



**SINGAPORE CHINESE GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR**

CANDIDATE NAME

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CLASS

4		

REGISTER
NUMBER

CENTRE
NUMBER

INDEX NUMBER

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CHEMISTRY

6092/01

PAPER 1 Multiple Choice

**30 August 2023
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 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.

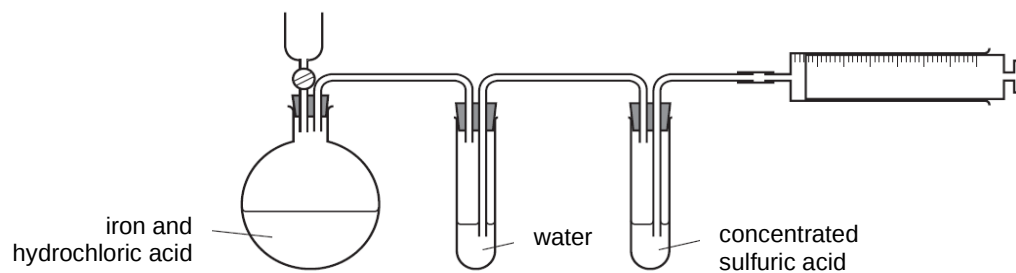
A copy of the Periodic Table is printed on page 18.

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

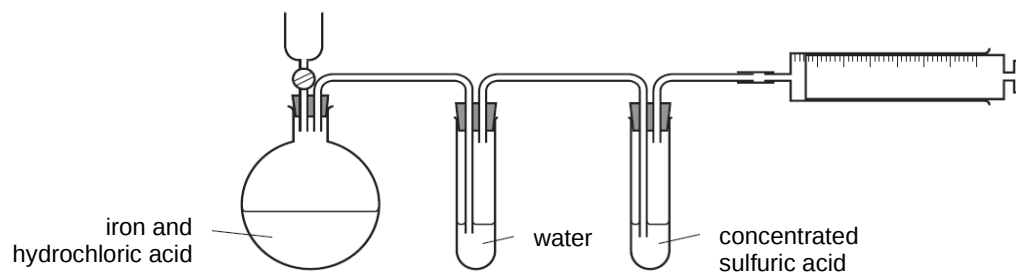
1. When iron reacts with dilute hydrochloric acid, hydrogen is formed. Due to the presence of impurities in the iron, some hydrogen sulfide gas is also formed in the reaction. Hydrogen sulfide gas is soluble in water.

Which diagram shows the apparatus suitable to prepare a pure and dry sample of hydrogen?

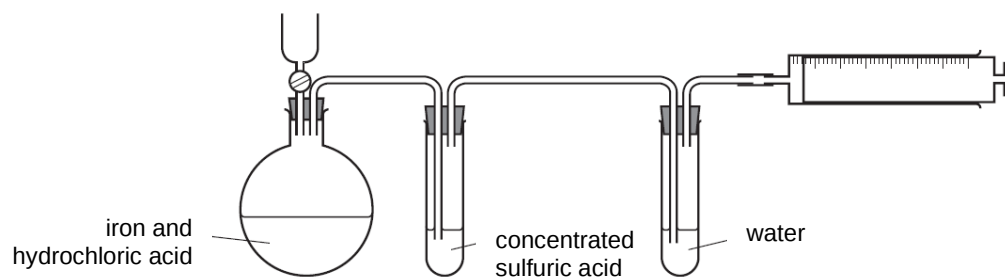
A



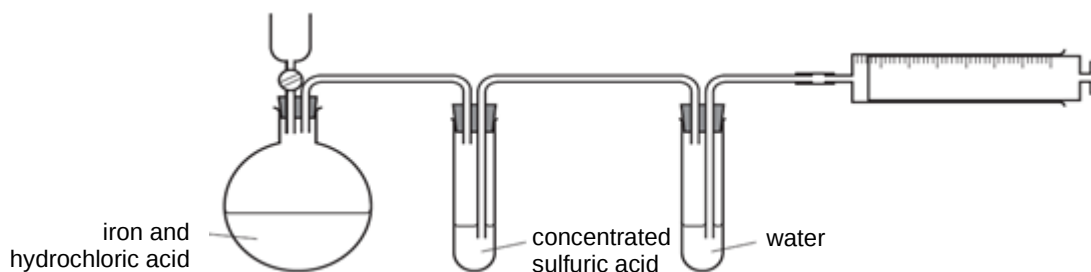
B



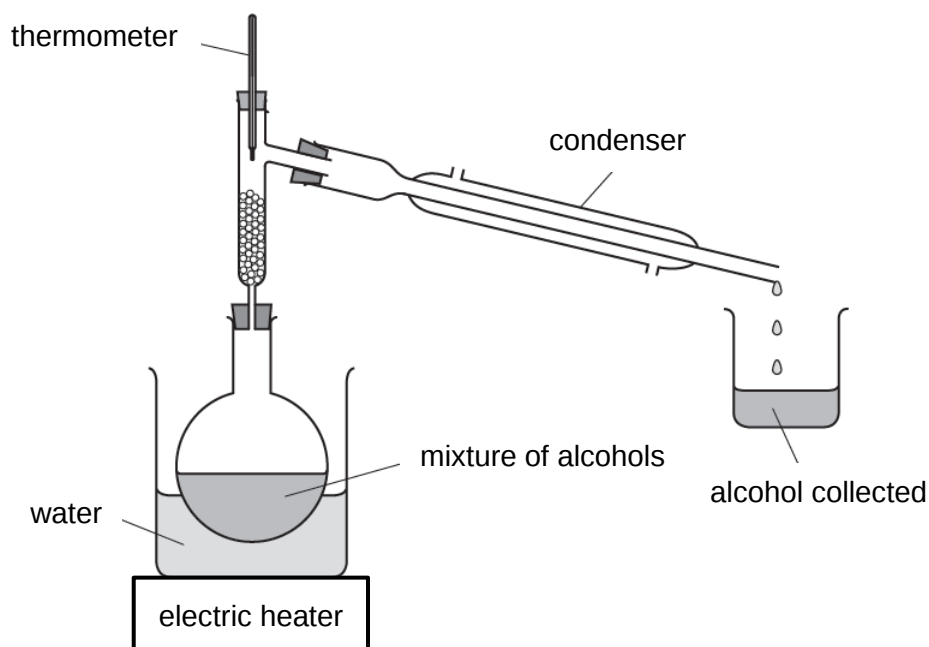
C



D



2. In which state does 1 dm³ of ethene contain the most particles?
- A gas at 100 °C
 B gas at room temperature
 C liquid
 D solid
3. A student carried out an experiment using the set-up shown below to separate a mixture containing four alcohols.



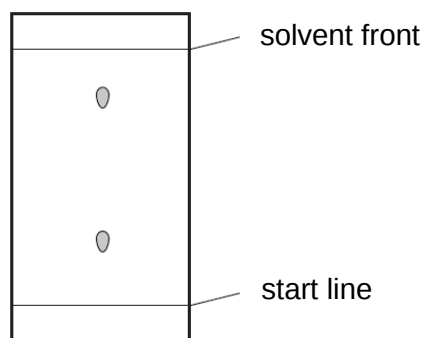
The table gives the boiling points of the four alcohols used.

alcohol	boiling point / °C
butanol	117
ethanol	79
pentanol	138
propanol	97

Despite repeated attempts, the student only managed to obtain two alcohols from the mixture. Which alcohols did he fail to obtain?

- A butanol and ethanol
 B butanol and pentanol
 C ethanol and propanol
 D pentanol and propanol

4. Chromatography is carried out on a mixture of three substances. The chromatogram is sprayed with a locating agent and the result is shown below.



What are the possible reasons why the chromatogram shows only two spots?

- 1 One of the substances in the mixture is insoluble in the solvent.
- 2 The locating agent did not react with one of the substances in the mixture.
- 3 Two of the substances in the mixture have the same R_f values.
- 4 The R_f value of one of the substances is too small.

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

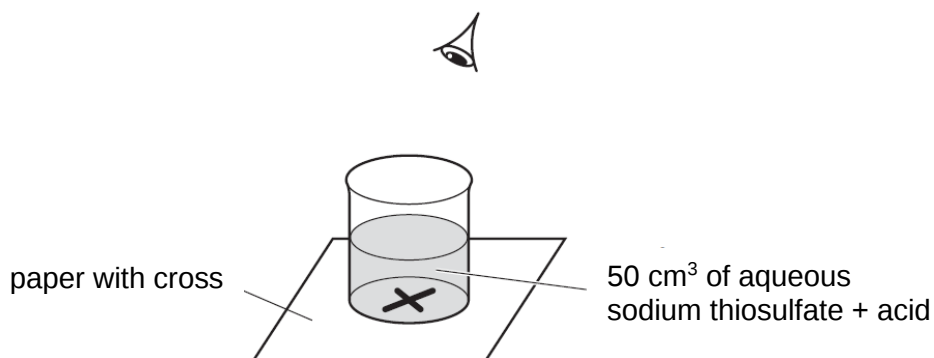
5. Aqueous sodium thiosulfate reacts with acid to make a precipitate of sulfur.



A student investigates the effect of temperature on the rate of this reaction.

The student:

- places a piece of paper with a cross on it below the reaction mixture as shown in the diagram
- measures the time taken for the cross to no longer be seen
- repeats the reaction at different temperatures.



Which apparatus is needed for this investigation?

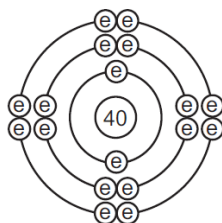
- A** electronic balance, pipette, stopwatch
B electronic balance, stopwatch, thermometer
C burette, gas syringe, thermometer
D measuring cylinder, stopwatch, thermometer

6. Three tests are carried out on salt S.

	test	result
1	Add dilute nitric acid to salt S.	Effervescence of a colourless odourless gas.
2	To 2 cm ³ of the mixture from test 1, add aqueous sodium hydroxide until no further changes is observed.	Green precipitate formed. Precipitate is insoluble in excess aqueous sodium hydroxide.
3	To 2 cm ³ of the mixture from test 1, add aqueous silver nitrate.	No precipitate formed.

What is the identity of S?

- A** copper(II) carbonate
B copper(II) chloride
C iron(II) carbonate
D iron(II) chloride
7. The diagram shows the electronic structure of a particle with a mass number of 40.

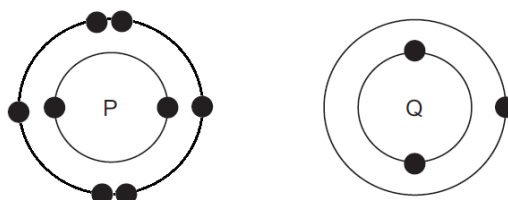


The table shows the suggestions that three students, 1, 2 and 3, made to identify the particle.

student	1	2	3
particle	Ar	Cl	Ca ²⁺

Which students are correct?

- A** 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 1, 2 and 3
8. The electronic structures of two atoms, P and Q, are shown.



P and Q combine to form a compound.

What is the type of bonding in the compound and what is the formula of the compound?

	type of bonding	formula
A	covalent	QP
B	covalent	Q ₂ P
C	ionic	QP
D	ionic	Q ₂ P

9. The properties of W, X, Y and Z are shown in the table.

	melting point / °C	boiling point / °C	electrical conductivity
W	1728	2230	does not conduct
X	3500	4800	conducts when solid
Y	120	not applicable	does not conduct
Z	– 183	– 162	does not conduct

What are correct identities of W, X, Y and Z?

	W	X	Y	Z
A	graphite	poly(ethene)	silicon dioxide	methane
B	methane	graphite	poly(ethene)	silicon dioxide
C	poly(ethene)	methane	graphite	silicon dioxide
D	silicon dioxide	graphite	poly(ethene)	methane

10. An aqueous solution contains 0.01 mol of $\text{Pb}^{2+}(\text{aq})$ and 0.01 mol of $\text{Cu}^{2+}(\text{aq})$.

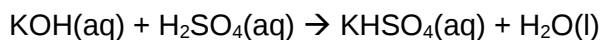
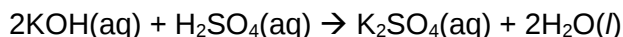
Aqueous ammonia is added until in excess. After shaking, the mixture is filtered. What remains on the filter paper?

- A 0.01 mol of a white hydroxide and 0.01 mol of a blue hydroxide
 B 0.01 mol of a white hydroxide
 C 0.01 mol of a blue hydroxide
 D no solid residue

11. 2.56 g of a metal oxide, MO_2 , is reduced to 1.92 g of the metal, M. What is the relative atomic mass of M?

- A 48
 B 96
 C 128
 D 192

12. Potassium sulfate, K_2SO_4 , and potassium hydrogensulfate, KHSO_4 , can both be prepared using aqueous potassium hydroxide and sulfuric acid.

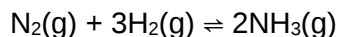


50 cm^3 of 1 mol/dm^3 potassium hydroxide is used each time.

Which row shows the correct volumes of 1 mol/dm^3 sulfuric acid required to prepare a sample of potassium sulfate and a sample of potassium hydrogensulfate?

	volume of sulfuric acid required to make potassium sulfate / cm^3	volume of sulfuric acid required to make potassium hydrogensulfate / cm^3
A	25	50
B	25	12.5
C	50	12.5
D	50	25

13. The Haber process is a reversible reaction.



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 0.45 moles of hydrogen with excess nitrogen?

- A 2160 cm^3
 B 3240 cm^3
 C 4860 cm^3
 D 7200 cm^3

14. Dilute aqueous solutions of potassium iodide and magnesium iodide are mixed together. A sample of the mixture is electrolysed using inert electrodes.

What are the possible products at each of the electrodes?

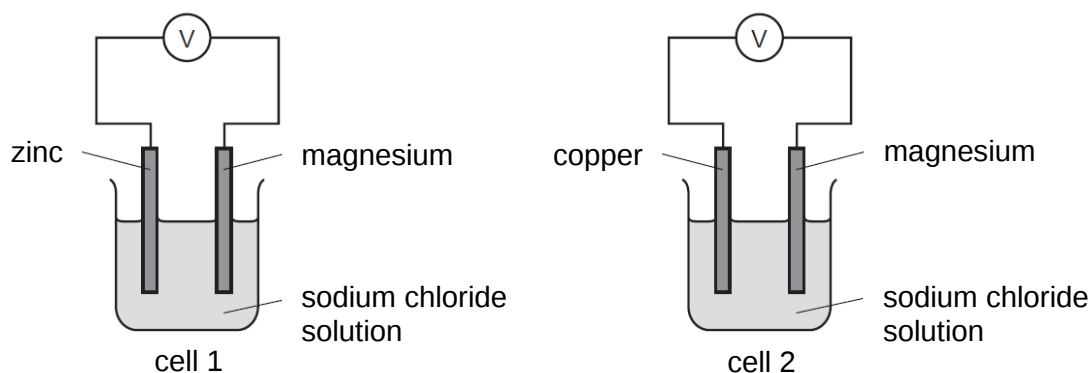
	anode	cathode
A	iodine	oxygen
B	iodine	potassium
C	oxygen	hydrogen
D	oxygen	magnesium

15. In an electrolysis experiment, the same quantity of charge deposited 27.0 g of silver and 4.33 g of chromium.
 [Ar: Ag, 108; Cr, 52]

What was the charge on the chromium ion?

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

16. The electrical energy, or voltage, of two simple cells is measured.

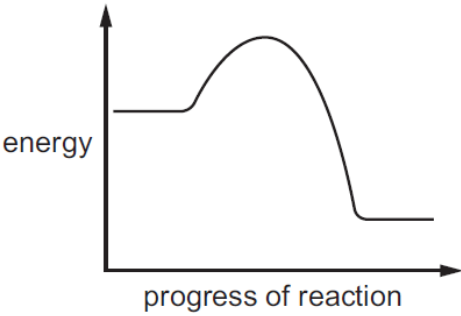
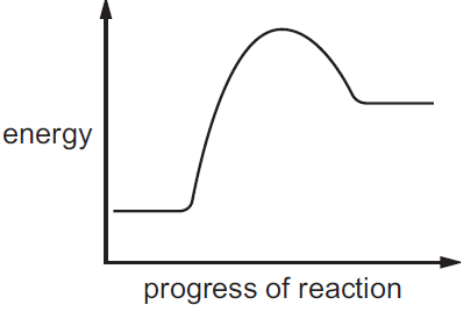
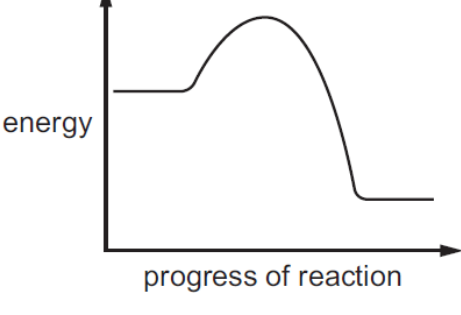
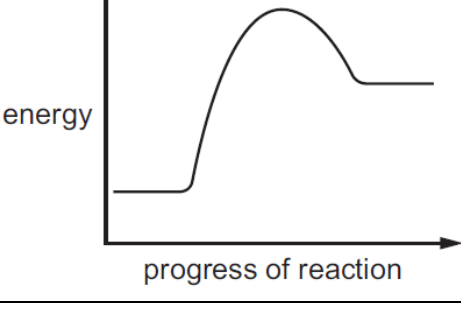


- statement 1: In cell 1, sodium ions gain electrons to form sodium.
 statement 2: In cell 2, copper(II) ions gain electrons to form copper.
 statement 3: In both cells, magnesium loses electrons to form magnesium ions.
 statement 4: The voltage of cell 1 is greater than cell 2.

Which statements are **incorrect**?

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

17. Which row describes an endothermic reaction?

	energy level diagram	energy transfer
A		energy is transferred from the reaction to the surroundings
B		energy is transferred from the reaction to the surroundings
C		energy is transferred from the surroundings to the reaction
D		energy is transferred from the surroundings to the reaction

18. The enthalpy change of combustion, ΔH , is the heat energy given out when one mole of a substance is completely burned in oxygen.

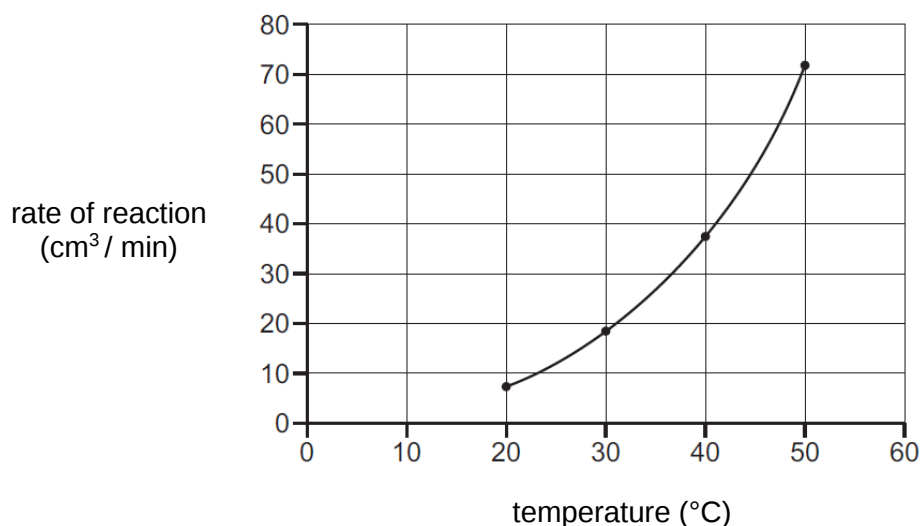
The enthalpy change of combustion and molar mass for four fuels are given in the table below.

fuel	ΔH (kJ/mol)	molar mass (g/mol)
ethanol	– 1371	46
hydrogen	– 286	2
methane	– 891	16
octane	– 5075	114

If 1 kg of each fuel is burned, which fuel will release the most energy?

- A ethanol
 B hydrogen
 C methane
 D octane
19. The rate of reaction between calcium carbonate and hydrochloric acid is studied by collecting the volume of gas released in one minute at different temperatures.

A graph of rate of reaction against temperature is shown.



Which statement best explains why increasing the temperature has this effect on the rate?

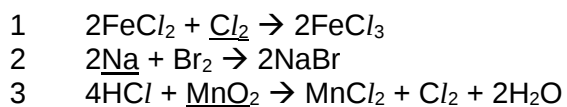
- A The kinetic energy of the particles increases so the particles are more closely packed.
 B The activation energy needed for the particles to react is reduced.
 C There are more collisions as calcium carbonate has greater surface area for reaction.
 D There are more frequent collisions between particles with enough energy to react.

20. A sign displayed in a flour mill is shown.



Which statement explains why there is a danger of explosion in a flour mill?

- A Flour burns very quickly because it is a fine powder.
 B Flour is a catalyst for combustion.
 C Flour mills get hot and speed up the rate of combustion.
 D The combustion of flour is endothermic.
21. The equations below show three different redox reactions.



Which equations show the underlined substance acting as an oxidising agent?

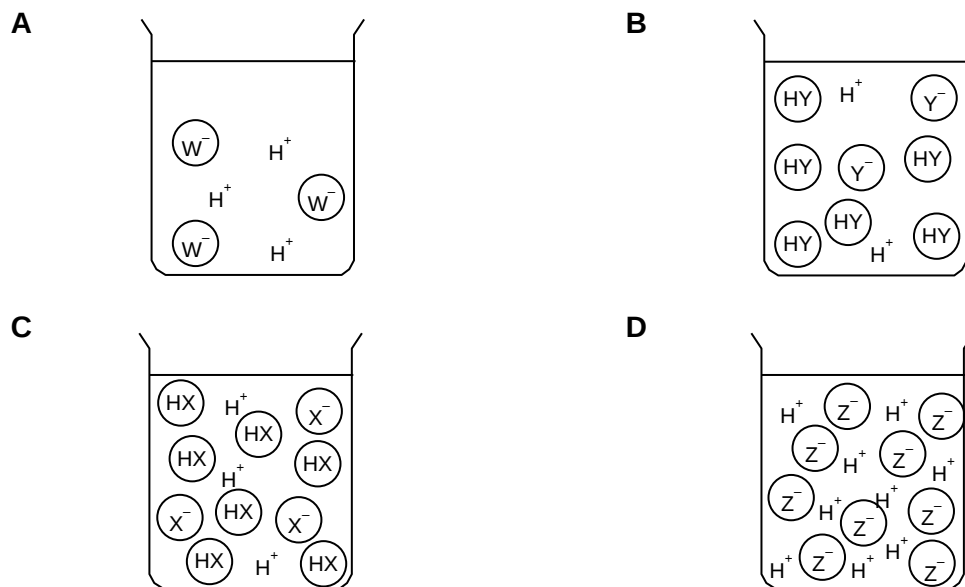
- A 1 and 2 B 1 and 3 C 2 and 3 D 1, 2 and 3
22. The results of some experiments with sulfur dioxide are shown.

experiment	description	result
1	mix with dilute hydrochloric acid	does not react
2	mix with aqueous sodium hydroxide	a salt forms
3	add aqueous potassium iodide	colourless solution turns brown
4	add acidified aqueous potassium manganate(VII)	purple solution turns colourless

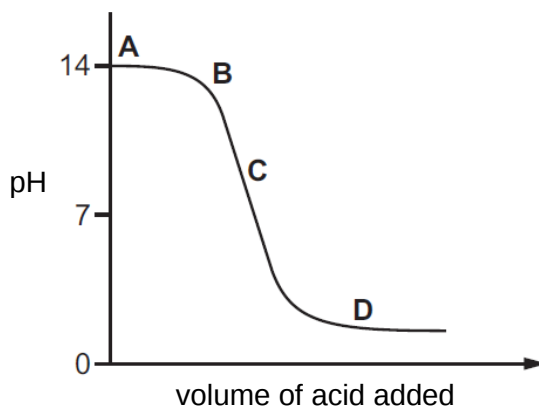
Which results are correct?

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

23. Four different acids are dissolved in water.
Which beaker represents a concentrated solution of a strong acid?
(Water molecules are not shown.)



24. The graph shows how the pH of a solution changes as an acid is added to an alkali.
Which letter represents the area of the graph where both acid and salt are present?



25. How many different salts could be made from a supply of ethanoic acid, hydrochloric acid, copper, magnesium oxide and zinc carbonate?

- A** 3
B 4
C 5
D 6

26. The properties of the element titanium, Ti, can be predicted from its position in the Periodic Table.

Which row identifies the properties of titanium?

(✓ = yes, ✗ = no)

	can be used as a catalyst	conducts electricity when solid	has low density	forms coloured compounds
A	✓	✓	✓	✗
B	✓	✓	✗	✓
C	✓	✗	✓	✓
D	✗	✓	✓	✓

27. A new element oxfordium, Ox, was discovered with the following properties.

solubility	electrical conductivity	formula of element	bonding in a molecule of Ox ₂
insoluble in water	does not conduct	Ox ₂	Ox ≡ Ox

In which group of the Periodic Table should the new element be placed?

- A Group III
 B Group V
 C Group VII
 D Group 0
28. Some of the reactions of four metals, P, Q, R and S, or compounds of these metals are described.
- P reacts with hydrochloric acid and can be extracted from its ore using carbon.
 - Q reacts with hydrochloric acid and cannot be extracted from its ore using carbon.
 - R does not react with hydrochloric acid.
 - The carbonate of S does not decompose when heated strongly.

What is the correct order of reactivity of the metals?

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

29. Four equations are shown.

- 1 $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- 2 $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
- 3 $\text{SiO}_2 + \text{CaO} \rightarrow \text{CaSiO}_3$
- 4 $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$

Which equations represent redox reactions that take place during the extraction of iron from haematite?

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

30. Which methods prevent iron from rusting?

	coating with zinc	coating with tin	washing with salt water
A	✓	✓	✓
B	✗	✓	✓
C	✓	✓	✗
D	✓	✗	✗

key
 ✓ = prevents rusting
 ✗ = does not prevent rusting

31. In what way do chlorofluorocarbons, methane and sulfur dioxide affect the atmosphere and the environment?

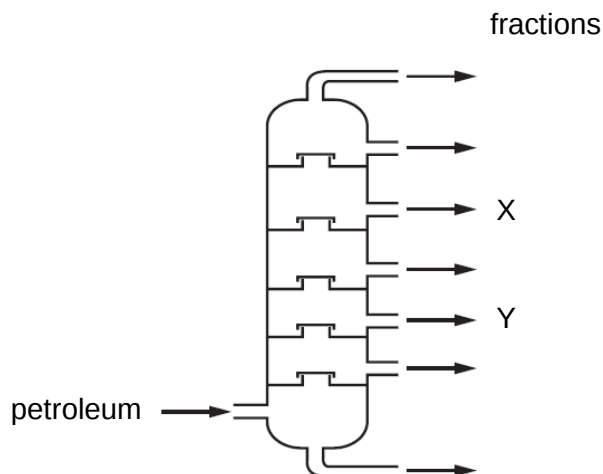
	chlorofluorocarbons	methane	sulfur dioxide
A	acid rain	depletion of the ozone layer	global warming
B	depletion of the ozone layer	acid rain	global warming
C	depletion of the ozone layer	global warming	acid rain
D	global warming	depletion of the ozone layer	acid rain

32. Nitrogen monoxide, NO, is formed in the engines of petrol-powered cars. One constituent of petrol is pentane, C₅H₁₂. Nitrogen monoxide is removed from exhaust fumes by catalytic converters.

Which row identifies the reactants that produce nitrogen monoxide and a reaction that removes it in the catalytic converter?

	reactants that produce NO	reaction that removes NO
A	pentane + one gas found in air	$\text{NO} + \text{CO} \rightarrow \frac{1}{2} \text{N}_2 + \text{CO}_2$
B	pentane + one gas found in air	$\text{NO} + \text{CO}_2 \rightarrow \text{NO}_2 + \text{CO}$
C	two gases found in air	$\text{NO} + \text{CO} \rightarrow \frac{1}{2} \text{N}_2 + \text{CO}_2$
D	two gases found in air	$\text{NO} + \text{CO}_2 \rightarrow \text{NO}_2 + \text{CO}$

33. Petroleum is separated into useful fractions by fractional distillation. The positions at which fractions X and Y are collected from the fractionating column are shown.



Which statement is correct?

- A X condenses at a higher temperature than Y.
 B X has longer chain molecules than Y.
 C The temperature increases up the column.
 D X and Y are collected simultaneously during the process.
34. The chemical formula of the first four members of a homologous series is shown below.

chemical formula
CH_3NH_2
$\text{CH}_3\text{CH}_2\text{NH}_2$
$\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$

Which row gives the general formula and functional group of this homologous series?

	general formula	functional group
A	$\text{C}_n\text{H}_{2n+1}\text{NH}_2$	carbon-carbon double bonds
B	$\text{C}_n\text{H}_{2n-1}\text{NH}_2$	carbon-carbon double bonds
C	$\text{C}_n\text{H}_{2n+1}\text{NH}_2$	amine
D	$\text{C}_n\text{H}_{2n-1}\text{NH}_2$	amine

35. Which product is obtained when bromine reacts with butene, $\text{CH}_3\text{CH}=\text{CHCH}_3$?

- A $\text{CH}_3\text{CH}=\text{CHCH}_2\text{Br}$
 B $\text{CH}_2\text{BrCH}_2\text{CH}_2\text{CH}_2\text{Br}$
 C $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHBr}_2$
 D $\text{CH}_3\text{CHBrCHBrCH}_3$

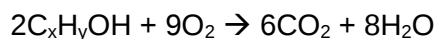
36. The molecules of two hydrocarbon compounds X and Y each contains only four carbon atoms. X is saturated and Y is unsaturated.

Which statement(s) is/are correct?

- 1 Under suitable conditions Y polymerises.
- 2 The complete combustion of 1 mole of Y produces more carbon dioxide than the complete combustion of 1 mole of X.
- 3 One molecule of Y contains more hydrogen atoms than one molecule of X.

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

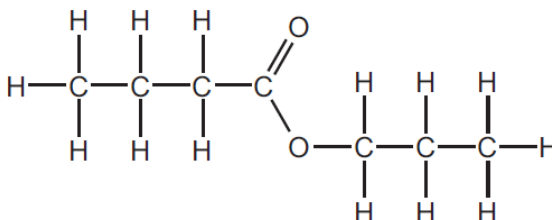
37. The formula of an alcohol is C_xH_yOH . The equation for its complete combustion is shown.



What are the values of x and y?

	x	y
A	3	7
B	3	8
C	6	7
D	6	8

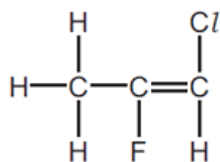
38. The structure of ester W is shown.



Which row gives the names of ester W and the alcohol and carboxylic acid from which it is made?

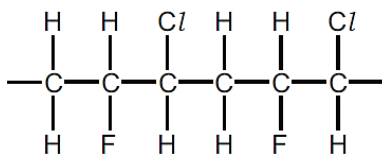
	name of ester W	alcohol	carboxylic acid
A	butyl propanoate	butanol	propanoic acid
B	butyl propanoate	propanol	butanoic acid
C	propyl butanoate	butanol	propanoic acid
D	propyl butanoate	propanol	butanoic acid

39. The diagram shows the structure of a monomer.

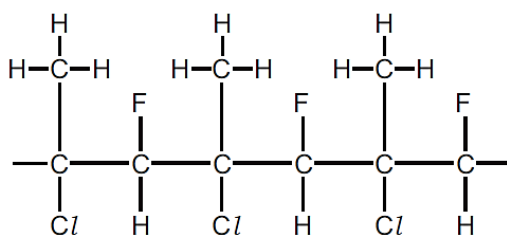


Which diagram shows the partial structure of its polymer?

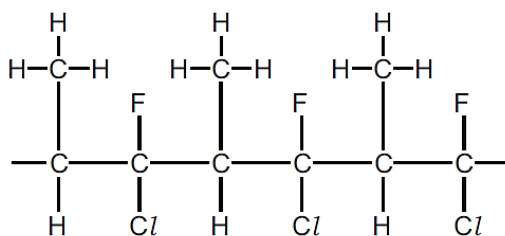
A



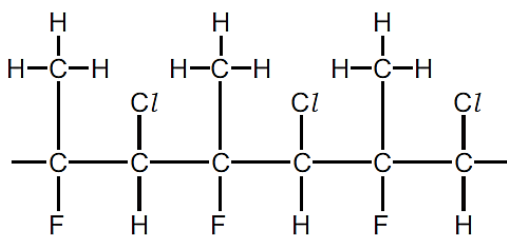
B



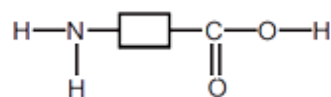
C



D

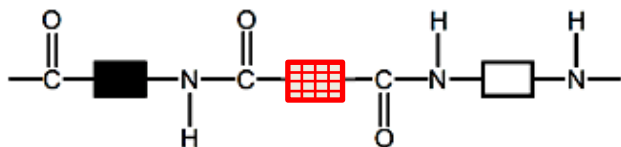


40. Polymer P is formed when the 3 monomers below undergo condensation polymerisation.

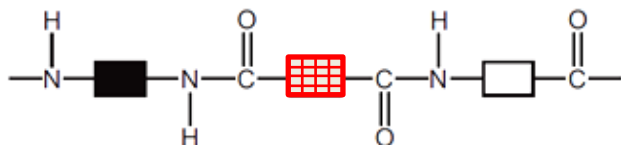


Which diagram represents the repeat unit of polymer P?

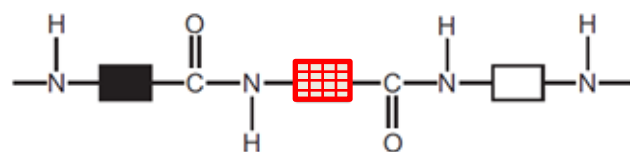
A



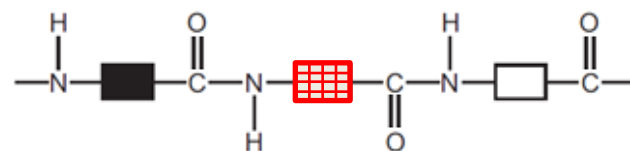
B



C



D



The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
1 H hydrogen 1 Key proton (atomic) number atomic symbol name relative atomic mass																	
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 -		
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			
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 -			
actinoids																	

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).