



Surname _____

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Centre Number _____

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Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

F

Foundation Tier

Chemistry Paper 1F

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

☐

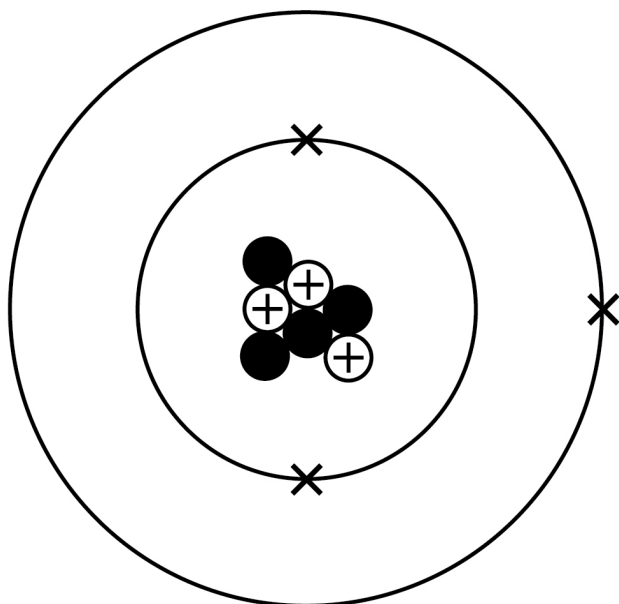
Noble gases



01.2

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

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.

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

[2 marks]



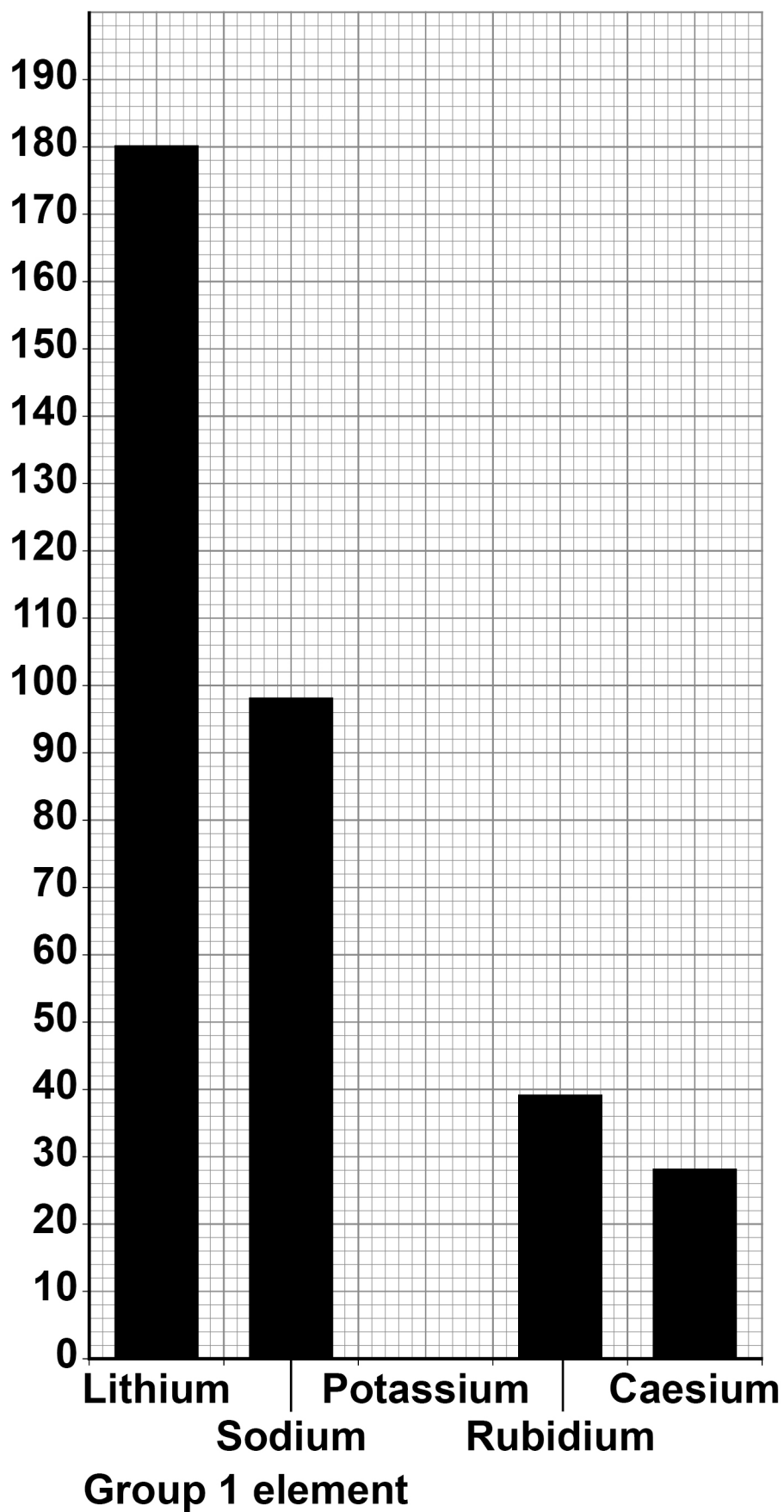
STAGE**PHYSICAL CHANGE**

	Boiling
Stage 1	Condensing
	Dissolving
Stage 2	Freezing
	Melting

FIGURE 2, on page 8, represents the melting points of some Group 1 elements.

[Turn over]



FIGURE 2**Melting point in °C**

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 8. [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 8. [1 mark]

Tick (✓) ONE box.

☐

Gas

☐

Liquid

☐

Solid

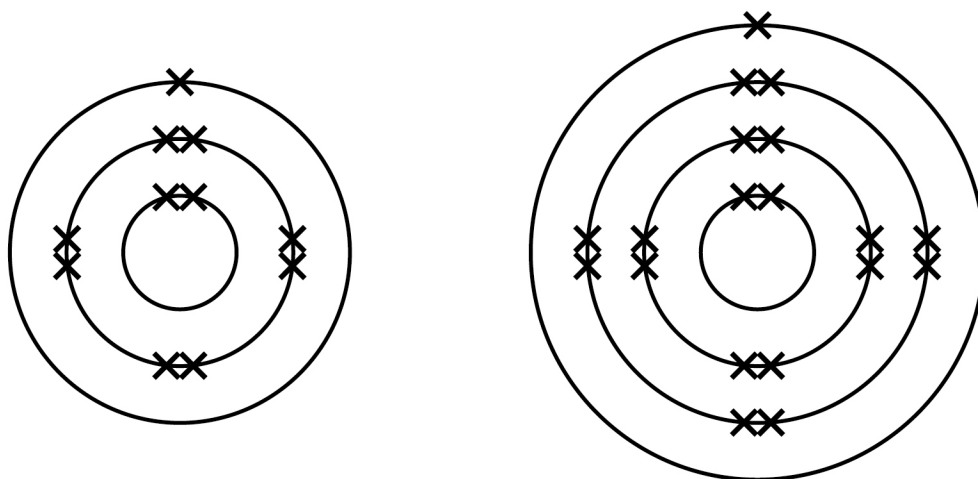
[Turn over]



01.9

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 _____

_____.



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[Turn over]



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.

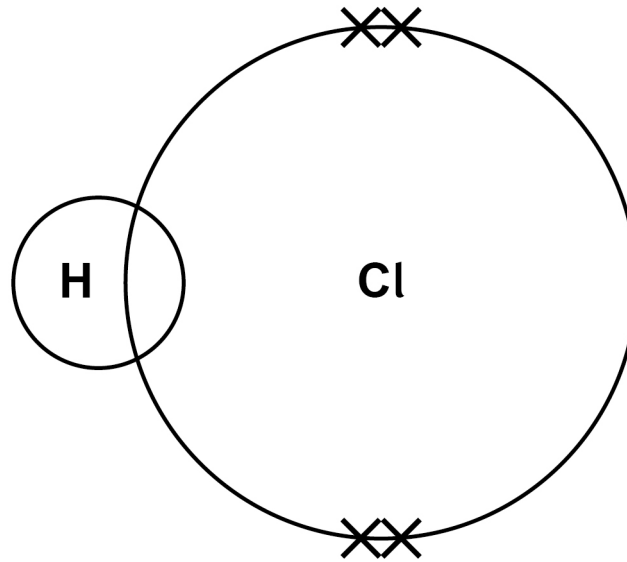
On the opposite page, complete the dot and cross diagram.

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

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



FIGURE 4



[Turn over]

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 \longrightarrow
_____ + 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

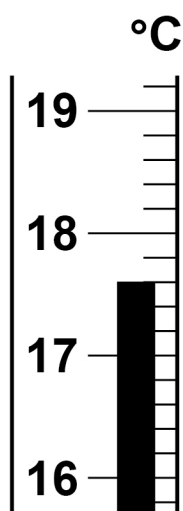
[Turn over]



0	2	.	4
---	---	---	---

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

FIGURE 5



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]



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^-

[Turn over]

8

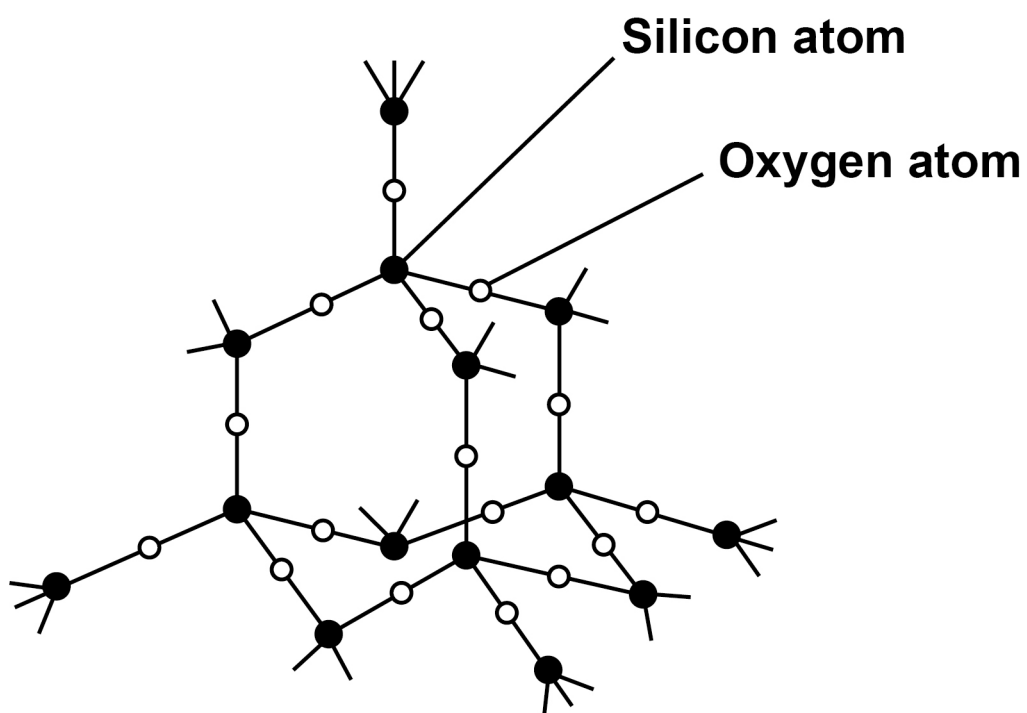


03

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?

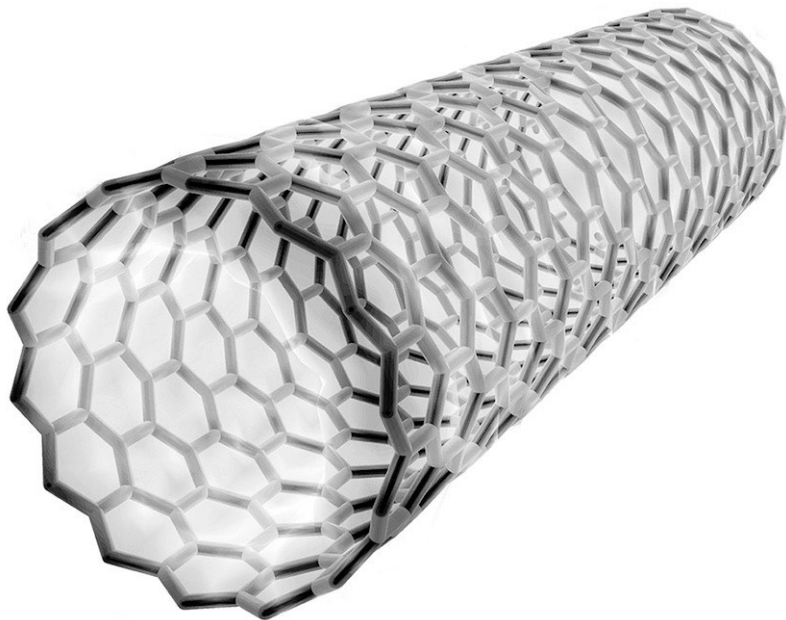
Use FIGURE 6, on the opposite page. [1 mark]

[Turn over]



FIGURE 7 represents part of a fullerene.

FIGURE 7



03.3

Complete the sentence.

Choose the answer from the list. [1 mark]

- hexagons
- octagons
- squares
- triangles

The structure of fullerenes is based on

_____.



0	3	.	4
---	---	---	---

Complete the sentence.

Choose the answer from the list. [1 mark]

- carbon
- hydrogen
- oxygen

The fullerene molecule shown in FIGURE 7 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

☐

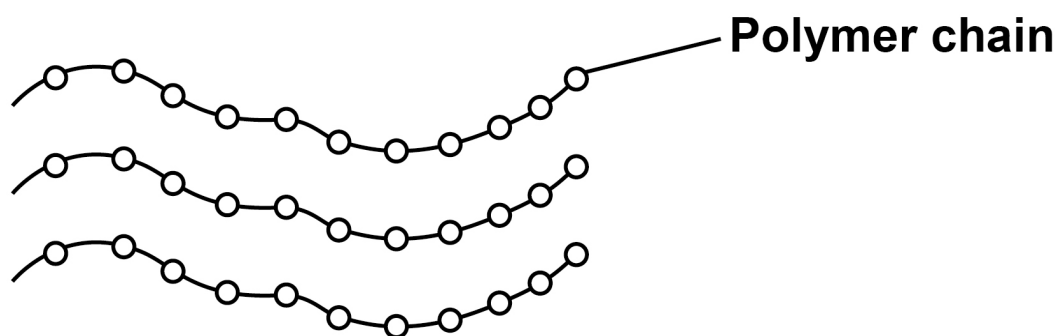
Sports injury packs

[Turn over]



FIGURE 8 represents part of the structure of a polymer.

FIGURE 8



03.6

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 list. [1 mark]

- atomic
- intermolecular
- macromolecular

In FIGURE 8 the polymer chains are held together by
_____ **forces.**

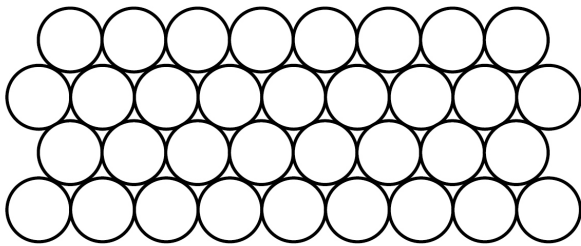
[Turn over]



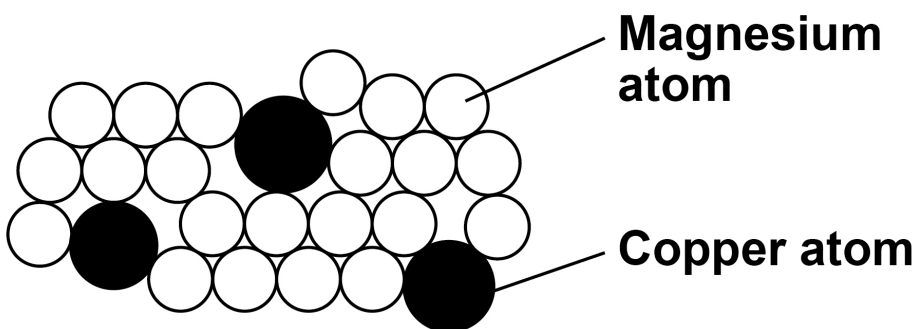
FIGURE 9 represents part of the structures of:

- magnesium metal
- a magnesium alloy.

FIGURE 9



Magnesium metal



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 =

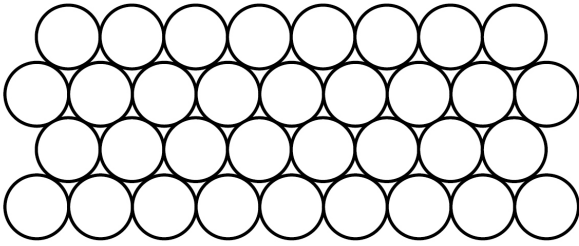
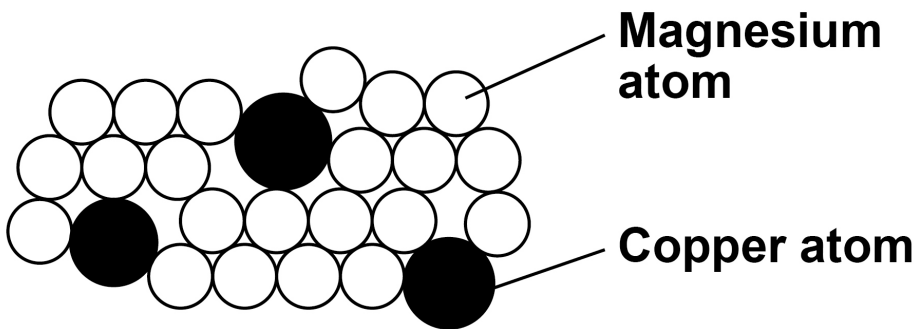
Total number of atoms in the alloy =

Percentage of copper atoms in the alloy =

_____ %

[Turn over]



REPEAT OF FIGURE 9**Magnesium metal****Magnesium 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]

<hr/>
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]



0	4	.	2
---	---	---	---

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



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) =

[Turn over]



0	4	.	4
---	---	---	---

Argon is a noble gas.

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



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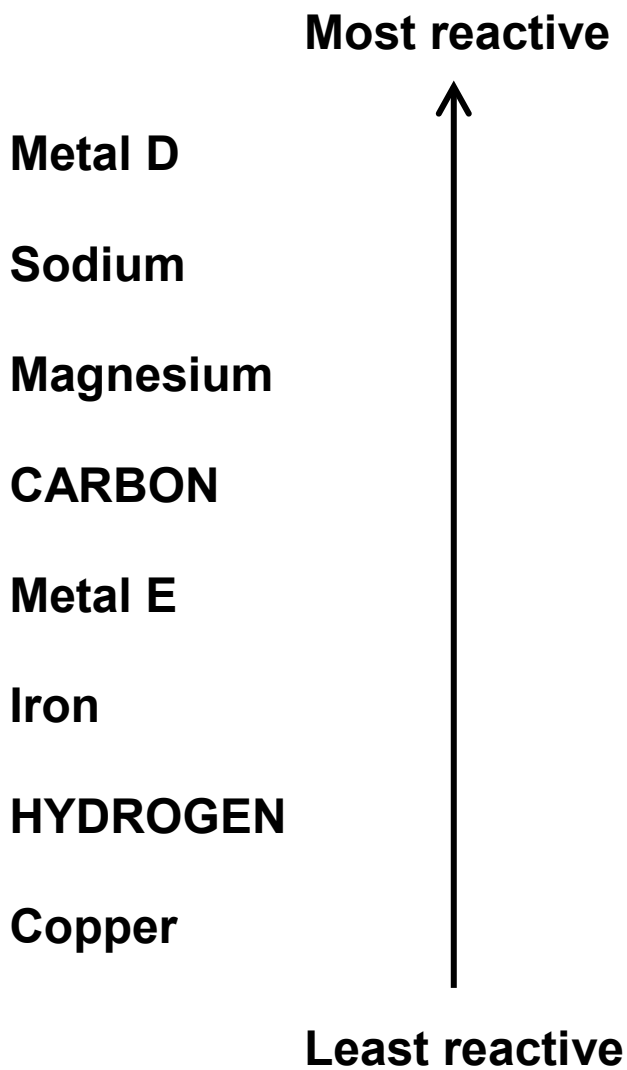
[Turn over]



0	4	.	5
---	---	---	---

FIGURE 10 shows a reactivity series.

FIGURE 10



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

Use FIGURE 10, on the opposite page. [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.

[Turn over]

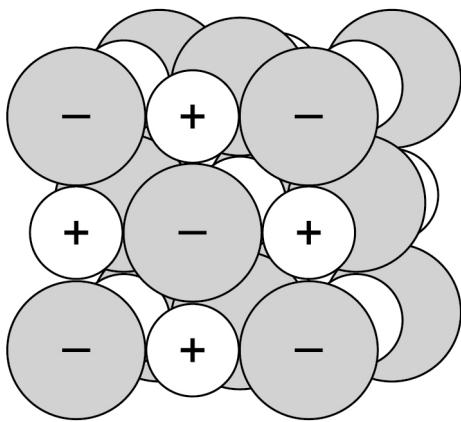


A substance conducts electricity when it has charged particles that are free to move.

04.6

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]

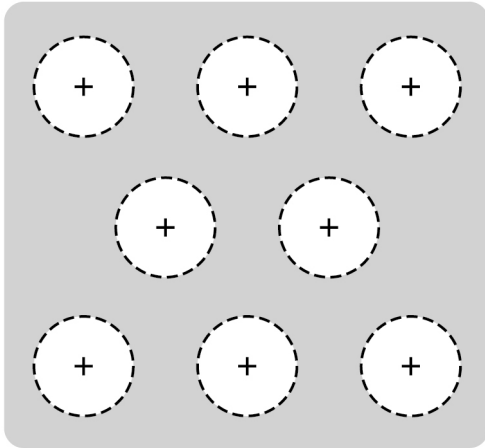
[Turn over]



04.7

FIGURE 12 represents the structure of sodium metal.

FIGURE 12



Sodium metal

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



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[Turn over]



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]

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 = _____

[Turn over]



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 44, shows the maximum mass of ammonium nitrate that can dissolve in 100 cm³ of water at different temperatures.



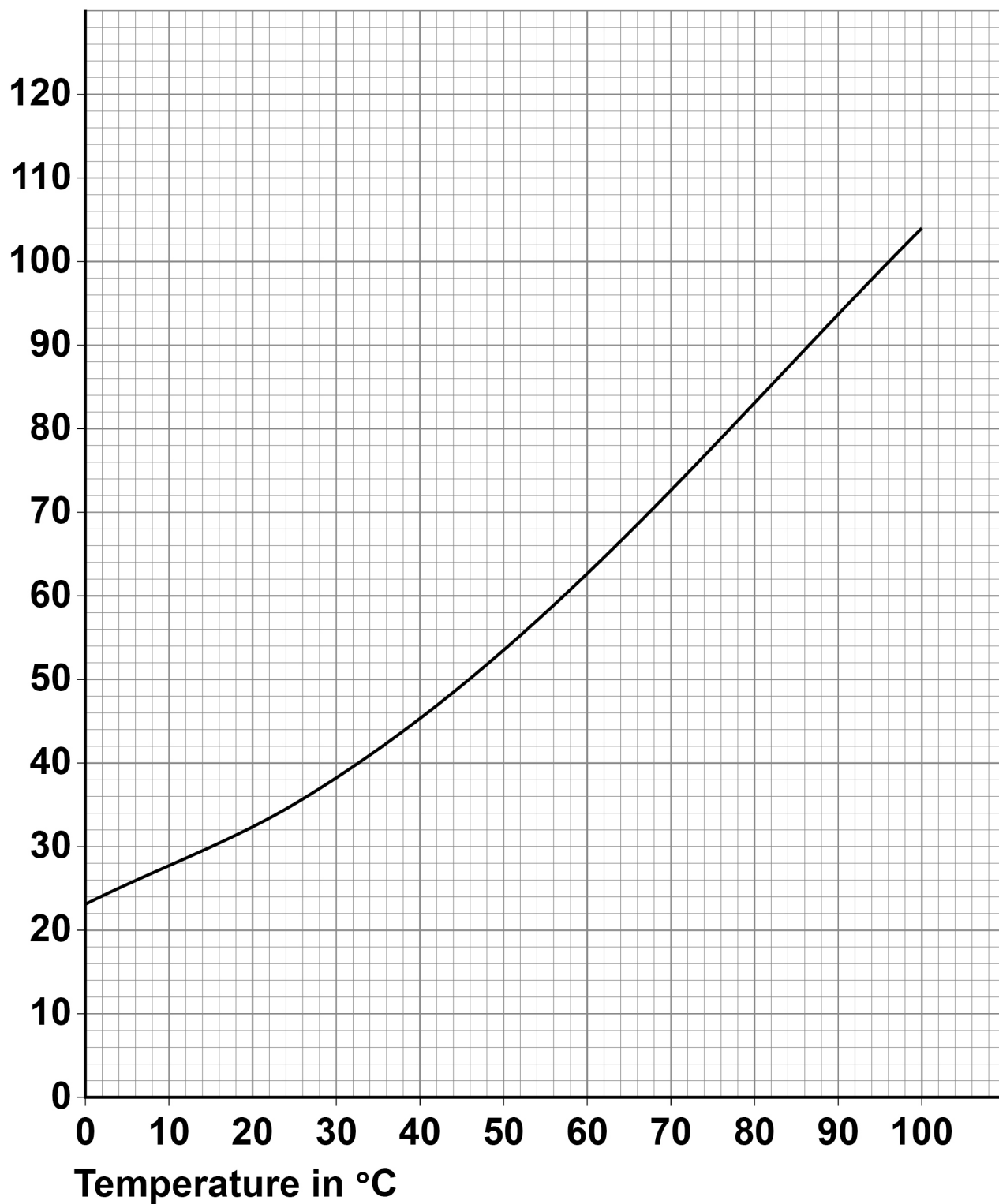
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[Turn over]



FIGURE 13

Maximum mass of ammonium nitrate that can dissolve in grams per 100 cm³ of water



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]

Mass = _____ g

[Turn over]

9

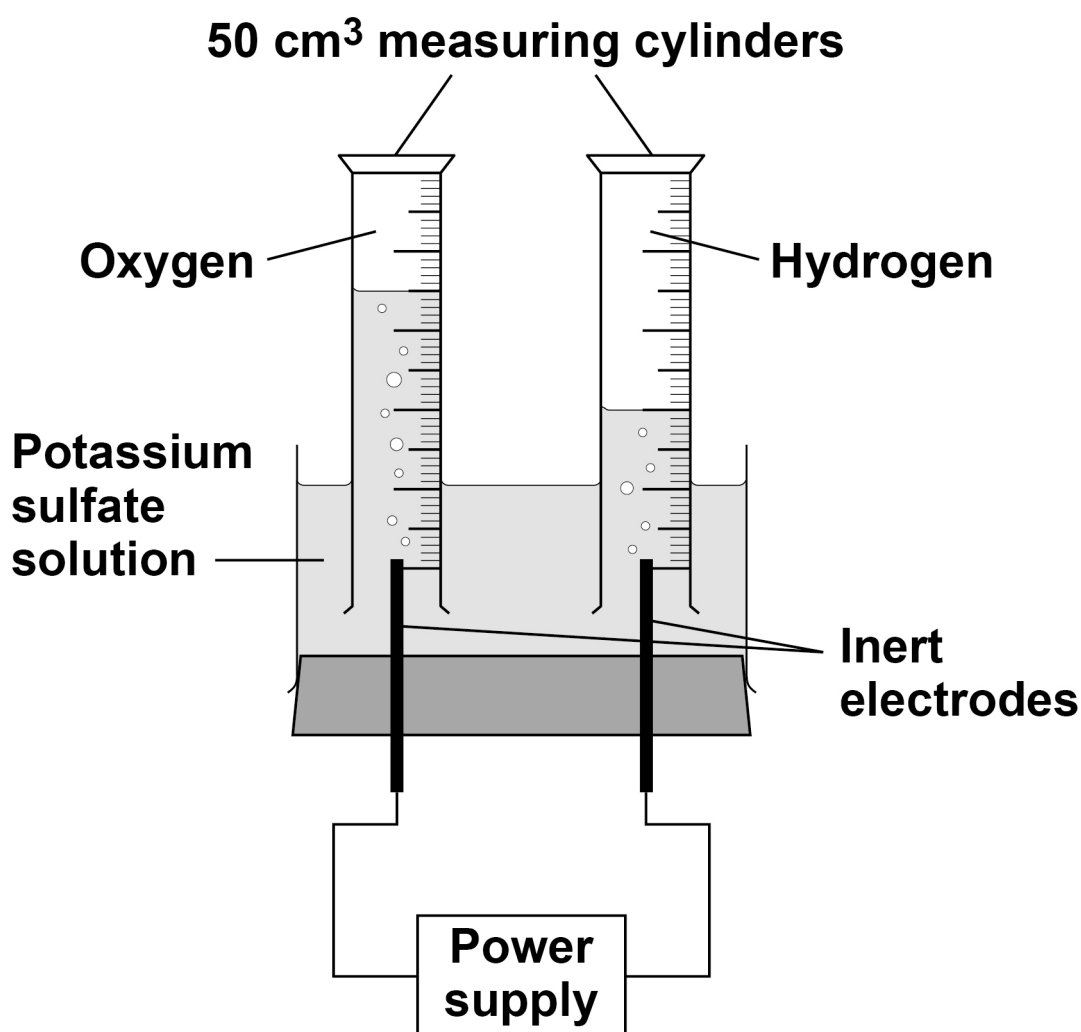


06

This question is about electrolysis.

FIGURE 14 shows the apparatus used to investigate the electrolysis of potassium sulfate solution.

FIGURE 14



06.1

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

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

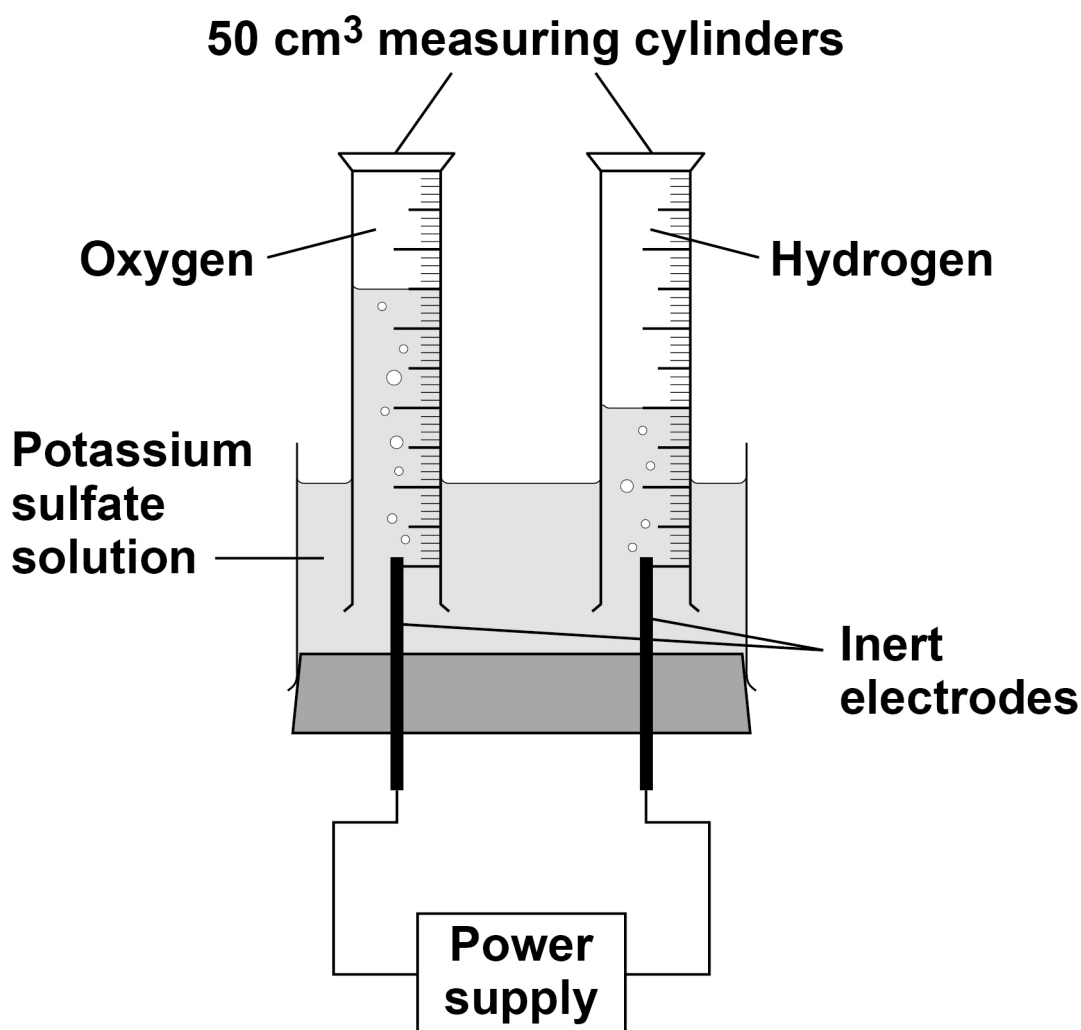
Tick (✓) ONE box.

☐ KSO_4 ☐ K_2SO_4 ☐ $\text{K}(\text{SO}_4)_2$ ☐ $\text{K}_2(\text{SO}_4)_2$

[Turn over]



REPEAT OF FIGURE 14



0	6	.	2
---	---	---	---

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

Use FIGURE 14. [1 mark]

Volume of hydrogen = _____ cm³

Volume of oxygen = _____ cm³



06.3

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]

[Turn over]



0	6	.	4
---	---	---	---

The experiment is repeated 4 times.

The volumes of oxygen collected in the 4 experiments are:

6 cm³ 9 cm³ 10 cm³ 11 cm³

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]

Mass = _____ g

[Turn over]

—
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]

[illegible]

END OF QUESTIONS

6



Additional page, if required.

Write the question numbers in the left-hand margin.

[illegible]

Additional page, if required.

Write the question numbers in the left-hand margin.

[illegible]

Additional page, if required.

Write the question numbers in the left-hand margin.

[illegible]

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

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