Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier

Chemistry Paper 1H

H

8464/C/1H

Friday 17 May 2024 **Morning**

Time allowed: 1 hour 15 minutes

[Turn over]

JUN248464C1H01

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On the front of this book, write your surname and forename(s), your centre number, your candidate number and add your signature.

MATERIALS

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.**

[Turn over]

- **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

Copper is a useful metal.

0 1 . 1

FIGURE 1, on the opposite page, shows the mass of copper produced between 1900 and 2010.

Give TWO conclusions that can be made from FIGURE 1. [2 marks]

1 _____

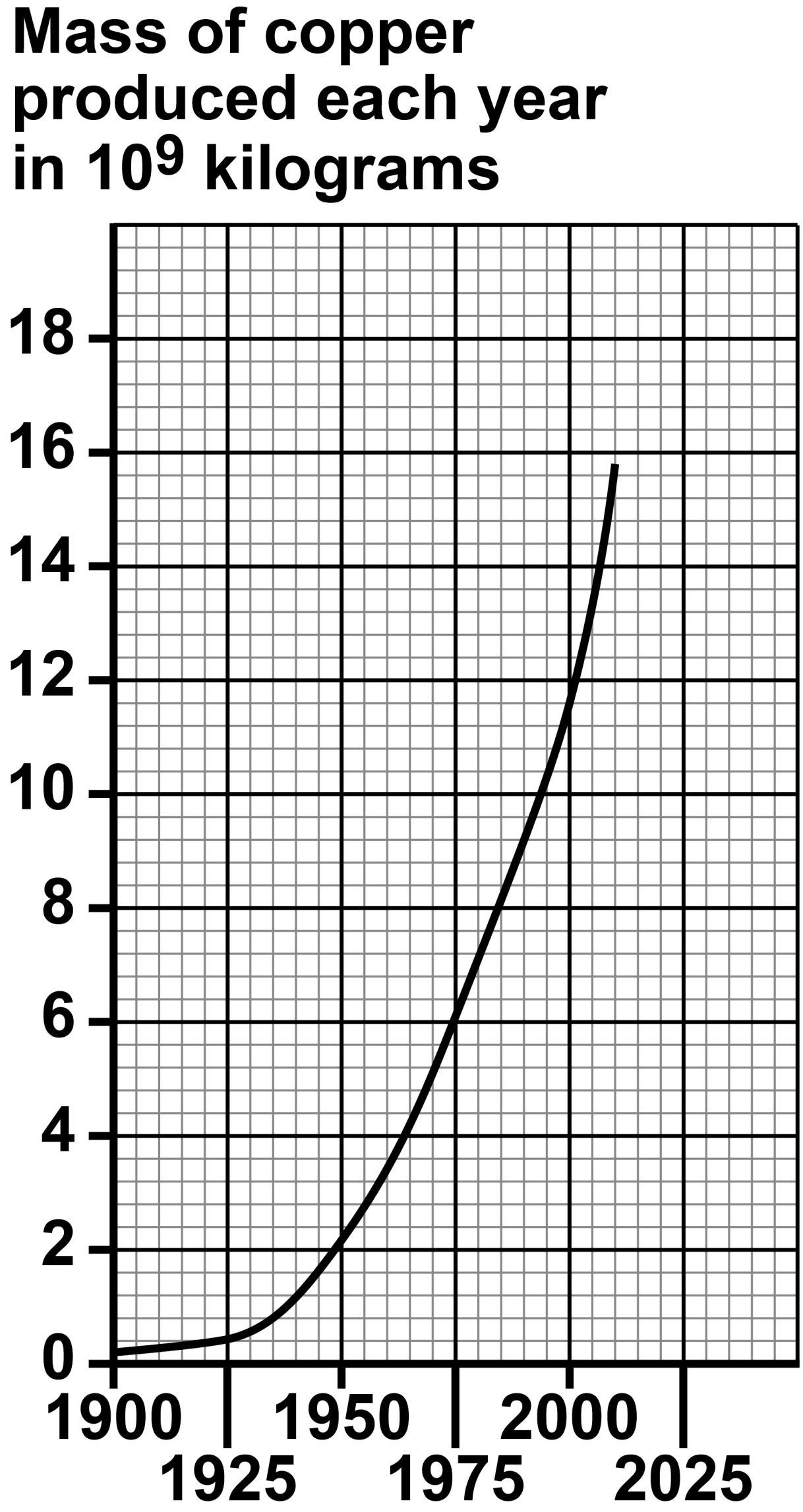
_____

2 _____

_____

_____

FIGURE 1



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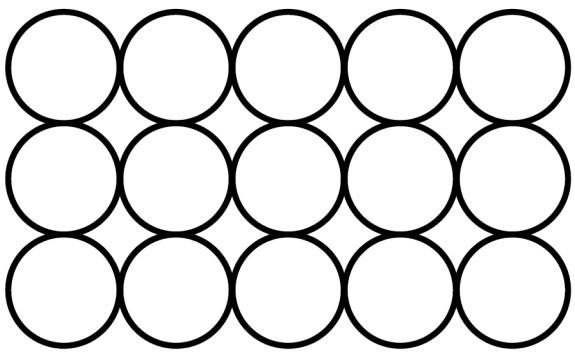
Mixtures of copper and zinc are heated to produce alloys.

0 1 . 2

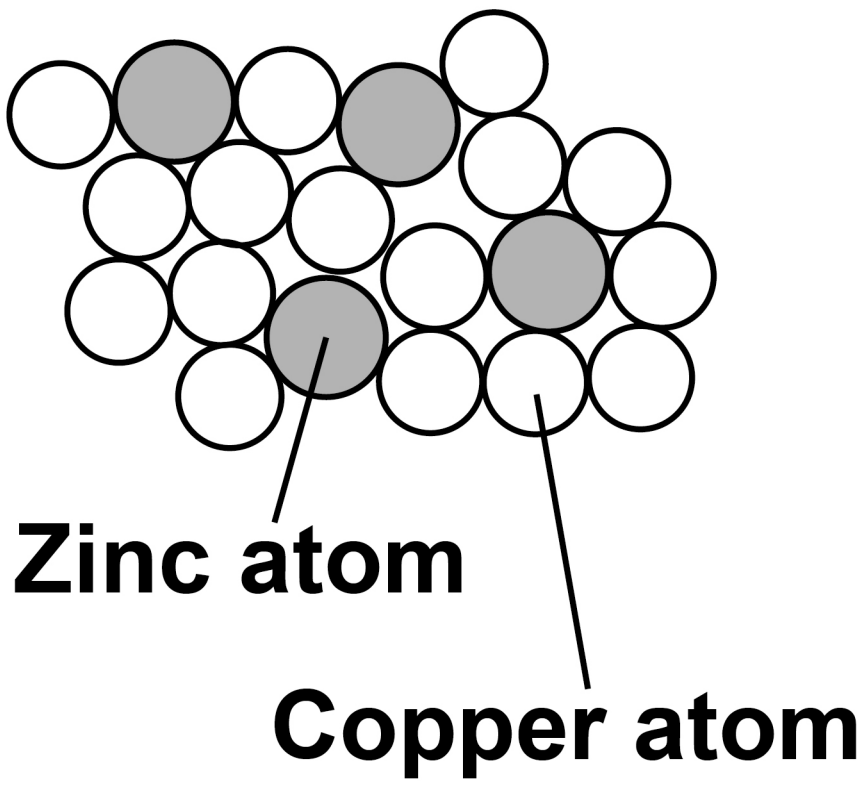
FIGURE 2 represents the structures of pure copper and of an alloy of copper and zinc.

FIGURE 2

PURE COPPER



ALLOY OF COPPER AND ZINC



Explain why the alloy of copper and zinc is harder than pure copper.

Use FIGURE 2. [3 marks]

0 1 . 3

A 5.25 g sample of an alloy of copper and zinc contains 13.5% zinc by mass.

Calculate the mass of COPPER in the 5.25 g sample.

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

Mass of COPPER (3 significant figures) =

g

9

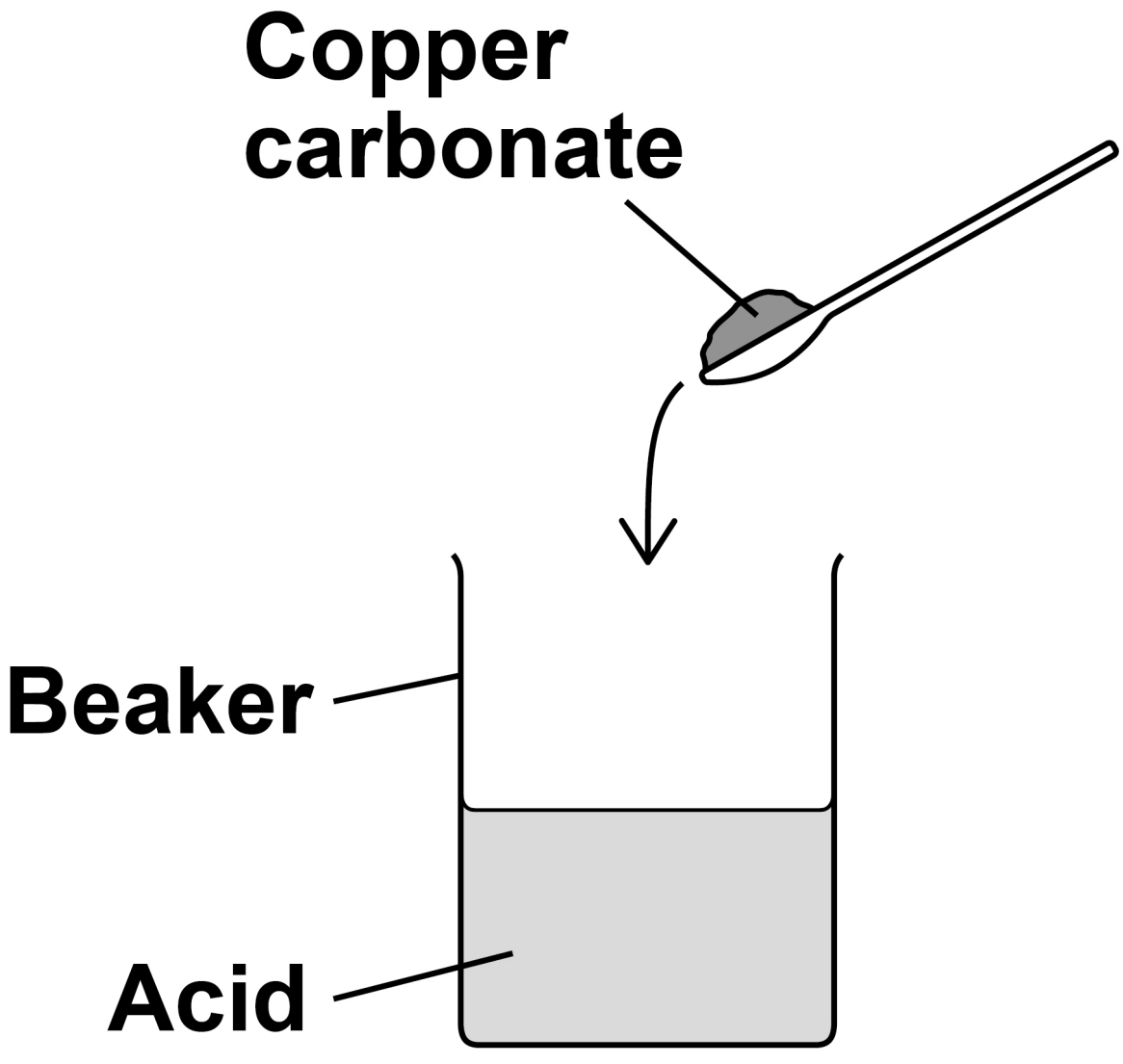
0 2

A student prepared copper sulfate by reacting an acid with excess copper carbonate.

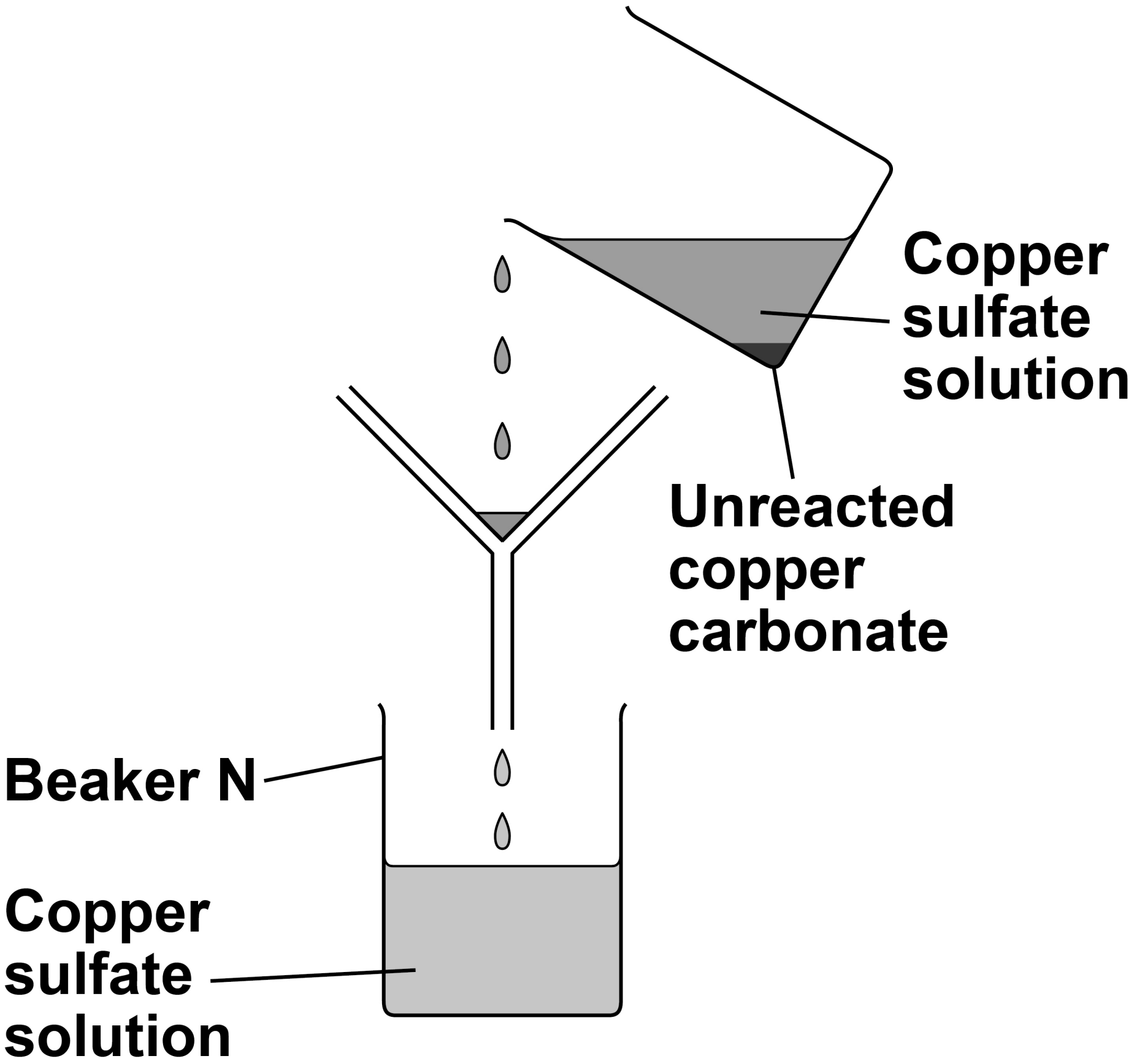
FIGURE 3, below and on the opposite page, shows the first two stages in the preparation of copper sulfate.

FIGURE 3

STAGE 1



STAGE 2



[Turn over]

0 2 . 1

What is the formula of the acid used to prepare copper sulfate? [1 mark]

Tick (✓) ONE box.

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

0 2 . 2

Why is excess copper carbonate used in STAGE 1, on page 12? [1 mark]

0 2 . 3

Beaker N, on page 13, contained copper sulfate solution.

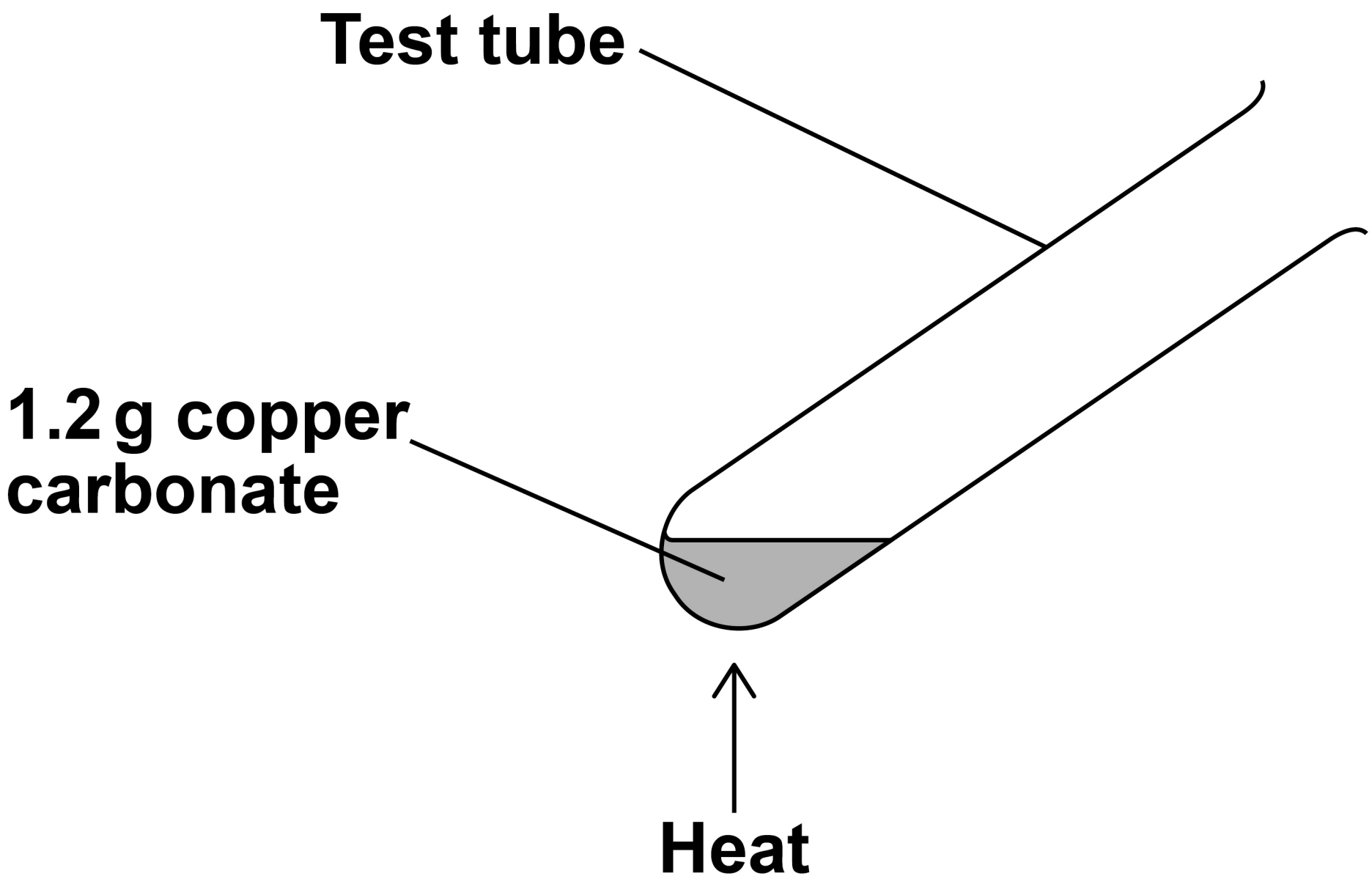
Describe how the student could produce copper sulfate crystals from the copper sulfate solution in beaker N. [2 marks]

A student investigated the thermal decomposition of copper carbonate.

Copper carbonate decomposes to form two products.

FIGURE 4 shows the apparatus.

FIGURE 4



This is the method used.

1. Add 1.2 g of copper carbonate to a test tube.
2. Heat the test tube and contents until the mass does not change.
3. Record the mass of the contents of the test tube after heating.
4. Repeat steps 1 to 3 with different masses of copper carbonate.

[Turn over]

TABLE 1 shows the results.

TABLE 1

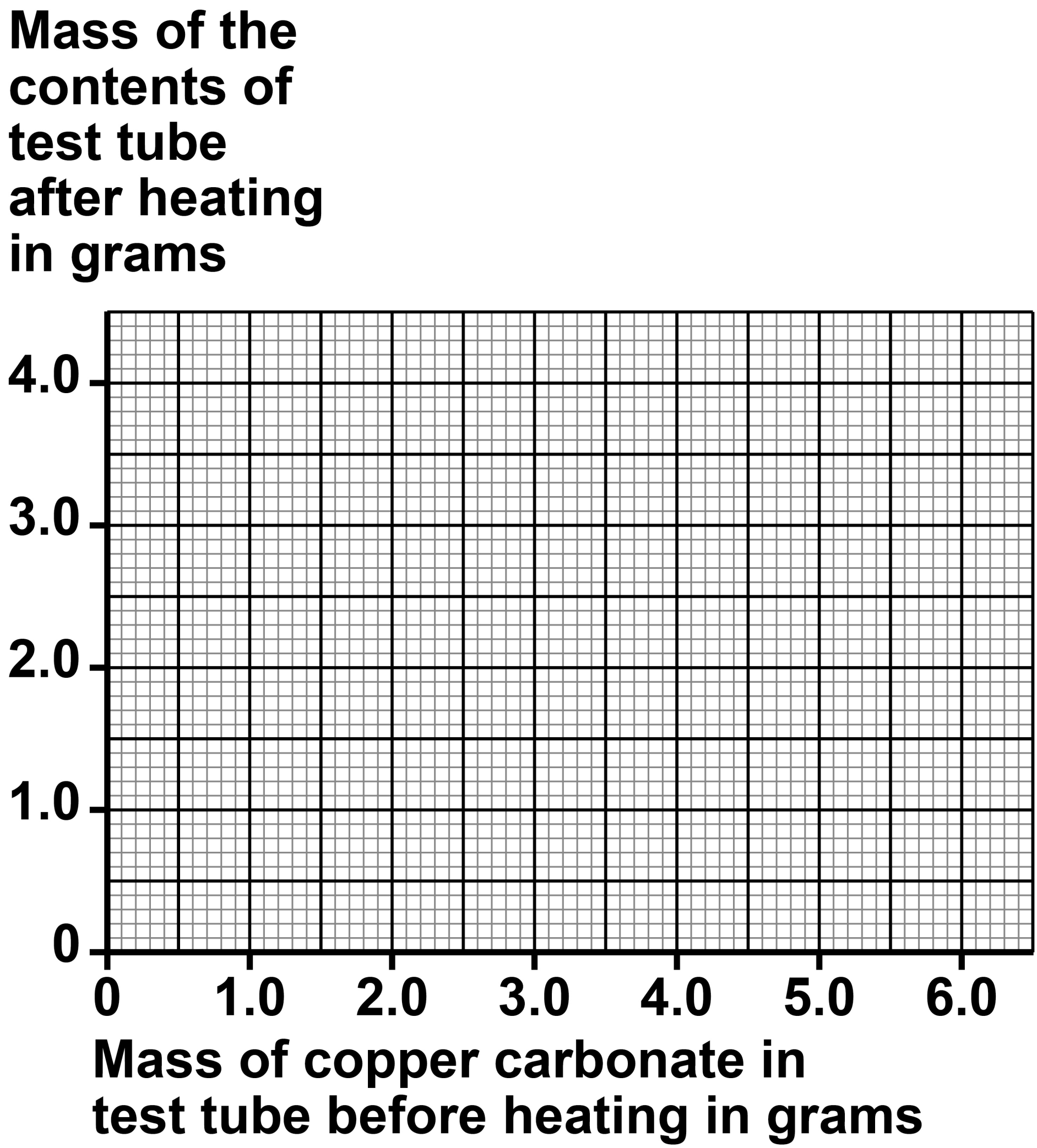
Mass of copper carbonate in test tube before heating in grams	Mass of the contents of test tube after heating in grams
1.2	0.8
2.4	1.7
3.6	2.2
4.8	3.1
6.0	3.9

0 2 . 4

Plot the data from TABLE 1 on FIGURE 5, on the opposite page.

Draw a line of best fit. [3 marks]

FIGURE 5



[Turn over]

0 2 . 5

Why does the mass of the contents of the test tube decrease in mass when copper carbonate is thermally decomposed? [1 mark]

8

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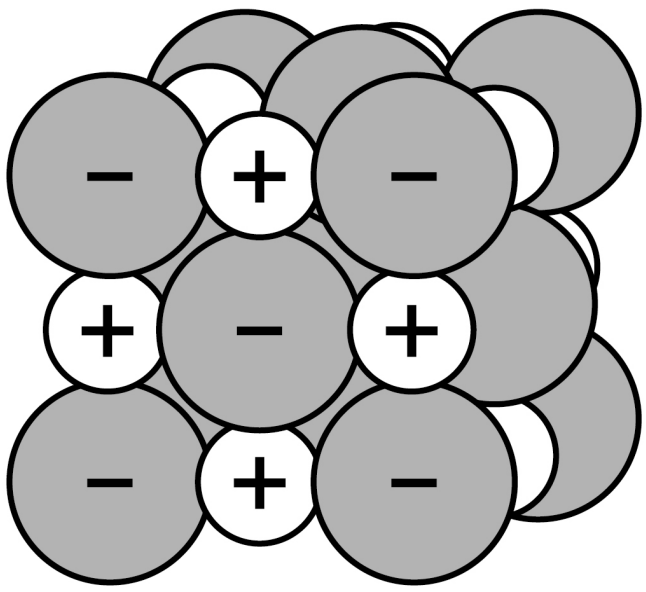
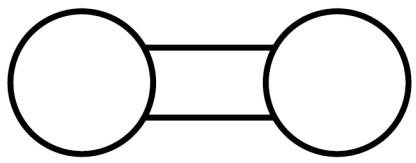
[Turn over]

0 3

TABLE 2 shows diagrams which represent the structures of two substances.

TABLE 2

SUBSTANCE	STRUCTURE
Sodium chloride NaCl	
Oxygen O_2	

Compare the structure and bonding of sodium chloride and oxygen. [6 marks]

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[Turn over]

0 4

Nitric acid (HNO_3) is a strong acid.

0 4 . 1

What is meant by a ‘strong acid’?
[1 mark]

0 4 . 2

Nitric acid is used as a dilute aqueous solution.

What is meant by 'dilute aqueous solution'? [1 mark]

0 4 . 3

10 cm^3 of a nitric acid solution has a pH of 1

Water is added to the nitric acid solution to change the pH of the nitric acid solution to pH 3

How does the hydrogen ion concentration change? [1 mark]

Tick (✓) ONE box.

- ☐ **Decreases by a factor of 100**
- ☐ **Decreases by a factor of 10**
- ☐ **Increases by a factor of 10**
- ☐ **Increases by a factor of 100**

0 4 . 4

Write the IONIC equation for the reaction between an acid and an alkali. [1 mark]

\+ ⟶

The equation shows the reaction between magnesium carbonate and nitric acid.

$$MgCO_3 + 2\,HNO_3 \longrightarrow$$

$$Mg(NO_3)_2 + H_2O + CO_2$$

0 4 . 5

What is the ratio of the number of moles of magnesium carbonate to the number of moles of nitric acid in the reaction?
[1 mark]

Tick (✓) ONE box.

- ☐ **1 : 1**
- ☐ **1 : 2**
- ☐ **2 : 1**
- ☐ **2 : 2**

[Turn over]

0 4 . 6

A student mixed some magnesium carbonate with excess nitric acid.

The student then added two drops of universal indicator to the solution.

What colour was the solution after the addition of universal indicator? [1 mark]

Tick (✓) ONE box.

☐ **Red**

☐ **Green**

☐ **Blue**

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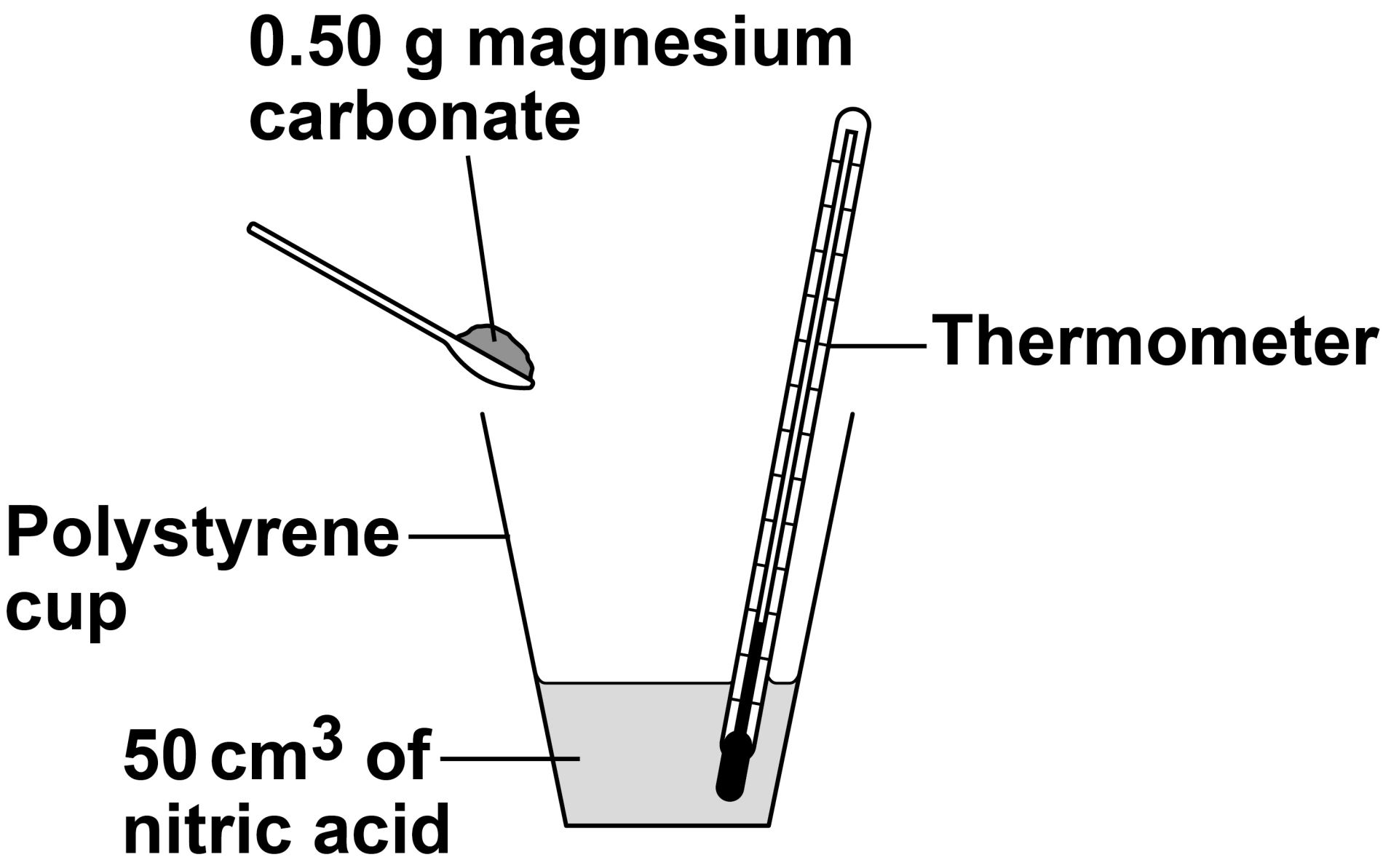
[Turn over]

A student investigated the temperature change when different masses of magnesium carbonate were reacted with excess nitric acid.

FIGURE 6 shows the apparatus.

FIGURE 6



This is the method used.

1. Pour 50 cm^3 of nitric acid into a polystyrene cup.
2. Measure the temperature of the solution.
3. Add 0.50 g of magnesium carbonate.
4. Stir the mixture.
5. Measure the temperature.
6. Repeat steps 1 to 5 with different masses of magnesium carbonate.

[Turn over]

0 4 . 7

Give TWO improvements to the METHOD to produce more accurate results.

Do NOT refer to improvements to the apparatus in your answer. [2 marks]

1

2

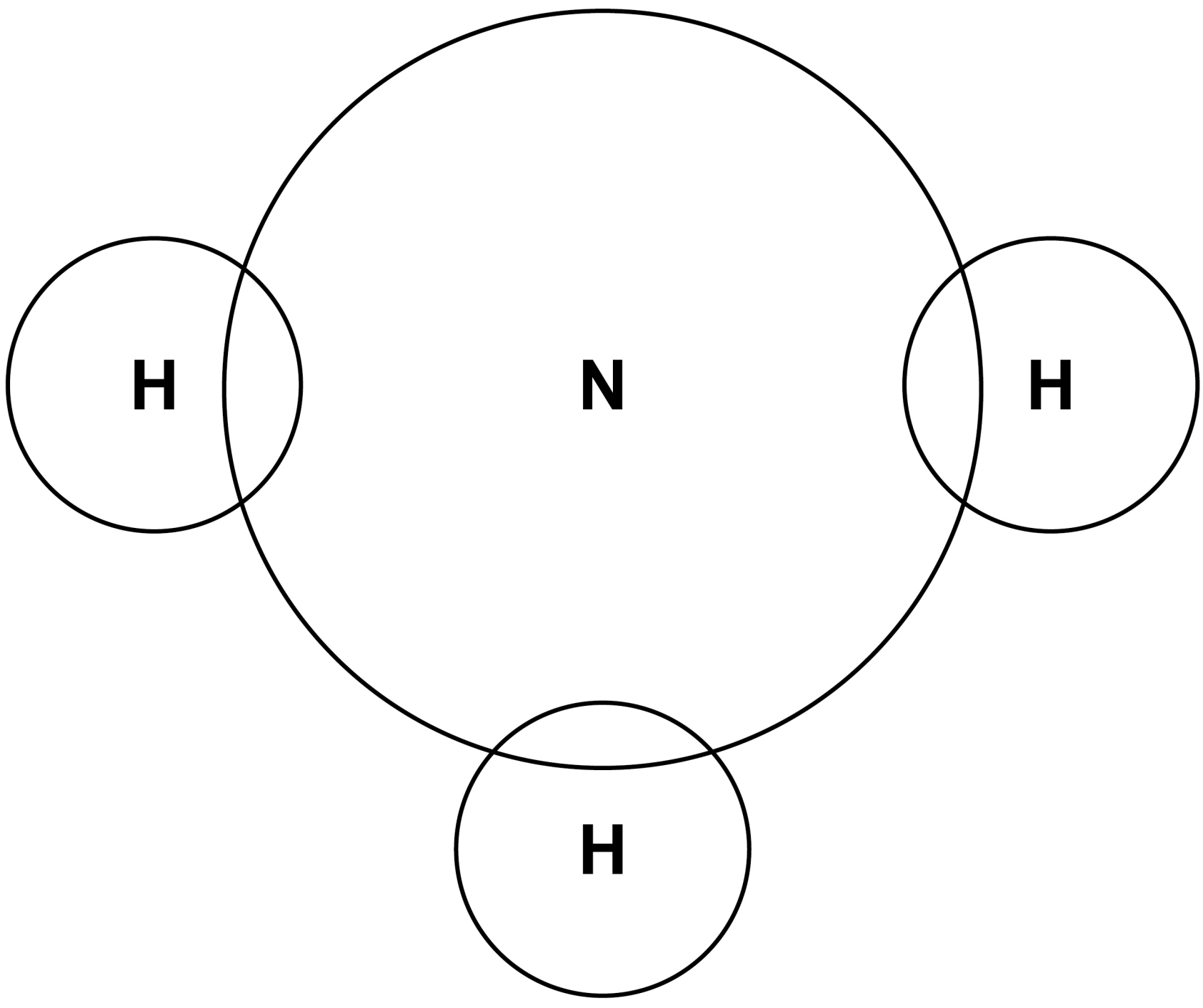
8

0 5

Nitrogen reacts with hydrogen to produce ammonia (NH_3).

0 5 . 1

Complete the dot and cross diagram for an ammonia molecule. [2 marks]



0 5 . 2

The equation for the reaction between nitrogen and hydrogen to produce ammonia is:

Calculate the mass of hydrogen that is needed to produce 25 g of ammonia.

Relative atomic masses (A_r):

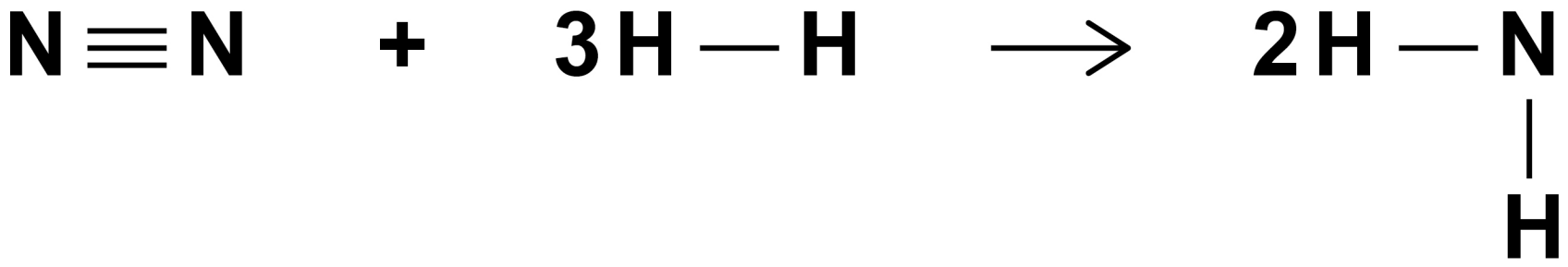
H = 1 N = 14 [4 marks]

Mass of hydrogen = _____ g

[Turn over]

FIGURE 7 shows the displayed formulae equation for the reaction of nitrogen with hydrogen.

FIGURE 7



In the reaction the energy released forming new bonds is 93 kJ/mol greater than the energy needed to break existing bonds.

TABLE 3, on the opposite page, shows bond energies.

TABLE 3

Bond	N ≡ N	H — H	N — H
Bond energy in kJ/mol	945	X	391

0 5 . 3

Calculate the bond energy X for the H — H bond.

Use FIGURE 7 and TABLE 3. [5 marks]

X = _____ kJ/mol

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[Turn over]

0 5 . 4

Energy is released from the reaction to produce ammonia.

FIGURE 8, on the opposite page, shows part of the reaction profile for the reaction between nitrogen and hydrogen to produce ammonia.

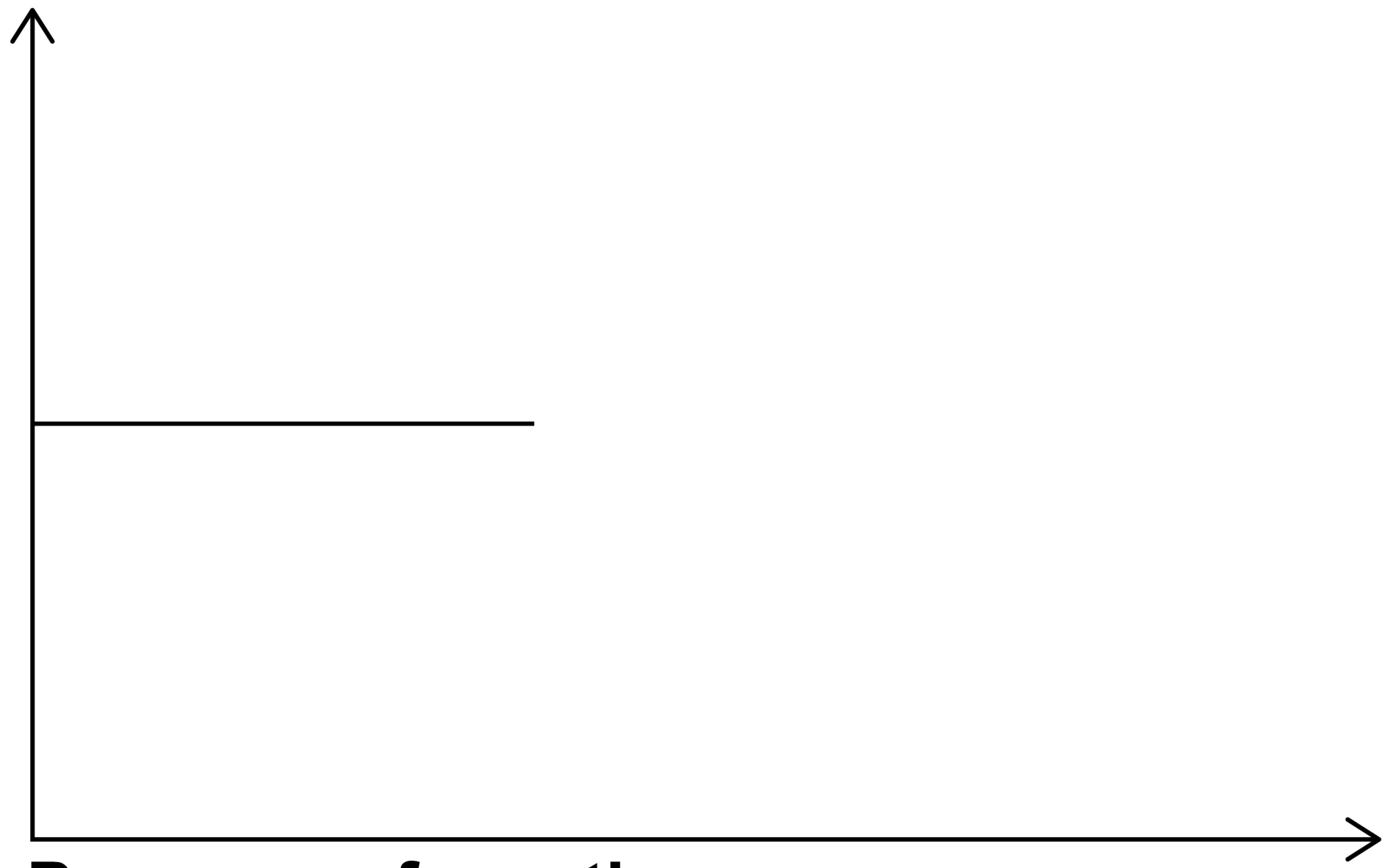
Complete FIGURE 8.

You should:

- **complete the profile line**
- **label the energy level of the reactants and the product**
- **label the OVERALL energy change.**

[3 marks]

FIGURE 8



0 6

In the Earth most metals are found as compounds.

0 6 . 1

Name ONE metal that is found in the Earth as the metal itself. [1 mark]

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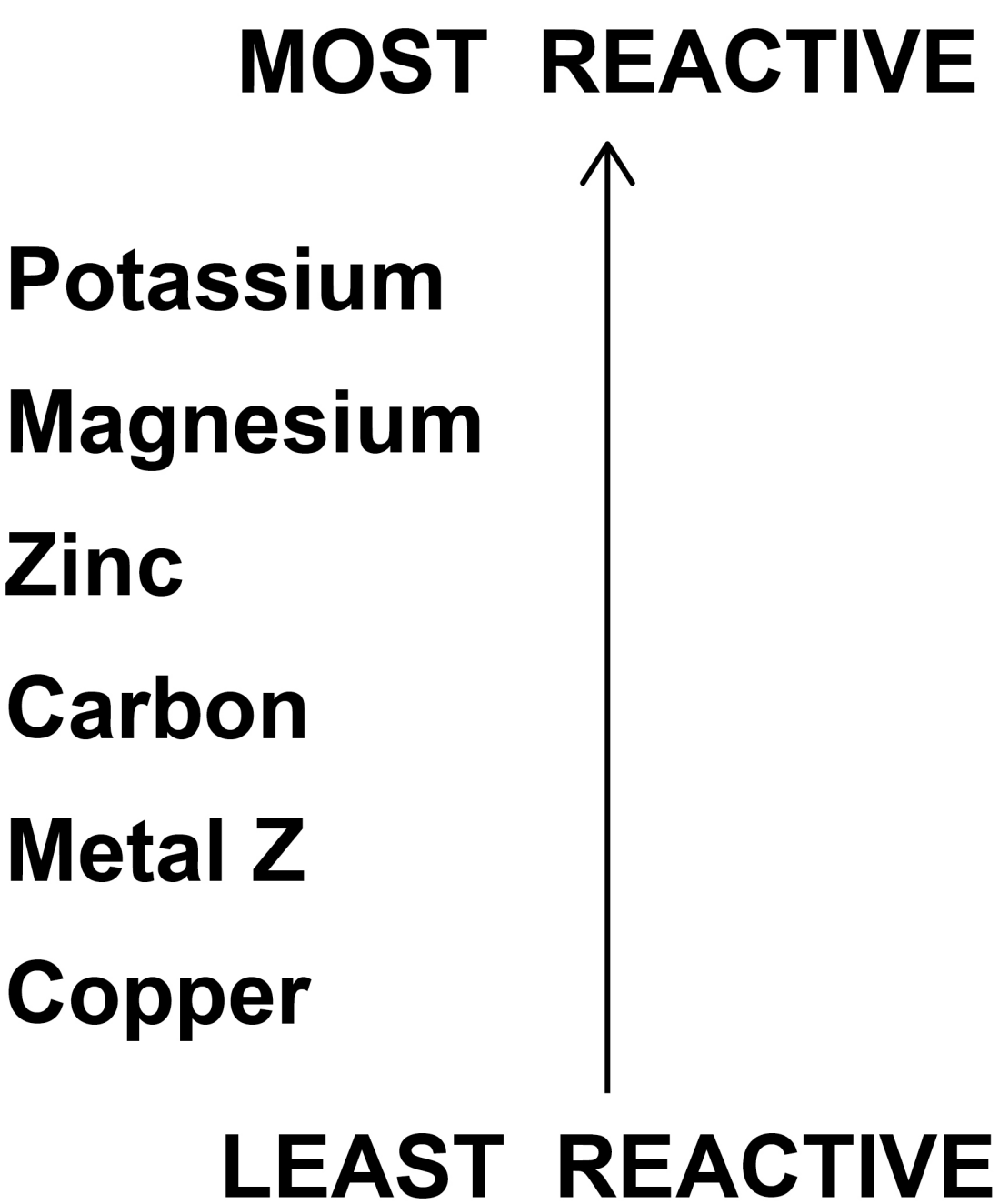
[Turn over]

FIGURE 9 shows a reactivity series.

FIGURE 9

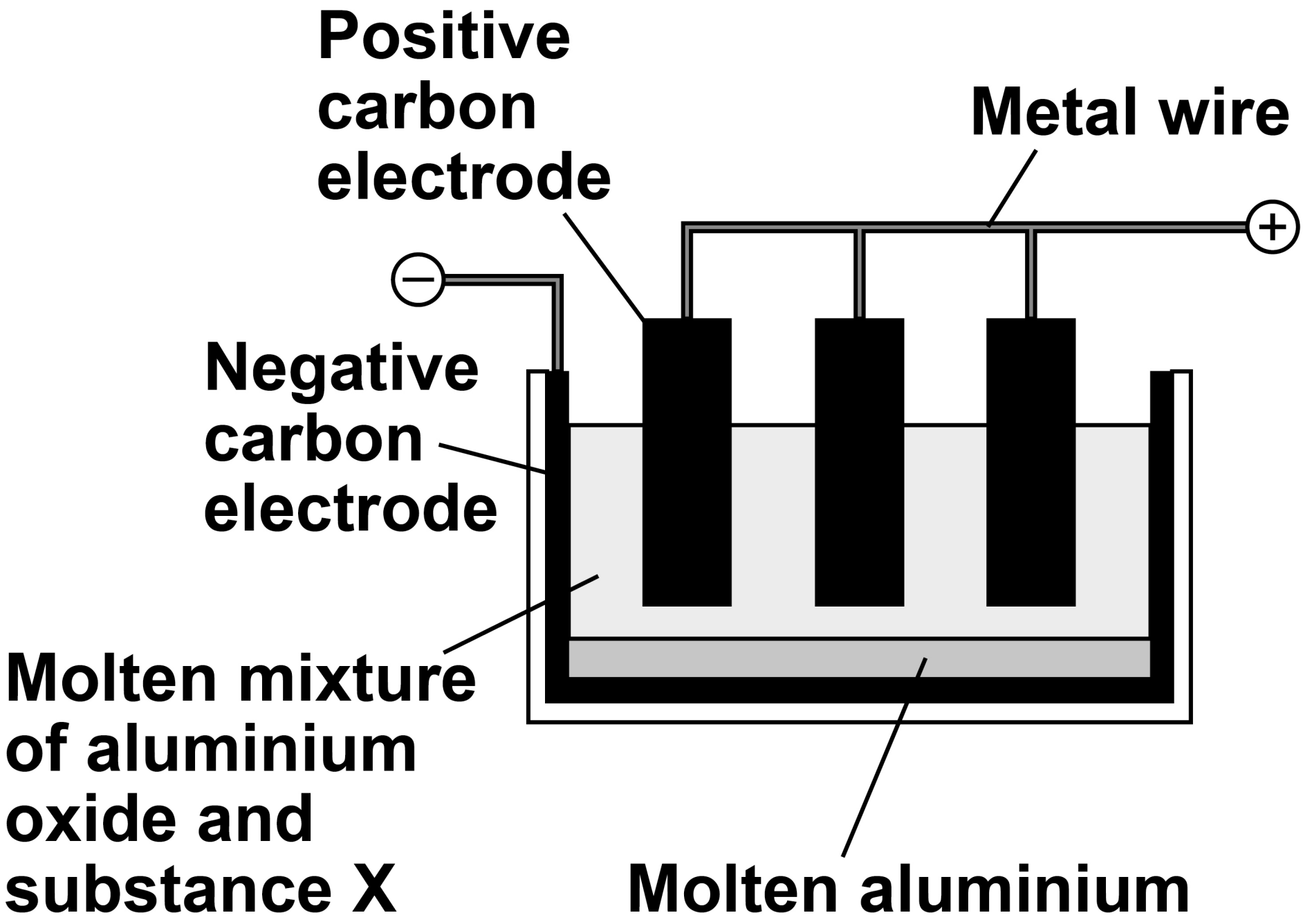


0 6 . 2

Suggest the most economical method for extracting metal Z from an oxide of metal Z. [1 mark]

FIGURE 10 shows the electrolysis cell used to extract aluminium from aluminium oxide.

FIGURE 10



0 6 . 3

Name substance X shown in FIGURE 10.
[1 mark]

0 6 . 4

Explain what happens to the POSITIVE carbon electrodes during the extraction of aluminium from aluminium oxide.
[3 marks]

0 6 . 5

The formula of aluminium oxide is Al_2O_3

Write a half equation for the reaction at the NEGATIVE electrode in FIGURE 10, on page 50. [2 marks]

_____ + _____ ⟶ _____

[Turn over]

8

0 7

Halogens are elements in Group 7 of the periodic table.

0 7 . 1

Calcium reacts with chlorine to produce calcium chloride.

Explain what happens to calcium atoms and to chlorine atoms when calcium reacts with chlorine to produce calcium chloride. [4 marks]

[Turn over]

0 7 . 2

Explain why chlorine is more reactive than bromine. [4 marks]

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[Turn over]

0 7 . 3

TABLE 4 shows the boiling points of four hydrogen halides.

TABLE 4

HYDROGEN HALIDE	BOILING POINT IN °C
HF	20
HCl	–85
HBr	–67
HI	–35

Describe how the boiling points of the hydrogen halides change as the relative formula mass changes. [2 marks]

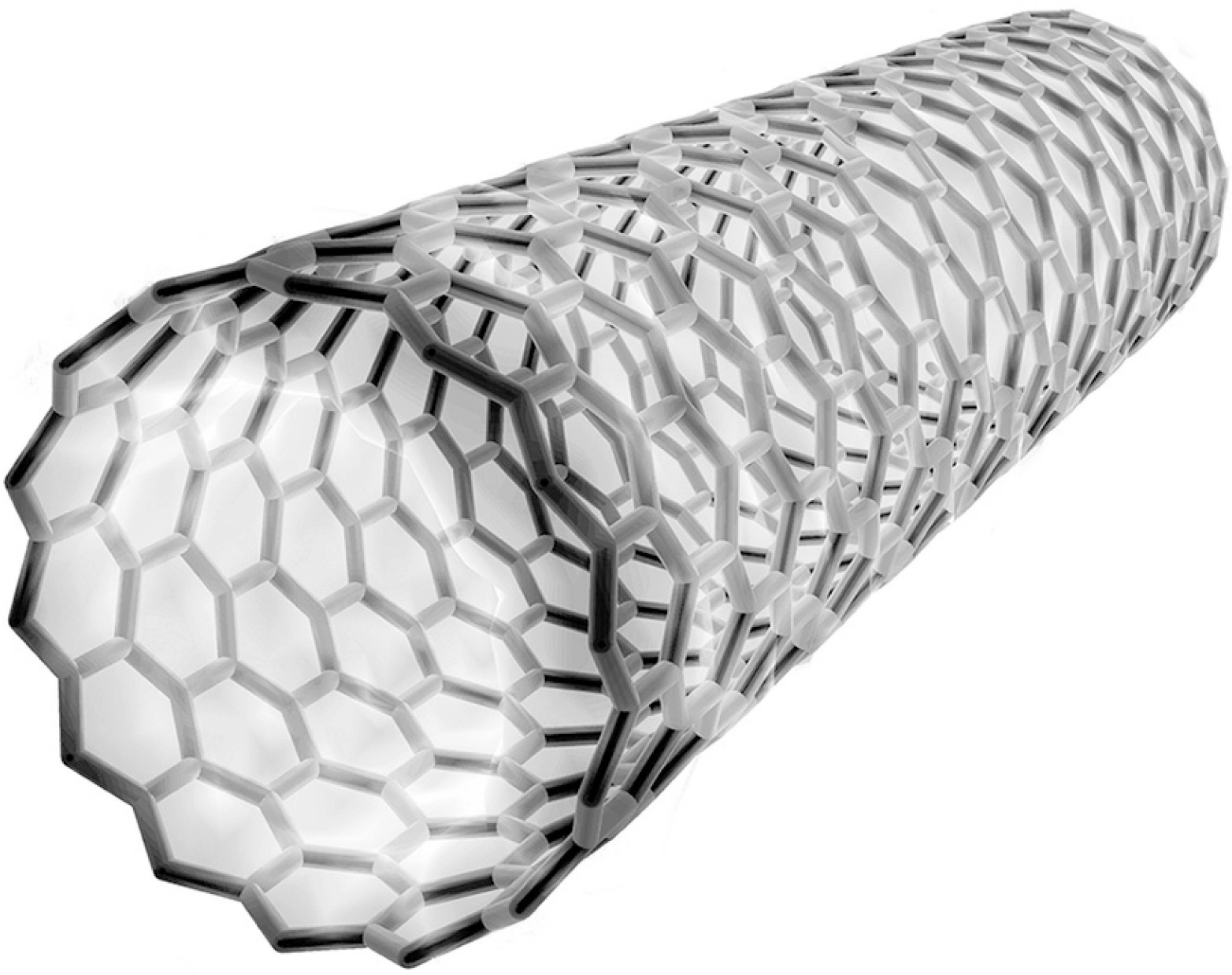
10

0	8

Carbon nanotubes are cylindrical fullerenes.

FIGURE 11 represents the structure of a carbon nanotube.

FIGURE 11



0 8 . 1

Describe the arrangement of carbon atoms in the nanotube shown in FIGURE 11. [1 mark]

0 8 . 2

Nanotubes are used in electronics.

Give ONE other use of nanotubes. [1 mark]

0 8 . 3

A nanotube contains 2380 carbon atoms.

Calculate the number of moles of carbon in this nanotube.

The Avogadro constant is 6.02×10^{23} per mole. [2 marks]

Number of moles of carbon =

_____ **mols**

0 8 . 4

Explain why carbon nanotubes can conduct electricity.

Refer to bonding between carbon atoms in your answer. [3 marks]

END OF QUESTIONS

7

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
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