



**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**



4

0	1
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**This question is about mixtures.**

0	1	.	1
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**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]**



5

**Substance and mixture**

**Ethanol from ethanol and water**

**Salt from sea water**

**The different colours in black ink**

**Method of separation**

**Chromatography**

**Crystallisation**

**Electrolysis**

**Filtration**

**Fractional distillation**

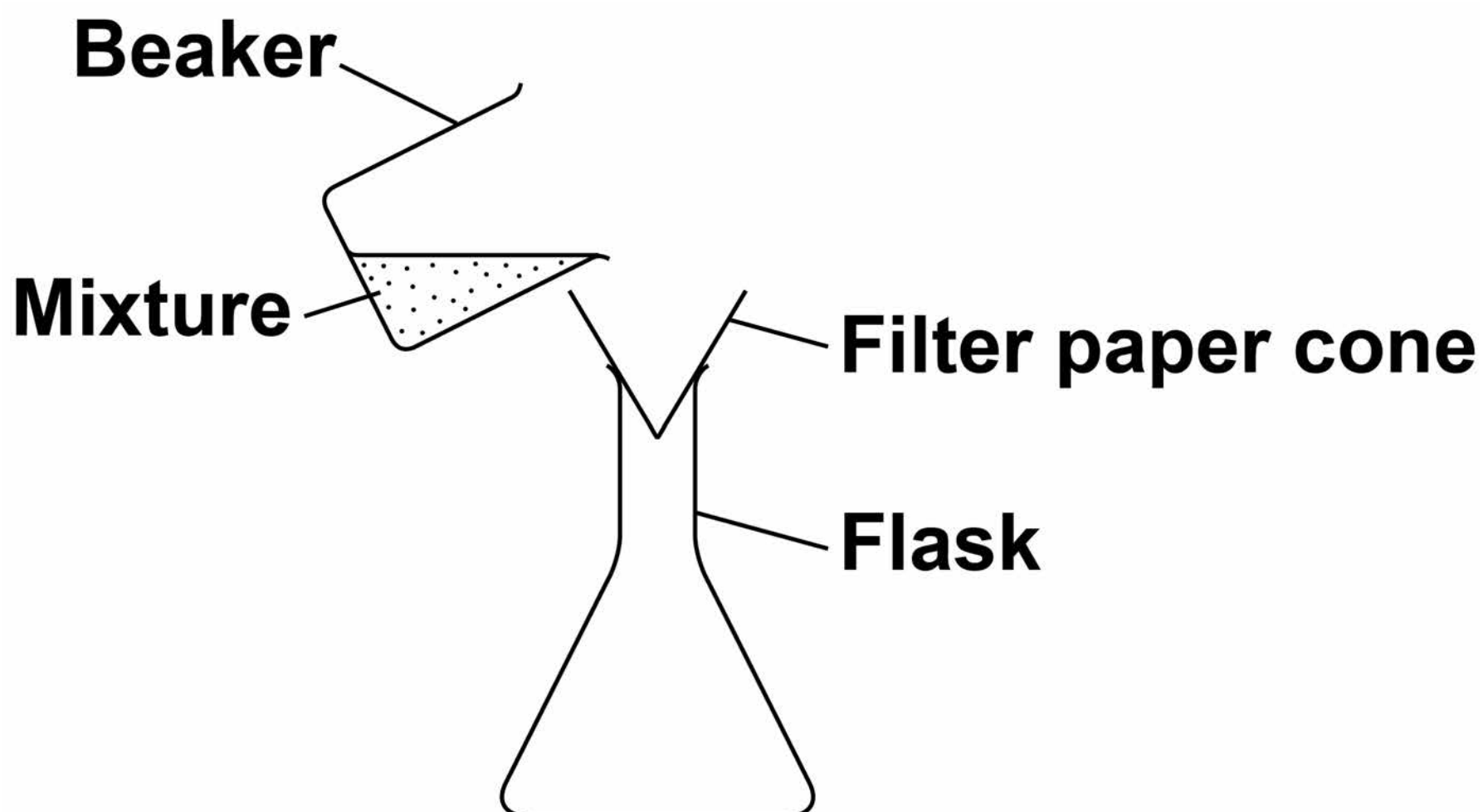
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**0 1 . 2** A student filters a mixture.

**FIGURE 1** shows the apparatus.

**FIGURE 1**



**Suggest ONE improvement to the apparatus. [1 mark]**

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**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** \_\_\_\_\_ .

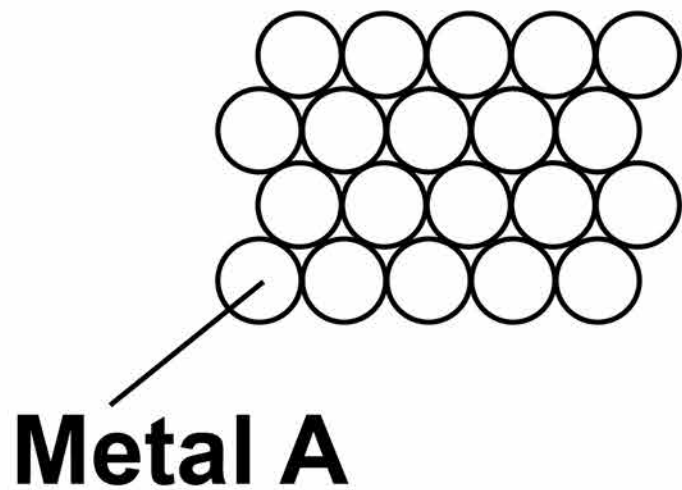
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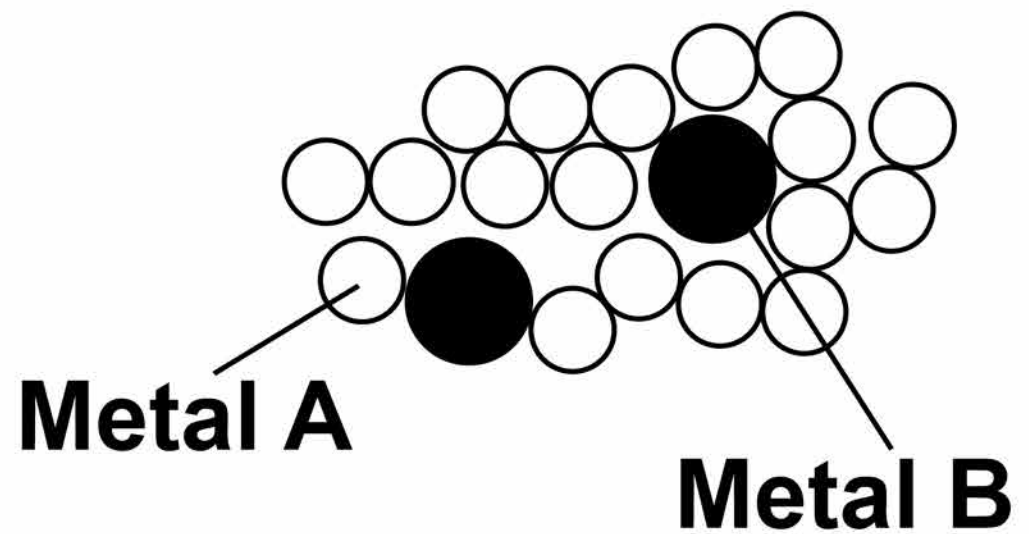
**FIGURE 2** shows the arrangement of atoms in a pure metal and in a mixture of metals.

**FIGURE 2**

**Pure metal**



**Mixture of metals**





9

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

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**Percentage of metal B atoms =**  
\_\_\_\_\_ %

**[Turn over]**



10

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

**Tick ONE box.**

**An alloy**

**A compound**

**A molecule**

**A polymer**



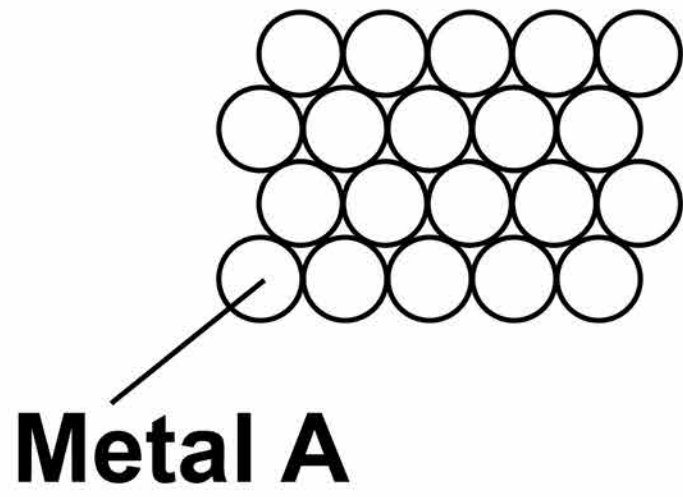
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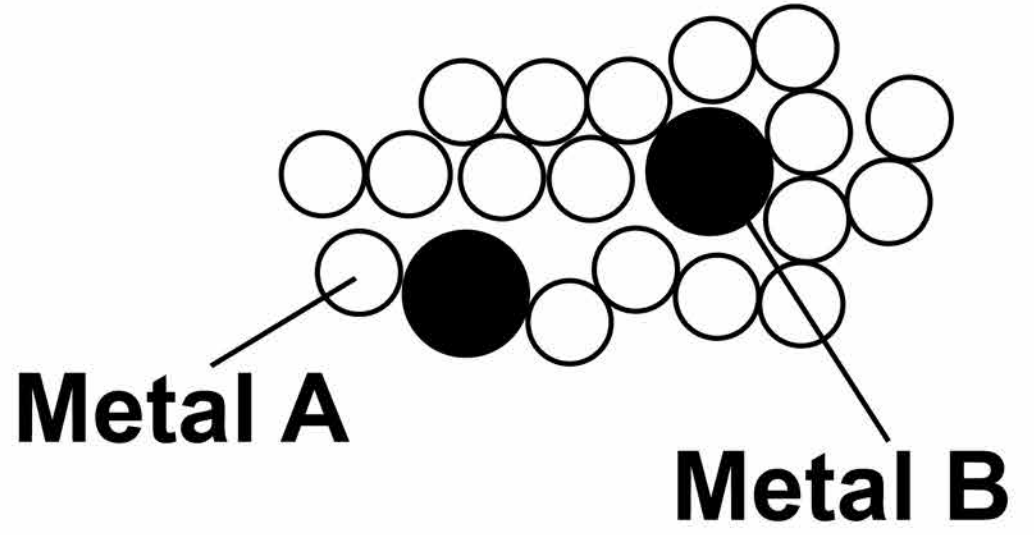


# Repeat of FIGURE 2

### Pure metal



### Mixture of metals



13

**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]**

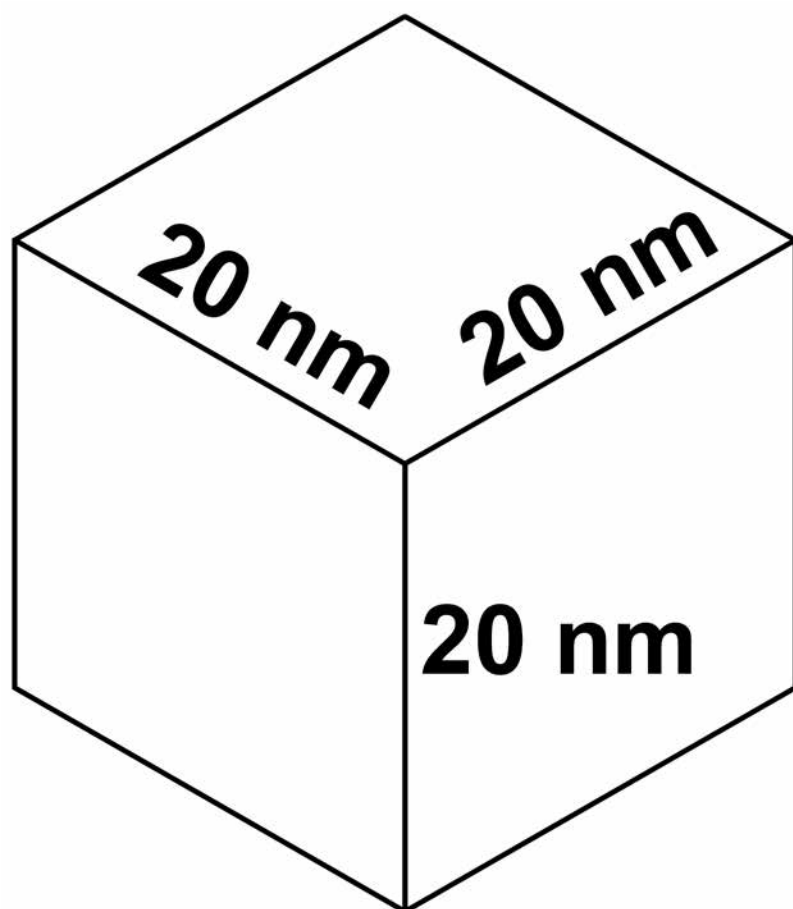


**01.7** A nanoparticle of pure metal A is a cube.

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

**FIGURE 3** shows the cube.

**FIGURE 3**



15

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

**Tick ONE box.**

**20 nm<sup>3</sup>**

**60 nm<sup>3</sup>**

**400 nm<sup>3</sup>**

**8000 nm<sup>3</sup>**

<b>11</b>

**[Turn over]**



16

**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]**

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17

**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]**



18

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

**Tick ONE box.**

**F****F<sub>2</sub>****F<sup>2</sup>****2F**

**BLANK PAGE**

**[Turn over]**



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

**TABLE 1 shows the student's observations.**

**TABLE 1**

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

**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]**

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**21**

**[Turn over]**



22

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,  $\text{TiO}_2$  ?

Relative atomic masses ( $A_r$ ):

O = 16      Ti = 48 [1 mark]

Tick ONE box.

64

80

128

768



23

**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]

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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**





**25**

**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**

	<b>Mass number</b>	<b>Percentage (%) abundance</b>
<b>Isotope 1</b>	<b>63</b>	<b>70</b>
<b>Isotope 2</b>	<b>65</b>	<b>30</b>



**03.2** Calculate the relative atomic mass ( $A_r$ ) of element X using the equation:

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

Use TABLE 2 on page 26.

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

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$A_r =$  \_\_\_\_\_

[Turn over]



28

**03.3** Suggest the identity of element X.

**Use the periodic table. [1 mark]**

**Element X is** \_\_\_\_\_



29

**03.4** The radius of an atom of element X is  $1.2 \times 10^{-10}$  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]

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Radius = \_\_\_\_\_ m

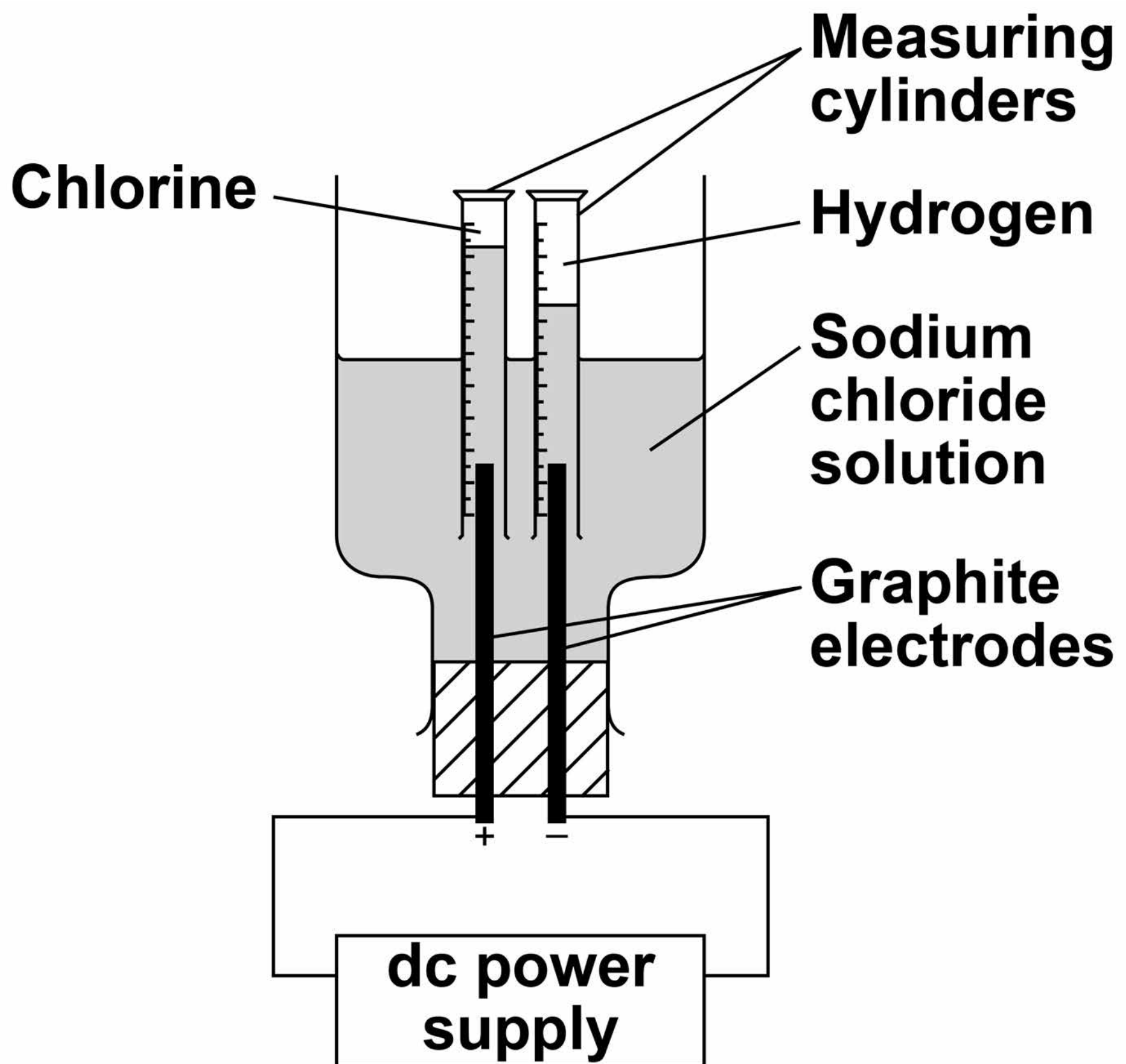
[Turn over]



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

**FIGURE 4** shows the apparatus.

**FIGURE 4**



**31**

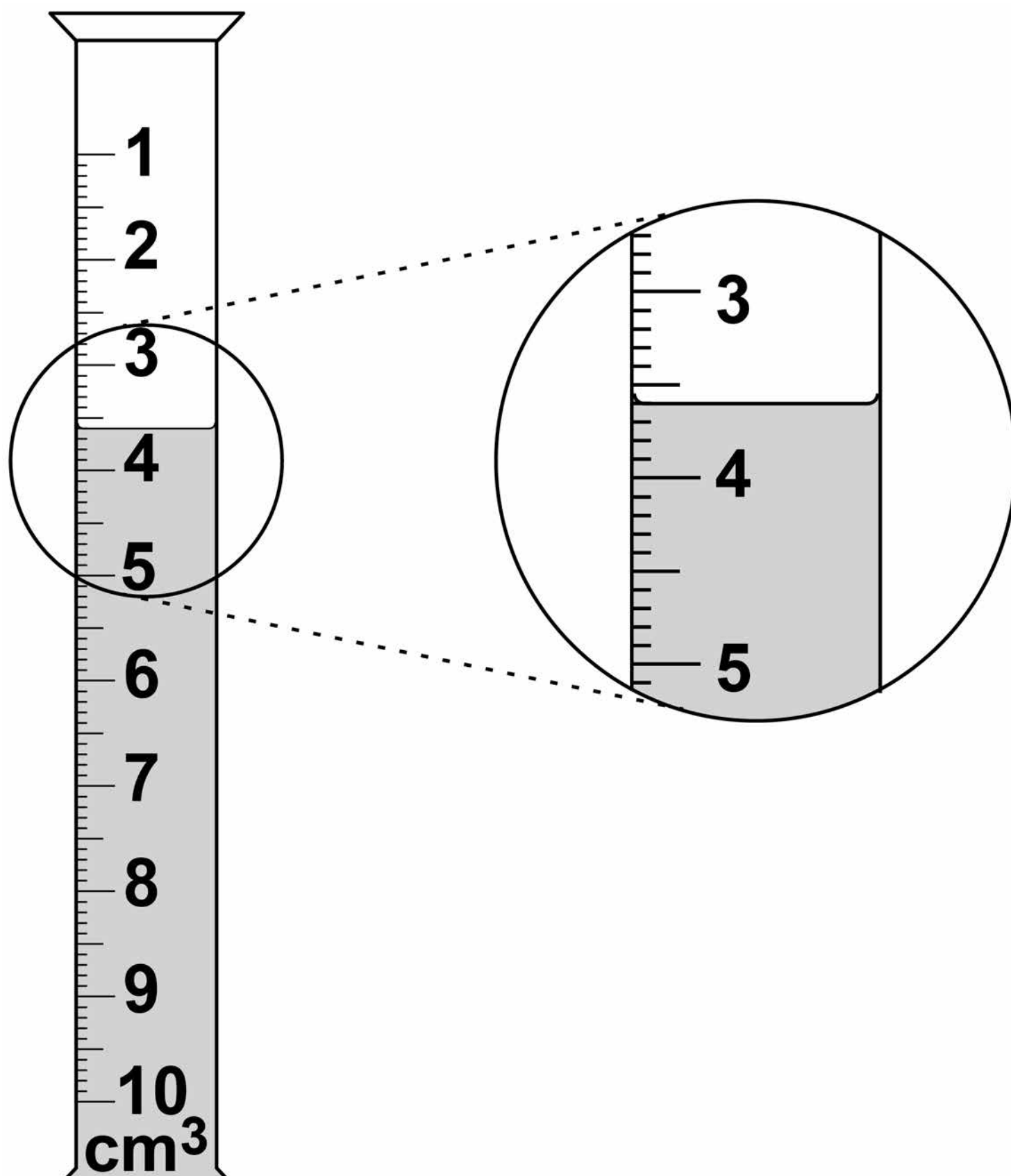
**The student measured the volume of gas collected in each measuring cylinder every minute for 20 minutes.**

**[Turn over]**



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

**FIGURE 5**





33

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

**Volume = \_\_\_\_\_ cm<sup>3</sup>**

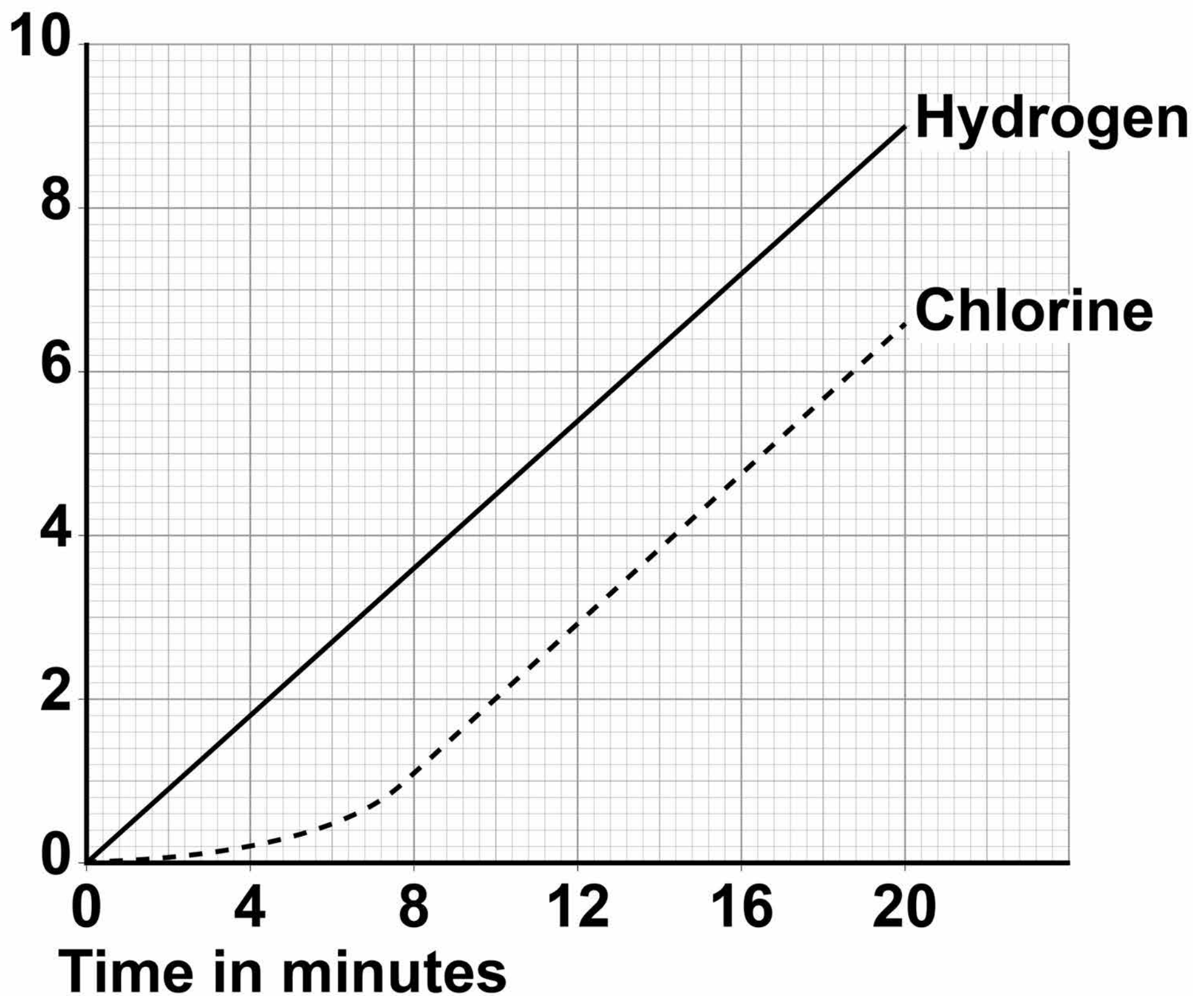
**[Turn over]**



**FIGURE 6** shows the results of the investigation.

**FIGURE 6**

**Volume  
of gas  
collected  
in  $\text{cm}^3$**



35

**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**

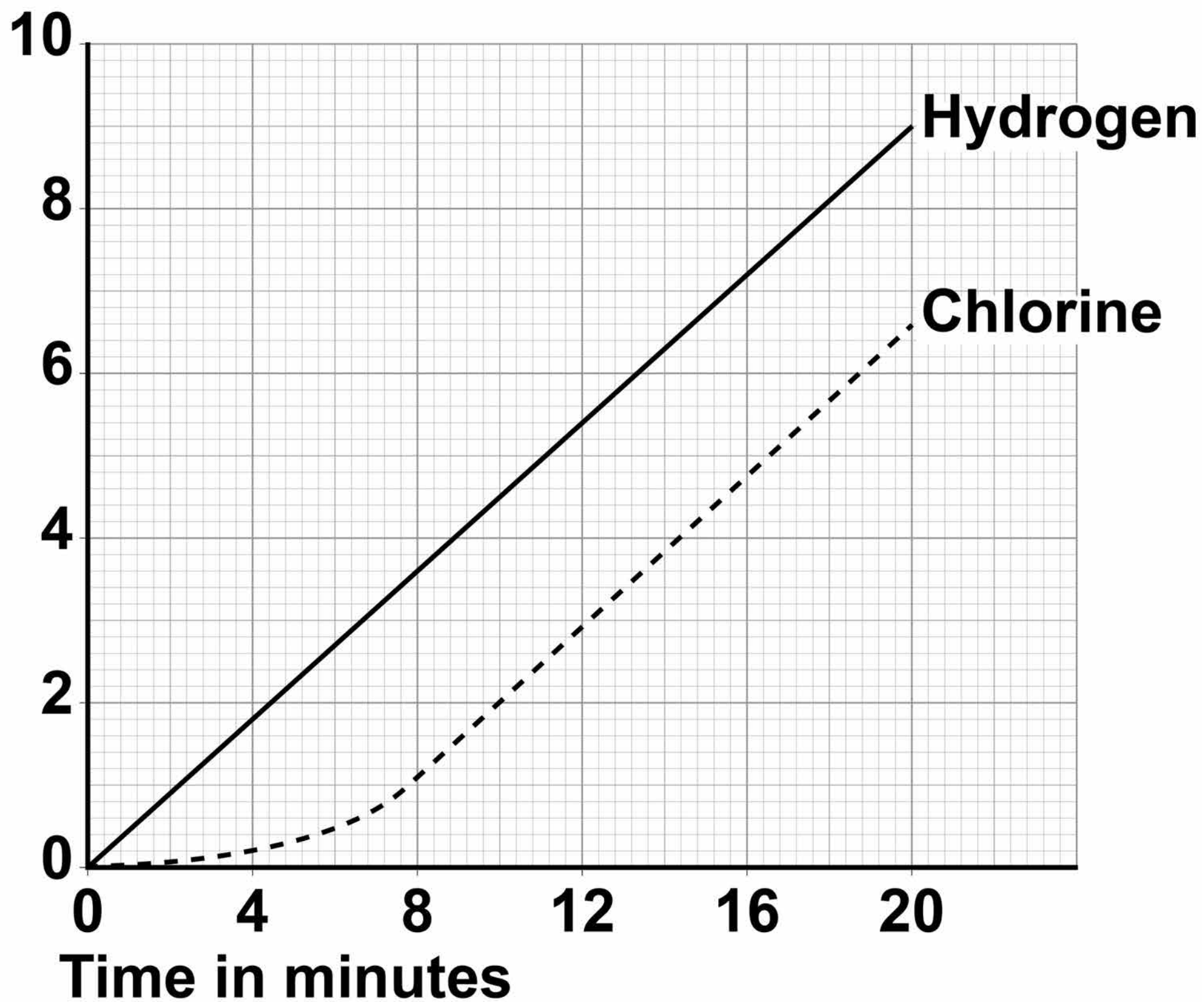
**[Turn over]**



36

## Repeat of FIGURE 6

Volume  
of gas  
collected  
in  $\text{cm}^3$



37

**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]**

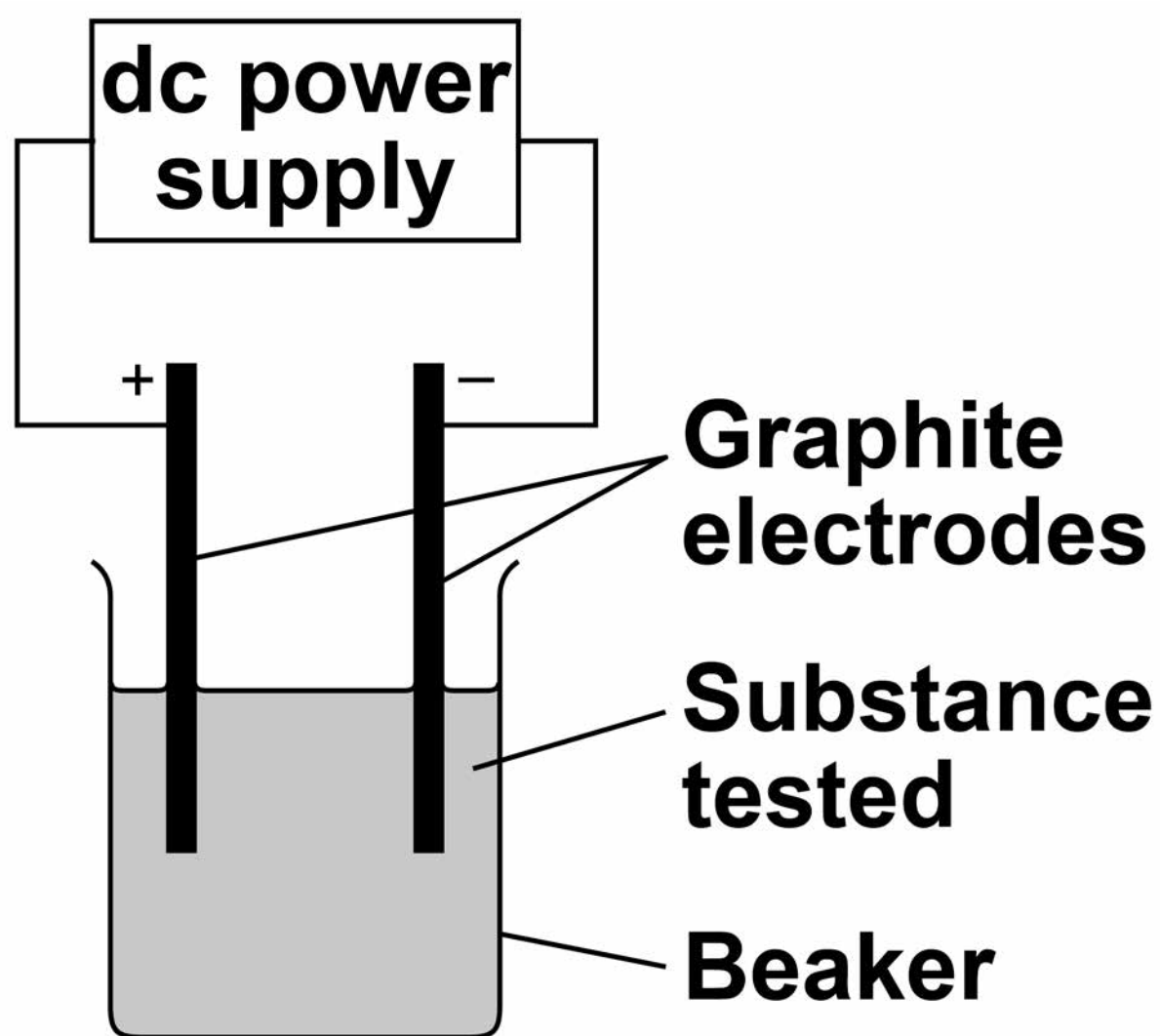


38

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

FIGURE 7 shows the apparatus used.

FIGURE 7



39

**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]**



40

**04.5** 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

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

**[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**

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

**The equation for the reaction is:**



**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]

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

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$X =$  \_\_\_\_\_  $g$

**[Turn over]**



**05.4** 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]

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[Turn over]



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

**The word equation for the reaction is:**

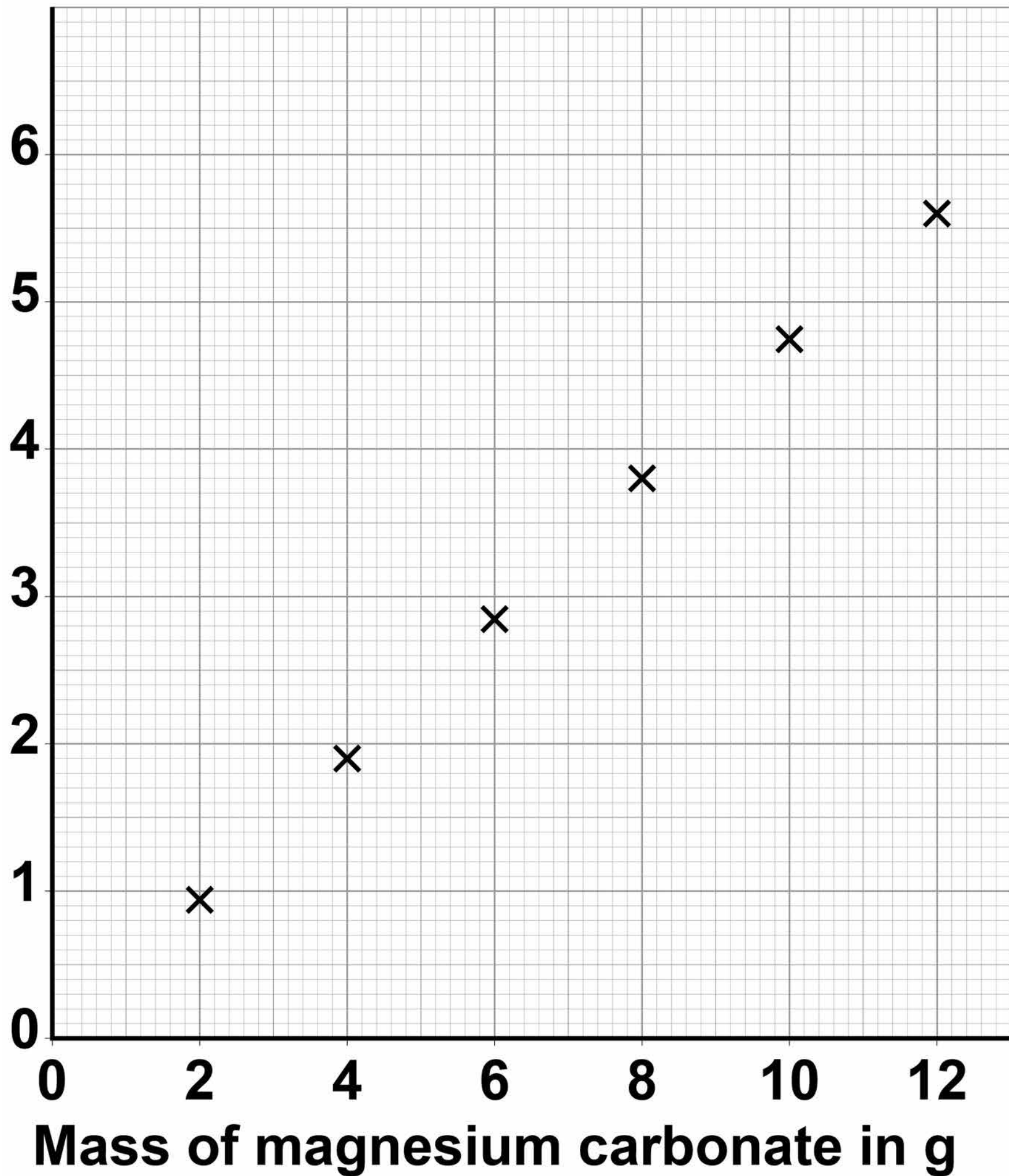
**magnesium carbonate →  
magnesium oxide + carbon dioxide**

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



**FIGURE 8**

**Mass of  
magnesium  
oxide in g**



**Mass of magnesium carbonate in g**

**[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**



53

**05.8** Calculate the mass of magnesium oxide produced when 168 g of magnesium carbonate is heated.

Use your answer to Question 05.7 [2 marks]

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Mass of magnesium oxide produced =

\_\_\_\_\_ g

[Turn over]

10



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

- 1. Measure 50 cm<sup>3</sup> 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.**



55

**06.1** 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**

**Dependent variable**

**Concentration of solution**

**Particle size of solid**

**Independent variable**

**Temperature change**

**Type of metal**

**Volume of solution**

**[Turn over]**



56

**06.2** 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]**



58

**TABLE 5 shows the student's results.**

**TABLE 5**

<b>Metal</b>	<b>Temperature increase in °C</b>
<b>Magnesium</b>	<b>38</b>
<b>Nickel</b>	<b>8</b>
<b>Zinc</b>	<b>16</b>

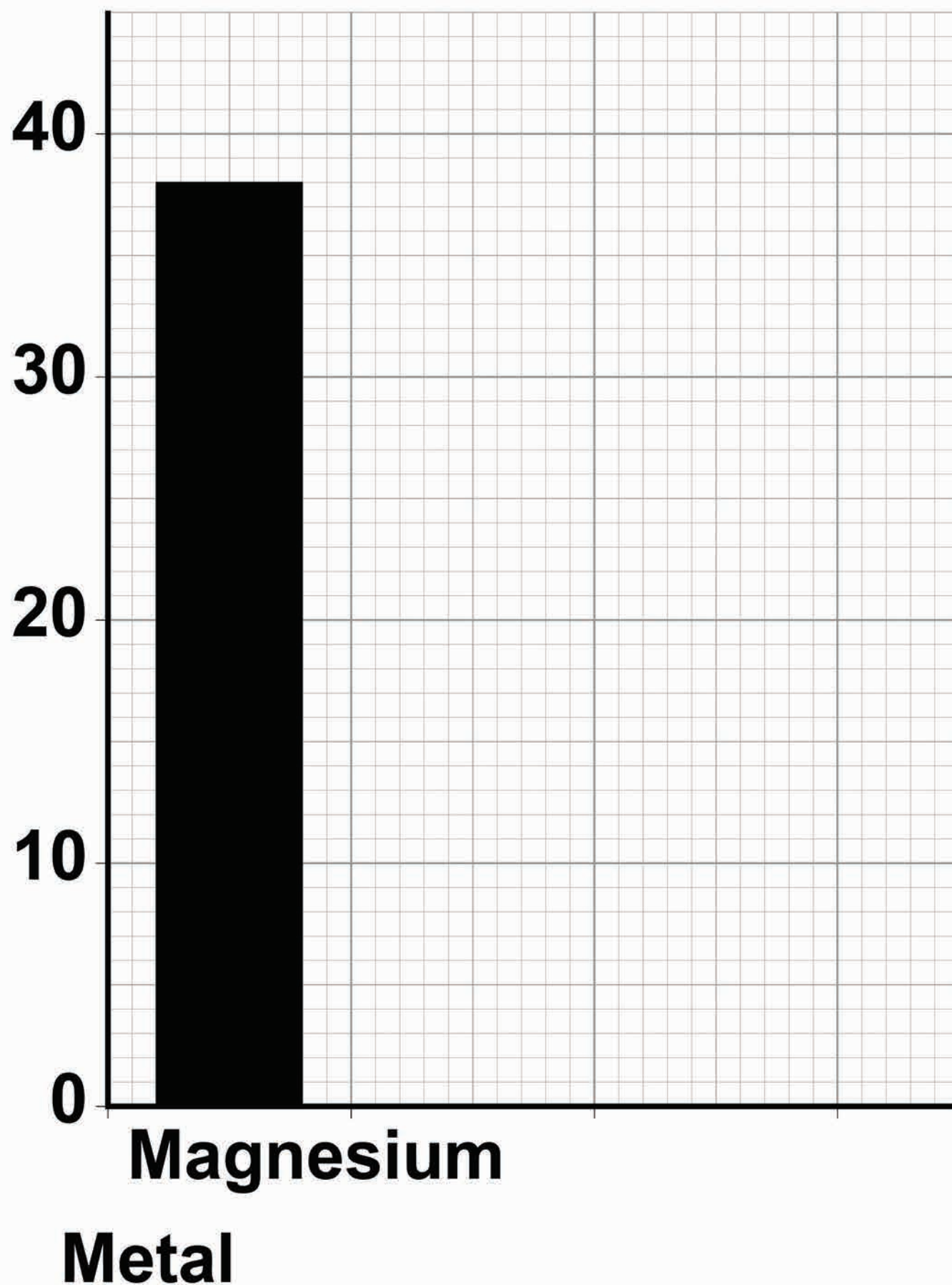
**0 6 . 3** Complete FIGURE 9, on the opposite page.

**Use data from TABLE 5 above.  
[2 marks]**



# FIGURE 9

Temperature  
increase  
in °C



[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]**

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**Repeat of TABLE 5**

<b>Metal</b>	<b>Temperature increase in °C</b>
<b>Magnesium</b>	<b>38</b>
<b>Nickel</b>	<b>8</b>
<b>Zinc</b>	<b>16</b>

61

**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]**



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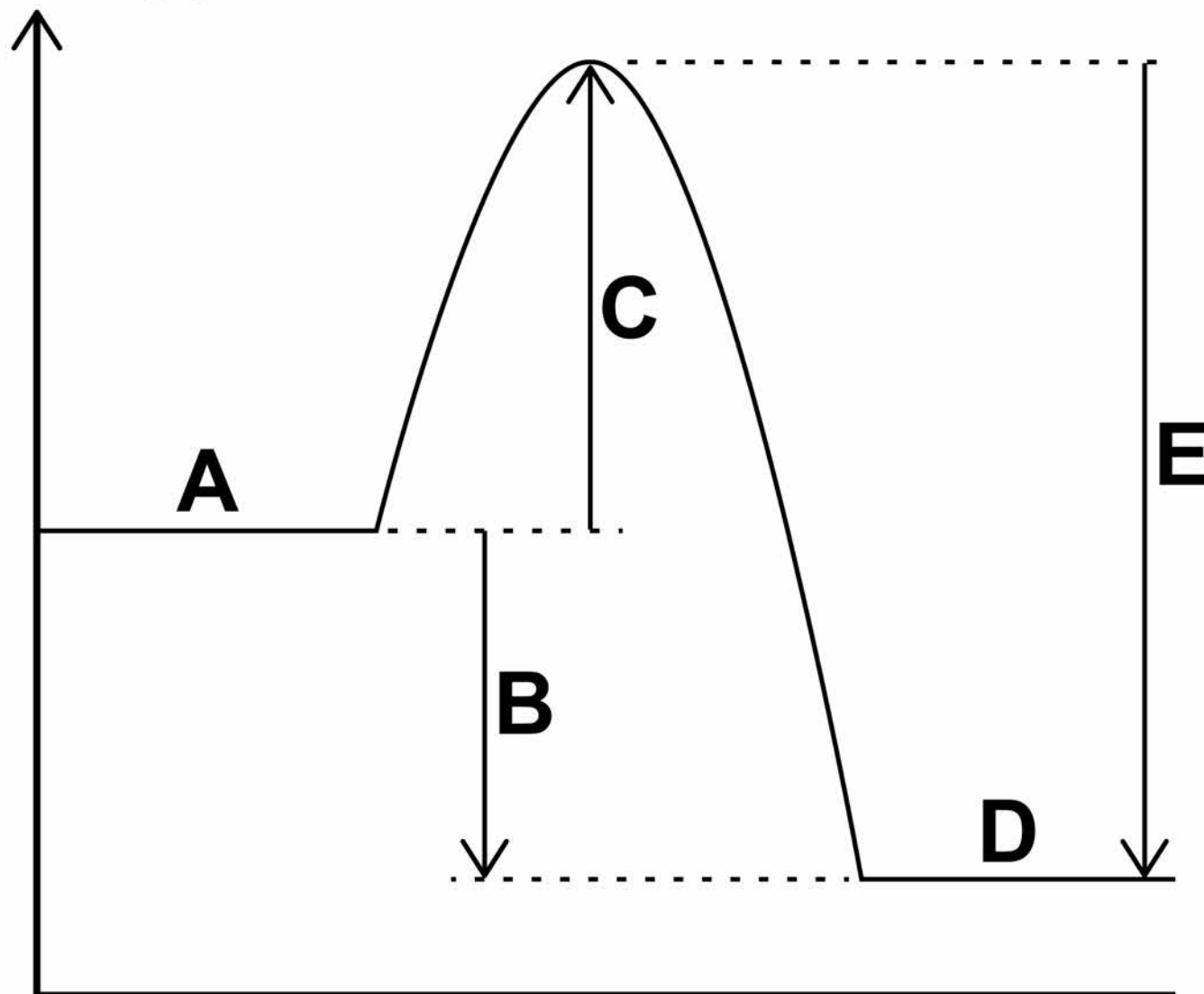




**FIGURE 10** shows the reaction profile for the reaction between zinc and copper sulfate solution.

**FIGURE 10**

**Energy**



**Progress of reaction**



65

06.7

Which letter represents the products of the reaction?  
[1 mark]

Tick ONE box.

A

B

C

D

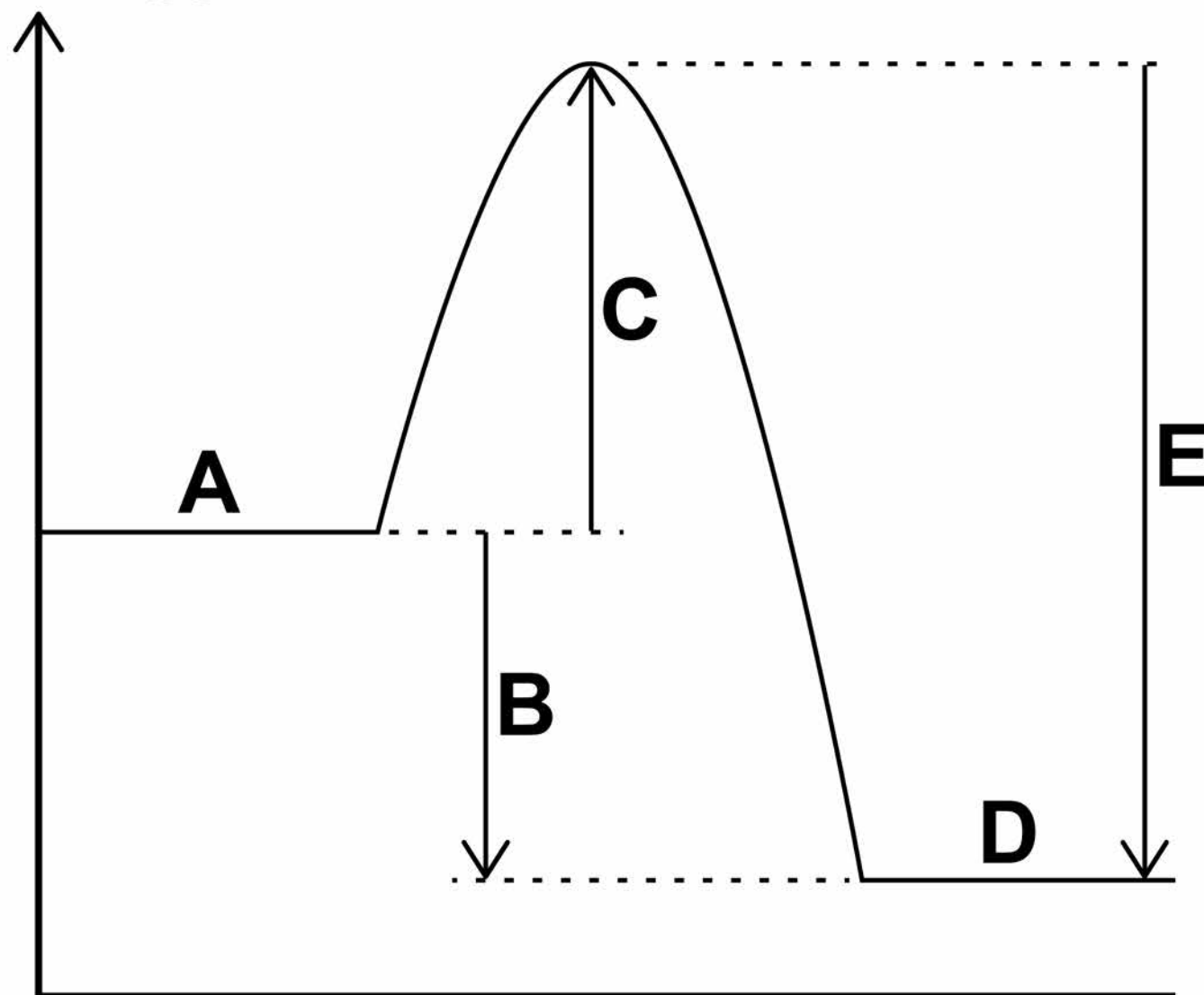
E

[Turn over]



# Repeat of FIGURE 10

Energy



Progress of reaction



67

06.8

Which letter represents the activation energy? [1 mark]

Tick ONE box.

A

B

C

D

E

[Turn over]

12



68

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

**A teacher burns sodium in oxygen.**

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

**sodium + oxygen →**

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69

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

**Tick ONE box.**

**Decomposition**

**Electrolysis**

**Oxidation**

**Precipitation**

**[Turn over]**



70

**07.3**

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



71

**07.4** The solution contains a substance with the formula NaOH

**Give the name of the substance.  
[1 mark]**

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**[Turn over]**

**07.5** All alkalis contain the same ion.

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

**Tick ONE box.**

**H<sup>+</sup>**

**Na<sup>+</sup>**

**OH<sup>-</sup>**

**O<sup>2-</sup>**





73

**07.6** A solution of NaOH had a concentration of  $40 \text{ g/dm}^3$

**What mass of NaOH would there be in  $250 \text{ cm}^3$  of the solution?  
[2 marks]**

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**Mass = \_\_\_\_\_ g**

**[Turn over]**



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

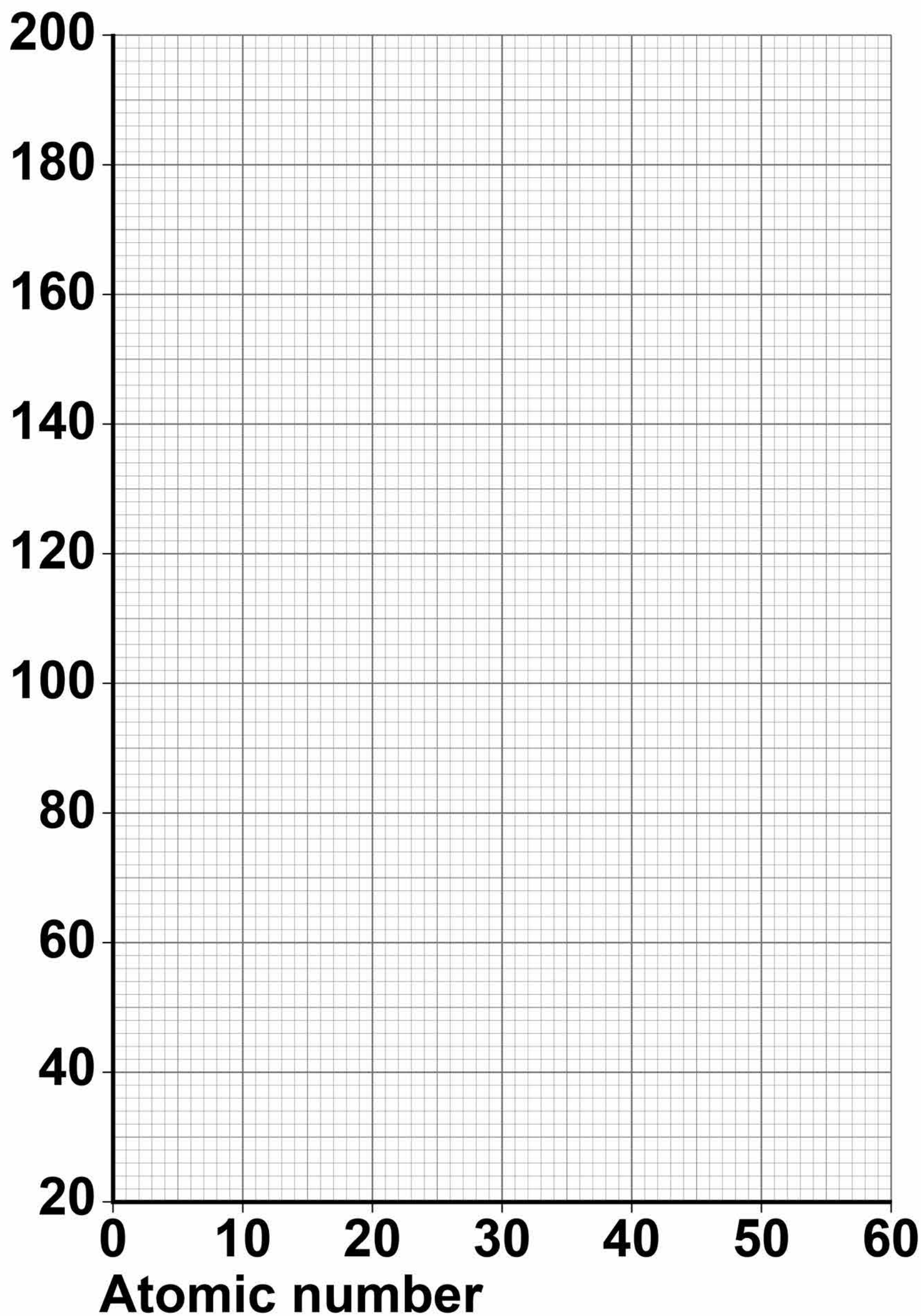
**TABLE 6** shows the atomic numbers and melting points of the Group 1 elements.

**TABLE 6**

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

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

**FIGURE 11**  
**Melting point**  
**in °C**



**[Turn over]**



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**07.8** Predict the melting point,  $X$ , of rubidium, atomic number 37

**Use FIGURE 11 on page 75.  
[1 mark]**

**Melting point = \_\_\_\_\_ °C**

**[Turn over]**

<b>10</b>



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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]

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- 0 8 . 2** Calcium nitrate contains the ions  $\text{Ca}^{2+}$  and  $\text{NO}_3^-$

Give the formula of calcium nitrate. [1 mark]

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**[Turn over]**









**09**

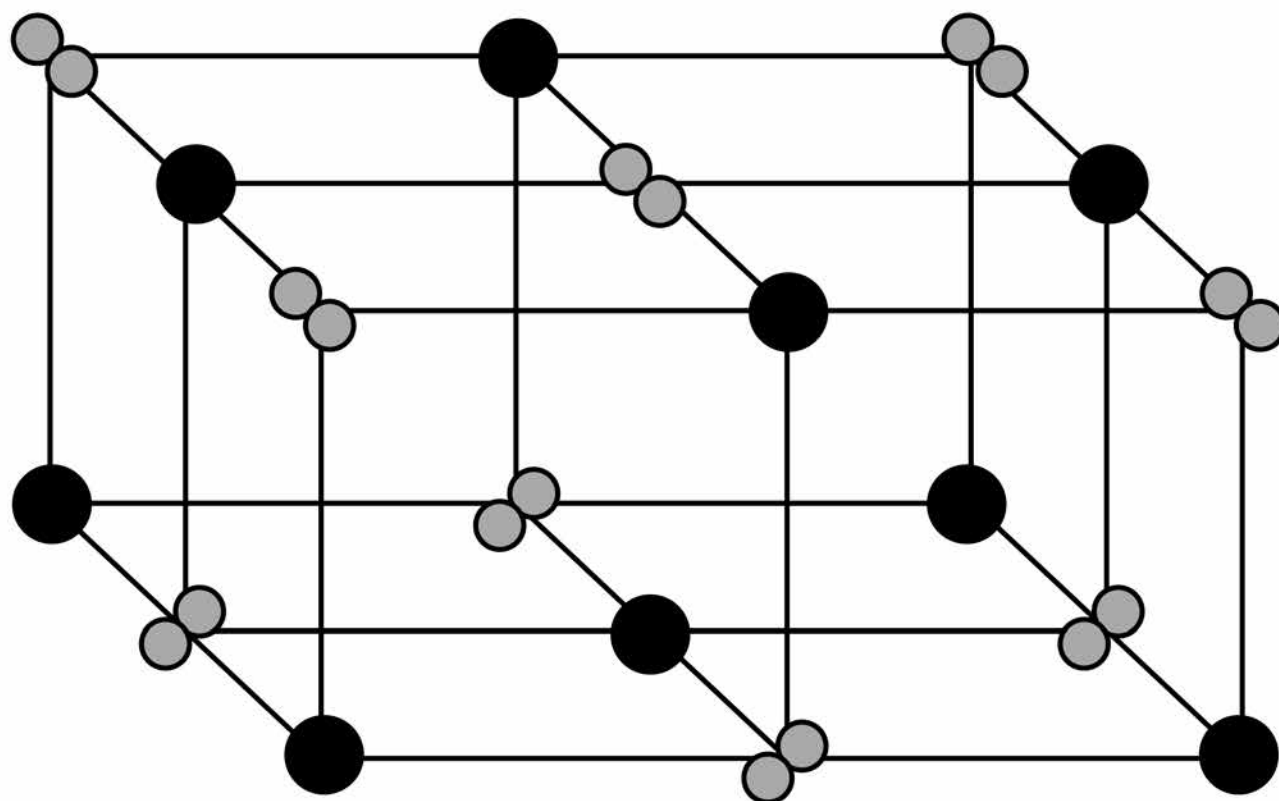
This question is about metals and metal compounds.

**09.1**

Iron pyrites is an ionic compound.

**FIGURE 12** shows a structure for iron pyrites.

**FIGURE 12**



**KEY**

● Fe

○ S



83

Determine the formula of iron pyrites.

Use FIGURE 12. [1 mark]

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**09.2** An atom of iron is represented as  ${}_{26}^{56}\text{Fe}$

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

Number of protons \_\_\_\_\_

Number of neutrons \_\_\_\_\_

Number of electrons \_\_\_\_\_

[Turn over]



**09.3** Iron is a transition metal.

**Sodium is a Group 1 metal.**

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

**1**

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**2**

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**Nickel is extracted from nickel oxide by reduction with carbon.**

**09.4 Explain why carbon can be used to extract nickel from nickel oxide. [2 marks]**

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**[Turn over]**

86

**09.5** An equation for the reaction is:



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

**Relative atomic masses ( $A_r$ ):**

$$\text{C} = 12 \quad \text{Ni} = 59$$

**Relative formula mass ( $M_r$ ):**

$$\text{NiO} = 75$$

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

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87

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**Percentage atom economy =**  
\_\_\_\_\_ %

**[Turn over]**

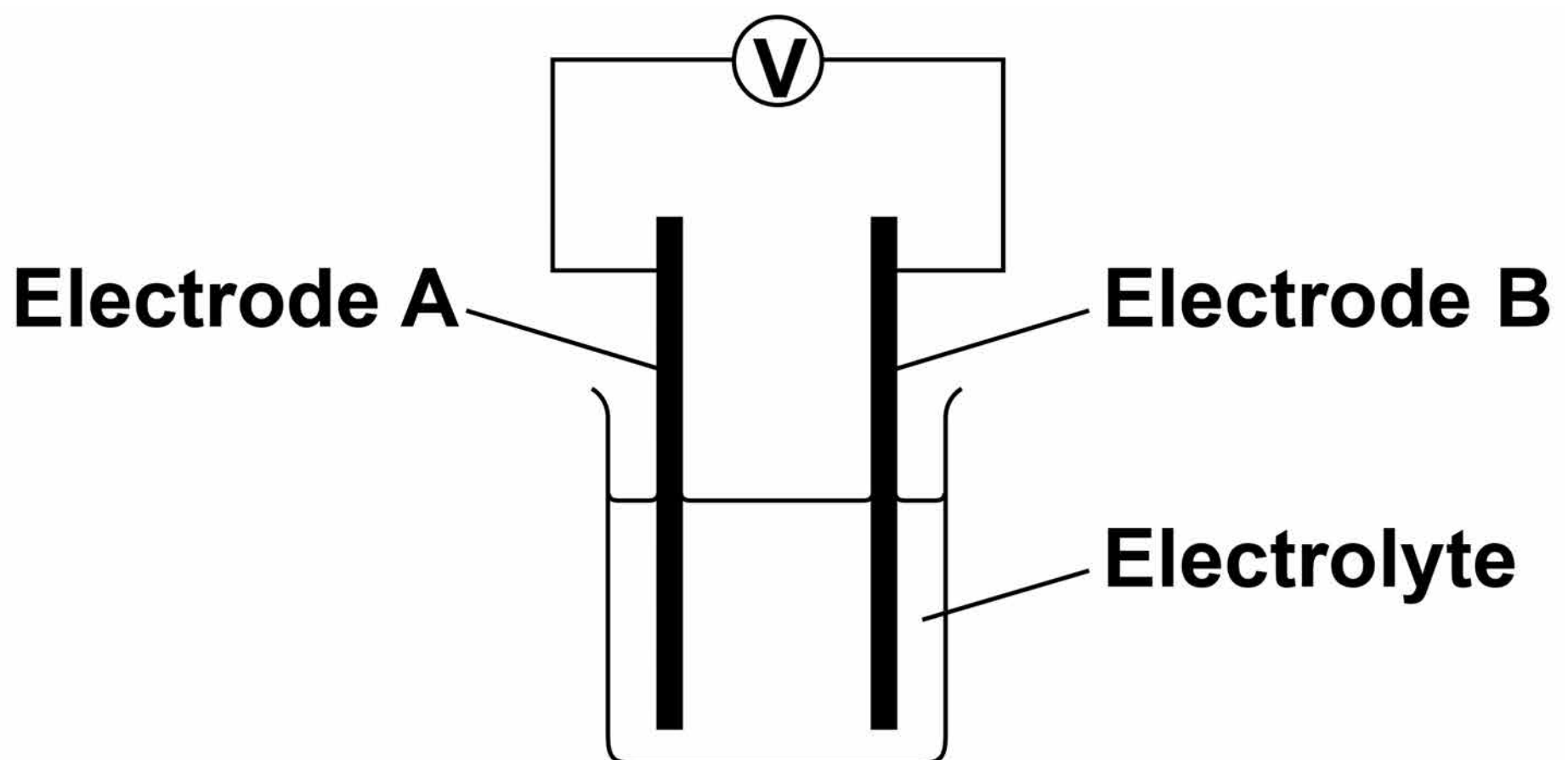
11



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

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

**FIGURE 13**





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

Tick ONE box.

	<b>Electrode A</b>	<b>Electrode B</b>	<b>Electrolyte</b>
<input type="checkbox"/>	<b>Copper</b>	<b>Copper</b>	<b>Sodium chloride solution</b>
<input type="checkbox"/>	<b>Zinc</b>	<b>Zinc</b>	<b>Water</b>
<input type="checkbox"/>	<b>Copper</b>	<b>Zinc</b>	<b>Sodium chloride solution</b>
<input type="checkbox"/>	<b>Copper</b>	<b>Zinc</b>	<b>Water</b>

[Turn over]



**Alkaline batteries are non-rechargeable.**

**1 0 . 2 Why do alkaline batteries eventually stop working? [1 mark]**

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**1 0 . 3 Why can alkaline batteries NOT be recharged? [1 mark]**

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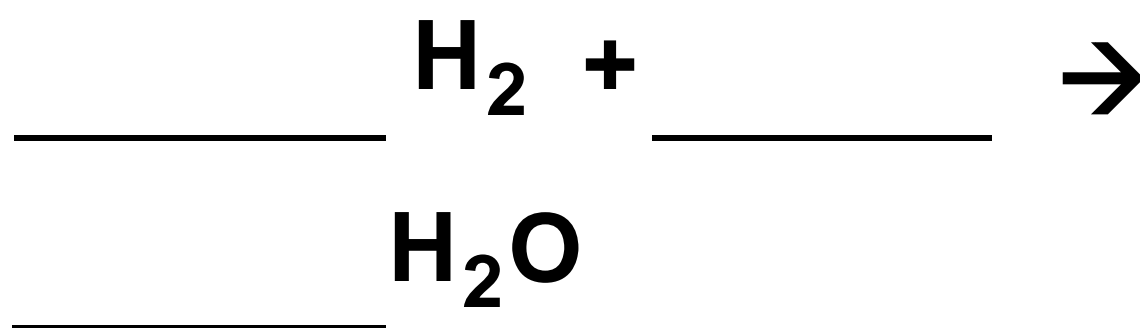
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Hydrogen fuel cells and rechargeable lithium-ion batteries can be used to power electric cars.

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



**[Turn over]**



**10.5** TABLE 7 shows data about different ways to power electric cars.

**TABLE 7**

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



<b>Cost of refuelling or recharging in £</b>	<b>50</b>	<b>3</b>
<b>Minimum cost of car in £</b>	<b>60 000</b>	<b>18 000</b>

**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]**

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**[Turn over]**





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**END OF QUESTIONS**

<b>11</b>

**There are no questions printed on this page.**

For Examiner's Use	
Question	Mark
1	
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<b>TOTAL</b>	

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