A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

Foundation Tier
Chemistry Paper 1F

F

8464/C/1F

Time allowed: 1 hour 15 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

INSTRUCTIONS

- **Use black ink or black ball-point pen.**

- **Pencil should only be used for drawing.**

- **Answer ALL questions in the spaces provided.**

- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**

- **Do all rough work in this book. Cross through any work you do not want to be marked.**

- **In all calculations, show clearly how you work out your answer.**

INFORMATION

- **The maximum mark for this paper is 70.**

- **The marks for questions are shown in brackets.**

- **You are expected to use a calculator where appropriate.**

- **You are reminded of the need for good English and clear presentation in your answers.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1

This question is about Group 1 elements.

0 1 . 1

What are the Group 1 elements known as? [1 mark]

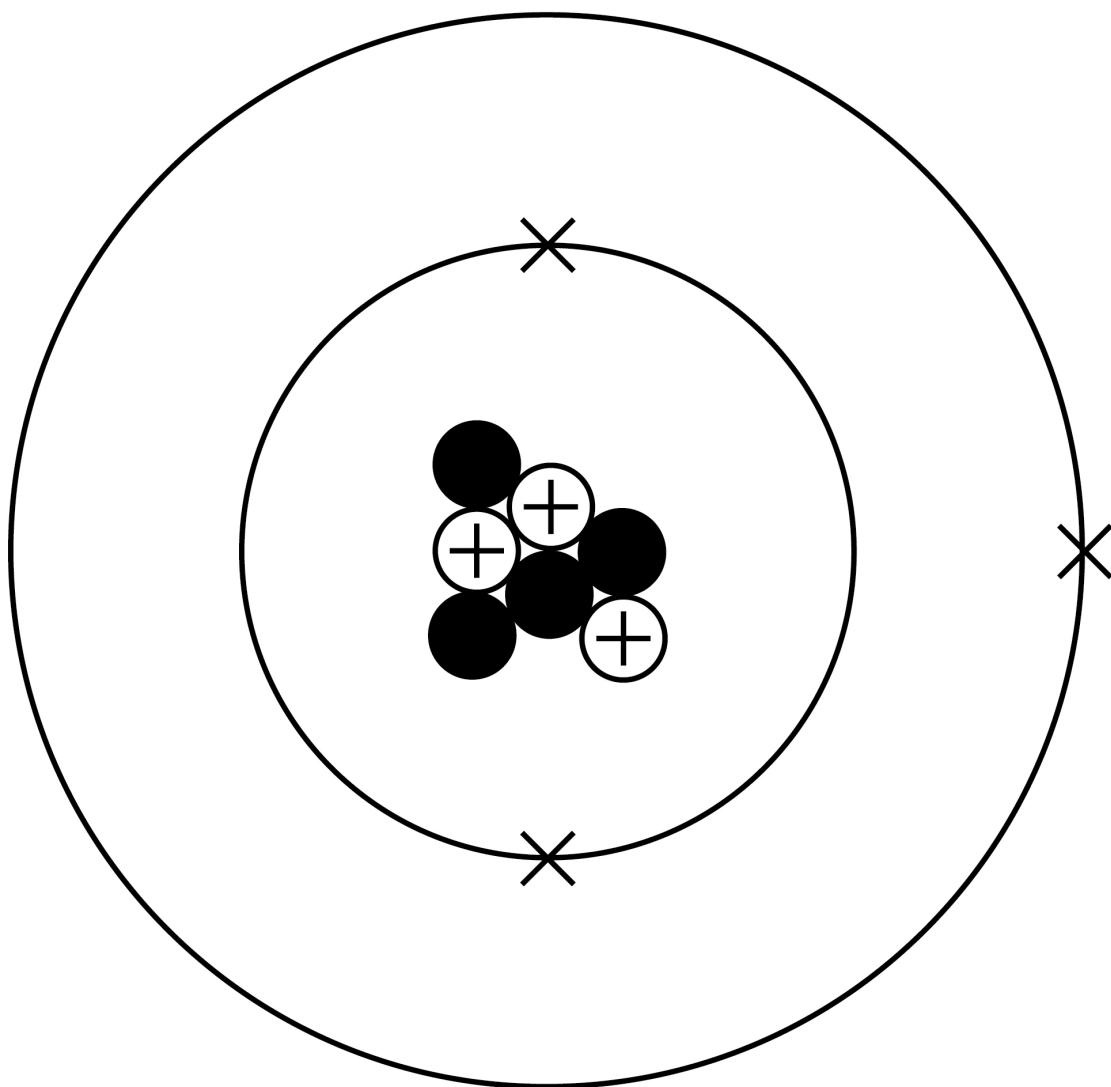**Tick (✓) ONE box.**

☐ **Alkali metals**

☐ **Halogens**

☐ **Noble gases**

0 1 . 2

FIGURE 1 shows a lithium atom.

FIGURE 1

What is the number of electrons and neutrons in the atom of lithium?
[2 marks]

Number of electrons _____

Number of neutrons _____

[Turn over]

0 1 . 3

What is the relative charge on a lithium ion? [1 mark]

Tick (✓) ONE box.

☐   **+1**

☐   **0**

☐   **−1**

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[Turn over]

0 1 . 4

Lithium is heated and then cooled in an experiment.

Stage 1   **Stage 2**

Lithium solid ⟶ **Lithium liquid** ⟶ **Lithium solid**

Two physical changes happen in the experiment.

On the opposite page, draw ONE line from each stage to the physical change that happens in that stage. [2 marks]

STAGE	PHYSICAL CHANGE
	Boiling
	Condensing
Stage 1	Dissolving
	Freezing
Stage 2	Melting

FIGURE 2, on page 10, represents the melting points of some Group 1 elements.

[Turn over]

FIGURE 2

Melting point in °C

Group 1 element
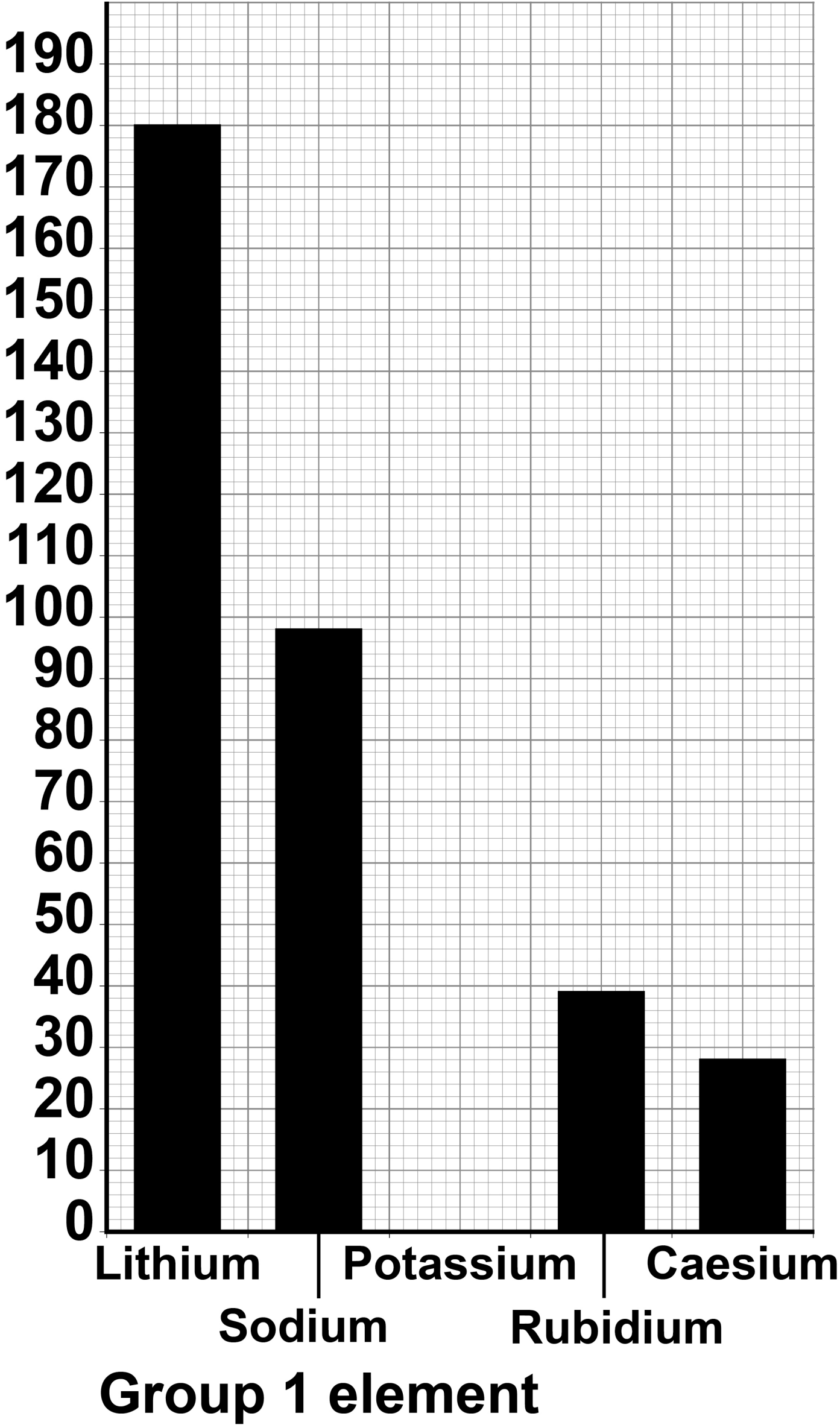
0 1 . 5

What is the melting point of caesium?

Use FIGURE 2, on the opposite page.
[1 mark]

Melting point = _____ °C

0 1 . 6

The melting point of potassium is 63 °C

Draw a bar for the melting point of potassium on FIGURE 2. [1 mark]

[Turn over]

0 1 . 7

Describe the trend of the melting points of the Group 1 elements in FIGURE 2, on page 10. [3 marks]

_____

_____

_____

_____

_____

_____

_____

0 1 . 8

The boiling point of sodium is 883 °C

What is the state of sodium at 150 °C?

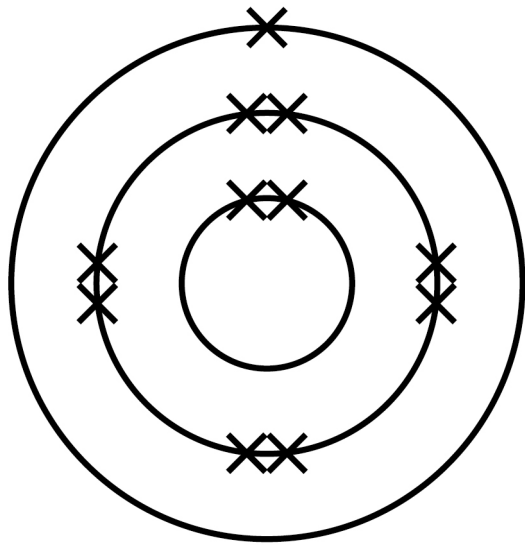**Use FIGURE 2, on page 10. [1 mark]**

Tick (✓) ONE box.

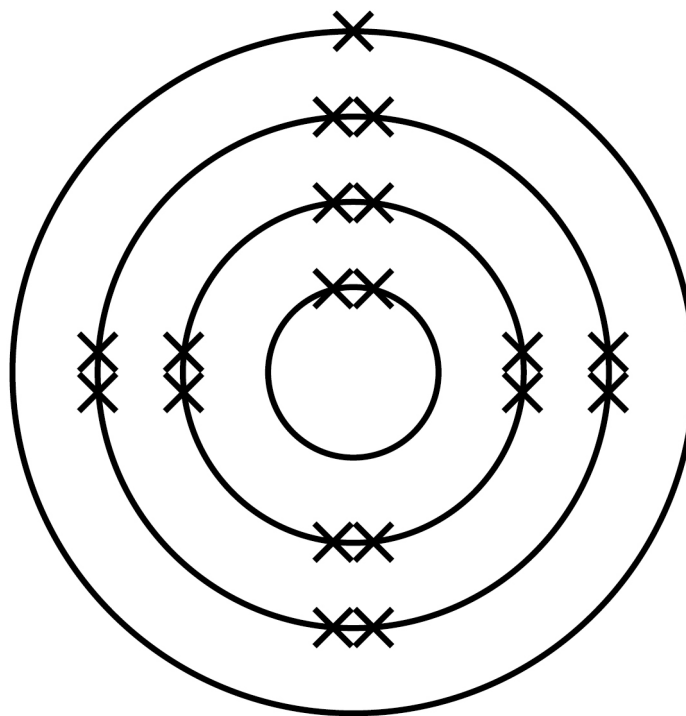☐   **Gas**

☐   **Liquid**

☐   **Solid**

[Turn over]

0 1 . 9

FIGURE 3 represents the electronic structure of a sodium atom and of a potassium atom.

FIGURE 3

Sodium atom

Potassium atom

Complete the sentence.

Choose the answer from the list.
[1 mark]

- **gains an electron**

- **loses an electron**

- **shares an electron**

Potassium is more reactive than sodium because potassium more easily

_____ .

[Turn over]

13

0 2

This question is about hydrogen chloride and sodium hydroxide.

0 2 . 1

A chlorine atom has 7 electrons in the outer shell.

A hydrogen atom has 1 electron in the outer shell.

FIGURE 4, on the opposite page, represents part of a dot and cross diagram for a molecule of hydrogen chloride.
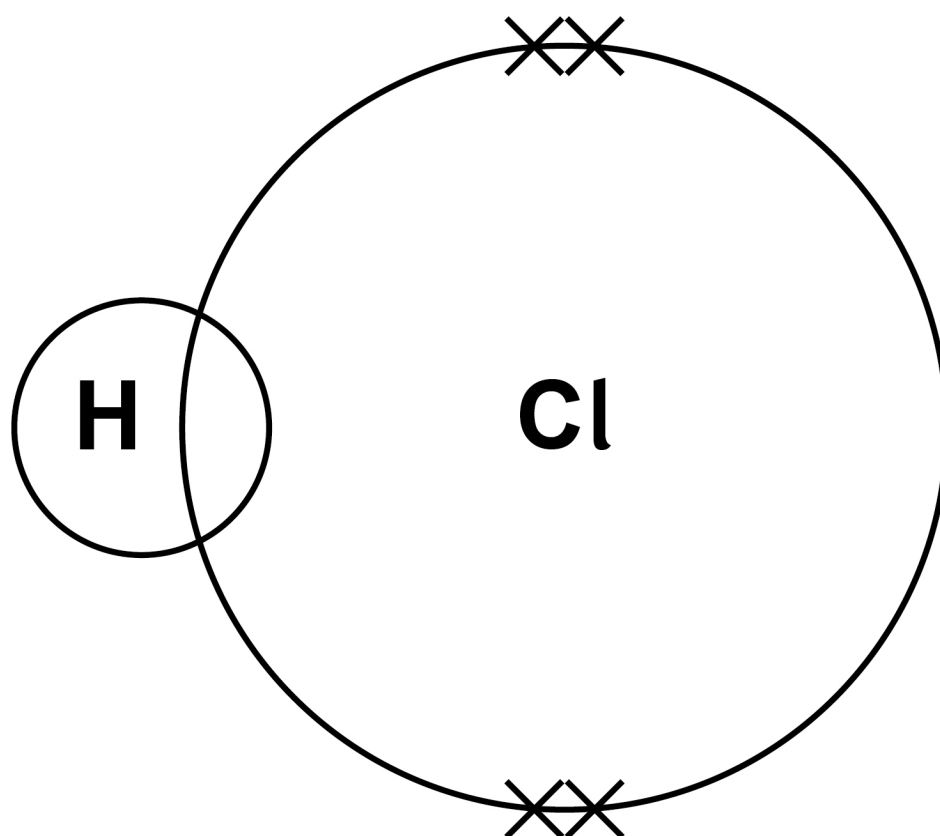
On the opposite page, complete the dot and cross diagram.

Use dots (o) and crosses (x) to represent electrons.

You should show only the electrons in the outer shells. [2 marks]

FIGURE 4

0 2 . 2

Hydrogen chloride dissolves in water to produce hydrochloric acid.

Hydrochloric acid reacts with sodium hydroxide solution.

Complete the word equation for the reaction between hydrochloric acid and sodium hydroxide. [1 mark]

hydrochloric acid + sodium hydroxide

⟶ _____ + **water**

Solutions of hydrochloric acid and sodium hydroxide are reacted and the temperature change is recorded.

| 0 | 2 | . | 3 |

In the reaction, 3.65 g of hydrogen chloride reacts with 4.00 g of sodium hydroxide.

1.80 g of water is produced.

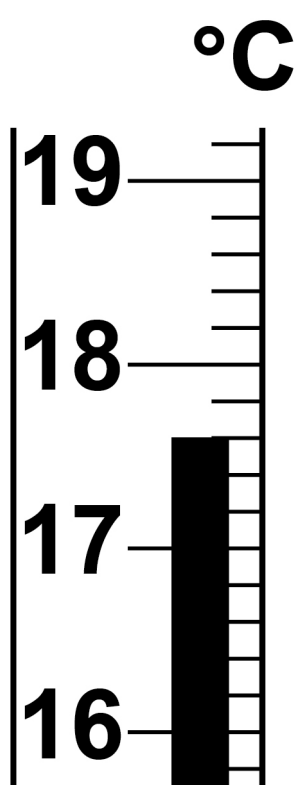Calculate the mass of the other product. [1 mark]

_____

_____

Mass = _____ g

[Turn over]

| 0 | 2 | . | 4 |

FIGURE 5 shows part of the thermometer used to measure the temperature.

FIGURE 5

°C

19 —
18 —
17 —
16 —

What is the temperature reading on the thermometer? [1 mark]

Temperature = _____ °C

0 2 . 5

In the reaction, the temperature increases.

What type of reaction is happening when the temperature increases? [1 mark]

_____

_____

[Turn over]

2 1

| 0 | 2 | . | 6 |

Sodium hydroxide is an alkali.

Which TWO ions are in sodium hydroxide solution? [2 marks]

Tick (✓) TWO boxes.

☐ Cl^-

☐ H^+

☐ Na^+

☐ O^{2-}

☐ OH^-

8

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[Turn over]

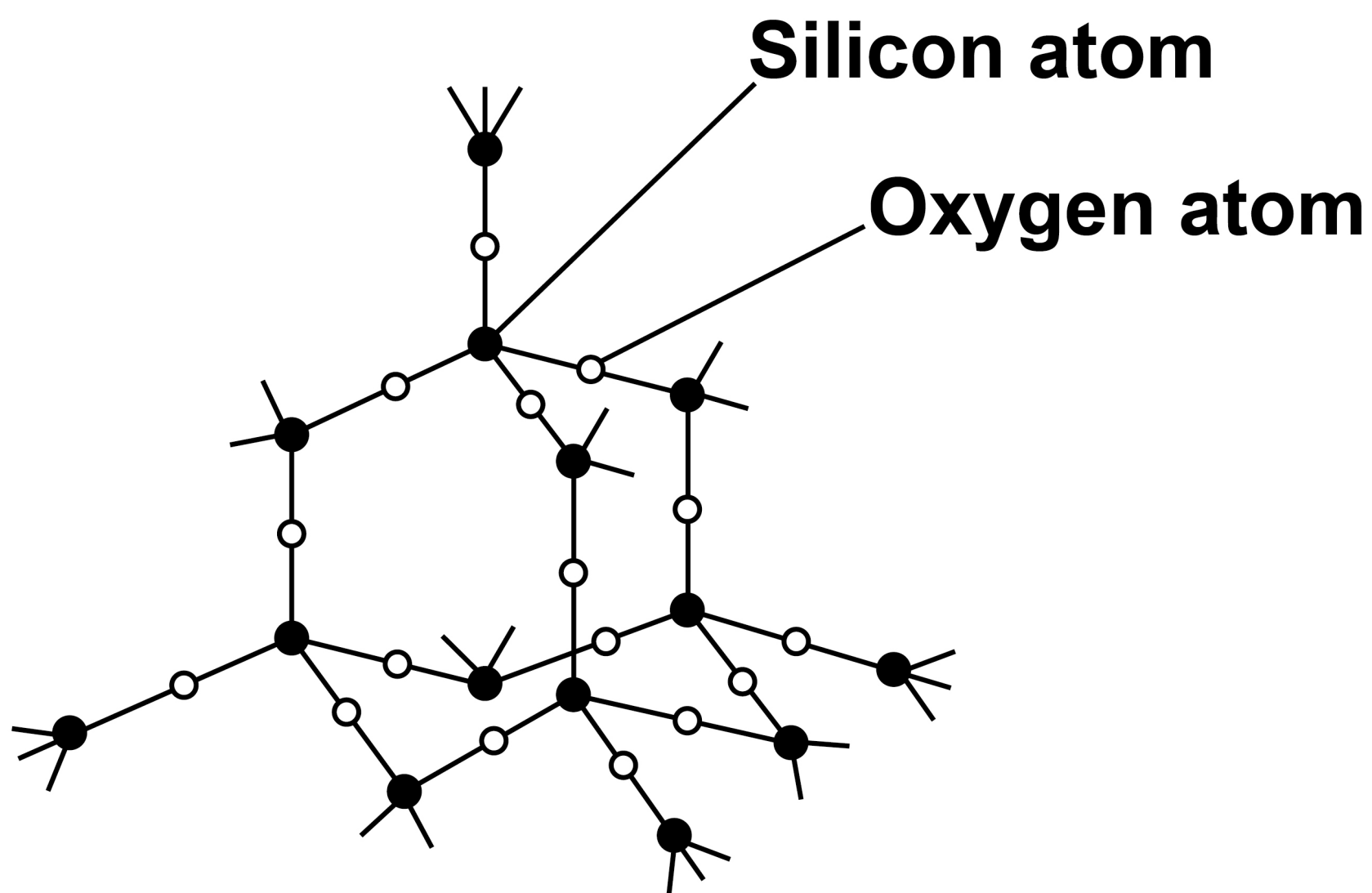**0 3**

This question is about structure and bonding.

FIGURE 6 represents part of the structure of silicon dioxide.

FIGURE 6

Silicon atom

Oxygen atom

0 3 . 1

What type of structure is silicon dioxide? [1 mark]

Tick (✓) ONE box.

☐ **Giant covalent**

☐ **Ionic lattice**

☐ **Simple molecular**

[Turn over]

0 3 . 2

Each oxygen atom forms two bonds.

What is the number of bonds formed by each silicon atom?
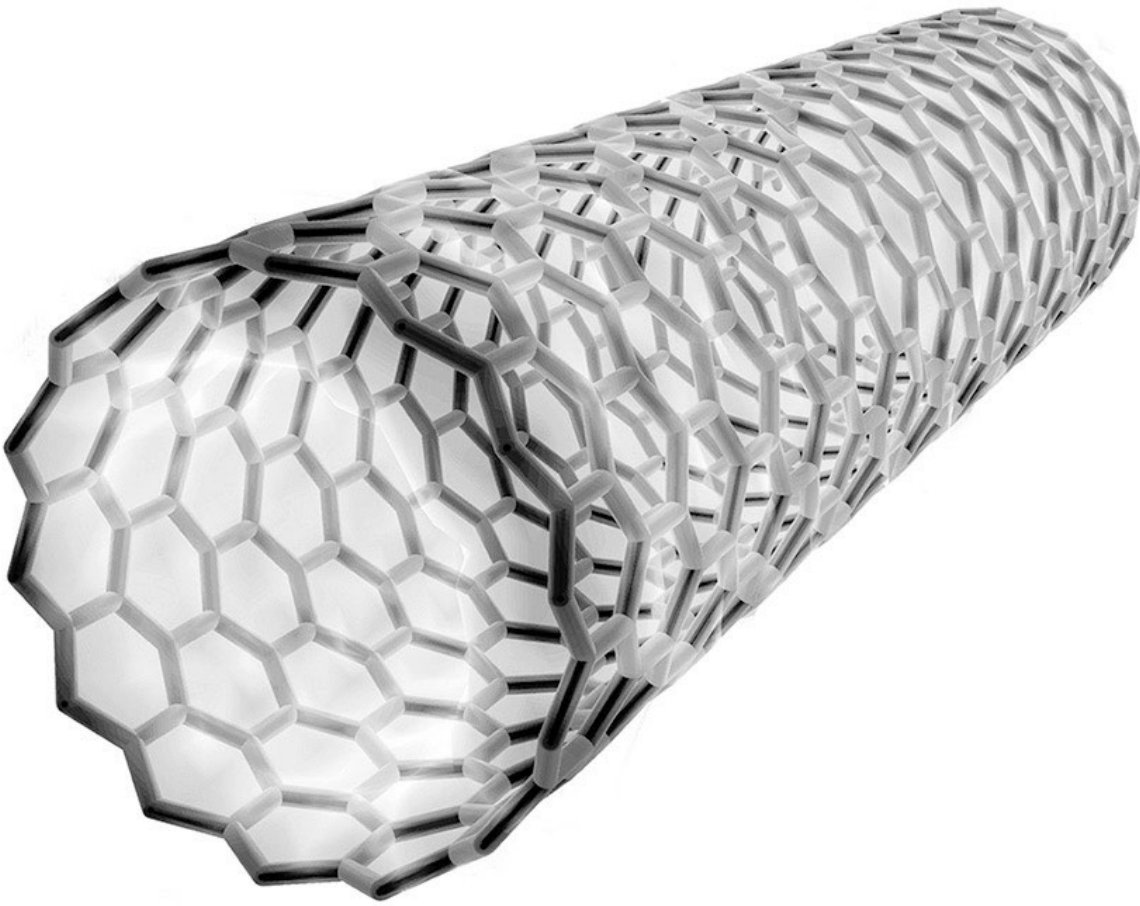
Use FIGURE 6, on page 24. [1 mark]

_____

_____

BLANK PAGE

[Turn over]

FIGURE 7 represents part of a fullerene.

FIGURE 7

0	3	.	3

Complete the sentence.

Choose the answer from the list. [1 mark]

- **hexagons**

- **octagons**

- **squares**

- **triangles**

The structure of fullerenes is based on

_____ .

[Turn over]

0 3 . 4

Complete the sentence.

Choose the answer from the list.
[1 mark]

- **carbon**
- **hydrogen**
- **oxygen**

The fullerene molecule shown in FIGURE 7, on page 28, is made from atoms of _____ .

$0\,3\,.\,5$

What is the fullerene molecule shown in FIGURE 7 used for? [1 mark]

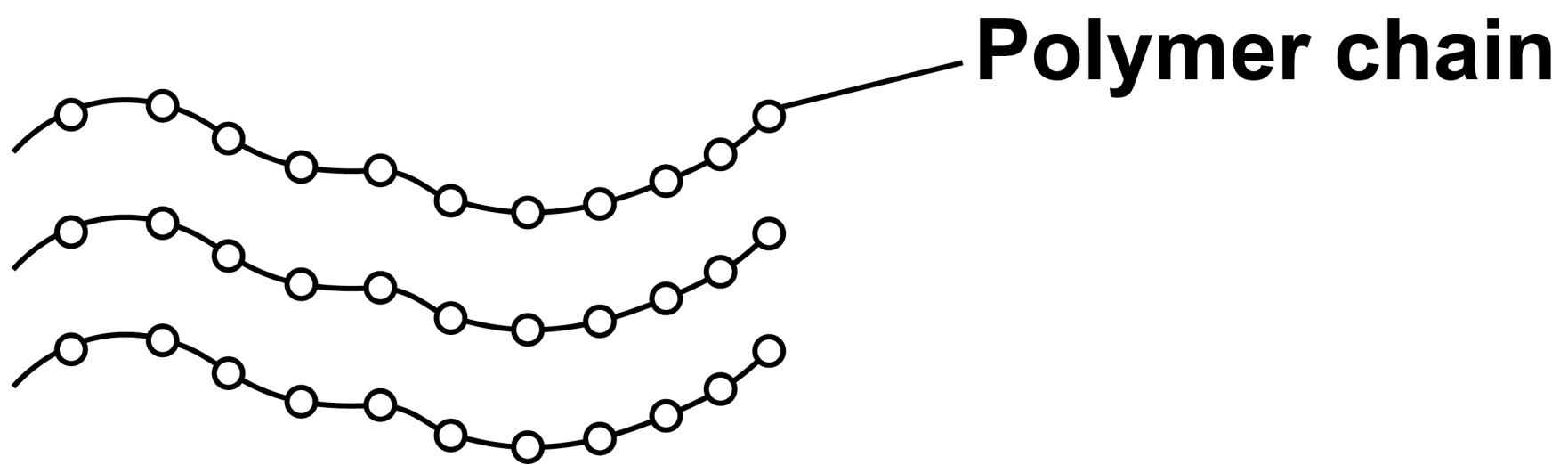**Tick (✓) ONE box.**

☐ **Electronics**

☐ **Hand warmers**

☐ **Sports injury packs**

[Turn over]

3 1

FIGURE 8 represents part of the structure of a polymer.

FIGURE 8

Polymer chain

0 3 . 6

What holds the atoms together in a polymer chain? [1 mark]

Tick (✓) ONE box.

☐	**Covalent bonds**
☐	**Ionic bonds**
☐	**Metallic bonds**

[Turn over]

0 3 . 7

Complete the sentence.

Choose the answer from the list.
[1 mark]

- **atomic**

- **intermolecular**

- **macromolecular**

In FIGURE 8, on page 32, the polymer chains are held together by
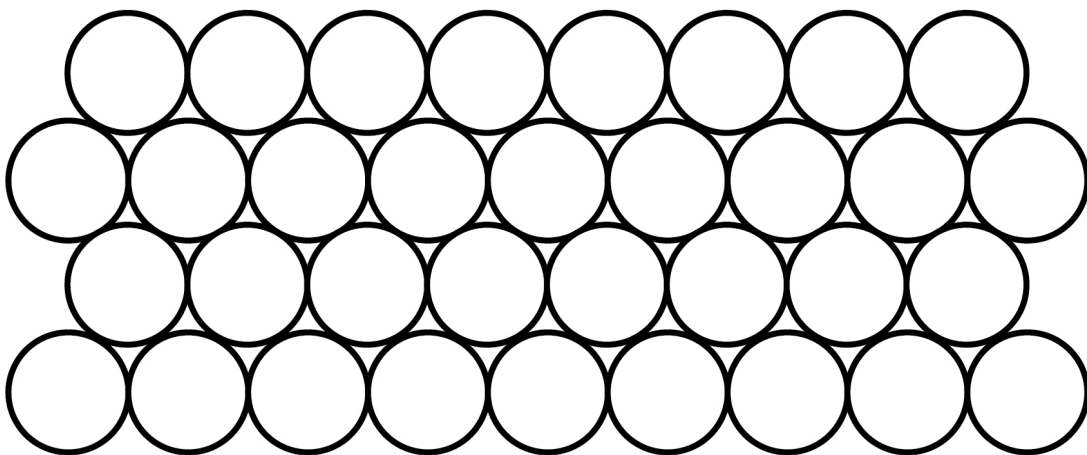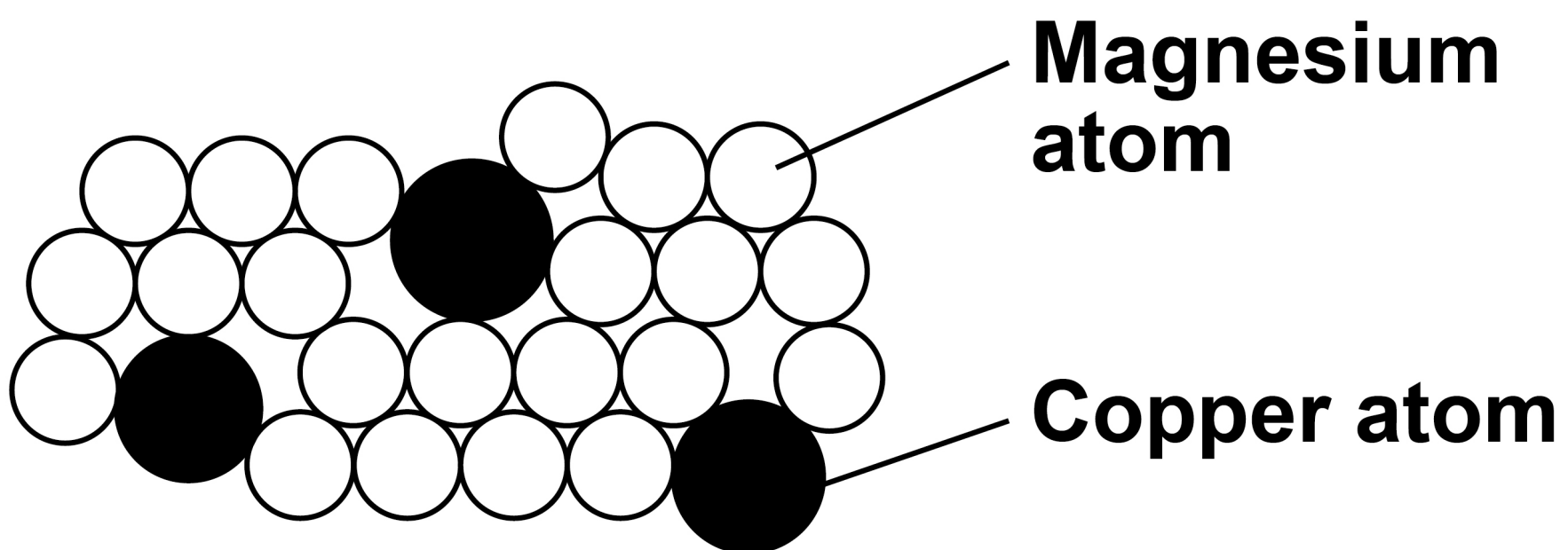
_____ forces.

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[Turn over]

FIGURE 9 represents part of the structures of:

- **magnesium metal**

- **a magnesium alloy.**

FIGURE 9

Magnesium metal

Magnesium atom

Copper atom

Magnesium alloy

| 0 | 3 |. | 8 |

Calculate the percentage of copper atoms in the alloy. [3 marks]

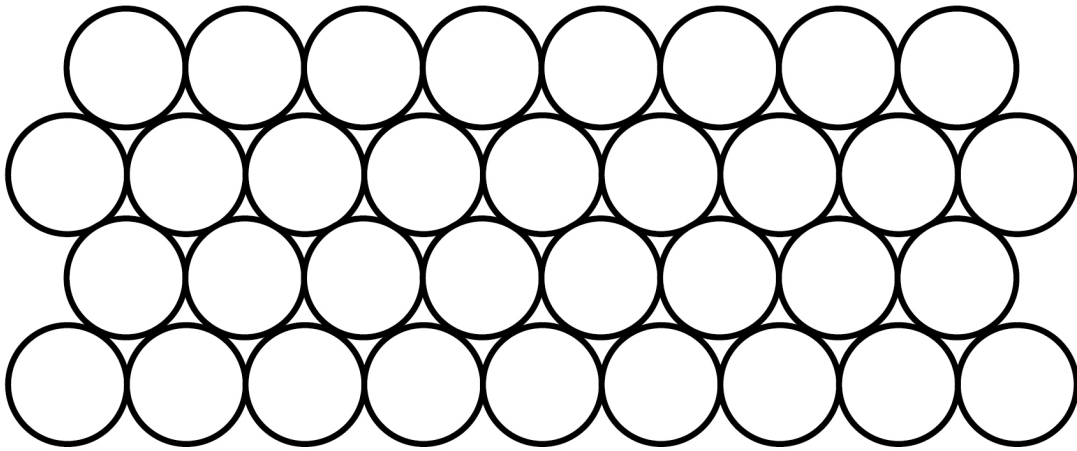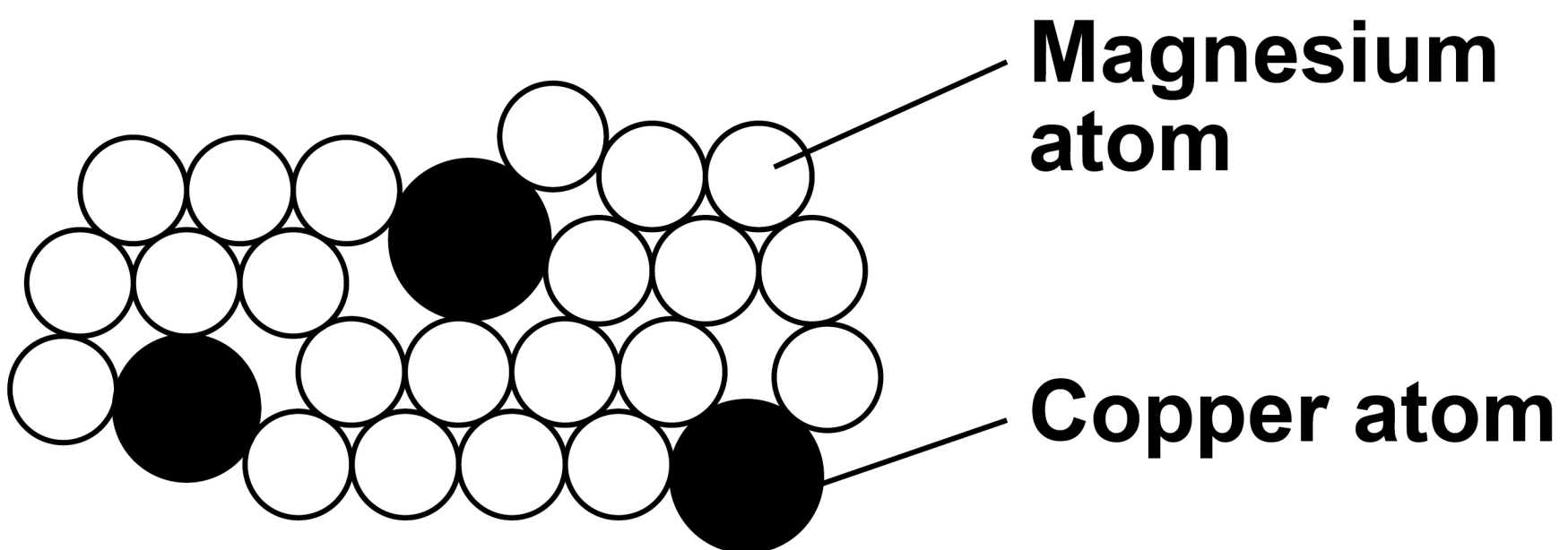**Number of magnesium atoms in the alloy =** _____

_____

_____

Number of copper atoms in the alloy =

_____

_____

Total number of atoms in the alloy =

_____

_____

_____

Percentage of copper atoms in the alloy =
_____ **%**

[Turn over]

REPEAT OF FIGURE 9

Magnesium metal

Magnesium atom

Copper atom

Magnesium alloy

0 3 . 9

Explain why the magnesium alloy is harder than magnesium metal.

Use FIGURE 9, on the opposite page.
[3 marks]

_____

_____

_____

_____

_____

_____

_____

_____

[Turn over]

13

0	4

This question is about elements and compounds.

0	4	.	1

Magnesium and oxygen react to produce magnesium oxide.

Balance the equation for the reaction.
[1 mark]

_____ $Mg + O_2 \longrightarrow 2\,MgO$

0 4 . 2

Suggest ONE safety precaution that should be taken when heating magnesium and oxygen. [1 mark]

_____

_____

_____

[Turn over]

0 4 . 3

Calculate the relative formula mass (M_r) of magnesium fluoride (MgF_2).

Relative atomic masses (A_r):

F = 19   Mg = 24

[2 marks]

_____

_____

_____

_____

_____

_____

Relative formula mass (M_r) = _____

0 4 . 4

Argon is a noble gas.

Explain why NO product is formed when magnesium and argon are heated together. [2 marks]
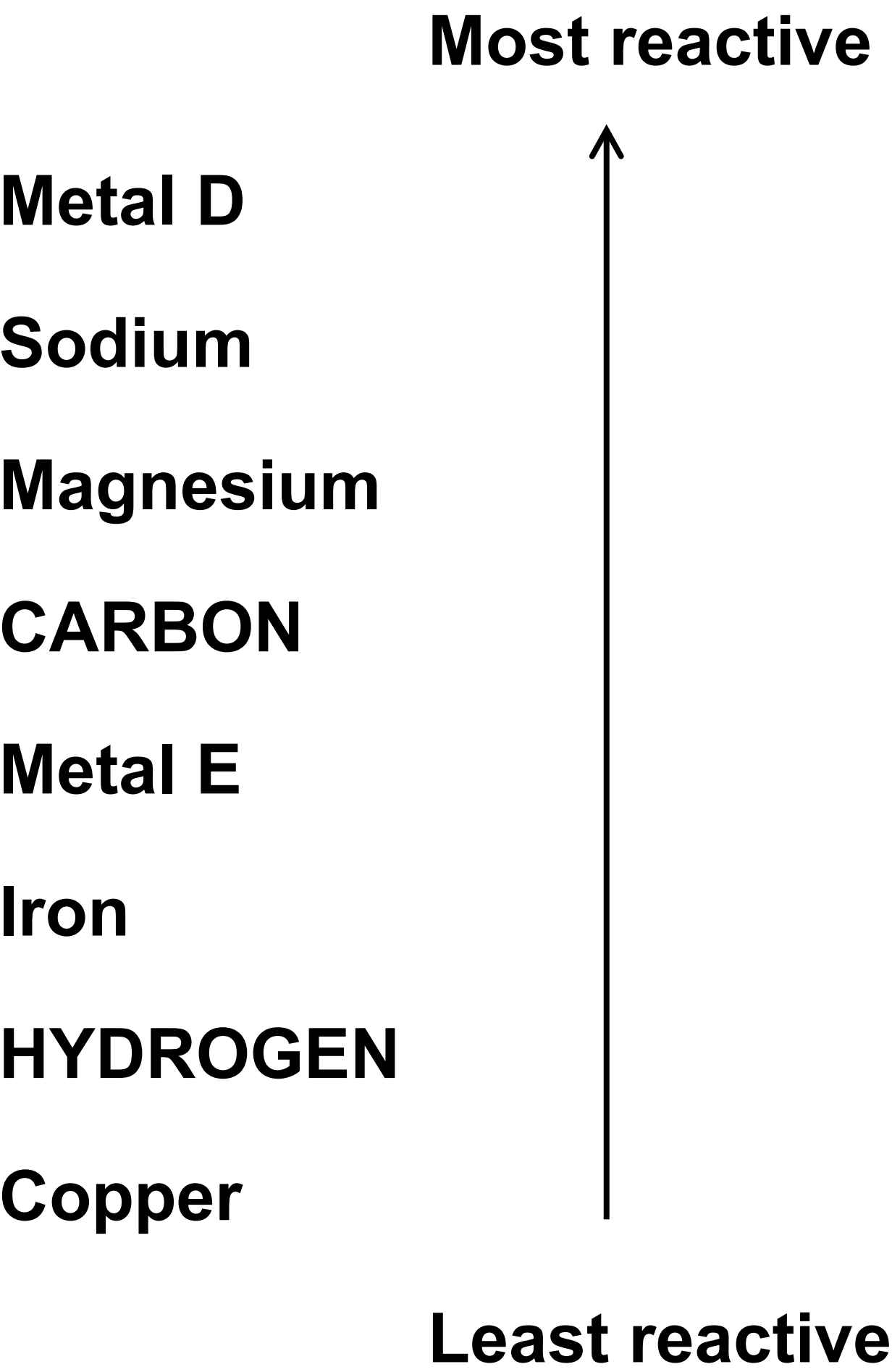
_____

_____

_____

_____

_____

_____

[Turn over]

0 4 . 5

FIGURE 10 shows a reactivity series.

FIGURE 10

Most reactive

Metal D

Sodium

Magnesium

CARBON

Metal E

Iron

HYDROGEN

Copper

Least reactive

BLANK PAGE

[Turn over]

On the opposite page, draw ONE line from each metal to the method used to extract that metal.

Use FIGURE 10, on page 44. [2 marks]

| Metal	Method used to extract that metal
	Extracted by electrolysis of a molten ionic compound.
Metal D	Extracted from its oxide by reduction with carbon.
Metal E	Extracted from its oxide by reduction with hydrogen.
	Removed from the Earth as the metal itself.

[Turn over]

A substance conducts electricity when it has charged particles that are free to move.

| 0 | 4 | . | 6 |

FIGURE 11 represents the structure of sodium chloride.

FIGURE 11
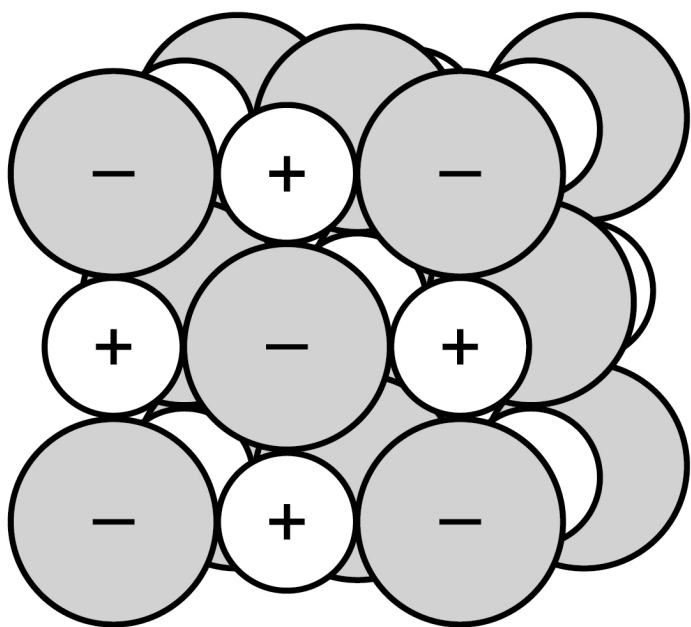
Sodium chloride

Explain why sodium chloride conducts electricity when molten but NOT when solid. [3 marks]

_____

_____

_____

_____

_____

_____

_____

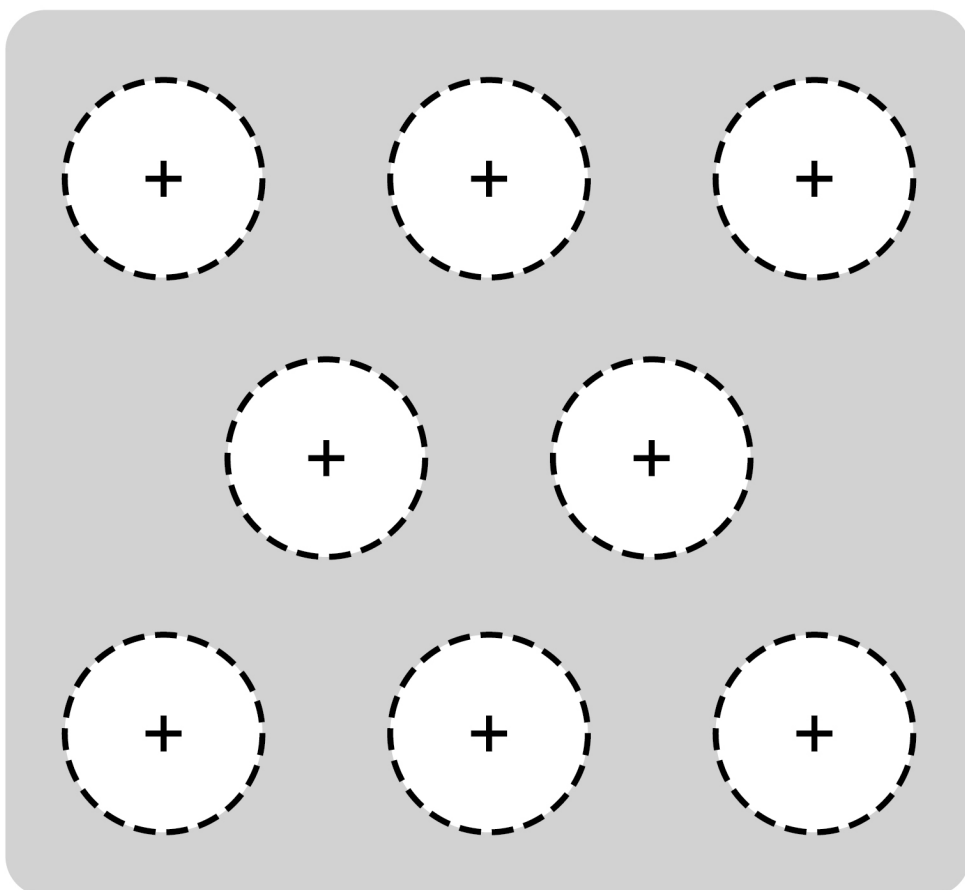_____

_____

_____

[Turn over]

0	4	.	7

FIGURE 12 represents the structure of sodium metal.

FIGURE 12

 Sodium metal

Explain why sodium metal conducts electricity when solid. [2 marks]

_____

_____

_____

[Turn over]

$\overline{\text{13}}$

0 5

This question is about salts.

Green copper carbonate and sulfuric acid can be used to produce blue copper sulfate crystals.

0 5 . 1

EXCESS copper carbonate is added to sulfuric acid.

Give THREE observations you would make. [3 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

| 0 | 5 | . | 2 |

How can the excess copper carbonate be removed? [1 mark]

_____

_____

_____

[Turn over]

0 5 . 3

The pH of the solution changes during the reaction.

What is the pH of the solution at the end of the reaction? [1 mark]

pH = _____

0 5 . 4

Copper carbonate and sulfuric acid react to produce copper sulfate.

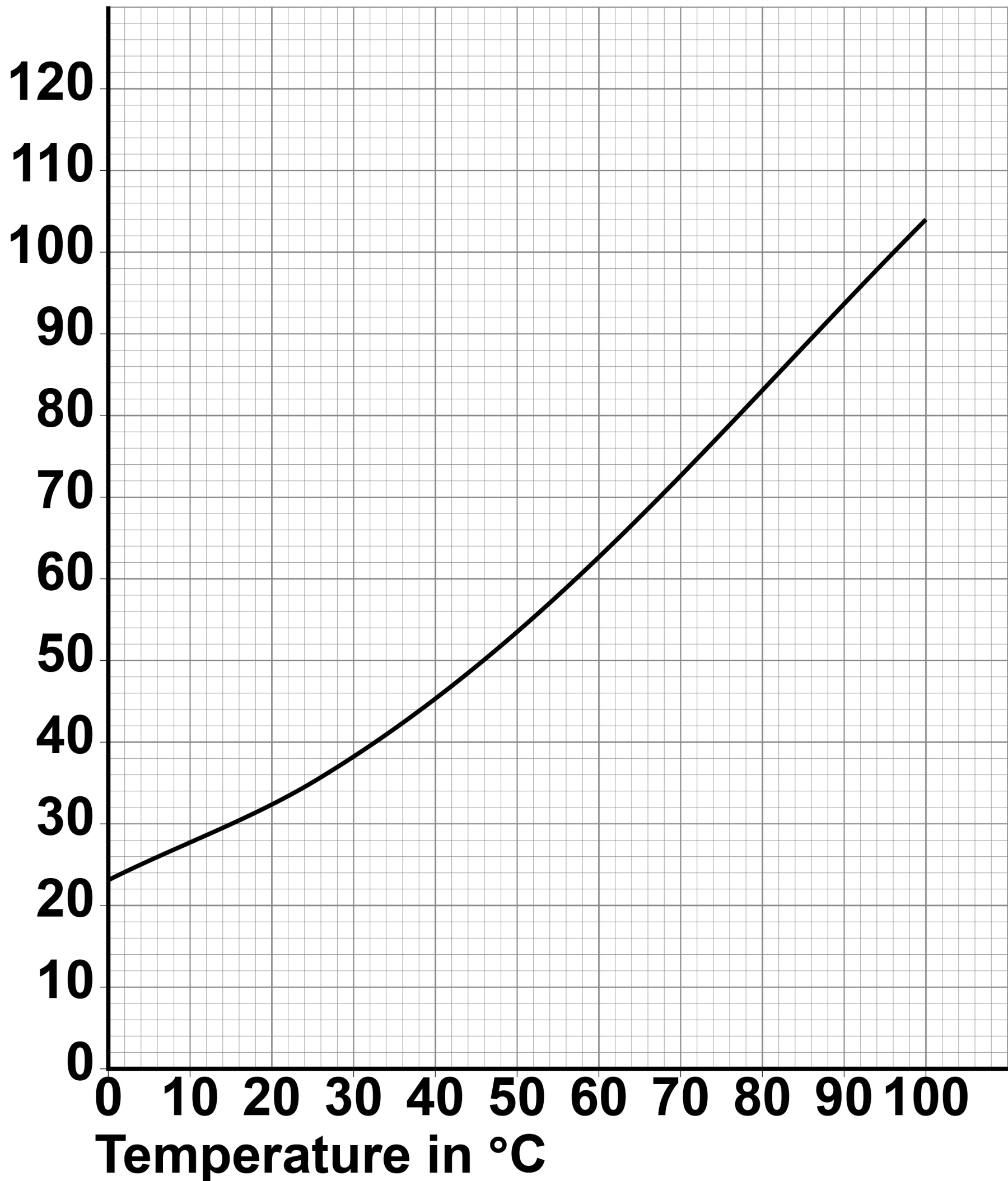**What type of reaction is this? [1 mark]**

_____

_____

0 5 . 5

Ammonium nitrate is a salt.

FIGURE 13, on page 56, shows the maximum mass of ammonium nitrate that can dissolve in 100 cm^3 of water at different temperatures.

[Turn over]

FIGURE 13

Maximum mass of ammonium nitrate that can dissolve in grams per 100 cm^3 of water

Temperature in °C

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[Turn over]

A student adds ammonium nitrate to water at 80 °C until no more dissolves.

The student cools 100 cm^3 of this solution of ammonium nitrate from 80 °C to 20 °C to produce crystals of ammonium nitrate.

Determine the mass of ammonium nitrate that crystallises on cooling 100 cm^3 of this solution from 80 °C to 20 °C
[3 marks]

_____

_____

_____

_____
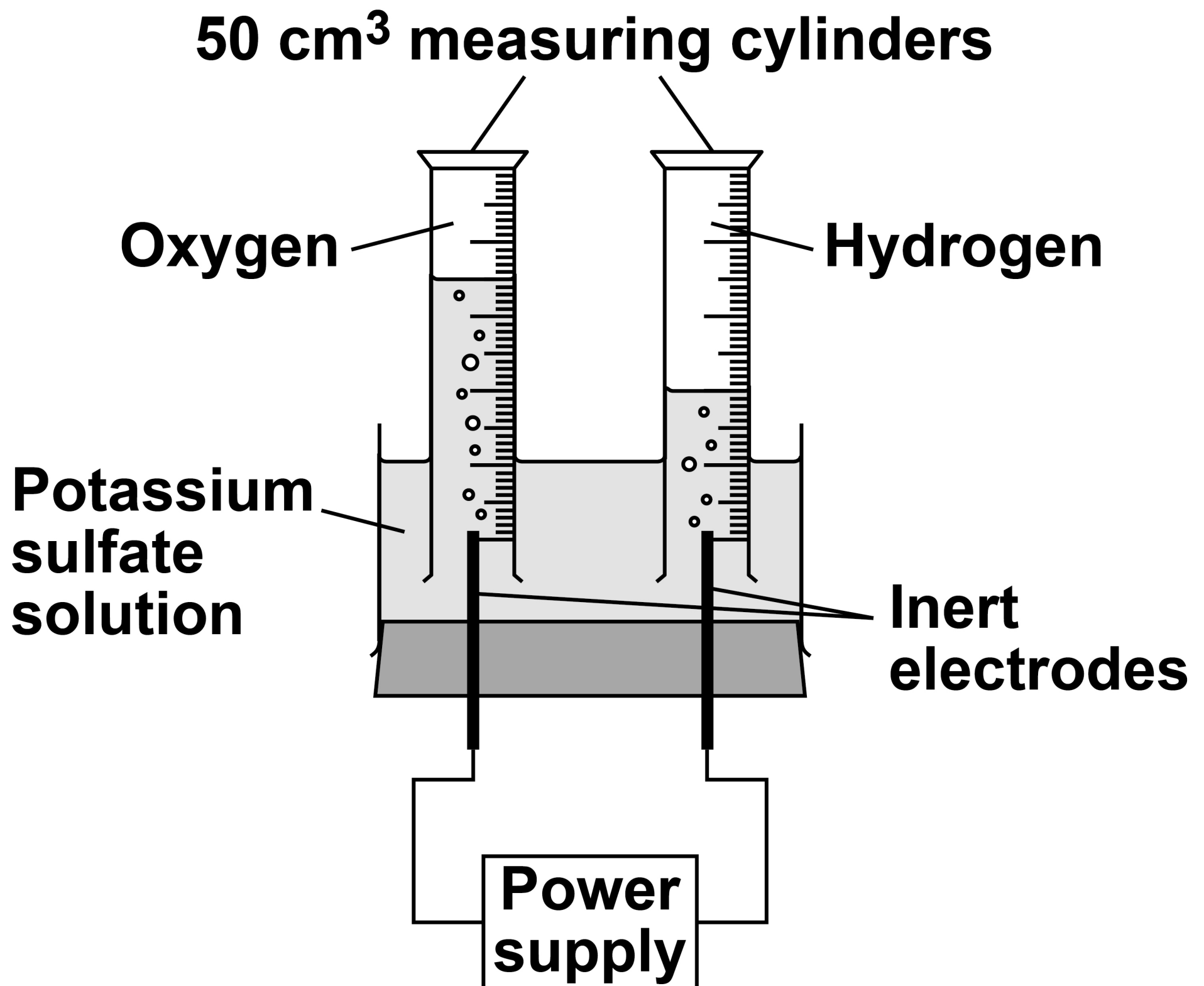
_____

_____

_____

_____

_____

Mass = _____ g

[Turn over]

9

0 6

This question is about electrolysis.

FIGURE 14, on the opposite page, shows the apparatus used to investigate the electrolysis of potassium sulfate solution.

FIGURE 14

50 cm³ measuring cylinders

Oxygen

Hydrogen

Potassium sulfate solution

Inert electrodes

Power supply

[Turn over]

BLANK PAGE

0 6 . **1**

Potassium sulfate contains K^+ and $SO_4{}^{2-}$ ions.

What is the formula of potassium sulfate? [1 mark]

Tick (✓) ONE box.

☐ **KSO_4**

☐ **K_2SO_4**

☐ **$K(SO_4)_2$**

☐ **$K_2(SO_4)_2$**

[Turn over]

REPEAT OF FIGURE 14

50 cm³ measuring cylinders

Oxygen

Hydrogen

Potassium
sulfate
solution

Inert
electrodes

Power
supply
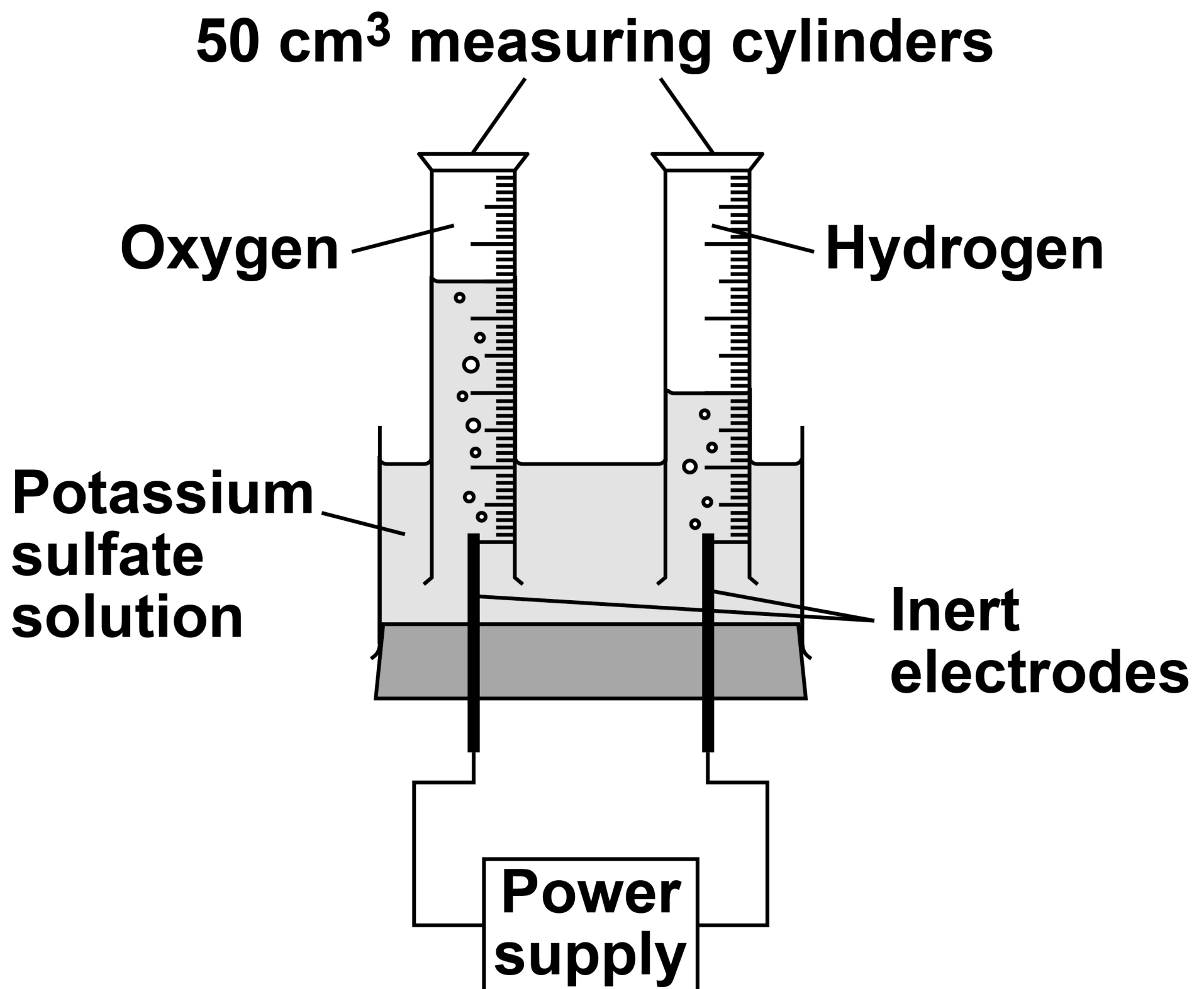
0 6 . 2

What are the volumes of gases collected in the electrolysis experiment?

Use FIGURE 14. [1 mark]

Volume of hydrogen = _____ cm^3

Volume of oxygen = _____ cm^3

[Turn over]

| 0 | 6 | . | 3 |

A student made the following hypothesis:

'The volumes of gases collected in this electrolysis experiment are in the same ratio as hydrogen atoms to oxygen atoms in a water molecule.'

Explain how the volumes of gases collected in the experiment in FIGURE 14, on page 64, support the student's hypothesis.

Use your answer to Question 06.2.
[2 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

[Turn over]

| 0 | 6 | . | 4 |

The experiment is repeated 4 times.

The volumes of oxygen collected in the 4 experiments are:

6 cm^3 9 cm^3 10 cm^3 11 cm^3

The mean volume of oxygen collected in the 4 experiments is 9 cm^3

The measure of uncertainty is the range of a set of measurements about the mean.

What is the measure of uncertainty in the 4 experiments? [1 mark]

Tick (✓) ONE box.

☐   **$9 \pm 1 \text{ cm}^3$**

☐   **$9 \pm 2 \text{ cm}^3$**

☐   **$9 \pm 3 \text{ cm}^3$**

[Turn over]

0	6	.	5

The potassium sulfate solution has 0.86 g of potassium sulfate dissolved in 25 cm^3 of water.

Calculate the mass of potassium sulfate needed to make 1.0 dm^3 of solution.
[3 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Mass = _____ **g**

___
8

[Turn over]

0 7

Plan an investigation to find the order of reactivity of three metals.

You should use the temperature change when each metal reacts with hydrochloric acid. [6 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

END OF QUESTIONS

6

75

**Additional page, if required.
Write the question numbers in the
left-hand margin.**

Additional page, if required.
Write the question numbers in the
left-hand margin.

Additional page, if required.
Write the question numbers in the
left-hand margin.

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