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.

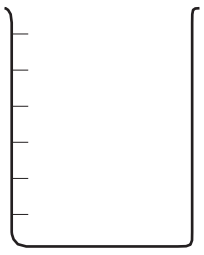
	For Examiner's use	
	TOTAL	

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



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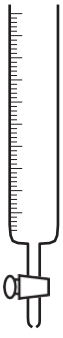

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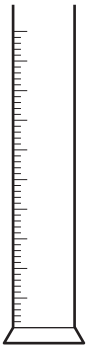
D



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

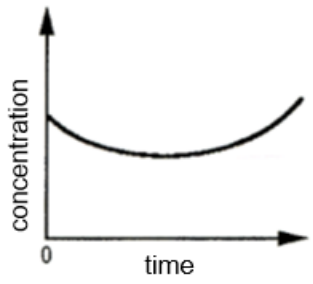
In what order should the steps be carried out?

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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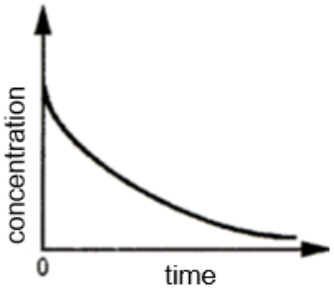

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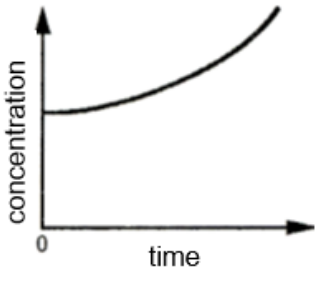

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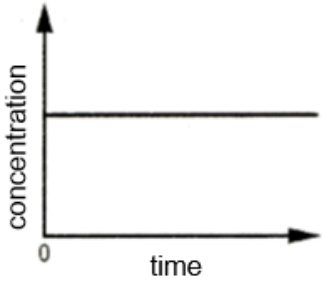


4 A new substance was discovered and a series of experiments were conducted on it.
Which observation suggests that the substance cannot be an element?

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.

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

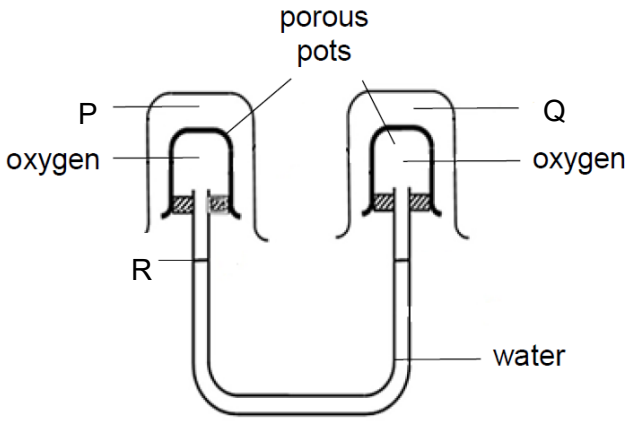
What can be deduced from the proton numbers and nucleon numbers of X, Y and Z?

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

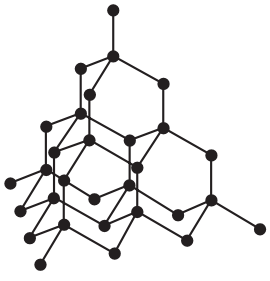
7 The diagram shown is set up using different gases in two beakers P and Q. The inverted smaller beakers both contain oxygen gas.

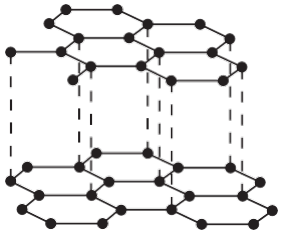


Which gases, when placed in beakers P and Q respectively, will cause the water level at R to rise initially?

	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.


P


Q

Which row is correct?

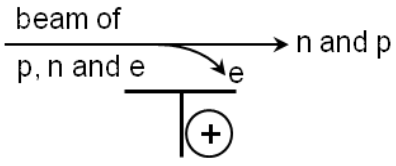
	has covalent bonding	conducts electricity
A	P only	P only
B	P only	Q only
C	both P and Q	P only
D	both P and Q	Q only

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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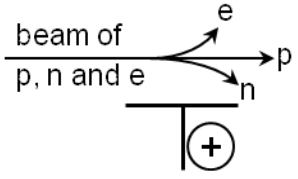

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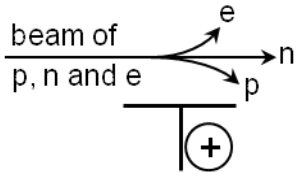

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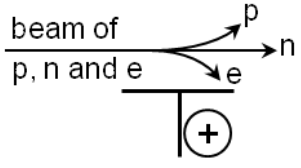


11 Element M has *n* protons and can form M^{2+} ions.
Element N has (*n* + 3) protons.

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.

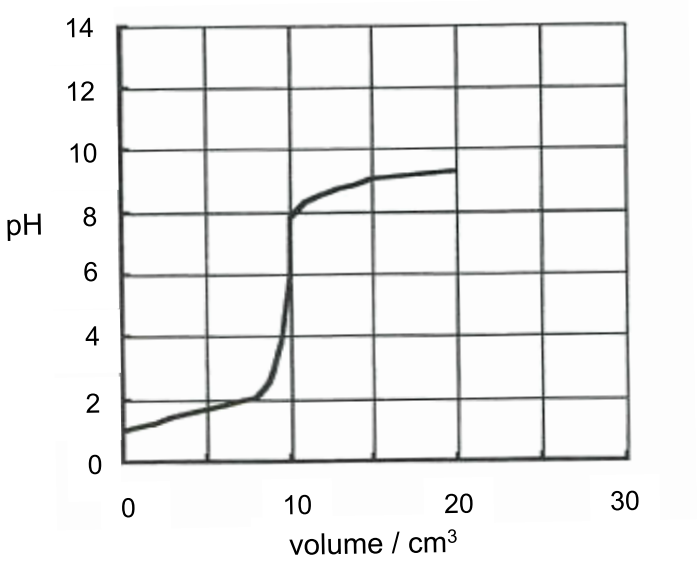
$$2SO_2\,(g) + O_2\,(g) \rightarrow 2SO_3\,(g)$$

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

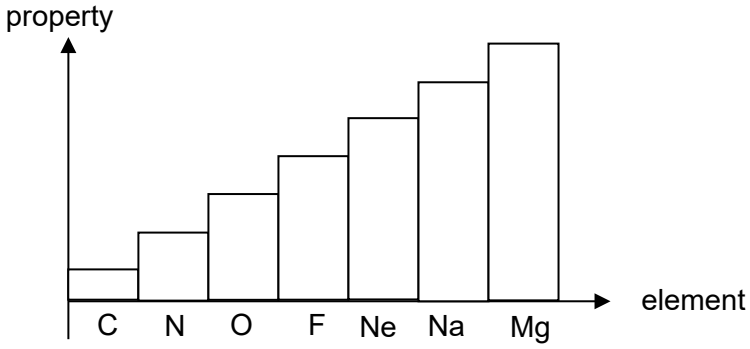
23 Which reaction is a redox reaction?

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.

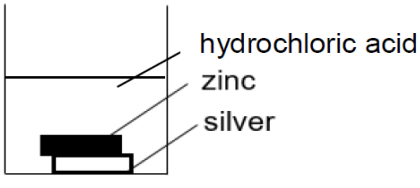


What could be the property?

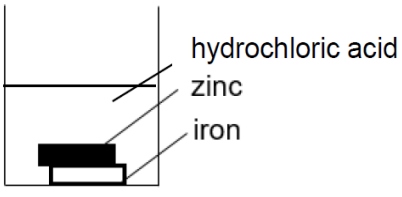
A atomic number
B atomic radius
C group number
D number of neutrons

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?

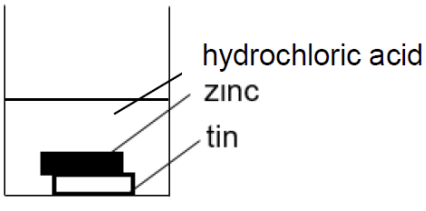
A



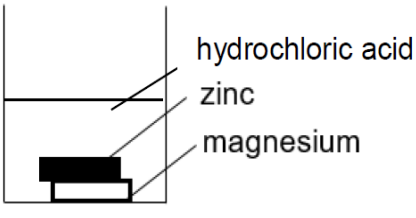
B



C



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,

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

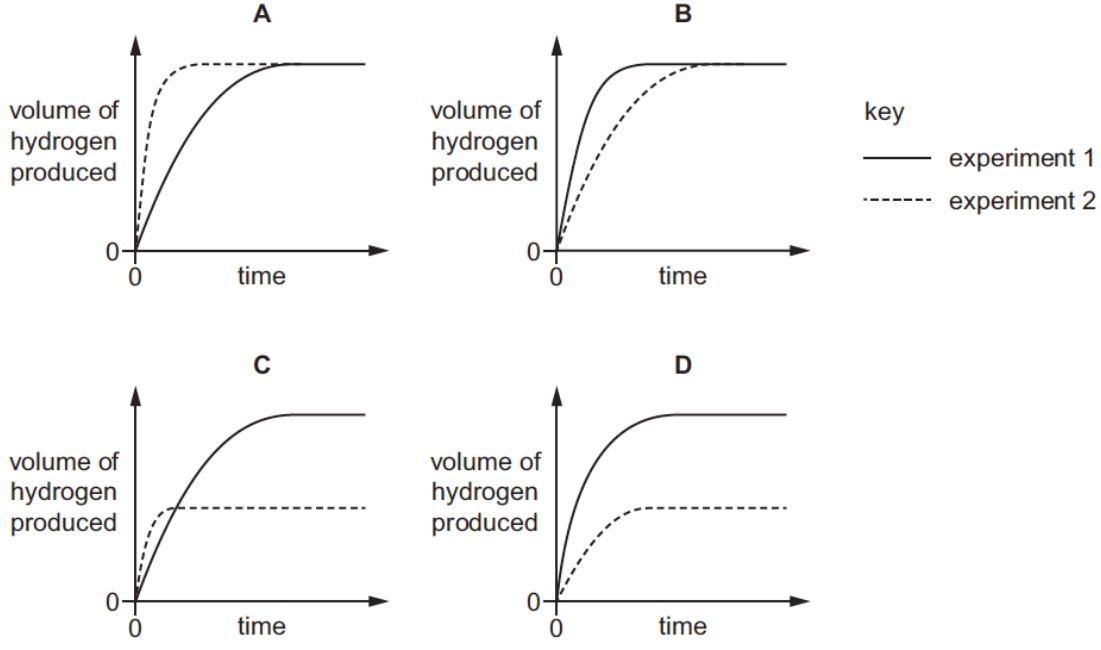
Two experiments are carried out at 25 °C

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:

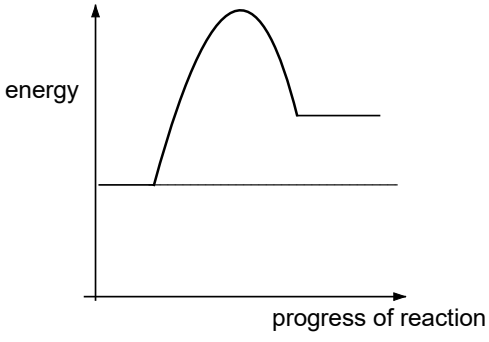
$$2N_2O_5\ (s) \rightarrow 2N_2\ (g) + 5O_2\ (g) \qquad \Delta H = -23\ kJ/mol$$

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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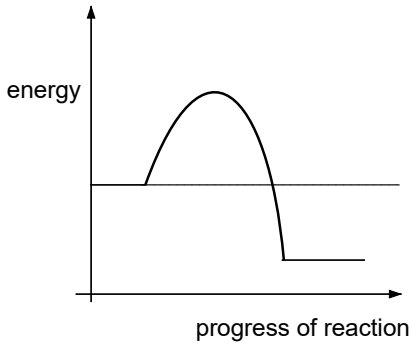
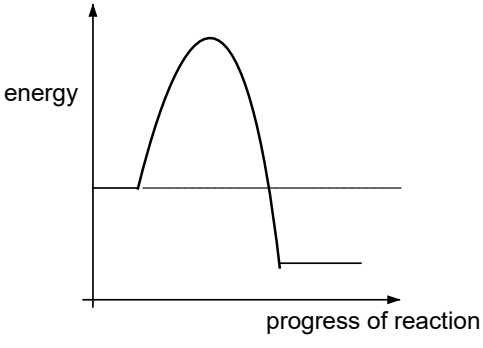
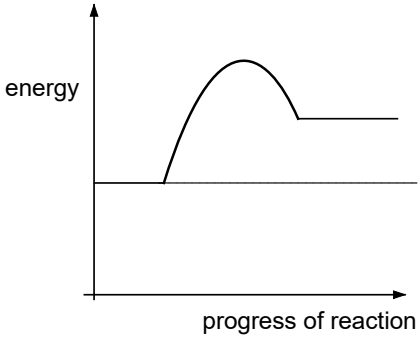


C



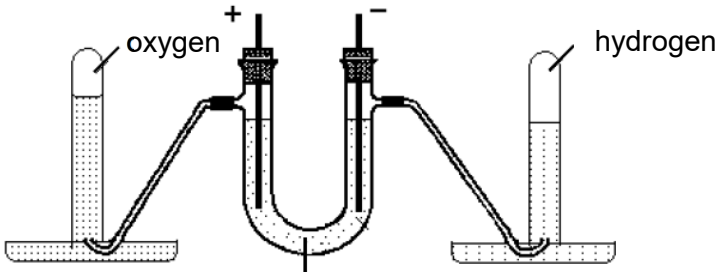
D



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	$Cr^{3+} + 3e^- \rightarrow Cr$

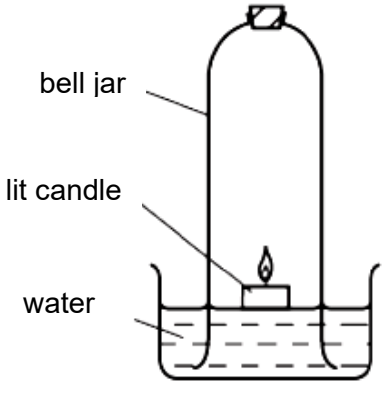
33 The diagram shows the electrolysis of dilute sodium chloride solution using inert electrodes.



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]

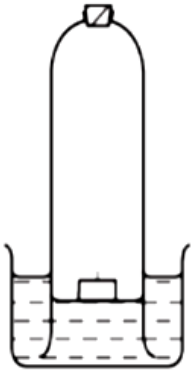
A 6*x* dm^3 of oxygen was collected at the anode.
B 6*x* dm^3 of hydrogen was collected at the cathode.
C 12*x* dm^3 of oxygen was collected at the cathode.
D 12*x* dm^3 of hydrogen was collected at the anode.

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

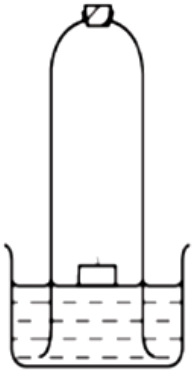


Which diagram shows the correct level of water after the candle stops burning?

A



B



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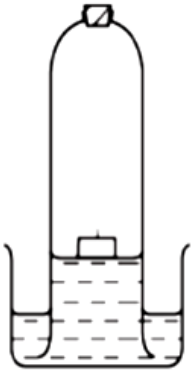

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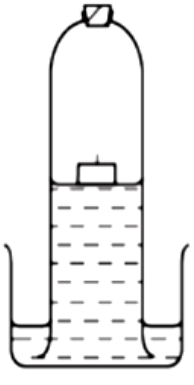


35 Ammonia is manufactured by the Haber process using an iron catalyst.

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.

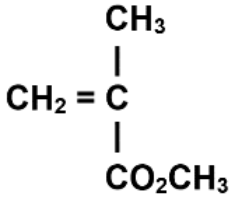
36 Which statement about the fractional distillation of petroleum is correct?

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?

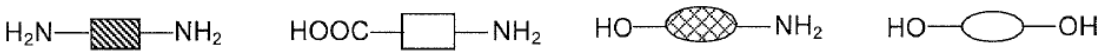
A Aqueous bromine is decolourised by bone cement.
B Less energy is released in the formation of C-C bond than the energy absorbed in the breaking of C=C bond.
C The empirical formula of bone cement is C_2H_4O.
D Water is formed in the polymerisation of methyl methacrylate.

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.).