AQA

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Chemistry Paper 1F

Time allowed: 1 hour 15 minutes

Materials

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.
- Fill in the boxes at the top of this page.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

0 1 This question is about Group 1 elements.

0 1 . 1 What are the Group 1 elements known as?

[1 mark]
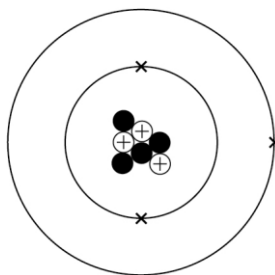
Tick (✓) **one** box.

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   3

Number of neutrons   4

0 1 . 3 What is the relative charge on a lithium ion?

[1 mark]

Tick (✓) **one** box.
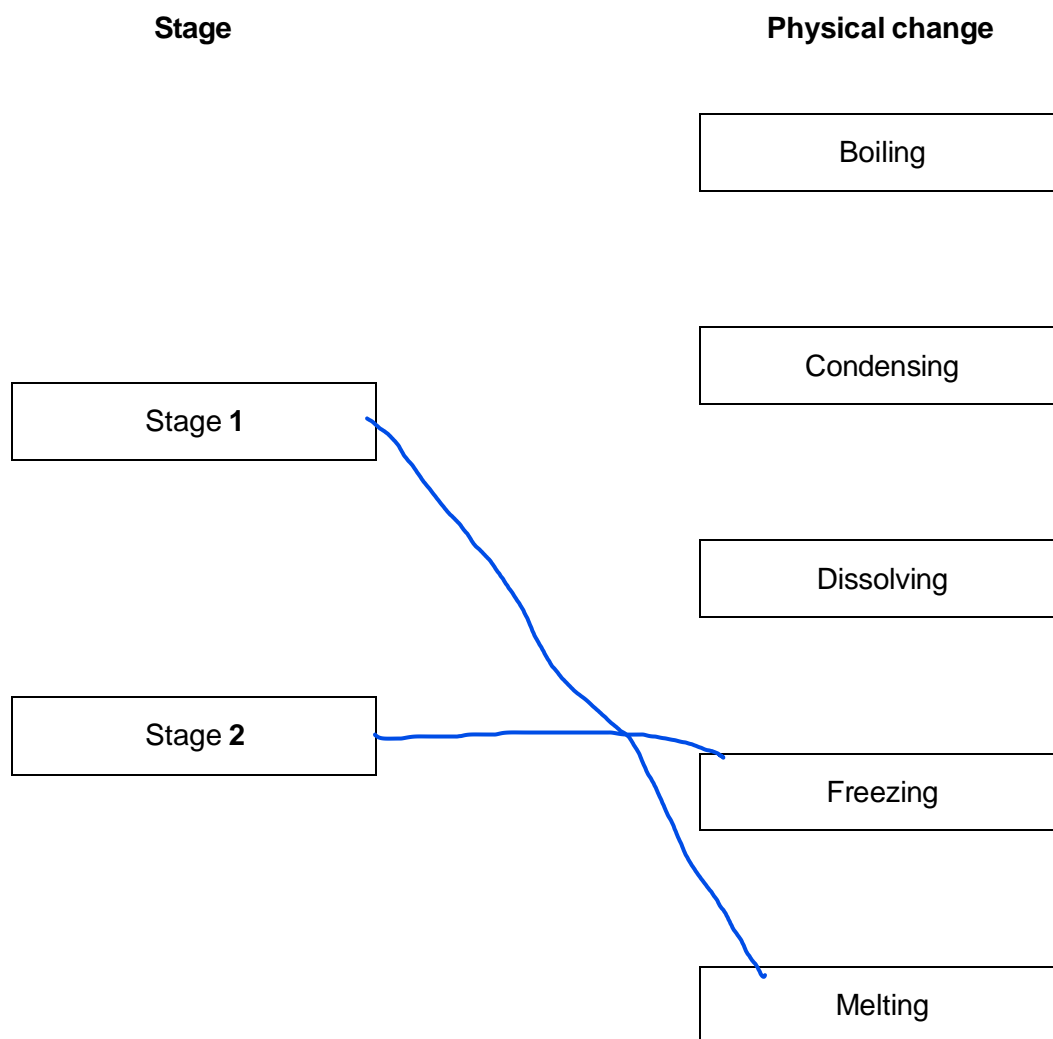
+1 ✓   0 ☐   −1 ☐

0 1 . 4 Lithium is heated and then cooled in an experiment.

Lithium solid $\xrightarrow{\text{Stage 1}}$ Lithium liquid $\xrightarrow{\text{Stage 2}}$ Lithium solid

Two physical changes happen in the experiment.

Draw **one** line from each stage to the physical change that happens in that stage.
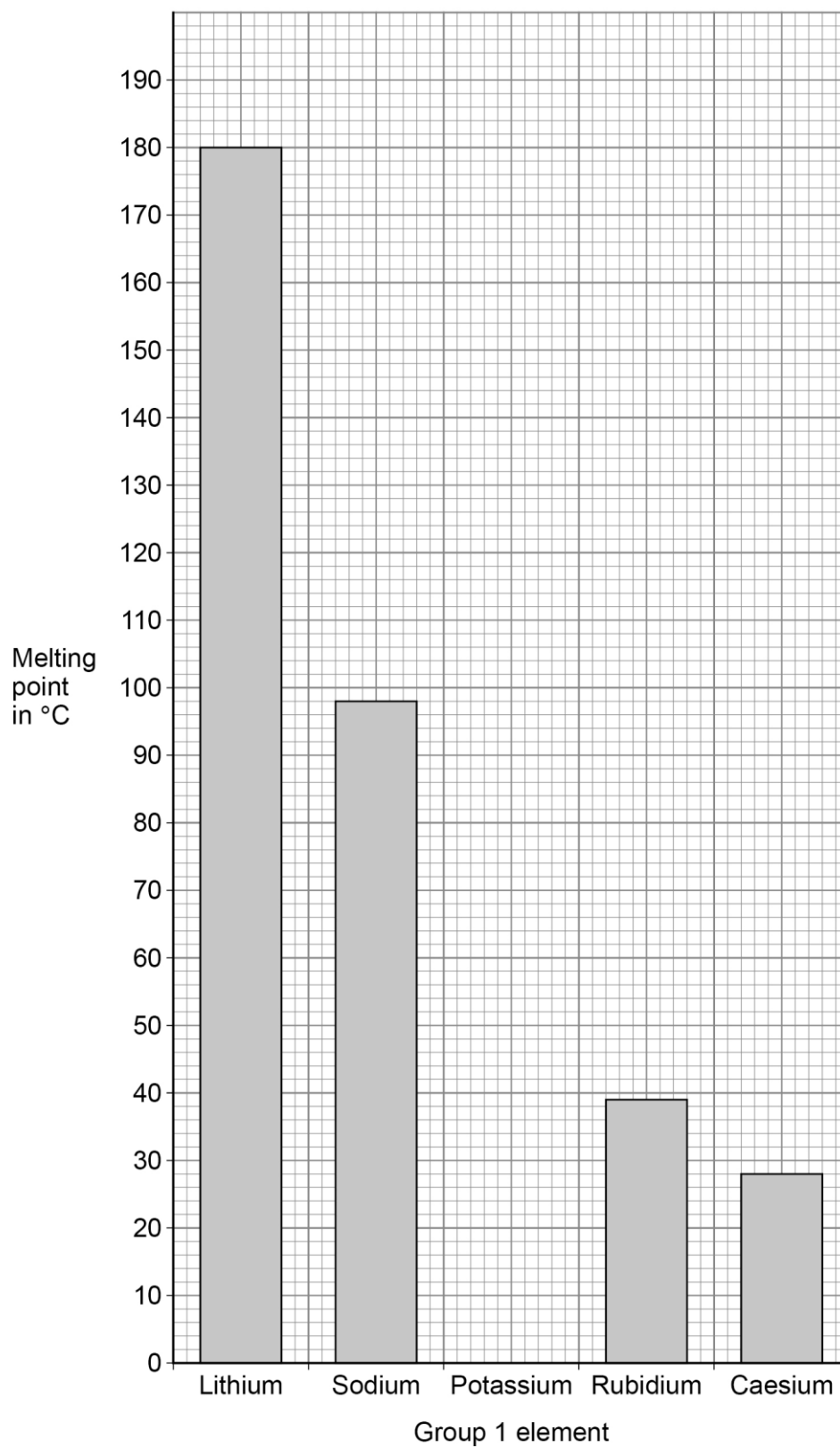
[2 marks]

Stage

Physical change

Boiling

Condensing

Stage **1**

Dissolving

Stage **2**

Freezing

Melting

Question 1 continues on the next page

Turn over ▶

Figure 2 represents the melting points of some Group 1 elements.

Figure 2

Melting point in °C (y-axis)

Group 1 element (x-axis): Lithium, Sodium, Potassium, Rubidium, Caesium

0 4

0 1 . 5 What is the melting point of caesium?

Use **Figure 2**.

[1 mark]

Melting point = <u>28</u> °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]

bar plotted at 63 °C

0 1 . 7 Describe the trend of the melting points of the Group 1 elements in **Figure 2**.

[3 marks]

melting point decreases as go down Group 1 and the differences get smaller

0 1 . 8 The boiling point of sodium is 883 °C

What is the state of sodium at 150 °C?

Use **Figure 2**.

[1 mark]

Tick (✓) **one** box.
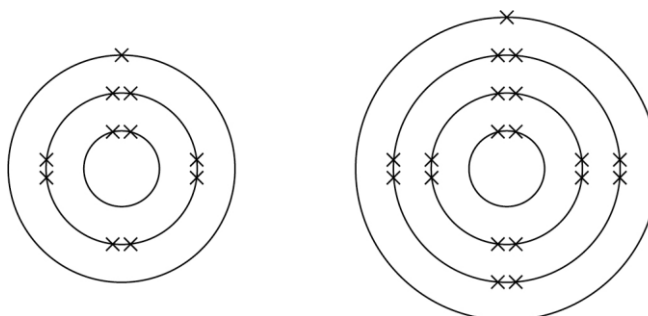
Gas ☐

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 box.

[1 mark]

| gains an electron | loses an electron | shares an electron |

Potassium is more reactive than sodium because potassium more

easily ___loses an electron___ .

13

0 2 This question is about hydrogen chloride and sodium hydroxide.

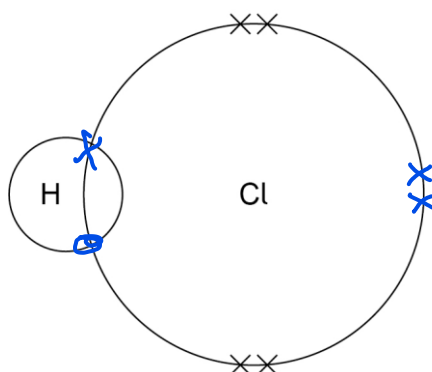**0 2 . 1** A chlorine atom has 7 electrons in the outer shell.

A hydrogen atom has 1 electron in the outer shell.

Figure 4 represents part of a dot and cross diagram for a molecule of hydrogen chloride.

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 → <u>sodium chloride</u> + water

Question 2 continues on the next page

Turn over ▶

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.
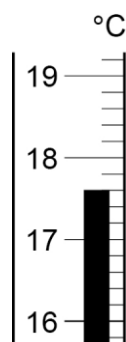
Calculate the mass of the other product.

[1 mark]

5.85 (g)

Mass = _____ g

0 2 . 4 **Figure 5** shows part of the thermometer used to measure the temperature.

Figure 5

What is the temperature reading on the thermometer?

[1 mark]

Temperature = 17.6 (°C) °C

0 2 . 5 In the reaction, the temperature increases.

What type of reaction is happening when the temperature increases?

[1 mark]

exothermic reaction

0 2 . 6 Sodium hydroxide is an alkali.

Which **two** ions are in sodium hydroxide solution?

[2 marks]

Tick (✓) **two** boxes.
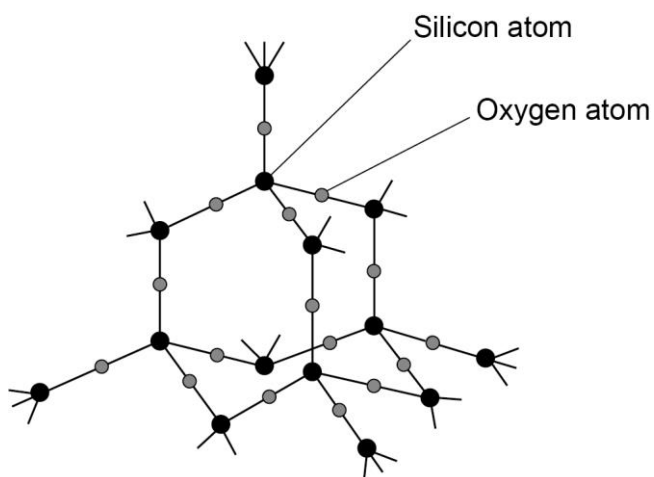
Cl^- ☐ H^+ ☐ Na^+ ✓ O^{2-} ☐ OH^- ✓

| 0 | 3 |

This question is about structure and bonding.

Figure 6 represents part of the structure of silicon dioxide.

Figure 6

| 0 | 3 | . | 1 |

What type of structure is silicon dioxide?

[1 mark]

Tick (✓) **one** box.

Giant covalent [✓]

Ionic lattice [ ]

Simple molecular [ ]

| 0 | 3 | . | 2 |

Each oxygen atom forms two bonds.

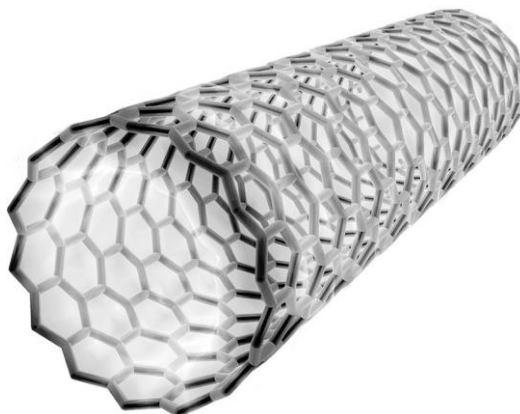What is the number of bonds formed by each silicon atom?

Use **Figure 6**.

[1 mark]

Four

Turn over ▶

Figure 7 represents part of a fullerene.

Figure 7

0 3 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

hexagons	**octagons**	**squares**	**triangles**

The structure of fullerenes is based on ___hexagons___ .

0 3 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

carbon	**hydrogen**	**oxygen**

The fullerene molecule shown in **Figure 7** is made from

atoms of ___carbon___ .

0 3.**5** What is the fullerene molecule shown in **Figure 7** used for?

[1 mark]

Tick (✓) **one** box.
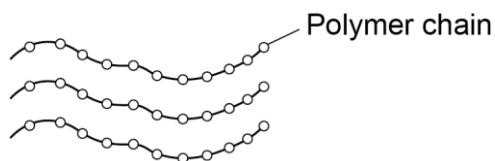
Electronics ☑

Hand warmers ☐

Sports injury packs ☐

Question 3 continues on the next page

Turn over ▶

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

0 3 . **7** Complete the sentence.

Choose the answer from the box.

[1 mark]

atomic	intermolecular	macromolecular

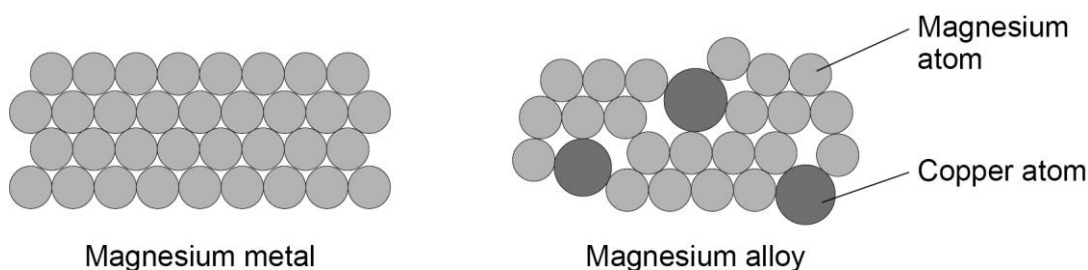In **Figure 8** the polymer chains are held together by

intermolecular   forces.

Figure 9 represents part of the structures of:

- magnesium metal
- a magnesium alloy.

Figure 9

Magnesium metal

Magnesium alloy

Magnesium atom

Copper atom

0 3 . 8 Calculate the percentage of copper atoms in the alloy.

[3 marks]

Number of magnesium atoms in the alloy = ___22___

Number of copper atoms in the alloy = ___3___

Total number of atoms in the alloy = $\dfrac{3}{25} \times 100$

Percentage of copper atoms in the alloy = ___12___ %

0 3 . 9 Explain why the magnesium alloy is harder than magnesium metal.

Use **Figure 9**.

[3 marks]

alloy is harder because copper atoms are larger so the layers of magnesium atoms are distorted and therefore the layers cannot easily slide

13

Turn over ▶

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DO NOT WRITE ON THIS PAGE
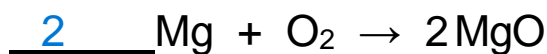**ANSWER IN THE SPACES PROVIDED**

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]

$$\underline{\quad 2 \quad}Mg + O_2 \rightarrow 2\,MgO$$

0 4 . 2 Suggest **one** safety precaution that should be taken when heating magnesium and oxygen.

[1 mark]

wear safety glasses / goggles

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]

(Mr =) 24 + (2 × 19)

= 62

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.
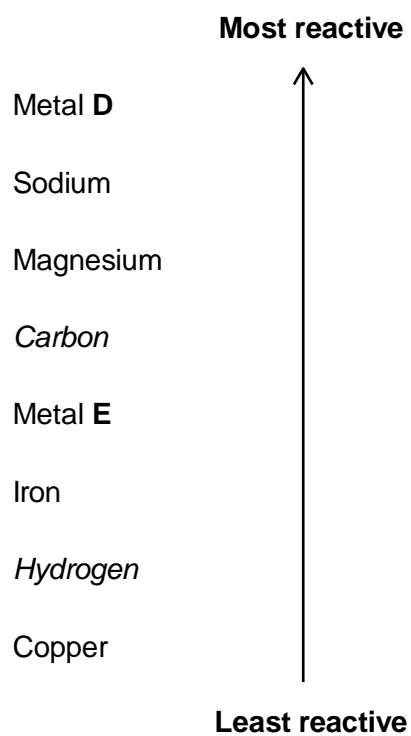
[2 marks]

argon has a full outer shell

Turn over ▶

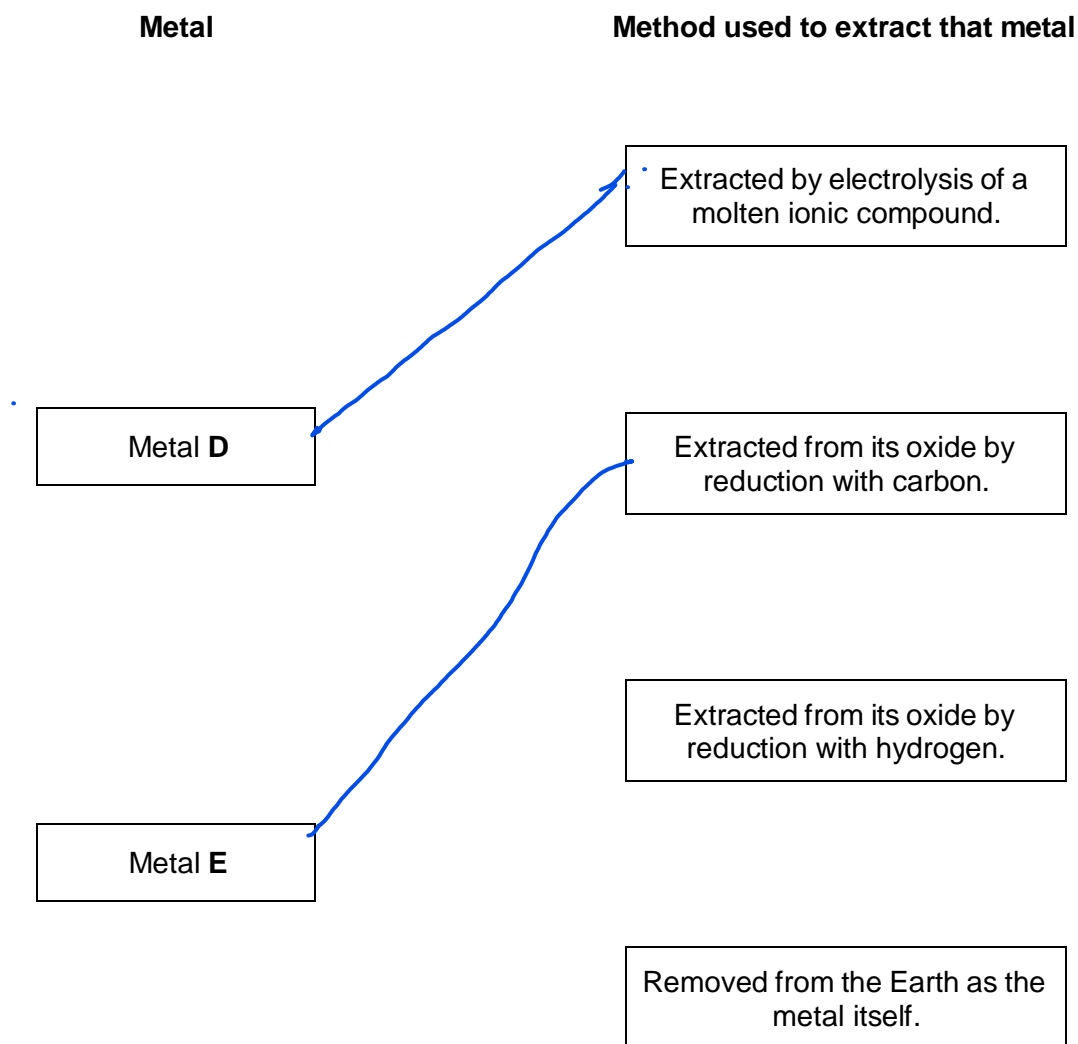**0 4 . 5** **Figure 10** shows a reactivity series.

Figure 10

Most reactive

Metal **D**

Sodium

Magnesium

Carbon

Metal **E**

Iron

Hydrogen

Copper

Least reactive

Draw **one** line from each metal to the method used to extract that metal.

Use **Figure 10**.

[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. |

| Extracted from its oxide by reduction with hydrogen. |

Metal E

| Removed from the Earth as the metal itself. |

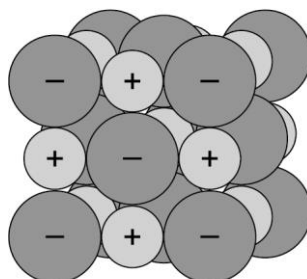**Question 4 continues on the next page**

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

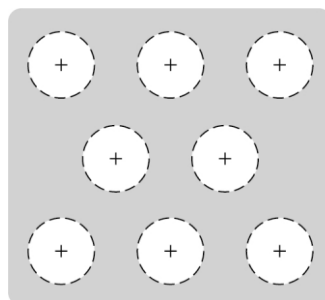Explain why sodium chloride conducts electricity when molten but **not** when solid.

[3 marks]

because ions which are free to move when molten but are fixed in

solid

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]

sodium contains delocalised electrons which carry electrical charge

through the metal / sodium

Turn over for the next question

13

Turn over ▶

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ANSWER IN THE SPACES PROVIDED

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 green solid / powder

2 colourless solution

3 blue solution formed

0 5 . 2 How can the excess copper carbonate be removed?

[1 mark]

filtration

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 = 7

0 5 . 4 Copper carbonate and sulfuric acid react to produce copper sulfate.

What type of reaction is this?
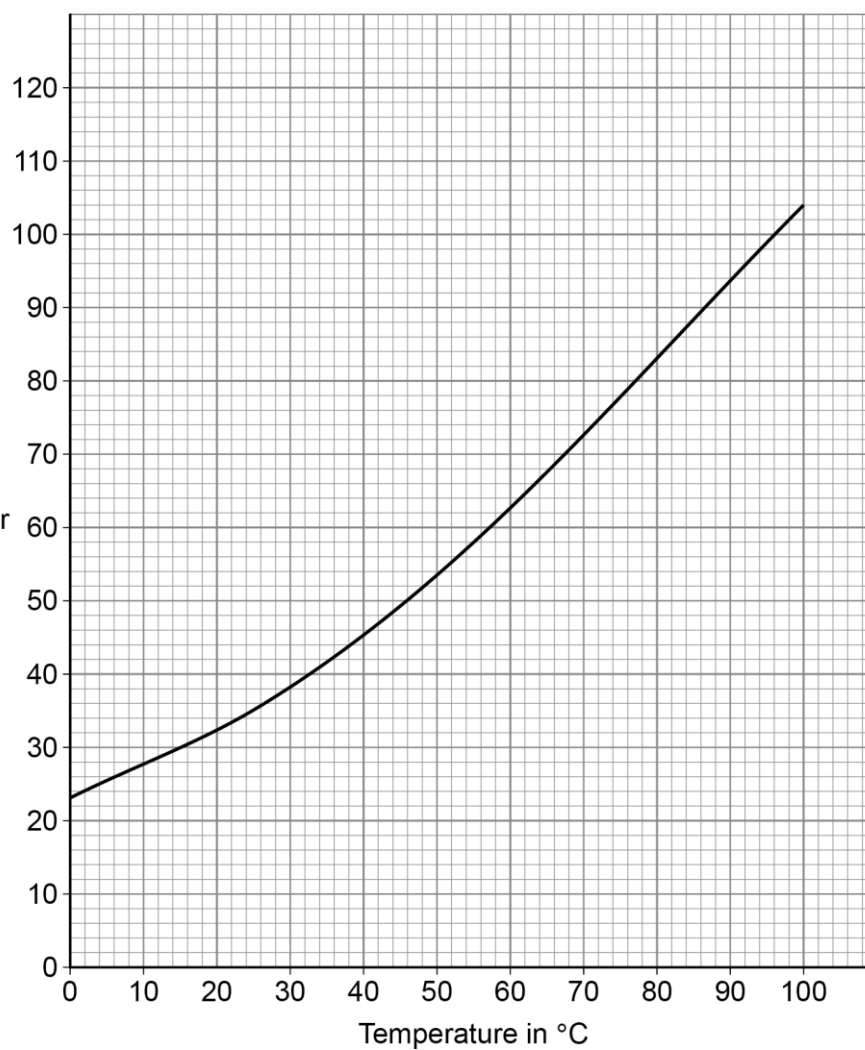
[1 mark]

neutralisation

Turn over ▶

0 5 . **5**   Ammonium nitrate is a salt.

Figure 13 shows the maximum mass of ammonium nitrate that can dissolve in 100 cm^3 of water at different temperatures.

Figure 13

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

Temperature in °C

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

The student cools 100 cm³ 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 cm³ of this solution from 80 °C to 20 °C

[3 marks]

83 (g at 80 °C)

_____

32 (g at 20 °C)

_____

(83–32 =) 51 (g)

_____

Mass = _____ g

9

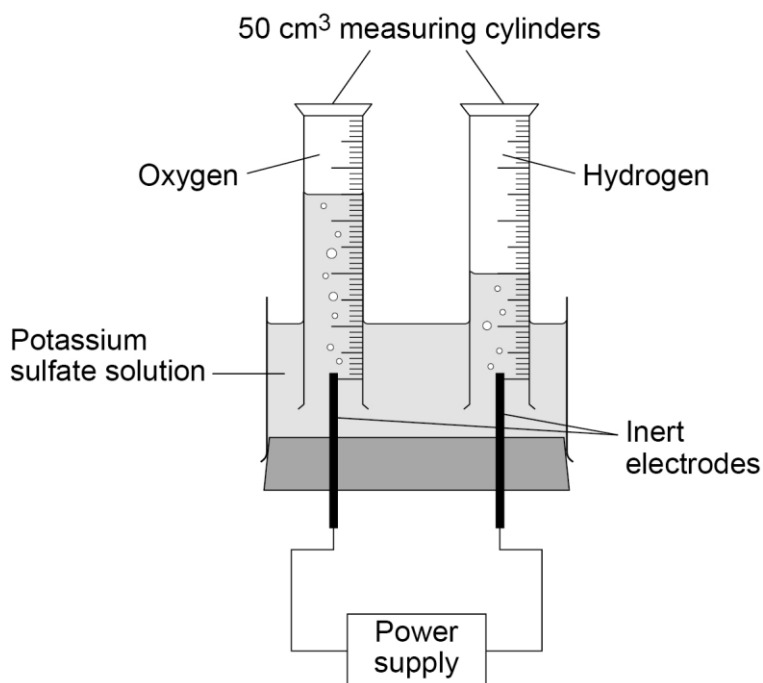**Turn over for the next question**

Turn over ▶

0 6 This question is about electrolysis.

Figure 14 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

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 ☑

$K(SO_4)_2$ ☐

$K_2(SO_4)_2$ ☐

0 6 . 2 What are the volumes of gases collected in the electrolysis experiment?

Use **Figure 14**.

[1 mark]

Volume of hydrogen = _____30_____ cm^3

Volume of oxygen = _15_____ cm^3

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** support the student's hypothesis.

Use your answer to Question **06.2**

[2 marks]

because the ratio of volume of hydrogen : oxygen is 2 : 1

and this is the same as the ratio of hydrogen atoms : oxygen atoms

in formula of H2O

Question 6 continues on the next page

Turn over ▶

0 6 . 4 The experiment is repeated 4 times.

The volumes of oxygen collected in the 4 experiments are:

$$6 \text{ cm}^3 \quad 9 \text{ cm}^3 \quad 10 \text{ cm}^3 \quad 11 \text{ cm}^3$$

The mean volume of oxygen collected in the 4 experiments is 9 cm³

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 ± 1 cm³ ☐

9 ± 2 cm³ ☐

9 ± 3 cm³ ✓

0 6 . 5 The potassium sulfate solution has 0.86 g of potassium sulfate dissolved in 25 cm³ of water.

Calculate the mass of potassium sulfate needed to make 1.0 dm³ of solution.

[3 marks]

conversion = $\dfrac{25}{1000}$

= 0.025 (dm3)

concentration = $\dfrac{0.86}{0.025}$

= 34.4 (g per dm3)

Mass = _____ g

8

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]

measure volume of (hydrochloric) acid
into a suitable container eg polystyrene cup   measure the initial
temperature of hydrochloric acid with a thermometer
add stated mass of one metal   and stir

measure the highest temperature reached of the solution

determine the temperature difference

repeat
repeat for each metal with same mass

in same physical state (powder, lump, etc)

with the same volume and / or concentration of hydrochloric acid
use results to arrange metals in order of reactivity

most reactive metal has the largest temperature change

6

END OF QUESTIONS

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2 9

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