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AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier

Chemistry Paper 1H

H

8464/C/1H

Thursday 16 May 2019 Morning

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.**
- **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

- **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.**

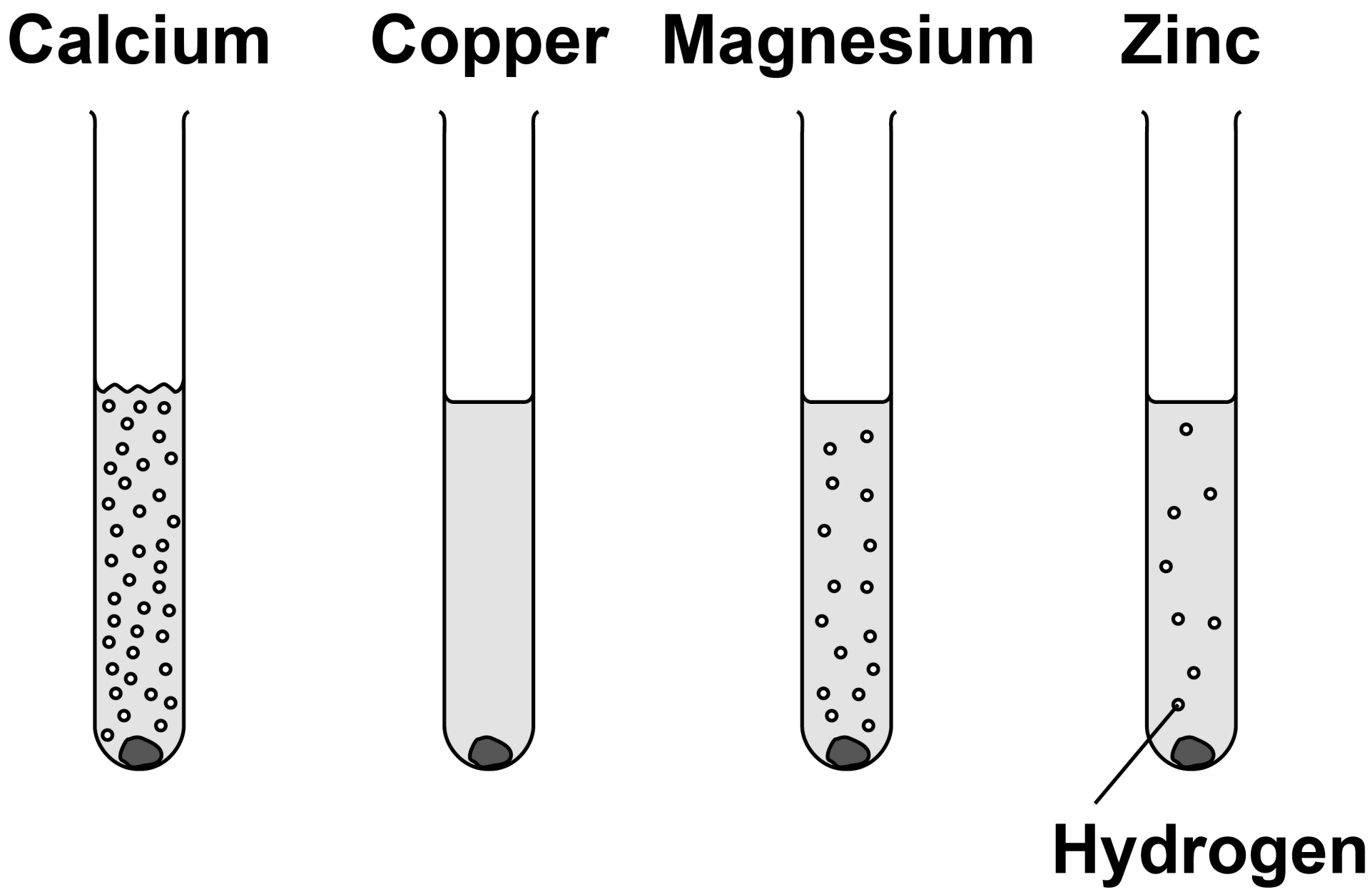
DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1

This question is about reactions of metals.

FIGURE 1 shows what happens when calcium, copper, magnesium and zinc are added to hydrochloric acid.

FIGURE 1



0 1 . 1

What is the order of decreasing reactivity of these four metals? [1 mark]

Tick (✓) ONE box.

- ☐ **Zn Ca Cu Mg**
- ☐ **Ca Cu Mg Zn**
- ☐ **Cu Zn Ca Mg**
- ☐ **Ca Mg Zn Cu**

[Turn over]

A student wants to make a fair comparison of the reactivity of the metals with hydrochloric acid.

0 1 . 2

Name TWO variables that must be kept constant. [2 marks]

1 _____

_____

_____

2 _____

_____

0 1 . 3

What is the independent variable in this reaction? [1 mark]

0 1 . 4

Predict the reactivity of beryllium compared with magnesium.

Give a reason for your answer.

Use the periodic table. [2 marks]

Reason

0 1 . 5

A solution of hydrochloric acid contains 3.2 g of hydrogen chloride in 50 cm^3

Calculate the concentration of hydrogen chloride in g per dm^3 [3 marks]

Concentration = _____ g per dm^3

9

0 2

This question is about salts.

Ammonium nitrate solution is produced when ammonia gas reacts with nitric acid.

0 2 . 1

Give the state symbol for ammonium nitrate solution. [1 mark]

---

0 2 . 2

What is the formula of nitric acid?
[1 mark]

Tick (✓) ONE box.

- ☐ **HCl**
- ☐ **HNO_3**
- ☐ **H_2SO_4**
- ☐ **NH_4OH**

[Turn over]

0 2 . 3

Ammonia gas dissolves in water to produce ammonia solution.

Ammonia solution contains hydroxide ions, OH^-

A student adds universal indicator to solutions of nitric acid and ammonia.

What colour is observed in each solution? [2 marks]

Colour in nitric acid

Colour in ammonia solution

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[Turn over]

0 2 . 4

The student gradually added nitric acid to ammonia solution.

Which row, A, B, C or D, shows the change in pH as the nitric acid is added until in excess? [1 mark]

Tick (✓) ONE box in the table on page 15.

	pH of ammonia solution at start	pH after addition of excess nitric acid
A	10	7
B	2	10
C	7	1
D	10	2

[Turn over]

0 2 . 5

Calculate the percentage by mass of oxygen in ammonium nitrate (NH_4NO_3).

Relative atomic masses (A_r):

H = 1 N = 14 O = 16

Relative formula mass (M_r):

NH_4NO_3 = 80

[3 marks]

Percentage by mass of oxygen =

_____ %

[Turn over]

0 2 . 6

Describe a method to investigate how the temperature changes when different masses of ammonium nitrate are dissolved in water.

You do NOT need to write about safety precautions. [6 marks]

0 3

This question is about oxygen.

0 3 . 1

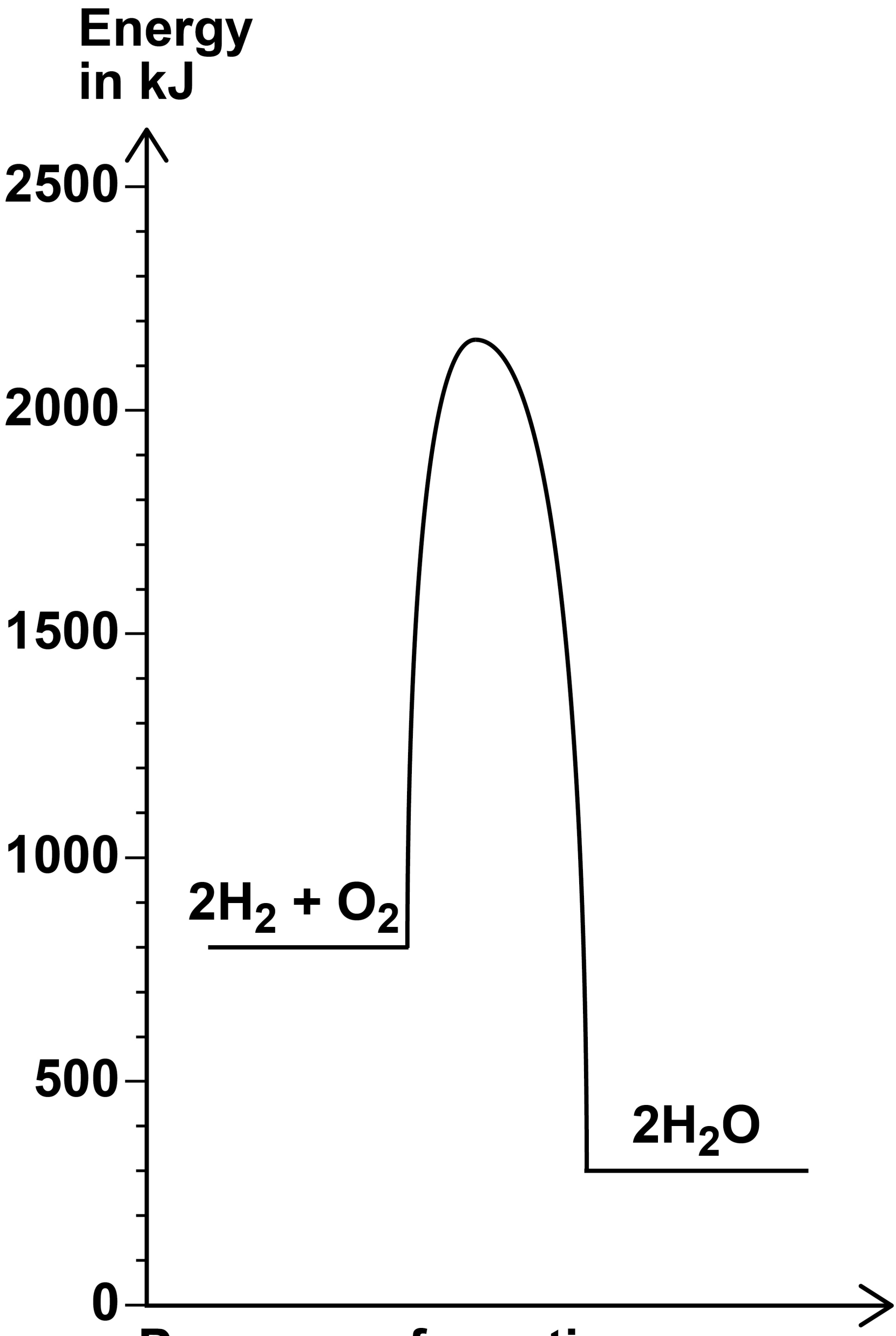
Hydrogen reacts with oxygen.

$$2\,H_2\,(g) + O_2\,(g) \rightarrow 2\,H_2O\,(g)$$

FIGURE 2 shows the relative energies of the reactants and products at a certain temperature.

Label the activation energy on FIGURE 2.
[1 mark]

FIGURE 2



[Turn over]

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0 3 . 2

Determine the overall energy change for the reaction between hydrogen and oxygen shown in Question 03.1

Use FIGURE 2 on page 21. [2 marks]

Energy change = _____ kJ

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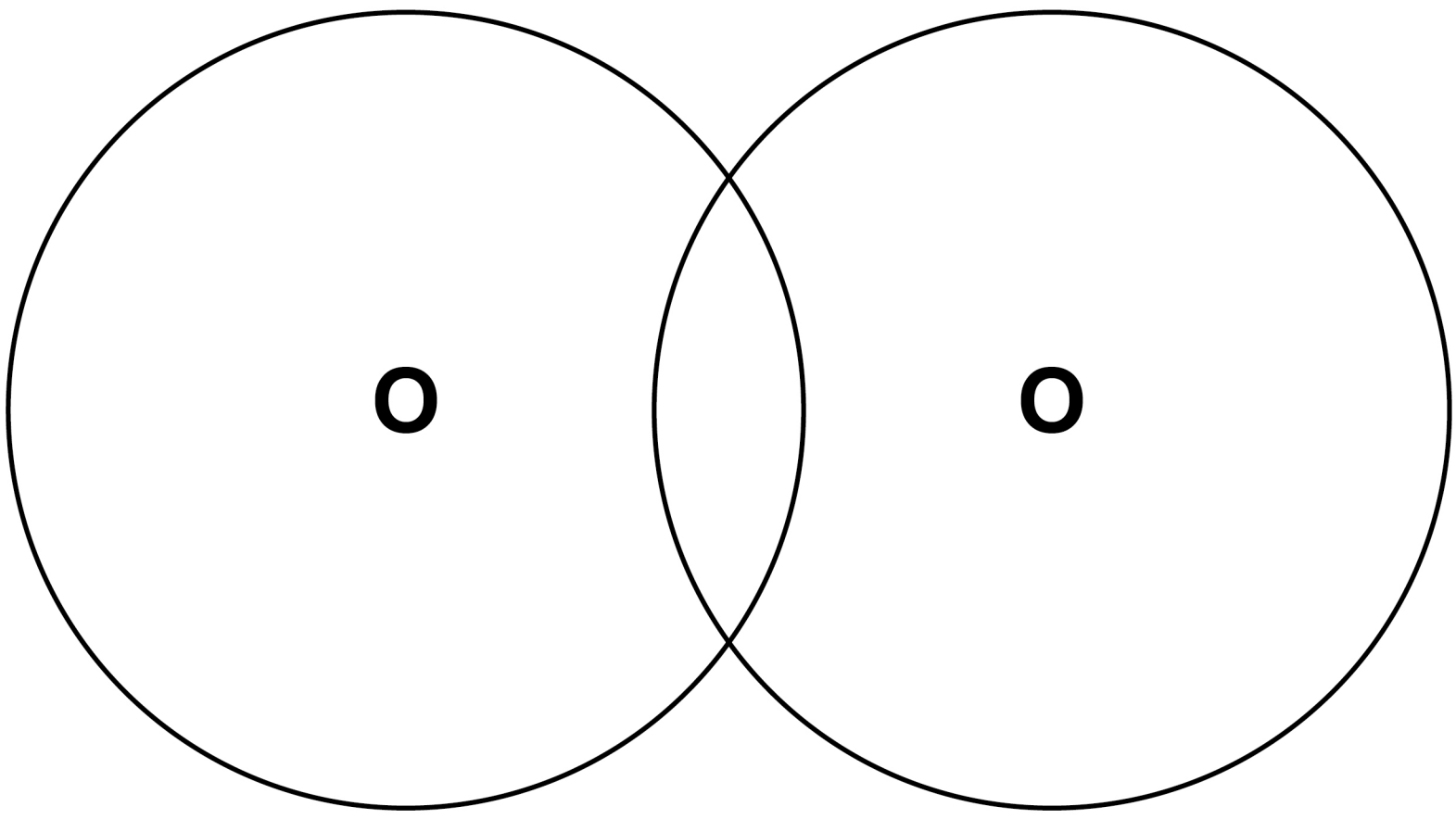
0 3 . 3

Oxygen is in Group 6 of the periodic table.

FIGURE 3 shows the outer energy levels in one molecule of oxygen (O_2).

Draw the electrons in the outer energy levels in FIGURE 3. [2 marks]

FIGURE 3



0 3 . 4

The equation shows the decomposition of hydrogen peroxide.

TABLE 1 shows the bond energies.

TABLE 1

Bond	O–O	O=O	O–H
Bond dissociation energy in kJ per mole	138	496	463

Calculate the overall energy change for the reaction. [3 marks]

Energy change = _____ kJ

8

0 4

This question is about elements in the periodic table.

0 4 . 1

What order did scientists use to arrange elements in early periodic tables?
[1 mark]

0 4 . 2

In the early periodic tables some elements were placed in the wrong groups.

Mendeleev overcame this in his periodic table.

Give ONE way Mendeleev did this.
[1 mark]

TABLE 2 shows the boiling points of fluorine, chlorine and bromine.

TABLE 2

Element	Boiling point in °C
Fluorine	–186
Chlorine	–34
Bromine	+59

0 4 . 3

Explain why the boiling points in TABLE 2 are low. [2 marks]

0 4 . 4

Explain the trend in the boiling points in TABLE 2 on page 30. [3 marks]

0 4 . 5

Explain why neon is unreactive.

Give the electronic structure of neon in your answer. [2 marks]

0 4 . 6

How many atoms are there in 1 g of argon?

The Avogadro constant is 6.02×10^{23} per mole.

Relative atomic mass (A_r): Ar = 40

[2 marks]

Number of atoms in 1 g = _____

11

0 5

This question is about electrolysis.

0 5 . 1

Some metals are extracted from molten compounds using electrolysis.

Why is electrolysis used to extract some metals? [1 mark]

_____

_____

_____

[Turn over]

0 5 . 2

Aluminium is produced by electrolysis of a molten mixture.

What TWO substances does the molten mixture contain? [2 marks]

1 _____

_____

2 _____

_____

0 5 . 3

Copper and chlorine are produced when molten copper chloride is electrolysed.

Complete the half equation for the reaction at each electrode. [2 marks]

Half equation at negative electrode

Cu^{2+} _____ → _____

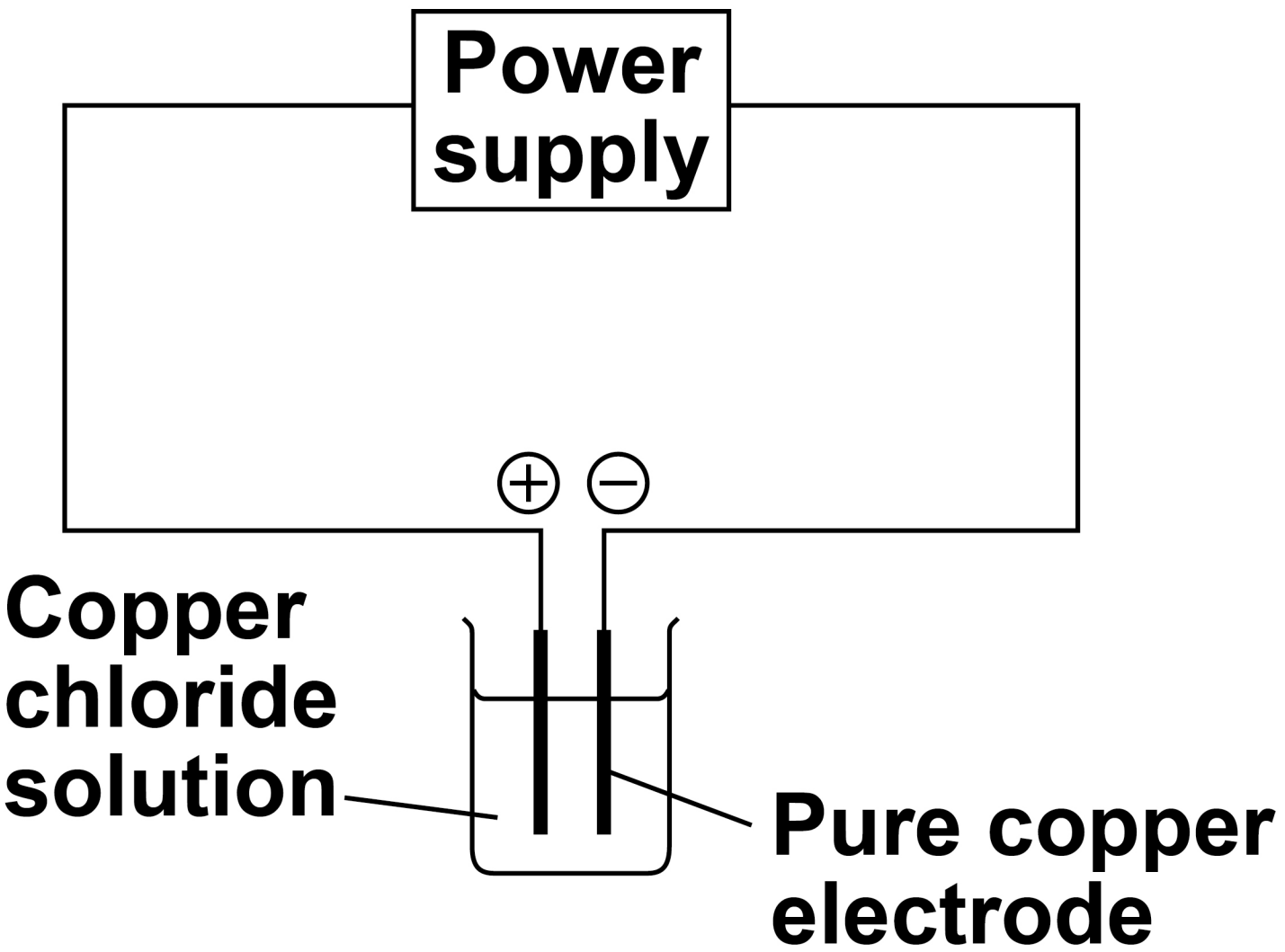
Half equation at positive electrode

$2\ Cl^{-}$ → _____

[Turn over]

FIGURE 4 shows the apparatus a student used to electrolyse copper chloride solution.

FIGURE 4



The student:

- **measured the mass of copper deposited on the negative electrode after 60 minutes**
- **compared the mass deposited with the expected value.**

0 5 . 4

Suggest TWO reasons why the mass deposited was different from the expected value. [2 marks]

1

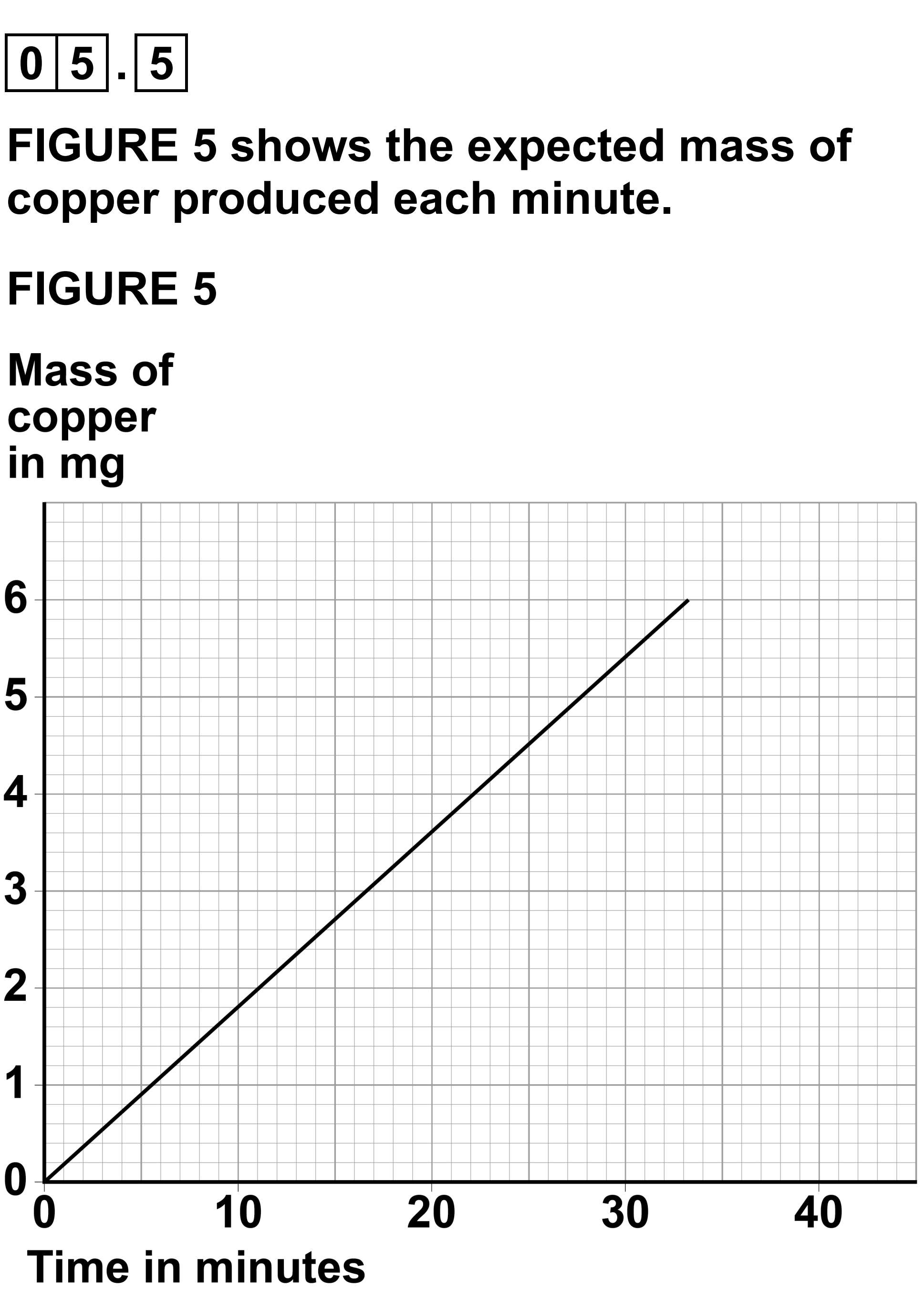
2

[Turn over]

0 5 . 5

FIGURE 5 shows the expected mass of copper produced each minute.

FIGURE 5



Determine the expected mass of copper after 24 hours.

Use FIGURE 5. [3 marks]

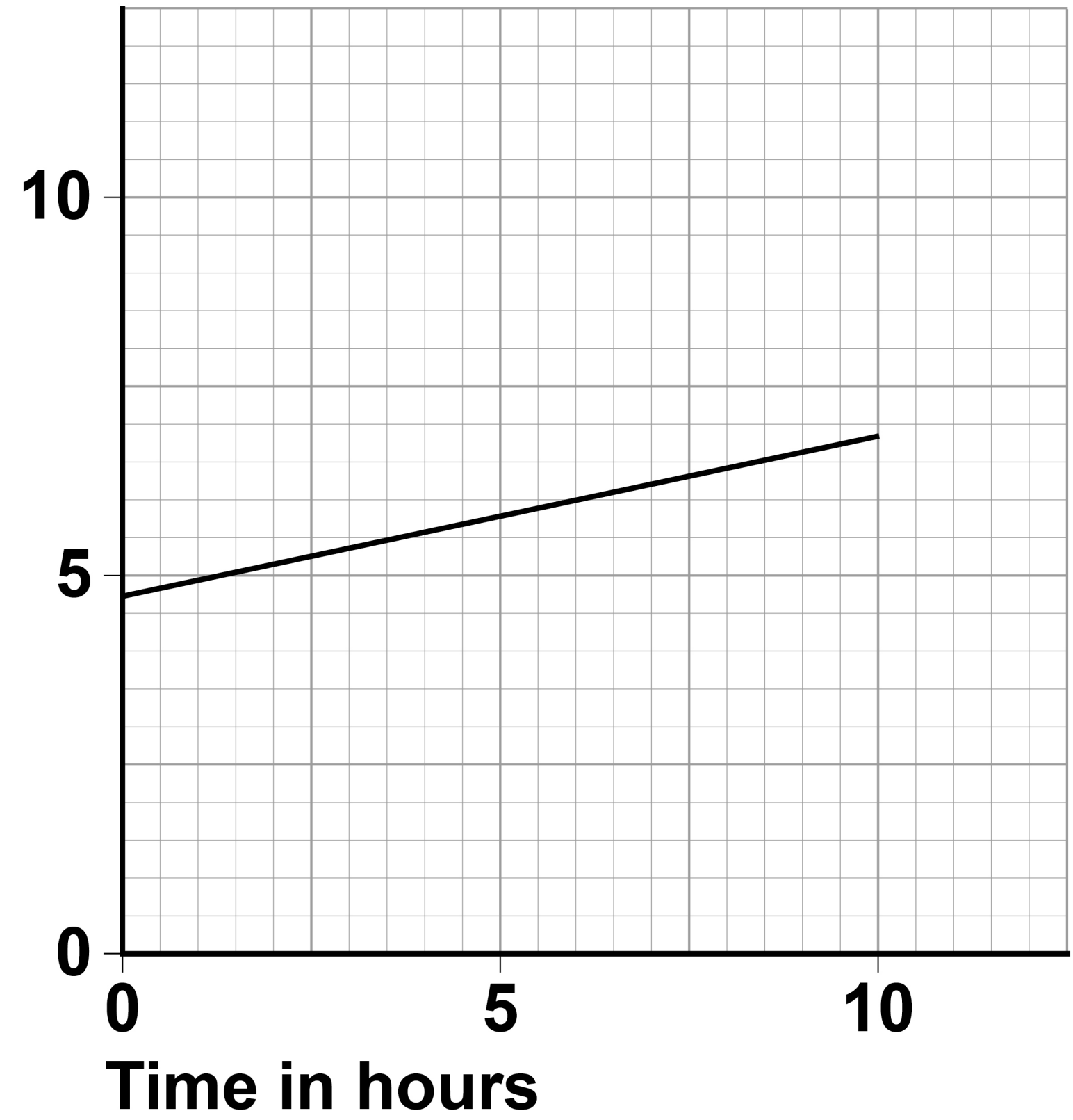
Mass = _____ mg

[Turn over]

Silver nitrate solution is electrolysed.

FIGURE 6 shows the change in mass of the negative electrode over 10 hours.

FIGURE 6



0 5 . 6

Determine the mass of the negative electrode at the start of the experiment.

Use FIGURE 6. [1 mark]

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0 5 . 7

Calculate the gradient of the line in FIGURE 6 on page 42.

Give the unit. [3 marks]

Gradient _____

Unit _____

0 6

This question is about sodium.

0 6 . 1

Sodium reacts with chlorine.

What is the balanced equation for the reaction? [1 mark]

Tick (✓) ONE box.

☐ **$Na + Cl \rightarrow NaCl$**

☐ **$Na + Cl_2 \rightarrow NaCl_2$**

☐ **$2Na + Cl_2 \rightarrow 2NaCl$**

☐ **$2Na + Cl \rightarrow Na_2Cl$**

0 6 . 2

Hot sodium is put in a gas jar of chlorine.

Describe the observations made before, during and after the reaction. [3 marks]

Before reaction

During reaction

After reaction

[Turn over]

0 6 . 3

Explain why sodium is less reactive than potassium. [4 marks]

0 6 . 4

Chlorine reacts with sodium and with hydrogen.

Compare the structure and bonding in sodium chloride and hydrogen chloride.
[6 marks]

END OF QUESTIONS

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