AQA

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

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

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

[Turn over]

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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.**

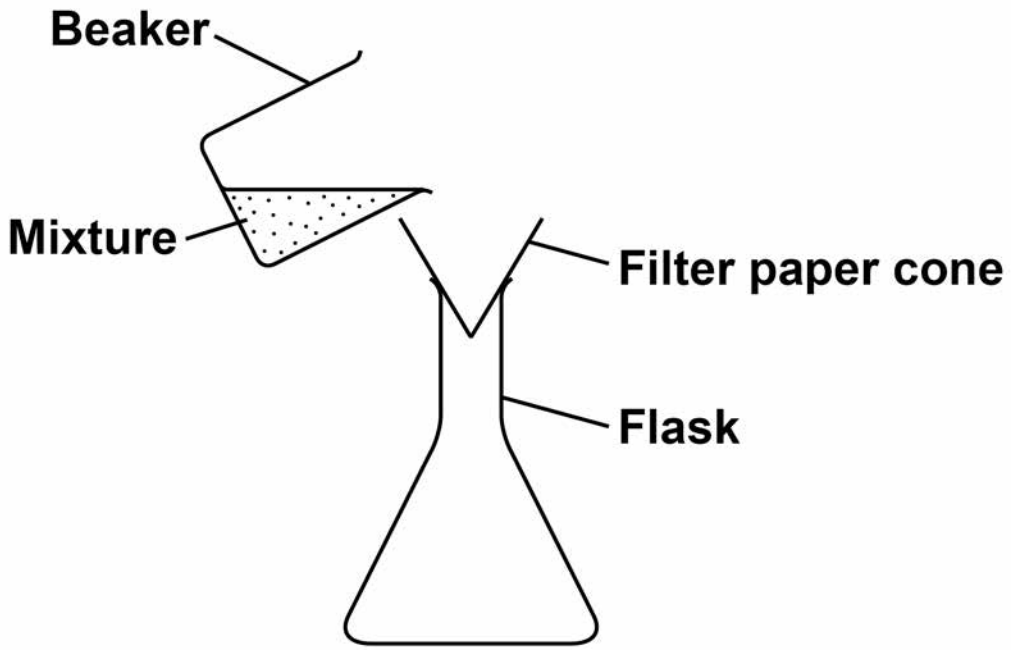
Draw ONE line from each substance and mixture to the best method of separation.
[3 marks]

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

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

FIGURE 1 shows the apparatus.

FIGURE 1



Suggest ONE improvement to the apparatus.
[1 mark]

_____

_____

_____

[Turn over]

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

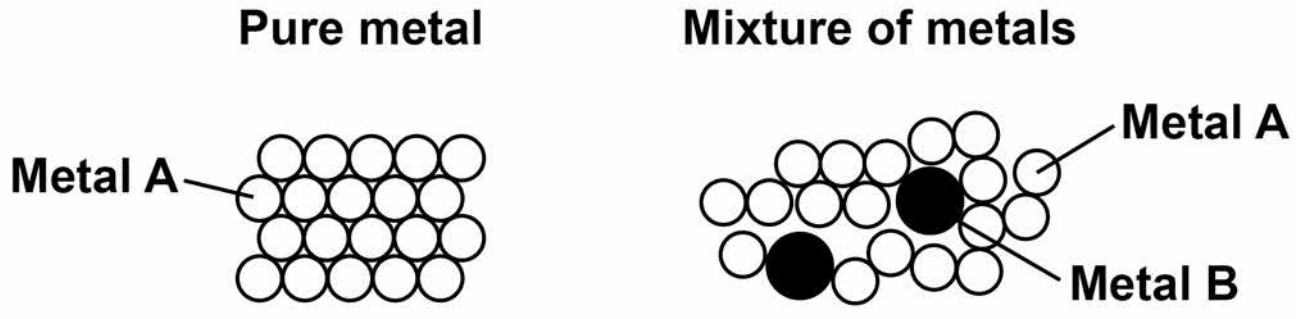
make the liquid _____ .

The vapour is then cooled to make it

_____ .

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 = _____ %

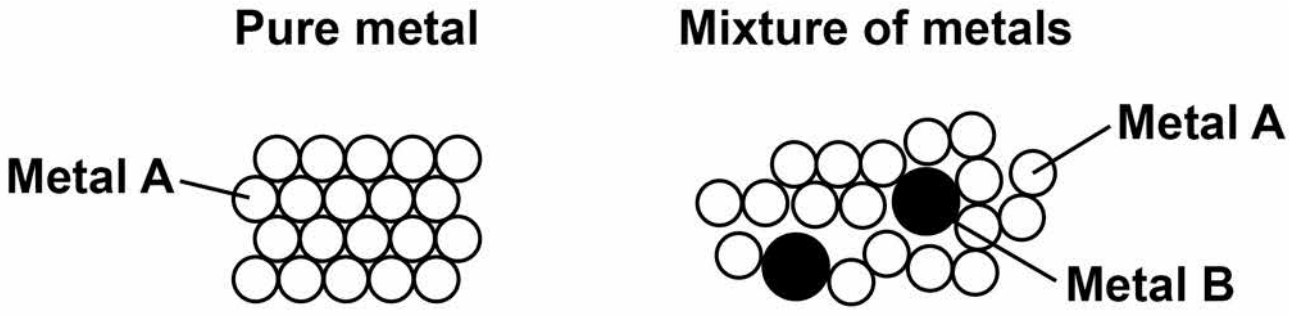
[Turn over]

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

Tick ONE box.

- ☐ **An alloy**
- ☐ **A compound**
- ☐ **A molecule**
- ☐ **A polymer**

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.**

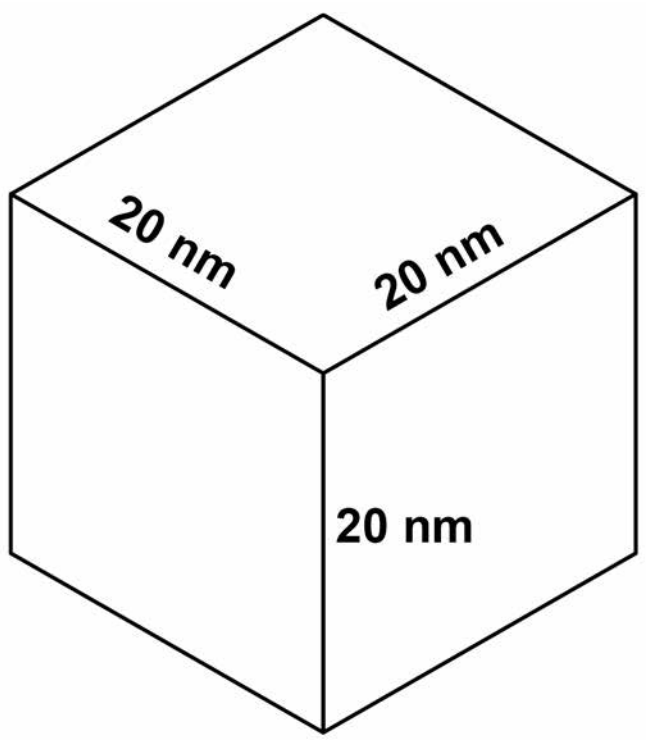
[Turn over]

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**

11

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**

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

Tick ONE box.

- ☐ **F**
- ☐ **F_2**
- ☐ **F^2**
- ☐ **2F**

[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 14.
[3 marks]

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 = _____ %

9

[Turn over]

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

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

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

Use TABLE 2 on page 20.

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

A_r = _____

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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]

_____

_____

_____

_____

_____

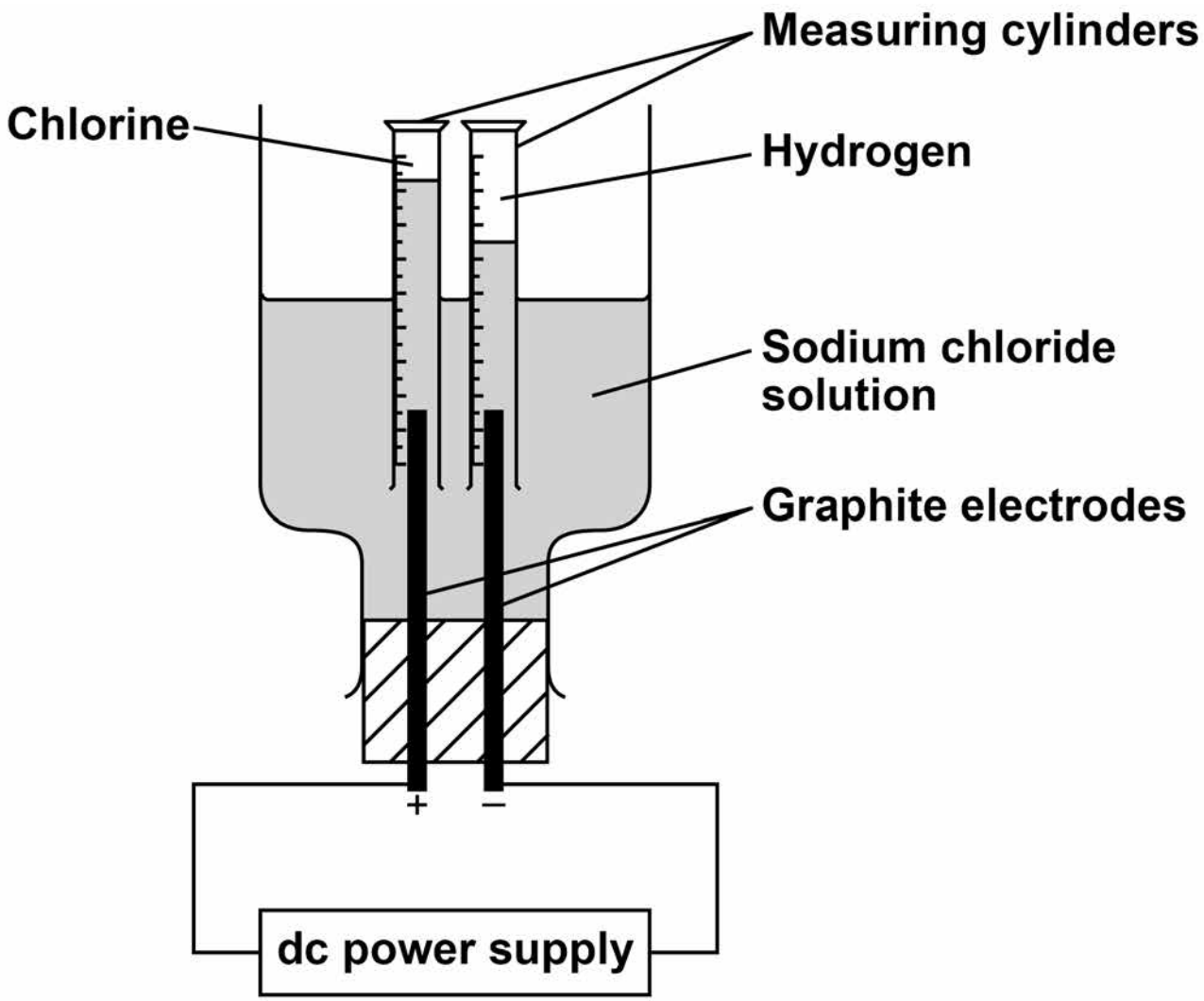
_____

Radius = _____ **m** **10**

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

FIGURE 4 shows the apparatus.

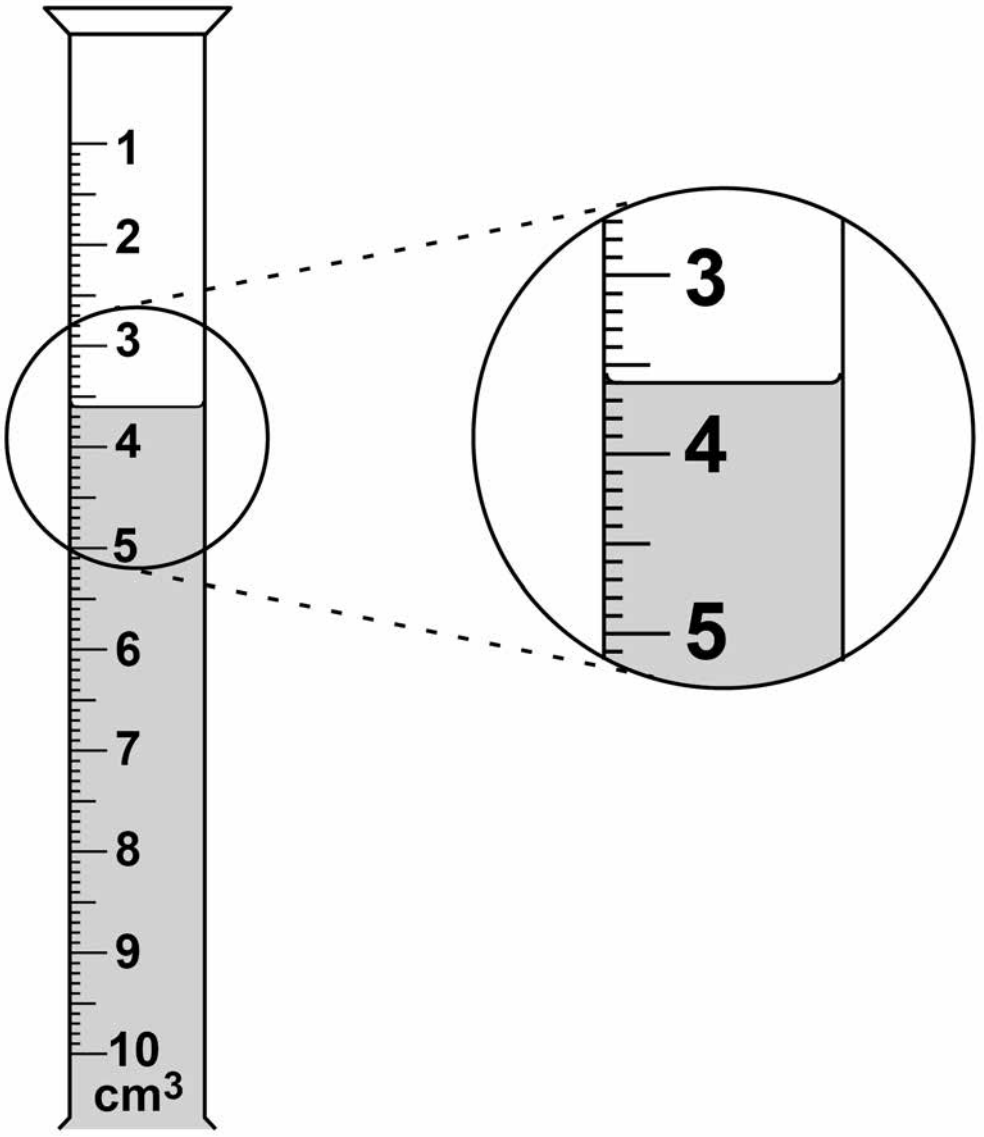
FIGURE 4



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

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

FIGURE 5



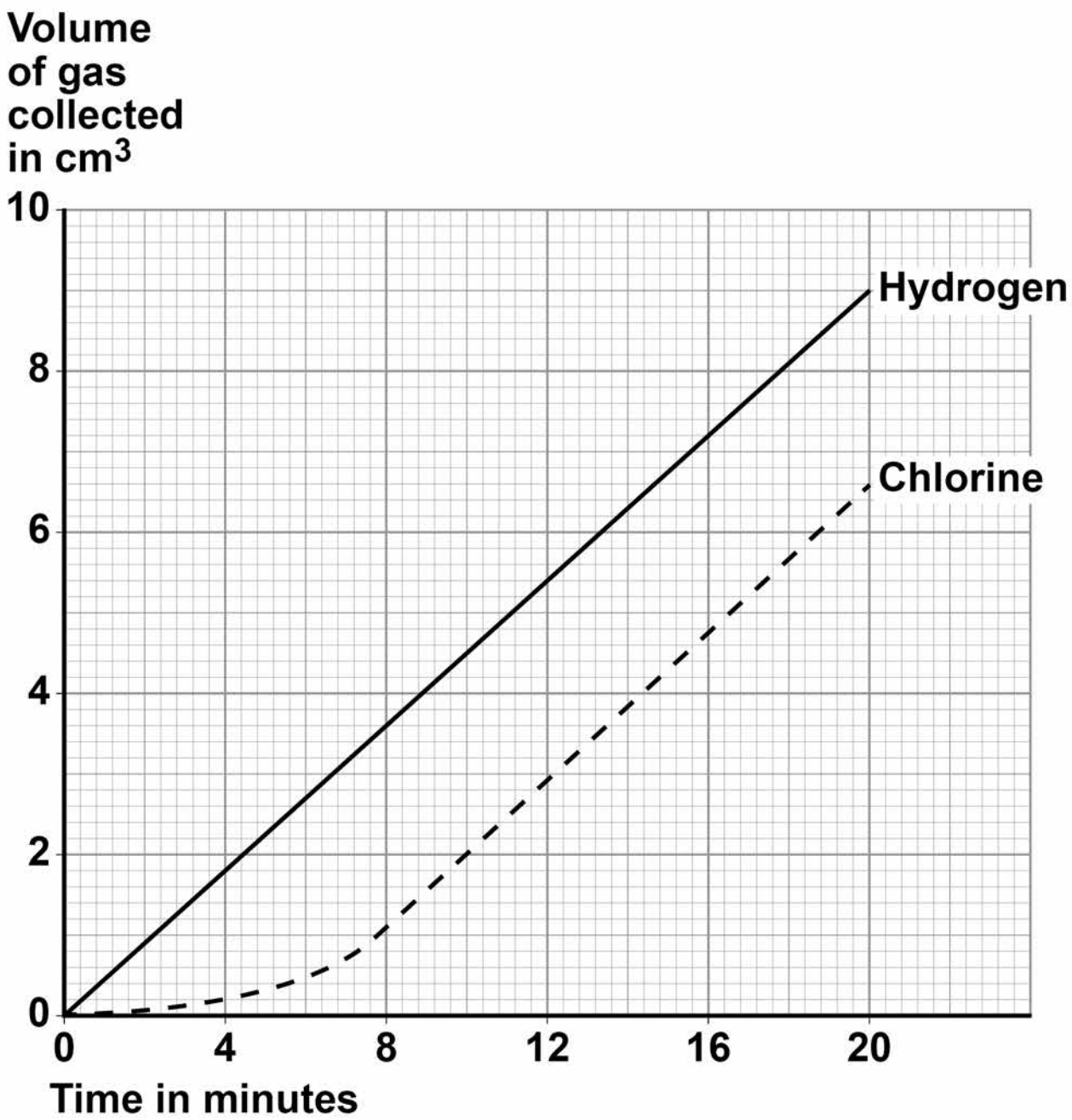
What is the volume of hydrogen gas collected? [1 mark]

Volume = _____ cm^3

[Turn over]

FIGURE 6 shows the results of the investigation.

FIGURE 6



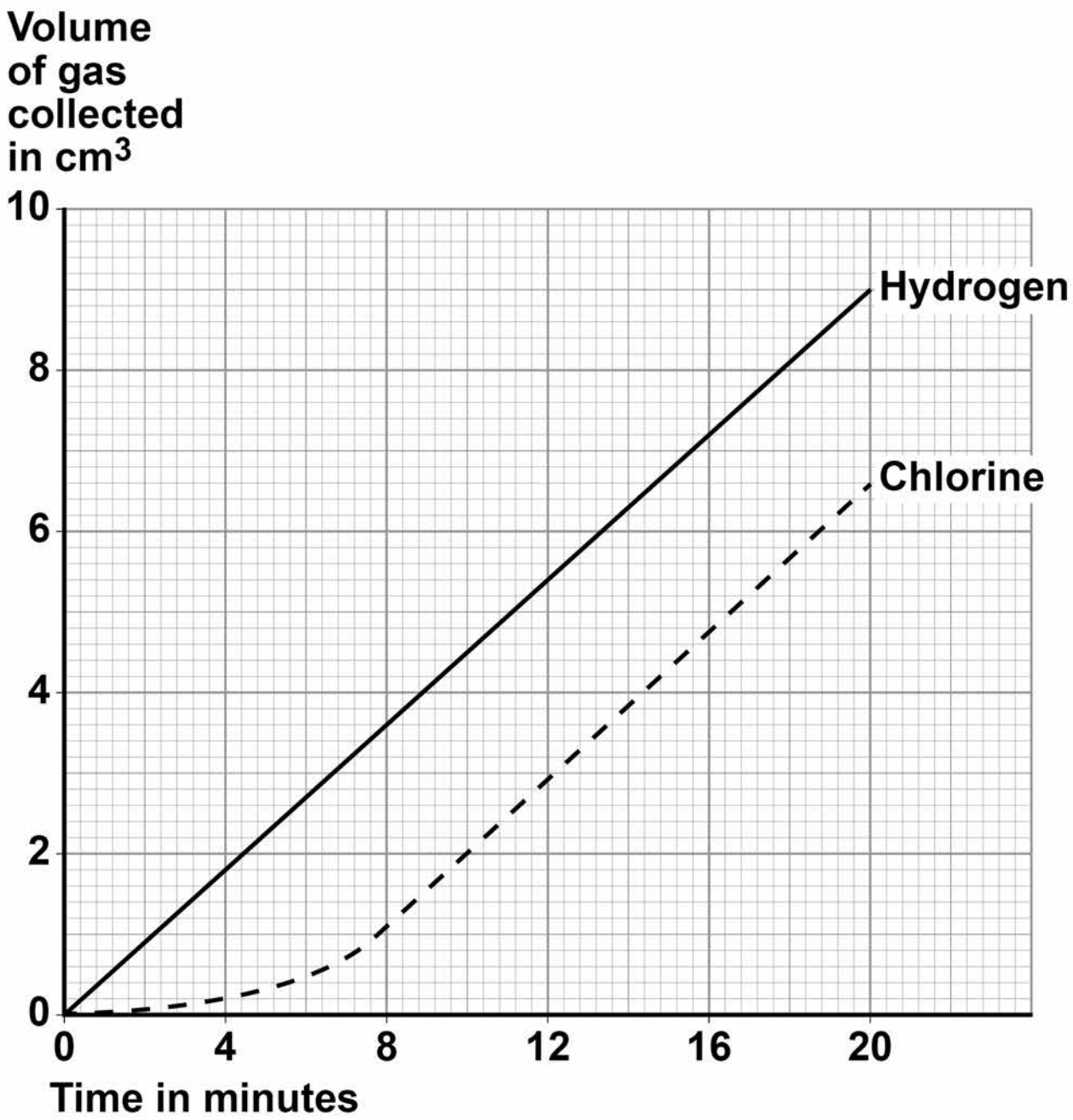
0 4 . 2 **Which of the lines on FIGURE 6, on page 26, show that the volume of gas collected is directly proportional to the time? [1 mark]**

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 28, show a positive correlation between the volume of gas collected and time? [1 mark]**

Tick ONE box.

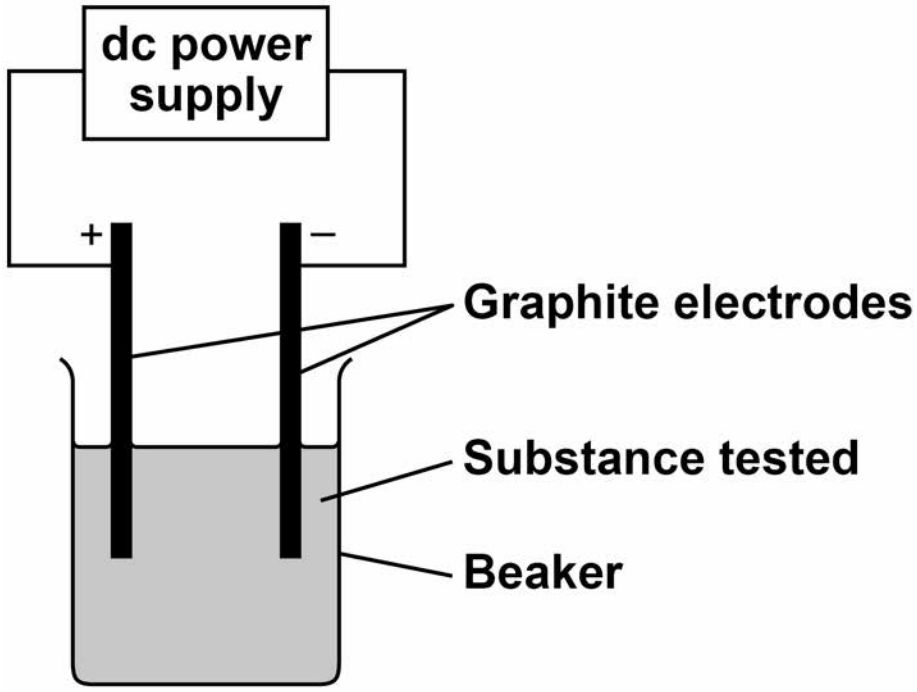
- ☐ **Both lines**
- ☐ **Chlorine line only**
- ☐ **Hydrogen line only**
- ☐ **Neither line**

[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 33 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		

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 35, shows the student's results.

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

_____ .

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 36. [1 mark]**

X = _____ g

0 5 . 4 **One of the results in TABLE 4, on page 36, is anomalous.**

Which result is anomalous? [1 mark]

Mass of copper carbonate _____ g

Trial _____

[Turn over]

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

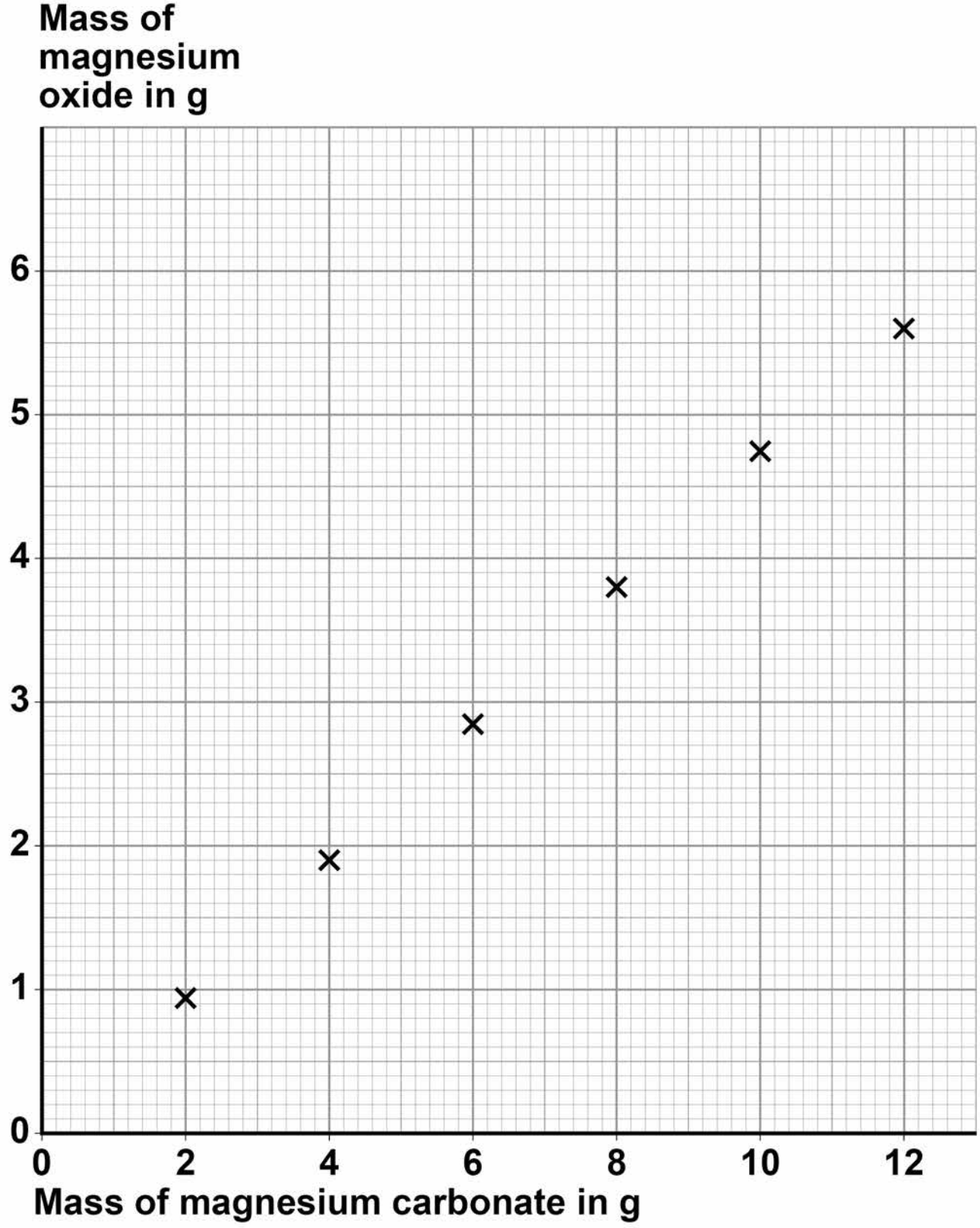
Another student repeated the investigation using magnesium carbonate instead of copper carbonate.

The word equation for the reaction is:

magnesium carbonate → magnesium oxide + carbon dioxide

FIGURE 8, on page 40, shows the results of the investigation.

FIGURE 8


Mass of magnesium oxide in g
0
1
2
3
4
5
6
0
2
4
6
8
10
12
Mass of magnesium carbonate in g

0 5 . 6 **Draw a line of best fit on FIGURE 8 on page 40. [1 mark]**

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

Use FIGURE 8 on page 40. [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**

[Turn over]

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

[Turn over]

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.

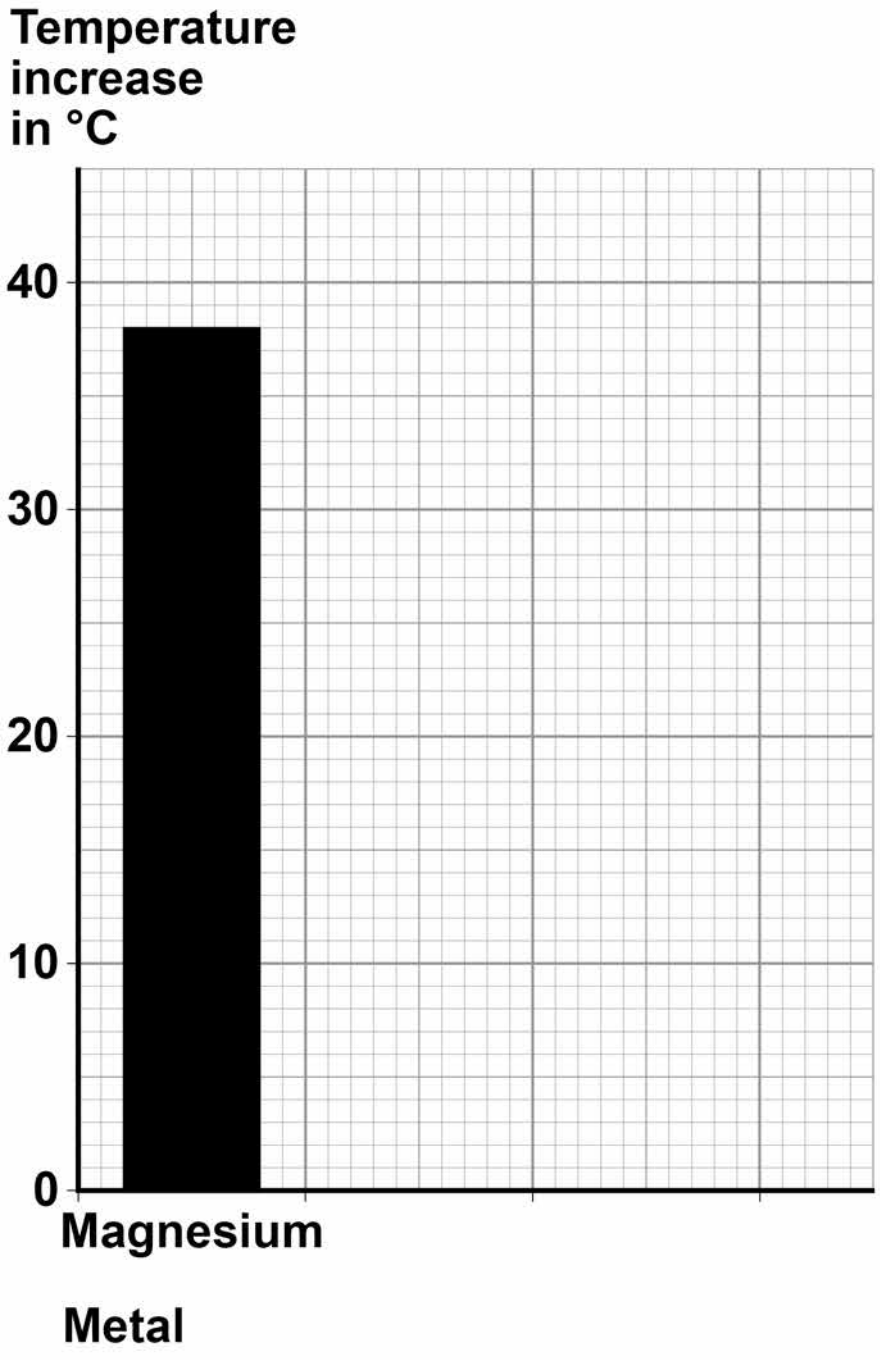
TABLE 5

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

0 6 . 3 **Complete FIGURE 9.**

Use data from TABLE 5 on page 46. [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]

_____

_____

_____

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 46. [1 mark]

Most reactive _____

_____

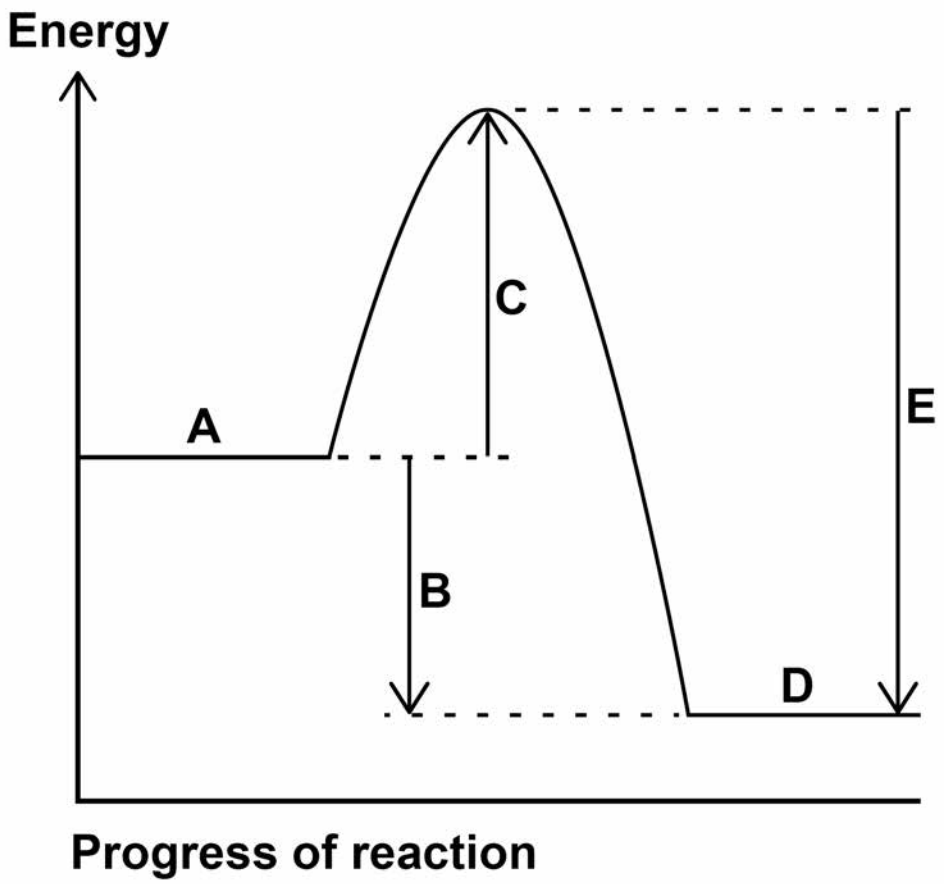
Least reactive _____

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 [3 marks]

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

FIGURE 10



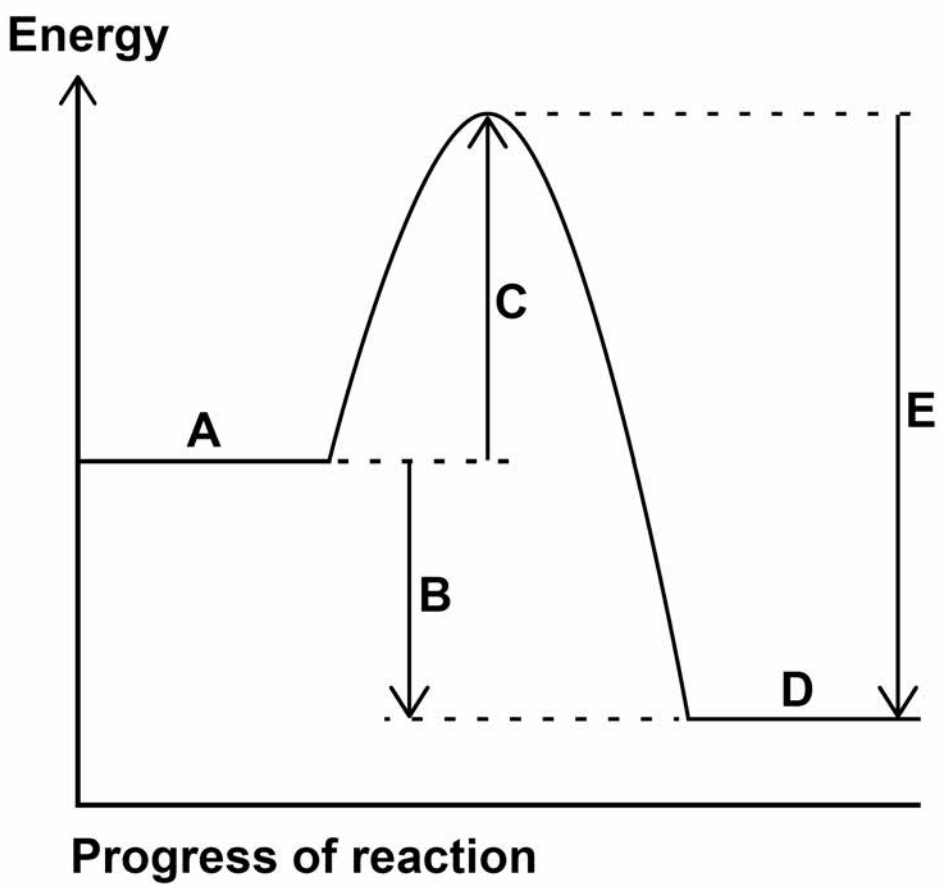
0 6 . 7 **Which letter represents the products of the reaction? [1 mark]**

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**

12

[Turn over]

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**

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.**

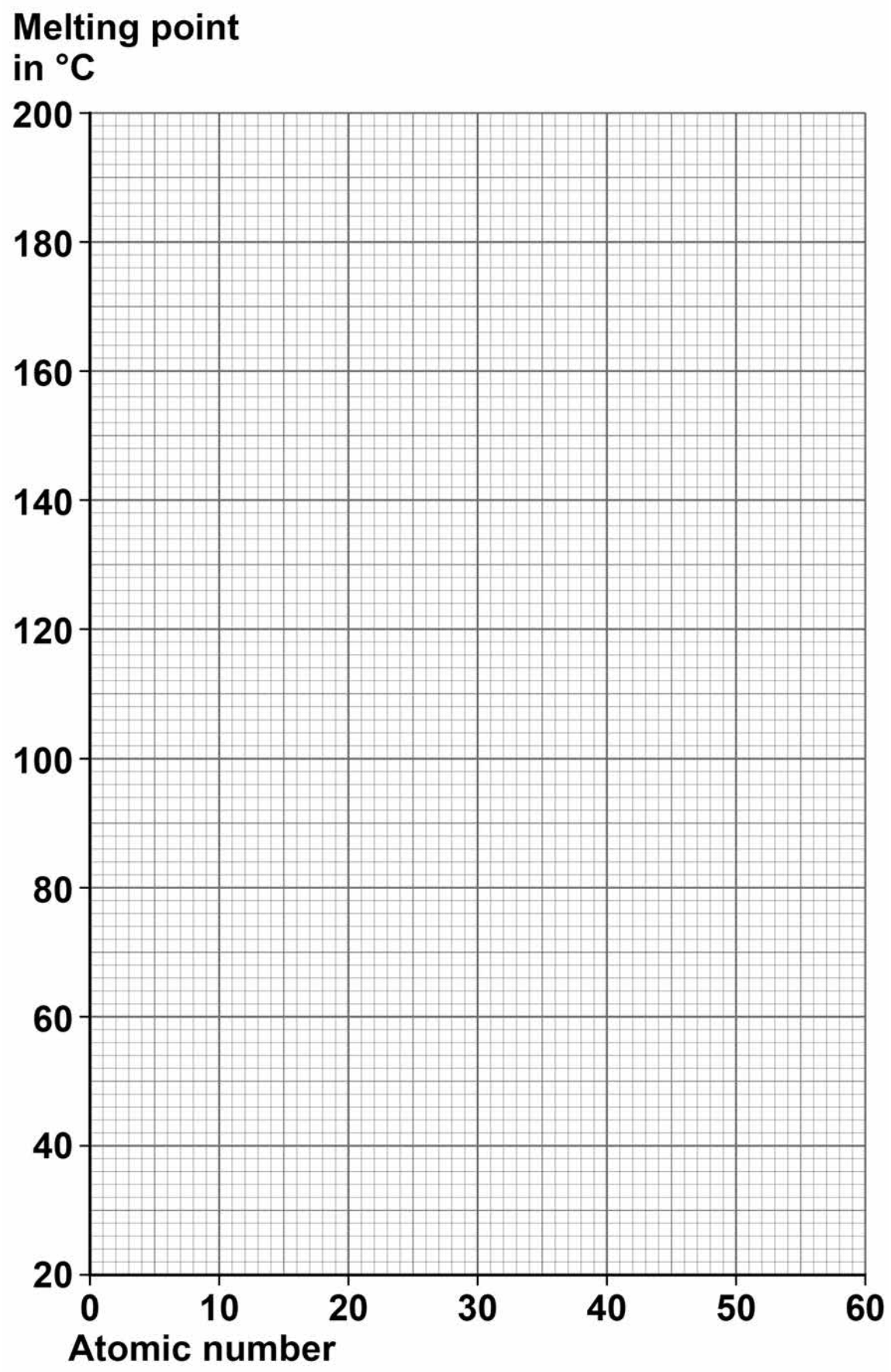
TABLE 6 shows the atomic numbers and melting points of the Group 1 elements.

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 59. [2 marks]

FIGURE 11


Melting point
in °C
200
180
160
140
120
100
80
60
40
20
0
10
20
30
40
50
60
Atomic number

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

Use FIGURE 11 on page 59. [1 mark]

Melting point = _____ °C

10

[Turn over]

BLANK PAGE

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]**

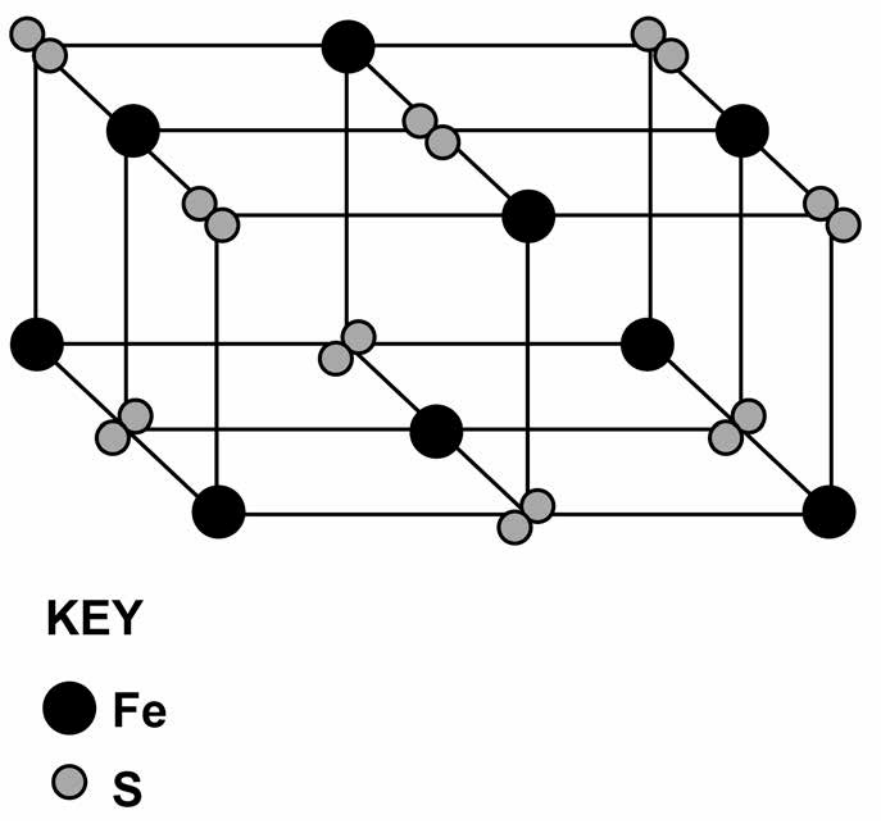
8

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 _____

_____

_____

[Turn over]

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 = _____ %

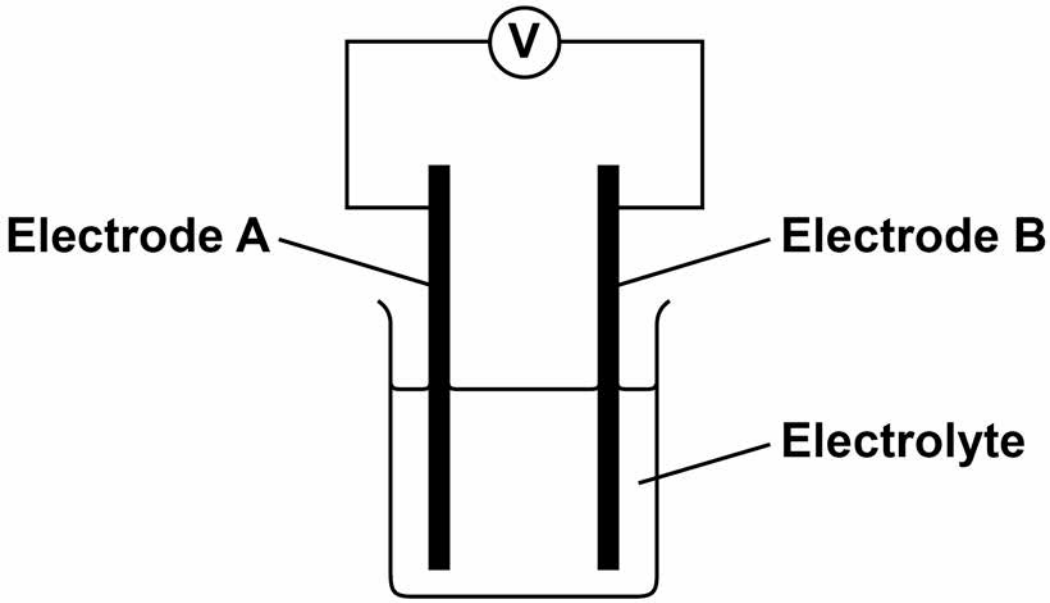
[Turn over]

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.

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

1 0 . 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.

1 0 . 4 **Complete the balanced equation for the overall reaction in a hydrogen fuel cell. [2 marks]**

$$\_\_\_\_\_\ H_2 + \_\_\_\_\_ \rightarrow \_\_\_\_\_\ H_2O$$

[Turn over]

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]

11

END OF QUESTIONS

There are no questions printed on this page

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	