A

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

CHEMISTRY

F

Foundation Tier Paper 1

8462/1F

Thursday 17 May 2018 Morning

Time allowed: 1 hour 45 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.**
- **Answer ALL questions in the spaces provided.**
- **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

- **There are 100 marks available on this paper.**
- **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 mixtures.**

0 1 . 1 **Substances are separated from a mixture using different methods.**

Draw ONE line from each substance and mixture to the best method of separation.
[3 marks]

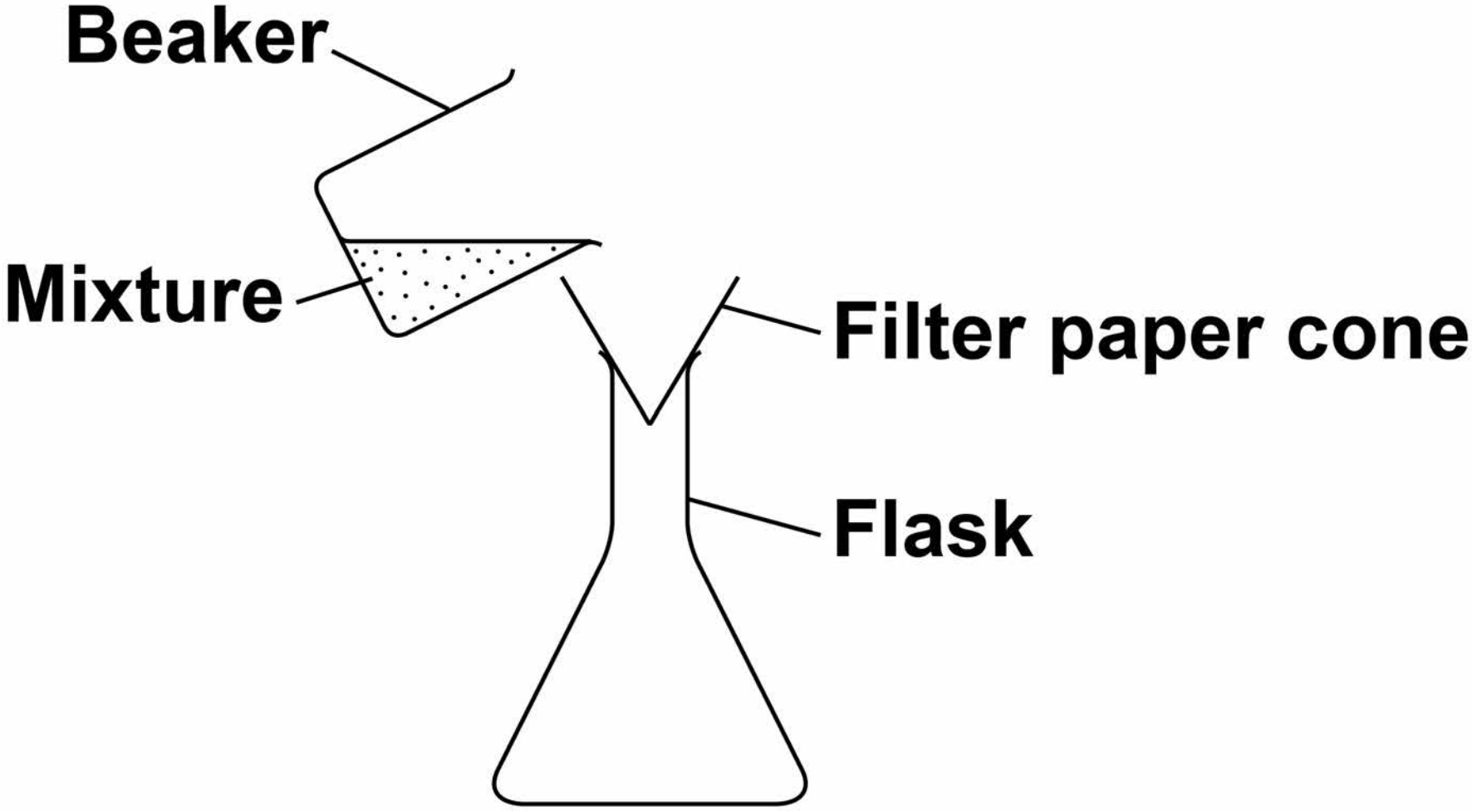
Substance and mixture	Method of separation
Ethanol from ethanol and water	Chromatography
	Crystallisation
Salt from sea water	Electrolysis
	Filtration
The different colours in black ink	Fractional distillation

[Turn over]

0 1 . 2 **A student filters a mixture.**

FIGURE 1 shows the apparatus.

FIGURE 1



Suggest ONE improvement to the apparatus. [1 mark]

0 1 . 3 Complete the sentences.

Choose answers from the list below. [2 marks]

- **condense**
- **evaporate**
- **freeze**
- **melt**
- **solidify**

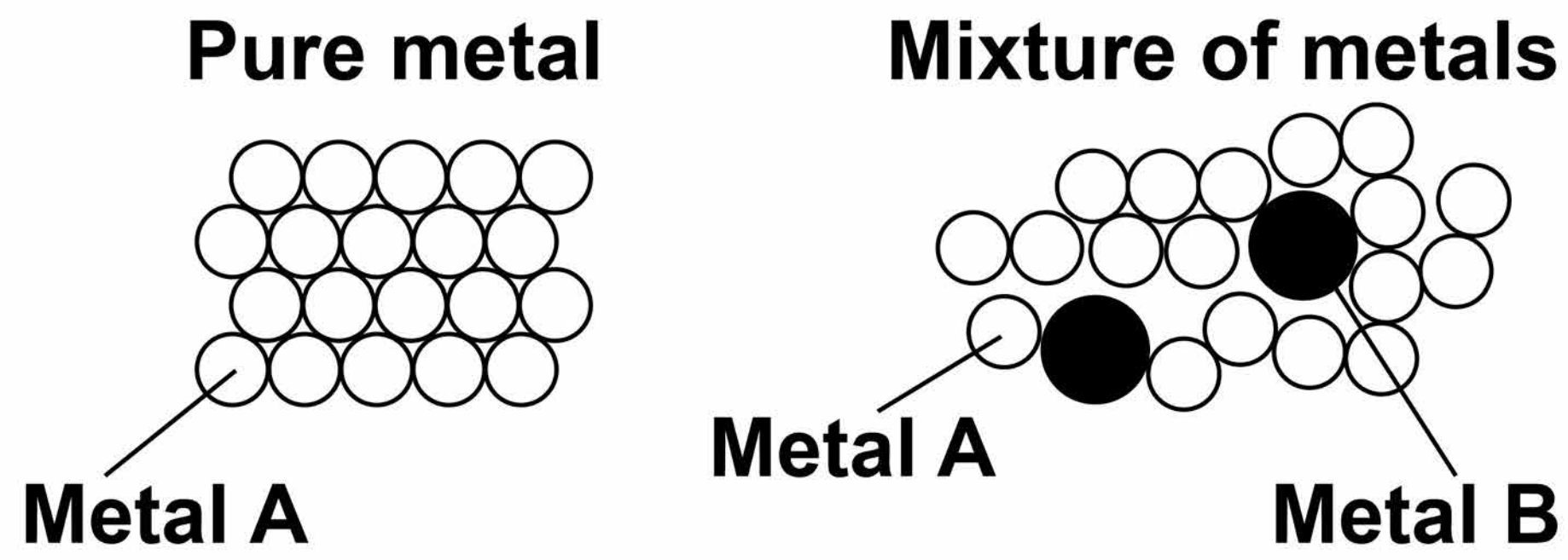
In simple distillation, the mixture is heated to make the liquid _____ .

The vapour is then cooled to make it _____ .

[Turn over]

FIGURE 2 shows the arrangement of atoms in a pure metal and in a mixture of metals.

FIGURE 2



0 1 . 4 **Calculate the percentage of metal B atoms in the mixture of metals shown in FIGURE 2.**
[2 marks]

Percentage of metal B atoms =

%

[Turn over]

0 1 . 5 What is a mixture of metals called? [1 mark]

Tick ONE box.

☐ **An alloy**

☐ **A compound**

☐ **A molecule**

☐ **A polymer**

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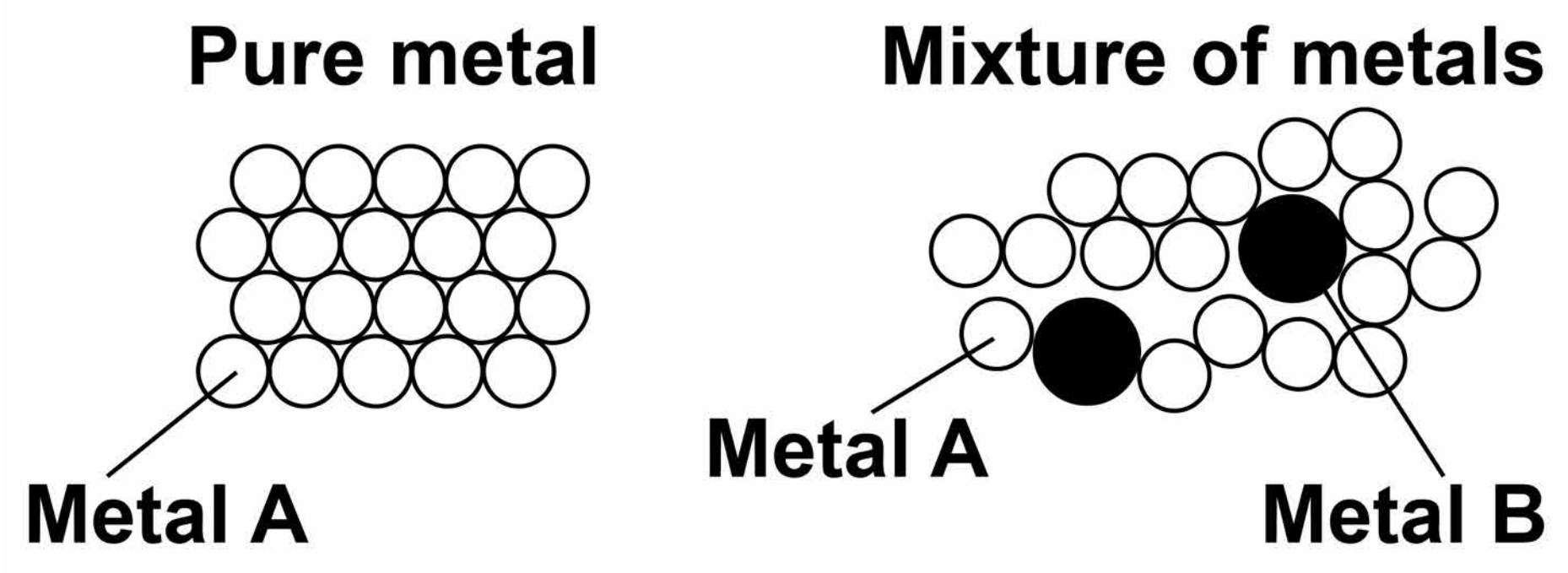
[Turn over]

Repeat of FIGURE 2



0 1 . 6 **Why is the mixture of metals in FIGURE 2 harder than the pure metal? [1 mark]**

Tick ONE box.

☐ **The atoms in the mixture are different shapes.**

☐ **The layers in the mixture are distorted.**

☐ **The layers in the mixture slide more easily.**

☐ **The mixture has a giant structure.**

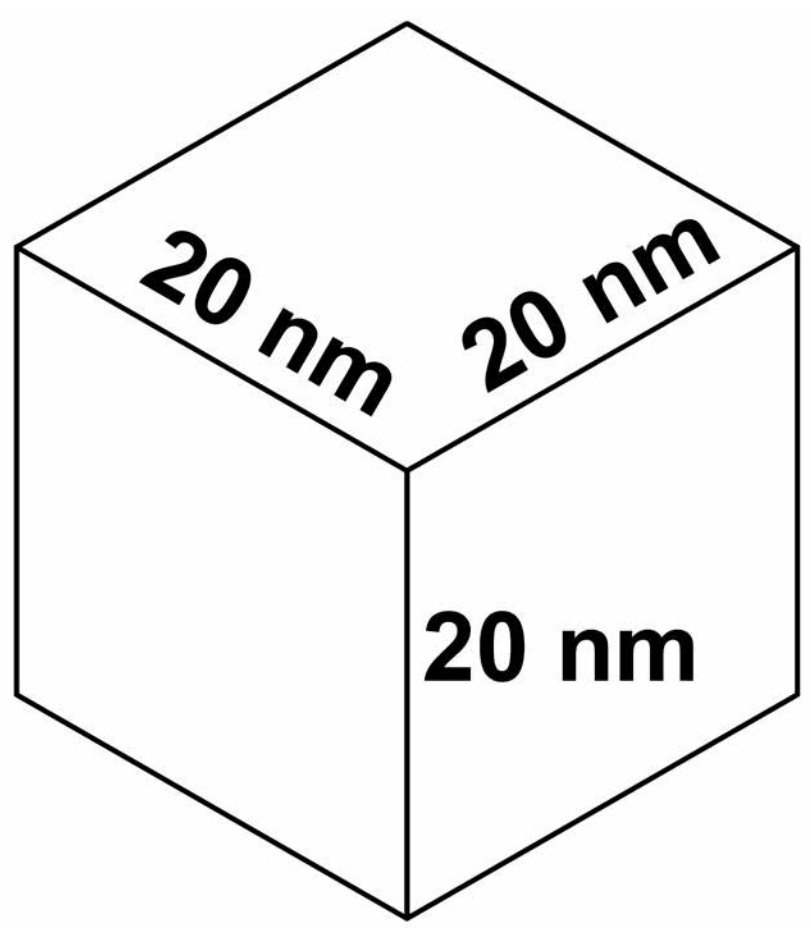
[Turn over]

0 1 . 7 **A nanoparticle of pure metal A is a cube.**

Each side of the cube has a length of 20 nm.

FIGURE 3 shows the cube.

FIGURE 3



What is the volume of the nanoparticle? [1 mark]

Tick ONE box.

- ☐ **20 nm^3**
- ☐ **60 nm^3**
- ☐ **400 nm^3**
- ☐ **8000 nm^3**

[Turn over]

0 2 **The halogens are elements in Group 7.**

0 2 . 1 **Bromine is in Group 7.**

Give the number of electrons in the outer shell of a bromine atom. [1 mark]

_____

0 2 . 2 **Bromine reacts with hydrogen. The gas hydrogen bromide is produced.**

What is the structure of hydrogen bromide? [1 mark]

Tick ONE box.

☐ **Giant covalent**

☐ **Ionic lattice**

☐ **Metallic structure**

☐ **Small molecule**

[Turn over]

0 2 . 3 **What is the formula for fluorine gas? [1 mark]**

Tick ONE box.

☐ **F**

☐ **F_2**

☐ **F^2**

☐ **2F**

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[Turn over]

A student mixes solutions of halogens with solutions of their salts.

TABLE 1 shows the student's observations.

TABLE 1

	Potassium chloride (colourless)	Potassium bromide (colourless)	Potassium iodide (colourless)
Chlorine (colourless)		Solution turns orange	Solution turns brown
Bromine (orange)	No change		Solution turns brown
Iodine (brown)	No change	No change	

0 2 . 4 **Explain how the reactivity of the halogens changes going down Group 7.**

Use the results in TABLE 1 on page 20. [3 marks]

2

A company uses chlorine to produce titanium chloride from titanium dioxide.

0 2 . 5 What is the relative formula mass (M_r) of titanium dioxide, TiO_2 ?

Relative atomic masses (A_r):

O = 16 Ti = 48 [1 mark]

Tick ONE box.

- ☐ 64
- ☐ 80
- ☐ 128
- ☐ 768

0 2 . 6 **The company calculates that 500 g of titanium dioxide should produce 1.2 kg of titanium chloride.**

However, the company finds that 500 g of titanium dioxide only produces 900 g of titanium chloride.

Calculate the percentage yield.
[2 marks]

Percentage yield = _____ %

[Turn over]

9

0 3 **This question is about the structure of the atom.**

0 3 . 1 **Complete the sentences.**

Choose answers from the list below.

Each word may be used once, more than once, or not at all.
[5 marks]

- **electron**
- **ion**
- **neutron**
- **nucleus**
- **proton**

The centre of the atom is the

_____ .

The two types of particle in the centre of the atom are the proton

and the _____ .

James Chadwick proved the

existence of the _____ .

Niels Bohr suggested particles orbit the centre of the atom. This type of

particle is the _____ .

The two types of particle with the same mass are the neutron and the

_____ .

[Turn over]

TABLE 2 shows information about two isotopes of element X.

TABLE 2

	Mass number	Percentage (%) abundance
Isotope 1	63	70
Isotope 2	65	30

26

0 3 . 2 **Calculate the relative atomic mass (A_r) of element X using the equation:**

$$A_r = \frac{\text{(mass number} \times \text{percentage) of isotope 1} + \text{(mass number} \times \text{percentage) of isotope 2}}{100}$$

Use TABLE 2 on page 26.

Give your answer to 1 decimal place. [2 marks]

A_r =

[Turn over]

0 3 . 3 Suggest the identity of element X.

Use the periodic table. [1 mark]

Element X is _____

0 3 . 4 The radius of an atom of element X is 1.2×10^{-10} m

The radius of the centre of the atom is $\frac{1}{10\,000}$ the radius of the atom.

Calculate the radius of the centre of an atom of element X.

Give your answer in standard form. [2 marks]

Radius = _____ m

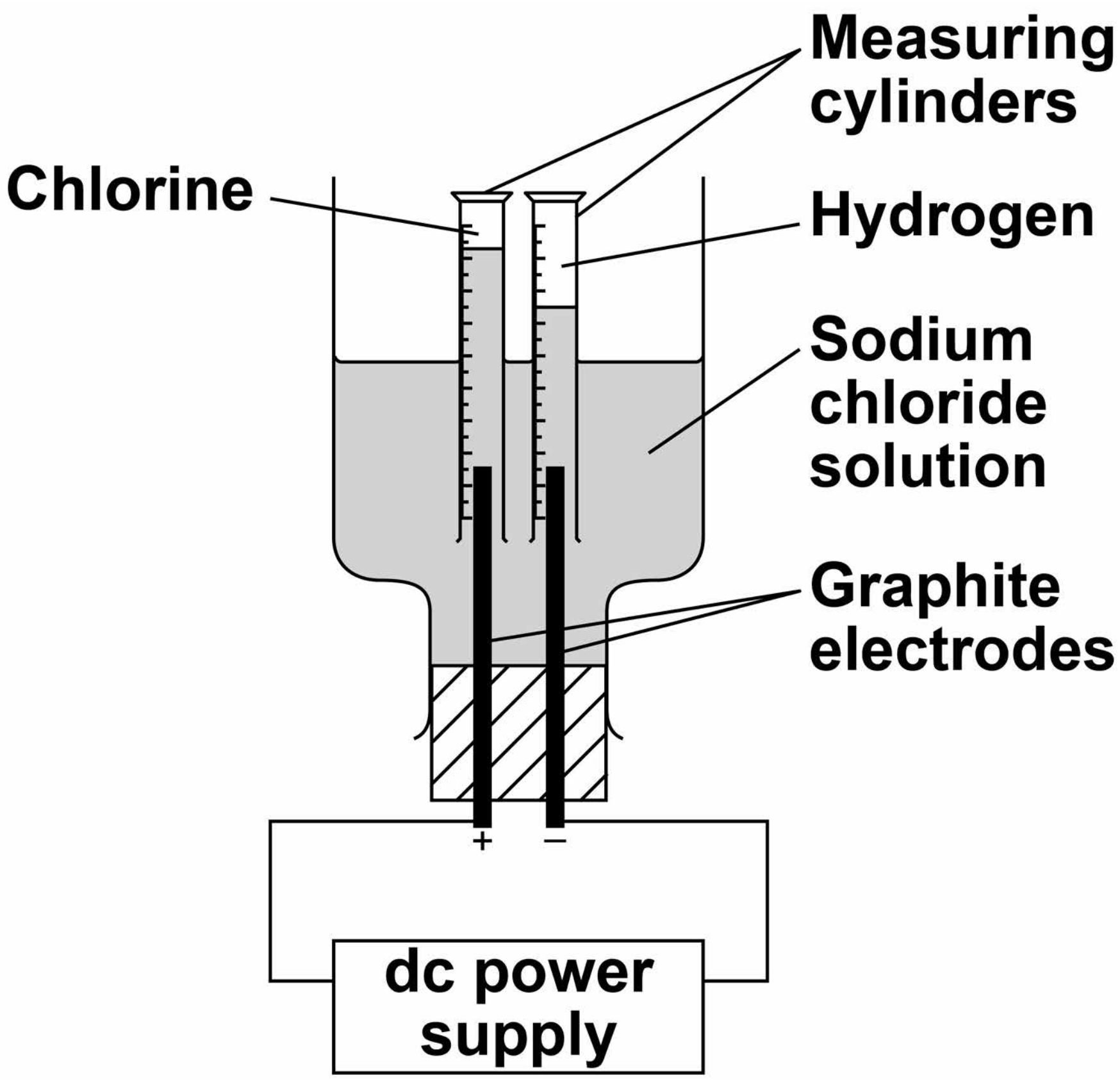
[Turn over]

10

0 4 **A student investigated the electrolysis of sodium chloride solution.**

FIGURE 4 shows the apparatus.

FIGURE 4

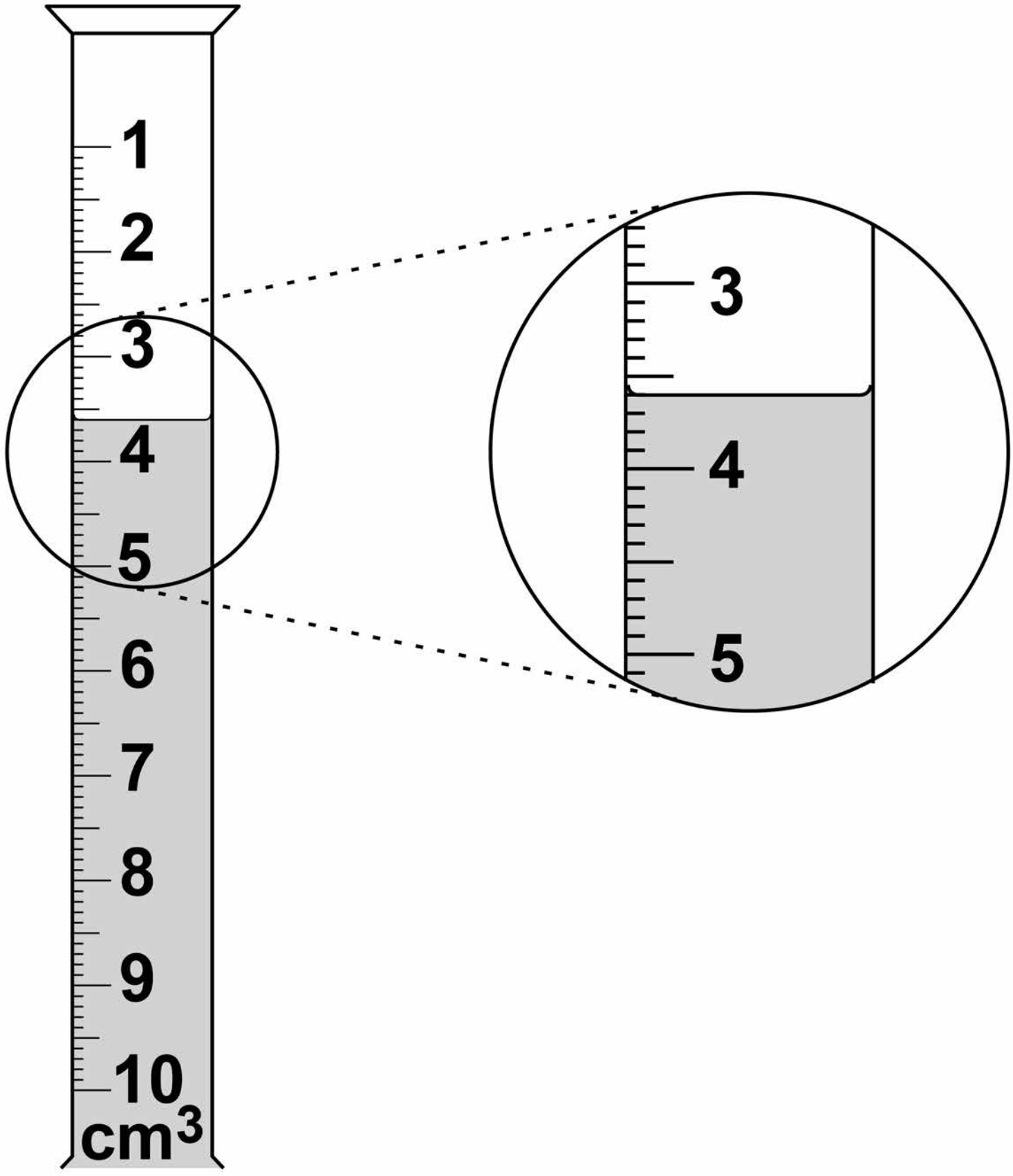


The student measured the volume of gas collected in each measuring cylinder every minute for 20 minutes.

[Turn over]

0 4 . 1 **FIGURE 5 shows the volume of hydrogen gas collected in the measuring cylinder after 8 minutes.**

FIGURE 5



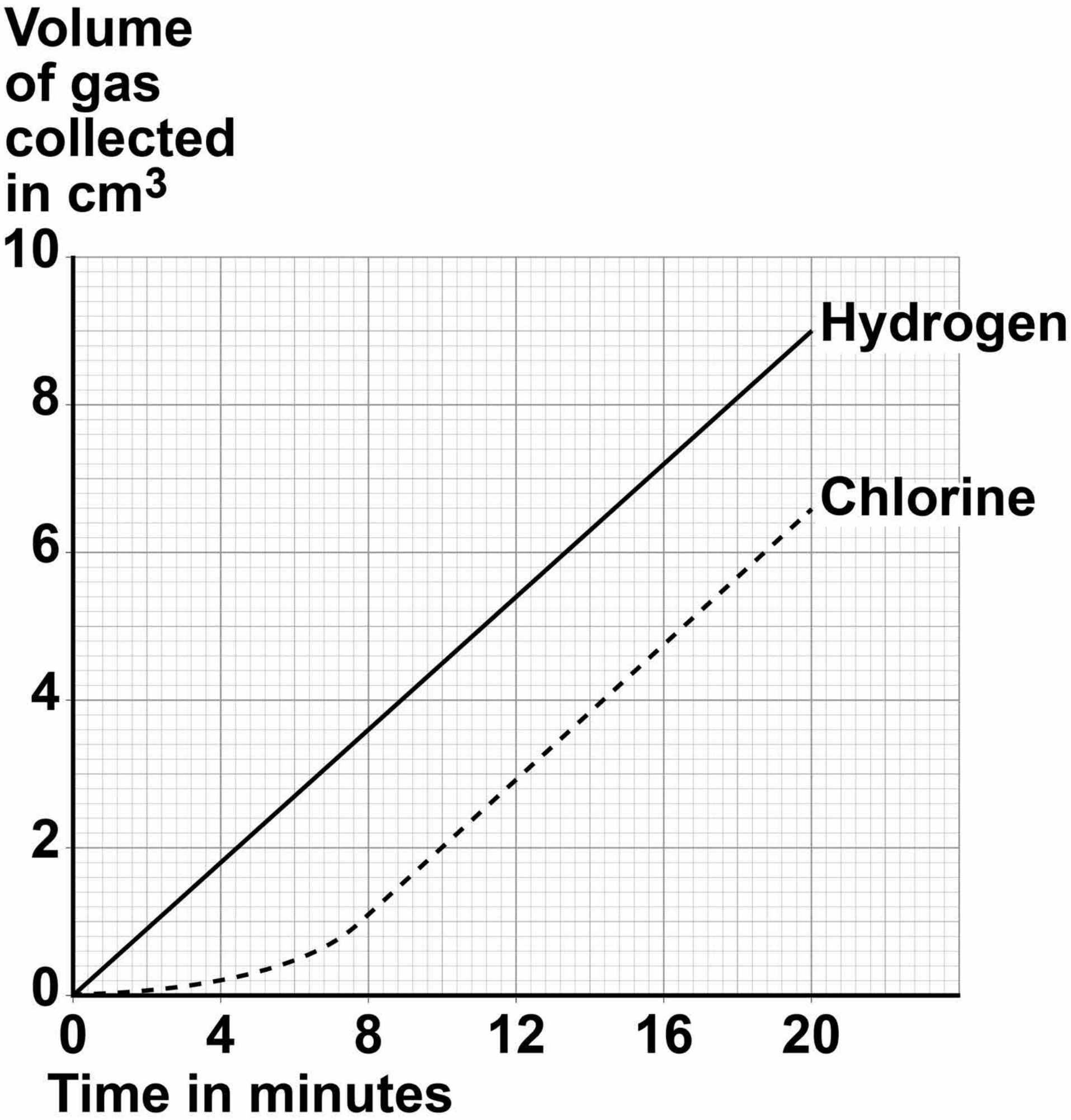
What is the volume of hydrogen gas collected? [1 mark]

Volume = _____ cm^3

[Turn over]

FIGURE 6 shows the results of the investigation.

FIGURE 6



0 4 . 2 **Which of the lines on FIGURE 6, on page 34, show that the volume of gas collected is directly proportional to the time? [1 mark]**

Tick ONE box.

☐ **Both lines**

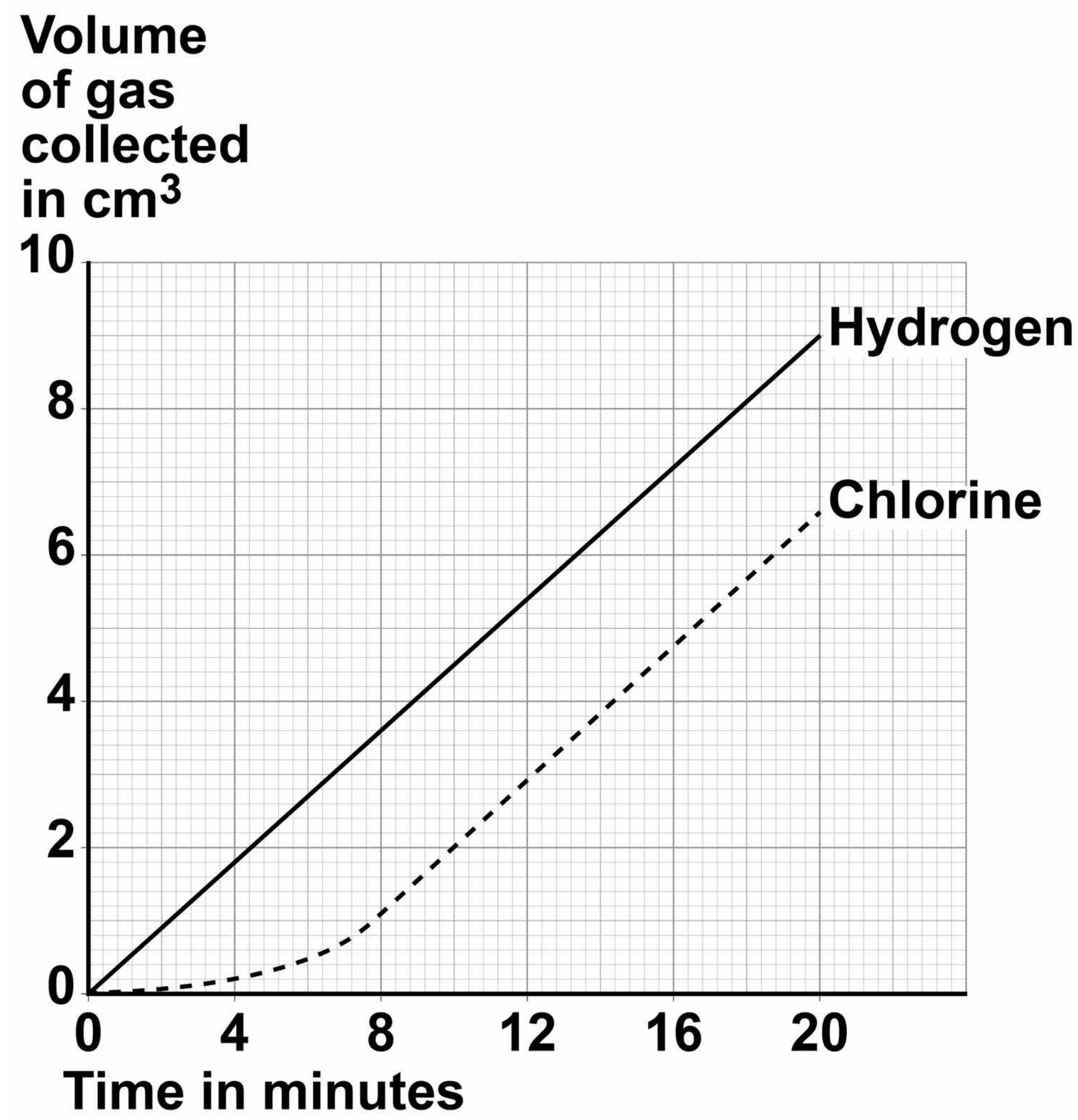
☐ **Chlorine line only**

☐ **Hydrogen line only**

☐ **Neither line**

[Turn over]

Repeat of FIGURE 6



0 4 . 3 **Which of the lines on FIGURE 6, on page 36, show a positive correlation between the volume of gas collected and time?**
[1 mark]

Tick ONE box.

☐ **Both lines**

☐ **Chlorine line only**

☐ **Hydrogen line only**

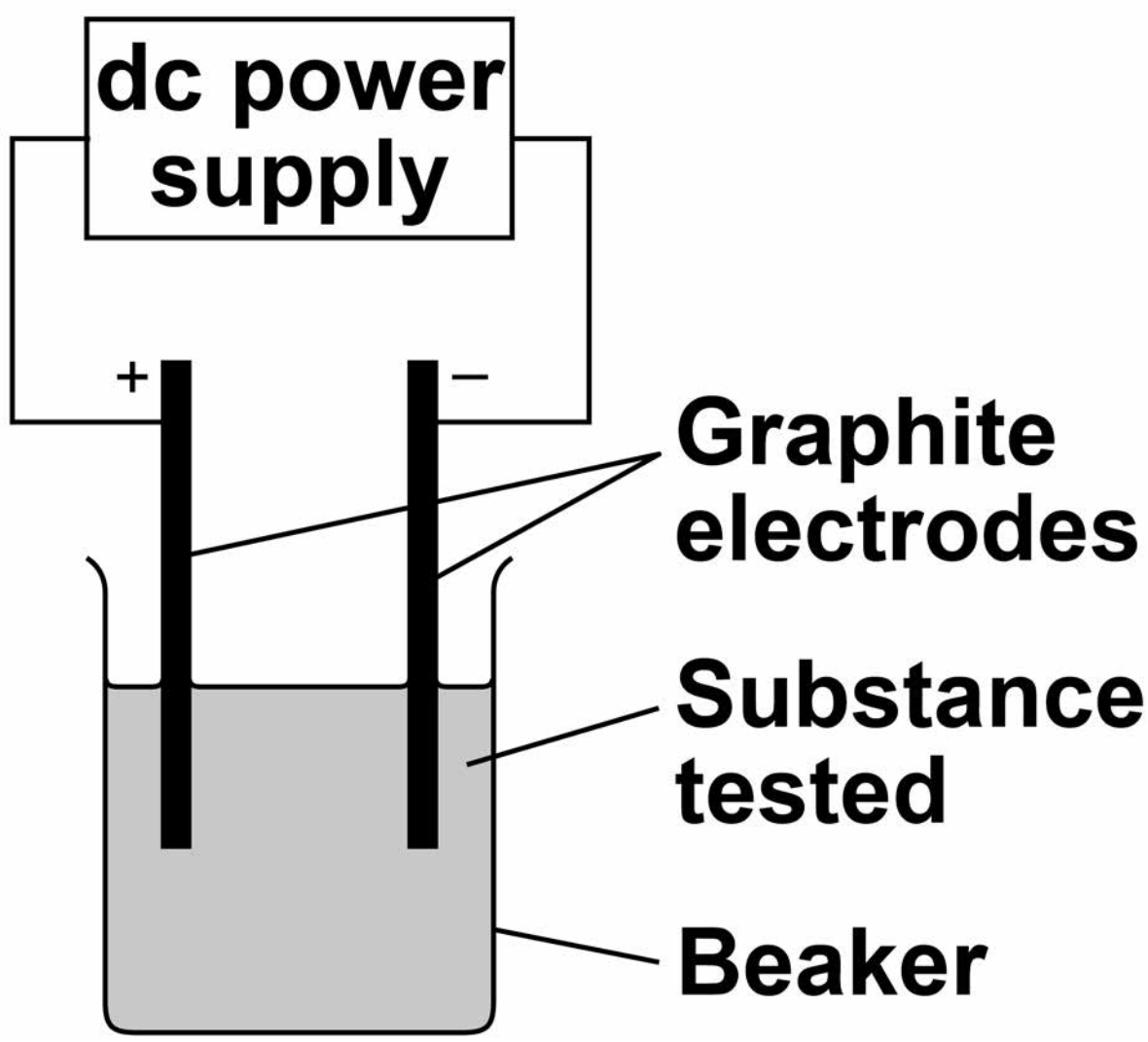
☐ **Neither line**

[Turn over]

A teacher demonstrates the electrolysis of different substances using graphite electrodes.

FIGURE 7 shows the apparatus used.

FIGURE 7



0 4 . 4 **Why can graphite conduct electricity? [1 mark]**

Tick ONE box.

☐ **Graphite exists in layers of atoms.**

☐ **Graphite has a giant structure.**

☐ **Graphite has a high melting point.**

☐ **Graphite has delocalised electrons.**

[Turn over]

0 4 . 5 **The teacher demonstrates the electrolysis of:**

- **molten zinc chloride**
- **potassium bromide solution.**

Complete TABLE 3 on page 41 to predict the products.

Choose answers from the list below. [4 marks]

- **chlorine**
- **bromine**
- **hydrogen**
- **oxygen**
- **potassium**
- **zinc**

TABLE 3

Substance electrolysed	Product at cathode (negative electrode)	Product at anode (positive electrode)
Molten zinc chloride		
Potassium bromide solution		

[Turn over]

8

0 5 **A student investigated the mass of copper oxide produced by heating copper carbonate.**

This is the method used.

1. **Weigh an empty test tube.**

2. **Weigh 2.00 g of copper carbonate into the test tube.**

3. **Heat the copper carbonate until there appears to be no further change.**

4. **Re-weigh the test tube and copper oxide produced.**

5. **Subtract the mass of the empty tube to find the mass of copper oxide.**

6. **Repeat steps 1–5 twice.**

7. **Repeat steps 1–6 with different masses of copper carbonate.**

TABLE 4, on page 44, shows the student's results.

[Turn over]

TABLE 4

Mass of copper carbonate in g	Mass of copper oxide in g			
	Trial 1	Trial 2	Trial 3	Mean
2.00	1.29	1.27	1.31	1.29
4.00	2.89	2.57	2.59	2.58
6.00	3.85	3.90	3.87	3.87
8.00	5.12	5.15	5.09	X
10.00	6.42	6.45	6.45	6.44

The equation for the reaction is:

$$CuCO_3(s) \rightarrow CuO(s) + CO_2(g)$$

0 5 . 1 Complete the sentence. [1 mark]

The state symbol shows carbon dioxide is a

_____ .

[Turn over]

Repeat of TABLE 4

Mass of copper carbonate in g	Mass of copper oxide in g			
	Trial 1	Trial 2	Trial 3	Mean
2.00	1.29	1.27	1.31	1.29
4.00	2.89	2.57	2.59	2.58
6.00	3.85	3.90	3.87	3.87
8.00	5.12	5.15	5.09	X
10.00	6.42	6.45	6.45	6.44

0 5 . 2 **Why do the contents of the test tube lose mass in the investigation? [1 mark]**

0 5 . 3 **Calculate the mean mass X in TABLE 4 on page 46. [1 mark]**

X = _____ g

[Turn over]

0 5 . 4 **One of the results in TABLE 4, on page 46, is anomalous.**

Which result is anomalous? [1 mark]

Mass of copper carbonate _____ g

Trial _____

0 5 . 5 Suggest how the investigation could be improved to make sure the reaction is complete. [2 marks]

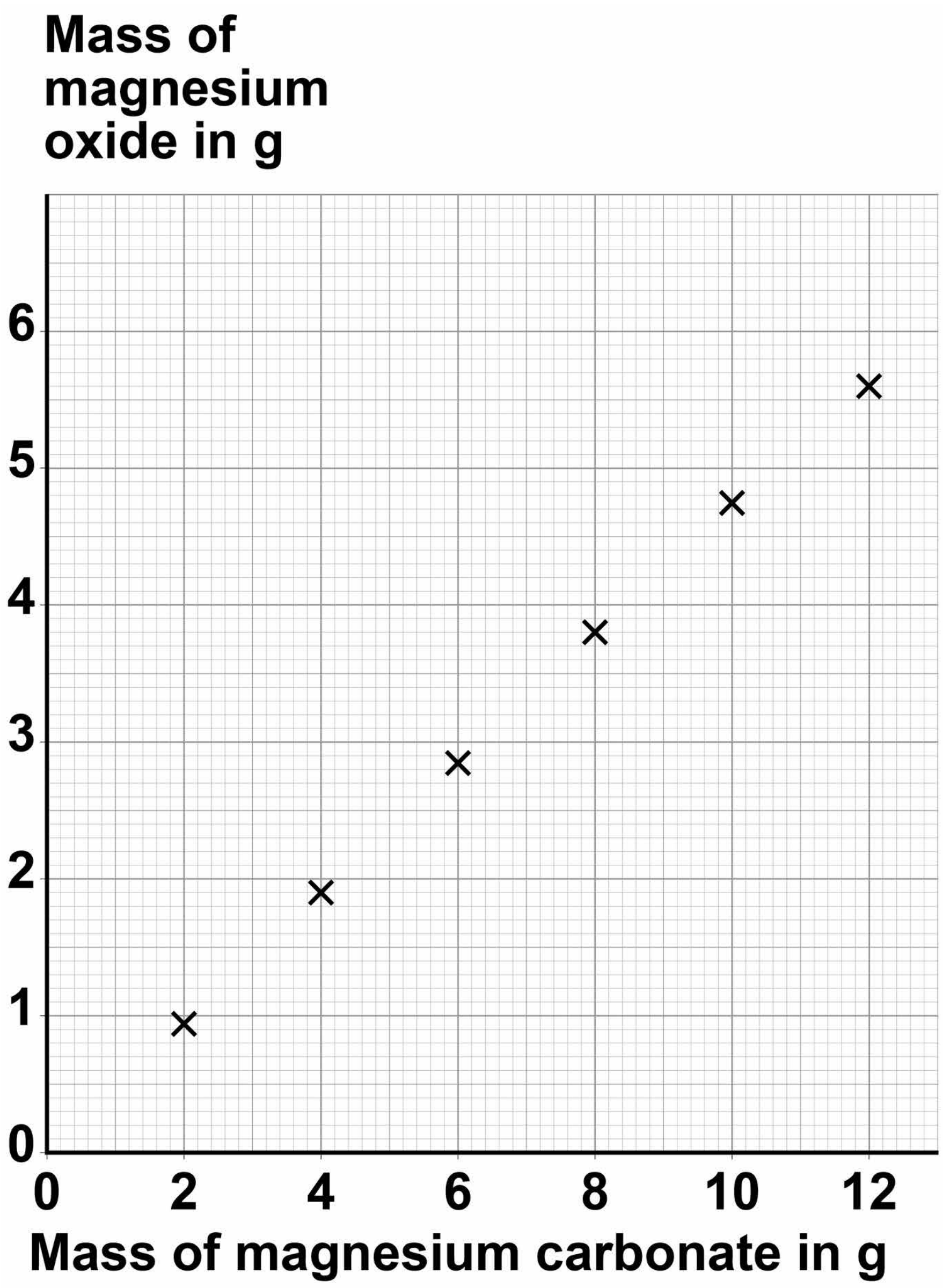
Another student repeated the investigation using magnesium carbonate instead of copper carbonate.

The word equation for the reaction is:

magnesium carbonate → magnesium oxide + carbon dioxide

FIGURE 8, on page 51, shows the results of the investigation.

FIGURE 8



[Turn over]

0 5 . 6 Draw a line of best fit on FIGURE 8 on page 51. [1 mark]

0 5 . 7 Determine the mass of magnesium oxide produced by 8.4 g of magnesium carbonate.

Use FIGURE 8 on page 51.
[1 mark]

Mass = _____ g

0 5 . 8 **Calculate the mass of magnesium oxide produced when 168 g of magnesium carbonate is heated.**

Use your answer to Question 05.7 [2 marks]

Mass of magnesium oxide produced =

_____ **g**

10

0 6 **A student investigated the temperature change in displacement reactions between metals and copper sulfate solution.**

This is the method used.

1. Measure 50 cm^3 of the copper sulfate solution into a polystyrene cup.

2. Record the starting temperature of the copper sulfate solution.

3. Add the metal and stir the solution.

4. Record the highest temperature the mixture reaches.

5. Calculate the temperature increase for the reaction.

6. Repeat steps 1–5 with different metals.

0 6 . 1 **Draw ONE line from each type of variable to the name of the variable in the investigation.**
[2 marks]

Type of variable	Name of variable in the investigation
	Concentration of solution
Dependent variable	Particle size of solid
	Temperature change
Independent variable	Type of metal
	Volume of solution

0 6 . 2 **The student used a polystyrene cup and NOT a glass beaker.**

Why did this make the investigation more accurate? [1 mark]

Tick ONE box.

☐ **Glass is breakable**

☐ **Glass is transparent**

☐ **Polystyrene is a better insulator**

☐ **Polystyrene is less dense**

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[Turn over]

TABLE 5 shows the student's results.

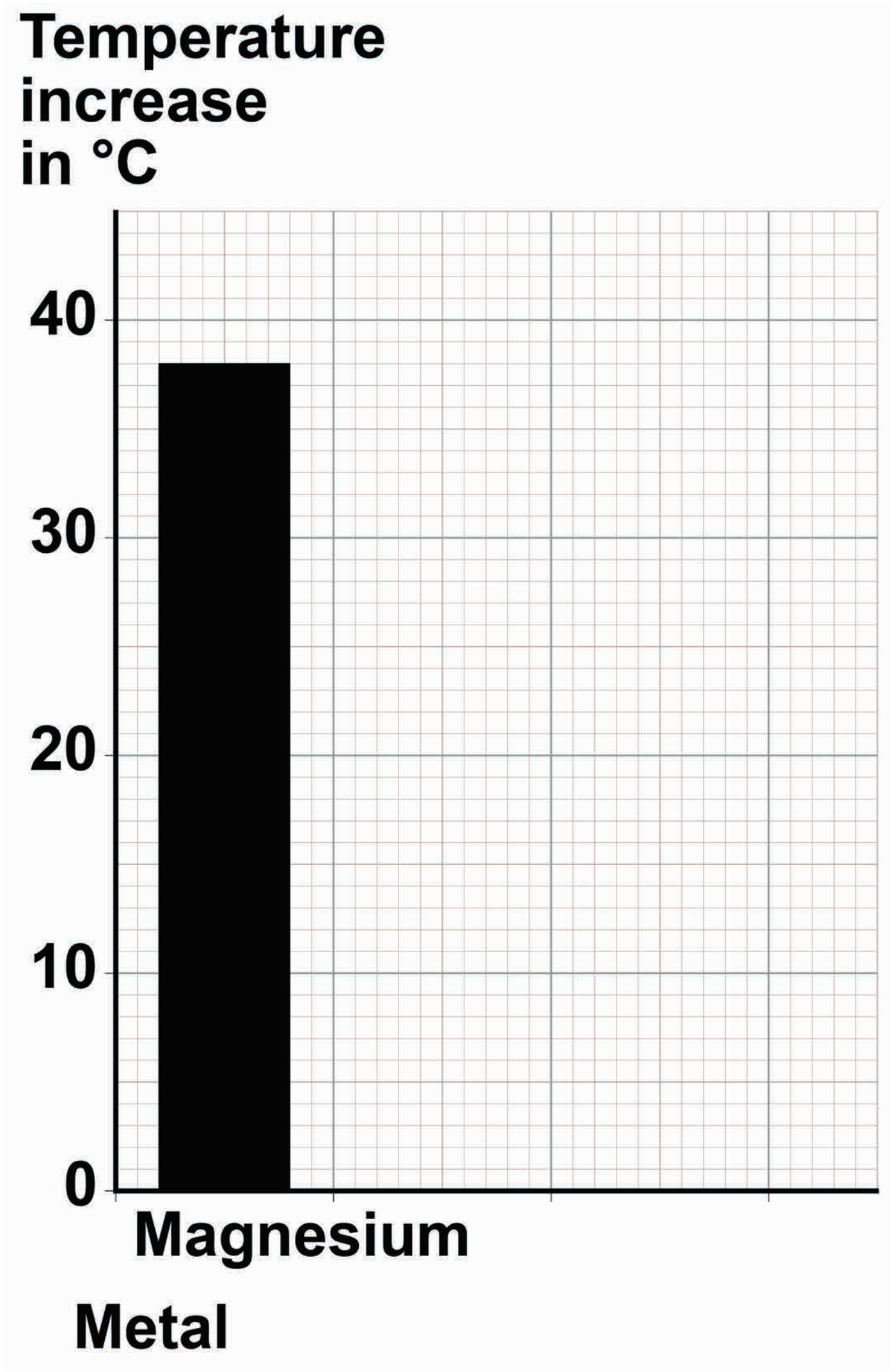
TABLE 5

Metal	Temperature increase in °C
Magnesium	38
Nickel	8
Zinc	16

0 6 . 3 Complete FIGURE 9, on the opposite page.

Use data from TABLE 5 above.
[2 marks]

FIGURE 9



[Turn over]

0 6 . 4 **The student concluded that the reactions between the metals and copper sulfate solution are endothermic.**

Give ONE reason why this conclusion is NOT correct.

[1 mark]

_____

_____

_____

Repeat of TABLE 5

Metal	Temperature increase in °C
Magnesium	38
Nickel	8
Zinc	16

0 6 . 5 **The temperature increase depends on the reactivity of the metal.**

Write the metals magnesium, nickel and zinc in order of reactivity.

Use TABLE 5 on page 60.
[1 mark]

Most reactive _____

_____

Least reactive _____

[Turn over]

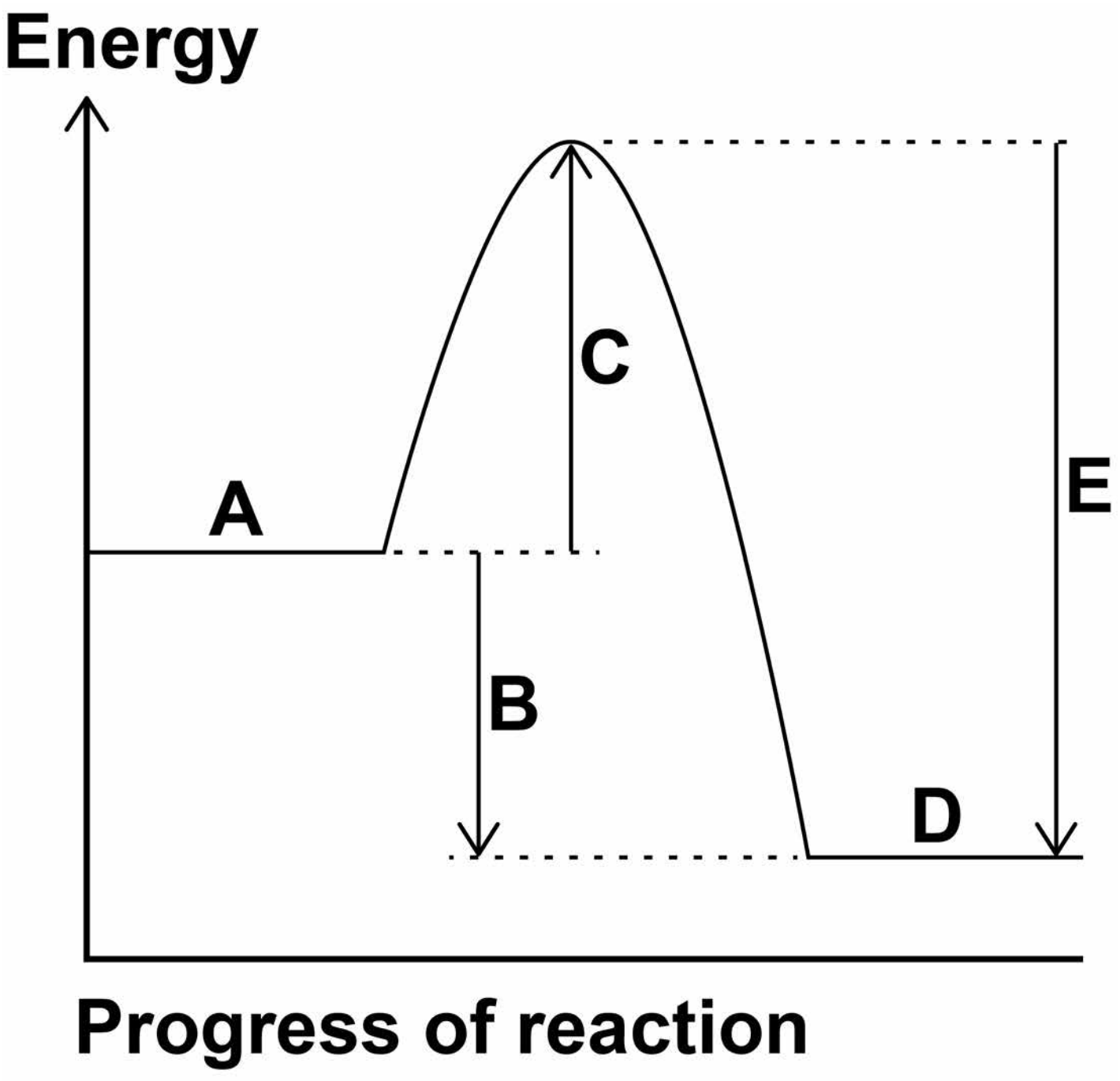
BLANK PAGE

0 6 . 6 **Y is an unknown metal.**

Describe a method to find the position of Y in the reactivity series in Question 06.5 on page 61 [3 marks]

FIGURE 10 shows the reaction profile for the reaction between zinc and copper sulfate solution.

FIGURE 10



0 6 . 7 **Which letter represents the products of the reaction? [1 mark]**

Tick ONE box.

☐ **A**

☐ **B**

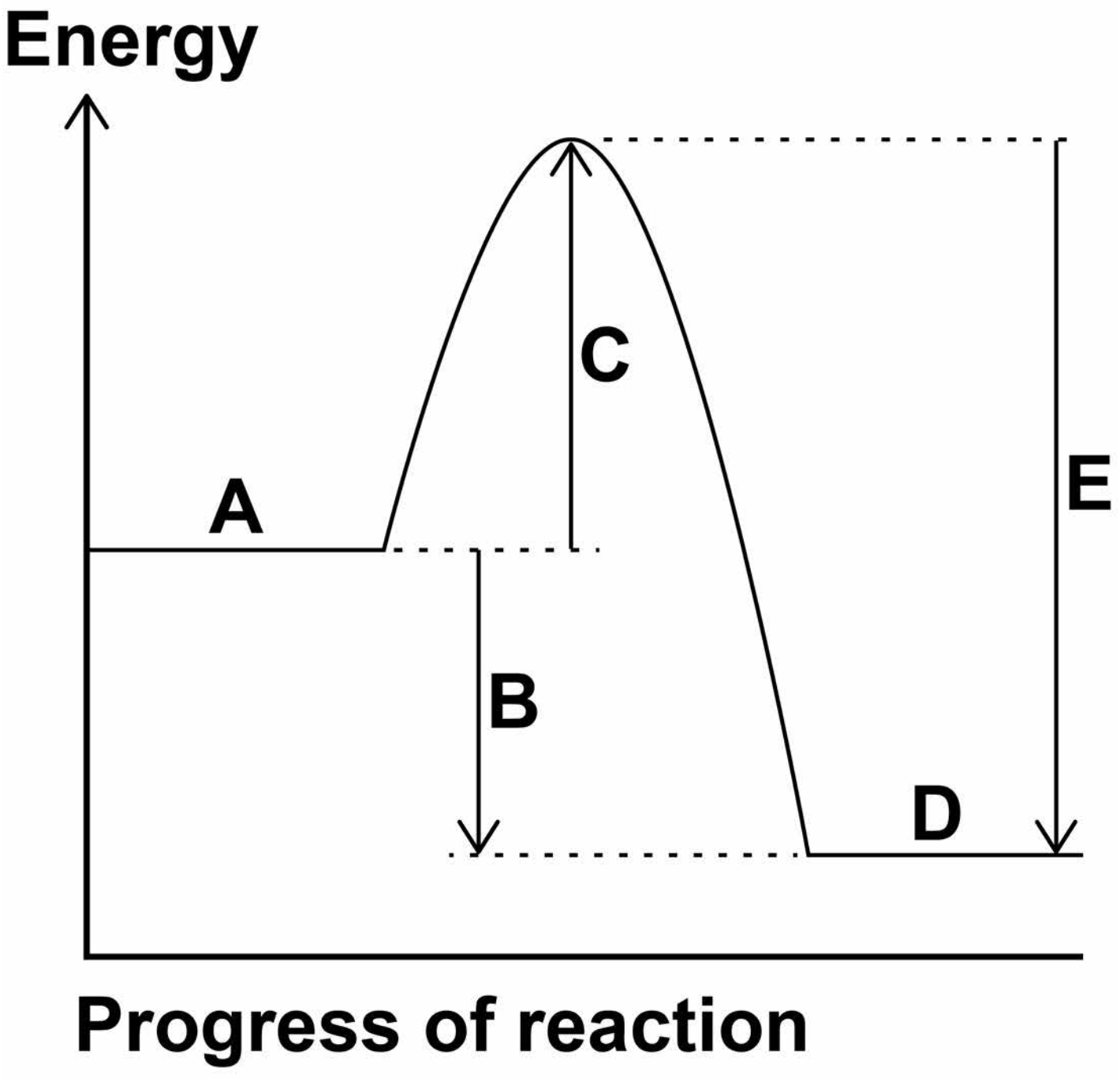
☐ **C**

☐ **D**

☐ **E**

[Turn over]

Repeat of FIGURE 10



0 6 . 8 **Which letter represents the activation energy? [1 mark]**

Tick ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

☐ **E**

[Turn over]

12

0 7 **This question is about elements in Group 1.**

A teacher burns sodium in oxygen.

0 7 . 1 **Complete the word equation for the reaction. [1 mark]**

sodium + oxygen → _____

0 7 . 2 What is the name of this type of reaction? [1 mark]

Tick ONE box.

☐ **Decomposition**

☐ **Electrolysis**

☐ **Oxidation**

☐ **Precipitation**

[Turn over]

0 7 . 3 **The teacher dissolves the product of the reaction in water and adds universal indicator.**

The universal indicator turns purple.

What is the pH value of the solution? [1 mark]

Tick ONE box.

☐ **1**

☐ **4**

☐ **7**

☐ **13**

0 7 . 4 **The solution contains a substance with the formula NaOH**

Give the name of the substance.
[1 mark]

_____

_____

[Turn over]

0 7 . 5 **All alkalis contain the same ion.**

What is the formula of this ion?
[1 mark]

Tick ONE box.

- ☐ H^+
- ☐ Na^+
- ☐ OH^-
- ☐ O^{2-}

0 7 . 6 **A solution of NaOH had a concentration of 40 g/dm^3**

What mass of NaOH would there be in 250 cm^3 of the solution? [2 marks]

Mass = _____ g

[Turn over]

0 7 . 7 **The melting points of the elements in Group 1 show a trend.**

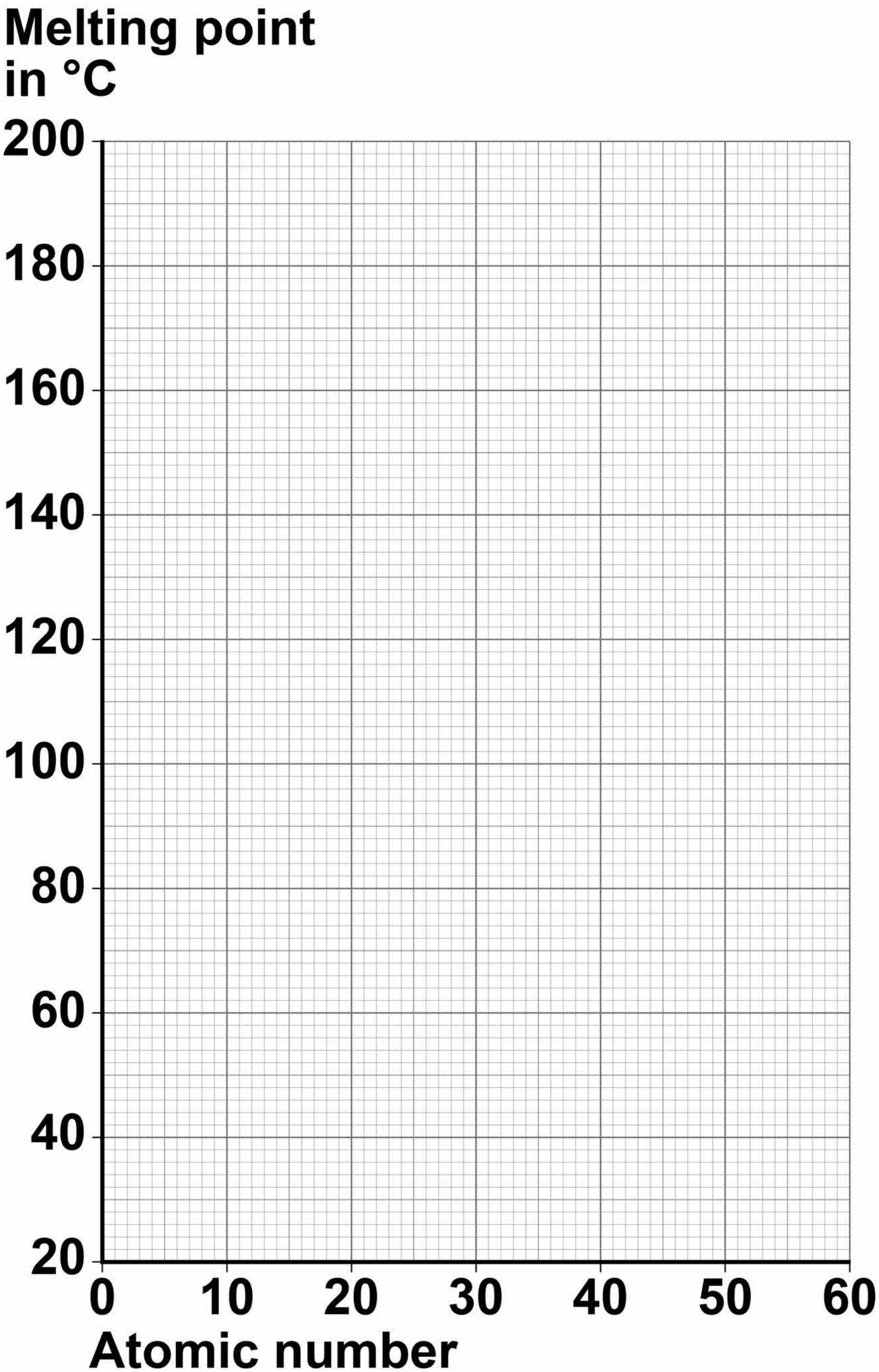
TABLE 6 shows the atomic numbers and melting points of the Group 1 elements.

TABLE 6

Element	Atomic number	Melting point in °C
Lithium	3	181
Sodium	11	98
Potassium	19	63
Rubidium	37	X
Caesium	55	29

Plot the data from TABLE 6 on FIGURE 11 on page 75. [2 marks]

FIGURE 11



[Turn over]

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0 7 . 8 **Predict the melting point, X, of rubidium, atomic number 37**

Use FIGURE 11 on page 75.
[1 mark]

Melting point = _____ °C

[Turn over]

10

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0 8 **Soluble salts are formed by reacting metal oxides with acids.**

0 8 . 1 **Give ONE other type of substance that can react with an acid to form a soluble salt. [1 mark]**

0 8 . 2 **Calcium nitrate contains the ions Ca^{2+} and NO_3^-**

Give the formula of calcium nitrate. [1 mark]

[Turn over]

0 8 . 3 **Describe a method to make pure, dry crystals of magnesium sulfate from a metal oxide and a dilute acid. [6 marks]**

[Turn over]

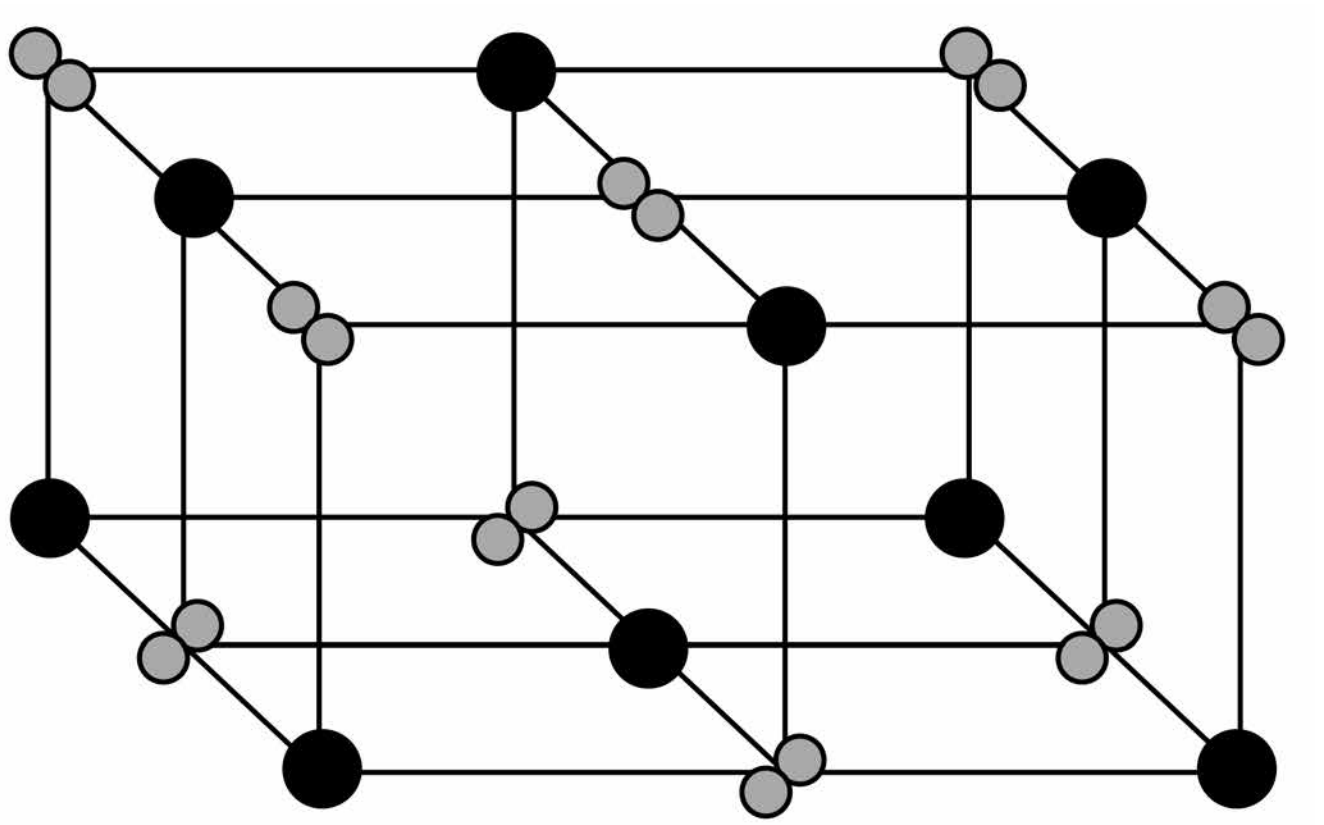
8

0 9 **This question is about metals and metal compounds.**

0 9 . 1 **Iron pyrites is an ionic compound.**

FIGURE 12 shows a structure for iron pyrites.

FIGURE 12



Determine the formula of iron pyrites.

Use FIGURE 12. [1 mark]

---

0 9 . 2 **An atom of iron is represented as** $^{56}_{26}Fe$

Give the number of protons, neutrons and electrons in this atom of iron. [3 marks]

Number of protons _____

Number of neutrons _____

Number of electrons _____

0 9 . 3 **Iron is a transition metal.**

Sodium is a Group 1 metal.

Give TWO differences between the properties of iron and sodium. [2 marks]

1

2

Nickel is extracted from nickel oxide by reduction with carbon.

0 9 . 4 Explain why carbon can be used to extract nickel from nickel oxide. [2 marks]

0 9 . 5 **An equation for the reaction is:**

$$NiO + C \rightarrow Ni + CO$$

Calculate the percentage atom economy for the reaction to produce nickel.

Relative atomic masses (A_r):
C = 12 Ni = 59

Relative formula mass (M_r):
NiO = 75

Give your answer to 3 significant figures. [3 marks]

Percentage atom economy =

_____ %

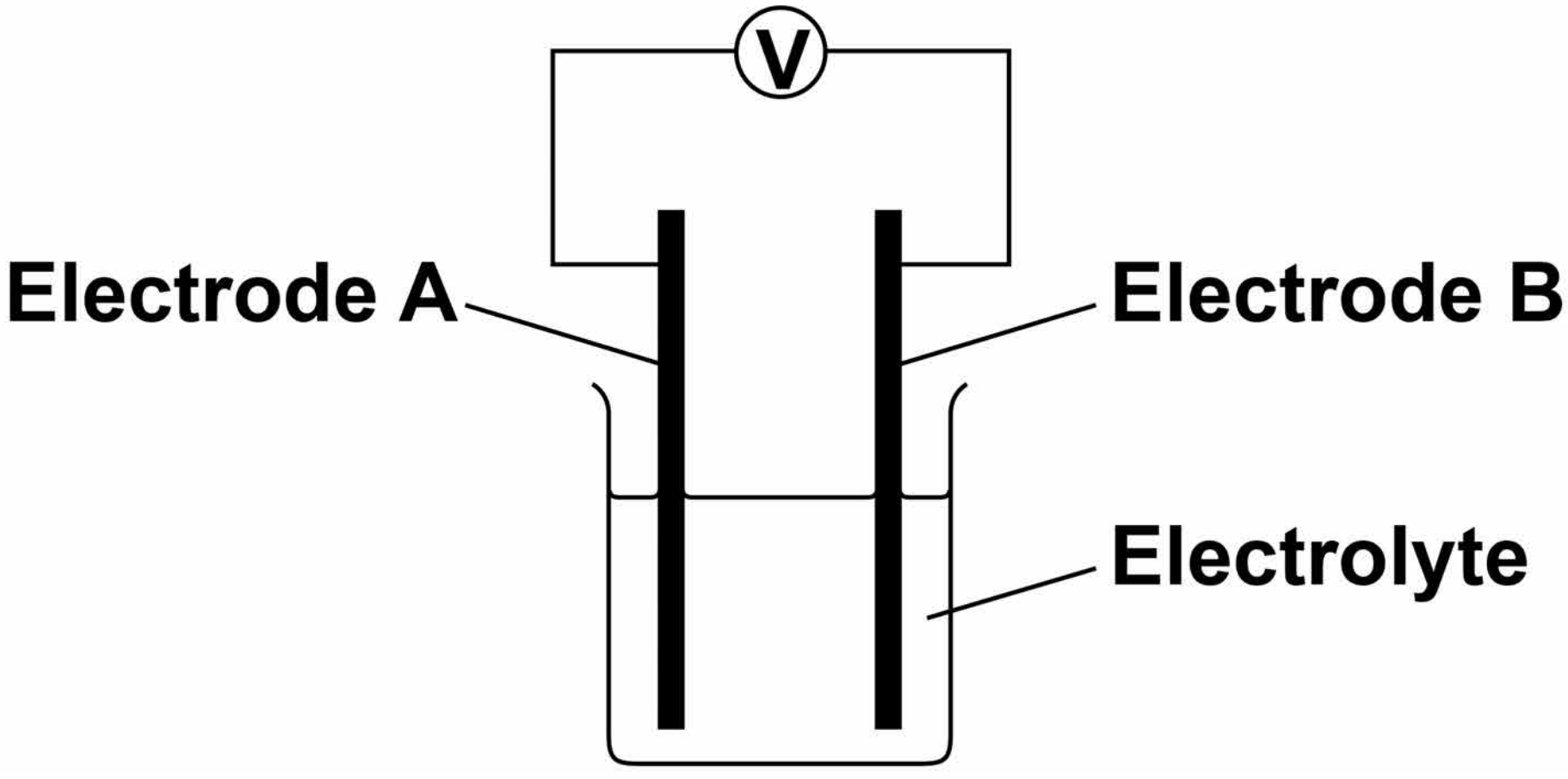
[Turn over]

11

1 0 **Chemical reactions can produce electricity.**

1 0 . 1 **FIGURE 13 shows a simple cell.**

FIGURE 13



Which of these combinations would NOT give a zero reading on the voltmeter in FIGURE 13? [1 mark]

Tick ONE box.

	Electrode A	Electrode B	Electrolyte
☐	Copper	Copper	Sodium chloride solution
☐	Zinc	Zinc	Water
☐	Copper	Zinc	Sodium chloride solution
☐	Copper	Zinc	Water

Alkaline batteries are non-rechargeable.

10.2 Why do alkaline batteries eventually stop working? [1 mark]

10.3 Why can alkaline batteries NOT be recharged? [1 mark]

Hydrogen fuel cells and rechargeable lithium-ion batteries can be used to power electric cars.

10.4 Complete the balanced equation for the overall reaction in a hydrogen fuel cell. [2 marks]

_____ H_2 + _____ → _____ H_2O

1 0 . 5 **TABLE 7 shows data about different ways to power electric cars.**

TABLE 7

	Hydrogen fuel cell	Rechargeable lithium-ion battery
Time taken to refuel or recharge in minutes	5	30
Distance travelled before refuelling or recharging in miles	Up to 415	Up to 240
Distance travelled per unit of energy in km	22	66

Cost of refuelling or recharging in £	**50**	**3**
Minimum cost of car in £	**60 000**	**18 000**

Evaluate the use of hydrogen fuel cells compared with rechargeable lithium-ion batteries to power electric cars.

Use TABLE 7 and your own knowledge. [6 marks]

END OF QUESTIONS

11

There are no questions printed on this page.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	