Q_2R

C QR_4

D Q_4R

13 A sample of a white crystalline substance is heated in the absence of oxygen. It melts sharply at 120 ^oC. On further heating, it gives off smoky fumes and a black solid remains.

What can we conclude about the white crystalline substance?

A an element which decomposed to simpler substance.

B a mixture of substances which combined chemically.

C a compound which decomposed to form simpler substance.

D a compound which combusted to form two products.

14 Nitrogen monoxide gas from motor vehicle exhausts can be removed by injecting a stream of ammonia gas into the exhaust vapour. The reaction is shown below.

$$6NO(g) + 4NH_3(g) \rightarrow 5N_2(g) + 6H_2O\ (g)$$

What volume of ammonia gas is needed to completely react with 3600 cm^3 of nitrogen monoxide?

A 600 cm^3

B 1200 cm^3

C 2400 cm^3

D 5400 cm^3

15 In an experiment, 10 cm^3 of a gaseous hydrocarbon, **X**, required 75 cm^3 of oxygen for complete combustion to give 60 cm^3 of carbon dioxide. All gas volumes were measured at room temperature and pressure.

What is the formula of **X**?

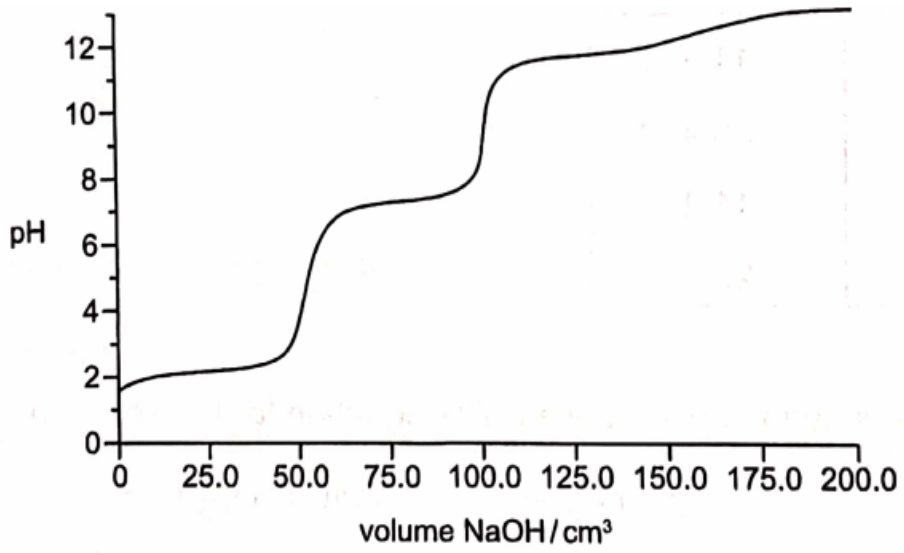
A C_6H_6
B C_6H_8
C C_6H_{10}
D $C_{12}H_{15}$

16 Which of the following contains 1 mole of ions when in aqueous state?

A 0.25 mol of Na_3PO_4
B 0.50 mol of CO
C 0.50 mol Cs_2O
D 1.00 mol CaO

17 When an acid is titrated with a strong base, an equivalence point is reached when the amount of base added is equal to the amount of H^+ dissociated.

The curve for the titration of 50.0 cm^3 of 0.10 mol/dm^3 phosphoric acid, H_3PO_4, against 0.10 mol/dm^3 NaOH is shown.



The table shows the pH range of colour changes of some acid-base indicators.

indicator	pH of colour changes
thymol blue	1.2 - 2.8 and 8.0-9.6
naphthyl red	3.7-5.0
neutral red	6.8-8.0

Which indicators should be used to show the first and second equivalence points?

A thymol blue for both
B thymol blue and then neutral red
C naphthyl red and then thymol blue
D naphthyl red and then neutral red

[Turn over

18 Sulfuric acid and nitric acid are both strong acids.

Ethanoic acid is a weak acid.

20.00 cm^3 solutions of 0.10 mol/dm^3 concentration of each of these three acids were separately titrated with a 0.10 mol/dm^3 solution of sodium hydroxide.

Which statement will correctly describe the condition for a complete reaction?

A all three acids would require the same volume of sodium hydroxide solution

B ethanoic acid and nitric acid would require the same volume of sodium hydroxide solution but sulfuric acid would require more

C nitric acid would require more sodium hydroxide solution than ethanoic acid but less than sulfuric acid

D sulfuric acid and nitric acid would require the same volume of sodium hydroxide solution but ethanoic acid would require less

19 The following table gives some information about four solutions P, Q, R and S. All the solutions have the same concentration.

solution	effect of adding zinc	electrical conductivity	effect of warming with ammonium chloride
P	no effervescence	low	ammonia gas evolved
Q	effervescence	high	no visible change
R	no effervescence	high	ammonia gas evolved
S	effervescence	low	no visible change

What is the order of the solutions in increasing pH?

	lowest pH → highest pH			
A	P	R	S	Q
B	Q	S	P	R
C	R	P	S	Q
D	S	Q	P	R

20 A student mixed two aqueous solutions of ionic compounds at a time and made the observations.

solution 1	solution 2	observations
$MgCrO_4$	$Ca(ClO_3)_2$	no precipitate observed.
$MgCrO_4$	$Pb(ClO_3)_2$	a yellow precipitate observed
$Mg(IO_3)_2$	$Ni(ClO_3)_2$	a brown precipitate observed
$Mg(IO_3)_2$	$Sr(ClO_3)_2$	a yellow precipitate observed

Which statement can be concluded based on these observations?

A $CaCrO_4$, $Ni(IO_3)_2$, $PbCrO_4$ and $Sr(IO_3)_2$ are insoluble.

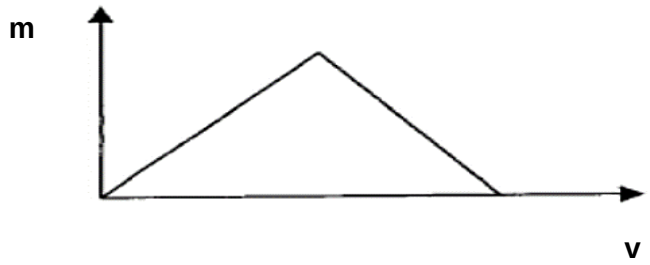
B $Ni(IO_3)_2$, $PbCrO_4$ and $Sr(IO_3)_2$ are insoluble.

C Only $Mg(ClO_3)_2$ and $Ni(IO_3)_2$ are insoluble.

D Only $Ni(IO_3)_2$ and $PbCrO_4$ are insoluble

21 In a test for the presence of a cation in an aqueous salt solution, aqueous sodium hydroxide is added slowly until in excess.

The diagram shows how the mass (m) of the precipitate varies with the volume (v) of sodium hydroxide added.



Which compound **cannot** be the aqueous salt solution?

A aluminium nitrate

B lead(II) nitrate

C zinc nitrate

D sodium nitrate

22 The following scheme shows the steps to prepare lead(II) chloride from lead(II) carbonate.

lead(II) carbonate $\xrightarrow{\text{reagent X}}$ lead(II) nitrate $\xrightarrow{\text{reagent Y}}$ lead(II) chloride

What are reagents X and Y?

	X	Y
A	aqueous sodium nitrate	dilute hydrochloric acid
B	aqueous sodium nitrate	sodium chloride
C	dilute nitric acid	dilute hydrochloric acid
D	dilute nitric acid	sodium chloride

23 One way of recovering tin from old printed circuit boards is to dissolve it in a mixture of concentrated hydrochloric acid and concentrated nitric acid.

The tin dissolves because it reacts with the mixture of these concentrated acids.

$$Sn + 4HCl + 2HNO_3 \rightarrow SnCl_4 + NO_2 + NO + 3H_2O$$

Which statement about this reaction is/are correct?

1 Nitrogen is present in three different oxidation states in the reactants and products.
2 The oxidation state of tin increases from 0 to +4.
3 The oxidation state of chlorine remains the same.

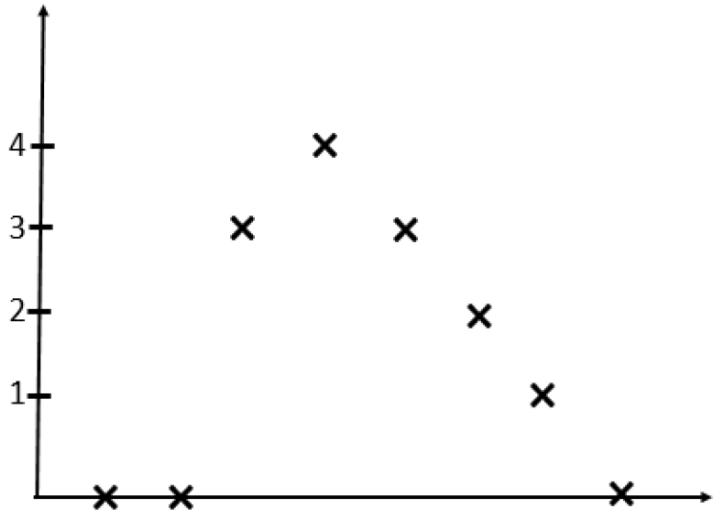
A 1 only
B 2 and 3
C 1 and 2
D 1, 2 and 3

24 Which of the properties listed will a typical group I element have?

1 A low density
2 A high melting point
3 Variable oxidation states
4 Form colourless compounds

A 1 and 2 only
B 1 and 4 only
C 2, 3 and 4 only
D 1, 2, 3 and 4

25 The graph below shows the trend of some elements.



Which labels could the axes be?

	x-axis	y-axis
A	melting point	elements across the period
B	reactivity	elements down the group
C	number of valence electrons shared during bonding	elements across the period
D	number of valence electrons transferred during bonding	elements down the group

26 Gallium is in Group III of the Periodic Table. It has a proton number of 31.

Selenium is in Group VI of the Periodic Table. It has a proton number of 34.

Which prediction is **incorrect**, based on the positions of gallium and selenium in the Periodic Table?

A A gallium atom has three valence electrons while a selenium atom has six.

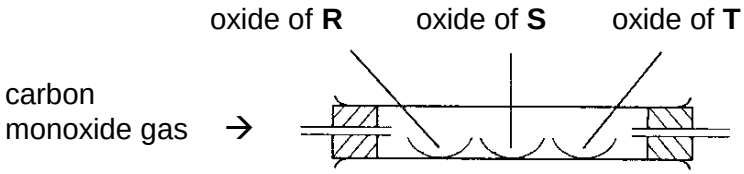
B Gallium forms Ga^{3+} ion and selenium forms Se^{2-} ion.

C Gallium has less metallic character than selenium.

D Gallium has similar properties to aluminium and selenium has similar properties to sulfur.

27 Three metallic oxide powders containing metals **R**, **S** and **T** are heated strongly in a hard glass tube as shown.

At the same time carbon monoxide gas is directed through the tube.



Oxide of **R** reacts slowly, oxide of **T** glows strongly while oxide of **S** does not undergo any changes.

Based on these observations, what is the order of reactivity of **R**, **S**, **T** and carbon?

	most reactive → least reactive			
A	**R**	**S**	**T**	carbon
B	**T**	**R**	carbon	**S**
C	**S**	carbon	**R**	**T**
D	**T**	carbon	**R**	**S**

28 A metal block left in the open for a few months was observed to have corroded. The rough coating on the surface of the metal block was scraped off and analysed.

The coating dissolved completely in dilute hydrochloric acid producing an orange solution.

What is the metal block made of, and what is the identity of the rough coating?

	metal block	rough coating
A	Fe	$Fe(OH)_3$
B	Zn	$ZnCO_3$
C	Cu	$CuCO_3$
D	A*l*	Al_2O_3

29 Which property best describes a metal which is found at the top of the reactivity series?

A readily loses electron

B burns to form an acidic oxide

C always forms an unstable compound

D forms an oxide which is easy to reduce with carbon

30 During electrolysis, 0.015 moles of chromium is deposited on the cathode when 0.090 moles of electrons is passed through molten electrolyte containing chromium.

Which substance could be the electrolyte?

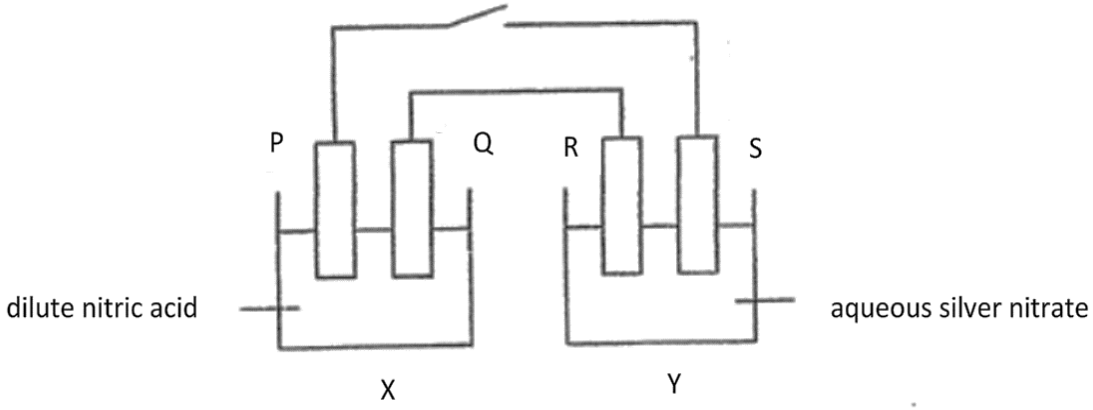
A $CrCl_4$

B $CrBr_2$

C $Cr_2(SO_4)_3$

D $Cr(NO_3)_6$

31 In the set-up X, P and Q are two different metals. In the set-up Y, R and S are carbon electrodes. When the circuit is closed, electric current flows. After some time, silver is formed on the carbon electrode S.



Which statement(s) concerning the set-up is/are correct?

1. In set-up Y, pH of the electrolyte decreases after some time.
2. Electrons flow in a clockwise direction in the circuit.
3. Metal Q is more reactive than metal P.
4. Effervescence is observed at Q.

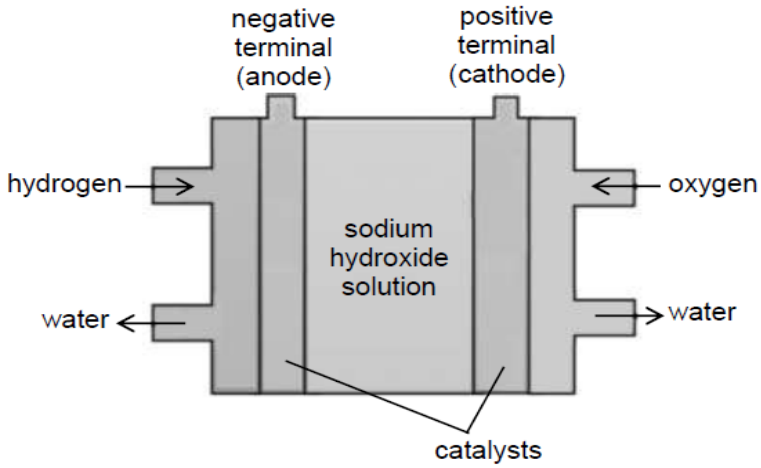
A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 4 only

32 Some cars use hydrogen-oxygen fuel cells to generate electricity as shown in the diagram.



Which half-equation represents the reaction that takes place at the positive terminal of the fuel cell?

A $H_2(g) + 2OH^-(aq) \rightarrow 2H_2O(l) + 2e$

B $O_2(g) + 2H_2O(l) + 4e \rightarrow 4OH^-(aq)$

C $2H_2O(l) + 2e \rightarrow H_2(g) + 2OH^-(aq)$

D $4OH^-(aq) \rightarrow O_2(g) + 2H_2O(l) + 4e$

33 Ammonia is manufactured by the Haber Process. The equation for the Haber process is given below.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92 kJ/mol$$

Which statement about the Haber Process is true?

A Hydrogen used is obtained from the hydrogenation of alkenes.

B Nitrogen used is obtained from the fractional distillation of crude oil.

C The reaction is exothermic as energy is absorbed to break the strong N≡N bonds.

D The yield of the reaction is always lower than 100% as the reaction is reversible.

34 Nitrogen in fertilisers are often found in the form of nitrates. The presence of certain bacteria in the soil converts nitrates into ammonium ions which can be retained in the soil better. However, in less ideal conditions, nitrogen is lost as ammonia gas.

What conditions in the soil would improve the production and retention of ammonium ions?

A oxidising and acidic

B oxidising and alkaline

C reducing and acidic

D reducing and alkaline

35 Which of the following statements about atmospheric pollutants is true?

A Carbon monoxide is oxidised by oxygen and dissolves in rainwater to form acid rain.

B Hydrocarbons react with fluorine to produce a gas that depletes the ozone layer.

C Ozone at low altitudes in the atmosphere helps to block off ultra-violet rays

D Sulfur dioxide can be removed from flue gases by passing over calcium carbonate

36 Diesel and petrol are used commonly as fuels for cars. The combustion of these fuels produces air pollutants.

The table shows the mass of air pollutants found in exhaust fumes when 1 kg of each fuel is combusted under identical conditions.

air pollutant produced	mass of air pollutant after diesel is combusted / g	mass of air pollutant after petrol is combusted / g
carbon monoxide	15	300
unburnt hydrocarbons	20	25
oxides of nitrogen	95	40

Which of the following can be inferred from the information in the table?

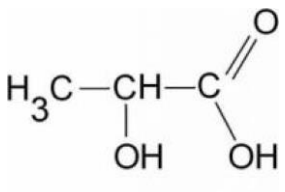
A A diesel engine has a higher temperature than a petrol engine.

B Burning of petrol contributes more towards acid rain.

C Combustion of petrol is more exothermic than that of diesel.

D Petrol requires less oxygen for complete combustion.

37 A molecule of 2-hydroxyl propanoic acid is shown.



Which of the following reactions can occur with this acid?

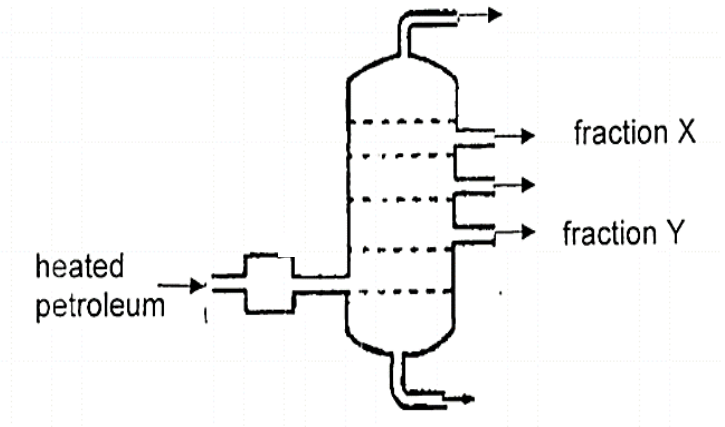
A It produces ammonia gas with ammonium nitrate.

B It decolourises aqueous bromine.

C It is insoluble in water.

D It undergoes condensation polymerisation.

38 The diagram shows the fractional distillation of petroleum.



Which statements about fractions **X** and **Y** are correct?

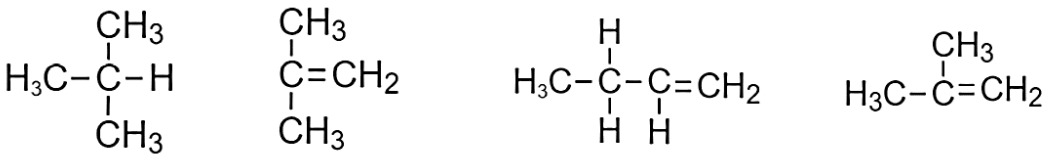
	X is more flammable than Y	X burns with a less sooty flame than Y	X is more viscous than Y
A	yes	no	no
B	yes	yes	no
C	no	yes	yes
D	no	no	yes

39 5 g of vegetable oil (M_r = 800) reacted completely with 900 cm^3 of hydrogen gas (measured at room temperature and pressure) to form margarine which is a saturated fat.

How many C=C bonds are there in one molecule of the oil?

A 3 **B** 4 **C** 5 **D** 6

40 The structures of four hydrocarbons are shown.



How many isomers of butene are there?

A 1 **B** 2 **C** 3 **D** 4

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**Key** proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

lume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

SERANGOON SECONDARY SCHOOL
PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS

CANDIDATE NAME	( )	CLASS	
CENTRE NUMBER	S	INDEX NUMBER	

CHEMISTRY

6092/01

Paper 1 Multiple Choice

24 Aug 2022
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on the last page.
The use of an approved scientific calculator is expected, where appropriate.

For examiner's use
40

This question paper consists of **19** printed pages, including this cover page.

548

1 25 cm^3 of aqueous sodium hydroxide is pipetted into a conical flask and titrated with dilute hydrochloric acid from a burette. How can the accuracy of the titration be improved?

I. Rinse the interior of the pipette with aqueous sodium hydroxide.
II. Rinse the interior of the pipette with aqueous hydrochloric acid.
III. Rinse the interior of the conical flask with aqueous sodium hydroxide.
IV. Rinse the interior of the burette with dilute hydrochloric acid.

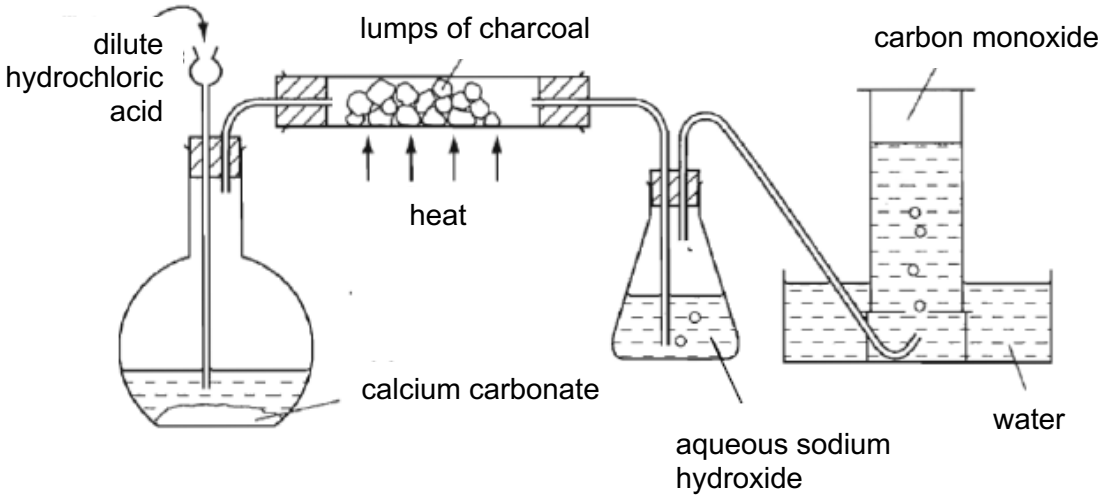
A I and III only

B I and IV only

C II and III only

D I, III and IV

2 The diagram below is a set-up used to obtain carbon monoxide.



What is the main purpose of the aqueous sodium hydroxide?

A Dry the carbon monoxide.

B Remove the carbon dioxide.

C Remove the excess acid.

D Remove the oxygen present.

3 Esters can be prepared by reactions of alcohols and carboxylic acids. The yield of these reactions is often low. One way of improving the yield is to remove the ester formed as the reaction proceeds and this can be done by carrying out fractional distillation.

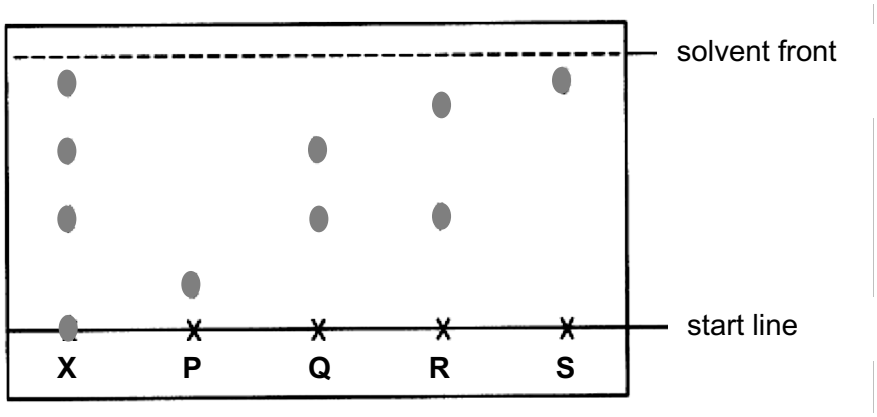
Which of the following mixtures will yield an ester as the distillate using this method?

A	ethanol (B.P: 78°C)	ethanoic acid (B.P: 118°C)	ethyl ethanoate (B.P: 77°C)
B	butanol (B.P: 117°C)	ethanoic acid (B.P: 118°C)	butyl ethanoate (B.P: 128°C)
C	ethanol (B.P: 78°C)	butanoic acid (B.P: 164°C)	ethyl butanoate (B.P: 121°C)
D	methanol (B.P: 65°C)	butanoic acid (B.P: 164°C)	methyl butanoate (B.P: 102°C)

B.P. : Boiling Point

4 Vitamins are essential nutrients needed in small amounts for various roles in the human body. They are either water-soluble or fat-soluble.

A sample of herbal tea, **X**, was analysed using chromatography with four water-soluble vitamins, P, Q, R and S, using water as the solvent. When the solvent front reached the position indicated, the chromatogram was placed under ultra-violet light. The following diagram shows the chromatogram obtained.



What can be deduced from the results?

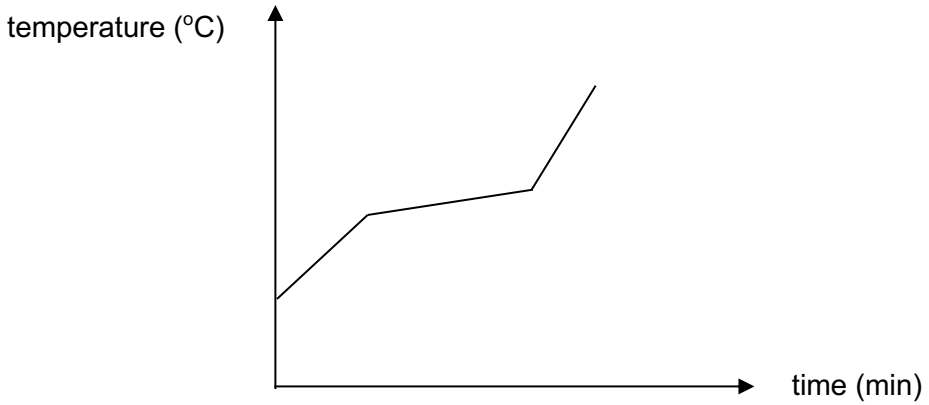
A All vitamins in **X** are soluble in water.

B One of the vitamins in **X** is not soluble in water.

C Vitamin **X** consists of vitamin Q, R and S.

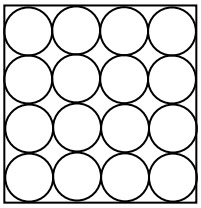
D Vitamin **X** contains three different components.

5 The diagram below shows the heating curve of substance X.

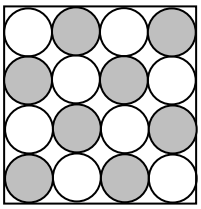


Which of the following represents the arrangement of the particles in substance X?

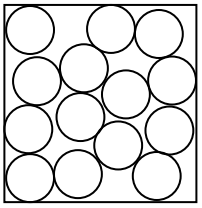
A



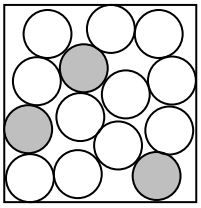
B



C



D



6 The chemical symbol of an element is shown below.

$$^{197}_{79}X$$

Which of the following describes how this element achieves a stable electronic configuration?

A gain electrons to form positive ion

B lose electrons to form negative ions

C lose electrons to form positive ions

D share electrons to form diatomic molecules

7 The proton number and electron number of some particles are shown below. The symbols used here do not represent the actual chemical symbol of the elements.

particle	P	Q	R	S
proton number	4	15	19	30
electron number	4	18	19	28

Which two particles are found in an ionic compound?

A P and R

B P and Q

C Q and S

D R and S

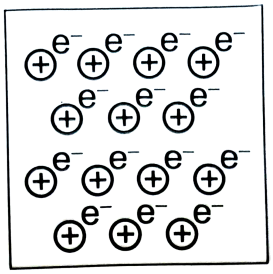
8 The properties of an unknown substance are given below.

- low melting and boiling point
- low density
- good conductor of electricity in solid state

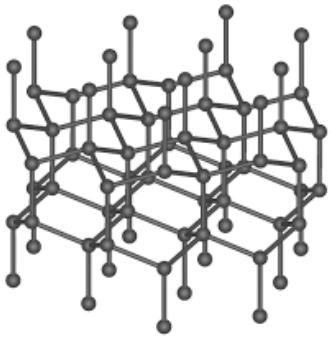
Which of the following is the substance?

A

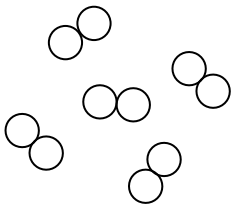
B



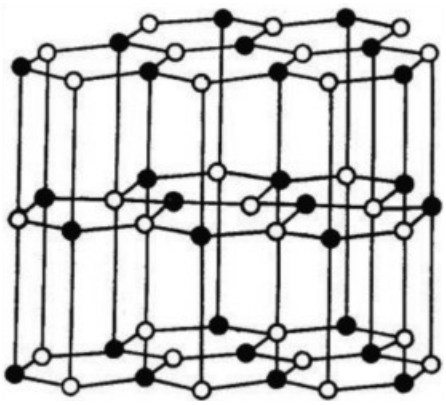
C



D



9 Which of the following best explains the reason why the substance with the structure shown below would be a good lubricant?



A strong covalent bonds between the layers of atoms

B weak forces of attraction between the layers of atoms

C weak covalent bonds between the layers of atoms

D weak electrostatic forces of attraction between the layers of atoms

10 Which statement about groups in the Periodic Table is correct?

A All groups contain both metals and non-metals.

B Atoms of the elements in the same group have the same number of total electrons.

C Atomic radius decreases down the group.

D Ionisation energy decreases down the group.

11 $X_2 + 2KY \rightarrow 2KX + Y_2$

Based on the equation shown above, _____.

A the reaction is a redox reaction

B the reaction is a metal displacement reaction

C X is less reactive than Y

D X_2 is the reducing agent

12 The setup below was used to collect the gas produced when an excess magnesium was added to 50 cm^3 of 1 mol/dm^3 of hydrochloric acid.
The time taken for the reaction to be completed was also recorded.
The table below shows the results obtained.

volume of gas (cm^3)	600
time taken for reaction to complete (s)	60

Which of the following would likely be the results obtained when same concentration of propanoic acid is used instead?

	volume of gas (cm^3)	time taken for reaction to complete (s)
A	300	30
B	300	60
C	600	60
D	600	180

13 In an experiment, 5 cm^3 of 1.0 mol/dm^3 of sodium hydroxide is gradually added to 10 cm^3 of 1.0 mol/dm^3 of hydrochloric acid, containing methyl orange indicator.

Which change occurs in the mixture?

A A white precipitate is formed.

B Methyl orange changes in colour.

C The concentration of OH^- increases.

D The concentration of H^+ decreases by half.

14 X, Y and Z elements are found in Period 3 of the Periodic Table.
X forms an acidic oxide when burnt in oxygen.
Y forms a basic oxide when burnt in oxygen.
Z forms an amphoteric oxide when burnt in oxygen.

What is the order of the three elements across the Periodic Table?

A X, Y, Z

B X, Z, Y

C Y, X, Z

D Y, Z, X

15 Which of the following reactions is **unlikely** to take place?

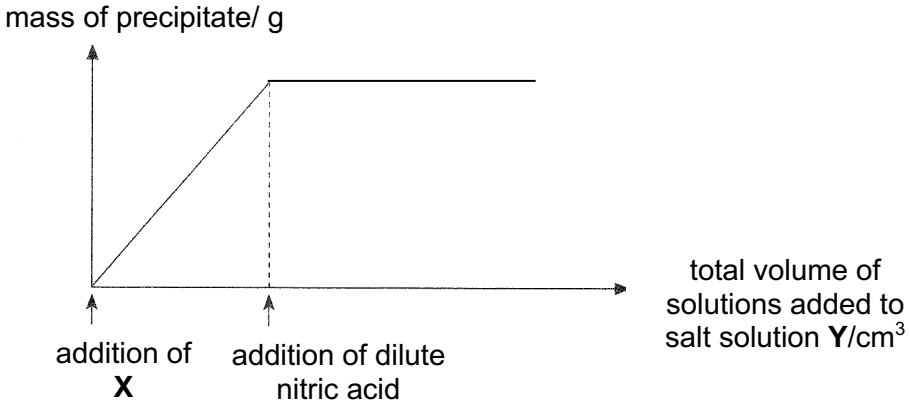
A Pb^{2+} (aq) + $2Cl^{-}$ (aq) → $PbCl_2$ (s)

B Fe^{2+} (aq) + Mg (s) → Mg^{2+} (aq) + Fe (s)

C $2H^{+}$ (aq) + Cu (s) → H_2 (g) + Cu^{2+} (aq)

D $2H^{+}$ (aq) + CO_3^{2-}(aq) → CO_2 (g) + H_2O (*l*)

16 In a chemistry experiment, solution **X** is gradually added to a salt solution **Y**, followed by the addition of a dilute nitric acid solution. The graph shows how the mass of precipitate formed changes with the addition of the different solutions.



Which of the following would produce the graph as shown above?

	solution **X**	ions present in salt solution **Y**
A	aqueous silver nitrate	chloride ion and carbonate ion
B	aqueous silver nitrate	nitrate ion and sulfate ion
C	aqueous barium nitrate	sulfate ion and carbonate ion
D	aqueous barium nitrate	sulfate ion and nitrate ion

17 The table shows the observations made when an aqueous solution X was tested.

reagent added	observation
acidified silver nitrate	solution remained colourless.
aqueous sodium hydroxide	pungent gas turns moist red litmus paper blue.

Which of the following could X possibly be?

A ammonium nitrate

B ammonium chloride

C zinc nitrate

D zinc chloride

18 A gas was produced during a reaction. The descriptions below show some of the properties of the gas produced.

- turns moist blue litmus paper red
- pungent smell
- no visible change with limewater

What is the identity of the gas produced?

A ammonia

B carbon dioxide

C nitrogen monoxide

D sulfur dioxide

19 Which element contains the greatest number of atoms in 1 g?

A aluminium

B carbon

C iodine

D nitrogen

20 An impure sample of 1 g of silver oxide reacts with excess of nitric acid to form silver nitrate and water. The reaction produces, 0.86 g of silver nitrate.

$$Ag_2O + 2HNO_3 \rightarrow AgNO_3 + H_2O$$

What is the percentage purity of the sample?

A 31.3 %

B 58.7 %

C 85.5 %

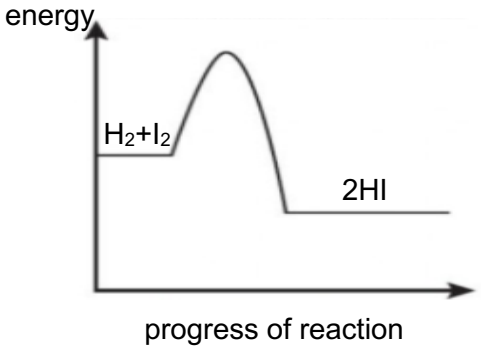
D 86.0 %

21 Hydrogen and iodine react according to the equation shown below.

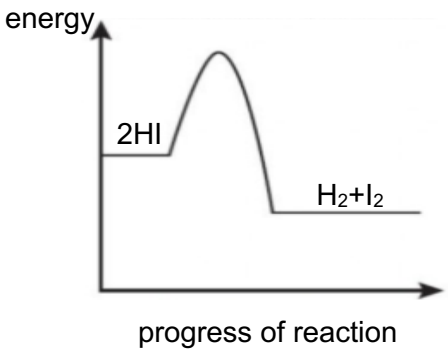
$$H_2 + I_2 \rightleftharpoons 2HI \quad \Delta H = +52.96 \text{ kJ}$$

Which of the following energy profile diagrams shows the backward reaction?

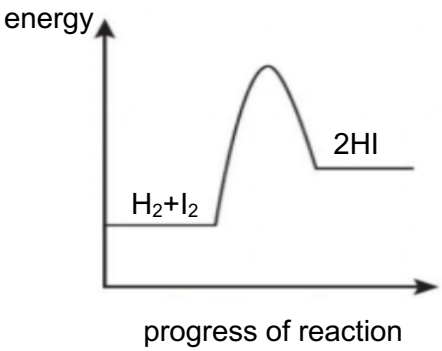
A



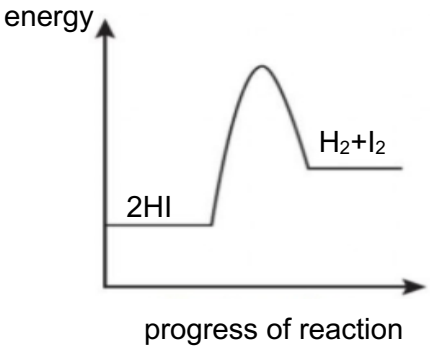
B



C



D



22 The scheme shows four stages I to IV in the conversion of solid candlewax, $C_{30}H_{62}$, into carbon dioxide and water.

$$C_{30}H_{62}(s) \xrightarrow{I} C_{30}H_{62}(l) \xrightarrow{II} C_{30}H_{62}(g) \xrightarrow{III} \begin{matrix} 30CO_2(g) \\ + \\ 31H_2O(g) \end{matrix} \xrightarrow{IV} \begin{matrix} 30CO_2(g) \\ + \\ 31H_2O(l) \end{matrix}$$

Which stage(s) is/are exothermic?

A III only

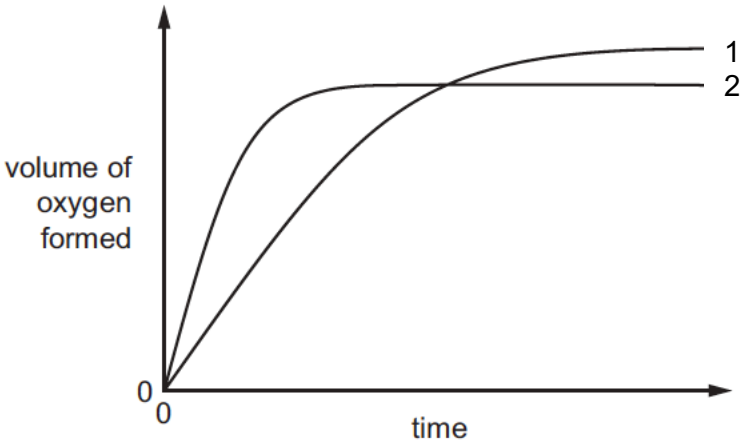
B III and IV only

C I, II and III only

D I, II and IV only

23 In the graph, curve 1 was obtained by observing the decomposition of 100 cm^3 of 1.0 mol/dm^3 hydrogen peroxide solution, catalysed by manganese(IV) oxide.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$



Which alteration to the original experimental conditions would produce curve 2?

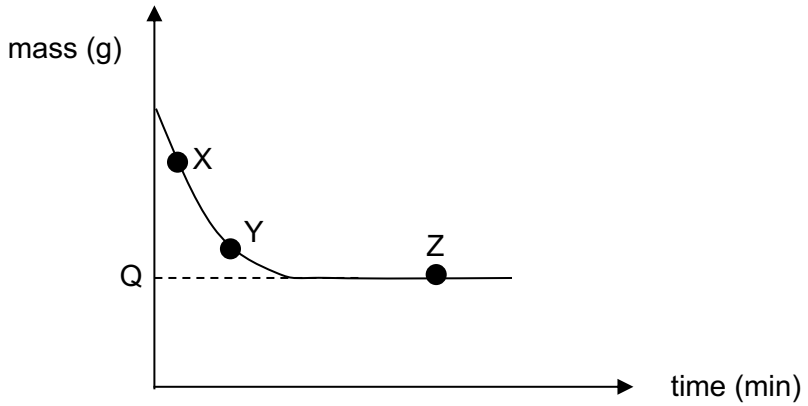
A increase the pressure

B lower the temperature

C using 100 cm^3 of 1.2 mol/dm^3 hydrogen peroxide solution

D using 50 cm^3 of 1.2 mol/dm^3 hydrogen peroxide solution

24 The graph shows the mass of hydrogen gas evolved, plotted against time, when excess hydrochloric acid reacts with 2 g of magnesium ribbon.



Which statement is correct?

A The reaction is faster at point X than at point Y.

B The reaction first reaches completion at point Z.

C The mass of hydrogen gas evolved will be higher if magnesium powder is used instead.

D Mass of hydrogen gas evolved is Q g.

25 The statements below describe the reactions of metals P, Q and R.

- Metal P does not react with cold water but reacts quickly with an acid.
- Metal Q reacts slowly with an acid but has no reaction with steam.
- Metal R reacts fast with cold water.

Which of the following statements is correct?

A Metal P can only be extracted by electrolysis from its ore.

B Metal Q exists naturally uncombined.

C Metal R cannot be reduced by coke.

D Metals P and Q are positioned below hydrogen in the metal reactivity series.

26 Which of the following equations show the protection of iron from rusting?

A $3Ca^{2+} + 2Fe \rightarrow 2Fe^{3+} + 3Ca$

B $Zn^{2+} + Fe \rightarrow Fe^{2+} + Zn$

C $Mg + Fe^{2+} \rightarrow Fe + Mg^{2+}$

D $Sn + Fe^{2+} \rightarrow Fe + Sn^{2+}$

27 Which of the following is true about steel?

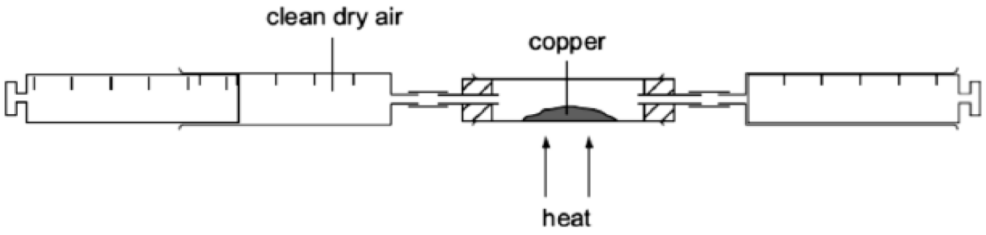
A It is resistant to corrosion.

B It is softer than pure metal.

C It is a poor conductor of electricity.

D It reacts with acid to form hydrogen gas.

28 A 150 cm^3 sample of clean, dry air is passed over hot excess copper at room temperature and pressure until there is no further change in volume. The pink copper metal turns black at the end of the reaction.



What is the minimum mass of copper metal that is needed for this reaction?

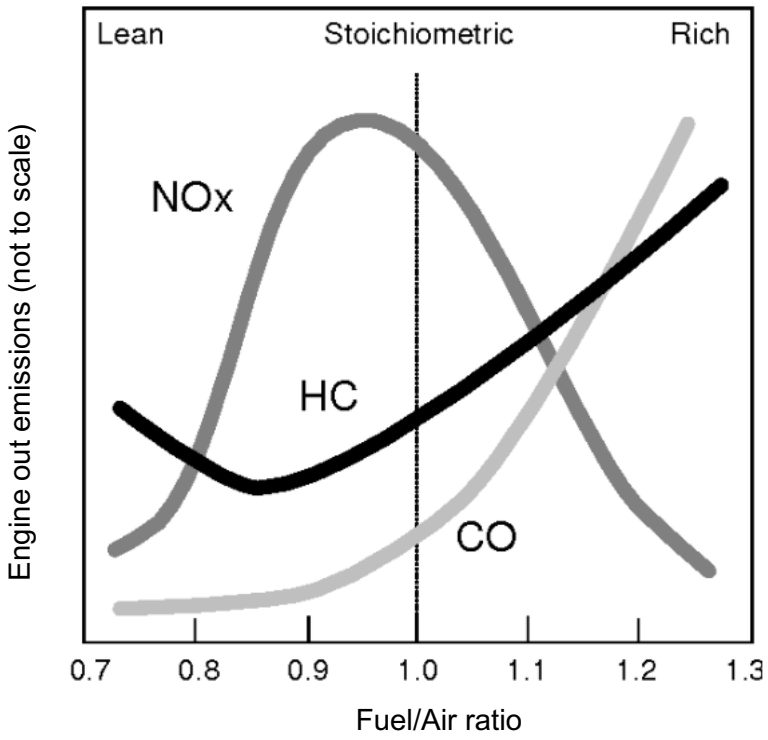
A 0.084 g

B 0.168 g

C 0.316 g

D 0.632 g

29 The diagram below shows the changes to the emission of different gases from a car engine at different fuel/air ratio.



Why is there an increase in the emission of CO when the fuel/air ratio increases from 0.8 to 1.0?

A There is a decrease in the volume of air in the engine, leading to internal combustion.

B There is an increase in the volume of air in the engine, leading to internal combustion.

C There is a decrease in the volume of air in the engine, leading to incomplete combustion.

D There is an increase in the volume of air in the engine, leading to incomplete combustion.

30 Which two processes in the carbon cycle help to regulate the carbon level in the atmosphere?

A combustion and respiration

B decomposition and respiration

C deforestation and photosynthesis

D photosynthesis and combustion

31 Why is iron metal added to Haber Process?

A To lower the pressure needed for the reaction.

B To lower the temperature needed for the reaction.

C To lower the activation energy level of the process.

D To react with hydrogen and nitrogen to form ammonia.

32 Given the following reaction

$$2MnO_4^- + 5SO_3^{2-} + 6H^+ \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$$

Which statement about the reaction above is true?

A MnO_4^- is acting as the reducing agent.

B SO_3^{2-} is oxidised to form SO_4^{2-} .

C H^+ is oxidised.

D SO_3^{2-} is neither oxidised nor reduced.

33 During electroplating process, an object is coated with silver metal. The mass of the was measured before and after the process.

mass of object before process (g)	4.78
mass of object after process (g)	6.15

The difference in the mass recorded is due to _____.

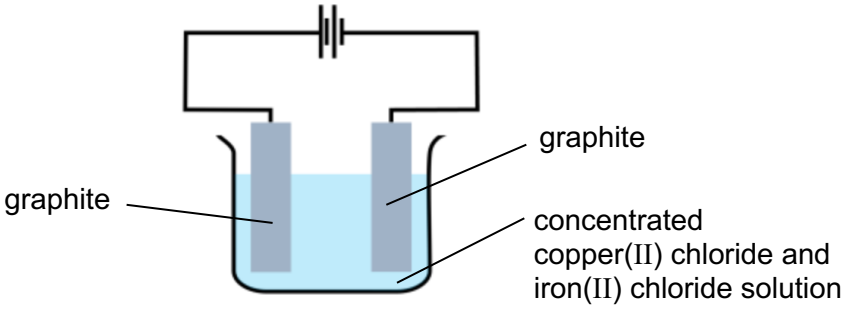
A a gas being produced at the object

B a salt being produced on the object

C oxidation of silver metal

D reduction of silver ions

34



Which of the following statements correctly describes the observations made in the setup a few hours later?

A Green fumes observed at the cathode.

B The electrolyte would be blue in colour.

C The electrolyte would be green in colour.

D The anode will increase in size.

35 In the electrolysis of an aqueous solution of cerium nitrate, 70 g of cerium, Ce, (A_r = 140) is deposited at the cathode by 2 moles of electrons. What is the charge on the cerium ion?

A 1+ **B** 2+

C 4+ **D** 6+

36 The table below shows the uses of two fractions obtained from fractional distillation of crude oil.

fraction	uses
X	fuel for lorries and trucks
Y	feedstock for petrol chemical industry

What is fraction X and Y based on the uses given?

	fraction X	fraction Y
A	diesel	lubricating oil
B	diesel	naphtha
C	petrol	lubricating oil
D	petrol	naphtha

37 One of the compounds found in bitumen has a molecular formula of $C_{20}H_{42}$. It undergoes cracking to form smaller molecules as shown in the equation below.

$$C_{20}H_{42} \rightarrow C_{12}H_{26} + 2 \_\_\_\_\_$$

What is the chemical formula of the other compound formed?

A C_4H_8

B C_4H_{10}

C C_8H_{16}

D C_8H_{18}

38 400 cm^3 of 5 mol/dm^3 of aqueous bromine was found to react with 1 mole of an unsaturated hydrocarbon.

What is the number of bromine atoms that would be found in the product formed?

A 2 **B** 3

C 4 **D** 6

39 Below shows a list of reactions.

I combustion of ethanol
II fermentation of glucose
III oxidation of ethanol by air in the presence of bacteria
IV reaction of sodium carbonate with ethanoic acid

In which reaction is carbon dioxide a product?

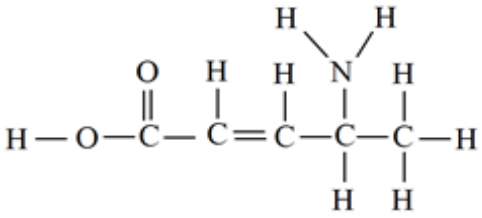
A I and II only

B I and IV only

C I, II and III only

D I, II and IV only

40 Which of the following reactions will **not** take place with the molecule shown below?



A bromination

B condensation polymerisation

C oxidation

D reaction with magnesium

END-OF-PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

TEMASEK SECONDARY SCHOOL
Preliminary Examination 2022
Secondary 4 Express

CHEMISTRY **6092/01**

Paper 1 **1 hour**

Question Booklet

Additional Material: OTAS

READ THESE INSTRUCTIONS FIRST

Do not open the booklet until you are told to do so.

Write your name, index number and class on the Optical Answer Sheet.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

You are not required to hand in this booklet at the end of the examination.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OTAS.

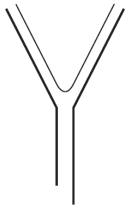
Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done on this booklet.

A copy of the Periodic Table is printed on page 17.

1 Hexane and octane are liquid hydrocarbons that mix together.

Which apparatus is used to separate a mixture of these two liquids?

A



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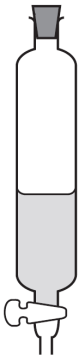

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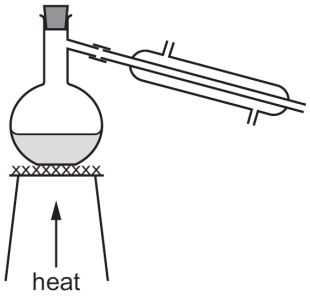

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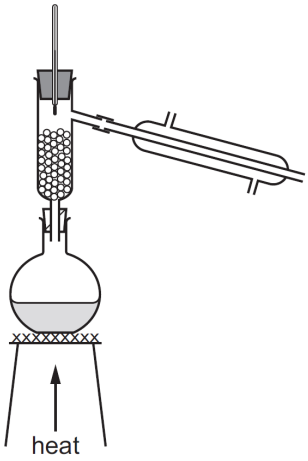


2 When a covalent liquid boils, its molecules become more widely spaced.

Which property of the molecules has the most influence on the energy required to boil a covalent liquid?

A the strength of the forces of attraction between the molecules
B the reactivity of the molecules
C the shape of the molecules
D the strength of the covalent bonds in the molecules

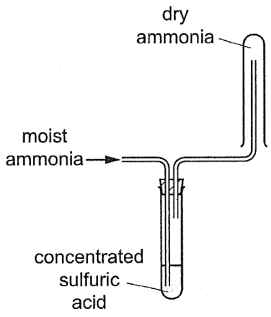
3 In which particle are the number of protons, neutrons and electrons all different?

A $^{11}_{5}B$ **B** $^{19}_{9}F^{-}$ **C** $^{23}_{11}Na^{+}$ **D** $^{24}_{12}Mg^{2+}$

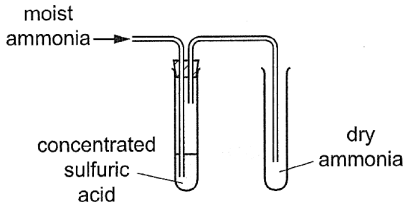
4 A student is provided with two drying agents: concentrated sulfuric acid and calcium oxide.

Which method should he use to collect a sample of dry ammonia?

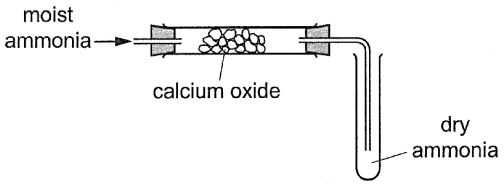
A



B



C



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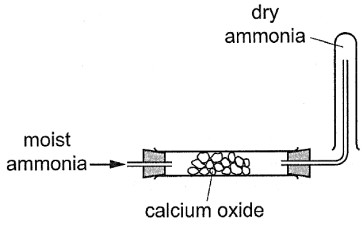


5 Silicon carbide, SiC, has a structure similar to diamond. Boron nitride, BN, has a structure similar to graphite. Bronze is an alloy of copper and tin.

Which statements about SiC, BN and bronze are correct?

1 All are bonded covalently.

2 All have a giant structure.

3 All have high melting points.

A 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

6 Some car paints contain small flakes of silicon dioxide, SiO_2.

In the structure of solid SiO_2,

- each silicon atom is bonded to x oxygen atoms,
- each oxygen atom is bonded to y silicon atoms,
- each bond is a z type bond.

What is the correct combination of x, y and z in these statements?

	x	y	z
A	2	1	covalent
B	2	1	ionic
C	4	2	covalent
D	4	2	ionic

7 In which compound does one of the atoms or ions have a different electronic configuration from each other?

A carbon dioxide
B phosphorus trichloride
C sodium oxide
D magnesium chloride

8 Which solid oxide does **not** lower the pH when added to sodium hydroxide solution?

A aluminium oxide
B silicon dioxide
C phosphorus oxide
D lithium oxide

9 The results of some experiments with sulfur dioxide are shown.

experiment	description	result
1	mix with dilute hydrochloric acid	does not react
2	mix with sodium hydroxide	a salt forms
3	add Universal Indicator	Universal Indicator turns purple
4	add acidified aqueous potassium manganate(VII)	purple solution turns colourless

Which results are correct?

A 1, 2 and 4 **B** 2, 3 and 4 **C** 1 and 2 only **D** 3 and 4 only

10 The table shows the concentration and pH values of the aqueous solutions L and M.

	L	M
concentration in mol/dm^3	2	2
pH	6	9

Student P concluded that L is a strong acid.
Student Q concluded that the extent of ionisation is low in L and high in M.

Which student(s) is(are) correct?

A both P and Q
B neither P nor Q
C P only
D Q only

11 A student investigates two acids W and X.

The same volumes of W and X are reacted separately with excess magnesium.

The student makes the following observations.

1 Hydrogen gas is produced at a faster rate with W than with X.

2 The total volume of hydrogen gas produced is the same for both acids.

Which statement explains these observations?

A The pH of W is higher than the pH of X.
B W is an organic acid.
C W is more concentrated than X.
D W is a strong acid while X is a weak acid.

12 Which reaction does **not** involve neutralisation?

A $H_2SO_4(aq) + 2NH_3(aq) \rightarrow (NH_4)_2SO_4(aq)$
B $H_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2HCl(aq)$
C $H_2SO_4(aq) + CuO(s) \rightarrow CuSO_4(aq) + H_2O(l)$
D $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

13 Zinc reacts with hydrochloric acid according to the following equation.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

The following statements were made about the reaction.

1 A 3.25 g sample of zinc reacts with an excess of hydrochloric acid to give 0.050 mol of zinc chloride.

2 A 6.50 g sample of zinc reacts completely with exactly 100 cm^3 of 1.00 mol/dm^3 hydrochloric acid.

3 A 13.0 g sample of zinc reacts with an excess of hydrochloric acid to give 9.60 dm^3 of hydrogen at room temperature and pressure.

Which statements are correct?

A 1 only **B** 1 and 2 only **C** 2 and 3 only **D** 1, 2 and 3

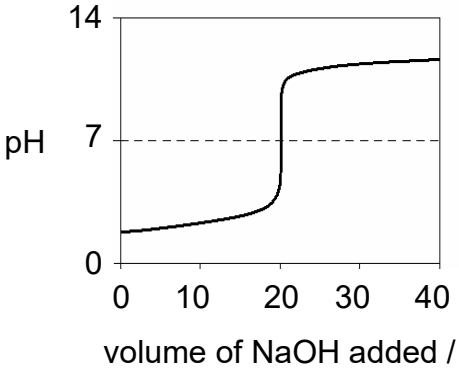
14 The table shows appropriate indicators used to identify the endpoint in titrations.

indicator	acidic colour	range of colour change	alkaline colour
methyl orange	red	3.1 – 4.4	yellow
methyl red	red	4.4 – 6.2	yellow
bromothymol blue	yellow	6.0 – 7.6	blue
cresolphthalein	colourless	8.1 – 9.7	red
alizarin yellow	yellow	10.1 – 12.0	red

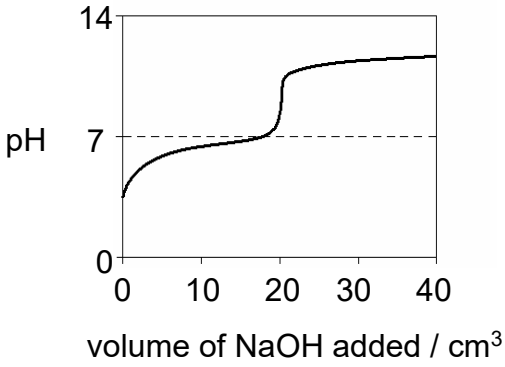
Curve 1 shows the changes in pH when NaOH was titrated to HCl in a conical flask.

Curve 2 shows the changes in pH when NaOH was titrated to a different acid in another conical flask.

curve 1



curve 2



The appropriate indicator for titration to obtain curve 1 is bromothymol blue.

Using the table, what is the appropriate indicator for curve 2?

A bromothymol blue
B cresolphthalein
C methyl orange
D methyl red

15 Which statement about ammonia is correct?

A Ammonia gas turns moist blue litmus paper red.
B Ammonia is used to increase pH of acidic soil.
C Ammonia is produced when a nitrate solution is warmed with sodium hydroxide.
D Ammonia molecule contains two pairs of electrons not involved in bonding.

16 One mole of compound X gives three moles of ions in aqueous solution. X reacts with ammonium carbonate to give an acidic gas.

What is compound X?

A calcium hydroxide
B ethanoic acid
C sodium hydroxide
D sulfuric acid

17 A sample of solid magnesium hydroxide is made by adding an excess of aqueous sodium hydroxide to an aqueous solution containing 1.20 g magnesium sulfate.

The mass of magnesium hydroxide formed is 0.26 g.

What is the percentage yield of magnesium hydroxide?

A 10.5 % **B** 21.7 % **C** 44.8 % **D** 61.9 %

18 Sulfur is present in two amino acids that make up proteins.

These are cysteine and methionine.

amino acid	cysteine	methionine
formula	$C_3H_7NO_2S$	$C_5H_{11}NO_2S$

Cysteine contains a higher percentage of sulfur by mass than methionine.

Which is the correct explanation for the above statement?

A The mass of sulfur atoms in a molecule of cysteine is greater than that in a molecule of methionine.

B The mass of carbon and hydrogen atoms in a molecule of cysteine is fewer than that in a molecule of methionine.

C The number of sulfur atoms in a molecule of cysteine is greater than that in a molecule of methionine.

D The relative molecular mass of cysteine is greater than the relative molecular mass of methionine.

19 Trends are seen in the physical and chemical properties of the elements of Group II and their compounds.

1 the rate of the reaction between the element and dilute hydrochloric acid

2 the solubility of the sulfates

3 the temperature of decomposition of the carbonates

Which trend(s) show(s) a **decrease** from magnesium to barium?

A 1, 2 and 3 **B** 1 and 3 only **C** 3 only **D** 2 only

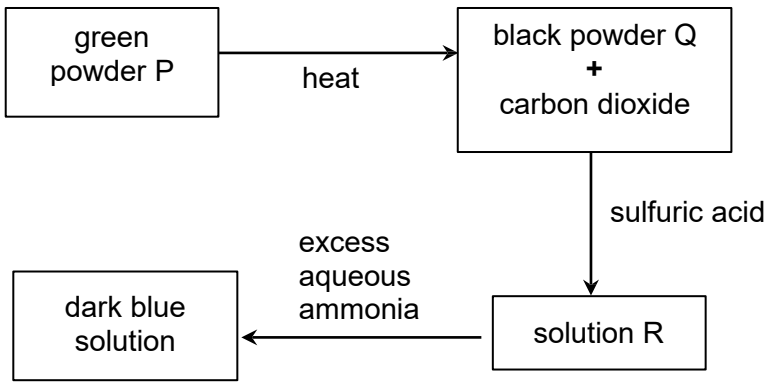
20 An unknown aqueous solution reacts with aqueous sodium hydroxide to form a reddish-brown precipitate and then aluminium powder is added.

The mixture is heated and a gas that turns damp red litmus paper blue is given off.

What is the unknown solution?

A ammonium chloride
B copper(II) nitrate
C iron(II) chloride
D iron(III) nitrate

21 The diagram below shows a series of tests starting with substance P.



Which statement is true?

A P can react directly with dilute sulfuric acid to give R.
B Q reacts with acids to liberate hydrogen gas.
C R is also green in colour.
D R forms a green precipitate with aqueous sodium hydroxide.

22 The following reactions are carried out.

reaction	result
propanoic acid added to aqueous ammonia	compound P formed
propanoic acid is added to ammonium carbonate	gas Q given off
ammonium propanoate is warmed with sodium hydroxide	gas R given off

Which correctly identify the compound and gases?

	compound P	gas Q	gas R
A	ammonium carbonate	carbon dioxide	hydrogen
B	ammonium propanoate	ammonia	carbon dioxide
C	ammonium carbonate	ammonia	hydrogen
D	ammonium propanoate	carbon dioxide	ammonia

23 The formulae for four substances containing chlorine are given below.

PCl_3 Cl_2O ClO_3^- ClO_4^-

Which correctly shows the oxidation numbers of chlorine in the above substances respectively?

	oxidation number of chlorine in			
	PCl_3	Cl_2O	ClO_3^-	ClO_4^-
A	-1	+1	+5	+7
B	+1	+1	+5	+7
C	-1	+1	+6	+8
D	+3	+2	-3	-4

24 Hydrogen peroxide, H_2O_2, reacts with silver oxide according to the following equation.

$$Ag_2O(s) + H_2O_2(l) \rightarrow 2Ag(s) + H_2O(l) + O_2(g)$$

What is the role played by hydrogen peroxide in this reaction?

A acid
B dehydrating agent
C oxidising agent
D reducing agent

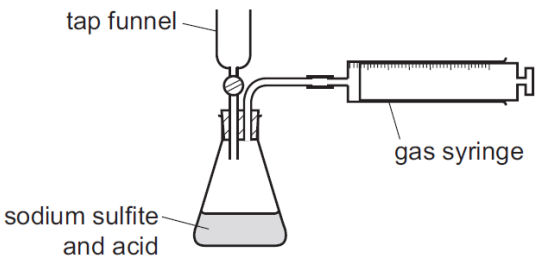
25 In which reaction is sulfur dioxide acting as an oxidizing agent?

A $SO_2 + 2H_2O + Cl_2 \rightarrow H_2SO_4 + 2HCl$
B $SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$
C $2SO_2 + O_2 \rightarrow 2SO_3$
D $SO_2 + 2H_2S \rightarrow 2H_2O + 3S$

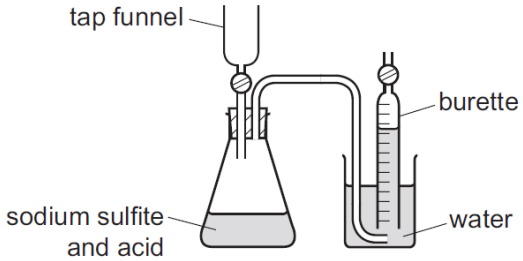
26 A student wanted to follow how the rate of the reaction of sodium sulfite with acid varies with time. The reaction produces gaseous sulfur dioxide.

Which apparatus is **not** suitable?

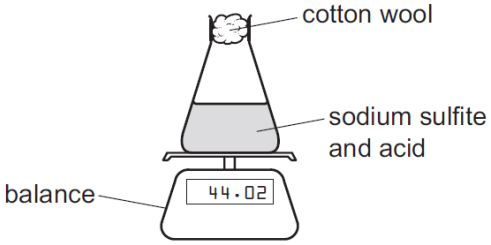
A



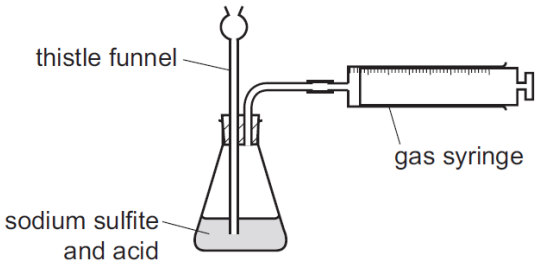
B



C

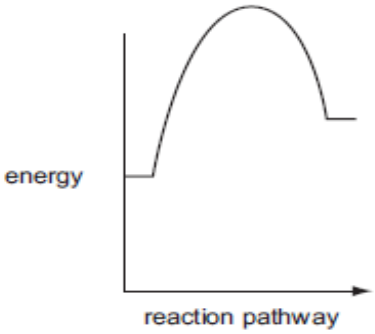


D

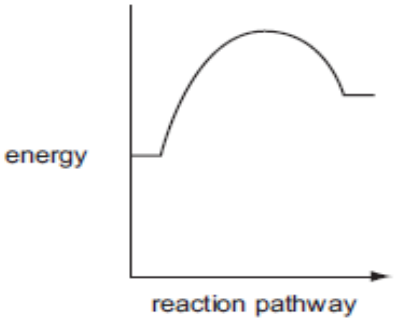


27 Which reaction profile shows the fastest exothermic reaction?

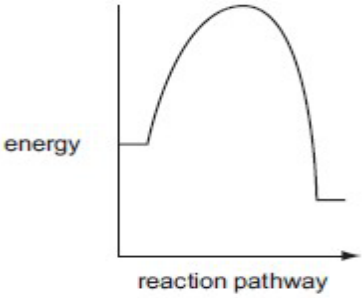
A



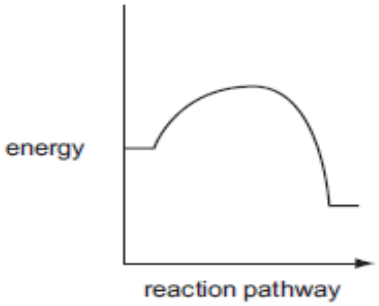
B



C



D



28 Four metals W, X, Y and Z and their compounds behaved as described.

1 Only X, Y and Z reacted with dilute hydrochloric acid.

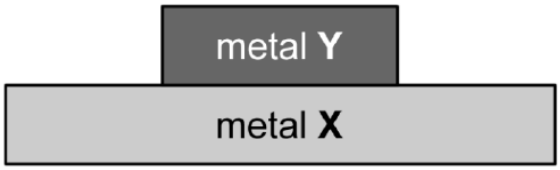
2 The oxides of W, X and Y were reduced to the metal when heated with carbon powder. The oxide of Z did not react.

3 A displacement reaction occurred when X was added to an aqueous solution of the nitrate of Y.

Which shows the metals arranged in ascending order based on their reactivity?

A W, X, Y, Z
B W, Y, X, Z
C Z, X, Y, W
D Z, Y, X, W

29 Metals can be protected against corrosion by sacrificial protection.
In the diagram shown below, metal X is being protected from corrosion by metal Y.



What are the possible identities of metal X and Metal Y?

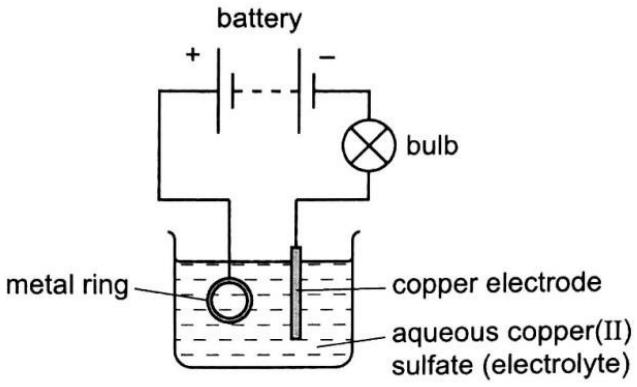
	metal X	metal Y
A	aluminum	iron
B	copper	silver
C	iron	copper
D	zinc	magnesium

30 Over 90% of all gold but less than 50% of iron is recycled.

Which is the likely reason for this difference?

A Gold is very scarce.
B Iron does not cause land pollution.
C Iron ores will never run out.
D It is more expensive to purify gold.

31 The diagram shows a failed attempt to copper-plate a metal ring.



Which action will plate the metal ring with copper?

A cooling the copper(II) sulfate solution in an ice bath
B exchange the position of copper electrode with the ring
C heating the copper sulfate solution to boiling point
D increasing the voltage from 3V to 6V

32 During the electrolysis of an aqueous solution of a cerium salt, 70 g of cerium is deposited at the cathode by 2 moles of electrons.

What is the formula of the cerium ion that has been discharged?

A Ce^{+} **B** Ce^{2+} **C** Ce^{3+} **D** Ce^{4+}

33 Which statement is true for both electrolytic cells and simple cells?

	electrolytic cell	simple cell
A	electrons flow from the positive to negative terminal	electrons flow from the negative to positive terminal
B	it converts chemical energy into electrical energy	it converts electrical energy into chemical energy
C	mass of the positive electrode may remain unchanged	mass of the positive electrode will decrease
D	oxidation occurs at positive electrode	oxidation occurs at negative electrode

34 Petroleum is separated into useful fractions by fractional distillation. The uses of these fractions are shown.

fraction	number of carbon atoms in the molecules	uses
gasoline	$C_5 – C_{10}$	fuel for cooking and heating
naphtha	$C_7 – C_{14}$	feedstock for chemicals
paraffin	$C_{15} – C_{25}$	fuel for large vehicles
lubricating oil	C_{20} to C_{35}	making waxes and polishes
bitumen	$>C_{70}$	making road surfaces

Which fractions are indicated wrongly with their corresponding properties and/or uses?

A gasoline and naptha
B lubricating oil and bitumen
C naptha and paraffin
D paraffin and gasoline

35 The table shows some members in the alkanals homologous series.

name	chemical formula
Ethanal	CH_3CHO
Butanal	$CH_3CH_2CH_2CHO$
Hexanal	$CH_3CH_2CH_2CH_2CH_2CHO$

What is the general formula for alkanals?

A $C_nH_{2n+1}COOH$
B $C_nH_{2n}CHO$
C $C_nH_{2n+1}CHO$
D $C_{n-1}H_{2n+1}CHO$

36 Which of the following must be the same for molecules which are isomers?

1 empirical formula
2 functional group
3 structural formula
4 molecular formula

A 1, 2 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2, 3 and 4

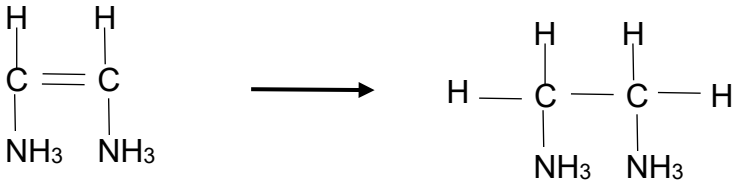
37 Ethanol can be manufactured from ethene or from glucose. The table gives statements about the processes involved.

	process using ethene	process using glucose
1	reaction is faster at 300 °C than at 200 °C	reaction is faster at 100 °C than at 30 °C
2	produces pure ethanol	produces a dilute aqueous solution of ethanol
3	is a catalytic reaction	is a catalytic reaction
4	uses steam	produces carbon dioxide

In which rows are both statements correct?

A 1 and 4 **B** 1, 2 and 3 **C** 2 and 4 **D** 2, 3 and 4

38 Compound X can be converted into compound Y.



compound X compound Y

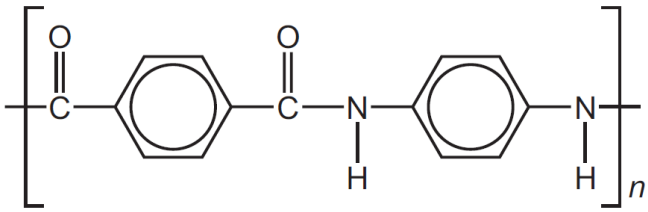
Which row correctly shows the reagents and conditions needed for the conversion?

	reagent	conditions
A	hydrogen	200 °C, nickel catalyst
B	concentrated sulfuric acid	heat
C	steam	300 °C, 60atm, phosphoric acid
D	monomer	450 °C; iron catalyst

39 What remains unchanged in the polymerisation of butene to poly(butene)?

A boiling point
B density
C molecular formula
D percentage composition of elements by mass

40 The diagram shows a polymer called *Kevlar*.



Which statement describes *Kevlar*?

A It is a polyester.
B It is formed in an addition polymerisation reaction.
C It is formed from the two monomers, a di-carboxylic acid and a di-amine.
D It has the same linkage as Terylene.

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

O

TAMPINES SECONDARY SCHOOL

Secondary Four Express
PRELIMINARY EXAMINATIONS 2022

NAME					
CLASS				**REGISTER NUMBER**	

CHEMISTRY **6092 / 01**

Paper 1 **14 Sep 2022**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your class, index number and name on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the Multiple Choice Answer Sheet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
Use of calculator is allowed. Each correct answer will score one mark. No marks will be deducted for a wrong answer.
A copy of the Periodic Table is printed on page 17.

The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use	
Paper 1 (40 marks)	

584

1 A student put exactly 25.0 cm^3 of dilute hydrochloric acid into a conical flask.

The student added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to use?

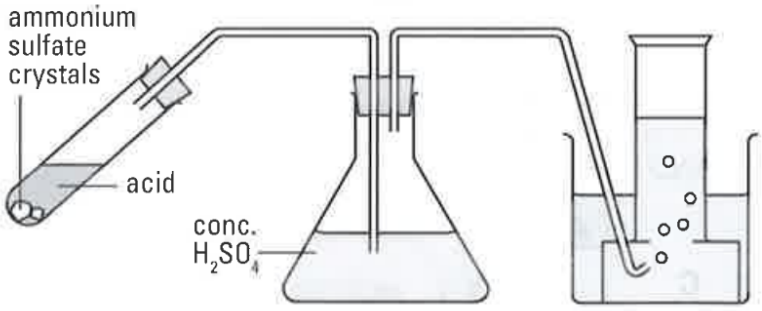
A balance, measuring cylinder, thermometer

B balance, pipette, stopwatch

C balance, pipette, thermometer

D burette, pipette, thermometer

2 The diagram below shows a set-up to prepare a dry sample of ammonia gas.



The experiment failed.

What modifications should be done to correct the set-up?

1 An alkali should be placed in the test-tube instead of an acid.
2 Anhydrous calcium oxide should be used instead of concentrated sulfuric acid.
3 The gas should be collected in a gas syringe instead of by displacement of water.

A 1 only

B 3 only

C 1 and 2 only

D 1, 2 and 3

3 Which statement best explains why two liquids can be separated by fractional distillation?

A Both have different boiling points.

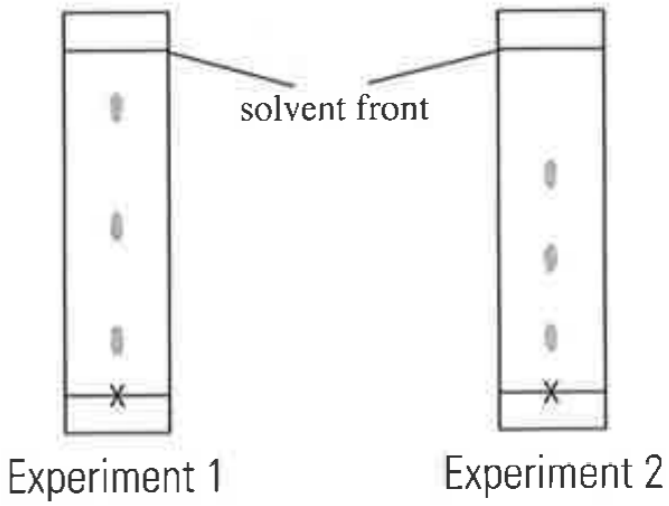
B Both have different densities.

C Both have different masses.

D Both have different reactivities.

4 A student carried out a chromatography of a sample to separate amino acids present.

He performed a second chromatography experiment on the sample. The following shows the two chromatograms obtained.



Why do the two chromatograms show different results?

A The solvent moved up the paper at different speeds.

B Different solvents were used for the two experiments.

C The sample for the second experiment was contaminated.

D The sample for the second experiment was more concentrated.

5 Which of the following steps can be used to separate sodium sulfate from calcium sulfate?

A dissolving in water → filtration → distillation of filtrate

B dissolving in water → filtration → evaporation of filtrate

C dissolving in water → distillation → evaporation of filtrate

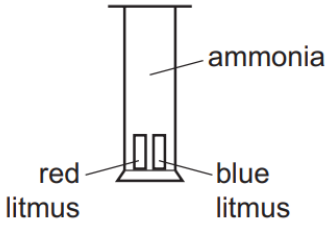
D sublimation → dissolving in water → evaporation of filtrate

6 Four gas jars each contain one of the gases ammonia, chlorine, hydrogen chloride and oxygen.

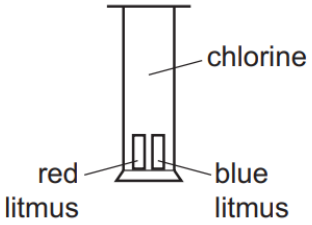
A strip of damp blue litmus paper and a strip of damp red litmus paper are placed in each jar.

In which gas jar will both the damp blue litmus paper and the damp red litmus paper change colour?

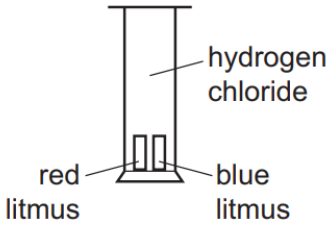
A



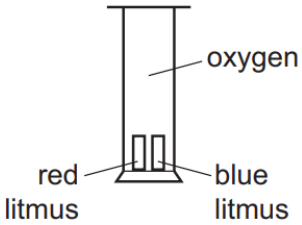
B



C



D



7 An alloy consists of two elements. On addition of concentrated nitric acid, it dissolves completely.
When aqueous sodium hydroxide is added, a blueish-white precipitate is formed. The precipitate turns more bluish when excess sodium hydroxide is added.

Which two elements form the alloy?

A copper and ammonium

B copper and calcium

C copper and iron

D copper and zinc

8 Which reagent can be used to differentiate ammonium sulfate from ammonium carbonate?

A aluminium foil and sodium hydroxide solution

B aqueous sodium hydroxide

C aqueous barium nitrate

D hydrochloric acid

9 The melting and boiling points of four substances are given in the table below.

substance	melting point / °C	boiling point / °C
P	104	128
Q	–18	24
R	20	212
S	545	1713

Based on the data given, which substance is a solid at room temperature and is likely to form a gas upon heating?

A P **B** Q

C R **D** S

10 An ion, X^{2-}, has 18 neutrons and 18 electrons.

What does its nucleus contain?

A 16 protons and 16 neutrons

B 16 protons and 18 neutrons

C 18 protons and 16 protons

D 18 protons and 18 neutrons

11 Iron has four stable isotopes and the percentage abundance of each isotope is shown below.

isotope	percentage abundance / %
^{54}Fe	5.8
^{56}Fe	91.6
^{57}Fe	2.2
^{58}Fe	0.4

What is the relative atomic mass of iron?

A 55.7 **B** 55.9

C 56.0 **D** 56.2

12 Five substances are shown below.

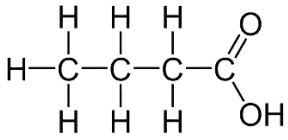
Zn (s) NaC*l* (s) H_2SO_4 (aq) MgCl_2 (*l*) graphite

How many of the substances contain delocalised electrons?

A 0 **B** 1

C 2 **D** 3

13 An organic compound is shown below.



How many electrons are involved in chemical bonding in the compound?

A 13 **B** 14

C 26 **D** 28

14 The physical properties of three substances are shown in the table below.

substance	melting point / °C	boiling point / °C	electrical conductivity		
			solid	liquid	aqueous
X	–114	–85	poor	poor	good
Y	3550	3825	good	good	insoluble
Z	402	953	poor	good	insoluble

Which of the following correctly identifies X, Y and Z?

	X	Y	Z
A	nitrogen dioxide	potassium iodide	silicon dioxide
B	sodium chloride	silicon chloride	zinc
C	hydrogen chloride	graphite	lead(II) iodide
D	sodium	diamond	calcium sulfate

15 Which of the following has the same number of molecules as 60 cm^3 of carbon dioxide at room temperature and pressure?

A 0.0850 g of ammonia

B 25 cm^3 of 0.10 mol/dm^3 aqueous hydrochloric acid

C 60 cm^3 of ethanol liquid

D 3.0×10^{21} atoms of oxygen

16 Ferrite is a mineral that is made of a mixture of the oxides of calcium and iron.

It contains 18.5% calcium and 51.9% iron by mass.

What is the empirical formula of ferrite?

A $CaFe_2O$ **B** $CaFe_2O_4$

C Ca_2FeO_2 **D** Ca_4Fe_2O

17 Aqueous titanium(III) chloride reacts violently with water to produce a titanium(IV) oxide precipitate, hydrochloric acid and hydrogen gas.

Which of the following shows the correct ionic equation for the reaction?

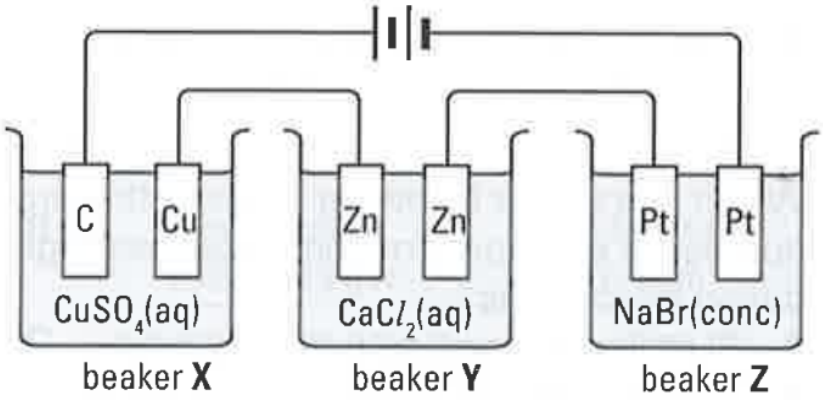
A $2TiCl_3\,(aq) + 4H_2O\,(l) \rightarrow 2TiO_2\,(s) + 6HCl\,(aq) + H_2\,(g)$

B $2Ti^{3+}\,(aq) + 4H_2O\,(l) \rightarrow 2TiO_2\,(s) + 6H^+\,(aq) + H_2\,(g)$

C $Ti^{3+}\,(aq) + 3Cl^-\,(aq) \rightarrow Ti^{4+}\,(aq) + 3Cl^-\,(aq)$

D $Ti^{3+}\,(aq) + 3Cl^-\,(aq) + 2H^+\,(aq) \rightarrow Ti^{4+}\,(aq) + 3Cl^-\,(aq) + H_2\,(g)$

18 An electrolytic cell is shown below.



Which beakers show a change in the colour of the electrolyte?

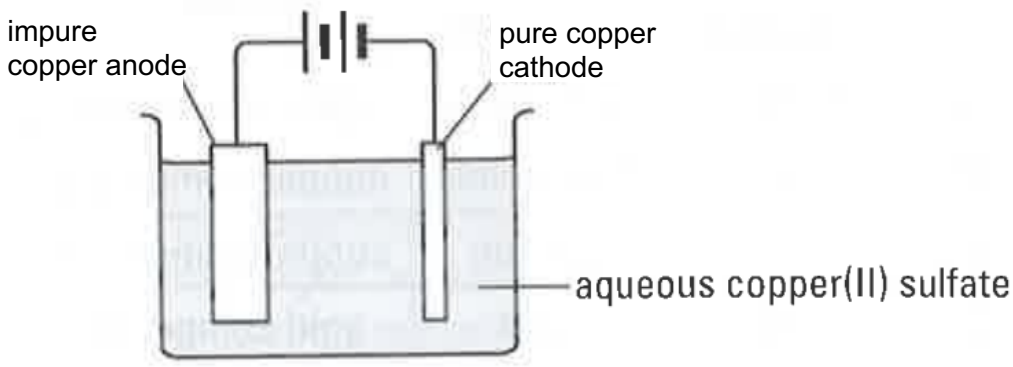
A beakers X and Y

B beakers Y and Z

C beakers X and Z

D beakers X, Y and Z

19 The purification of copper is shown below.



The impure copper anode had an initial mass of 100 g while the pure copper cathode had an initial mass of 10 g. At the end of the purification, the anode weighed 10 g while the cathode weighed 80 g.

What is the percentage impurity of the copper anode?

A 10%

B 20%

C 30%

D 90%

20 Which process is exothermic?

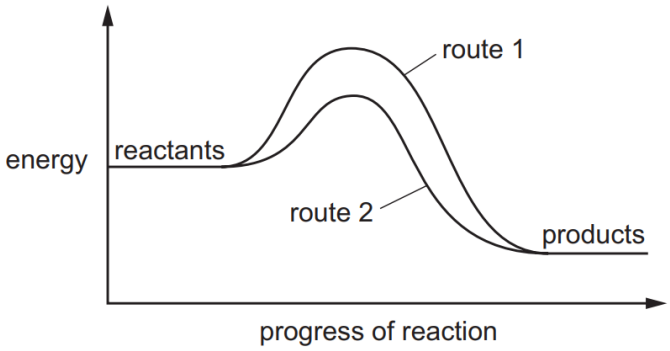
A Melting of ice

B Evaporation of ethanol

C Formation of iodine vapour from iodine crystals

D Condensation of water vapour to form liquid droplets

21 The diagram below shows the energy profile for a reaction.

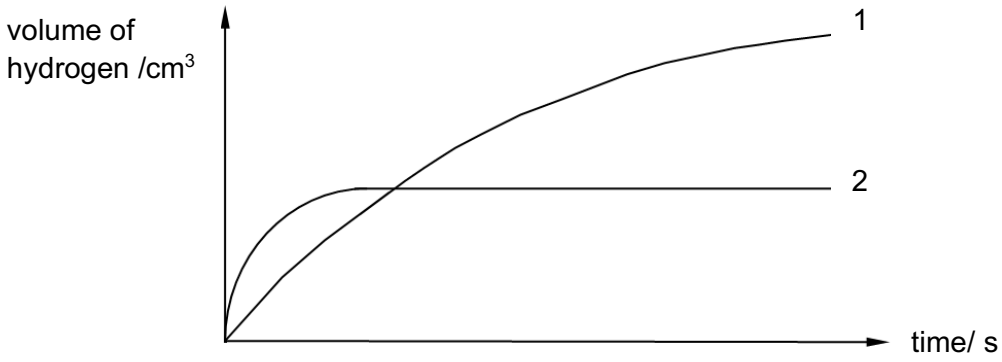


Which statements about this reaction are correct?

1 More energy is needed to break the bonds than is released when new bonds are formed.
2 Route 1 and route 2 give the same overall equation for the reaction.
3 Route 2 uses a catalyst.
4 The reaction is exothermic.

A 1, 2 and 3 **B** 1 and 2 only **C** 2, 3 and 4 **D** 3 and 4 only

22 In the diagram below, curve 1 represents the volume of hydrogen produced when 6 g of magnesium granules reacts completely with an excess of acid at 40 °C.



Which change could produce curve 2?

A decrease the temperature to 20°C

B use a catalyst for the reaction

C use a more concentrated solution of the acid

D use 3 g of magnesium powder

23 The nitrogen cycle is a biochemical cycle that occurs naturally. It involves the conversion of nitrogen-containing substances that takes place through biological and physical processes.

Which of the following changes of nitrogen-containing substances shows the greatest increase in oxidation number?

A NH_4^+ to NO_3^-

B NO_2^- to N_2O

C N_2 to NO_3^-

D N_2O to NO_3^-

24 Element X burns in oxygen to form a white solid.

The white solid is soluble in acid and alkali. What could X be?

A aluminium

B calcium

C copper

D silicon

25 Which statement about oxides is correct?

A A solution of sodium oxide has a pH less than pH 7.

B A solution of sulfur dioxide has a pH greater than pH 7.

C Magnesium oxide reacts with nitric acid to make a salt.

D Sulfur dioxide reacts with hydrochloric acid to make a salt.

26 Which method produces the highest yield of calcium sulfate from calcium carbonate?

A Addition of aqueous hydrochloric acid

B Addition of aqueous sodium sulfate

C Addition of hydrochloric acid, followed by barium sulfate

D Addition of hydrochloric acid, followed by sulfuric acid

27 Which methods are suitable for preparing both zinc sulfate and copper(II) sulfate?

1 reacting the metal oxide with warm dilute aqueous sulfuric acid
2 reacting the metal with dilute aqueous sulfuric acid
3 reacting the metal carbonate with dilute aqueous sulfuric acid

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

28 Ammonia is produced by a reversible reaction in the Haber process. Which statement is true about a reversible reaction?

A A high temperature is needed for the reaction to occur.

B A catalyst is needed for a reversible reaction.

C The reaction has low activation energy.

D The yield of the products will be less than 100%.

29 The melting point of lithium is 181°C. The melting point of sodium is 98°C.

Which statement best explains why lithium has a higher melting point than sodium?

A Lithium has fewer electrons than sodium.

B Sodium is more reactive than lithium.

C The electrostatic forces of attraction between the oppositely charged ions in lithium is stronger than in sodium.

D The electrostatic forces of attraction between the positive ions and the 'sea of delocalised electrons' is stronger in lithium than in sodium.

30 Which of the following is not a typical property of the element $^{91}_{40}Zr$?

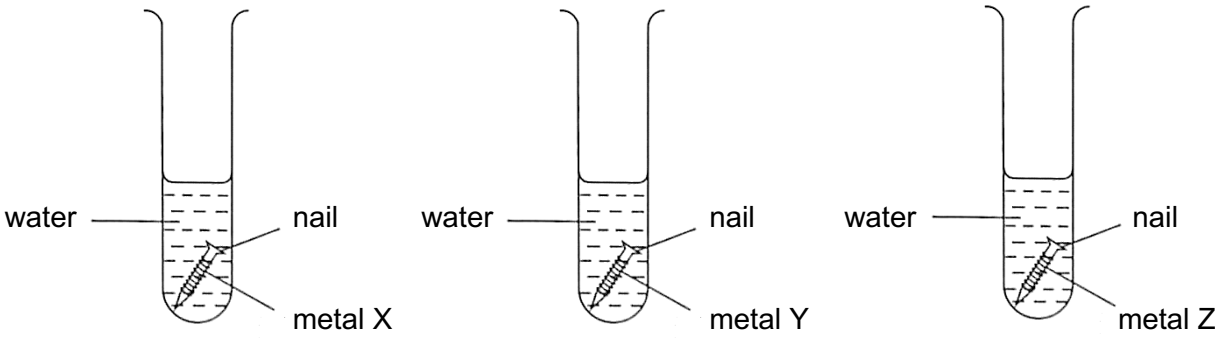
A forms a colourless solution

B forms compounds with variable oxidation states

C high density

D high melting and boiling point

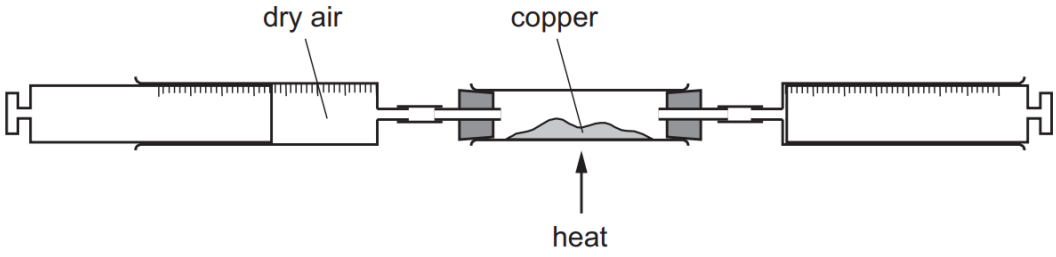
31 In an experiment to investigate the properties of three metals in sacrificial protection, the iron nails are found rusted only when they are coiled with metals X and Yas shown below. The iron nail coiled with Z is not rusted.



Which of the following combinations shows the identities of metals X, Y and Z?

	metal X	metal Y	metal Z
A	lead	platinum	zinc
B	tin	nickel	silver
C	gold	silver	copper
D	sodium	lead	chromium

32 Dry air is passed over hot copper until all the oxygen has reacted, as shown below.



The volume of gas at the end of the reaction is 120 cm^3.

What is the starting volume of dry air?

A 132 cm^3 **B** 152 cm^3 **C** 180 cm^3 **D** 570 cm^3

33 Which statement is correct?

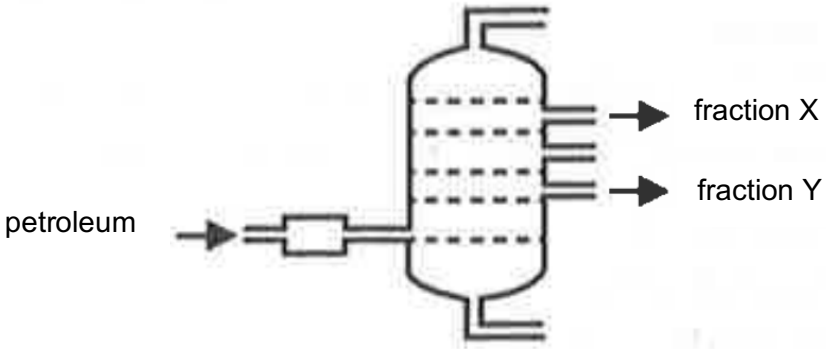
A Atmospheric carbon dioxide is not a cause of climate change.

B Atmospheric methane is produced by respiration.

C Burning natural gas decreases the level of carbon dioxide in the atmosphere.

D Decomposition of vegetation causes an increase in atmospheric methane.

34 The fractional distillation of crude oil is shown below.



Which statement about fractions X and Y is correct?

A Fraction X has a lower boiling point than fraction Y.

B Fraction X is more viscous than fraction Y.

C Fraction X has stronger intermolecular forces than fraction Y.

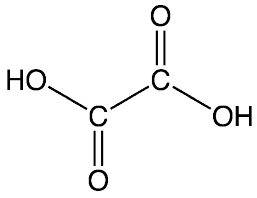
D Fraction X produces a smokier flame than fraction Y when burnt.

35 Crude oil is separated into useful fractions in an oil refinery.

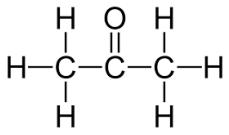
Which of the following shows the correct use of a fraction from crude oil?

	fraction	use of fraction
A	bitumen	for making polishes and waxes
B	lubricating oil	fuel for diesel engines
C	naphtha	feedstock for making plastics
D	petroleum gas	fuel for aircraft engines

36 The structures of some organic compounds are shown below.



1



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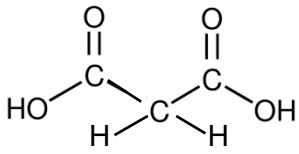

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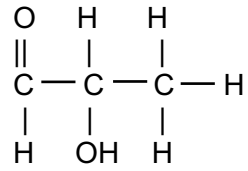


4

Which of the structures belong to the same homologous series?

A 1 and 2 **B** 1 and 3

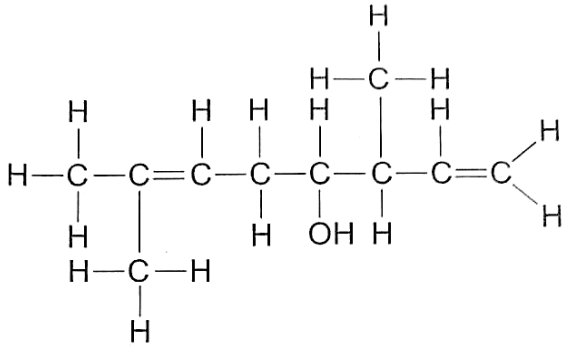
C 2 and 3 **D** 2 and 4

37 How many different unsaturated isomers are possible for a compound with the molecular formula C_4H_8?

A 3 **B** 4

C 5 **D** 6

38 Linalool is a naturally-occuring compound found in lavender which gives it a pleasant floral smell. The structure of linalool is shown below.



Given that linalool reacts with chlorine in the dark, what is the volume of chlorine required to react completely with 0.1 moles of linalool, at room temperature and pressure?

A 1.2 dm^3 **B** 2.4 dm^3

C 3.6 dm^3 **D** 4.8 dm^3

39 An organic substance is found to decolourise bromine water and to react with sodium carbonate, forming a colourless gas which forms a white precipitate in limewater.

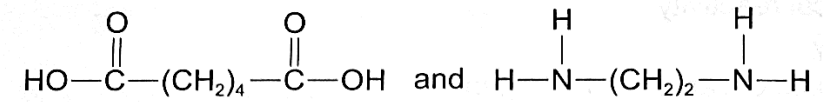
Some functional groups are listed below.

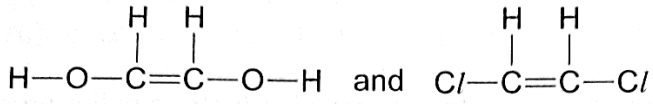
1 —OH hydroxyl group
2 C═C double bond
3 —COOH carboxyl group

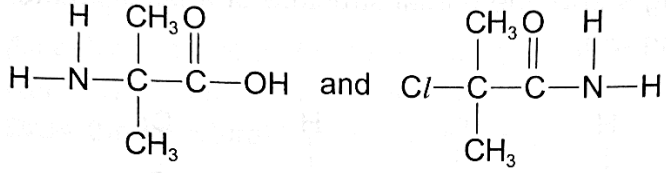
Which functional groups could be present in the substance?

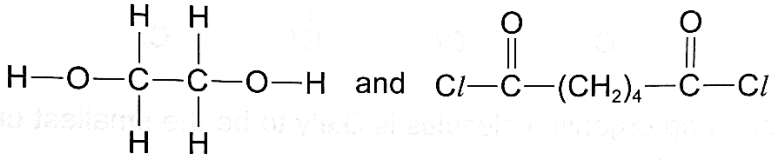
A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

40 Which of the following pairs of organic compounds will most likely form a polyester?

A 

B 

C 

D 

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

	Class	Register Number
Name		

6092/01
CHEMISTRY

22/4P/6092/1

PAPER 1

Monday **12 September 2022** **1 hour**

NIL SINE LABORE

VS

VICTORIA SCHOOL

PRELIMINARY EXAMINATION
SECONDARY FOUR

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and index number on all the work you hand in.
Do not use staples, paper clips, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the one that you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

A copy of Periodic Table is printed on **page 16**.

This question paper consists of 16 printed pages, including the cover page.

1 Which statement about states of matter is correct?

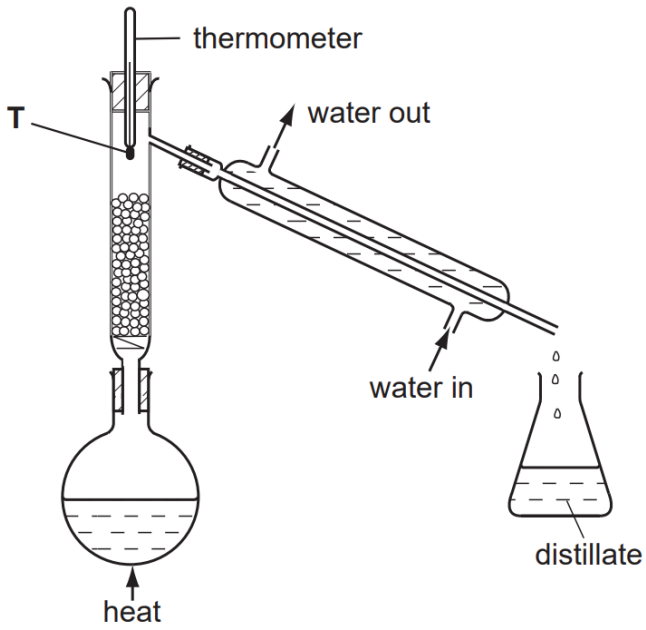
A When a liquid reaches its boiling point, it becomes a gas. This process is called evaporation.

B When a gas condenses, it becomes a liquid and energy is lost to the surroundings.

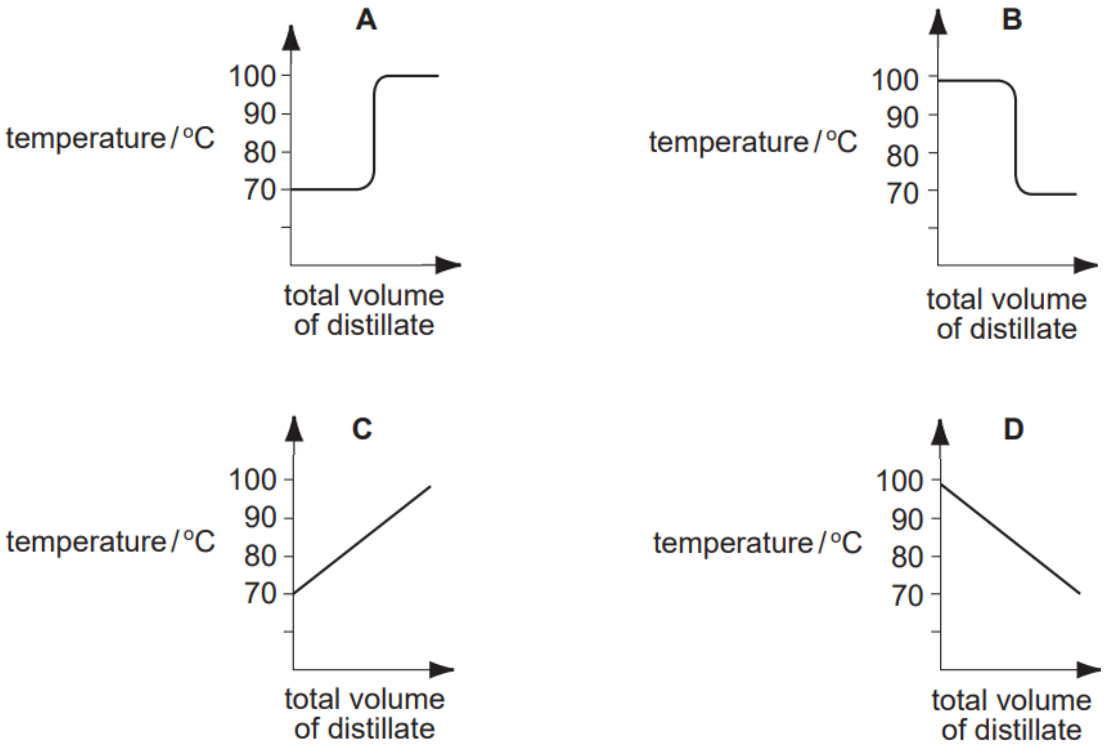
C When a solid changes directly to a gas, the process is called deposition.

D When a solid melts, the particles get further apart and have less energy.

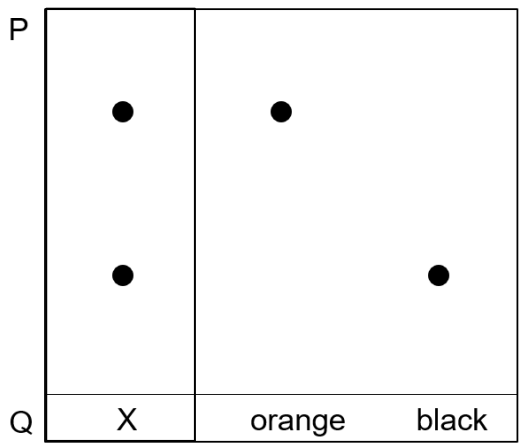
2 The diagram shows apparatus used to separate hexane (boiling point, 70 °C) and heptane (boiling point, 98 °C)?



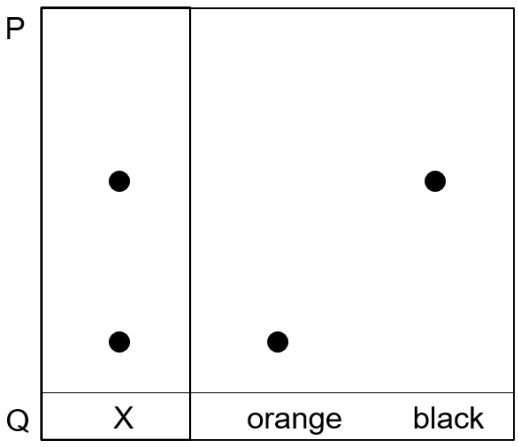
Which graph would be obtained if the temperature at point T was plotted against the total volume of distillate collected?



3 The colours in a soft drink, X, was analysed by chromatography. The experiment was performed using two different solvents, water and ethanol. The results are shown below.



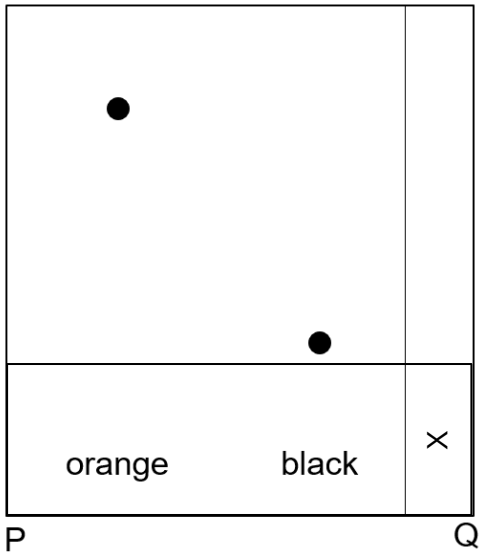
water



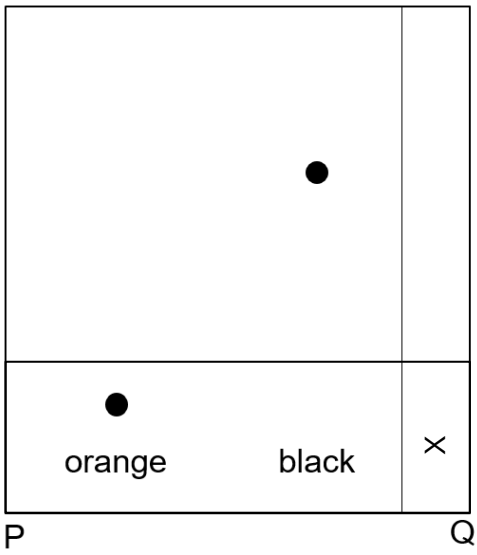
ethanol

How would the final chromatogram appear if only mixture X was first developed in water, then turned through 90° anticlockwise and edge PQ was placed in ethanol?

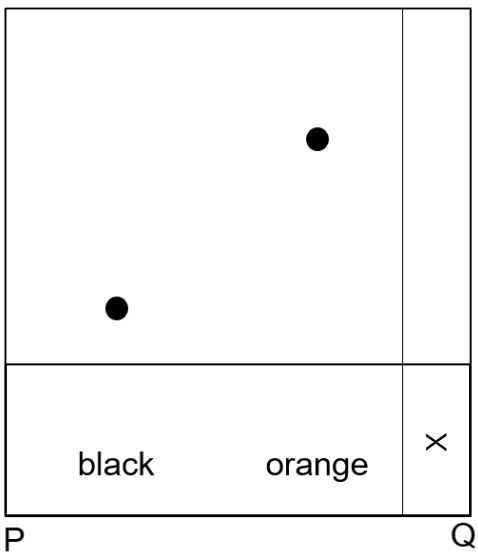
A



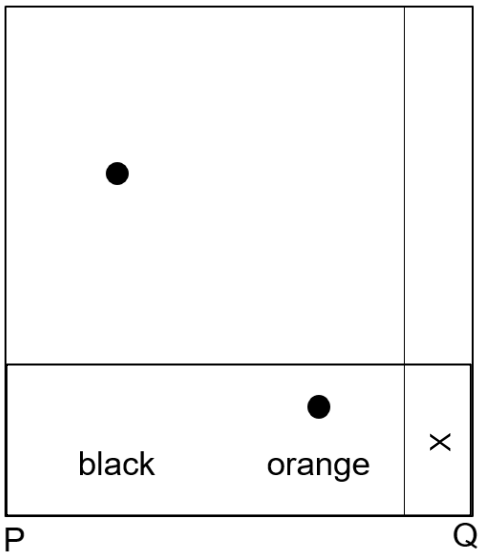
B



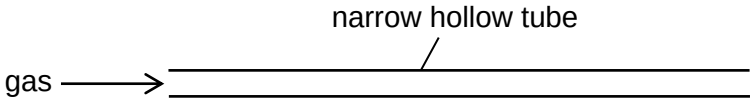
C



D



4 A gas is allowed to diffuse across a narrow hollow tube as shown below.



Which of the following changes will not affect the rate of diffusion of the gas through the tube?

A place the tube vertically

B lower the temperature of the gas from 25 °C to 20 °C

C lowering the pressure from 1 atm to 0.5 atm

D replacing the nitrogen gas with carbon monoxide gas

5 Which of the following is an element and forms crystals containing polyatomic molecules?

A copper

B graphite

C iodine

D oxygen

6 The metals Cr, Co, Fe and Mn are transition elements.

Which particles have the same number of electrons?

A Co^{2+} and Cr

B Co^{2+} and Fe^{3+}

C Cr and Mn^{2+}

D Fe^{3+} and Mn^{2+}

7 Naturally-occurring bromine has a relative atomic mass of 80 and consists entirely of two isotopes of relative atomic masses 79 and 81.

What can be deduced about naturally-occurring bromine from this information only?

A Bromine contains the two isotopes in equal proportions.

B Bromine has different oxidation states.

C Bromine isotopes have different numbers of protons.

D Bromine is radioactive.

8 When a covalent liquid boils, its molecules become more widely spaced.

Which property of the molecules has the most influence on the energy required to boil a covalent liquid?

A forces of attraction between the molecules

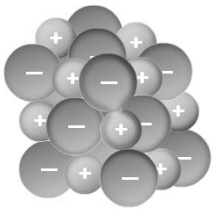
B reactivity of the molecules

C size of the molecules

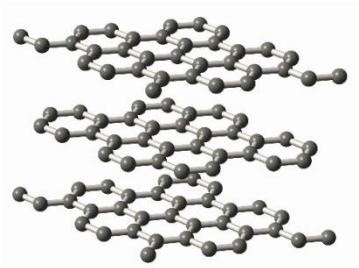
D strength of the covalent bonds in the molecules

9 The diagram below shows three substances which can conduct electricity.

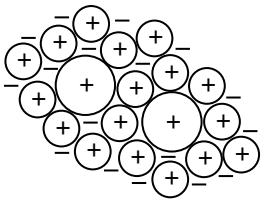
I



II



III



What are the particles that enable them to conduct electricity?

	I	II	III
A	electrons	electrons	electrons
B	ions	atoms	electrons and ions
C	ions	electrons	electrons
D	electrons and ions	atoms and electrons	electrons and ions

10 Which statement is typical of a solid non-metal element?

A It conducts electricity.

B It forms an acidic oxide.

C It has more than one oxidation state.

D It reacts vigorously with chlorine.

11 The statements below describe elements X and Y.

An atom of X has more protons than an atom of Y.

An atom of Y has more valence electrons than an atom of X.

Particles of X and Y combine to form an ionic structure.

Which of the following statements can be deduced based on the statements above?

A An atom of X has more electron shells than an atom of Y.

B X forms negatively charged ions.

C X and Y are in the same period of the Periodic Table.

D X and Y are in the same group of the Periodic Table.

12 Part of the procedure to obtain crystals of a soluble salt is shown below.

1 25.0 cm^3 of a dilute acid was accurately measured into a conical flask.

2 A known, accurate volume of alkali was gradually added to the conical flask until the solution was neutral.

3 The solution was then heated in an evaporating dish, cooled and washed with approximately 10 cm^3 of cold distilled water.

Which of the following shows the correct apparatus used in steps 1 to 3?

	1	2	3
A	burette	pipette	measuring cylinder
B	measuring cylinder	burette	pipette
C	pipette	burette	measuring cylinder
D	pipette	measuring cylinder	burette

13 An alloy of copper and zinc is added to an excess of dilute hydrochloric acid. The resulting mixture is then filtered.

Which observations are correct?

	filtrate	residue
A	colourless solution	none
B	colourless solution	red-brown
C	blue solution	grey
D	blue solution	none

14 Solid X is insoluble in water. It gives off a gas when heated and also when reacted with dilute sulfuric acid.

What is X?

A aluminium oxide

B sodium carbonate

C sodium nitrate

D zinc carbonate

15 Hydrazine (N_2H_4) is a powerful reducing agent. When reacted with aqueous solution containing silver ions, nitrogen is one of the products formed.

Which one of the following equations is the ionic equation of this reaction?

A $N_2H_4 + 2Ag^+ \rightarrow N_2 + 2AgH_2$

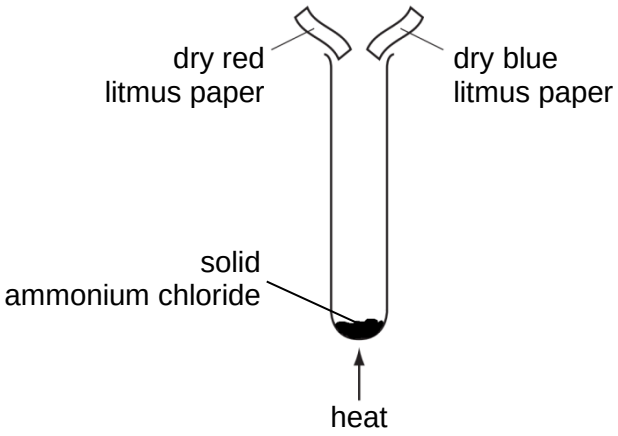
B $N_2H_4 + Ag^+ \rightarrow N_2 + 2H_2 + Ag$

C $N_2H_4 + Ag^+ \rightarrow N_2 + 4H^+ + Ag$

D $N_2H_4 + 4Ag^+ \rightarrow N_2 + 4H^+ + 4Ag$

16 Ammonium chloride decomposes to form ammonia and hydrogen chloride when heated as shown in the diagram below.

$$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$$



What will be observed after some time?

	red litmus paper	blue litmus paper
A	turns blue	turns red then blue
B	turns blue then red	turns red
C	turns blue then red	turns red then blue
D	no change	no change

17 The addition of dilute acid to a solution containing anion Q and the subsequent addition of barium nitrate can be used to identify the anion Q.

What is Q?

A carbonate

B chloride

C iodide

D sulfate

18 Which of the following is the best method to prepare a pure and dry sample of magnesium carbonate from a solid mixture of magnesium carbonate and lead(II) oxide?

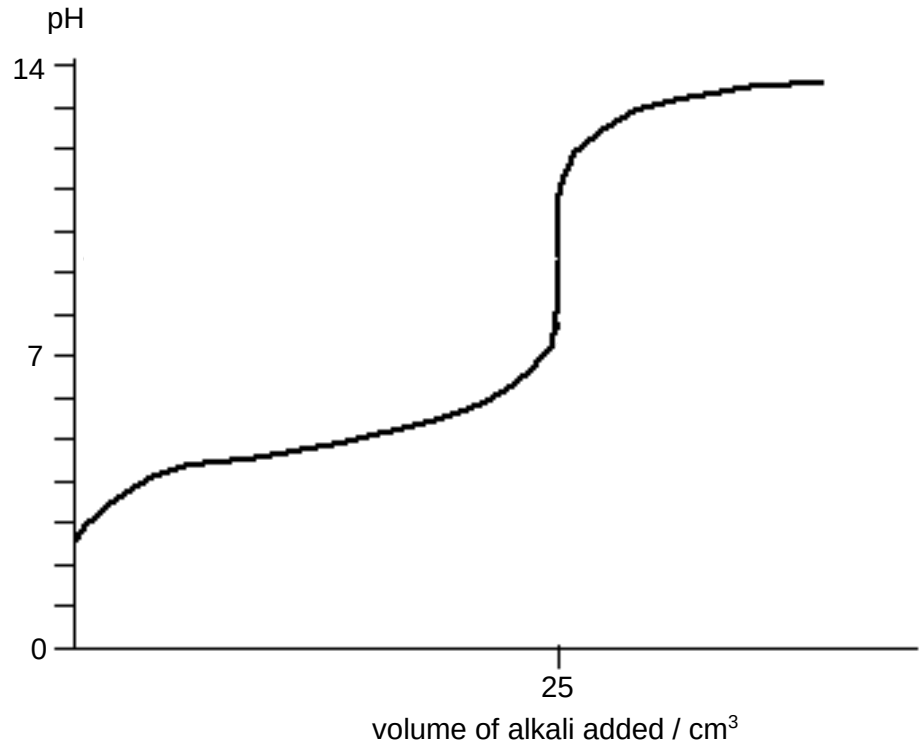
A Add excess dilute acid, filter, crystallise filtrate, filter and dry.

B Add excess dilute acid, filter, rinse residue with distilled water and dry.

C Add excess aqueous sodium hydroxide, filter, rinse residue with distilled water and dry.

D Add excess aqueous sodium hydroxide, filter and heat filtrate to dryness.

19 Joe titrated dilute ethanoic acid with aqueous sodium hydroxide. The pH changes were recorded with a pH meter and represented in the graph below.



The diagram below shows the pH ranges of three indicators.

pH	1	2	3	4	5	6	7	8	9
methyl orange	red			yellow					
phenolphthalein	colourless								pink
bromothymol blue	yellow					blue			

Which indicator(s) can Joe use to determine the end-point of the titration?

A methyl orange only

B phenolphthalein only

C bromothymol blue and phenolphthalein only

D bromothylmol blue, methyl orange and phenolphthalein

20 The Haber process is used to make ammonia at a temperature of 450 °C and a pressure of 200 atm. The temperature is changed to 700 °C but the pressure is kept the same.

What will be the effects of this change on the production of ammonia?

A It is made at an increased rate and the yield increases.

B It is made at an increased rate and the yield decreases.

C It is made at a decreased rate and the yield increases.

D It is made at a decreased rate and the yield decreases.

21 Aqueous acidified potassium manganate(VII) was added to a 2.30 g sample of ethanol. The mixture was then boiled under reflux for some time.

The percentage yield of the organic product collected by distillation was 60.0%.

What is the mass of the product collected?

A 1.32 g **B** 1.80 g **C** 3.00 g **D** 5.00 g

22 Ammonia is used to make nitric acid, HNO_3 by the Ostwald Process.

Three reactions occur in the following stages.

1 $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

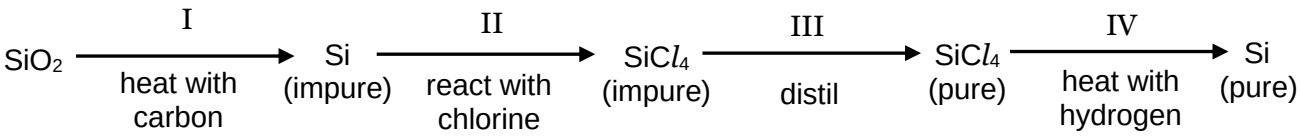
2 $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

3 $3NO_2(g) + H_2O(l) \rightarrow 2HNO_3(aq) + NO(g)$

What is the number of moles of nitric acid produced from the reaction between 50.0 dm^3 of oxygen gas and excess ammonia gas in stage 1?

A 1.11 **B** 1.25 **C** 1.39 **D** 1.74

23 The reaction scheme represents the process for obtaining pure silicon.



In which of the stages is the silicon reduced?

A I only **B** IV only **C** I and IV **D** II and III

24 Three chemical reactions are represented as shown in the equations below.

$$Cl_2 + 2H_2O + SO_2 \rightarrow 2HCl + H_2SO_4$$

$$Cl_2 + H_2S \rightarrow 2HCl + S$$

$$SO_2 + 2H_2S \rightarrow 2H_2O + 3S$$

Which of the following shows the reducing power of the reducing agents in a decreasing order?

A chlorine, hydrogen sulfide, sulfur dioxide

B chlorine, sulfur dioxide, hydrogen sulfide

C hydrogen sulfide, sulfur dioxide, chlorine

D sulfur dioxide, hydrogen sulfide, chlorine

25 Which is a property of aqueous potassium iodide?

A It does not conduct electricity.

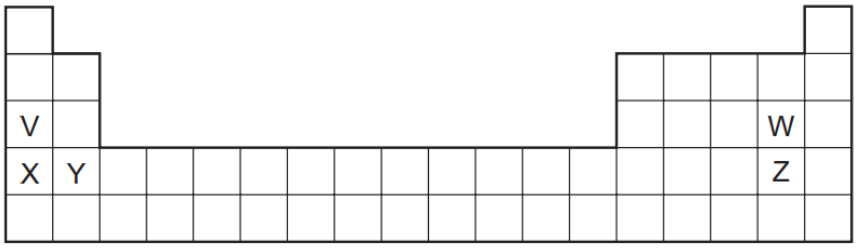
B It is a purple solution.

C It is decolourised by chlorine.

D It reacts with aqueous bromine to form iodine.

26 Part of the Periodic Table is shown.

The letters are not the symbols of the elements.



Which statement about the elements is not correct?

A V is less reactive than X.

B W is more reactive than Z.

C Y forms an ion with same electronic configuration as X.

D Z has a higher melting point than W.

27 The exhaust gas of a car fitted with a catalytic converter contains oxides of nitrogen.

Which of the following modifications should be made to lower the concentration of oxides of nitrogen present in the exhaust gas?

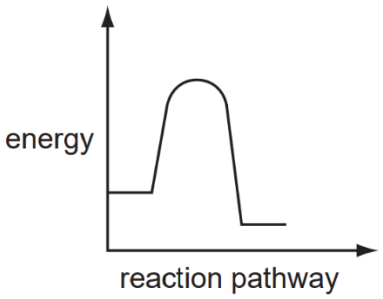
1 decrease the size of the catalyst in the converter

2 increase the temperature of combustion in the engine

3 increase the rate of exhaust gas flowing through the converter

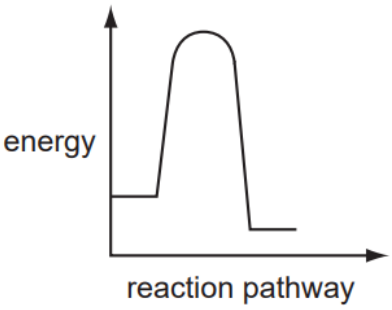
A 1 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

28 The diagram shows the reaction pathway for the forward reaction of a reversible reaction without a catalyst.

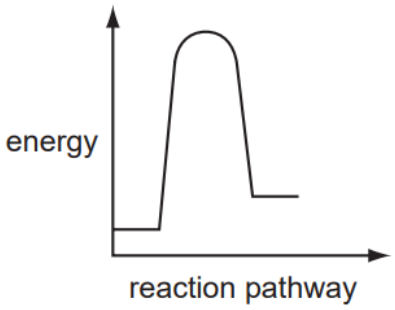


Which diagram shows the addition of a catalyst that speeds up the backward reaction?

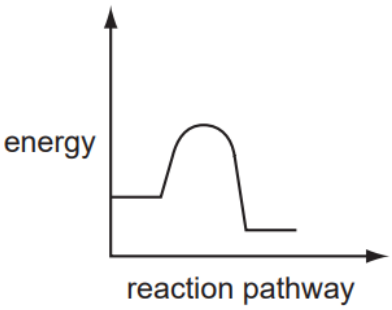
A



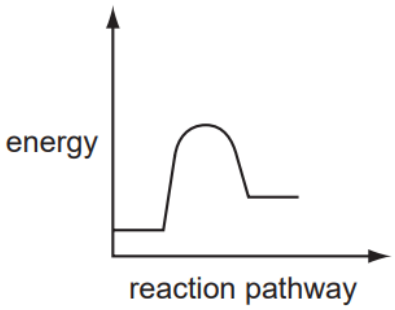
B



C



D



29 The scheme shows four stages, 1 to 4, in the conversion of solid candlewax, $C_{30}H_{62}$, into carbon dioxide and water.

1 $C_{30}H_{62}(s) \rightarrow C_{30}H_{62}(l)$

2 $C_{30}H_{62}(l) \rightarrow C_{30}H_{62}(g)$

3 $C_{30}H_{62}(g) + 45.5O_2(g) \rightarrow 30CO_2(g) + 31H_2O(g)$

4 $30CO_2(g) + 31H_2O(g) \rightarrow 30CO_2(g) + 31H_2O(l)$

Which stages are exothermic?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

30 The properties of the compound of metals X - Z are shown below.

- Carbonate of X does not decompose upon heating.
- Metal Y displaces iron but not zinc from their sulfate salts.
- Oxide of Z decomposes slowly to its metal at room temperature.

Which metal(s) is/are suitable to be used as a sacrificial metal to protect iron?

A X only **B** Y only **C** Z only **D** X and Y

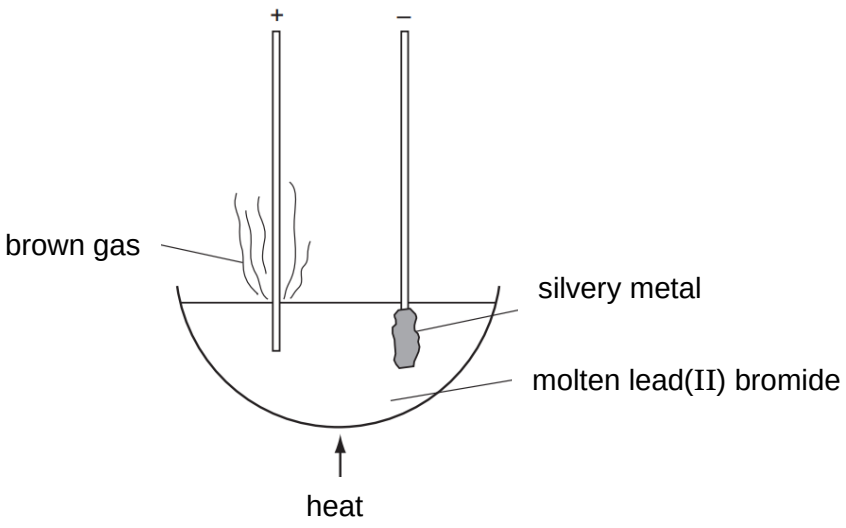
31 The products from the thermal decomposition of carbonates and hydroxides of three metals X, Y and Z are shown below.

metal	carbonate	hydroxide
X	carbon dioxide and metal oxide	metal oxide and water
Y	no reaction	metal oxide and water
Z	carbon dioxide and metal oxide	metal, oxygen and water

What is the order of reactivity of the metals, starting with the least reactive?

A X, Y, Z **B** X, Z, Y **C** Z, Y, X **D** Z, X, Y

32 The diagram shows the electrolysis of molten lead(II) bromide using inert electrodes.



What happens during this electrolysis?

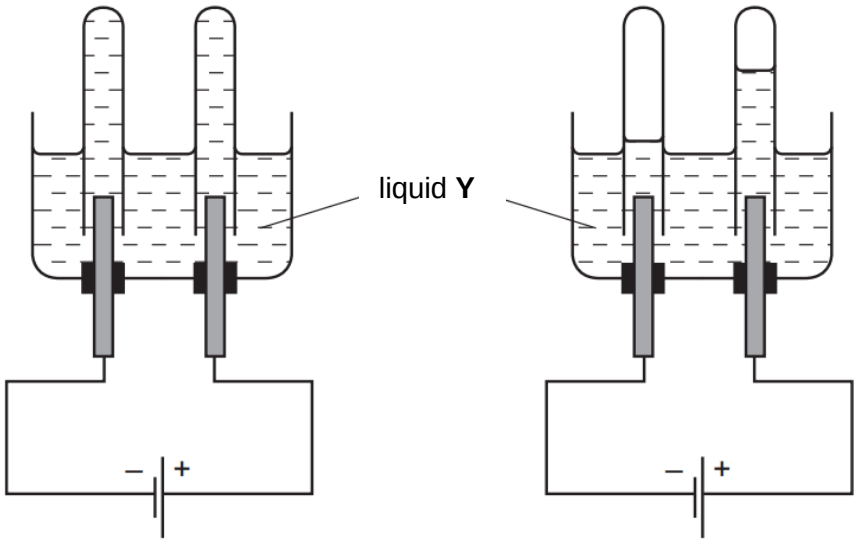
A Atoms change to ions.

B Covalent bonds are broken.

C Ions change to atoms.

D New compounds are formed.

33 The diagrams show an electrolysis experiment using inert electrodes.



before electrolysis after electrolysis

Which could be the possible identity of liquid Y?

A aqueous copper(II) sulfate

B concentrated aqueous sodium chloride

C dilute sulfuric acid

D ethanol

34 These statements refer to hydrogen and its use as a fuel.

1 Both water and hydrocarbons can be used as a source of hydrogen.

2 In a fuel cell, hydrogen reacts with oxygen to generate electricity.

3 The reaction taking place in a fuel cell is a redox reaction.

Which statements are correct?

A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

35 Hydrazine, N_2H_4 is widely used as a rocket fuel as it burns in oxygen to produce harmless gases as shown in the equation below.

$$N_2H_4 + O_2 \rightarrow N_2 + 2H_2O$$

However, hydrazine does not burn spontaneously in oxygen.

Which of the following explains why hydrazine does not burn spontaneously?

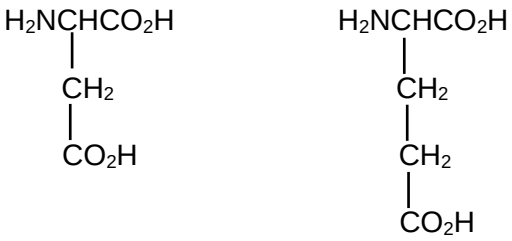
1 Hydrazine is a liquid.

2 The N≡N bond is very strong.

3 The activation energy is very high.

A 1 only **B** 3 only **C** 2 and 3 only **D** 1, 2 and 3

36 The diagram below shows the structural formula of aspartic acid and glutamic acid.



aspartic acid glutamic acid

Aspartic acid and glutamic acid can react with each other to form amide linkages.

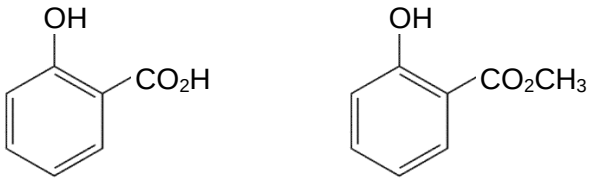
What is the maximum number of different organic compounds that can be formed when one molecule of aspartic acid reacts with one molecule of glutamic acid?

A 1 **B** 2 **C** 3 **D** 4

37 Methyl salicylate, the main ingredient used in the treatment of muscular pain and joint can be prepared from salicylic acid.

The diagram below shows the structural formula of methyl salicylic acid and methyl salicylate.

 represents the formula C_6H_6



salicylic acid methyl salicylate

What is the best method to prepare methyl salicylate from salicylic acid?

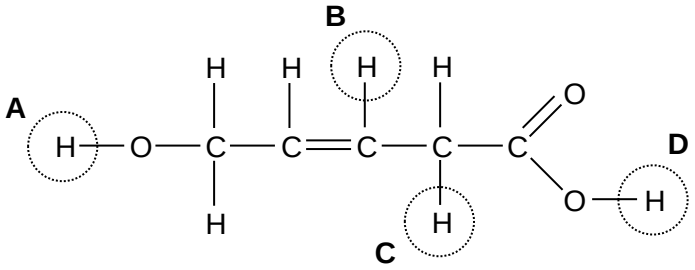
A heating with ethanol

B heating with methanol

C heating with ethanol and concentrated sulfuric acid

D heating with methanol and concentrated sulfuric acid

38 The full structural formula of compound **X** is shown below.



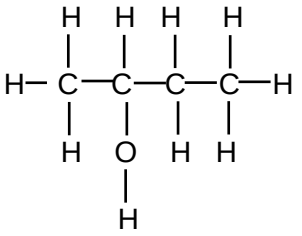
Which of the hydrogen will react with sodium carbonate?

39 Which of the following statements about alcohols is/are correct ?

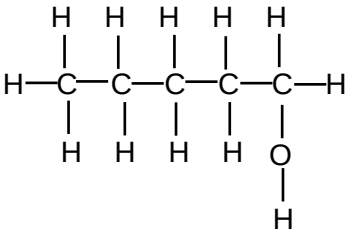
1 Alcohols contain hydroxide ions, OH^-.

2 Methanol is oxidised to methanoic acid using acidified potassium manganate(VII).

3 Alcohols X and Y shown below are isomers.



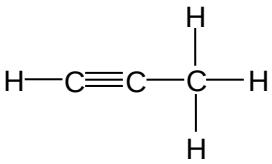
X



Y

A 2 only **B** 1 and 2 only **C** 2 and 3 only **D** 1, 2 and 3

40 The structure of propyne is shown below.



Propyne undergoes polymerisation to form polypropyne. 100 kg of propyne is used during polymerisation.

Which of the following statements is correct?

A The mass of polypropyne is larger than 100 kg.

B Polypropyne burns with a smokier flame than propyne.

C Polypropyne has a higher percentage by mass of carbon.

D Propyne burns in air to produce a larger volume of carbon dioxide than polypropyne.

End of Paper

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name: ..... ( ) Class: .....

WOODLANDS SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022

EXPRESS

Level:	Secondary Four Express	Marks:	40
Subject:	Chemistry	Day:	Wednesday
Paper:	6092/01	Date:	24th August 2022
Duration:	1 hour	Time:	1235 – 1335

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.
Read the instructions on the Answer Sheet very carefully.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

At the end of the examination, submit the OTAS separately from the question paper.
A copy of the Periodic Table is printed on page 18.
The use of an approved scientific calculator is expected, where appropriate.

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.
This document consists of **17** printed pages and 1 blank page.

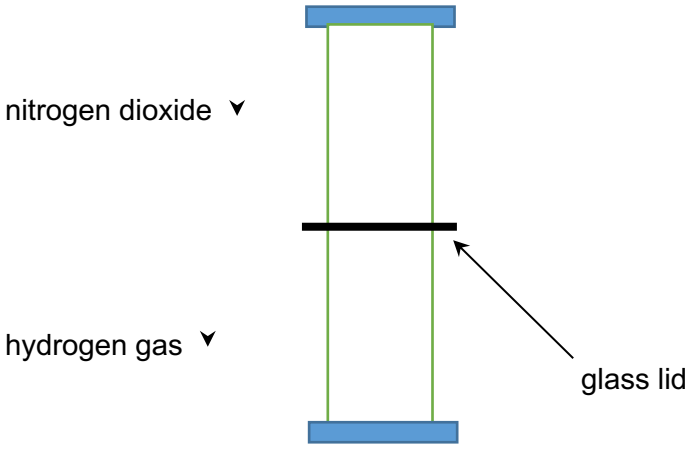
1 Which one of the following apparatus is suitable for measuring 11.60 cm^3 of acid?

A burette
B conical flask
C measuring cylinder
D pipette

2 Which one of the following correctly describes the particles in a dilute sugar solution at room temperature?

	sugar molecules	water molecules
A	close together, moving at random	widely separated, vibrating slightly
B	widely separated, moving at random	close together, moving at random
C	widely separated, moving at random	close together, not moving
D	widely separated, not moving	widely separated, moving at random

3 The diagram below shows two gas jars separated by a glass lid. The upper gas jar contains brown nitrogen dioxide while the lower gas jar contains colourless hydrogen gas.



When the glass lid is removed, both gas jars are coloured brown in a short time.

What is the reason for this observation?

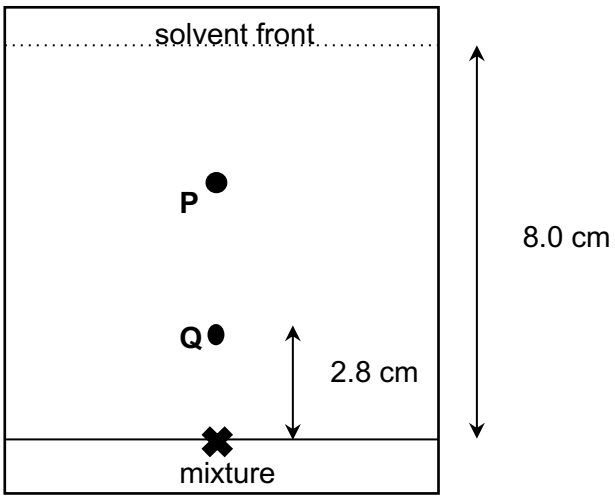
A All molecules are in constant, random motion.
B Nitrogen dioxide diffused faster than hydrogen gas.
C Nitrogen dioxide is heavier than hydrogen gas.
D Nitrogen dioxide reacted with hydrogen gas.

4 Which of the following tests is/are best to show that a solution is hydrochloric acid?

test	action
I	Add acidified barium nitrate to the solution
II	Add acidified silver nitrate to the solution
III	Add sodium carbonate to the solution

A I, II and III
B II only
C II and III only
D III only

5 A colourless mixture is separated into its two constituents, **P** and **Q**, by paper chromatography as shown below. **P** and **Q** are acidic and alkaline in nature respectively.



What locating agent should be used, and what is the R_f value of **Q**?

	locating agent	R_f value of **Q**
A	barium nitrate	0.40
B	litmus solution	0.35
C	methyl orange	0.70
D	sodium hydroxide	1.43

6 The diagram below shows the experimental set up for a simple distillation. It is commonly used to separate liquids in a mixture.

Which of the following substances may be condensed using a water condenser?

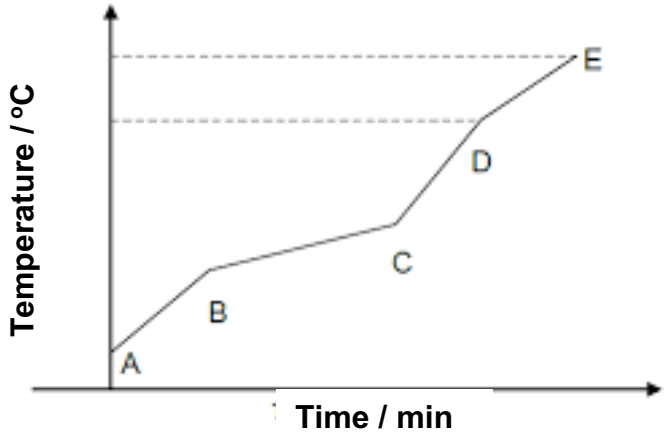
	substance	melting point/ ^{o}C	boiling point/ ^{o}C
A	ammonia	-79	-33
B	hydrogen chloride	-115	-85
C	nitrogen dioxide	-73	-10
D	pentane	-130	36

7 50 cm^3 of aqueous bromine was added to 50 cm^3 of cyclohexene in a beaker. Two layers of colourless solutions are observed.

Which one of the following methods can be used to obtain the organic layer?

	method	organic layer obtained
A	evaporation	bottom layer
B	evaporation	top layer
C	separating funnel	bottom layer
D	separating funnel	top layer

8 The graph below shows the temperature changes of a substance as it is heated from room temperature to boiling point. It is a solid at room temperature.



Which one of the following conclusion can be made about the substance?

A It is a mixture.
B It is a liquid between B and C.
C Its melting point is 100 °C.
D Its boiling point is 110 °C.

9 Which of the following has the same electronic configuration as a calcium ion?

A aluminium atom
B barium atom
C chloride ion
D oxide ion

10 Which one of the following correctly gives the numbers of the different sub-atomic particles to be found in a hydroxide ion?

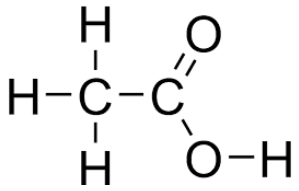
	protons	neutrons	electrons
A	8	8	8
B	8	8	9
C	9	8	10
D	9	9	10

11 X, Y and Z are three elements with consecutive proton (atomic) numbers. X has the lowest proton (atomic) number and Y is a halogen.

How can a stable compound be formed?

A Each atom of X gives an electron to an atom of Y, to form X^+Y^-.
B Each atom of Y receives an electron from an atom of Z, to form Y^-Z^+.
C Each atom of X shares a pair of electrons with two atoms of Y.
D Each atom of X shares an electron with an atom of Y.

12 How many unshared electrons are there in a molecule of ethanoic acid?



A 4
B 8
C 12
D 16

13 In which of the following compound(s) is/are covalent bonds found?

I aqueous ammonia
II graphite
III nitric acid

A I and II only
B I, II and III
C II only
D II and III only

14 Propane burns completely in oxygen according to the equation shown.

$$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$$

If 100 cm^3 of propane is burnt in 200 cm^3 of oxygen at 200 ^oC, what is the total volume of the gases left at the end of the reaction?

A 60 cm^3
B 180 cm^3
C 340 cm^3
D 380 cm^3

15 What is the concentration of hydrogen ions in 0.5 mol/dm^3 sulfuric acid?

A 1 g/dm^3
B 2 g/dm^3
C 49 g/dm^3
D 98 g/dm^3

16 An aqueous solution has a pH value of 1.

What information does this fact give about the ions present in the solution?

	concentration of H^+ ions	concentration of OH^- ions
A	high	low
B	high	none
C	low	low
D	low	high

17 Which one of the following does **not** show the correct reaction of nitric acid?

	reactant	product
A	aqueous ammonia	ammonia
B	barium	hydrogen
C	sodium oxide	water
D	zinc carbonate	carbon dioxide

18 Oxides of elements may be classified as acidic, basic or amphoteric.

Which set of properties is correctly classified?

	acidic	basic	amphoteric
A	dissolves in water to form acidic solution	reacts with acids only	reacts with alkalis only
B	dissolves in water to form acidic solution	reacts with acids only	reacts with both acids and alkalis
C	reacts with alkalis only	dissolves in water to form alkaline solution	reacts with acids only
D	reacts with alkalis only	reacts with both acids and alkalis	dissolves in water to form neutral solution

19 Which of the following salts is correctly prepared?

	salt	reactants	method
A	barium chloride	barium hydroxide + hydrochloric acid	reaction of acid with excess solid
B	copper(II) carbonate	copper(II) nitrate + sodium carbonate	precipitation
C	magnesium sulfate	sulfuric acid + magnesium chloride	titration
D	silver chloride	silver carbonate + sodium chloride	precipitation

20 Which one of the following processes is endothermic?

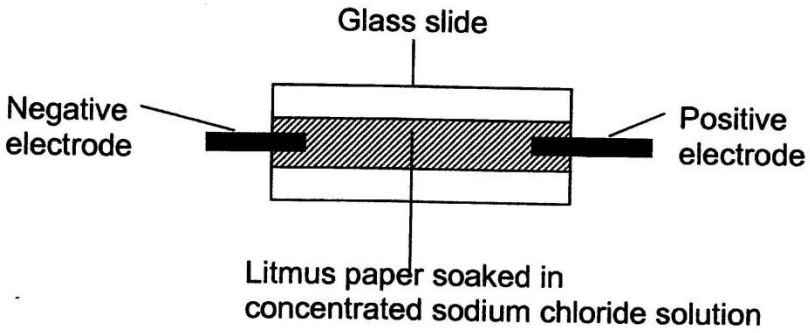
A sodium hydroxide + hydrochloric acid $\rightarrow$ sodium chloride + water
B N_2 (l) $\rightarrow$ N_2 (g)
C N_2 (g) + $3H_2$ (g) $\rightarrow$ $2NH_3$ (g)
D ammonia + water $\rightarrow$ aqueous ammonia

21 Hydrogen reacts with oxygen in a fuel cell to generate electricity directly.

Which one of the following statements is correct?

A Bond breaking energy in this reaction is lower than bond forming energy.
B Each O-H bond is stronger than each H-H bond and each O=O bond.
C More bonds are formed than broken in this reaction.
D This reaction has a positive enthalpy change.

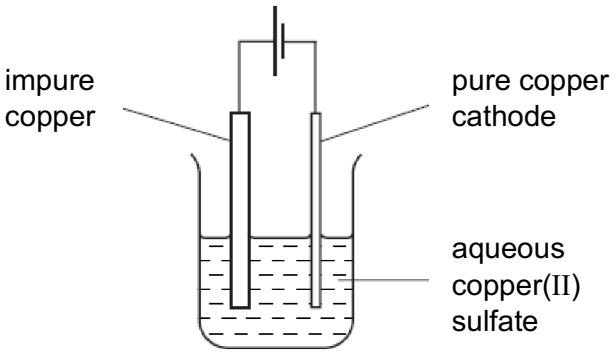
22 An electrolytic cell was set up as shown below.



After electricity is passed for a few minutes, what colour would you expect to observe in the litmus paper near the negative and positive electrode?

	near the negative electrode	near the positive electrode
A	blue	white
B	no change	blue
C	red	white
D	white	blue

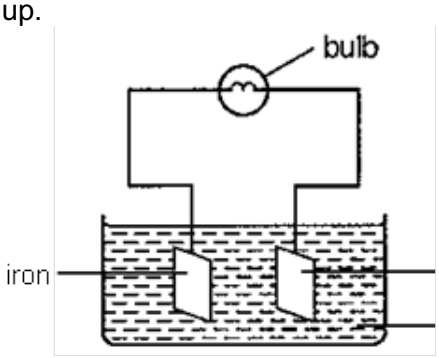
23 To purify an impure copper rod, the following electrolytic cell was set up.



Which one of the following correctly shows the half equations for the reactions occurring at the anode and cathode?

	at the anode	at the cathode
A	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$	$2H^+ + 2e^- \rightarrow H_2$
B	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$	$Cu^{2+} + 2e^- \rightarrow Cu$
C	$Cu \rightarrow Cu^{2+} + 2e^-$	$2H^+ + 2e^- \rightarrow H_2$
D	$Cu \rightarrow Cu^{2+} + 2e^-$	$Cu^{2+} + 2e^- \rightarrow Cu$

24 The diagram below shows an electric cell. When the circuit was closed, the bulb lighted up.

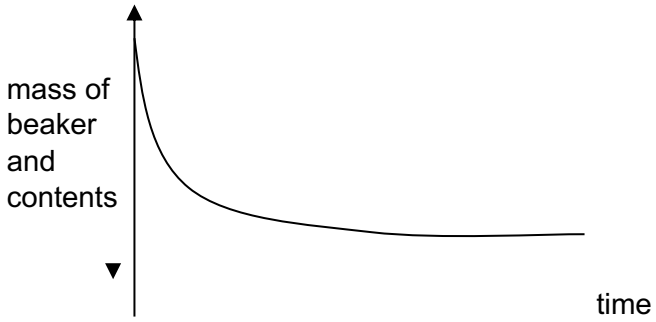


What changes will be observed at the electrodes and in the electrolyte?

	at the iron electrode	at the copper electrode	in the electrolyte
A	It becomes thicker	effervescence	no change
B	It becomes thicker	it becomes thinner	turns pale green
C	it becomes thinner	effervescence	turns pale green
D	it becomes thinner	it becomes thicker	no change

25 Two solutions were mixed in a beaker and the mass of the beaker and contents was then recorded at various times. The graph shows the results.

What could the two solutions have been?

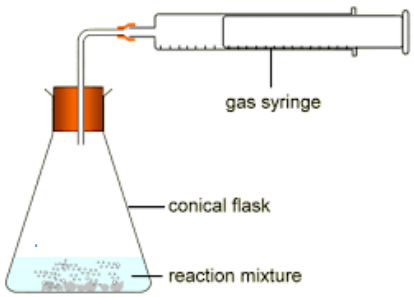


A aqueous copper (II) sulfate and aqueous ammonia
B aqueous sodium carbonate and dilute nitric acid
C aqueous sodium hydroxide and aqueous zinc sulfate
D dilute hydrochloric acid and aqueous sodium oxide

26 Which of the following methods can be used to determine the rate of the reaction below?

$$Pb(NO_3)_2\ (aq) + 2KI\ (aq) \rightarrow PbI_2\ (s) + 2KNO_3\ (aq)$$

method I



method II

method III

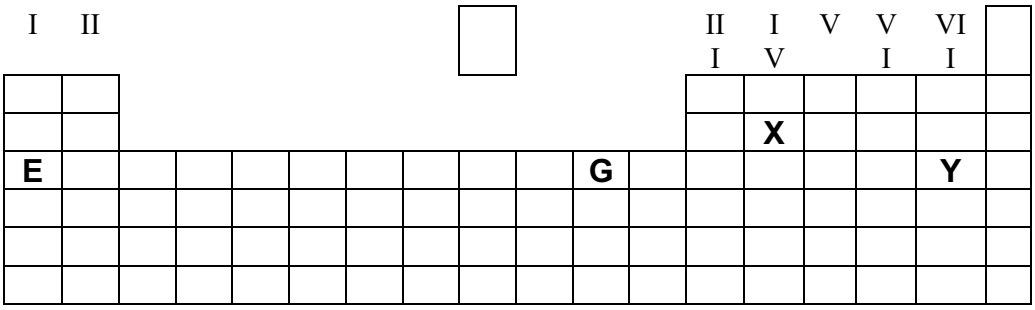
A I and II only
B I and III only
C II and III only
D III only

27 In which reaction is the underlined substance oxidised?

A $\underline{Br_2} + 2I^- \rightarrow 2Br^- + I_2$
B $\underline{Cl_2} + 2Fe^{2+} \rightarrow 2Fe^{2+} + 2Cl^-$
C $\underline{CO_3^{2-}} + 2H^+ \rightarrow CO_2 + H_2O$
D $\underline{Mg} + 2H^+ \rightarrow Mg^{2+} + H_2$

Four elements are shown in the Periodic Table below. Use the Periodic Table to answer questions **28** and **29**.

28 Four elements are shown in the Periodic Table below.



Which one of the following statement(s) is/are correct?

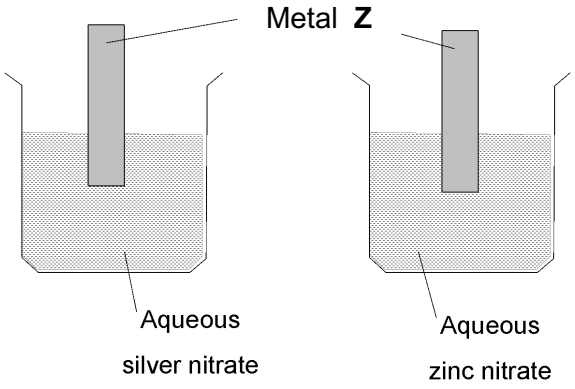
I **E** forms E^{2-} ion.
II **E**, **X** and **Y** have non-metallic character.
III **X** forms giant molecular structure with oxygen.
IV **X** has the smallest atomic number.

A I, II and III only
B II and III only
C II, III and IV only
D III and IV only

29 Which one of the following correctly describes element G?

	density	melting point	oxidation state(s)
A	0.0045	-130	+2, +4, +6
B	0.97	92	+1
C	8.96	1085	+1, +2
D	9.9	1923	+4

30 The following experiment was set up to test the reactivity of metal **Z**. It was observed that in the beaker containing silver nitrate, the colourless solution turns blue. In the beaker containing zinc nitrate, no visible change was observed.



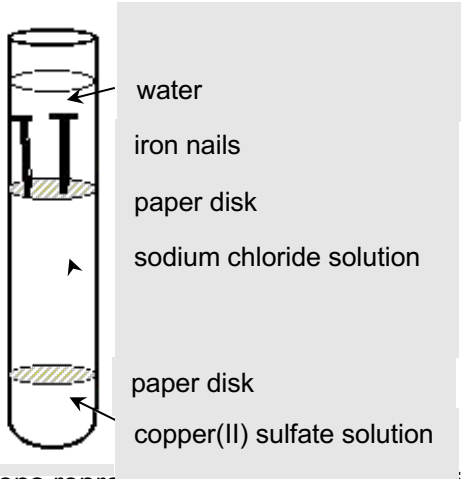
What could metal **Z** be?

A calcium
B copper
C gold
D iron

31 Which one of the following sets of information is correct?

	type of steel	additive	property	use
A	high carbon steel	carbon	strong and malleable	machinery
B	low carbon steel	chromium	brittle	drill bits
C	mild steel	carbon	softer and more easily shaped	car bodies
D	stainless steel	cobalt	corrosion-resistant	cutlery

32 The following experiment was set up for 2 days. At the end of 2 days, the iron nails rusted and reddish-brown powder was observed at the bottom of the test tube.



Which of the following equations represents the overall reaction in the test tube?

A $2\ Fe\ (s) + 3\ Cu^{2+}\ (aq) \rightarrow 2\ Fe^{3+}\ (s) + 3\ Cu\ (s)$
B $Fe\ (s) + Cl^{-}\ (aq) \rightarrow FeCl_3\ (aq)$
C $Fe\ (s) + n\ H_2O\ (l) + O_2\ (g) \rightarrow Fe_2O_3.nH_2O\ (s)$
D $Fe^{3+}\ (s) + Cu\ (aq) \rightarrow Fe^{2+}\ (aq) + Cu^{+}\ (s)$

33 Which one of the following substances can be an alternative substitute for limestone in the Blast Furnace?

A ammonium chloride
B calcium oxide
C phosphorus (V) oxide
D zinc sulfate

34 Methods used to stop iron from rusting include; coating with tin; coating with zinc; and connection to magnesium rods.
Which metal is most often used to protect iron in food containers, in oil pipelines and in roofing sheets?

	food containers	oil pipelines	roofing sheets
A	magnesium	tin	zinc
B	tin	zinc	magnesium
C	tin	magnesium	zinc
D	zinc	magnesium	tin

35 The air in 4 cities, **A**, **B**, **C** and **D** were analyzed, and the concentration of three air pollutants in parts per million (ppm) were tabulated below.

In which city will the air pollution problem be most reduced if car owners are made to install catalytic converters by law?

	concentration of carbon dioxide / ppm	concentration of carbon monoxide / ppm	concentration of nitrogen dioxide / ppm
A	27	23	36
B	34	35	48
C	68	50	12
D	70	24	39

36 Which of the following statements describe the differences between saturated and unsaturated hydrocarbons?

I Saturated hydrocarbons have C=C bond(s), but not unsaturated hydrocarbons.
II Saturated hydrocarbons undergo substitution reaction while unsaturated hydrocarbons do not.
III Unsaturated hydrocarbons have a general formula of C_nH_{2n}, while saturated hydrocarbons have a general formula of C_nH_{2n+1}.
IV Unsaturated hydrocarbons will decolourise aqueous bromine at room temperature, but not saturated hydrocarbons.

A I, II only
B I, II, IV only
C II, IV only
D III, IV only

37 Which one of the following is the correct set of conditions for manufacturing margarine from unsaturated vegetable oils?

A concentrated sulfuric acid and heating
B high pressure, temperature and catalyst
C nickel catalyst and heating
D phosphoric (V) acid catalyst and heating

38 Which one of the following shows the correct order of reactions that produce ethanoic acid from ethane?

A dehydrogenation → hydration → oxidation
B dehydrogenation → fermentation → esterification
C substitution → addition → reduction
D substitution → dehydration → oxidation

39 In the polymerisation of ethene to form poly(ethene), there is no change in

A boiling point.
B density.
C empirical formula.
D mass.

40 In many vineyards, wine are made from grape juice.

Which of the following statements about the reaction involved is/are true?

I The conditions needed are 40 °C and yeast as catalyst.
II The equation for this reaction is: $C_6H_{12}O_3 \rightarrow 3C_2H_5OH$
III This reaction is called fermentation.
IV The reaction needs to be carried out in the absence of oxygen.

A I, II only
B II, III only
C II, III, IV only
D III, IV only

Name: _____ ( ) Class: _____

WHITLEY SECONDARY SCHOOL

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PRELIMINARY EXAMINATION 2022

SUBJECT	**:**	**Chemistry (6092/01)**
LEVEL	**:**	**Secondary 4 Express**
DATE	**:**	**29 August 2022**
DURATION	**:**	**1 hour**
SETTER	**:**	**Ms Ng Soo Hoon**
VETTERS	**:**	**Ms Charlene Lye and Mr Ng Mun Leong**

READ THESE INSTRUCTIONS FIRST
Write your name, class and index number in the spaces at the top of this page.

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

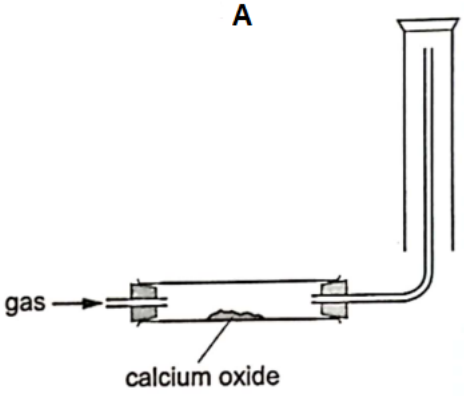
Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page **15**.
The use of an approved scientific calculator is expected, where appropriate.

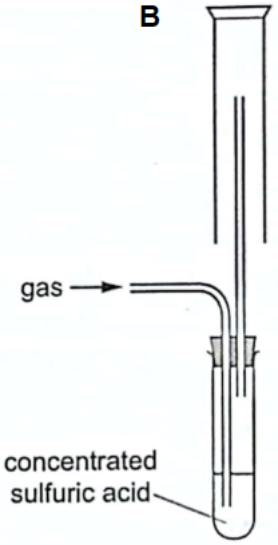
1 A gas turns moist blue litmus paper red, is soluble in water and is less dense than air.

Which diagram shows a correct way of drying and collecting the gas?

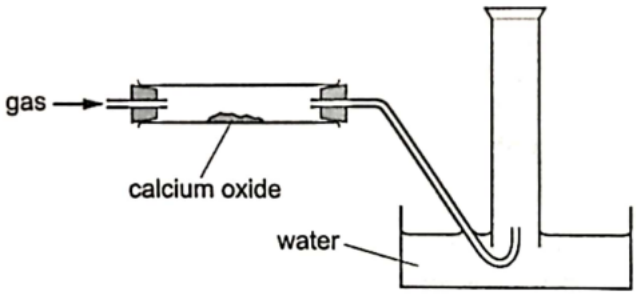
A



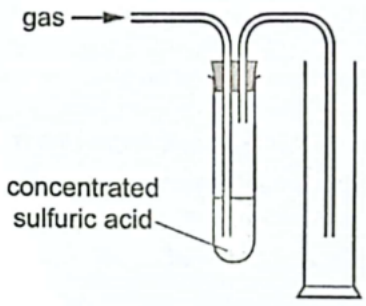
B



C



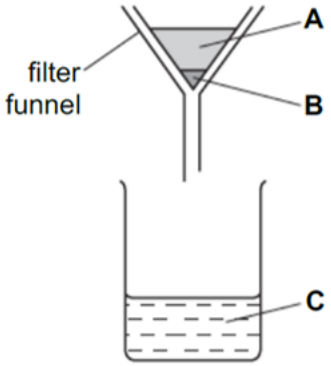
D



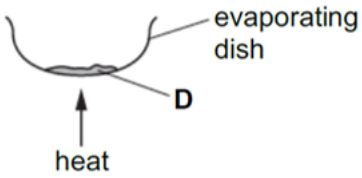
2 A mixture of sand and sodium chloride can be separated in three steps.

Step 1 is to add water to the mixture.
The diagram shows Steps 2 and 3.

Where is pure sodium chloride collected?



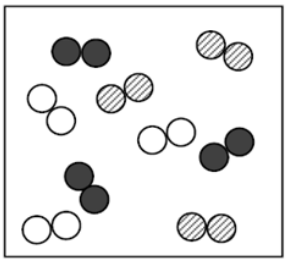
step 2



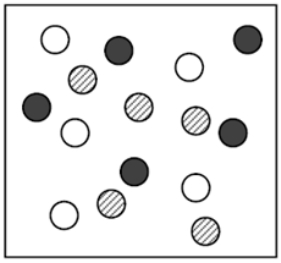
step 3

3 A gaseous mixture is made up of nitrogen, oxygen and nitrogen monoxide.
Which diagram could show a pure sample of this mixture?

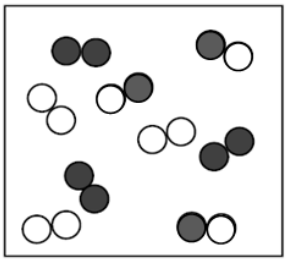
A



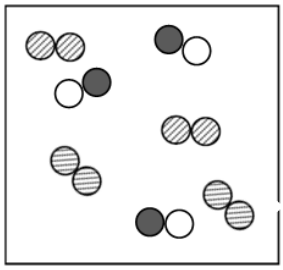
B



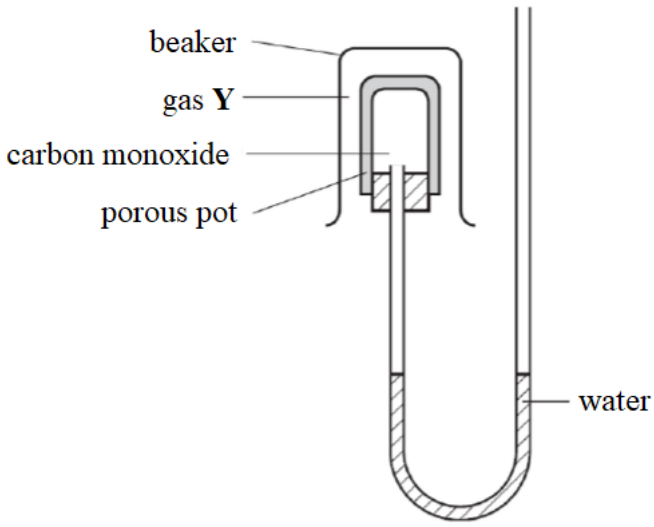
C



D



4 A beaker of an unknown gas **Y** was inverted over a porous pot containing carbon monoxide as shown. The apparatus was left for a while but the water level did not change.



The gas **Y** could have been

A ammonia.

B carbon dioxide.

C chlorine.

D nitrogen.

5 The boiling points of some gases are given in the following table.

gases	boiling point /°C
nitrogen	−196
xenon	−108
oxygen	−183

A mixture of liquid oxygen, nitrogen and xenon at −200 °C was heated up by 15 °C.

Which of the substances will still be in the liquid state at this higher temperature?

A nitrogen only

B xenon only

C a mixture of nitrogen and oxygen

D a mixture of oxygen and xenon

6 An element, **R**, has p protons and n neutrons in its nucleus.

Which of the following gives a possible correct number of protons, neutrons and electrons in a negative ion of an isotope of **R**?

	protons	neutrons	electrons
A	p	n + 1	p + 1
B	p	n + 1	p − 1
C	p + 1	n	p + 1
D	p + 1	n	p − 1

7 Which statement explains why potassium chloride, KCl, has a lower melting point than calcium oxide, CaO?

A Potassium is more reactive than calcium.

B The melting point of potassium is lower than calcium.

C Potassium chloride is covalent but calcium oxide is ionic.

D The forces of attraction between K^+ and Cl^- is weaker than that between Ca^{2+} and O^{2-}.

8 Which particles are responsible for the conduction of electricity through metals?

A electrons only

B electrons and positive ions

C negative ions only

D negative ions and positive ions

9 The atomic numbers and mass numbers of elements **P** and **Q** are given below:

element	atomic Number	mass number
P	20	40
Q	9	19

What is the relative molecular mass of the compound formed between **P** and **Q**?

A 29 **B** 38 **C** 59 **D** 78

10 68 g of hydrogen peroxide decomposes in the presence of manganese(IV) oxide to give 1.2 dm^3 of oxygen gas as follows.

$$2H_2O_2 \rightarrow O_2 + 2H_2O$$

What is the percentage purity of the hydrogen peroxide?

A 2.5% **B** 5.0% **C** 10.0% **D** 15.0%

11 In an experiment, 4.0 cm^3 of 1.0 mol/dm^3 aqueous copper(II) sulfate and 8.0 cm^3 of 1.0 mol/dm^3 aqueous sodium carbonate are mixed.

$$CuSO_4(aq) + Na_2CO_3(aq) \rightarrow Na_2SO_4(aq) + CuCO_3(s)$$

What does the reaction vessel contain once the reaction is complete?

A a colourless solution only

B a green precipitate and a blue solution

C a green precipitate and a colourless solution

D a white precipitate and a colourless solution

12 Elements **X**, **Y** and **Z** are all in the same period of the Periodic Table.

X forms an amphoteric oxide.

Solid **Y** does not conduct electricity.

Z forms an ionic oxide, **Z**O.

In which order do the elements appear in the Periodic Table?

A **X** → **Y** → **Z**

B **Y** → **X** → **Z**

C **Z** → **X** → **Y**

D **Z** → **Y** → **X**

13 20 cm^3 of an aqueous 1.0 mol/dm^3 solution of the hydroxide of metal **X**, exactly neutralises 60 cm^3 of aqueous 0.5 mol/dm^3 sulfuric acid.

What is the formula for the sulfate of **X**?

A X_2SO_4 **B** XSO_4 **C** $X_2(SO_4)_3$ **D** $X(SO_4)_2$

14 The information below concerns 3 elements **X**, **Y** and **Z**.

X: Its oxide is decomposed by heat to the element.

Y: Its carbonate is not decomposed by heat.

Z: Its oxide is not decomposed by heat but its carbonate decomposes.

In order of decreasing reactivity, the 3 elements should be arranged as

A **Y**, **Z**, **X** **B** **X**, **Y**, **Z** **C** **Y**, **X**, **Z** **D** **X**, **Z**, **Y**

15 The oxides of three elements, **T**, **U** and **V**, are added to water.

	oxide of **T**	oxide of **U**	oxide of **V**
water added	dissolved to form a solution of pH 2	insoluble	dissolved to form a solution of pH 10

The oxide of U is white in colour.

What are **T**, **U** and **V**?

	T	**U**	**V**
A	calcium	aluminium	sulfur
B	calcium	copper	sulfur
C	sulfur	aluminium	calcium
D	sulfur	copper	calcium

16 Which of the following reagents cannot be used to differentiate sodium hydroxide solution from sodium chloride solution?

A aqueous calcium nitrate solution

B aqueous copper(II) nitrate solution

C aqueous lithium nitrate solution

D aqueous zinc nitrate solution

17 An indicator has just been produced in the laboratory. The table shows the colours of the indicator at different pH values.

pH	colour
0 – 3	red
3.5 – 5	green
6 – 14	purple

This new indicator would be suitable for distinguishing

A aqueous potassium nitrate and aqueous potassium hydroxide.

B aqueous hydrogen chloride and carbon dioxide.

C aqueous ammonia and aqueous potassium hydroxide.

D water and aqueous potassium chloride.

18 **Y** is a white solid mixture that has the following properties.

Y dissolves in water.

When dilute hydrochloric acid is added to an aqueous solution of **Y**, bubbles are produced.

When chlorine is bubbled through an aqueous solution of **Y**, the solution turns red-brown.

What is present in **Y**?

A calcium carbonate, $CaCO_3$, and potassium bromide, KBr

B copper(II) carbonate, $CuCO_3$, and magnesium iodide, MgI_2

C sodium carbonate, Na_2CO_3, and sodium bromide, NaBr

D sodium nitrate, $NaNO_3$, and ammonium bromide, NH_4Br

19 An atmospheric pollutant can be removed by the process of reduction.

Which pollutant is removed by this process?

A carbon monoxide in a catalytic convertor

B nitrogen dioxide in acid rain by reaction with calcium carbonate

C nitrogen oxide in a catalytic convertor

D sulfur dioxide from flue gases by reaction with calcium carbonate

20 An aqueous ammonia is added to a solution of a salt. A white precipitate is formed which dissolves in an excess of aqueous ammonia. Which metal ion could the salt contain?

A Al^{3+} **B** Ca^{2+} **C** Cu^{2+} **D** Zn^{2+}

21 Iron pipes corrode rapidly when exposed to seawater.

Which metal, when attached to the iron pipes, would **not** offer protection against corrosion?

A aluminium

B magnesium

C copper

D zinc

22 Steel is an alloy of iron with a very small percentage of carbon.

Which statement is correct?

A A decrease in the percentage of carbon makes the steel more brittle.

B An increase in the percentage of carbon makes the steel softer.

C Carbon disrupts the metallic structure of iron.

D Iron atoms are the same size as carbon atoms.

23 Which of the underlined substances acts as a reducing agent?

A $2Mg + \underline{O_2} \rightarrow 2MgO$

B $\underline{Cu^{2+}} + Zn \rightarrow Cu + Zn^{2+}$

C $\underline{FeO} + H_2SO_4 \rightarrow FeSO_4 + H_2O$

D $CuO + \underline{H_2} \rightarrow Cu + H_2O$

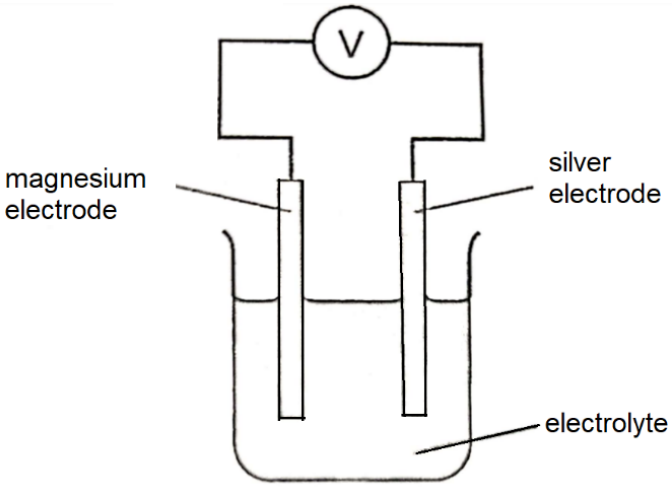
24 Metal **M** forms a chloride $\mathbf{M}Cl_2$.

M is between copper and silver in the reactivity series.

If a concentrated aqueous solution of $\mathbf{M}Cl_2$ is electrolysed, which reactions will occur at the cathode and the anode?

	cathode (negative electrode)	anode (positive electrode)
A	$\mathbf{M}^+ + e^- \rightarrow \mathbf{M}$	$2Cl^- - 2e^- \rightarrow Cl_2$
B	$\mathbf{M}^+ + e^- \rightarrow \mathbf{M}$	$4OH^- - 4e^- \rightarrow 2H_2O + O_2$
C	$\mathbf{M}^{2+} + 2e^- \rightarrow \mathbf{M}$	$2Cl^- - 2e^- \rightarrow Cl_2$
D	$\mathbf{M}^{2+} + 2e^- \rightarrow \mathbf{M}$	$4OH^- - 4e^- \rightarrow 2H_2O + O_2$

25 The diagram below shows a cell.



Which statement about the cell is correct?

A Electrons pass from the magnesium electrode to the silver electrode through the electrolyte.

B The cell shows that silver is more reactive than magnesium.

C The magnesium electrode loses electrons.

D The silver electrode is oxidised.

26 In an electrolysis experiment, the same amount of charge deposited 68.9 g of silver and 6.64 g of chromium.

What is the charge on the chromium ion?

A +2 **B** +3 **C** +5 **D** +6

27 Which statement about the alkali metals is correct?

A Their melting points decrease on descending the group.

B Their reactivities decrease on descending the group.

C They form covalent bonds with the halogens.

D They form oxides on reacting with water.

28 Which process does **not** result in the formation of **both** carbon dioxide and water?

A addition of a dilute acid to a carbonate

B complete combustion of methane

C complete combustion of ethene

D gently heating crystals of hydrated sodium carbonate, $Na_2CO_3.10H_2O$

29 Which statement about transition elements is incorrect?

A Catalysts are transition elements or their compounds.

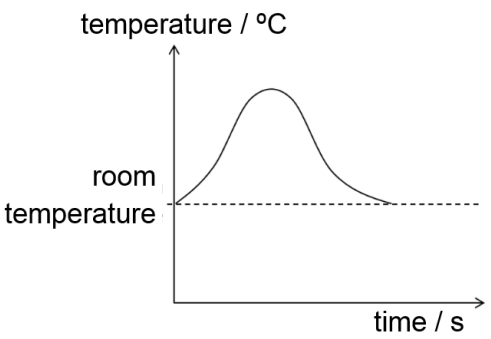
B All coloured compounds contain transition elements.

C Transition elements conduct electricity because they have variable oxidation states.

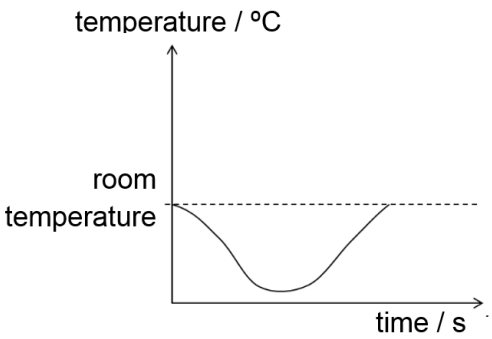
D Transition elements have high melting points due to strong attraction between positive ions and a ‘sea of electrons’.

30 Which graph shows how the temperature alters as aqueous sodium hydroxide is added to diluted sulfuric acid and then the resulting solution is left to stand?

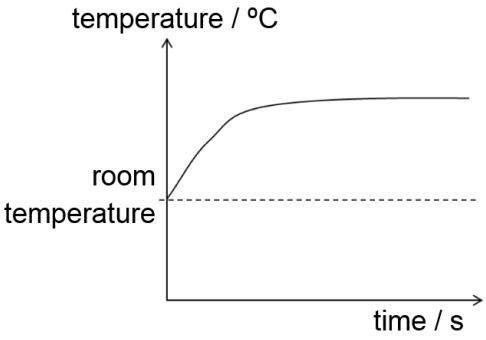
A



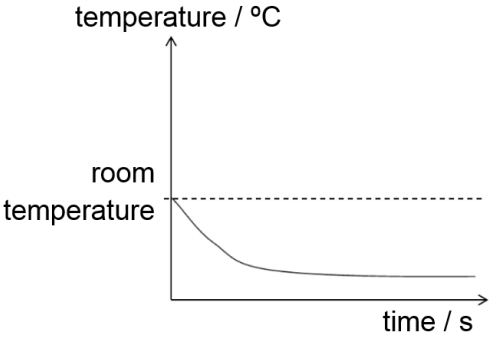
B



C



D



31 The equations for three reactions are given below:

Reaction **1** $H_2 \rightarrow 2H$

Reaction **2** $2H + O \rightarrow H_2O$

Reaction **3** $HCl \rightarrow H + Cl$

Which of these reaction(s) is/are endothermic?

A Reaction **1** only.

B Reactions **1** and **2** only.

C Reactions **1** and **3** only.

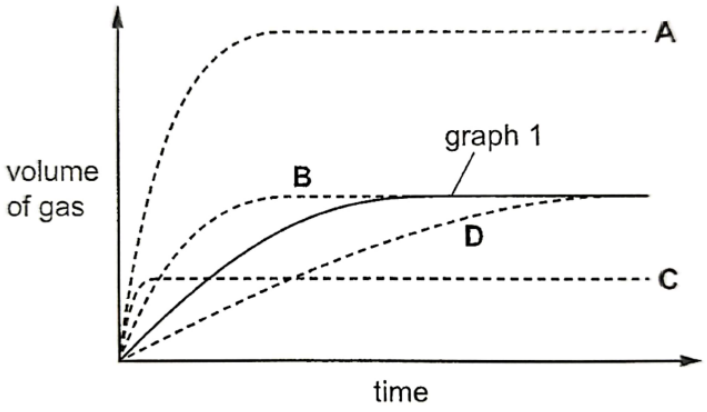
D Reactions **2** and **3** only.

32 A sample of 0.5 g of magnesium ribbon is reacted with an excess of 1 mol /dm^3 hydrochloric acid.

The volume of hydrogen produced over time is measured.

The results are plotted to give graph 1.

Which graph would be produced when 0.5 g of magnesium ribbon is reacted with an excess of 2.0 mol / dm^3 hydrochloric acid under the same conditions?



33 In the reaction between zinc and hydrochloric acid, the following changes could be made to the conditions.

1 increase in concentration of the acid

2 increase in particle size of the zinc

3 increase in pressure on the system

4 increase in temperature of the system

Which pair of changes will increase the rate of reaction?

A **1** and **2** **B** **1** and **4** **C** **2** and **3** **D** **3** and **4**

34 Which of the following properties shows an increase in the alkane series from butane → propane → ethane → methane?

A boiling point

B flammability

C melting point

D viscosity

35 In the reaction between 23 g of ethanol and excess hydrogen bromide, the mass of bromoethane obtained is 27 g.

$$C_2H_5OH + HBr \rightarrow C_2H_5Br + H_2O$$

What is the percentage yield of bromoethane?
[M_r: C_2H_5OH, 46; C_2H_5Br, 109]

A 25% **B** 50% **C** 60% **D** 75%

36 Hydrocarbon **Q**, on heating with a catalyst, forms a solid compound, **R**.

Both **Q** and **R** have the same empirical formula.

What type of reaction is this?

A addition polymerisation
B condensation polymerisation
C hydrogenation
D substitution

37 Petroleum can be separated into fractions using fractional distillation.

Which statements are correct?

1 Alkanes used in polishes and waxes have a higher boiling point than those used as diesel fuel.
2 Any of the fractions could be used as fuels because their enthalpy changes of combustion are negative.
3 The fraction used for petrol (gasoline) is extracted from higher up the fractionating column than the fraction used for paraffin (kerosene).
4 The fraction obtained at a particular point in the fractionating column always contains the same compounds in the same ratio.

A **1**, **2** and **3** only **B** **1** and **4** only
C **2** only **D** **3** and **4** only

38 The cracking of one mole of **X**, a large alkane, produces two moles of ethene, two moles of propene and one mole of propane.

How many carbon atoms does one molecule of **X** contain?

A 8 **B** 10 **C** 13 **D** 16

39 What is added to polyunsaturated vegetable oils to form solid margarine?

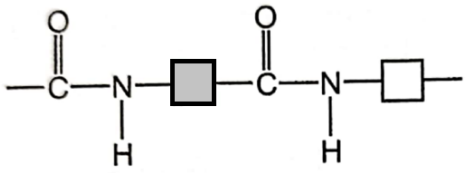
A bromine

B hydrogen

C oxygen

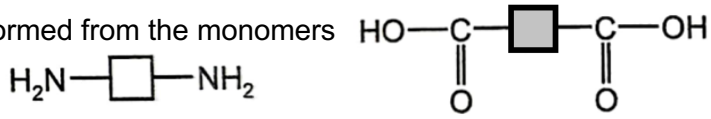
D water

40 The diagram shows the partial structure of a polymer.



What statement about this polymer is correct?

A It is a polyamide.

B It is formed from the monomers 

C It is formed in an addition polymerization reaction.

D The partial structure shown is that of nylon.

END OF PAPER 1

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

West Spring Secondary School
Preliminary Examination 2022

CHEMISTRY **6092/01**

Paper 1

SECONDARY 4 EXPRESS

Name _____ ( ) **Date** **31 August 2022**

Class _____ **Duration** **1 hour**

Additional materials: Laminated Periodic Table,
Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your index number, class and name on the Answer Sheet.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the laminated Periodic Table is provided separately.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **16** printed pages including the cover page.

Setter: Mdm Sharena

[Turn over

1 A student follows the rate of the reaction when 0.19 g of calcium carbonate reacts with excess acid at room temperature and pressure.

What is most suitable for measuring volume of gas produced at different times during this experiment?

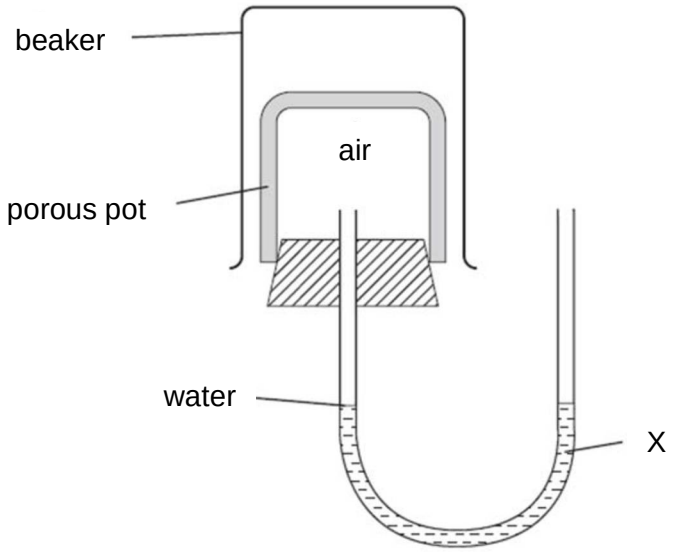
A a 50 cm^3 gas syringe

B an inverted 250 cm^3 measuring cylinder filled with water

C an inverted 50 cm^3 burette filled with water

D place the apparatus on a balance and measure the loss in mass

2 The apparatus shown in the diagram was set up.



Which gas, when present inside the beaker, will cause the water level at X to fall?

A ammonia, NH_3

B carbon dioxide, CO_2

C hydrogen, H_2

D nitrogen, N_2

3 Some students are asked to describe the difference between the particles in gases and liquids.

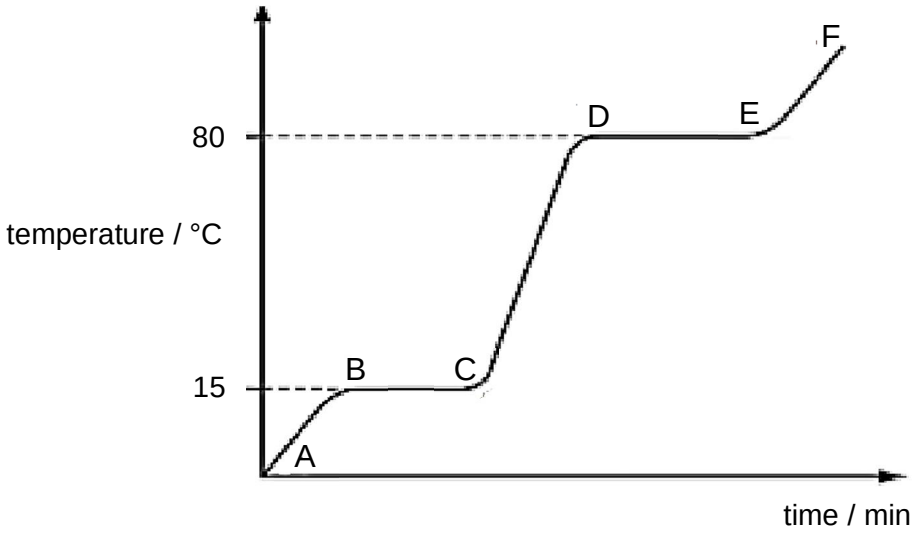
Three of their suggestions are:

1 Particles in gases are further apart than particles in liquids.
2 Particles in gases are bigger than particles in liquids.
3 Particles in gases are smaller than particles in liquids.

Which suggestion or suggestions are correct?

A 1 only **B** 2 only **C** 3 only **D** 1, 2 and 3

4 The graph shows a change of temperature when substance Y is heated.



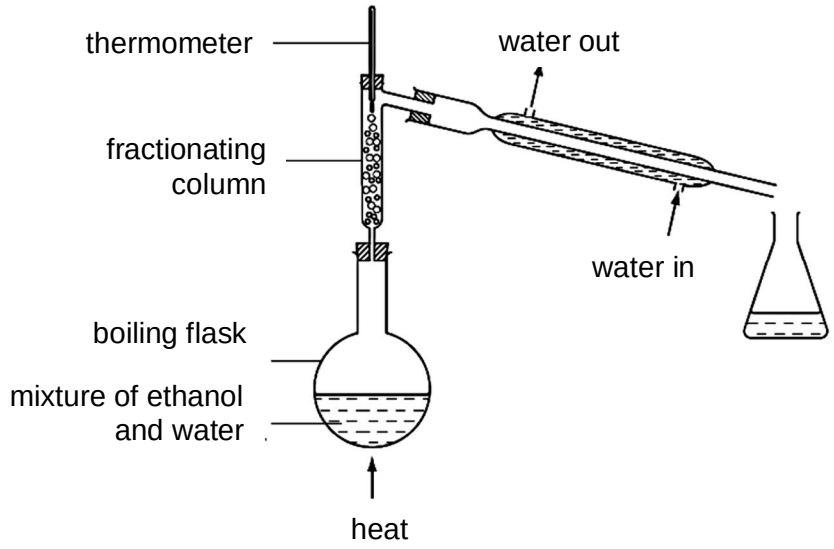
Which stage shows that substance Y is melting?

A A to B **B** B to C **C** D to E **D** E to F

5 At which temperature does a concentrated aqueous solution of sodium chloride begin to boil?

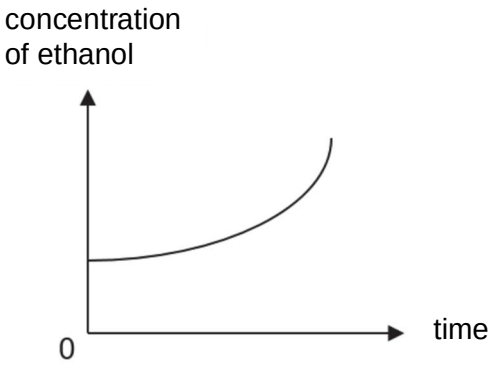
A 93 °C **B** 99 °C **C** 100 °C **D** 104 °C

6 Fractional distillation is used to distil ethanol (boiling point 78°C) from a dilute ethanol solution.



Which graph best shows the change in concentration of ethanol in the boiling flask as distillation proceeds?

A



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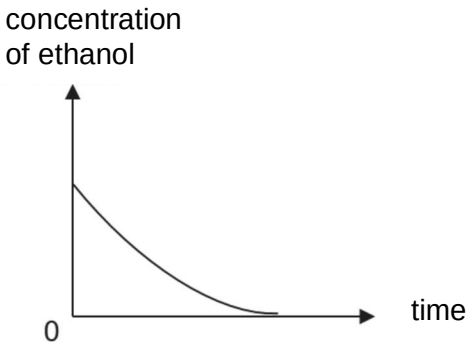

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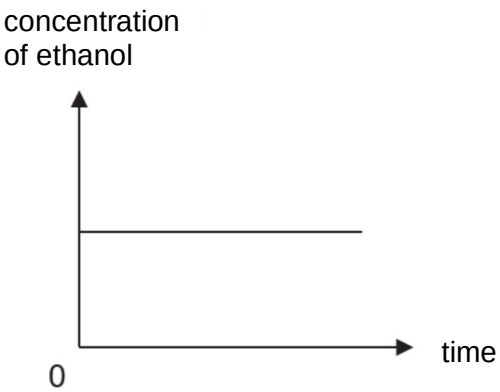

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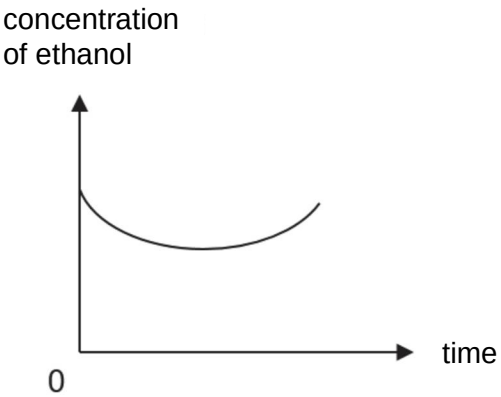


7 Some properties of four substances P, Q, R and S are given in the table below.

substance	percentage composition by mass	electrical conductivity when solid	effect of heat
P	constant	yes	solid burns in air to form an oxide
Q	varies	no	liquid burns to form carbon dioxide and water
R	constant	no	solid decomposes to form two products
S	varies	yes	solid melts

Which classification of the substances as an element, a mixture or a compound is correct?

	element	compound	mixture
A	P	Q, R	S
B	P	R	Q, S
C	R	Q, P	S
D	S	P	Q, R

8 An ion Q^{3-} has 18 electrons.

If its nucleon number is 31, what is the composition of its nucleus?

A 15 protons and 15 neutrons

B 15 protons and 16 neutrons

C 18 protons and 13 neutrons

D 21 protons and 10 neutrons

9 Which statement about atoms is correct?

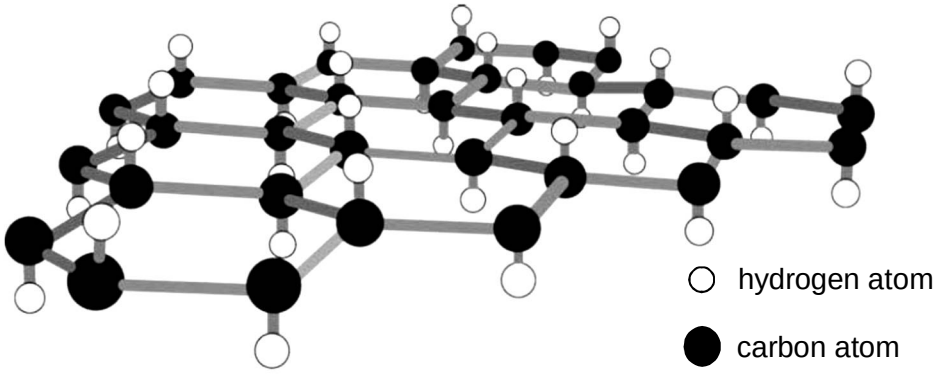
A The mass of an atom is almost entirely due to its nucleus.

B The nucleus and the electrons repel each other.

C The protons and neutrons have opposite charges.

D The shell nearest to the nucleus always contains the most electrons.

10 Graphane, an allotrope of carbon has a similar structure to graphite, except that, it has one hydrogen atom attached to each carbon as shown in the diagram.



Which set of properties will graphane have?

1 It is soft.
2 It has a giant molecular structure.
3 It conducts electricity in the solid state.

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 1, 2 and 3

11 Carbon disulfide is a simple covalent compound used in manufacturing polymers.

Which statement about carbon disulfide would you predict to be true?

A It has a low boiling point and conducts electricity when molten.
B It has a low boiling point and is soluble in organic solvents.
C It is a crystalline solid at room temperature and conducts electricity when molten.
D It is a crystalline solid at room temperature and is soluble in organic solvents.

12 The formula of thallium carbonate is Tl_2CO_3 and that of sodium chlorite is $NaClO_2$.

What is the formula of thallium chlorite?

A $TlClO_2$ **B** Tl_2ClO_2 **C** $Tl(ClO_2)_2$ **D** $Tl_2(ClO_2)_3$

13 Two of the reactions used in the manufacture of nitric acid, HNO_3, are shown.

$$2NO + O_2 \rightarrow 2NO_2$$

$$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$$

What is the maximum number of moles of nitric acid which could be formed from one mole of nitrogen monoxide, NO?

A 0.5 mol **B** 1.0 mol **C** 2.0 mol **D** 4.0 mol

14 Basic copper carbonate, $Cu_2CO_3(OH)_2$, is used as a pigment in paint.

What is the percentage by mass of copper in basic copper carbonate?

A 28.8 % **B** 31.2 % **C** 57.7 % **D** 62.4 %

15 20 cm^3 of hydrogen is reacted with 20 cm^3 of oxygen as shown in the equation.

$$2H_2\,(g) + O_2\,(g) \rightarrow 2H_2O\,(l)$$

What are the volumes of gases remaining at the end of the reaction?

[All volumes are measured at room temperature and pressure.]

	volume of hydrogen / cm^3	volume of oxygen / cm^3	volume of product / cm^3
A	0	0	20
B	0	0	40
C	0	10	0
D	10	10	0

16 Which statement best explains why farmers should not lime the soil and add ammonium nitrate fertiliser at the same time?

A It is too costly to add both substances together at the same time.

B The lime makes the soil too alkaline for plant growth.

C The lime will react with ammonium nitrate and result in the loss of nitrogen.

D The lime will react with ammonium nitrate to produce acidic substances that inhibit plant growth.

17 The table gives information about three indicators.

indicator	colour change low pH → high pH	pH at which colour change takes place
methyl orange	red → yellow	4.0
bromothymol blue	yellow → blue	6.5
phenolphthalein	colourless → pink	9.0

If equal volumes of these three indicators were mixed, which colour would be observed at pH 5?

A blue **B** green **C** orange **D** yellow

18 How many different sulfates in total could be prepared by the reaction of dilute sulfuric acid with the following substances?

- copper
- magnesium
- silver
- zinc carbonate

A 1 **B** 2 **C** 3 **D** 4

19 An aqueous solution of a chloride is made by the reaction of hydrochloric acid with the hydroxide of metal M:

$$M(OH)_2\ (s) + 2HCl\ (aq) \rightarrow MCl_2\ (aq) + 2H_2O\ (l)$$

Which metal **cannot** be M?

A copper

B iron

C lead

D magnesium

20 In addition to sodium ions and chloride ions, sea water contains magnesium ions and sulfate ions.

Which method could be used to measure the amount of sulfate ions present in a sample of sea water?

A Add excess aqueous lead(II) nitrate, dry and weigh the precipitate formed.

B Add excess aqueous barium nitrate, dry and weigh the precipitate formed.

C Evaporate off all the water and weigh the remaining solid.

D Measure the electrical conductivity of the sample.

21 A pale green solution Z, gives a green precipitate with excess aqueous sodium hydroxide.

An alkaline gas is only given off when the mixture is warmed with powdered aluminium.

Which ions does Z contain?

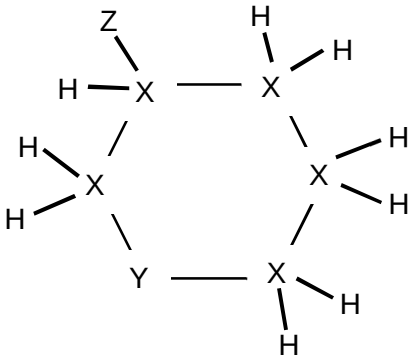
A ammonium and copper(II) ions

B ammonium and iron(II) ions

C copper(II) and nitrate ions

D iron(II) and nitrate ions

22 The compound below is made up of hydrogen and the elements X, Y and Z.



Which statement is incorrect?

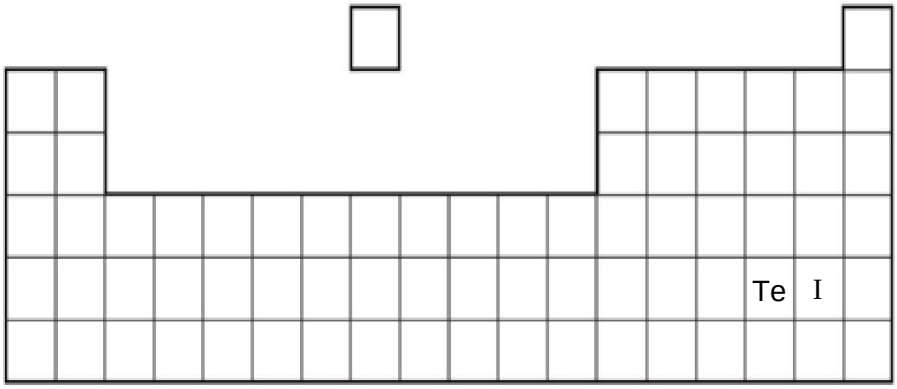
A Element Z is most likely from Group I.

B Element X is most likely from Group IV

C The compound has a simple molecular structure.

D The compound has the molecular formula X_5YH_9Z.

23 Iodine, I, has a lower relative atomic mass than tellurium, Te, but is placed after it in the Periodic Table.



Which statement explains why iodine (I) is placed after tellurium (Te) in the Periodic Table?

A Iodine has fewer neutrons than tellurium.

B Iodine has fewer protons than tellurium.

C Iodine has more neutrons than tellurium.

D Iodine has more protons than tellurium.

24 Lithium reacts with water to form solution P and gas Q.

When solution P reacts with hydrochloric acid, salt R is formed.

What are the formulae of P, Q and R?

	P	Q	R
A	Li_2O	H_2	LiC*l*
B	Li_2O	O_2	Li_2C*l*
C	LiOH	H_2	LiC*l*
D	LiOH	O_2	Li_2C*l*

25 Ammonia is produced by the Haber process.

Which statement is correct?

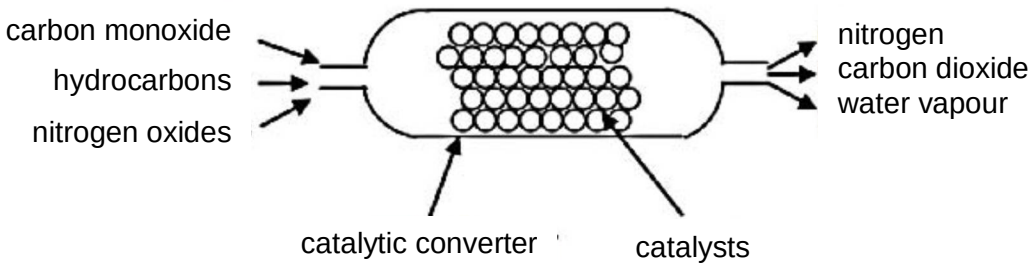
A A high pressure of 500 atm and temperature of 450 °C are used in the process.

B Hydrogen is obtained from fractional distillation of crude oil.

C Iron is used as a catalyst to increase the activation energy in the process.

D Nitrogen obtained from liquid air is used as one of the raw materials.

26 The diagram shows the cross section of a catalytic converter in the exhaust system of a car.

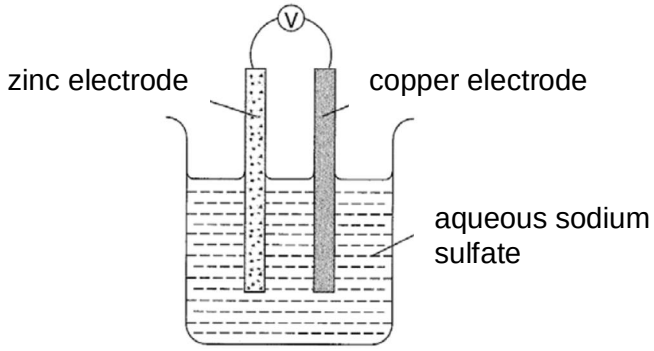


Which process(es) take(s) place in the converter?

1 Hydrocarbons oxidise to form carbon dioxide and water vapour.
2 Carbon monoxide reacts with nitrogen oxides to form carbon dioxide and nitrogen.
3 Nitrogen oxides react with hydrocarbons to form water vapour and nitrogen.

A 1 only
B 2 only
C 1 and 2
D 1 and 3

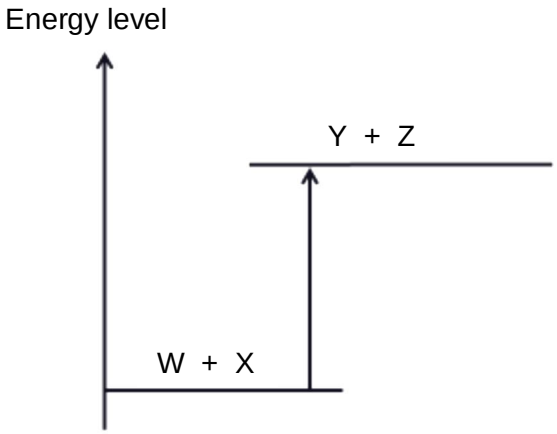
27 The diagram shows a simple cell.



Which option describes what happens in the cell?

A Copper ionizes and becomes smaller.
B Zinc ionizes and becomes smaller.
C Effervescence of hydrogen gas is observed at the zinc electrode.
D Effervescence of oxygen gas is observed at the copper electrode.

28 The energy level diagram for a reaction is as shown.



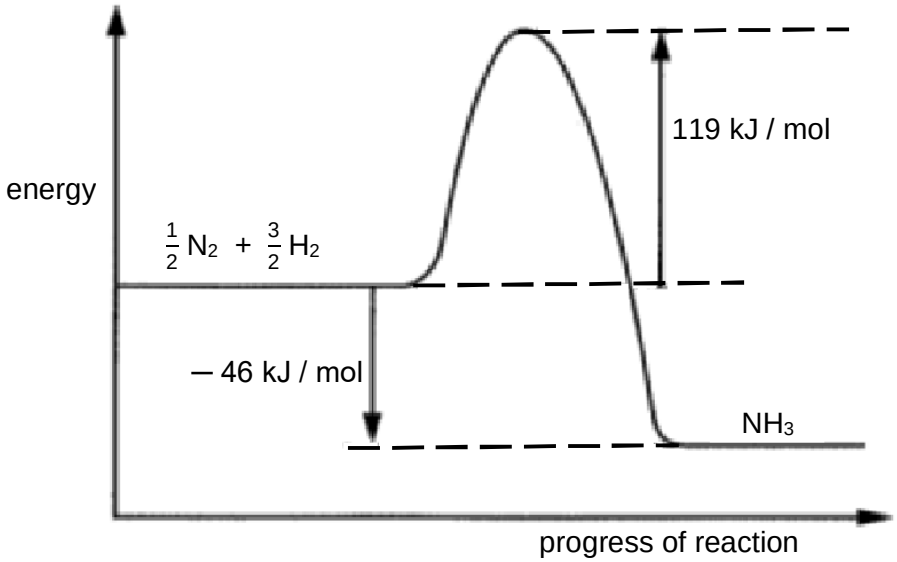
The initial temperature measured was 28.0 °C.

As the reaction progressed, the reaction temperature changed by 5.5 °C.

What would be the final temperature recorded?

A 22.5 °C **B** 28.0 °C **C** 33.5 °C **D** 39.0 °C

29 The energy profile diagram shows the formation of ammonia.



What is the activation energy for the decomposition of ammonia into its elements?

A 46 kJ / mol **B** 73 kJ / mol **C** 119 kJ / mol **D** 165 kJ / mol

30 Which is the overall equation for the reactions that take place in a hydrogen fuel cell?

A $2H_2 + O_2 \rightarrow 2H_2O$

B $2H_2O \rightarrow 2H_2 + O_2$

C $2H^+ + 2e^- \rightarrow H_2$

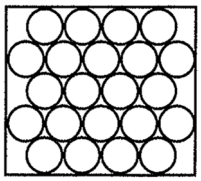
D $H_2 \rightarrow 2H^+ + 2e^-$

31 Iron rusts easily, hence steel structures should be treated to slow down the rusting process.

Which option describes incorrectly how each method protects iron from rusting and its main disadvantage?

	method	how it protects	disadvantage
A	alloying steel with chromium to make stainless steel	chromium reacts with oxygen in the air to form a barrier of chromium oxide which prevents iron from rusting	production of stainless steel is costly
B	coating steel plates with zinc	zinc is less reactive than iron, and provides a barrier between iron and the atmosphere	when the coating of zinc is scratched, iron will corrode in place of zinc, making it rust more quickly
C	painting steel	provides a barrier between the iron and the atmosphere	paint scrapes off easily to expose iron to the atmosphere
D	storing steel objects in a dry place	absence of water prevents iron from rusting quickly	difficult to keep storage place dry at all times

32 The arrangement of atoms in pure iron is shown.



Steel can be made by adding carbon to pure iron.

Which description of the arrangement of atoms in steel is correct?

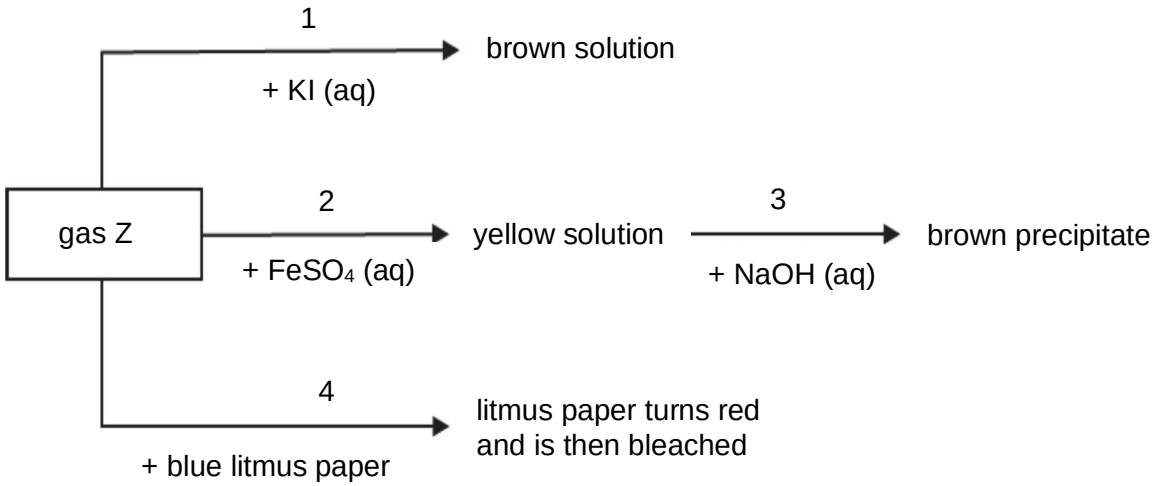
A A regular pattern of carbon atoms with iron atoms fitting into the gaps between them.

B A regular pattern of iron atoms with carbon atoms fitting into the gaps between them.

C An irregular pattern of iron atoms with carbon atoms randomly spread throughout the structure.

D Rows of iron atoms alternating with rows of carbon atoms.

33 The scheme below shows reactions of a gas Z.



Which statement is incorrect?

A Gas Z is chlorine.

B In stage 1, potassium iodide is reduced to form iodine.

C In stage 2, iron(II) sulfate is oxidized to form iron(III) sulfate.

D The brown precipitate formed in stage 3 is iron(III) hydroxide.

34 Hydrogen peroxide (H_2O_2) acts as an oxidising agent in some reactions, but in others, as a reducing agent.

reaction 1: $H_2O_2 + 2KI + H_2SO_4 \rightarrow I_2 + K_2SO_4 + 2H_2O$

reaction 2: $5H_2O_2 + 2KMnO_4 + 3H_2SO_4 \rightarrow 2MnSO_4 + K_2SO_4 + 5O_2 + 8H_2O$

reaction 3: $H_2O_2 + Ag_2O \rightarrow 2Ag + O_2 + 2H_2O$

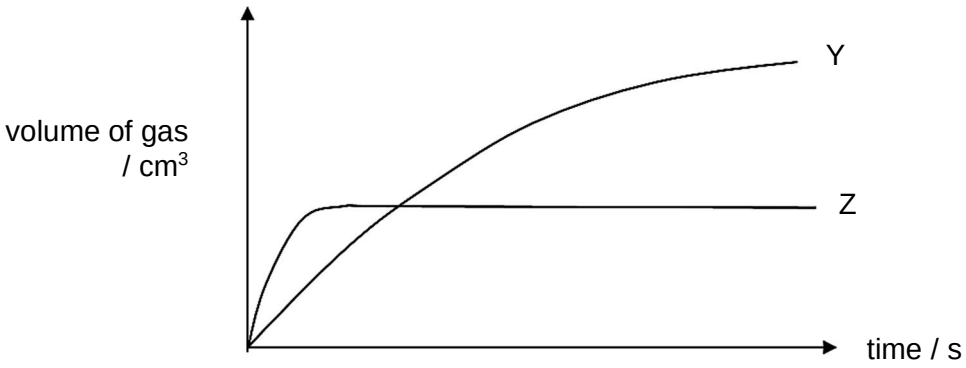
Which row identifies correctly the role of hydrogen peroxide in each reaction?

	reaction 1	reaction 2	reaction 3
A	oxidising agent	reducing agent	reducing agent
B	oxidising agent	reducing agent	oxidising agent
C	reducing agent	oxidising agent	oxidising agent
D	reducing agent	oxidising agent	reducing agent

35 Manganese(IV) oxide catalyses the decomposition of aqueous hydrogen peroxide to water and oxygen.

In order to follow the rates of this reaction for two different solutions of hydrogen peroxide the total volumes of oxygen evolved were recorded at regular time intervals and the results were plotted.

In each experiment, the same mass of catalyst was used and the temperature was the same.



If graph Y corresponds to 20 cm^3 of 4.0 mol / dm^3 hydrogen peroxide solution, what is the volume and concentration of graph Z?

A 5 cm^3 of a 8.0 mol / dm^3 solution

B 10 cm^3 of a 2.0 mol / dm^3 solution

C 20 cm^3 of a 4.0 mol / dm^3 solution

D 20 cm^3 of a 8.0 mol / dm^3 solution

36 When crude oil is fractionally distilled, which compounds leave from the top of the fractionating column?

A The compounds that are the least flammable.

B The compounds that are the most viscous.

C The compounds with the highest relative molecular mass.

D The compounds with the lowest boiling points.

37 What is the structure of the product of the reaction between butene, $CH_3{-}CH_2{-}CH{=}CH_2$, and bromine, Br_2?

A $CH_3{-}CH_2{-}CHBr{-}CH_2Br$

B $CH_3{-}CHBr{-}CH_2{-}CH_2Br$

C $CH_2Br{-}CH_2{-}CH_2{-}CH_2Br$

D $CH_2Br{-}CH_2{-}CHBr{-}CH_3$

38 X reacts with steam to form Y.

Y is oxidized to Z.

$$X \xrightarrow{+\text{ steam}} Y \xrightarrow{\text{oxidation}} Z$$

If X is propene, what is the formula of Z?

A C_3H_6 **B** C_3H_7OH **C** C_2H_5COOH **D** C_3H_7COOH

39 Which carboxylic acid would combine with ethanol to give the ester $C_2H_5COOC_2H_5$?

A butanoic acid

B ethanoic acid

C methanoic acid

D propanoic acid

40 The table refers to the polymers nylon and poly(ethene).

Which row is correct?

	polymer	type	use
A	nylon	addition	cling film
B	nylon	condensation	parachutes
C	poly(ethene)	addition	parachutes
D	poly(ethene)	condensation	cling film

END OF PAPER

XINMIN SECONDARY SCHOOL CHEMISTRY PRELIMS 2022 P1

1 An unknown white solid, M, melts between 171 °C and 174 °C. When chromatography is performed with water as the solvent, M produces only one spot on the chromatogram.

Which statement must be true about M?

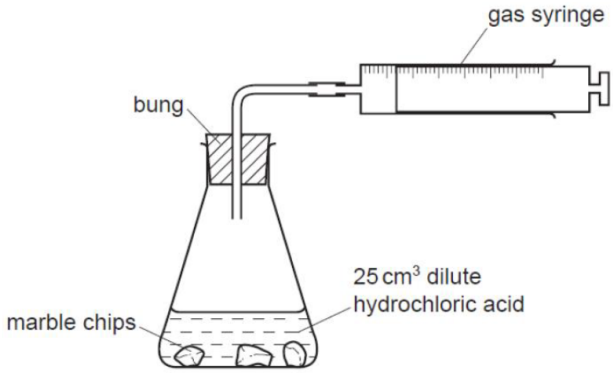
A M can sublime.

B M is an ionic compound.

C M is impure as it melts over a range of temperatures.

D M is pure as it produced only 1 spot on the chromatogram.

2 The apparatus shown in the diagram below was set up by a student to measure the volume of carbon dioxide gas produced when different masses of marble chips were added to 25 cm^3 of dilute hydrochloric acid.



Which other apparatus did the student use for his experiment?

A Filter funnel and mass balance

B Filter funnel and stopwatch

C Measuring cylinder and mass balance

D Measuring cylinder and stopwatch

3 Two isotopes of carbon, C-12 and C-13 are found combined in a giant molecule. The average relative atomic mass of carbon in the giant molecule is 12.4.

What is the proportion of C-12 atoms in the giant molecule?

A 50%

B 60%

C 70%

D 80%

4 Three elements X, Y and Z belong to the same period in the Periodic Table. The properties of the oxide formed by the three elements are shown below.

oxide of X:	Insoluble in water and aqueous sodium hydroxide but dissolves readily in dilute hydrochloric acid
oxide of Y:	Has low boiling point and does not react with both aqueous sodium hydroxide and dilute hydrochloric acid
oxide of Z:	Insoluble in water but dissolves in both aqueous sodium hydroxide and dilute hydrochloric acid

Based on the statements above, arrange X, Y and Z in order of increasing atomic number in the Periodic Table.

A X, Y, Z

B Y, X, Z

C X, Z, Y

D Y, Z, X

5 Elements X and Y are in Group VII of the Periodic Table.
X is a liquid while Y is a solid at room temperature and pressure.

Which statement is correct?

A Atoms of X has more protons than atoms of Y.

B X displaces Y from an aqueous solution of Y.

C Y is a stronger oxidising agent than X.

D Molecules of Y have more atoms than molecules of X.

6 What can be deduced about two gases that have the same relative molecular mass?

A They have the same rate of diffusion at room temperature and pressure.

B They have the same solubility in water at room temperature.

C They have the same number of atoms in one molecule.

D They have the same boiling point.

7 Which substance will react with dilute sulfuric acid to produce a colourless solution only?

A zinc hydroxide

B copper(II) oxide

C sodium carbonate

D barium chloride

8 An ion has 23 electrons and a mass number of 56.
What is the charge on the ion if it has 30 neutrons?

A –2 **B** +2 **C** –3 **D** +3

9 The table below shows the physical properties of substances P, Q, R and S.

Substance	Melting point / °C	Electrical conductivity	
		in solid state	in molten state
P	High	Poor	Good
Q	High	Good	Good
R	High	Poor	Poor
S	Low	Poor	Poor

Using the information from the table, which statement is true about substances P, Q, R and S?

A Substance R consists of weak bonds between the atoms.

B Substance S exists in a simple molecular structure.

C Substance P contains mobile electrons to conduct electricity when in molten state.

D Substance Q consists of strong electrostatic attractions between oppositely charged ions.

10 In 1986, an accident in Chernobyl Nuclear Power Plant resulted in the melting of its nuclear reactor core, and the release of radioactive isotopes into the atmosphere.

One of these radioactive isotopes is $^{131}_{53}\mathrm{I}$, which has been linked to an increased risk of thyroid cancer.

Which statement about $^{131}_{53}\mathrm{I}$ is correct?

A An atom of $^{127}_{53}X$ is an isotope of $^{131}_{53}\mathrm{I}$.

B An atom of $^{131}_{53}\mathrm{I}$ has 78 nucleons.

C An ion of $^{131}_{53}\mathrm{I}$ has 131 neutrons.

D A molecule of $^{131}_{53}\mathrm{I}$ has a relative molecular mass of 184.

11 A sample of potassium oxide, K_2O, is dissolved in 250 cm^3 of distilled water. 25.0 cm^3 of the solution is neutralised by 15.0 cm^3 of 1 mol/dm^3 dilute sulfuric acid.

What is the mass of potassium oxide dissolved in 250 cm^3 of distilled water?

A 6.9 g

B 8.1 g

C 14.1 g

D 28.2 g

12 A piece of seashell has a mass of 23.0 g. Seashell contains impure calcium carbonate. When analysed, the seashell is found to contain 0.226 moles of pure calcium carbonate.

What is the percentage purity of calcium carbonate in the piece of seashell?

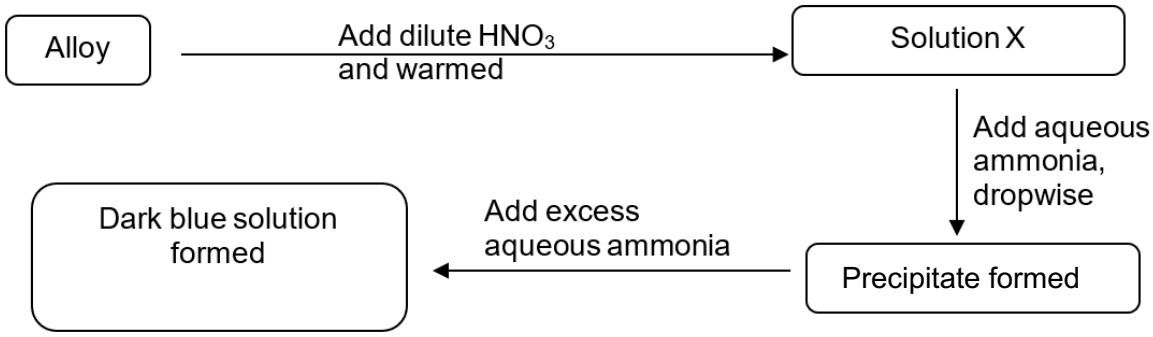
A 0.4 %

B 0.983 %

C 1.70 %

D 98.3 %

13 A student conducted the following tests on a sample of alloy containing two metals.



What are the two possible metals present in the alloy?

A iron and zinc

B aluminium and copper

C zinc and copper

D lead and iron

14 Aqueous copper(II) sulfate is electrolysed using copper electrodes.

Which statement is true?

A A colourless gas is liberated at the anode.

B The electrolyte turns from blue to colourless.

C A reddish-brown solid is deposited at the cathode.

D The electrolyte becomes acidic.

15 In electroplating a chromium bracelet with silver, which combination is correct?

	anode	cathode	electrolyte
A	bracelet	silver	silver nitrate
B	silver	bracelet	silver nitrate
C	bracelet	silver	chromium nitrate
D	silver	bracelet	silver chloride

16 Four different metals, zinc, silver, magnesium and iron were added separately in excess, to blue copper(II) sulfate solution in four beakers.

How many beaker(s) of solution will be colourless after a week?

A 1 **B** 2 **C** 3 **D** 4

17 Hydrogen peroxide, H_2O_2, reacts with an oxide, M_2O, as shown below.

$$M_2O\ (s)\ +\ H_2O_2\ (l)\ \rightarrow\ 2M\ (s)\ +\ H_2O\ (l)\ +\ O_2\ (g)$$

What is the function of the oxide M_2O, in this reaction?

A an oxidising agent

B a reducing agent

C a catalyst

D a base

18 In the electrolysis of molten aluminium oxide, 4 moles of aluminium ions (Al^{3+}) were discharged at the cathode.

Which one of the following would be discharged by the same amount of electricity?

A 4 mole of Cu^{2+} in the electrolysis of aqueous copper(II) sulfate

B 6 moles of Pb^{2+} in the electrolysis of molten lead(II) bromide

C 6 moles of Ag^{+} in the electrolysis of aqueous silver nitrate

D 12 moles of Zn^{2+} in the electrolysis of molten zinc sulfate

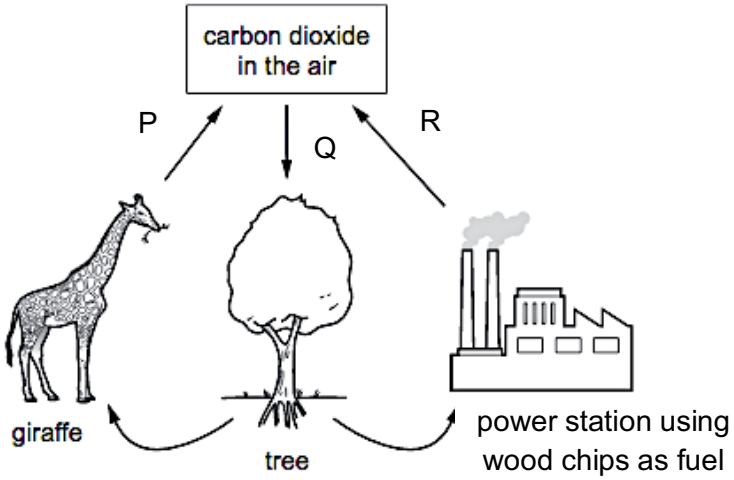
19 The following waste gases from a coal burning power station are passed through wet powdered calcium carbonate to reduce gaseous pollutants from escaping into the atmosphere.

sulfur dioxide	carbon monoxide	sulfur trioxide
nitrogen monoxide	nitrogen dioxide	carbon dioxide

How many waste gases will be removed by the wet powdered calcium carbonate?

A 2 **B** 3 **C** 4 **D** 5

20 The diagram shows part of the carbon cycle. P, Q and R refer to specific processes of the carbon cycle.

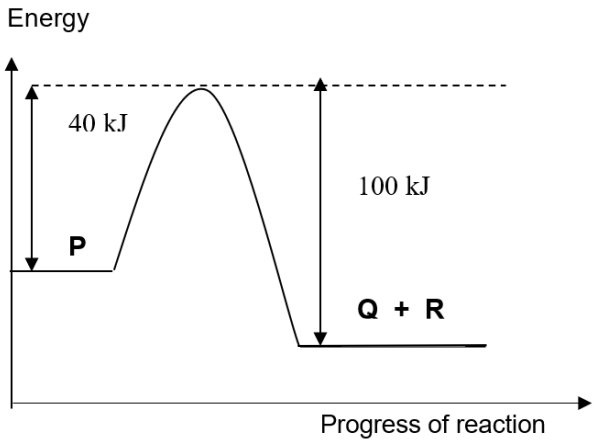


Which row correctly describe the energy changes of these processes?

	P	Q	R
A	endothermic	exothermic	endothermic
B	endothermic	endothermic	exothermic
C	exothermic	exothermic	endothermic
D	exothermic	endothermic	exothermic

21 The diagram below represents the energy profile diagram for the reaction,

$$P \rightarrow Q + R \qquad \Delta H = X \text{ kJ / mol}$$



What is the value of X?

A – 60 **B** + 60 **C** – 140 **D** + 140

22 Which property shows an increasing trend in the elements, from Group I to Group VII, across a period of the Periodic Table?

A metallic character

B non-metallic character

C number of electron shells

D reactivity with water

23 Aerials in portable radios are made of a mixture of the oxides of calcium and iron known as 'ferrite'. It contains 18.5% calcium and 51.9% iron by mass.

Which is the empirical formula of 'ferrite'?

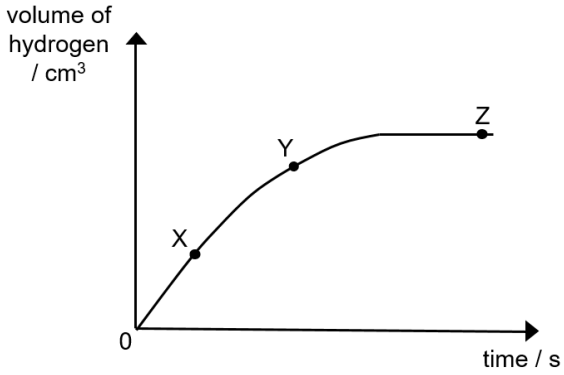
A $CaFe_2O$

B $CaFe_2O_4$

C Ca_2FeO_2

D Ca_4Fe_2O

24 The graph shows how the volume of hydrogen gas produced by the reaction between 50 cm^3 of 2.0 mol / dm^3 hydrochloric acid and an excess of magnesium varied with time.



Which statement is correct?

A The reaction is faster at point Y than point X.

B All the magnesium has reacted at point Z.

C The volume of gas produced is doubled if 100 cm^3 of 2.0 mol / dm^3 hydrochloric acid is used.

D The time taken to reach completion decreases if 100 cm^3 of 2.0 mol / dm^3 hydrochloric acid is used.

25 Which is the overall equation for the reactions that take place in a hydrogen fuel cell?

At the positive electrode: $O_2\,(g) + 2H_2O\,(l) + 4e^- \rightarrow 4OH^-\,(aq)$
At the negative electrode: $2H_2\,(g) + 4OH^-\,(aq) \rightarrow 4H_2O\,(l) + 4e^-$

A $2H_2\,(g) + O_2\,(g) \rightarrow 2H_2O\,(l)$

B $2H_2O\,(l) \rightarrow 2H_2\,(g) + O_2\,(g)$

C $2H^+\,(aq) + 2e^- \rightarrow H_2\,(g)$

D $4OH^-\,(aq) \rightarrow 2H_2O\,(l) + O_2\,(g) + 4e^-$

26 Which of the statements are true of the Haber process?

1 Ammonia formed is condensed and obtained as a liquid.
2 Hydrogen gas is obtained from cracking of crude oil.
3 Nickel catalyst is used to increase the yield of ammonia.
4 Nitrogen gas is oxidised to form ammonia.

A 1 and 2 only

B 1 and 3 only

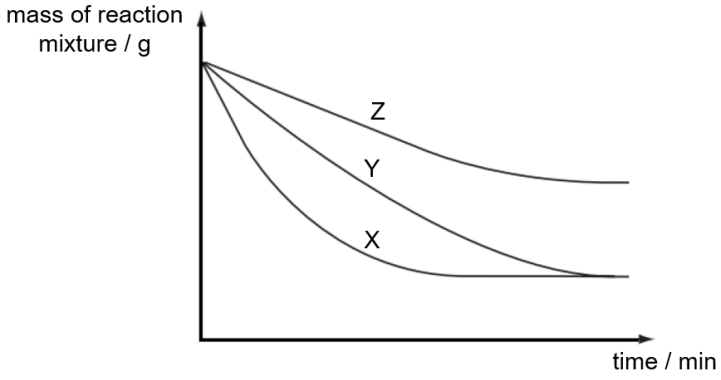
C 2 and 3 only

D 3 and 4 only

27 A student carried out two experiments under the same room temperature and pressure to investigate the speed of reaction of marble with 0.2 mol / dm^3 hydrochloric acid.

experiment 1: excess powdered marble is added to 20 cm^3 of dilute hydrochloric acid
experiment 2: excess marble chips is added to 20 cm^3 of dilute hydrochloric acid

The mass of the reaction mixture was measured at regular time intervals and plotted against time.



Which pair of curves is obtained in the two experiments?

	experiment 1	experiment 2
A	X	Y
B	Y	Z
C	X	Z
D	Y	X

28 Tin is a metal between iron and lead in the reactivity series.

Which method is used for the extraction of tin from its ores?

A heat with limestone

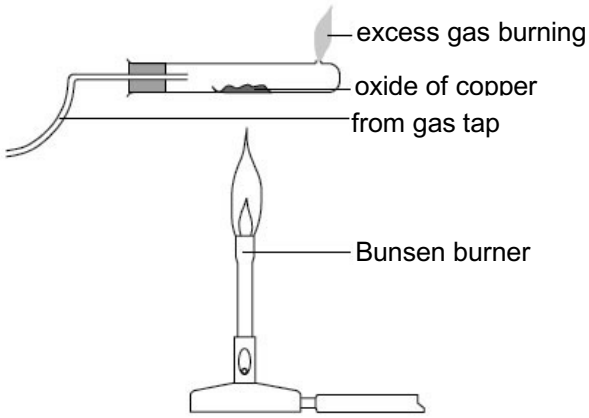
B heat with carbon

C electrolysis of the molten ore

D heat with copper powder

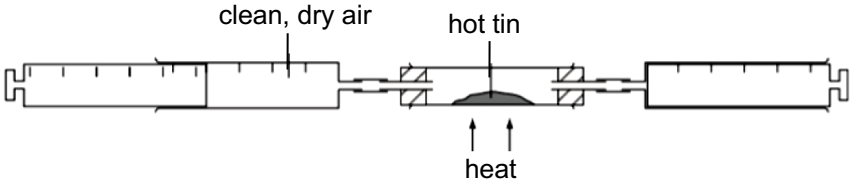
29 The following set-up is used to study the reduction of an oxide of copper by heating it with a gas.

The oxide of copper is Cu_2O, which is a red solid. What would be observed when the reaction has stopped, and what is the purpose of burning the excess gas?



	observation	purpose of burning excess gas
A	red solid turns pink	carbon dioxide is a pollutant
B	red solid remains unchanged	carbon monoxide used to reduce oxide is poisonous
C	red solid turns pink	hydrogen gas used to reduce oxide is highly flammable
D	red solid turns black	nitrogen dioxide gas used to reduce oxide is a pollutant

30 A sample of clean, dry air is passed over hot tin until all the oxygen in the air has reacted with tin.



The volume of air decreases by 30 cm^3.
What was the estimated original volume of the sample of air?

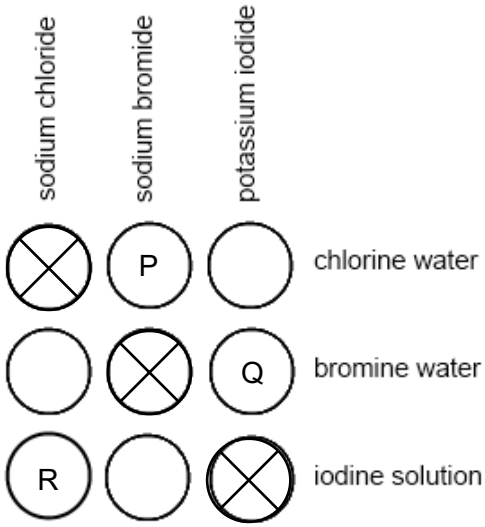
A 6 cm^3

B 40 cm^3

C 120 cm^3

D 145 cm^3

31 Drops of chlorine, bromine and iodine water are added to petri-dishes containing salt solutions of other halides, shown below.



Which option correctly identifies what will be observed in dishes P, Q and R?

	P	Q	R
A	colourless solution turns orange	colourless solution turns brown	no visible reaction
B	orange solution turns colourless	brown solution turns orange	pale yellow solution turns brown
C	colourless solution turns orange	no visible reaction	colourless solution turns brown
D	orange solution turns colourless	no visible reaction	no visible reaction

32 The compound C_6H_{10} is a member of a hydrocarbon homologous series.
Which one of the following is the first member of this series?

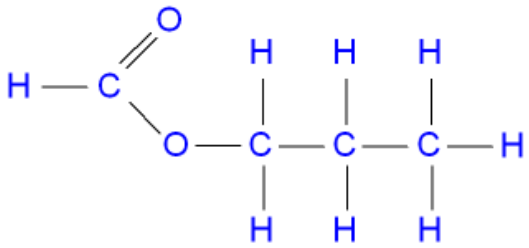
A C_2H_2

B C_2H_3

C C_2H_4

D C_2H_6

33 A compound associated with the smell or flavour of raspberries has the structure:



Which alcohol and carboxylic acid can be used to make this compound in the laboratory?

A butanol and ethanoic acid

B methanol and propanoic acid

C propanol and methanoic acid

D ethanol and ethanoic acid

34 Which comparison of the properties of pentane, C_5H_{12} and propane is true?

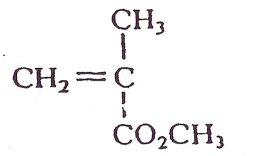
A Propane has a higher boiling point.

B Propane has a lower melting point.

C Propane is less flammable.

D Propane is more viscous.

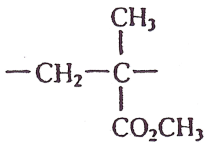
35 In an artificial hip joint, bone cement is used to attach the polyethene cup for the joint to the pelvic girdle. Bone cement is formed by the polymerisation of 2-methylpropenoate and the process is highly exothermic.



2-methylpropenoate

Which one of the following is/are correct statements about this polymerisation?

1. The repeat unit of the polymer is



2. The formation of cement occurs by addition polymerisation.
3. Less energy is released in making two C−C bonds than absorbed in breaking a C=C bond.

A 1 and 2

B 2 and 3

C 1 and 3

D 1, 2 and 3

36 A gaseous hydrocarbon Q, on heating with a catalyst, forms a solid compound R.
Both Q and R have the same empirical formula.

What type of reaction is this?

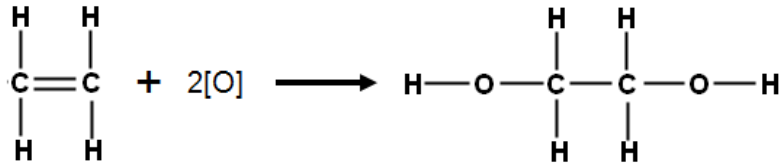
A addition polymerisation

B condensation polymerisation

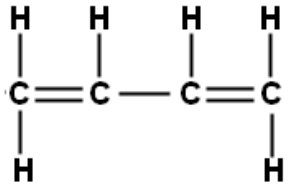
C hydrogenation

D substitution

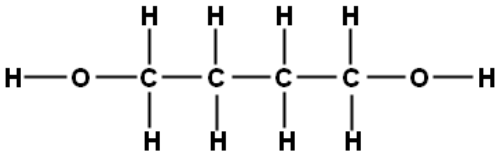
37 Cold, dilute potassium manganate(VII) can be used to oxidise alkenes to diols. An example is shown below with ethene. The [O] represents an oxygen atom from the oxidising agent.



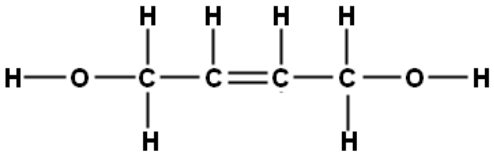
What is the product when the compound below is reacted with cold, dilute potassium manganate(VII)?



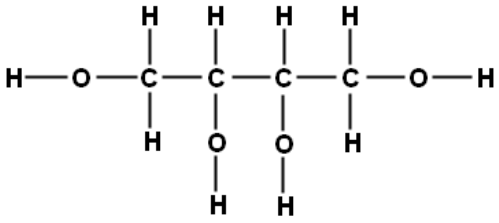
A



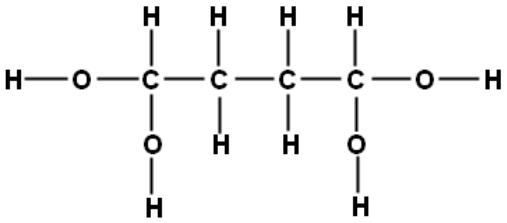
B



C



D



38 How many different alkenes have the molecular formula C_4H_8 ?

A 2 **B** 3 **C** 4 **D** 5

39 A carboxylic acid has the formula $C_2H_4O_2$.

What type of formula is this?

A empirical formula

B general formula

C molecular formula

D structural formula

40 An alcohol, X, was fully oxidised to a carboxylic acid. Neutralisation of the acid with calcium carbonate gave a salt of formula $(CH_3CO_2)_2Ca$.

What was alcohol X?

A CH_3OH

B C_2H_5OH

C C_3H_7OH

D C_4H_9OH

End of Paper

YISHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY 4 EXPRESS

CANDIDATE NAME							
CLASS					INDEX NUMBER		

CHEMISTRY **6092/01**

Paper 1 Multiple Choice **1 September 2022**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** or **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 20.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **19** printed pages with **1** blank page.

[Turn over

679

1 Magnesium sulfate is prepared by reacting excess magnesium carbonate with dilute sulfuric acid.

$$MgCO_3(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + CO_2(g) + H_2O(l)$$

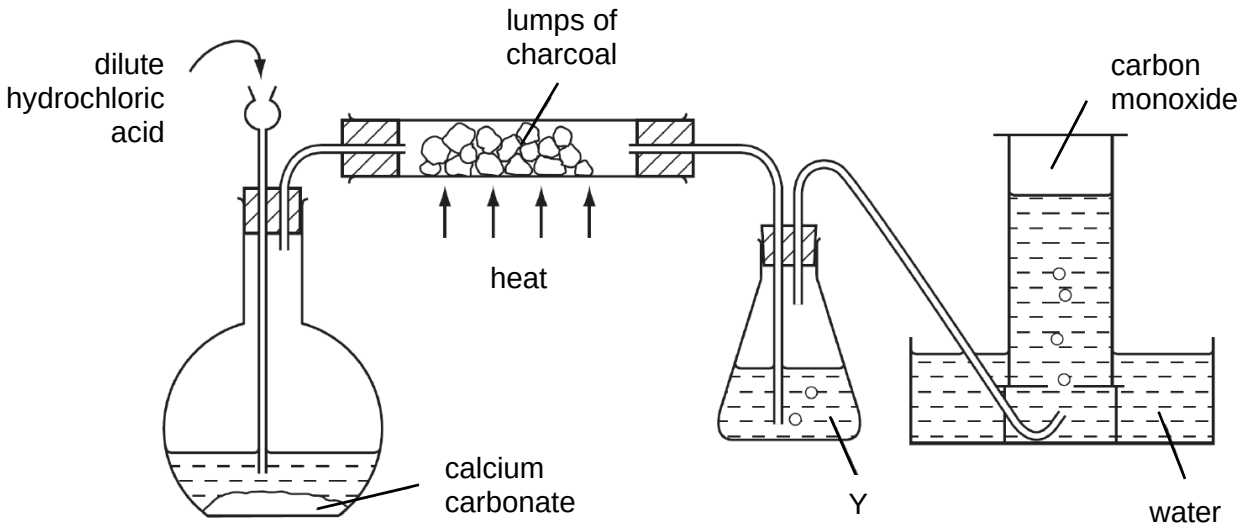
In addition to measuring cylinder, the following pieces of apparatus are available.

1 thermometer
2 evaporating dish
3 filter funnel
4 gas syringe

Which two pieces of apparatus are needed to obtain magnesium sulfate crystals?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

2 The diagram shows apparatus used to obtain carbon monoxide.



What is the main purpose of Y?

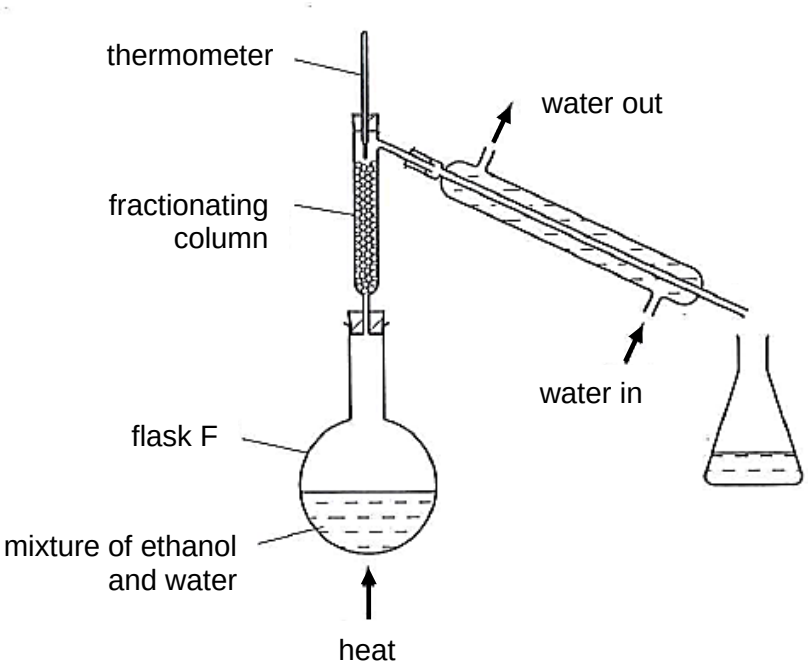
A to dry the gas

B to prevent water from being sucked back on to the hot charcoal

C to remove carbon dioxide from the gas

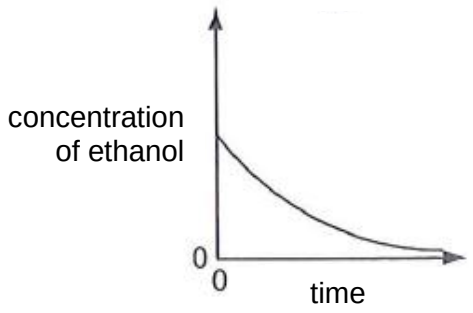
D to remove hydrogen chloride from the gas

3 The apparatus shown is used to distil ethanol from a mixture of ethanol and water.

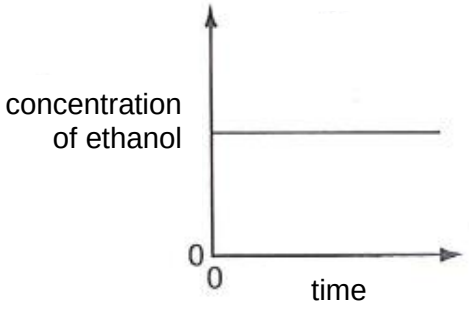


Which graph shows the change in concentration of ethanol in flask F over time?

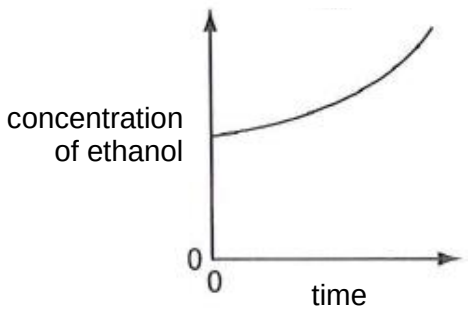
A



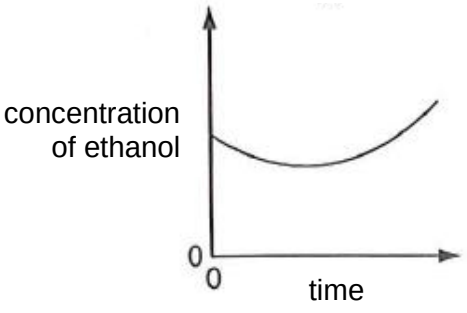
B



C



D



4 Aqueous sodium hydroxide was added to a mixture of an aqueous solution of Z. On warming, ammonia gas evolved. When aluminium foil is added to the reaction mixture and warmed, more ammonia gas was given off.

What could chemical Z be?

A aluminium nitrate

B aluminium sulfate

C ammonium nitrate

D ammonium sulfate

5 Some students are asked to describe differences between liquids and gases.

Four of their descriptions are:

1 Particles in liquid and gas are disorderly arranged.
2 Particles in gas are smaller than in liquid.
3 Particles in liquid vibrate about fixed positions.
4 When a force is applied, particles in gas are able to move closer together.

Which descriptions are correct?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

6 Which particle contains the same number of both neutrons and electrons?

A $^{40}_{20}Ca^{2+}$ **B** $^{24}_{12}Mg^{2+}$ **C** $^{19}_{9}F^{-}$ **D** $^{32}_{16}S^{2-}$

7 Solid copper metal, aqueous copper(II) sulfate, solid graphite and molten sodium chloride will all conduct electricity.

Which pair will conduct electricity because they both contain mobile ions?

A aqueous copper(II) sulfate and molten sodium chloride

B solid copper metal and aqueous copper(II) sulfate

C solid copper metal and solid graphite

D solid graphite and molten sodium chloride

8 Which salt contains covalent bond?

A ammonium chloride

B magnesium bromide

C potassium iodide

D sodium fluoride

9 Which statement explains why potassium chloride, KC*l*, has a lower melting point than calcium oxide, CaO?

A Potassium is more reactive than calcium.

B Potassium chloride has covalent bonds and calcium oxide has ionic bonds.

C The melting point of potassium is lower than that of calcium.

D The attraction between K^+ and Cl^- is weaker than Ca^{2+} and O^{2-}.

10 Bromoethane reacts with sodium hydroxide.

The equation for the reaction is shown.

$$C_2H_5Br + NaOH \rightarrow C_2H_5OH + NaBr$$

In an experiment, 10.90g of bromoethane is converted into 3.45g of ethanol.

What is the percentage yield of ethanol?

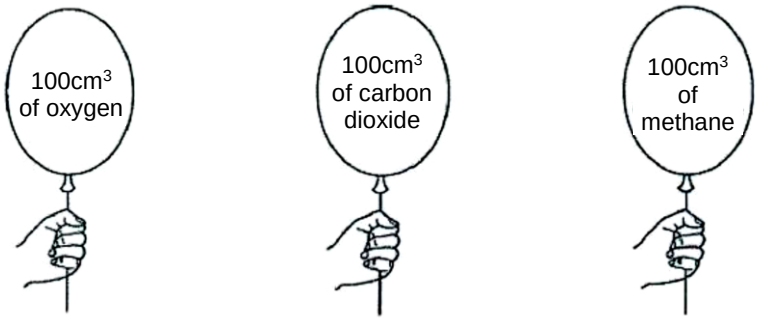
A 32 %

B 42 %

C 75 %

D 100 %

11 The diagram shows three balloons filled with different gases held by students. All gas volumes were measured at room temperature pressure.



The students made the following statements.

1 The number of moles of gases in the 3 balloons is different.

2 The number of molecules in the 3 balloons is the same.

3 The mass of gases in the 3 balloons is different.

Which statements are correct?

A 1 and 2

B 1 and 3

C 1, 2 and 3

D 2 and 3

12 A piece of chalk has a mass of 23.0 g. Chalk is impure calcium carbonate.

When analysed, the chalk is found to contain 0.226 moles of pure calcium carbonate, $CaCO_3$.

What is percentage purity of the piece of chalk?

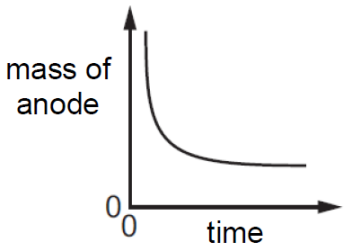
[M_r: $CaCO_3$, 100]

A 0.983 % **B** 1.02 % **C** 77.0 % **D** 98.3 %

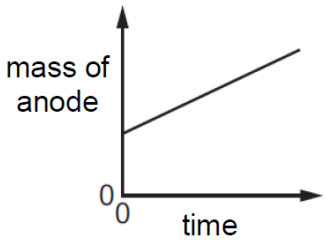
13 Aqueous copper(II) sulfate is electrolysed using copper electrodes. The current is constant and the anode is weighed at regular time intervals.

Which graph is obtained when the mass of the anode is plotted against time?

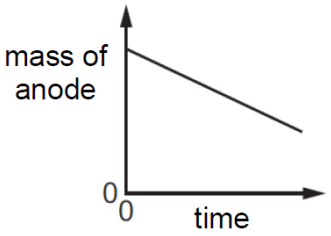
A



B



C



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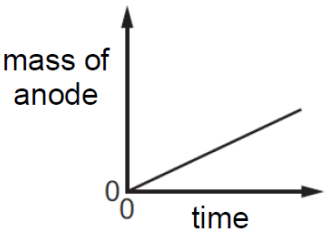


14 Three different processes using electrolysis with inert electrodes are listed.

1 electrolysis of concentrated aqueous sodium chloride

2 electrolysis of dilute sulfuric acid

3 electrolysis of dilute copper(II) chloride

Which processes form a gas at the cathode?

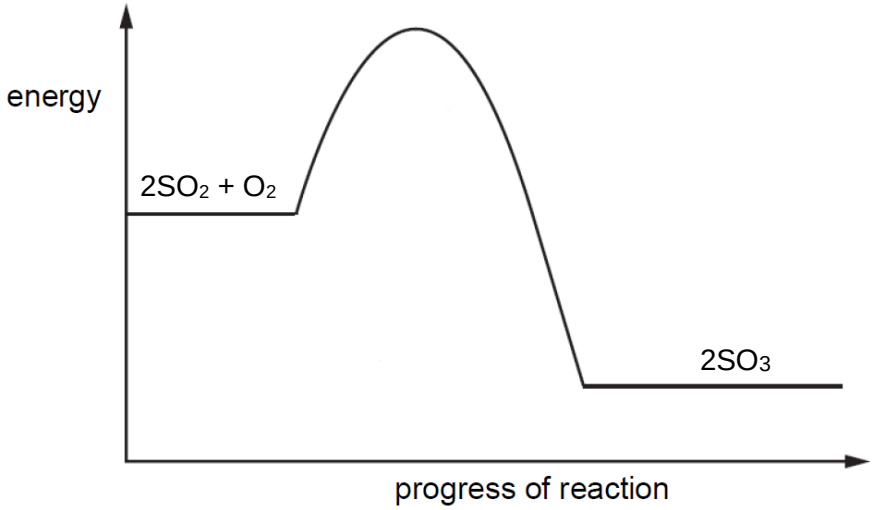
A 1 and 2

B 2 only

C 2 and 3

D 3 only

15 The energy profile diagram for the reversible reaction $2SO_2 + O_2 \rightleftharpoons 2SO_3$ is shown.



Which statements about this reaction are both correct?

	statement 1	statement 2
A	The reverse reaction is endothermic.	The activation energy is different for the forward and reverse reactions.
B	The reverse reaction is endothermic.	The activation energy is the same for the forward and reverse reactions.
C	The reverse reaction is exothermic.	The activation energy is different for the forward and reverse reactions.
D	The reverse reaction is exothermic.	The activation energy is the same for the forward and reverse reactions.

16 The table compares the strengths of bonds present in substances, P_2, Q_2 and PQ_3 that are involved in the reaction shown.

$$P_2 + 3Q_2 \rightarrow 2PQ_3$$

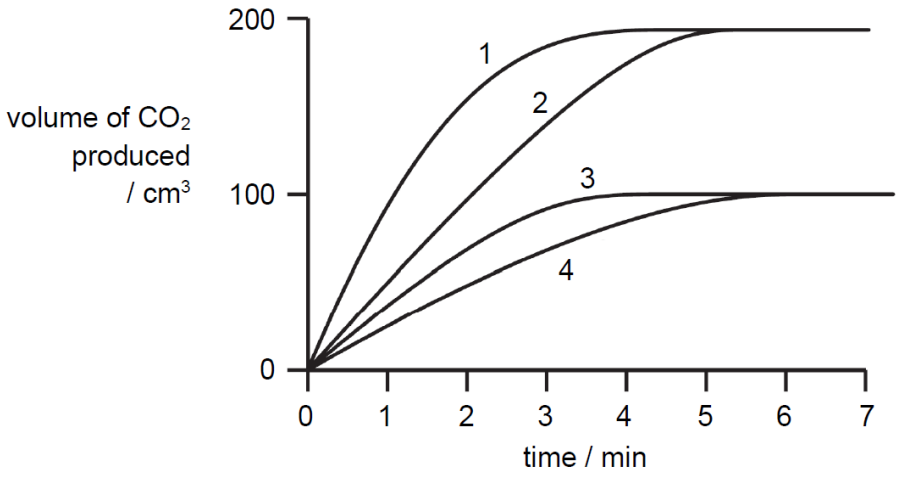
Which comparison of the strengths of the bonds will result in the most endothermic reaction?

	bonds in P_2	bonds in Q_2	bonds in PQ_3
A	strong	strong	weak
B	strong	weak	weak
C	weak	strong	strong
D	weak	weak	strong

17 In four separate experiments, 1, 2, 3 and 4, dilute nitric acid was added to excess marble chips and the volume of carbon dioxide formed was measured.

In all four experiments, the same volume of dilute nitric acid was used. Its concentration, or temperature, or both concentration and temperature, were changed.

The results of the experiments are shown on the graph.



Which statement is correct?

A A lower concentration of acid was used in experiment 1 than in experiment 3.

B Experiment 4 was faster than experiment 3.

C The acid used in experiment 2 was of a lower temperature than in experiment 1.

D The temperature of the acid was the same in experiments 1 and 2.

18 Separate samples of a solution H is added to aqueous potassium iodide and to acidified potassium manganate(VII). The iodide ions remain unchanged and the manganate(VII) ions are reduced in the reaction.

What are the observations?

	aqueous potassium iodide	acidified potassium manganate(VII)
A	brown solution turns colourless	colourless solution turns purple
B	colourless solution turns brown	purple solution turns colourless
C	solution remains brown	solution remains colourless
D	solution remains colourless	purple solution turns colourless

19 Three elements X, Y and Z belong to the same period in the Periodic Table.

The properties of their oxides are given in the table.

oxide of X:	soluble in both nitric acid and aqueous sodium hydroxide
oxide of Y:	insoluble in water and aqueous sodium hydroxide but dissolves readily in nitric acid
oxide of Z:	changes acidified potassium manganate(VII) from purple to colourless

Based on the statements above, arrange X, Y and Z in order of **decreasing** atomic numbers in the Periodic Table.

A Y, X, Z

B X, Y, Z

C Z, Y, X

D Z, X, Y

20 Four statements about acids were made.

1 Their pH value is less than 7.

2 They are completely ionised when dissolved in water.

3 They react with any metal to give hydrogen gas.

4 Dibasic acids are stronger than monobasic acids.

Which statements must be true for all acidic solutions?

A 1 only

B 1 and 3

C 1, 2 and 4

D 1, 2, 3 and 4

21 Which reactants could be used safely to prepare sodium nitrate?

A aqueous sodium hydroxide and dilute nitric acid

B aqueous sodium sulfate and aqueous potassium nitrate

C sodium and dilute nitric acid

D sodium and aqueous potassium nitrate

22 Which statement about the manufacture of ammonia by the Haber Process is correct?

A Nickel is used as a catalyst in this process.

B The reactants and product are compounds.

C The reactants are both obtained from the air.

D A high yield is favoured by conditions of high pressure and low temperature.

23 Elements from Group IV of the Periodic Table are shown.

carbon
silicon
germanium
tin
lead
flerovium

Which does **not** occur down Group IV?

A The elements become more metallic.

B The elements have more electron shells.

C The number of outer shell electrons increases.

D The proton number of the elements increases.

24 A new element, Gr, was discovered with the following properties.

solubility	electrical conductivity	formula of element	bonding in a molecule of the element
insoluble	does not conduct	Gr_2	Gr ≡ Gr

Which group is Gr from?

A Group III

B Group V

C Group VII

D Group 0

25 Which pair of compounds shows that transition elements have variable oxidation states?

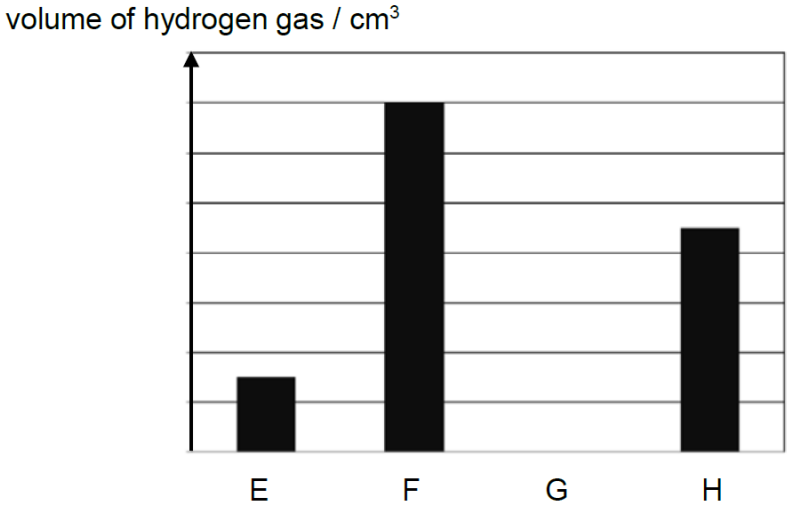
A Cr_2O_3 and $CrBr_3$

B $CuSO_4$ and $CuCl_2$

C Fe_2O_3 and $FeCl_2$

D NiO and $NiCl_2$

26 The bar chart shows the volume of hydrogen gas collected in 1.0 min when equal masses of metals E, F, G and H were added to excess dilute nitric acid



The carbonates of these metals were then heated.

Which row correctly shows the temperature required to decompose the carbonates in increasing order?

	increasing temperature →			
A	F	E	H	G
B	F	H	E	G
C	G	E	F	H
D	G	E	H	F

27 Which process removes carbon dioxide from the atmosphere?

A combustion of fuels
B photosynthesis
C respiration
D volcanic activity

28 The list shows the position of metal Q in the reactivity series of metals.

Na Al Fe Q Cu Ag

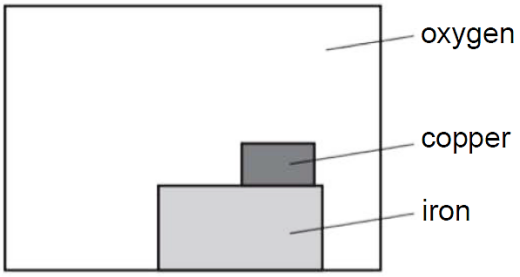
Which method(s) could be used to extract metal Q?

1 electrolysis of the solid metal oxide
2 heating the metal oxide with copper
3 heating the metal oxide with carbon

A 1, 2 and 3
B 1 and 3
C 2 and 3
D 3 only

29 Which diagram correctly shows the conditions required for rusting to take place and the metal used as sacrificial protection?

A



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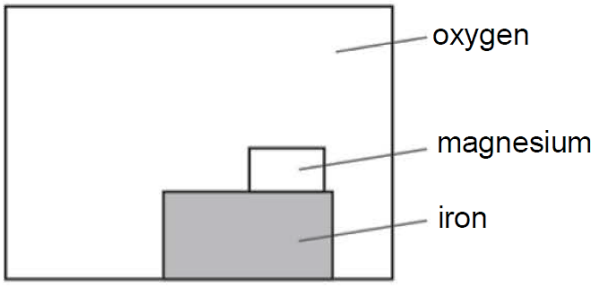

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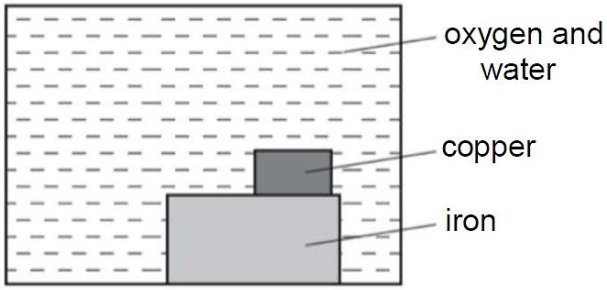

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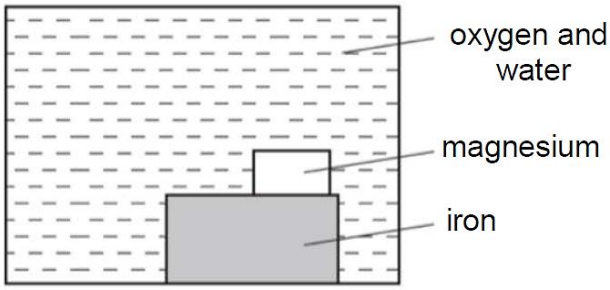


30 Petrol and diesel are two common fuels used by cars and buses respectively. The combustion of these fuels produces air pollutants.

The table shows the mass of pollutants found in the exhaust fumes when 1 kg of each fuel is burnt.

fuel	mass of pollutants/ g			
	carbon monoxide	oxides of nitrogen	sulfur dioxide	unburnt hydrocarbons
petrol	240	20	1	25
diesel	10	60	4	20

Which statement can be inferred from the table?

A Petrol contributes more towards the formation of acid rain.

B Carbon monoxide is produced by complete combustion of the fuels.

C All the pollutants listed can be removed by installing a catalytic converter.

D The temperature in the petrol engine is lower than that in the diesel engine.

31 Which method is the **least** effective method in reducing the amount of pollutant gases that cause acid rain?

A Burning fuel with low sulfur content.

B Reduce usage of air−conditioners.

C Pass waste gases through catalytic converters in motor vehicles.

D Use limestone to absorb pollutant gases from factories.

32 The table shows the boiling points of four fractions obtained when crude oil is distilled.

fraction	W	X	Y	Z
boiling point/ ^{o}C	35 – 75	80 – 145	150 – 250	greater than 250

Which statement describing the fractions is true?

A Fraction W is more flammable than fraction Y.

B Fraction W is more viscous than fraction Z.

C The density of fraction X is greater than that of fraction Z.

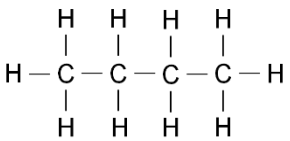
D The molecules in X have a longer chain length than those in fraction Z.

33 Several observations of an organic compound were made:

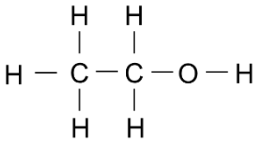
- liquid Br_2 remained brown when added to it in the dark
- there was no observable change when it was heated with acidified $KMnO_4$
- there was no observable change when it was added to Mg metal

Which is the organic compound?

A



B



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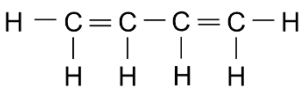

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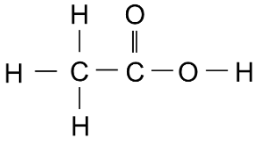


34 The table shows the reactions between chlorine and methane.

Which row shows the correct equation and condition of the reaction?

	equation	condition
A	$Cl_2 + CH_4 \rightarrow CH_2Cl_2 + H_2$	gases are mixed in the presence of UV light
B	$Cl_2 + CH_4 \rightarrow CH_2Cl_2 + H_2$	methane is bubbled into aqueous chlorine
C	$Cl_2 + CH_4 \rightarrow CH_3Cl + HCl$	gases are mixed in the presence of UV light
D	$Cl_2 + CH_4 \rightarrow CH_3Cl + HCl$	methane is bubbled into aqueous chlorine

35 When decane, $C_{10}H_{22}$, is cracked, only three compounds are formed.

The compounds are ethane, ethene and propene.

What is the ratio of the compounds formed?

	ethane	ethene	propene
A	1	1	1
B	1	1	2
C	1	2	1
D	2	1	1

36 One mole of hydrocarbon, J reacts with three moles of bromine to form a saturated organic compound.

What could be the molecular formula of J?

A C_3H_6

B C_4H_6

C C_5H_8

D C_6H_8

37 The properties of three substances are given:

1 an ester from an alcohol and a carboxylic acid

2 ethanol from ethene

3 margarine from vegetable oil

In which preparations are one or more double bonds converted to single bonds?

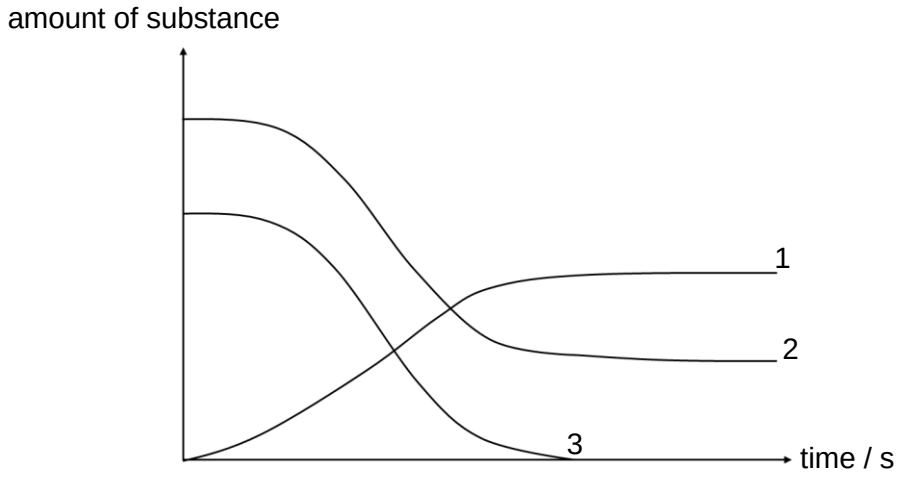
A 1 and 2

B 1 only

C 2 and 3

D 3 only

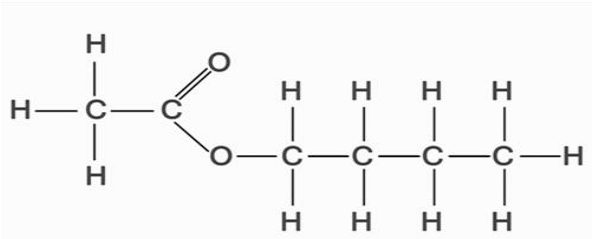
38 The graphs show the amount of various substances present in a mixture during the process of fermentation.



Which row shows the correct substance for each graph?

	graph 1	graph 2	graph 3
A	ethanol	yeast	glucose
B	glucose	yeast	ethanol
C	glucose	ethanol	yeast
D	ethanol	glucose	yeast

39 A food chemist wants to create the odour of pineapples using the organic compound,



Which row correctly shows the pair of reactants that would react to form this compound and the name of the compound?

	reactant 1	reactant 2	name of the compound
A	CH_3CH_2OH	$CH_3CH_2CH_2CH_2OH$	ethyl butanoate
B	CH_3CH_2OH	$CH_3CH_2CH_2COOH$	ethyl butanoate
C	CH_3COOH	$CH_3CH_2CH_2CH_2OH$	butyl ethanoate
D	$CH_3CH_2CH_2COOH$	CH_3COOH	butyl ethanoate

40 The table refers to the polymers nylon and poly(ethene).

Which row is correct?

	polymer	type	use
A	nylon	addition	cling film
B	nylon	condensation	parachutes
C	poly(ethene)	addition	parachutes
D	poly(ethene)	condensation	cling film

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**Key** proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 A*l* aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 C*l* chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 T*l* thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 F*l* flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

YUYING SECONDARY SCHOOL
PRELIMINARY EXAMINATION
Secondary 4 Express

NAME _____

CLASS _____ **REG. NO** _____

CHEMISTRY 6092/1

Paper 1 **25 August 2022**

1 hour

Candidates answer on the Question Paper. **Setter: Mr Danny Louis**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on this question booklet.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

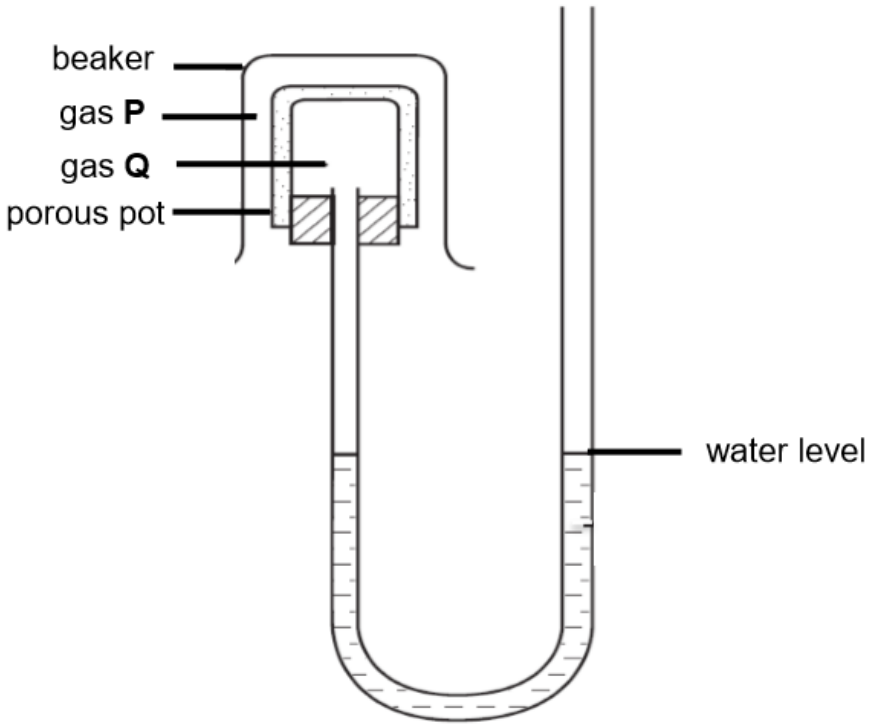
Answer **all** questions.
For each question there are four possible answers **A, B, C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

The use of an approved calculator is expected, where appropriate.
A copy of the Periodic Table is printed on page 17.

For Examiner's Use	
Total	/40

This document consists of **17** printed pages.

1 A beaker of gas **P** is inverted over a porous pot containing gas **Q** as shown.



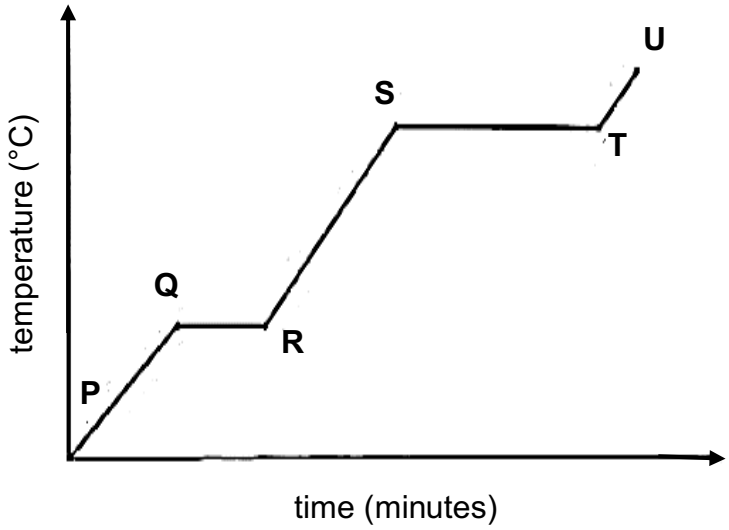
Which pair of gases will result in the water level remaining unchanged?

	P	**Q**
A	CH_4	N_2
B	C_2H_4	CO
C	C_2H_6	CO_2
D	C_3H_8	O_2

2 Which of the following occurs when iodine sublimes?

A distance between iodine particles increases
B forces of attraction between iodine particles become stronger
C iodine particles become lighter
D iodine particles begin to be arranged in a more orderly manner

3 The following shows the heating curve of ice.



Which description in the table below **best** explains the respective section of the graph?

	section	description
A	**P** to **Q**	all ice molecules are in fixed positions
B	**Q** to **R**	the average kinetic energy of the particles remains constant
C	**R** to **S**	the volume of steam is increasing
D	**T** to **U**	water is boiling

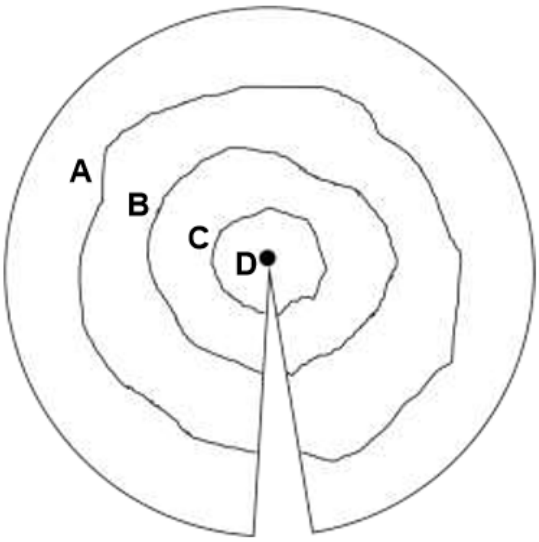
4 Propyl ethanoate and water are two liquids, which are immiscible.
Which method is **best** to separate a mixture of propyl ethanoate and water?

A filtration
B fractional distillation
C use a separating funnel
D evaporation to dryness

5 Which piece of apparatus is **not** required to obtain water from a can of green tea?

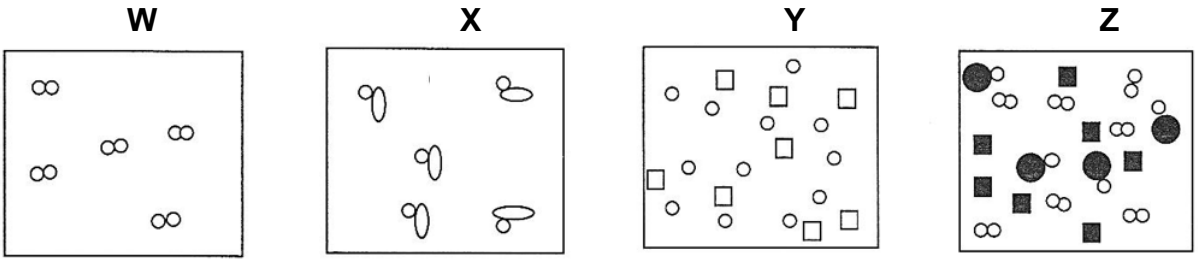
A white tile
B condenser
C distillation flask
D fractionating column

6 Paper chromatography was used to separate an ink which is comprised of several dyes. In the experiment, a few drops of solvent was added to the centre of the filter paper and allowed to spread out.
The diagram below shows the chromatogram obtained from the experiment.
Which dye has the greatest solubility in the solvent used?



7 The diagrams below can be used to illustrate the following.

I pure element
II mixture of elements
III pure compound
IV mixture of elements and a compound



Which row in the table below is **correct**?

	I	II	III	IV
A	**W**	**X**	**Y**	**Z**
B	**Z**	**W**	**X**	**Y**
C	**W**	**Y**	**X**	**Z**
D	**X**	**Z**	**W**	**Y**

8 The table shows details of the particles present in the ions of potassium and sulfur.

formula	proton number	nucleon number	number of neutrons	number of electrons
K^+	19	39	**X**	**Y**
S^{2-}	**Z**	32	16	18

What are the values of **X**, **Y** and **Z**?

	X	Y	Z
A	20	19	20
B	21	19	16
C	21	18	20
D	20	18	16

9 Which element would be expected to form an ion with the largest ionic radius?

A chlorine
B fluorine
C magnesium
D oxygen

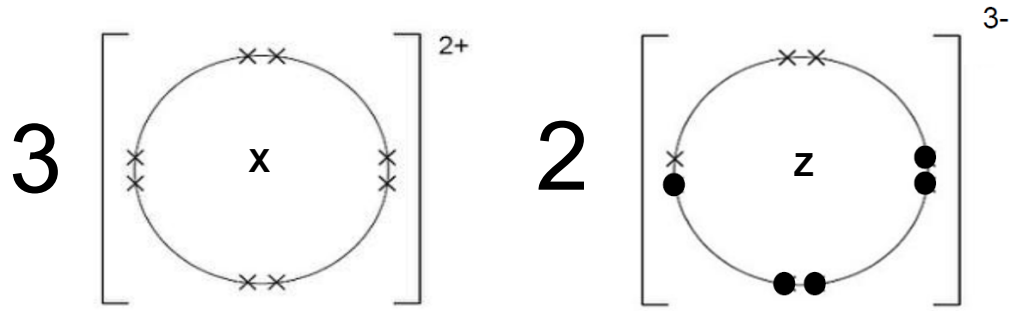
10 Element **J** is found in Group II of the Periodic Table. It has an atomic number b, and a nucleon number a.
Which entry shows the correct information on the ion formed by isotope atom **J**?

	number of protons	number of neutrons	number of electrons
A	a	a – b + 1	b + 2
B	a	b	b – 2
C	b	a – b	b – 2
D	b	b – a	b – 2

11 An element **S** has 2 isotopes of mass numbers 16 and 18. Its average relative atomic mass is 16.4.
What is the proportion of each isotopes in element **S**?

A 50% of S-16 and 50% of S-18
B 60% of S-16 and 40% of S-18
C 70% of S-16 and 30% of S-18
D 80% of S-16 and 20% of S-18

12 The dot-and-cross diagram (with only the outer electrons) of the compound formed between element **X** and **Z** is shown below.

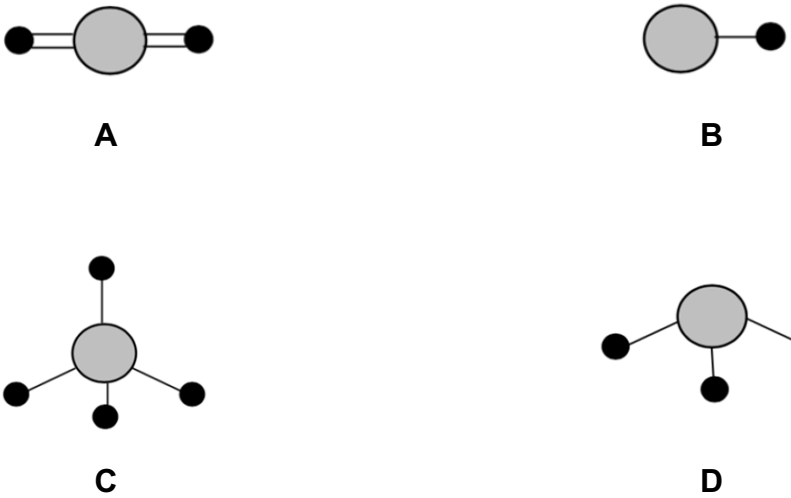


Which of the following is the correct set of formula of the chloride of **X** and **Z**?

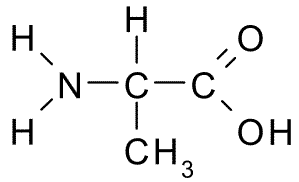
A **X**C*l* , **Z**$_3$C*l*
B **X**C*l* , **Z**C*l*$_3$
C **X**C*l*$_2$, **Z**$_3$C*l*
D **X**C*l*$_2$, **Z**C*l*$_3$

13 The models shown below represent two molecules.

Which model **correctly** represents the molecule formed between **X** and **Z**?



14 An amino acid, alanine, has the following structure.



How many pairs of valence electrons are **not** involved in bonding in the alanine molecule?

A 4
B 5
C 9
D 10

15 The relative molecular mass of a compound with the formula $K_3Co(CN)_x$ is 332.
What is the value of **x**?

A 3
B 4
C 5
D 6

16 The formula of an oxide of element **R** is R_2O.
6.2 g of R_2O contains 4.6 g of **R**.
How many moles of **R** ions does 6.2 g of R_2O contain?

A $\frac{1.6}{16} \div 2$
B $\frac{1.6}{16} \times 2$
C $\frac{6.2}{16 \times 2}$
D $\frac{6.2}{16} \times 2$

17 When the metal bismuth (Bi) is added to copper(II) nitrate, bismuth(III) nitrate and copper are formed.
What is the ionic equation of this reaction?

A $Bi(s) + Cu^{2+}(aq) \rightarrow Bi^{3+}(aq) + Cu(s)$
B $2Bi(s) + 3Cu^{2+}(aq) \rightarrow 2Bi^{3+}(aq) + 3Cu(s)$
C $Bi(s) + Cu(NO_3)_2(aq) \rightarrow Bi(NO_3)_3(aq) + Cu(s)$
D $Bi^{3+}(aq) + 3NO_3^-(aq) \rightarrow Bi(NO_3)_3(aq)$

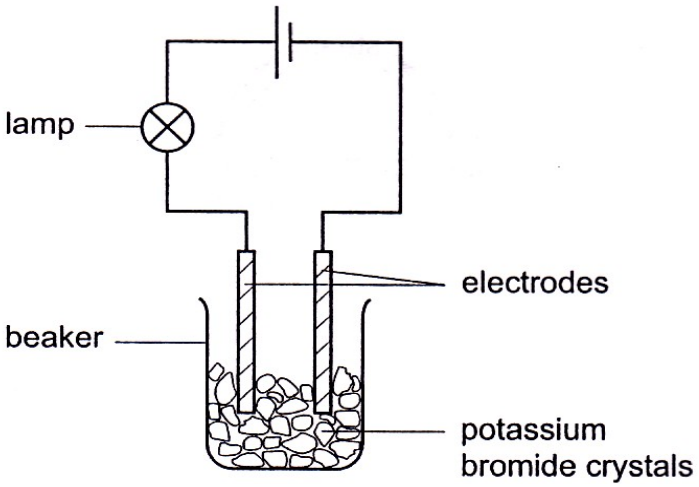
18 68 g of impure hydrogen peroxide, H_2O_2 (M_r = 34) decomposes in the presence of manganese(IV) oxide, to produce 2.4 dm^3 of oxygen gas at room temperature and pressure as shown in the equation below.

$$2\ H_2O_2 \rightarrow O_2 + 2\ H_2O$$

What is the purity of the hydrogen peroxide?

A 2.5 %
B 5.0 %
C 10.0 %
D 15.0 %

19 In the set-up shown below, the lamp does not light. Distilled water is then added to the beaker and the lamp lights up.



Which statement explains these results?

A Electrons are free to move in the solution when potassium bromide dissolves.
B Metal ions are free to move when potassium bromide melts.
C Metal ions are free to move when potassium reacts with water.
D Oppositely charged ions are free to move in the solution when potassium bromide dissolves.

20 A concentrated aqueous solution containing each of the following ions : Cl^-, SO_4^{2-}, Na^+, Cu^{2+}, is electrolysed using platinum electrodes.
Which row shows the ions that are discharged **first** at the two electrodes?

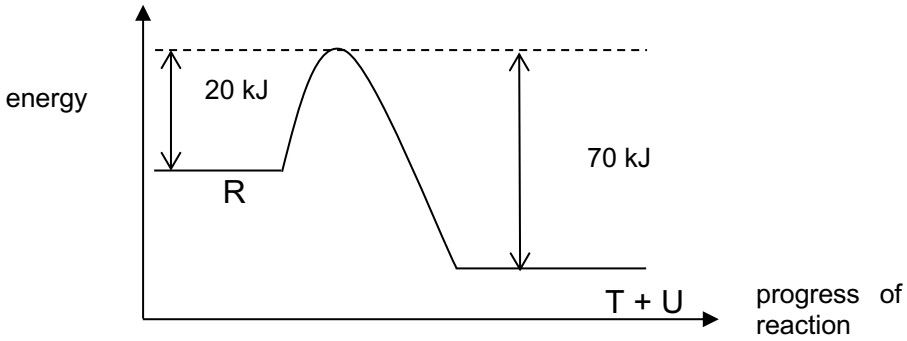
	at anode	**at cathode**
A	Cl^-	Cu^{2+}
B	Cl^-	Na^+
C	SO_4^{2-}	Cu^{2+}
D	SO_4^{2-}	Na^+

21 Which statement describes what happens in a hydrogen-oxygen fuel cell?

A Electricity is generated.
B Electricity is used to produce water.
C Hydrogen is burned to produce steam.
D Hydrogen reacts to form fuel.

22 The diagram below represents the energy profile diagram for the following reaction:

$R \rightarrow T + U$



What is the enthalpy change for this reaction?

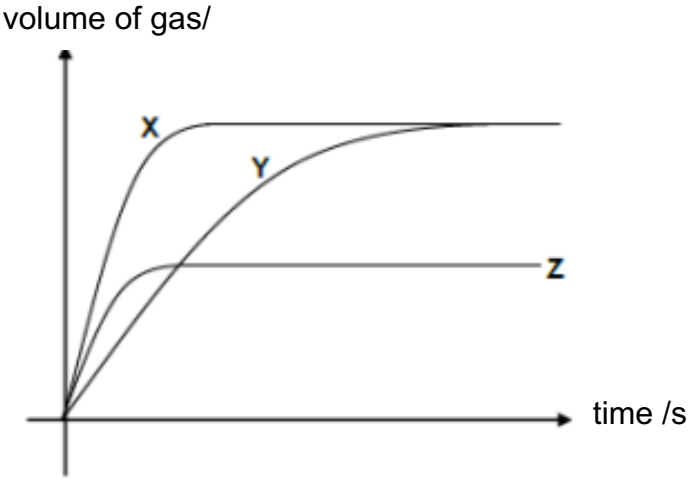
A + 50 kJ
B − 50 kJ
C − 70 kJ
D + 90 kJ

23 In which reaction is pressure **least** likely to affect the rate of reaction?

A $C\,(s) + CO_2\,(g) \rightarrow 2CO\,(g)$
B $N_2\,(g) + 3H_2\,(g) \rightarrow 2NH_3\,(g)$
C $NaOH\,(aq) + HCl\,(aq) \rightarrow NaCl\,(aq) + H_2O\,(l)$
D $2SO_2\,(g) + O_2\,(g) \rightarrow 2SO_3\,(g)$

24 A student performed three experiments to produce carbon dioxide gas using excess magnesium carbonate and dilute nitric acid at 30°C.

experiment	magnesium carbonate	dilute nitric acid	
	particle size	volume (cm^3)	concentration (mol/dm^3)
1	powdered	20	1.00
2	lumps	10	1.00
3	lumps	40	0.50



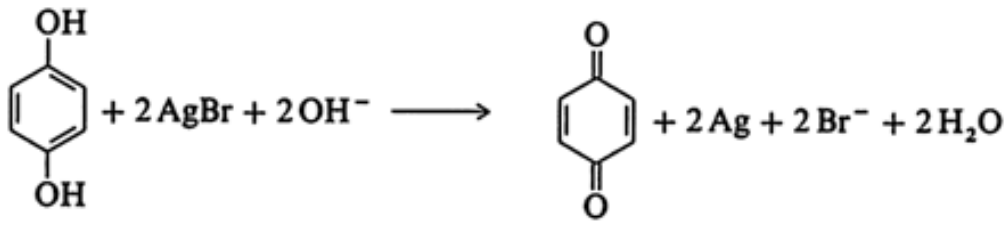
Which graph **best** represents each of the three experiments?

	experiment 1	experiment 2	experiment 3
A	X	Y	Z
B	Y	X	Z
C	X	Z	Y
D	Z	X	Y

25 Colour changes are often observed when redox reactions occur.
Which colour change is due to the reduction of the named agent?

A Black solid copper(II) oxide changes to blue aqueous copper(II) sulfate.
B Colourless aqueous potassium iodide changes to become a brown solution.
C Green aqueous iron(II) chloride changes to yellow/brown aqueous iron(III) chloride.
D Purple acidified potassium manganate(VII) changes to become colourless.

26 When exposed film from a camera is developed, one step involves reacting the light-activated silver bromide crystals with aqueous alkaline hydroquinone.



Which of the following **best** describes the role of hydroquinone?

A an acid
B an oxidizing agent
C an acid and reducing agent
D a base and oxidizing agent

27 The table below gives some statements about acids and alkalis and explanations for these statements.
Which row shows both a correct statement and a correct explanation for the statement?

	statement	**explanation**
A	ammonia can be made by heating ammonium sulfate with calcium hydroxide	the hydroxide ion acts as a base and removes H^+ from the ammonium ion
B	the pH of a weak acid is higher than the pH of a strong acid of the same concentration	pH shows the extent of ionisation– the more ionised the acid is, the higher the pH
C	calcium hydroxide can be used to control pH in soils	metal hydroxides are acidic and can reduce excess alkalinity
D	when an acid reacts with a metal, the metal is reduced	reduction is gain of electrons

28 Given a supply of lead(II) carbonate, copper(II) carbonate, dilute nitric acid and aqueous sodium hydroxide, how many different salts could be prepared?

A 1
B 2
C 3
D 4

29 An aqueous solution containing a mixture of copper(II), lead(II) and zinc ions was treated with an excess of aqueous ammonia. What was the precipitate left behind at the end of the reaction?

A copper(II) hydroxide and lead(II) hydroxide
B copper(II) hydroxide and zinc hydroxide
C lead(II) hydroxide only
D zinc hydroxide only

30 The positions of five elements **P, Q, R, S** and **T** are shown in the part of the Periodic Table.

Period	I	II	III	IV	V	VI	VII	0
1st								
2nd				**Q**				**S**
3rd					**T**		**R**	
4th	**P**							

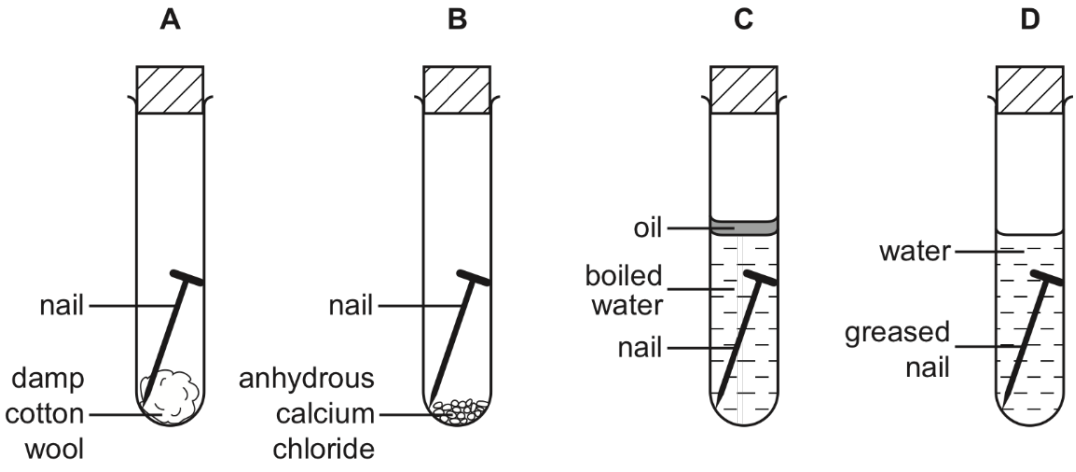
Which statement about the elements shown is **not correct**?

A Element **S** exists as a monoatomic gas.
B Element **P** is the most reactive metal shown in the table above.
C Element **T** has 5 valence electrons in its outermost shell.
D Elements **Q** and **R** form an ionic compound which has the formulae of $\mathbf{QR_4}$.

31 Which alloy of iron is used in surgical instruments?

A high carbon steel
B low carbon steel
C mild steel
D stainless steel

32 In which test-tube is the iron nail **most** likely to rust?



33 Some facts about three metals are as follows.

metal	fact
rhodium	found naturally as an alloy with other metals
thallium	extracted by electrolysis of its molten chloride
cobalt	extracted by heating its oxide with coke

What is the likely order of reactivity of the metals?

	least reactive	⟶	most reactive
A	rhodium	thallium	cobalt
B	thallium	cobalt	rhodium
C	rhodium	cobalt	thallium
D	cobalt	rhodium	thallium

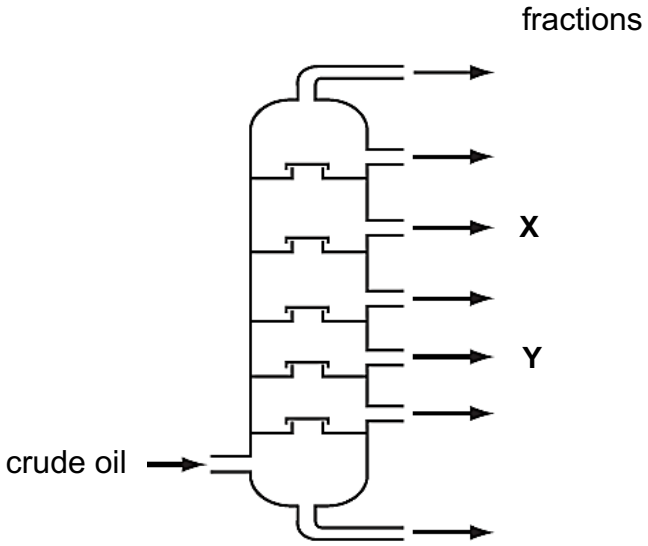
34 Which pair of pollutants cause damage to buildings?

A CFCs and carbon monoxide
B methane and carbon dioxide
C unburnt hydrocarbon and nitrogen monoxide
D nitrogen dioxide and sulfur dioxide

35 Nitrogen and hydrogen gases react to form ammonia gas in the Haber process. A higher yield of ammonia is favoured by a lower temperature but in industry, a high temperature of 450°C is used. Why is this so?

A At high temperatures, gases expand and less volumes are needed.
B At high temperatures, the catalyst is more effective.
C At low temperatures, liquid ammonia is collected instead.
D At low temperatures, the rate of reaction is too slow.

36 The diagram below shows the different fractions after crude oil has undergone fractional distillation.



Which statement is **correct**?

A **X** and **Y** are both used as fuels.
B **X** has a higher boiling point than **Y**.
C **X** has a lower relative molecular mass than Y.
D **X** has more carbon atoms than **Y**.

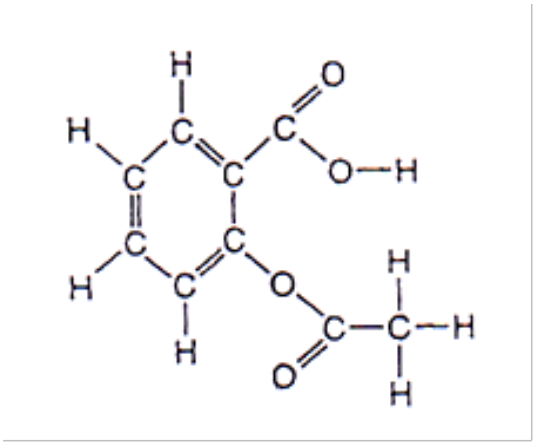
37 One mole of a hydrocarbon **Q** reacted completely with 1 mole of hydrogen gas in the presence of a heated catalyst.
What could be the formula of **Q**?

A C_2H_6
B C_3H_8
C C_5H_{10}
D C_7H_{16}

38 A food chemist wants to create a flavor from pineapples for a product. An ester with this flavor has the formula $C_3H_7CO_2C_2H_5$.
Which pair of organic compounds will react to form this ester?

A $C_2H_5CO_2H$ and C_2H_5OH
B $C_2H_5CO_2H$ and C_3H_7OH
C $C_3H_7CO_2H$ and C_2H_5OH
D $C_3H_7CO_2H$ and C_3H_7OH

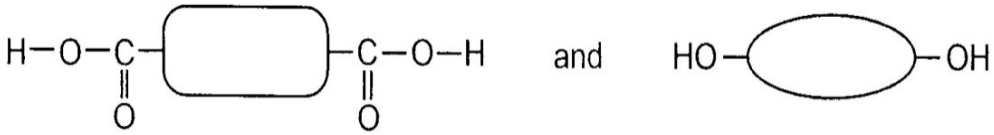
39 Aspirin is a drug which is used as a general painkiller. The structural formula of aspirin is shown below.



Which of the following statements about aspirin is **incorrect**?

A It decolourises aqueous bromine.
B It turns acidified potassium manganate(VII) colourless.
C It is formed from an alcohol and a carboxylic acid.
D Its aqueous solution reacts with solid sodium carbonate.

40 A synthetic polymer is made by the condensation polymerisation of the two monomers shown below.



Which of the following shows the correct changes in the properties of the polymer formed?

	melting point	**percentage composition of carbon by mass**
A	increases	increases
B	increases	no change
C	decreases	decreases
D	no change	no change

END OF PAPER

ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2022

SECONDARY 4E

Candidate's Name	Class	Register Number
	4E	

CHEMISTRY 6092/01

26 Aug 2022
1 hour

Additional Materials: OTAS

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, index number and class on the OTAS in the spaces provided.

There are **forty** questions on this paper. Answer all questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the one you consider correct and record your choice in soft pencil on the separate OTAS.

Read the instructions on the OTAS very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

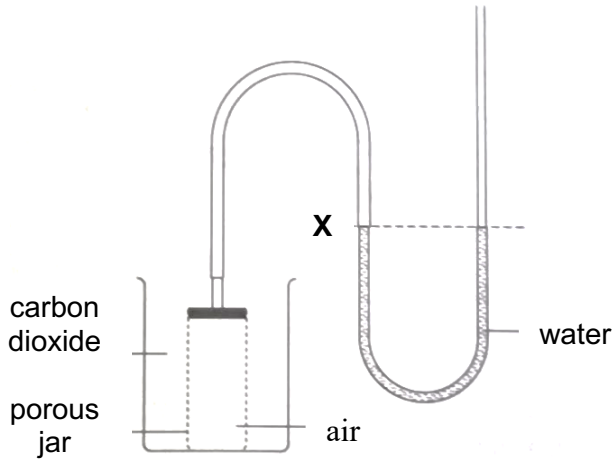
A copy of the Periodic Table is printed on page 17.

Setter: Ms Ong Lay Hong
Vetter: Ms Julia Yeo

This document consists of **17** printed pages, including this cover page.

[Turn over

1 The apparatus shown in the diagram was set up.



The water level at **X** gradually moved up above the mark. When the water levels were observed to have stopped moving, the beaker of carbon dioxide were removed.
The water level at **X** then fell below the mark before returning back to the mark.

Which of the following is likely to explain why the water level at **X** fell below the mark?

A Air inside the porous jar diffused out faster than the carbon dioxide.

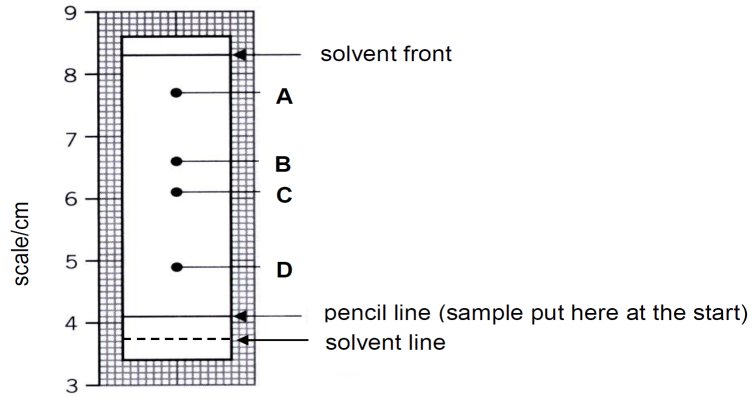
B Carbon dioxide in the porous jar diffused out slower than air which diffused in.

C Air around the porous jar diffused in slower than the carbon dioxide diffused out.

D Carbon dioxide around the porous jar continued to diffuse in faster than air diffused out.

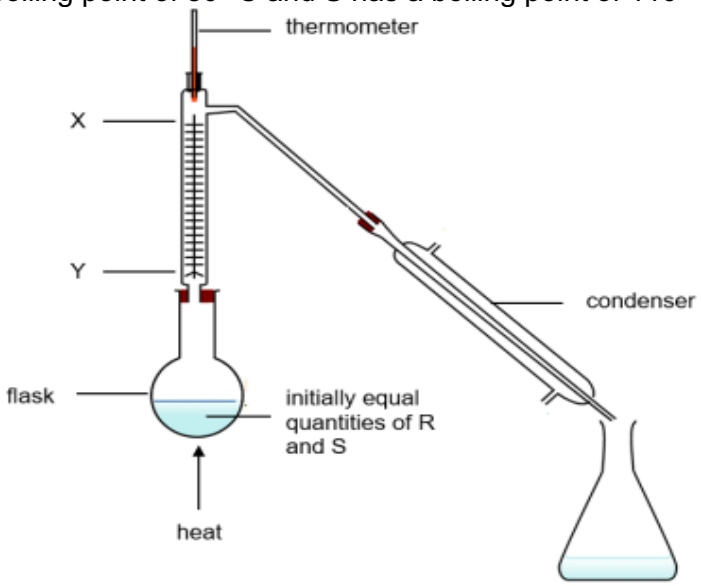
2 The urine samples of athletes are routinely checked for the presence of drugs which can enhance their performance.

The following diagram (not drawn to scale) shows a chromatogram of the urine sample of an athlete. He is suspected to have taken a banned drug with a retention value, R_f of 0.60.



Which position, **A**, **B**, **C** or **D** indicates the presence of this drug?

3 The diagram below shows the fractional distillation of two liquids, **R** and **S**.
R has a boiling point of 80 °C and **S** has a boiling point of 110 °C.

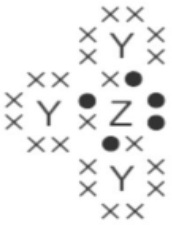


Which statement(s) about the experiment is/are correct when the thermometer shows 80 °C?

1 The liquid left in the flask contains more **S** than **R**.
2 The vapour at point **Y** only contains **R**.
3 The temperature at **X** is higher than the temperature at **Y**.

A 1 only
B 1 and 2
C 2 and 3
D 1, 2 and 3

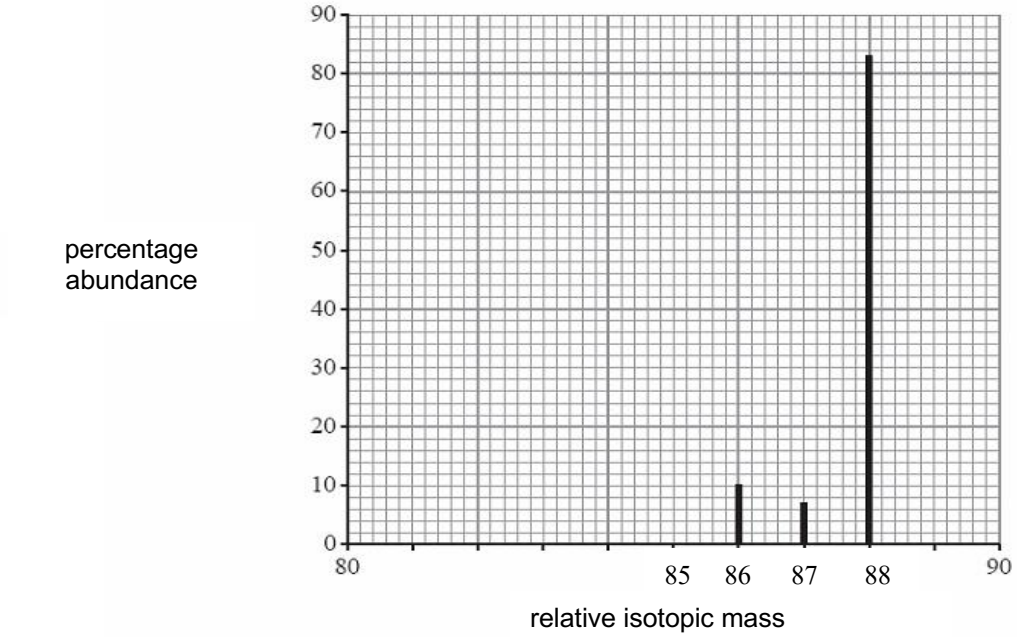
4 The diagram shows the outer shell electron arrangement of a molecule of a compound made up of the elements **Z** and **Y.**



What is the formula of the compound formed between **Z** and magnesium?

A Mg**Z**
B Mg$\mathbf{Z}_2$
C $Mg_2\mathbf{Z}_3$
D $Mg_3\mathbf{Z}_2$

5 Strontium is used in fireworks to produce crimson flames.
The graph below shows the percentage abundance (%) and relative masses of three naturally occurring isotopes of strontium.



What is the relative atomic mass of naturally occurring strontium?

A 83.4 **B** 87.0

C 87.7 **D** 88.0

6 A radioactive isotope of thallium, $^{201}_{81}T\ell$, is used to assess damage in heart muscles after a heart attack.

Which statement about $^{201}_{81}T\ell$ is correct?

A The isotope has a nucleon number of 120.

B The number of electrons in one atom of this isotope is 81.

C The number of neutrons in one atom of this isotope is 201.

D $^{201}_{82}T\ell$ is an isotope of $^{201}_{81}T\ell$

7 The table below shows the electronic configuration of elements **W**, **X**, **Y** and **Z**.

W	X	Y	Z
2.4	2.6	2.7	2.8.8.1

Which of the following formulae represent compounds with boiling points below room temperature?

1 $\mathbf{WX_2}$
2 $\mathbf{XY_2}$
3 $\mathbf{Z_2X}$

A 1 and 2 **B** 1 and 3

C 2 and 3 **D** 1, 2 and 3

8 The following substances all contain covalent bonds.

1 ammonia
2 carbon dioxide
3 ethanol
4 diamond

Which substances contain only single bonds?

A 1 and 2 **B** 1 and 4

C 3 and 4 **D** 1, 3 and 4

9 In a pathology laboratory, a sample of urine containing 0.120 g of urea, NH_2CONH_2 was treated with an excess of nitrous acid. The urea reacted according to the following equation.

$$NH_2CONH_2 + 2HNO_2 \rightarrow CO_2 + 2N_2 + 3H_2O$$

The gas produced was passed through aqueous sodium hydroxide and the final volume measured.
What was this final volume of gas left behind at room temperature and pressure?

A 9.6 cm^3 **B** 14.4 cm^3

C 48.0 cm^3 **D** 96.0 cm^3

10 Citric acid, the predominant acid in lemon juice, is a tribasic acid.
A student titrated 25.0 cm^3 samples of lemon juice with 0.55 mol/dm^3 NaOH. The average titration volume was 29.50 cm^3.
The molar mass of citric acid is 192.12 g/ mol.
What was the concentration of citric acid in the lemon juice?

A 1.04 g/dm^3 **B** 41.6 g/dm^3

C 125 g/dm^3 **D** 374 g/dm^3

11 A washing powder contains sodium hydrogencarbonate, $NaHCO_3$ as one of its ingredients.
In a titration, a solution containing 1.00 g of the washing powder was found to react completely with 7.15 cm^3 of 0.100 mol/dm^3 of dilute hydrochloric acid.

Assuming that sodium hydrogen carbonate is the only ingredient that reacts with the acid, what is the percentage by mass of sodium hydrogencarbonate in the washing powder?

A 3.0 % **B** 6.0 %

C 12.0 % **D** 24.0 %

12 Compound **X** has the molecular formula, Mn_2O_3.

The following are some statements about compound **X**.

- One mole of compound **X** contains 110 g of manganese and 48 g of oxygen.
- The oxidation state of manganese is +2 in Mn_2O_3.
- The charge of the oxide ion is -2.
- The empirical formula of compound **X** is Mn_2O_3.
- Three moles of oxygen molecules are needed to make one mole of compound **X**.

How many statements about compound **X** are correct?

A 2 **B** 3

C 4 **D** 5

13 Which equation suggests that a metal oxide, RO, behaves as an amphoteric oxide?

A $RO\ (s) + 2H^+\ (aq) \rightarrow R^{2+}\ (aq) + H_2O\ (l)$

B $RO\ (s) + 2OH^-\ (aq) \rightarrow RO_2^{2-}\ (aq) + H_2O\ (l)$

C $RO\ (s) + H_2O\ (l) \rightarrow R^{2+}\ (aq) + 2OH^-\ (aq)$

D $RO\ (s) + NH_4^+\ (aq) \rightarrow R^{2+}\ (aq) + H_2O\ (l) + NH_3\ (g)$

14 Which of the following does not show the appropriate reagents used for preparation of the named salts?

	salt	reagents
A	barium sulfate	barium nitrate + sulfuric acid
B	lead(II) chloride	lead(II) carbonate + hydrochloric acid
C	lithium nitrate	lithium hydroxide + nitric acid
D	magnesium chloride	magnesium + hydrochloric acid

15 The following substances are used in the laboratory to test for the various ions and gases.

acidifed potassium manganate(VII)	aqueous ammonia	aqueous barium nitrate
aqueous silver nitrate	red litmus paper	limewater
aqueous sodium hydroxide	blue litmus paper	wooden splint

When testing for ammonia, chlorine, hydrogen and oxygen, what is the minimum number of items from the table above needed to identify these four gases?

A 2 **B** 3

C 4 **D** 5

16 Solutions of 0.1 mol/dm^3 $Ca(NO_3)_2$ and 0.1 mol/dm^3 of $Zn(NO_3)_2$ undergo a series of reactions using pure reagents.

$Ca(NO_3)_2$ + excess Na_2CO_3(aq) → **L +** excess HCl(aq) → **M +** excess NaOH(aq) → **N**

$Zn(NO_3)_2$ + excess Na_2CO_3(aq) → **X +** excess HCl(aq) → **Y +** excess NaOH(aq) → **Z**

L, M and **N** are calcium compounds.

X, **Y** and **Z** are zinc compounds.

How many of the **L**, **M**, **N**, **X**, **Y** and **Z** are white precipitate?

A 2 **B** 3

C 4 **D** 5

17 **X**, **Y** and **Z** are metals which form the cations $\mathbf{X}^{3+}$, $\mathbf{Y}^{2+}$ and $\mathbf{Z}^{+}$ respectively.

$\mathbf{Y}^{2+} + \mathbf{Z} \rightarrow$ no visible change

$3\mathbf{Y}^{2+} + 2\,\mathbf{X} \rightarrow 2\mathbf{X}^{3+} + 3\mathbf{Y}$

$2\mathbf{Z}^{+} + \mathbf{Y} \rightarrow \mathbf{Y}^{2+} + 2\mathbf{Z}$

Given the following information above, what is the order of increasing reactivity of the metals?

A **X**, **Y**, **Z** **B** **Y**, **X**, **Z**

C **Z**, **X**, **Y** **D** **Z**, **Y**, **X**

18 Which of the statement(s) is/are true about the elements in Group **I** of the Periodic Table?

1 They are reducing agents.
2 The ionic radius increases down the group.
3 The melting point decreases down the group.

A 2 only **B** 1 and 2

C 2 and 3 **D** 1, 2 and 3

19 Chlorine is reacted with aqueous potassium iodide and a brown solution is formed.
Which statement about this reaction is correct?

A Iodide ions gain electrons.

B The oxidation state of chlorine decreases.

C Chlorine is reduced because it loses electrons.

D Iodine gains electrons more easily than chlorine.

20 An element **R** reacts in the following ways.

1 $2\mathbf{R}(s) + O_2(g) \rightarrow 2\mathbf{R}O(s)$

2 $\mathbf{R}(s) + 2HCl\,(aq) \rightarrow \mathbf{R}Cl_2(aq) + H_2(g)$

3 $\mathbf{R}(s) + H_2O\,(l) \rightarrow$ no reaction

4 $\mathbf{R}O(s) + H_2\,(g) \rightarrow$ no reaction

Which statement can be deduced about element **R**?

A **R** can be obtained from its oxide by reduction with carbon.

B **R** can displace magnesium from a solution of magnesium nitrate.

C **R** forms a metal carbonate that will not decompose under strong heating.

D **R** reacts more vigorously with hydrochloric acid than to calcium.

21 Which statement correctly shows the general trend of the oxides of Period 3 elements from sodium to chlorine?

A The melting points of the oxides increase.

B The electrical conductivities of the molten oxides increase.

C The bonds of the oxides show a trend from ionic to covalent.

D The oxides show a trend from acidic to amphoteric and then to basic.

22 Four stages in making steel from iron ore are listed below.

1 Carbon dioxide reacts with coke.
2 Limestone and hot air are added.
3 Basic oxides remove impurities.
4 Haematite is reduced.

In which order do these stages occur?

A 1, 2, 3 and 4

B 1, 4, 2 and 3

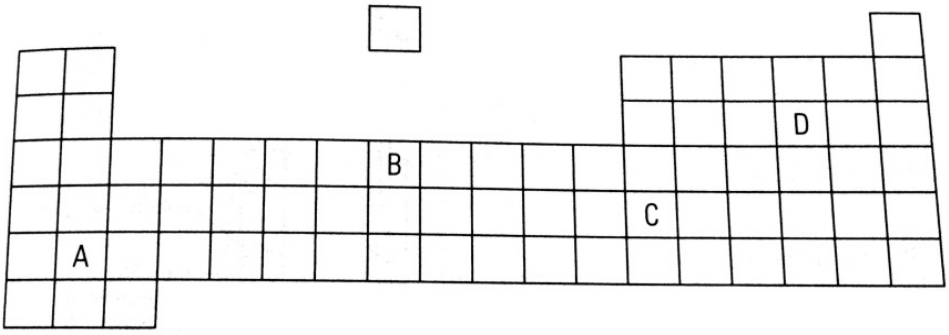
C 2, 1, 4 and 3

D 2, 4, 1 and 3

23 The following reactions takes place in the presence of an ion of the element **X**.

step 1: $2\ X^{2+} + S_2O_8^{2-} \rightarrow 2X^{3+} + 2SO_4^{2-}$
step 2: $2\ X^{3+} + 2\ I^- \rightarrow 2X^{2+} + I_2$

In which of the following position could element **X** be found in the Periodic Table?



[Turn over

24 A cheap carbon monoxide detector for a gas heater consists of a patch containing palladium chloride crystals. When carbon monoxide is present, the crystals turn from orange to black as the following reaction takes place.

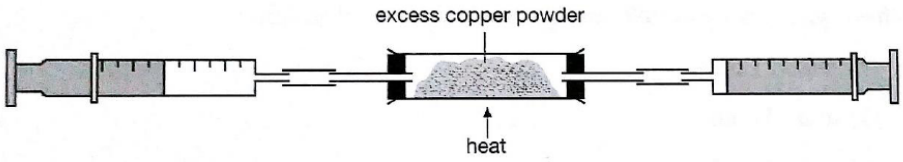
$CO(g) + PdCl_2(s) + H_2O(l) \rightarrow CO_2(g) + Pd(s) + 2HCl(aq)$

Which is the element whose oxidation state decreases in this reaction?

A carbon **B** chloride

C hydrogen **D** palladium

25 The set-up of an experiment is shown below. At room temperature, the system initially contains 80 cm^3 of nitrogen, 60 cm^3 of oxygen and 20 cm^3 of argon.



The plungers of the gas syringes are moved to and fro until there is no further change in the system. The system is then allowed to cool to room temperature.

Which of the following statements concerning the experiment are correct?

1 Black solids would be formed in the glass tube.
2 The total volume of the gases in the system would decrease by 60 cm^3.
3 The same change in total volume of gases would be observed if excess copper is replaced with excess zinc powder.

A 1 and 2 **B** 1 and 3

C 2 and 3 **D** 1, 2 and 3

26 Ammonium chloride dissolves in water according to the equation below.

$$NH_4Cl\,(s) \rightarrow NH_4Cl\,(aq) \qquad \Delta H = +15.0 \text{ kJ/mol}$$

When 0.2 moles of ammonium chloride dissolves in 50 cm^3 of water,

1 The concentration of the solution is 4.00 mol/dm^3.

2 The temperature of the water decreases.

3 Some heat energy is lost to the surroundings.

4 The heat change is 3.0 kJ.

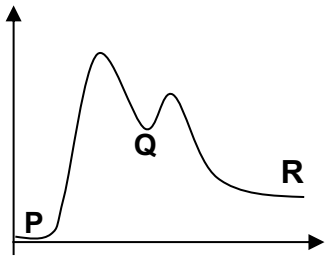
Which of the above statements are true?

A 1, 2 and 3 **B** 1, 2 and 4

C 1, 3 and 4 **D** 2, 3 and 4

27 In the conversion of compound **P** into compound **R**, it was found that the reaction proceeded by way of compound **Q.**
The following graph shows the energy profile diagram for the reactions.

What can be deduced from the diagram?



step **1**: **P** → **Q**
step **2**: **Q** →**R**

A Both steps are endothermic.

B The overall reaction to convert **P** to **R** is exothermic.

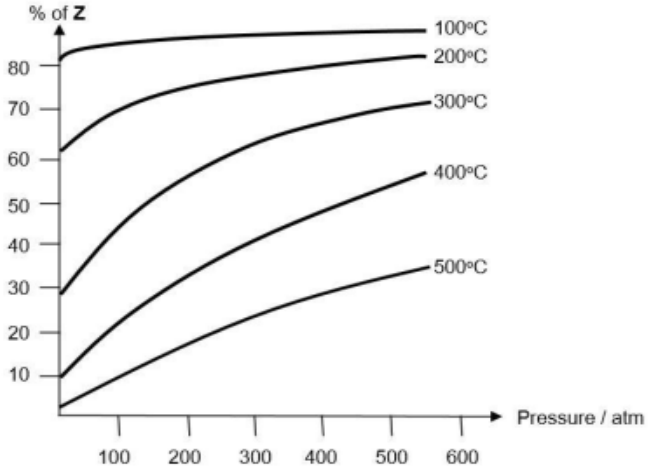
C Step **2** involves breaking of stronger bonds than step **1** because **Q** is at higher energy level.

D Step **1** is harder to take place than step **2** because more energy is needed for bond breaking.

28 In an industrial process, two gases **X** and **Y** react together to form a single gaseous product **Z**.

$$\mathbf{X}(g) + \mathbf{Y}(g) \rightleftharpoons \mathbf{Z}(g)$$

The percentage yield of product **Z** varies according to the pressure and the temperature as shown in the graph.



Which change decreases both the speed of reaction and the volume of **Z** produced?

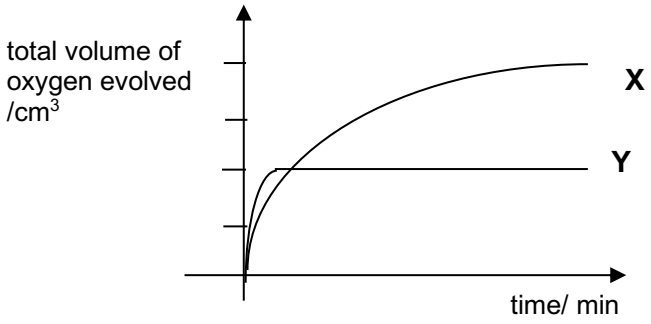
A decreasing the pressure

B decreasing the temperature

C increasing the pressure

D increasing the temperature

29 The result of an experiment involving the decomposition of 20.0 cm^3 of hydrogen peroxide of 1.5 mol/dm^3 is represented by graph **X** below.



Which one of the following produces graph **Y**?

	volume of hydrogen peroxide used /cm^3	concentration of hydrogen peroxide used / mol/dm^3
A	10.0	1.5
B	5.0	2.5
C	20.0	0.75
D	7.5	2.0

30 Dilute hydrochloric acid reacts with an aqueous solution of sodium thiosulfate, $Na_2S_2O_3$, according to the chemical equation below:

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + S(s) + SO_2(g)$$

10.0 cm^3 portions of 2.00 mol/dm^3 dilute hydrochloric acid were added to four separate conical flasks. Each flask contains 90.0 cm^3 sodium thiosulfate solution which was prepared by dilution with different volumes of water as shown in the table.

conical flask	sodium thiosulfate solution		volume of water added/cm^3
	initial concentration/ mol/dm^3	volume/cm^3	
W	1.00	80.0	10.0
X	1.50	60.0	30.0
Y	2.50	30.0	60.0
Z	3.00	20.0	70.0

In which conical flask would the reaction proceed at the fastest rate?

A **W** **B** **X**

C **Y** **D** **Z**

31 The volume ratio of unknown gases produced at the positive electrode and negative electrode during the electrolysis of unknown electrolyte solution **M** is 1:2 respectively.

Which row correctly identifies electrolyte solution **M** and the positive and negative electrodes?

	electrolyte solution **M**	positive electrode	negative electrode
A	concentrated zinc chloride	platinium	graphite
B	aqueous sodium nitrate	graphite	platinium
C	aqueous silver nitrate	silver	silver
D	aqueous silver nitrate	platinium	platinium

32 During the electrolysis of an aqueous solution of a molybdenum salt, 19.2 g of molybdenum is deposited at the cathode by the same amount of charge that deposits 12.8 g of copper.

What is the formula of the molybdenum ion?
[Ar Mo, 96]

A Mo^+ **B** Mo^{2+}

C Mo^{3+} **D** Mo^{4+}

33 Element **X** is extracted by the electrolysis of a molten compound of elements **X** and **Y**. The electrode reactions are shown below.

cathode: $\mathbf{X}^{2+} + 2e^- \rightarrow \mathbf{X}$
anode: $2\mathbf{Y}^{2-} \rightarrow \mathbf{Y}_2 + 4e^-$

Which substance could be the molten compound?

A aluminium oxide **B** calcium chloride

C magnesium oxide **D** potassium chloride

34 To reduce atmospheric pollution, the following waste gases from a coal-burning power station are passed through aqueous calcium hydroxide.

carbon monoxide	carbon dioxide	nitrogen dioxide
sulfur dioxide	phosphorus(V) oxide	ethene

How many waste gases will not be removed by the above process?

A 2 **B** 3

C 4 **D** 5

35 The reaction of different vegetable oils with hydrogen was investigated.

100 cm^3 of hydrogen was passed through 1 g samples of vegetable oils containing a suitable catalyst. The volume of hydrogen gas that remained after each reaction was recorded in the table below.

vegetable oil	volume of hydrogen gas that remained after the reaction / cm^3
P	100
Q	87
R	63
S	0

Which vegetable oil(s) is/ are unsaturated?

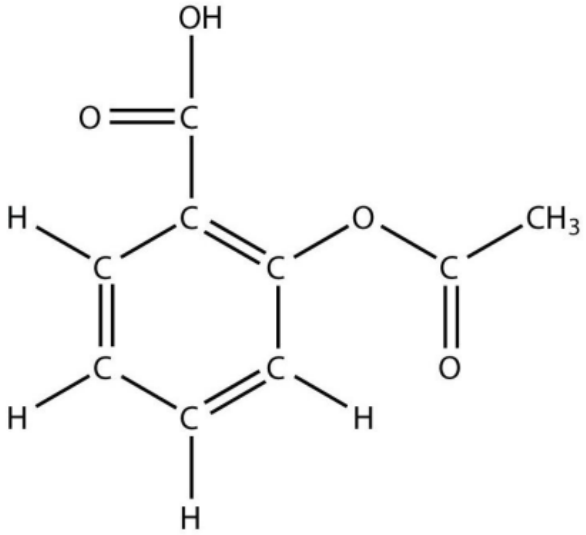
A **P** only

B **S** only

C **P**, **Q** and **R**

D **Q**, **R** and **S**

36 Aspirin is a drug which is used as a general painkiller. The structural formula of aspirin is shown below.



Which statement is incorrect about aspirin?

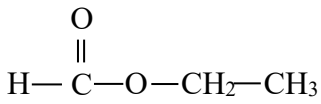
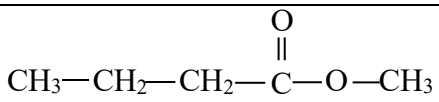
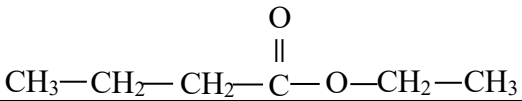
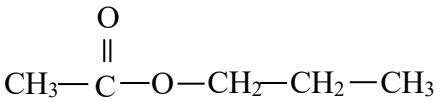
A It is not a hydrocarbon.

B It decolourises acidified aqueous potassium manganate(VII).

C It can be formed from an alcohol and a carboxylic acid

D Effervescence is observed when is aqueous solution is added to sodium carbonate.

37 The table gives some information about some esters and the fragrance they produce.

ester	fragrance
	rum
	apple
	pineapple
	pear

An ester is made from ethanol and butanoic acid. What fragrance would the ester have?

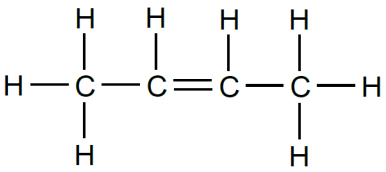
A apple **B** pear

C pineapple **D** rum

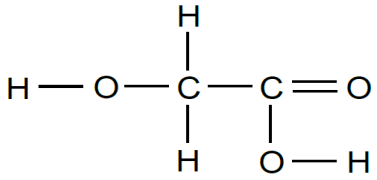
[Turn over

38 Which of the molecules shown cannot be polymerised?

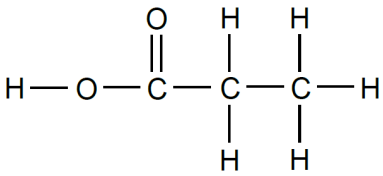
A



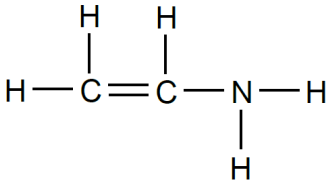
B



C



D



39 Which statement about fractional distillation of petroleum is correct?

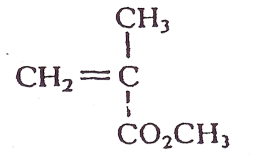
A At each level in the column, only one compound is collected.

B The higher up the column, the greater the temperature.

C The molecules collected at the bottom of the column are the most flammable.

D The molecules reaching the top of the column have the smallest relative molecular mass

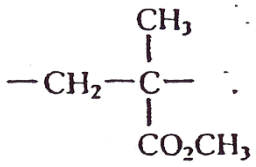
40 In an artificial hip joint, bone cement is used to attach the poly(ethene) cup for the joint to the pelvic girdle. Bone cement is formed by the polymerisation of 2-methylpropenoate and the process is highly exothermic.



2-methylpropenoate

Which statements about this polymerisation of 2 methylpropenoate are correct?

1 The repeat unit of the polymer is



2 The formation of cement occurs by addition polymerisation.

3 The energy given out in making the two C−C bonds is greater than the energy taken in to break a C=C bond.

A 1 and 2 **B** 1 and 3

C 2 and 3 **D** 1, 2 and 3

End of paper

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**Key** proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).