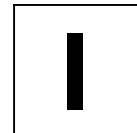


[Science] Chemistry O Level Exam Paper
Preliminary Examination Set [I]
Secondary Four Express & Five Normal



CANDIDATE NAME:

CLASS:

INDEX NUMBER:

Science(Chemistry)

5076/01

Paper 1 Multiple Choice

5078/01

2024

30 min

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid/tape.

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.

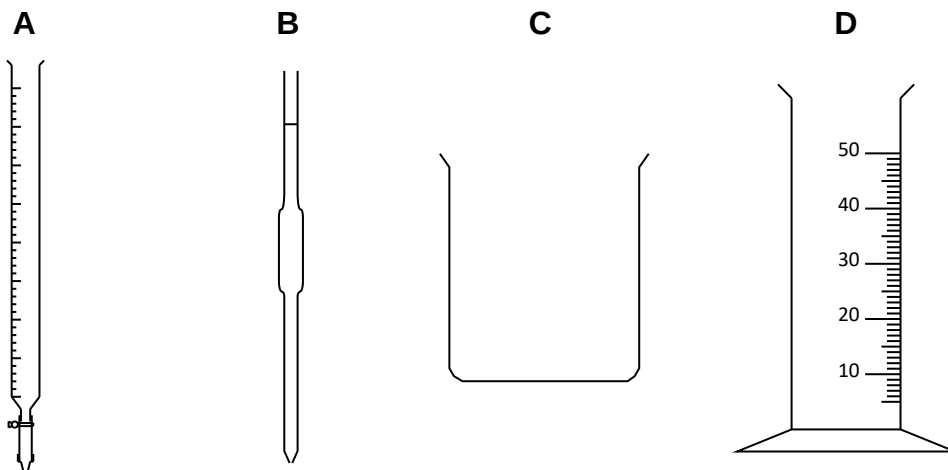
Any rough working should be done in this booklet.

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

SECTION A: MULTIPLE CHOICE QUESTIONS [20 MARKS]

There are 20 questions in this section. Answer **ALL** questions. Choose the correct answer and record your choice on the OAS paper provided.

- 1 Which apparatus is most suitable to be used to measure the volume of sodium hydroxide needed to completely react with 25.0 cm^3 of sulfuric acid?



- 2 The table shows the melting and boiling point of four substances.

In which substance are the particles arranged in a disorderly manner and sliding over one another at $-50\text{ }^{\circ}\text{C}$?

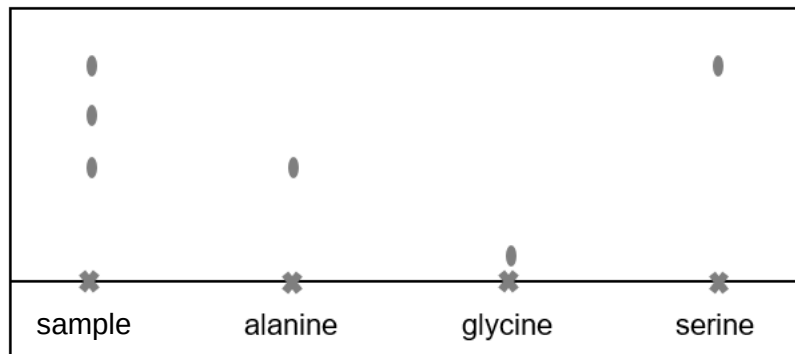
	melting point / $^{\circ}\text{C}$	boiling point / $^{\circ}\text{C}$
A	-114	-80
B	-84	-20
C	20	450
D	1610	2230

- 3 A series of experiments were conducted on a new substance discovered.

Which observation suggests that this substance **cannot** be an element?

- A Decomposing the substance by heating gave two products.
- B It dissolves in water to give a colourless solution.
- C It has a fixed melting point.
- D It form two oxides when heated in air.

- 4 Paper chromatography was carried out on a given sample together with three amino acids (alanine, glycine, serine) that are suspected to be present in the sample.



Which conclusion can be deduced from the chromatogram?

- A** Glycine is the most soluble amino acid.
- B** Serine is more soluble than alanine.
- C** The sample contains alanine, glycine and an unknown amino acid.
- D** The unknown amino acid in the sample is less soluble than alanine but more soluble than serine.

- 5 Which option shows the correct information of an electron?

	relative mass	relative charge
A	-1	$\frac{1}{1840}$
B	0	-1
C	$\frac{1}{1840}$	0
D	$\frac{1}{1840}$	-1

- 6 Two statements about magnesium chloride are made below.

statement 1: A large amount of energy is needed to overcome the strong electrostatic forces between ions in magnesium chloride.

statement 2: Magnesium chloride conducts electricity due to free-moving ions.

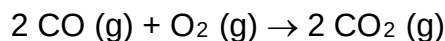
Which option correctly describes the two statements?

- A Both statements are incorrect.
 - B Both statements are correct but statement 1 does not explain statement 2.
 - C Both statements are correct and statement 1 explains statement 2.
 - D Statement 1 is correct but statement 2 is not.
- 7 0.5 g of calcium carbonate reacts completely with 0.5 mol/dm³ of hydrochloric acid according to the following equation:



What is the volume of the hydrochloric acid?

- A 0.005 dm³
 - B 5 dm³
 - C 10 cm³
 - D 20 cm³
- 8 15 cm³ of carbon monoxide reacts with 5 cm³ of oxygen. The equation for the reaction is shown.



What is the volume of gases present at the end of the experiment?

- A 10 cm³ of carbon dioxide only
- B 30 cm³ of carbon dioxide only
- C 5 cm³ of carbon monoxide and 10 cm³ of carbon dioxide
- D 10 cm³ of carbon monoxide and 10 cm³ of carbon dioxide

- 9** When Universal Indicator is added to solution **R**, it turns yellow.

Which statement about solution **R** is true?

- A** It has a pH value of 1.
- B** It has more hydrogen ions than hydroxide ions.
- C** It reacts with copper to produce hydrogen gas.
- D** It turns red litmus paper blue.

- 10** The following tests were carried out on an unknown salt.

test	observation
add excess sodium hydroxide and heat	colourless solution seen gas produced turns damp red litmus paper blue
add hydrochloric acid	colourless solution seen gas produced forms a white precipitate in limewater

What is the identity of this salt?

- A** ammonium carbonate
- B** ammonium chloride
- C** calcium carbonate
- D** zinc chloride

- 11** Which statement about elements across a period of the Periodic Table is true?

- A** The density of the elements increases.
- B** The metallic character of the elements increases.
- C** The non-metallic character of the elements increases.
- D** The number of electron shells of the elements increases.

- 12** Elements **P** and **Q** are in Group 17 of the Periodic Table. It is observed that **P** displaces **Q** from its solution.

- 1 Molecules of **P** have more atoms than molecules of **Q**.
- 2 **P** is a liquid at room temperature while **Q** is a solid at room temperature.
- 3 **Q** is darker in colour compared to **P**.

Which statement(s) is / are correct?

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

- 13** **W**, **X**, **Y** and **Z** are four different metals. Some properties of these metals are listed below.

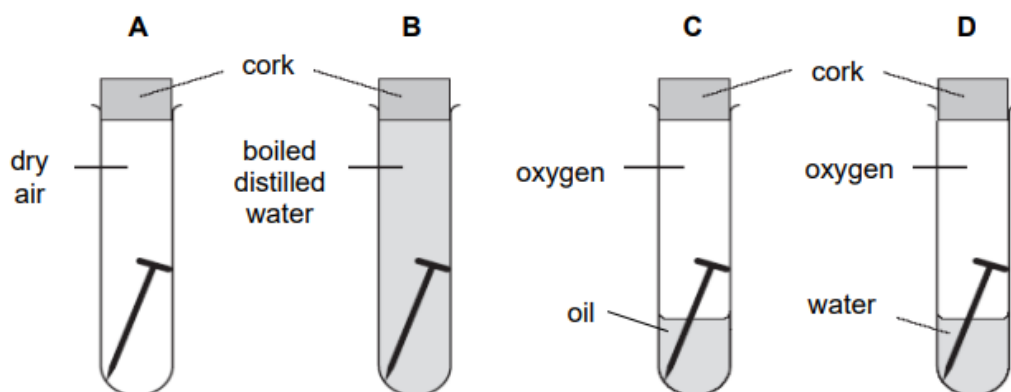
- 1 **X** reacts more vigorously with cold water than **Y**.
- 2 **X** and **Y** can only be extracted by electrolysis.
- 3 **W** displaces **Z** from its blue solution, forming a reddish-brown solid.
- 4 **W** can be extracted by heating with carbon.

What are metals **W**, **X**, **Y** and **Z**?

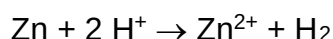
	W	X	Y	Z
A	copper	sodium	potassium	iron
B	copper	potassium	sodium	iron
C	iron	sodium	calcium	copper
D	iron	calcium	sodium	copper

- 14 Four iron nails are placed into different test tubes to investigate the rate of rusting under different conditions.

In which test tube would the iron nail rust first?



- 15 The reaction between zinc metal and hydrochloric acid is represented by the equation below.



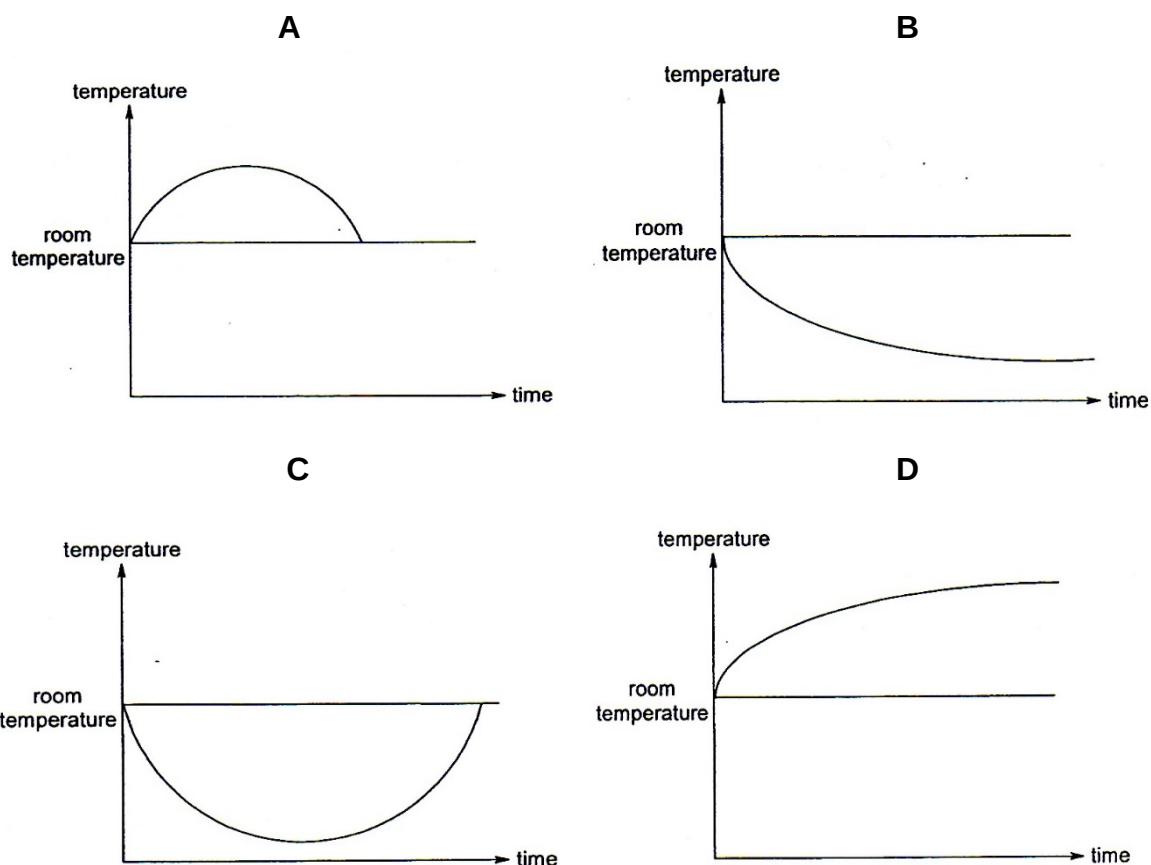
Which statement correctly describes the reaction?

- A Hydrogen has been oxidised as it has gained two electrons.
 B Hydrogen has been reduced as it has lost two electrons.
 C Zinc has been oxidised as it has lost two electrons.
 D Zinc has been reduced as it has gained two electrons.
- 16 In which reaction is the change in pressure least likely to affect the rate of reaction?
- A $2 \text{Zn (s)} + \text{O}_2 \text{ (g)} \rightarrow 2 \text{ZnO (s)}$
 B $\text{H}_2 \text{ (g)} + \text{Cl}_2 \text{ (g)} \rightarrow 2 \text{HCl (g)}$
 C $\text{Na (s)} + \text{H}_2\text{O (g)} \rightarrow \text{Na}_2\text{O (s)} + \text{H}_2 \text{ (g)}$
 D $\text{KOH (aq)} + \text{HNO}_3 \text{ (aq)} \rightarrow \text{KNO}_3 \text{ (aq)} + \text{H}_2\text{O (l)}$
- 17 Which option correctly matches the air pollutant with its source?

	air pollutant	source
A	carbon monoxide	volcanic eruptions
B	carbon monoxide	internal combustion in car engines
C	oxides of nitrogen	internal combustion in car engines
D	sulfur dioxide	lightning activity

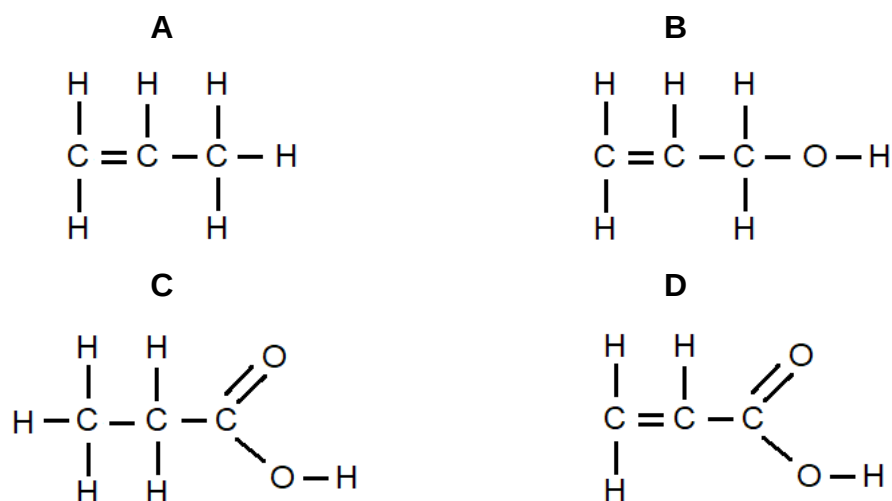
- 18 The dissolving of ammonium nitrate in water is an endothermic change.

Which graph shows how the temperature of the mixture changes as 2 g of ammonium nitrate is added to 50 cm³ of water and the mixture is left to stand?

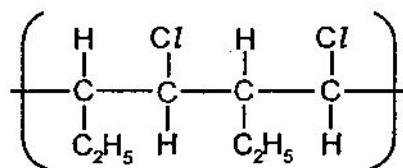


- 19 An organic compound, X, decolourises red-brown aqueous bromine and extinguishes a lighted splint with a 'pop' sound when it reacts with magnesium.

Which of the following is X?

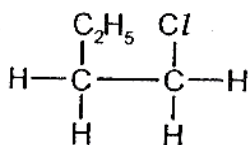


- 20 The structural formula of part of a polymer is shown below.

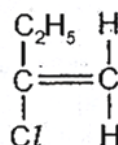


Which monomer was used to form this polymer?

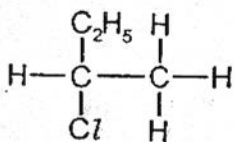
A



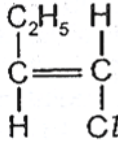
B



C



D



– End of Paper 1 –

Data Sheet

Colours of Some Common Metal Hydroxides

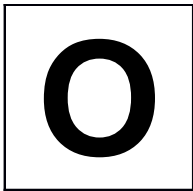
aluminium hydroxide	white
calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
zinc hydroxide	white

The Periodic Table of Elements

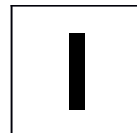
Group																	
1	2																
		1 Hhydrogen 1															
		Key proton (atomic) number atomic symbol name relative atomic mass															
3	4																
Li lithium 7	Be beryllium 9																
11	12																
Na sodium 23	Mg magnesium 24																
19	20																
K potassium 39	Ca calcium 40																
37	38																
Rb rubidium 85	Sr strontium 88																
55	56																
Cs caesium 133	Ba barium 137																
87	88																
Fr francium	Ra radium																

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

The Avogadro constant, $L = 6.02 \times 10^{23} \text{ mol}^{-1}$.



[Science] Chemistry O Level Exam Paper
Preliminary Examination Set [I]
Secondary Four Express & Five Normal



CANDIDATE NAME:

CLASS:

INDEX NUMBER:

Science(Chemistry)

Paper 2 Theory

5076/03

2024

5078/03

1 hour 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid/tape.

Section A

Answer **all** questions.

Section B

Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

Section A	
Section B	
Total	

Section A

Answer **all** the questions in the spaces provided.

- 1** A list of substances is given in the box below.

aluminium	oxygen	sulfur
magnesium oxide	zinc oxide	nitric acid
ammonium nitrate	sodium hydroxide	calcium

Use the substances above to answer the following questions.

- (a)** Name the element that has a proton number of 16.
.....[1]
- (b)** Name the element that forms an oxide which only reacts with acids.
.....[1]
- (c)** Name two substances that react with each other to evolve a basic gas.
.....[1]
- (d)** Name a substance that is able to conduct electricity in the solid state.
.....[1]

[Total: 4]

- 2 The set-up in Fig. 2 is used to obtain a sample of ethanol from a solution of coloured dyes dissolved in ethanol.

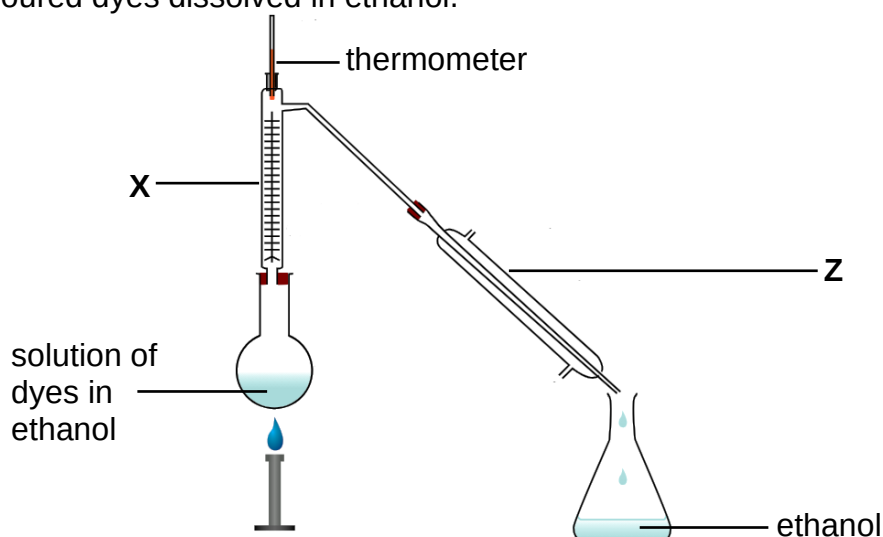


Fig. 2

- (a) Name apparatus X.
..... [1]
- (b) Based on the information given in Fig. 2, what can you deduce about the boiling point of ethanol compared to the coloured dyes?
.....
.....[1]
- (c) State how you would be able to determine from the set-up that the ethanol collected is pure.
..... [1]
- (d) Describe the changes in movement and arrangement of the ethanol particles as they move from X to Z.
.....
.....
.....
.....[2]

[Total: 5]

3 Sodium is an alkali metal found in Group 1 of the Periodic Table.

(a) Suggest why Group 1 metals are known as alkali metals.

.....
.....[1]

(b) State one trend observed in the properties of Group 1 metals.

.....
.....[1]

(c) Sodium has two radioactive isotopes, sodium-22 and sodium-24.

(i) Explain why both sodium isotopes have similar chemical properties.

.....
..... [1]

(ii) Complete the table to show the number of sub-atomic particles present in each particle of sodium.

particle	number of protons	number of neutrons	number of electrons
${}^{22}_{11}\text{Na}$			
${}^{24}_{11}\text{Na}^+$			

[2]

[Total: 5]

- 4 Copper reacts with hot concentrated nitric acid to form nitrogen dioxide gas. The equation for the reaction is shown below.



- (a) State and explain if this is a typical acid-metal reaction.

.....
.....[1]

- (b) Complete the tables by stating the oxidation states of copper and nitrogen in the substances shown.

substance	oxidation state of nitrogen
HNO_3	
NO_2	

substance	oxidation state of copper
Cu	
$\text{Cu}(\text{NO}_3)_2$	

[3]

- (c) In terms of oxidation states, explain why this reaction is a redox reaction.

.....
.....
.....
.....[2]

[Total: 6]

5 Fig. 5 shows the reactions involving a mixture containing metal **L** and salt **M**.

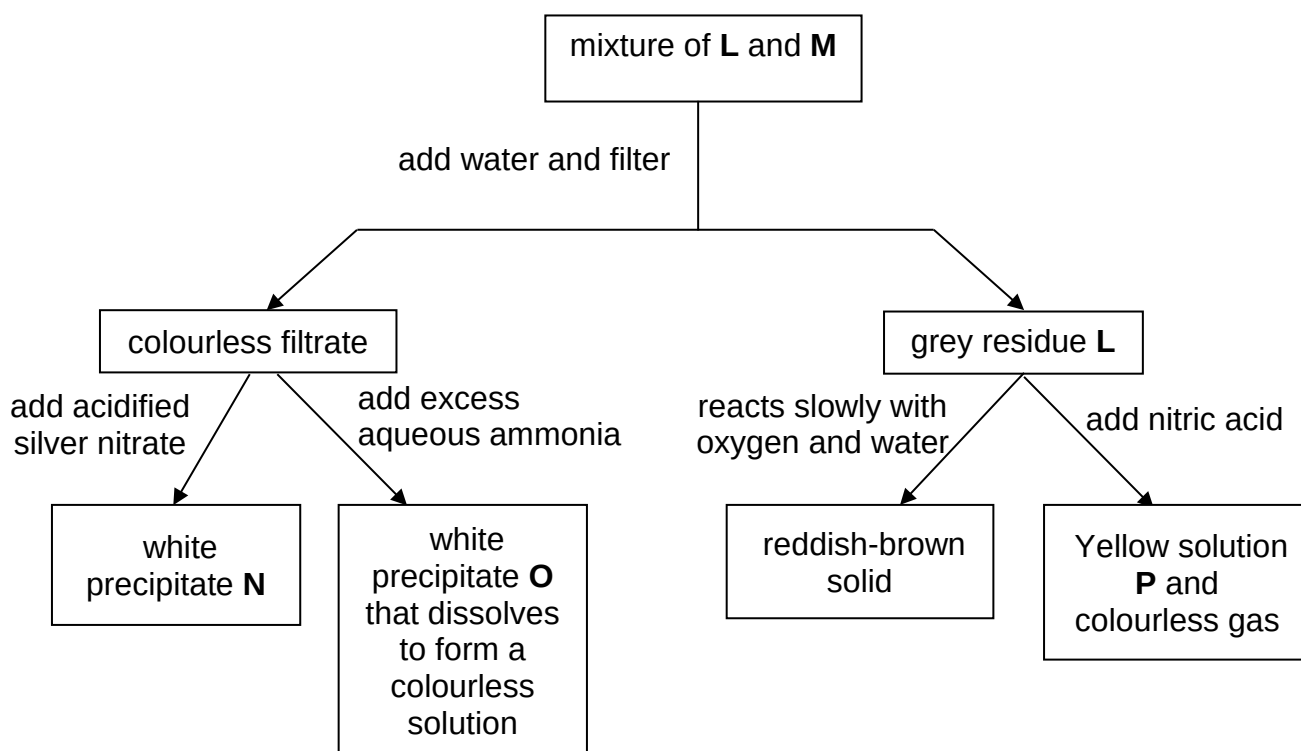


Fig. 5

(a) Identify substances **L**, **M**, **N**, **O** and **P**.

L:

M:

N:

O:

P:

[5]

(b) Write a balanced chemical equation, with state symbols, for any of the reactions above.

..... [2]

[Total: 7]

- 6 Alkanes, cycloalkanes and alkenes are examples of homologous series. Fig. 6 shows the structure of some members of these homologous series.

number of carbon atoms	alkane	cycloalkane	alkene
5	pentane <pre> H H H H H H - C - C - C - C - C - H H H H H H </pre>	cyclopentane <pre> H H H-C C-H H-C C-H H-C C-H H H </pre>	pentene <pre> H H H H H H - C - C - C - C = C - H H H H H H </pre>
6	hexane <pre> H H H H H H H - C - C - C - C - C - C - H H H H H H H </pre>	cyclohexane <pre> H H H-C C-H H-C C-H H-C C-H H-C C-H H H </pre>	hexene <pre> H H H H H H H - C - C - C - C - C = C - H H H H H H H </pre>
7	heptane <pre> H H H H H H H H - C - C - C - C - C - C - C - H H H H H H H H </pre>	cycloheptane <pre> H H H H-C C C-H H-C C C-H H-C C C-H H-C C C-H H H H </pre>	heptene <pre> H H H H H H H H - C - C - C - C - C - C = C - H H H H H H H H </pre>

Fig. 6

- (a) Deduce the general formula of cycloalkanes.

..... [1]

- (b) State one difference in physical property between cyclohexane and cycloheptane.

.....
 [1]

- (c) Write a chemical equation for the complete combustion of pentane.

..... [1]

- (d) State the reagent(s) and condition(s) needed to form hexane from hexene.

reagent(s) :

condition(s) : [1]

[Total: 4]

- 7 Fig. 7 shows some chemical reactions of an unsaturated compound **W**.

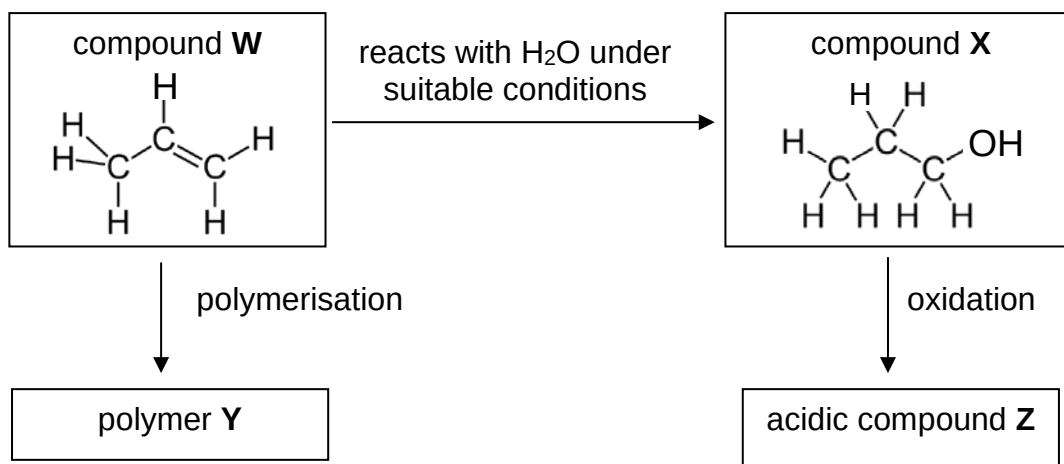


Fig. 7

- (a) State whether compound **W** is a hydrocarbon. Explain your answer.

.....
 [1]

- (b) (i) Compound **Z** was formed from compound **X** in the laboratory. State the reagent(s) and condition(s) required for this reaction.

reagent(s) :

condition(s) : [1]

- (ii) Describe an observation you would expect during this oxidation process.

.....
 [1]

(iii) Draw the full structural formula of compound **Z** formed.

[1]

(c) Describe a chemical test that can be carried out to differentiate between compound **W** and compound **Z**. Include relevant observations in your answer.

.....
.....
.....
..... [2]

(d) Draw the structure of polymer **Y**, showing 2 repeating units.

[1]

[Total: 7]

- 8** Experiments were carried out to extract metals **X**, **Y** and iron from their oxides. Table 8 shows the results of the experiments conducted.

Table 8

experiment	iron	X	Y
heating metal oxide with carbon	metal oxide reduced	metal oxide remains unchanged	metal oxide reduced
heating metal oxide with hydrogen	metal oxide remains unchanged	metal oxide remains unchanged	metal oxide reduced

- (a)** Arrange the metals **X**, **Y** and iron in order of decreasing reactivity.

..... [1]

- (b)** Suggest a suitable identity for metal **X**. Explain your answer.

.....
..... [2]

[Total: 3]

- 9 A student was provided with a sample of zinc granules and a bottle of 1 mol/dm³ nitric acid. Using the chemicals provided, design an experiment to investigate the effect of temperature of the reactants on the rate of reaction.

You may use any other apparatus commonly found in the school laboratory.

Your answer should also include:

- the measurements you would take
- the results you would expect to obtain and hence a conclusion to the aim of the experiment.

You may use a diagram to help you in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 4]

10 Fluorine is a halogen that forms many compounds with metals and non-metals.

(a) Aluminium fluoride is a compound used to inhibit the fermentation process in beer and wine production. It is soluble in water and has a high melting point of 1260 °C.

(i) Draw a 'dot-and-cross' diagram to show the arrangement of all electrons in aluminium fluoride.

[2]

(ii) Explain, in terms of electrons, how and why fluorine reacts with aluminium.

.....
.....
.....
..... [2]

(b) Nitrogen trifluoride, NF_3 , is a compound used in the manufacture of LCD displays and other microelectronics.

(i) Draw a 'dot-and-cross' diagram to show the arrangement of the outer shell electrons in a molecule of nitrogen trifluoride.

[2]

- (ii) With reference to structure and bonding, explain why nitrogen trifluoride exists in the gaseous state at room temperature.

.....
.....
.....
..... [2]

- (iii) Nitrogen trifluoride is a greenhouse gas that has a global warming potential much greater than carbon dioxide.

Describe two potential effects of increased levels of greenhouse gases in our atmosphere.

.....
.....
.....
..... [2]

[Total: 10]

Section B

Answer **one** question from this section.

- 11** A student investigates the reaction of copper(II) carbonate lumps with 1.0 mol/dm³ dilute hydrochloric acid that is in excess.



The volume of gas collected in the gas syringe is recorded every 10 s and the results obtained are shown in Fig. 10.

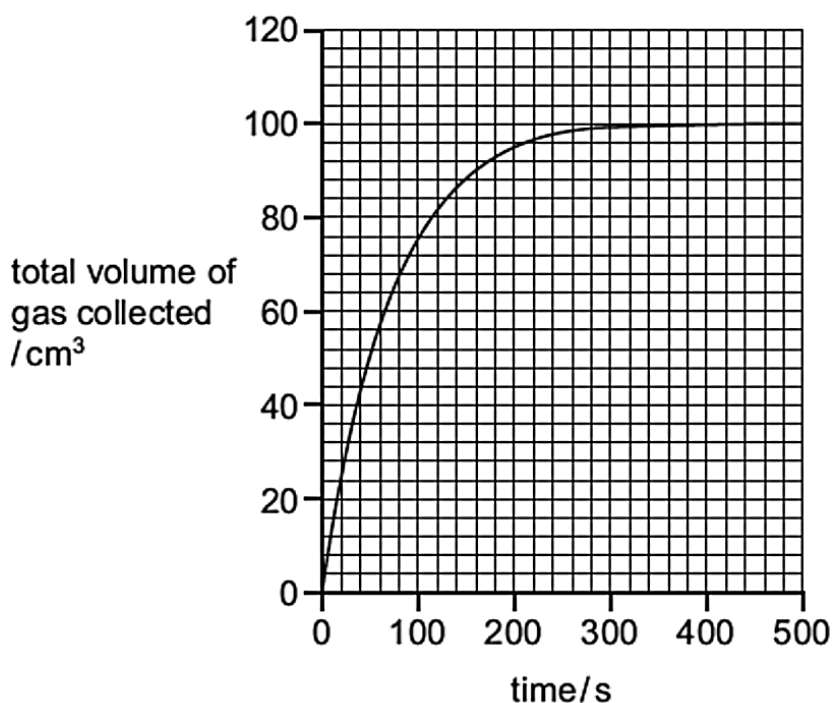


Fig. 11

- (a)** State the time taken for the reaction to be half complete.

time = s [1]

- (b)** State a reason why the gradient of the graph decreases with time.

.....
.....[1]

- (c)** Write an ionic equation for this reaction.

.....[1]

- (d) (i) With reference to Fig. 11, calculate the total amount of gas produced.

amount of gas produced = mol [1]

- (ii) Calculate the molar mass of copper(II) carbonate.

molar mass = g/mol [1]

- (iii) Using the values in (d)(i) and (d)(ii), calculate the mass of copper(II) carbonate used.

mass = g [2]

- (e) The experiment was repeated using copper(II) carbonate powder instead. All the other conditions remain the same.

- (i) On Fig. 11, draw the graph you would expect to obtain for this experiment. [1]

- (ii) Explain, in terms of collision theory, how the gradient of the graph is different.

.....
.....
.....
..... [2]

[Total: 10]

- 12** A student carried out an experiment to investigate the speed of reaction between excess sodium thiosulfate solution and dilute hydrochloric acid.



50 cm³ of sodium thiosulfate solution was poured into a beaker. The beaker was placed on top of a piece of paper with a cross drawn on it. 10 cm³ of dilute hydrochloric acid was added to the beaker and the time taken for the cross to be covered by the sulfur precipitate was recorded.

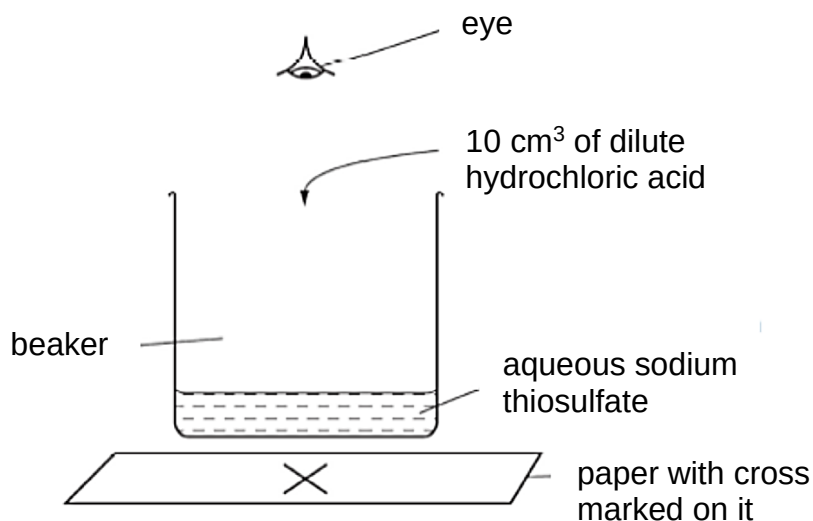


Fig. 12.1

The experiment was repeated using different volumes of water mixed with different volumes of sodium thiosulfate. The results of the experiments are shown in Table 12.2.

Table 12.2

experiment	1	2	3	4	5
volume of sodium thiosulfate solution / cm ³	50	40	30	20	10
volume of water / cm ³	0	10	20	30	40
time taken / s	4	6	9	12	25

- (a)** **(i)** Based on the results in Table 12.2, describe the trend seen between the volume of water used and the time taken for the cross to be covered.

.....

.....[1]

- (ii) Explain, in terms of collision theory, the results obtained in Table 12.2.

.....
.....
.....
.....
.....[3]

- (b) A student carries out further steps to isolate the sulfur precipitate from the mixture in the experiment.

- (i) Briefly describe how the sulfur precipitate formed can be obtained from the mixture.

.....
.....[1]

- (ii) If the mass of the sulfur precipitate obtained in experiment 1 is 0.2 g, calculate the amount of sulfur produced.

amount of sulfur produced = mol [1]

- (iii) Hence, using the values in (b)(ii), calculate the concentration of dilute hydrochloric acid used in the experiment.

concentration = mol/dm³ [2]

- (c) The experiments above are hazardous when conducted in a closed environment. Explain why it is hazardous and a possible effect it will have on the student when conducted in a closed environment.

.....
.....
.....
.....[2]

[Total: 10]

- End of Paper 3 -

Colours of Some Common Metal Hydroxides

aluminium hydroxide	white
calcium hydroxide	white
copper(II) hydroxide	blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
zinc hydroxide	white

Group																		
1	2	13										14	15	16	17	18		
		1 H hydrogen 1																
		Key proton (atomic) number atomic symbol name relative atomic mass																
3 Li lithium 7	4 Be beryllium 9																	
11 Na sodium 23	12 Mg magnesium 24																	
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	113 Nh nihonium	114 Fl flerovium	115 Mc moscovium	116 Lv livermorium	117 Ts tennessine	118 Og oganeson
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	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.).
The Avogadro constant, $L = 6.02 \times 10^{23} \text{ mol}^{-1}$.