A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

COMBINED SCIENCE: SYNERGY

Higher Tier

Paper 3 Physical sciences

H

8465/3H

Friday 7 June 2019 **Afternoon**

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]

JUN198465 3H 01

For this paper you must have:

- **a ruler**
- **a protractor**
- **a scientific calculator**
- **the periodic table (enclosed)**
- **the Physics Equations Sheet (enclosed).**

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Answer ALL questions in the spaces provided. Do not write on blank pages.**
- **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 100.**
- **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

Answer ALL questions in the spaces provided.

0 1

Catalase is an enzyme.

0 1 . 1

What type of molecule is an enzyme? [1 mark]

0 1 . 2

Hydrogen peroxide decomposes in the presence of catalase.

This is the equation for the reaction:

$$2\ H_2O_2(aq) \longrightarrow 2\ H_2O(l) + O_2(g)$$

Describe how the student could test for the gas produced. [2 marks]

Test _____

_____

Result _____

_____

_____

A student investigated the effect of pH on the activity of catalase.

0 1 . 3

Describe how the student could use an indicator to measure the pH of a solution. [2 marks]

_____

_____

_____

_____

_____

_____

_____

TABLE 1 shows the results.

TABLE 1

pH	Enzyme activity in arbitrary units
3.0	0
4.0	6
5.0	22
6.0	37
7.0	44
8.0	34
9.0	16
10.0	2

0 1 . 4

What is the optimum pH for catalase in this reaction?

Use TABLE 1. [1 mark]

Optimum pH = _____

0 1 . 5

How could the student find a more accurate value for the optimum pH? [1 mark]

Tick (✓) ONE box.

- ☐ **Decrease the hydrogen peroxide concentration**
- ☐ **Increase the pH range**
- ☐ **Increase the temperature to 60 °C**
- ☐ **Use smaller pH intervals**

[Turn over]

0 1 . 6

Explain the result for catalase at pH 3.0
[3 marks]

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[Turn over]

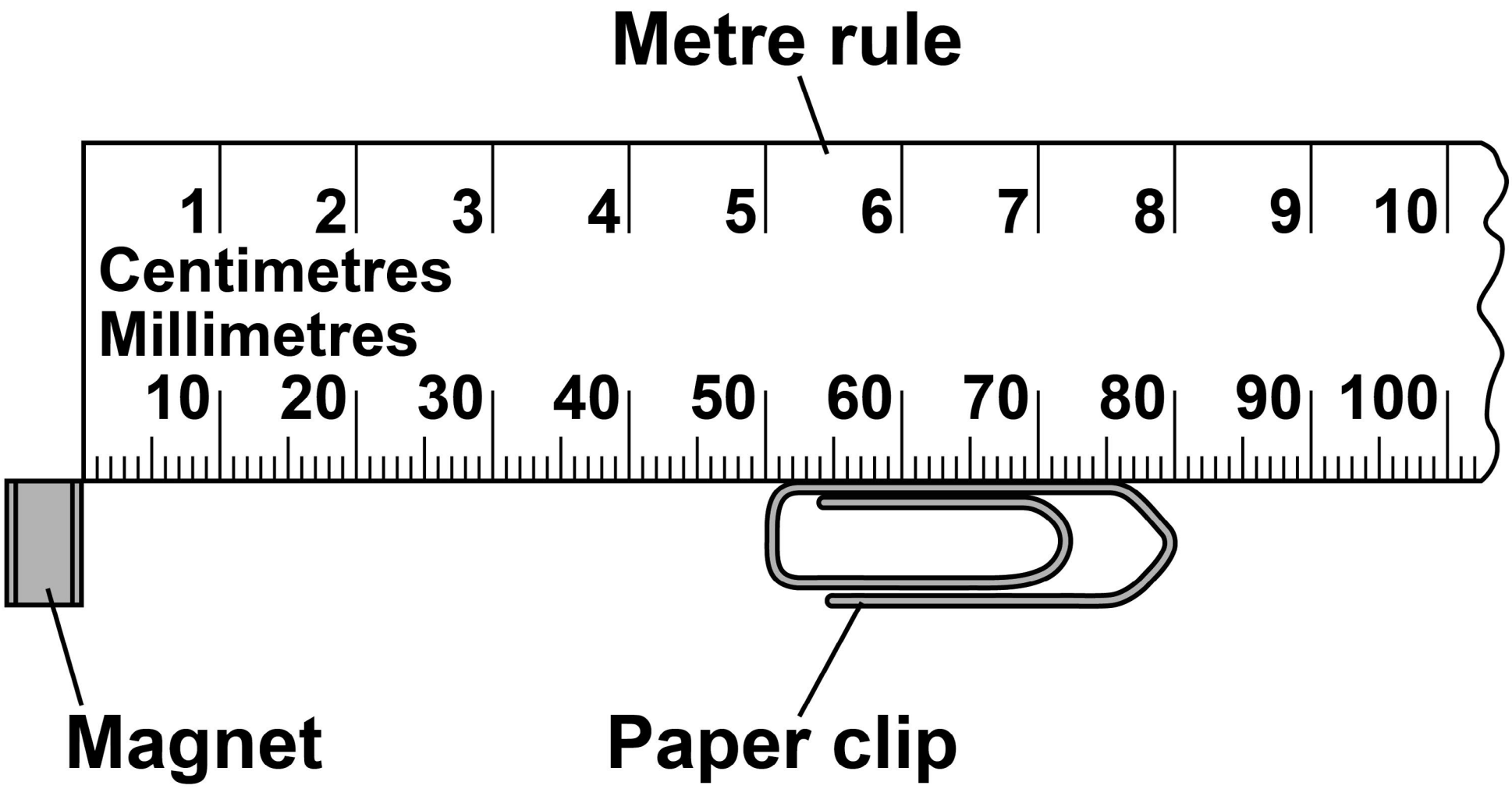
0 2

A student investigated magnets.

The student used a paper clip, metre rule and magnets.

FIGURE 1 shows the apparatus with one magnet.

FIGURE 1



0 2 . 1

Write down the resolution of the metre rule. [1 mark]

Resolution = _____

0 2 . 2

Explain why the paper clip is attracted to the magnet. [2 marks]

_____

_____

_____

_____

_____

[Turn over]

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The student placed the paper clip at different distances from the magnet.

She recorded the minimum distance at which the paper clip did not move towards the magnet.

She repeated the investigation using different numbers of magnets.

0 2 . 3

Suggest why the magnets used should be identical. [1 mark]

TABLE 2 shows the results of the investigation.

TABLE 2

Number of magnets	Minimum distance at which paper clip did not move in cm
1	1.8
2	3.6
3	5.4
4	6.6
5	X
6	7.1
7	7.2
8	7.2

0 2 . 4

Predict the value X in TABLE 2. [1 mark]

X = _____ cm

There is a resultant force on the paper clip. The resultant force causes the paper clip to accelerate towards the magnet.

0 2 . 5

Write the equation which links acceleration, mass and resultant force.
[1 mark]

0 2 . 6

The mass of the paper clip is 0.0012 kg

Calculate the acceleration of the paper clip when the resultant force on it is 0.000168 N

Give the unit. [4 marks]

Acceleration = _____

Unit _____

The Earth has a magnetic field.

0 2 . 7

The magnetic field is probably caused by movements inside the Earth.

Name the part of the Earth in which the movements take place. [1 mark]

0 2 . 8

Give ONE piece of evidence to show that the Earth's magnetic field has changed over time. [1 mark]

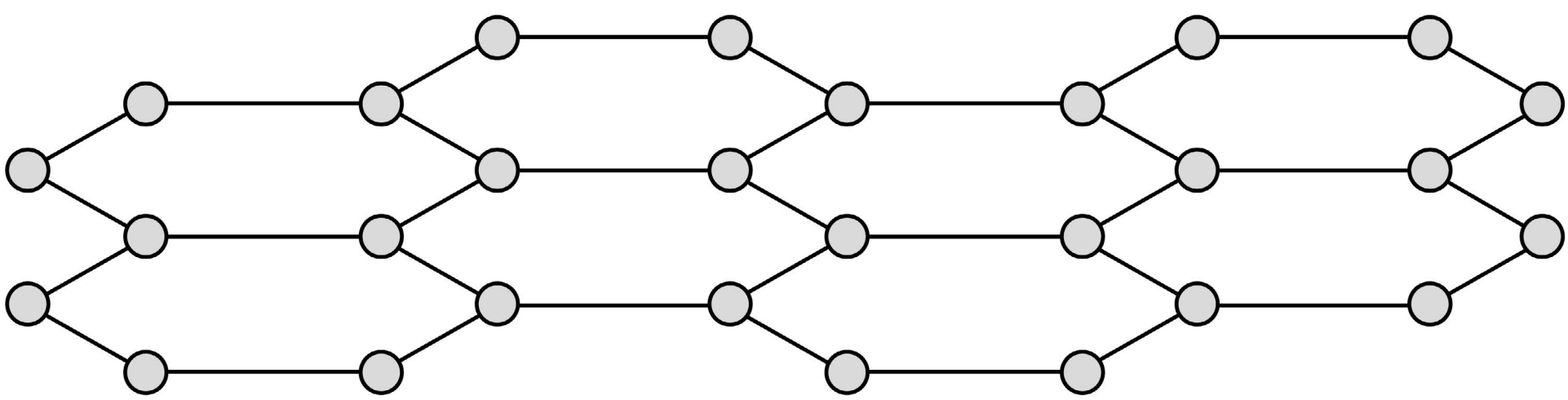
0 3

This question is about graphene and graphite.

Graphene is a single layer of graphite.

FIGURE 2 represents part of the structure of graphene.

FIGURE 2



0 3 . 1

Graphene is one atom thick. The diameter of the atom is 3.4×10^{-10} m

What is the thickness of a graphene layer in nanometres?

1 nm = 10^{-9} m [1 mark]

Tick (✓) ONE box.

- ☐ **0.034 nm**
- ☐ **0.34 nm**
- ☐ **3.4 nm**
- ☐ **34 nm**

[Turn over]

0 3 . 2

Which is ONE use of graphene? [1 mark]

Tick (✓) ONE box.

- ☐ As a detergent
- ☐ As a solvent
- ☐ In composites
- ☐ To produce polymers

0 3 . 3

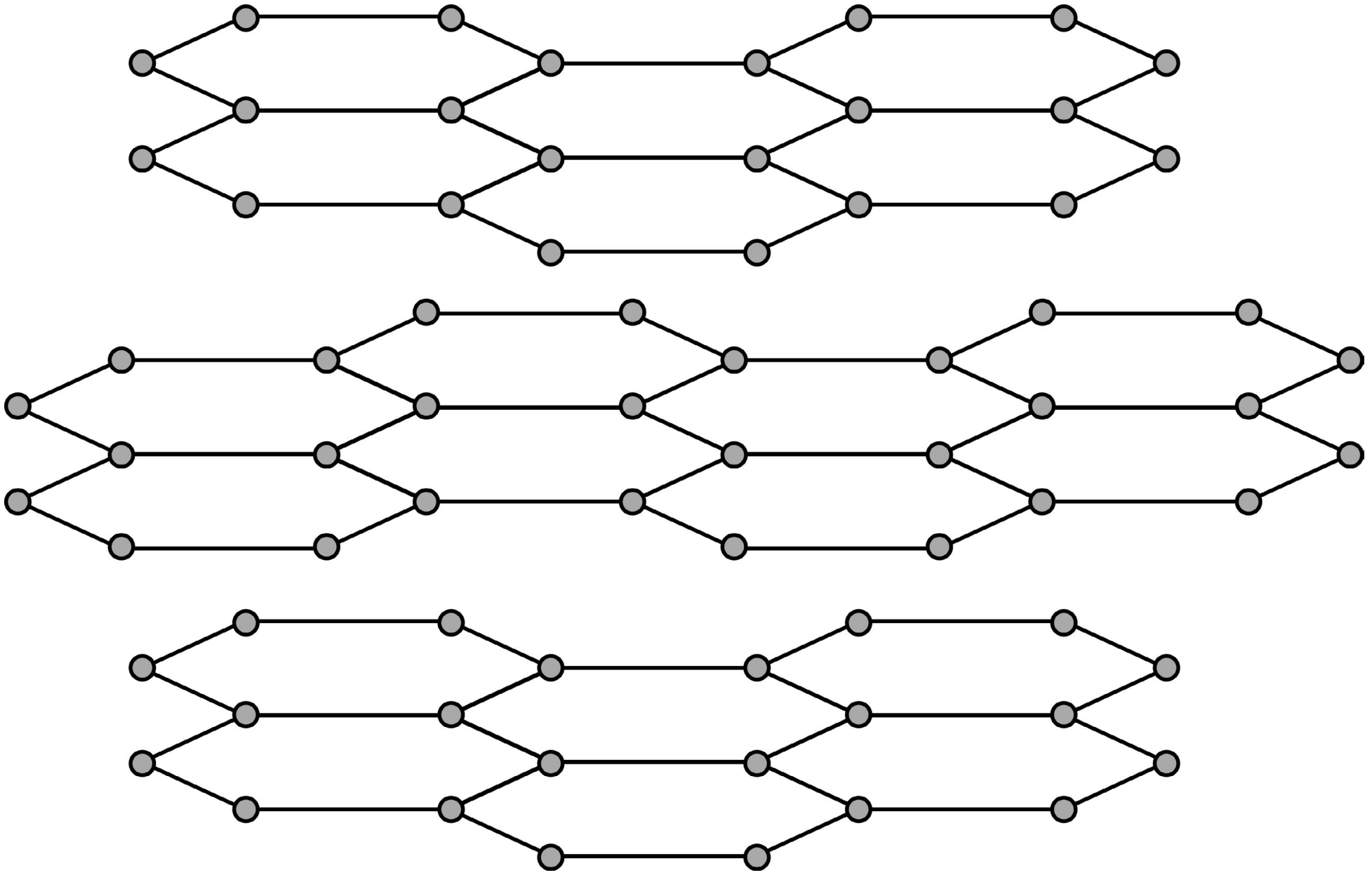
Graphene and graphite are used in electronics.

Suggest ONE reason why graphene is a more suitable material for use in electronics than graphite. [1 mark]

0 3 . 4

FIGURE 3 represents part of the structure of graphite.

FIGURE 3



Graphite is used as a contact in electric motors because graphite:

- **conducts electricity**
- **is slippery.**

Explain why graphite has these properties.

You should refer to the structure and bonding of graphite in your answer.
[6 marks]

9

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[Turn over]

0 4

This question is about hydrocarbons.

0 4 . 1

When a hydrocarbon $C_{10}H_{22}$ is cracked, two substances are produced.

Complete the equation for the reaction. [1 mark]

$$C_{10}H_{22} \longrightarrow C_7H_{16} + \_\_\_\_\_$$

0 4 . 2

Explain why the hydrocarbon C_7H_{16} has a lower boiling point than $C_{10}H_{22}$
[2 marks]

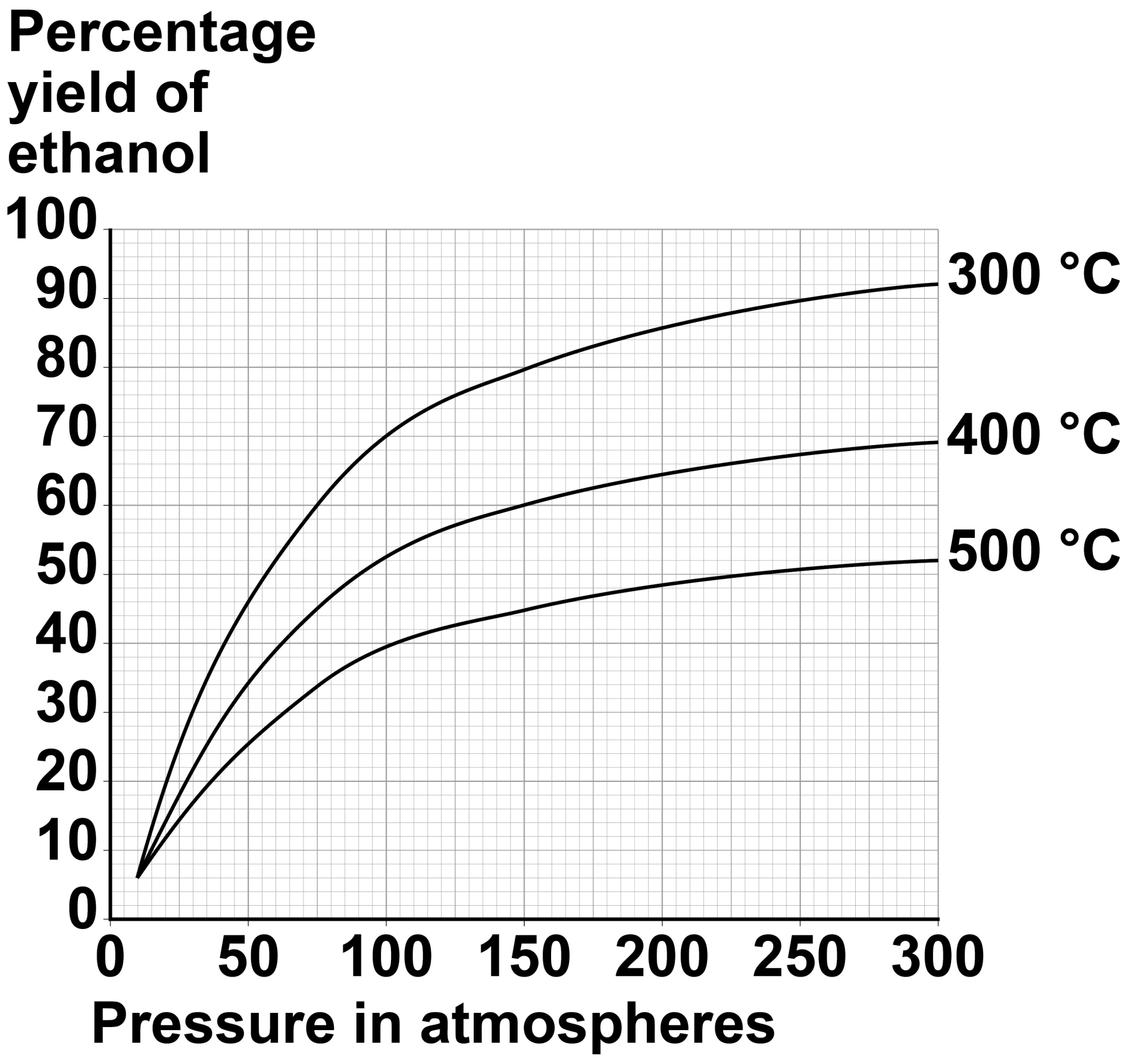
Ethanol is produced by reacting ethene with steam.

The equation for the reaction is:

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g)$$

FIGURE 4, on the opposite page, shows the percentage yield of ethanol using different reaction conditions.

FIGURE 4



[Turn over]

0 4 . 3

Explain why changing the pressure affects the percentage yield of ethanol.
[3 marks]

The forward reaction is exothermic.

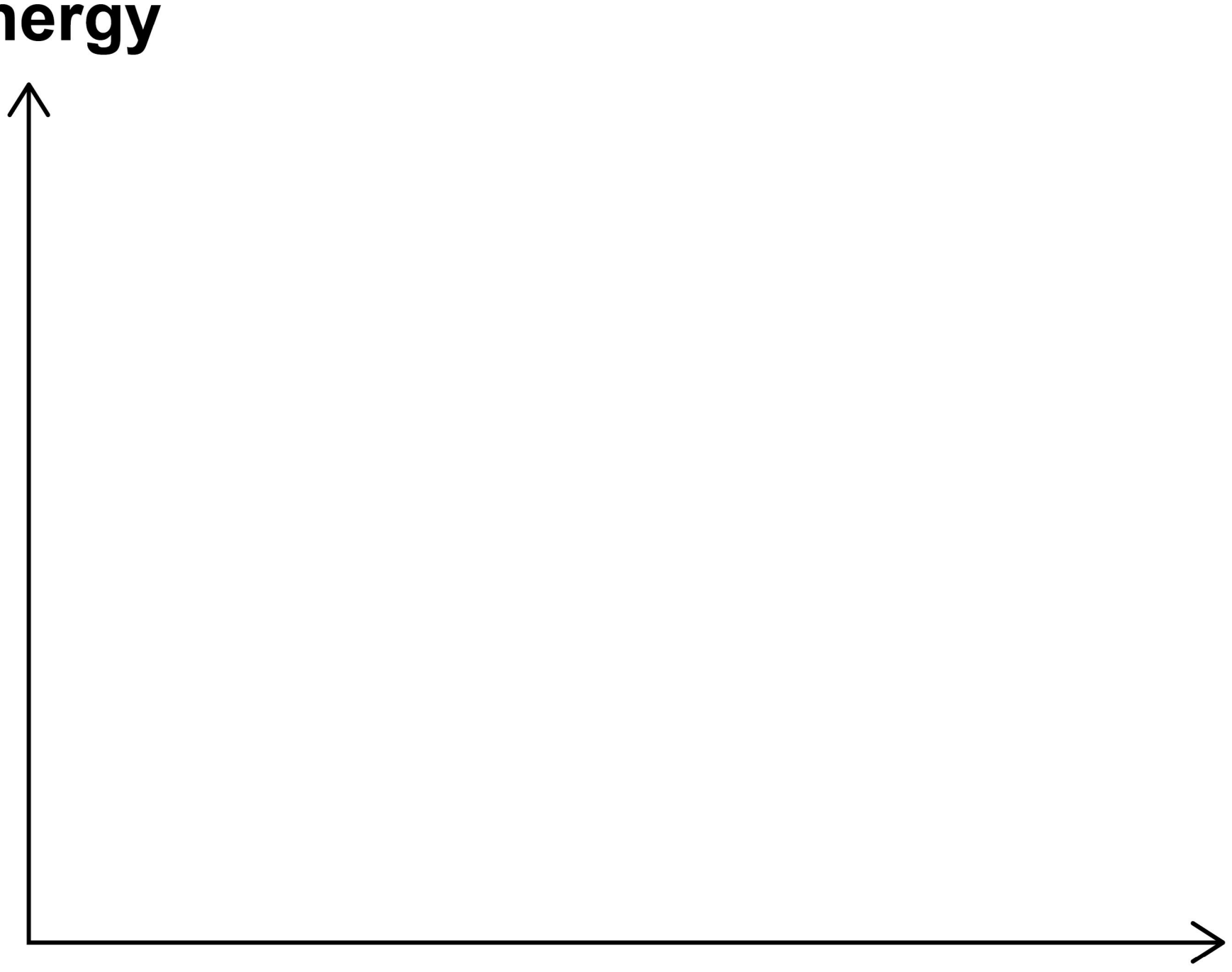
0 4 . 4

How does FIGURE 4, on page 29, provide evidence for this? [1 mark]

0 4 . 5

FIGURE 5 shows part of a reaction profile diagram.

FIGURE 5



A catalyst is used in the reaction to produce ethanol.

Complete FIGURE 5, on the opposite page, to show how the catalyst increases the rate of this reaction.

You should label the reaction profile diagram. [4 marks]

0 4 . 6

Suggest why the catalyst does NOT affect the yield of ethanol at equilibrium.
[2 marks]

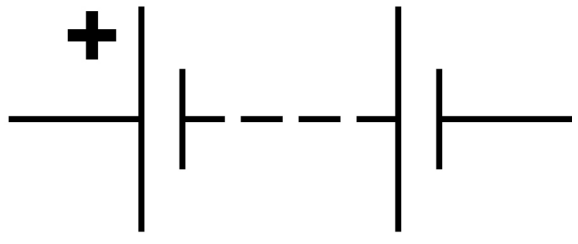
0 5

A student investigated how the resistance of a thermistor varies with temperature.

0 5 . 1

The student made measurements to determine the resistance of the thermistor at room temperature. He used an ammeter and a voltmeter.

On the opposite page, complete the circuit diagram to show a circuit the student could use. [3 marks]



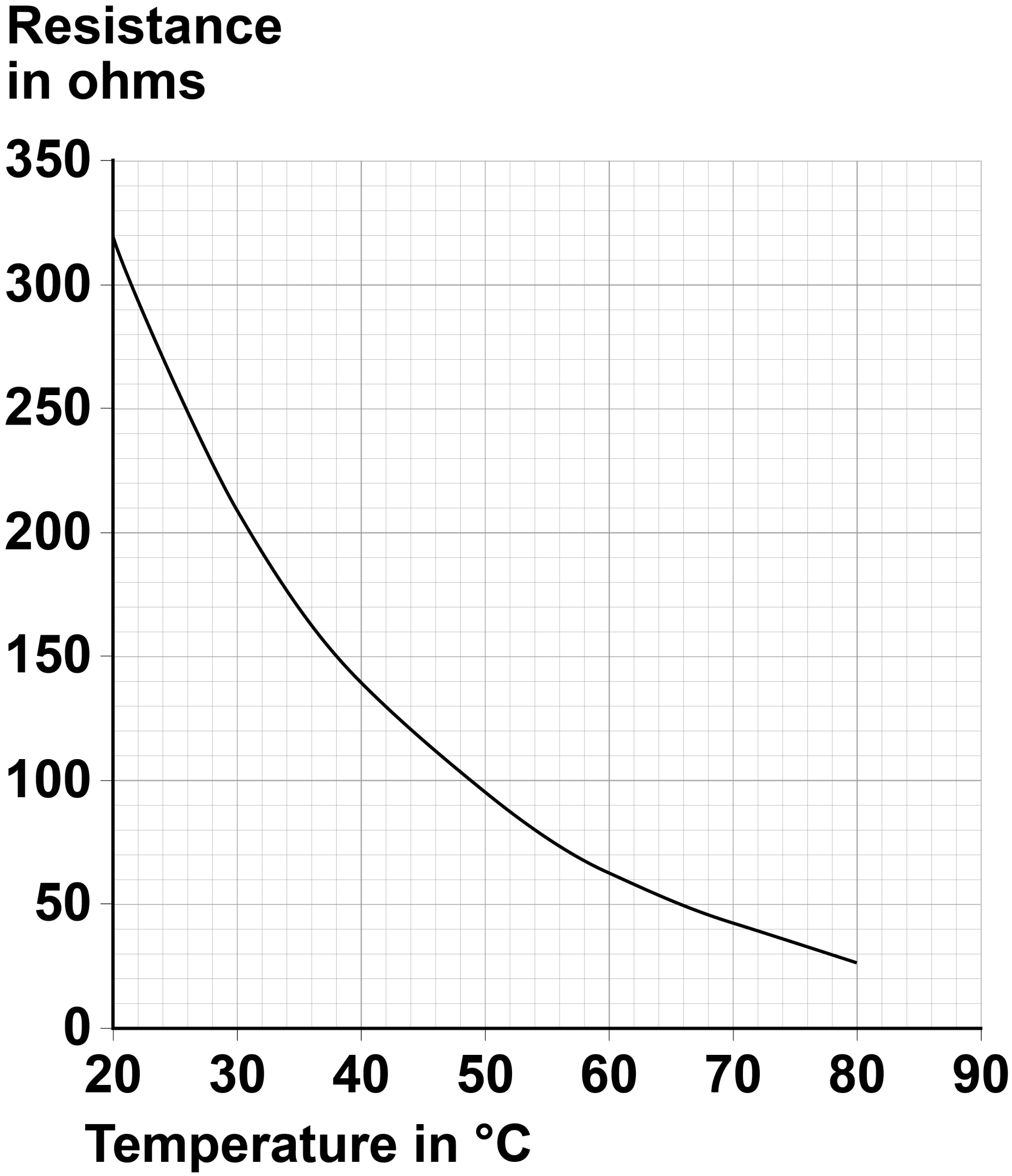
[Turn over]

The student repeated the measurements with the thermistor at different temperatures.

He plotted a graph of resistance against temperature.

FIGURE 6, on the opposite page, shows the graph.

FIGURE 6



[Turn over]

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0 5 . 2

One set of readings was:

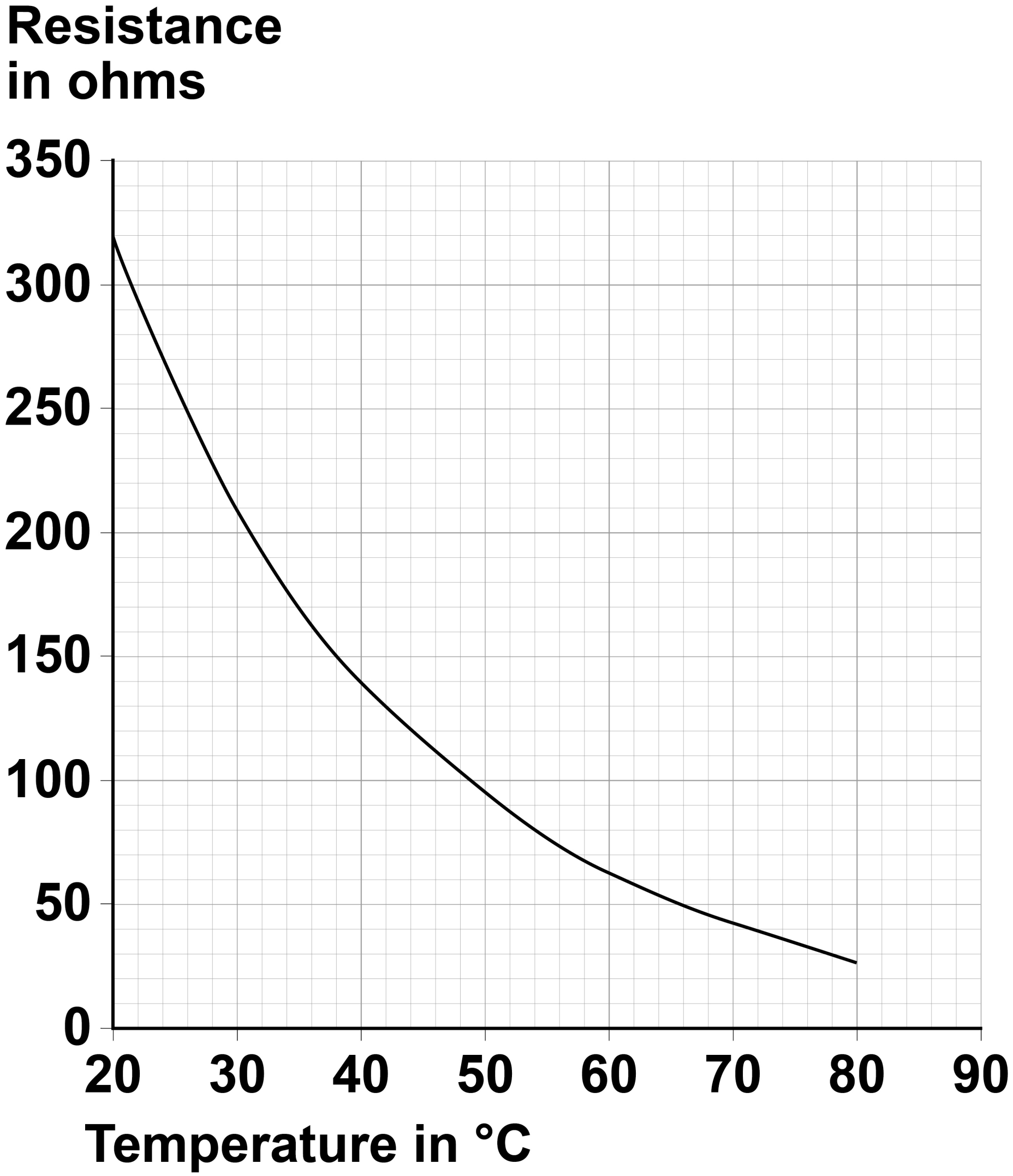
- **potential difference = 5.60 V**
- **current = 0.04 A**

Determine the temperature of the thermistor. [4 marks]

Temperature = _____ °C

[Turn over]

Repeat of FIGURE 6



0 5 . 3

Explain how the graph shows that the thermistor is most sensitive to changes in temperature between 20 °C and 25 °C
[2 marks]

9

0 6

A student investigated the rate of the reaction between magnesium and hydrochloric acid.

The student measured the volume of hydrogen gas produced.

0 6 . 1

How could the student collect and measure the volume of gas produced? [1 mark]

0 6 . 2

At the start of the investigation the volume of gas was 0 cm^3

The student took readings at 20-second intervals.

Readings for the volume of gas were 24 cm^3, 44 cm^3, 59 cm^3, 70 cm^3, 76 cm^3 and 79 cm^3

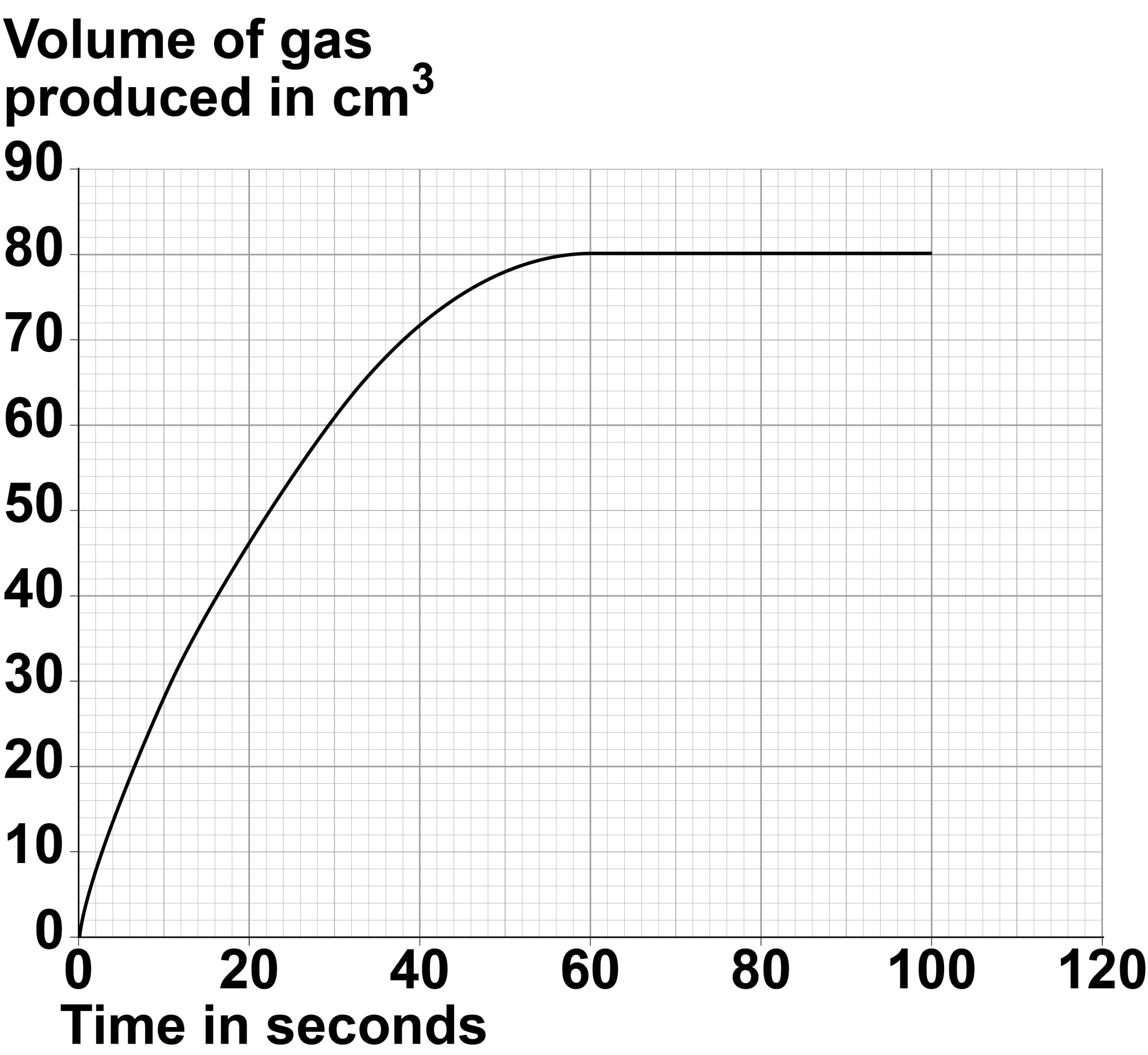
Draw a results table for the investigation.

Include the student's results in the table. [3 marks]

The student repeated the investigation at a higher temperature.

FIGURE 7 shows the results.

FIGURE 7



0 6 . 3

Determine the rate of reaction at 30 seconds.

Show your working on FIGURE 7.

Give your answer to 2 significant figures.
[4 marks]

Rate = _____ cm^3/s

[Turn over]

0 6 . 4

The rate of reaction increases at higher temperatures.

Explain why.

Answer in terms of particles. [3 marks]

11

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[Turn over]

0 7

A 1 kg mass is made from a platinum and iridium alloy.

0 7 . 1

The platinum and iridium alloy is harder than pure platinum.

Explain why alloys are harder than the pure metal. [3 marks]

0 7 . 2

The 1 kilogram mass consisted of 900 g platinum and 100 g iridium.

What was the ratio of platinum atoms to iridium atoms in the alloy?

Relative atomic masses (A_r): Pt = 195 Ir = 192 [1 mark]

Tick (✓) ONE box.

☐ **0.99 :1.00**

☐ **8.86 :1.00**

☐ **9.00 :1.00**

☐ **9.14 :1.00**

[Turn over]

The Avogadro constant is the number of atoms in 1 mole of a substance.

0 7 . 3

What is the value of the Avogadro constant? [1 mark]

Tick (✓) ONE box.

- ☐ 6.02×10^{23} per mole
- ☐ 6.02×10^{24} per mole
- ☐ 6.02×10^{25} per mole
- ☐ 6.02×10^{26} per mole

0 7 . 4

Scientists could use a sample of silicon to define the Avogadro constant.

Copper is an impurity in the silicon sample.

There are 70 nanograms of copper in 1 g of the sample.

Calculate the mass of copper in grams in 1 kg of the sample.

Give your answer in standard form.

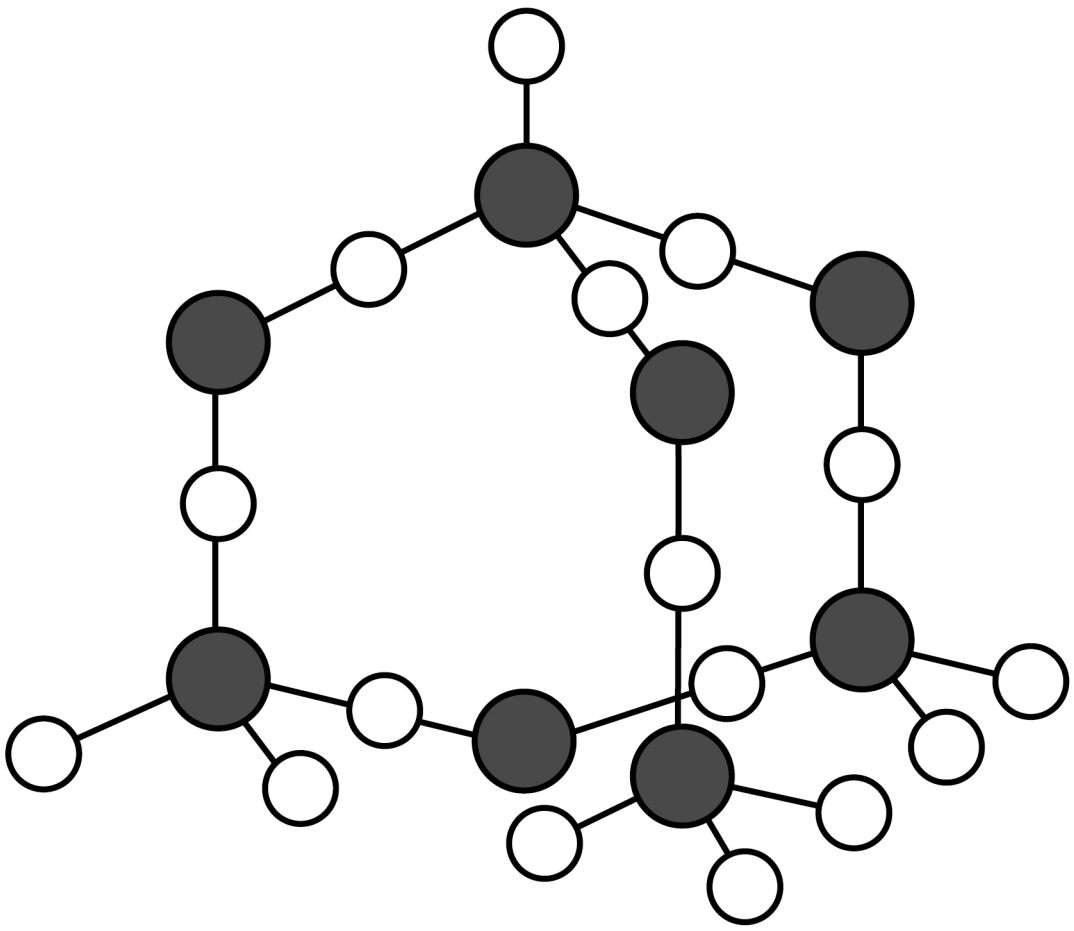
1 nanogram = 10^{-9} g [2 marks]

Mass of copper = _____ g

Silicon mainly occurs in the Earth's crust as silicon dioxide.

FIGURE 8 represents part of the structure of silicon dioxide.

FIGURE 8



KEY

○ **Oxygen atom (O)**

● **Silicon atom (Si)**

0 7 . 5

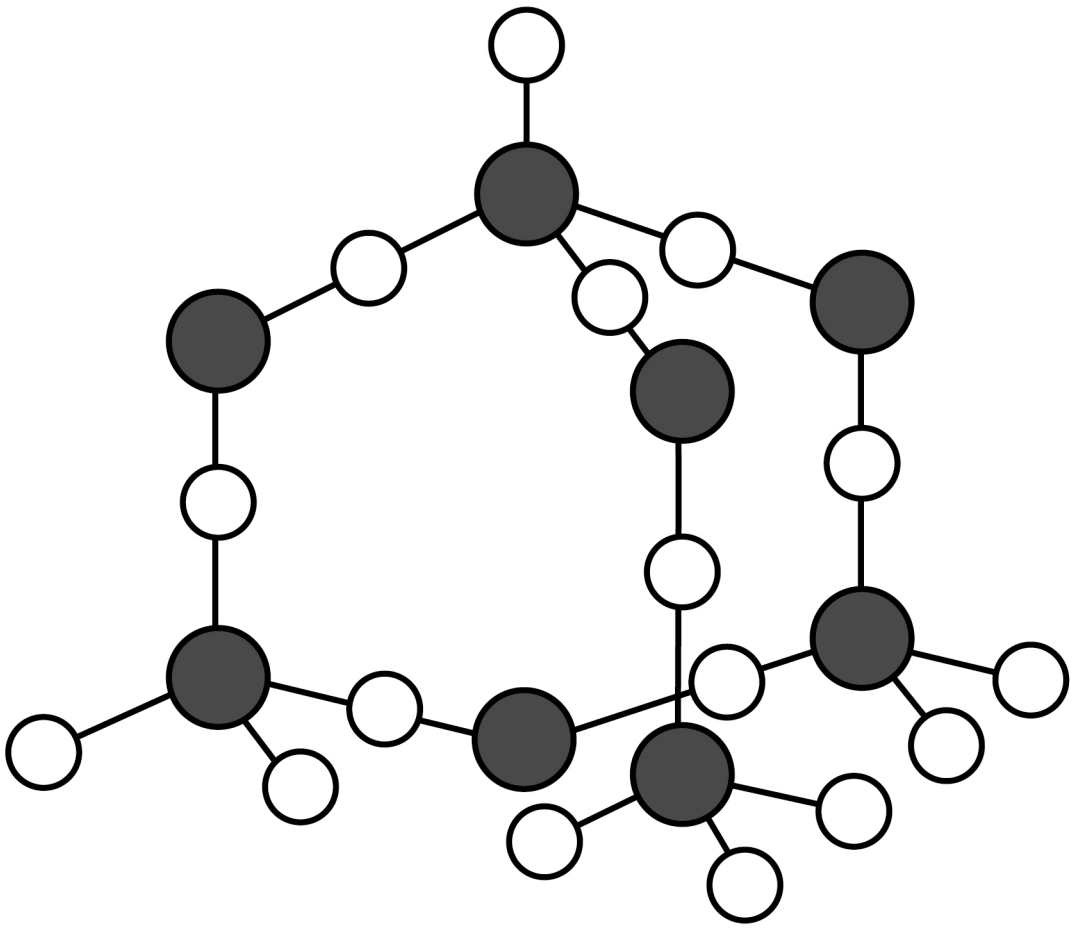
Determine the empirical formula of silicon dioxide.

Use FIGURE 8. [1 mark]

Empirical formula = _____

[Turn over]

Repeat of FIGURE 8



KEY

○ **Oxygen atom (O)**

● **Silicon atom (Si)**

0 7 . 6

Describe the structure and bonding in silicon dioxide. [3 marks]

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0 8

A student planned to make copper sulfate crystals from excess copper oxide and dilute sulfuric acid.

The equation for the reaction is:

$$CuO(s) + H_2SO_4(aq) \longrightarrow CuSO_4(aq) + H_2O(l)$$

0 8 . 1

Why is it necessary to add excess copper oxide? [1 mark]

0 8 . 2

This is the method used.

1. **Add 25 cm^3 of dilute sulfuric acid to a conical flask.**
2. **Gently warm the dilute sulfuric acid.**
3. **Add excess copper oxide to the dilute sulfuric acid.**
4. **Stir the mixture.**
5. **Heat to evaporate all the water from the mixture.**

Suggest TWO improvements to the method.

Explain why each improvement is needed.
[4 marks]

1 _____

_____

_____

_____

2

[Turn over]

0 8 . 3

The student used:

- **2 g of copper oxide (in excess)**
- **25 cm^3 of a solution of dilute sulfuric acid with a concentration of 49 g/dm^3**

Determine by how many moles the copper oxide (CuO) was in excess.

Relative atomic masses (A_r):

Cu = 63.5 O = 16

Relative formula mass (M_r) of sulfuric acid = 98 [5 marks]

Number of moles in excess =

10

[Turn over]

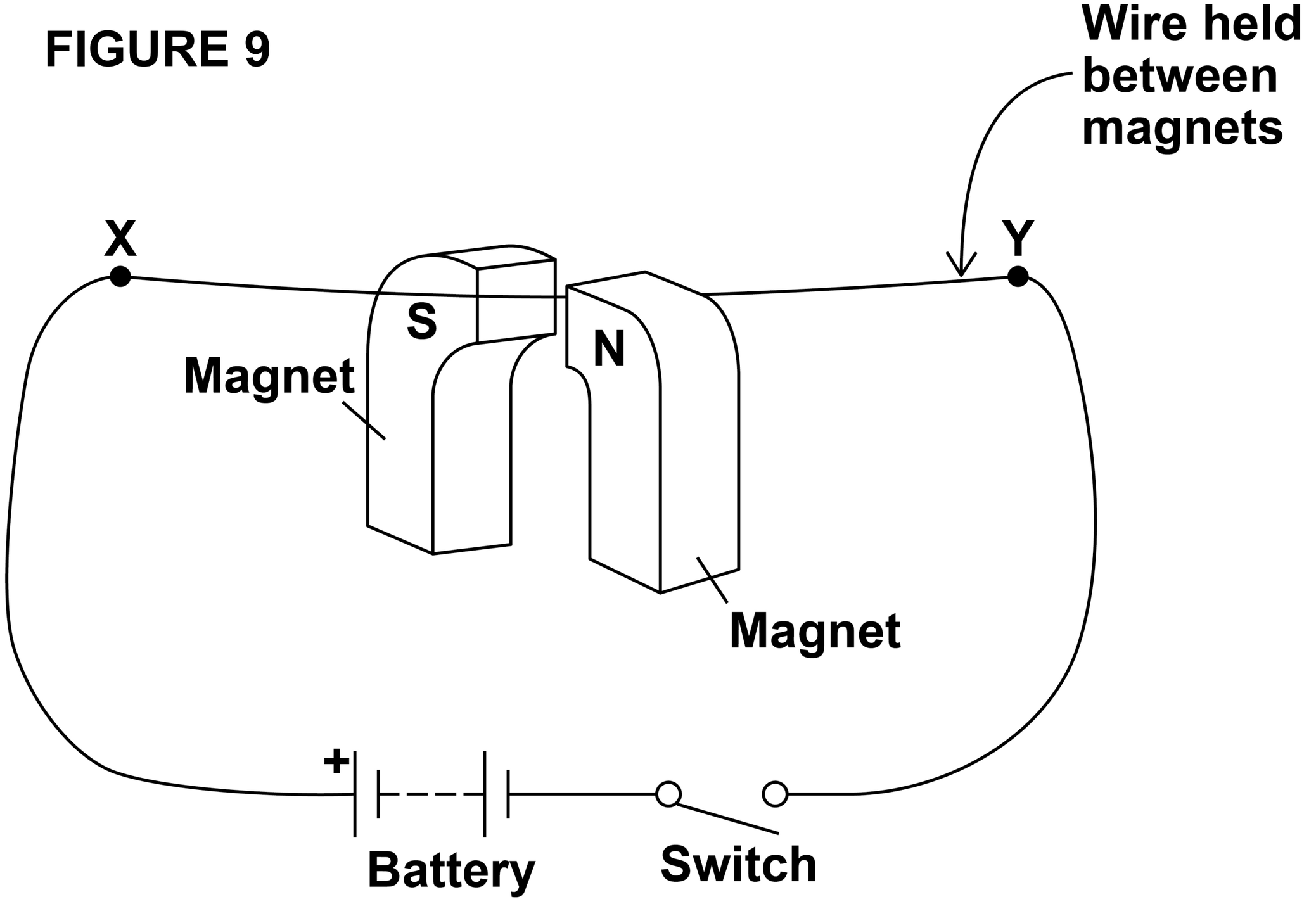
0 9

A student investigated the motor effect.

0 9 . 1

FIGURE 9, on the opposite page, shows the apparatus used.

FIGURE 9



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The student closed the switch and the wire moved.

Explain why. [5 marks]

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0 9 . 2

Give TWO ways of reversing the direction of the movement of the wire. [2 marks]

1 _____

_____

2 _____

_____

_____

[Turn over]

Electric motors use the motor effect.

Energy is supplied to the electric motor by a battery.

The battery is charged using a charger.

0 9 . 3

When the charger is connected to the battery, the potential difference across the battery is 15.0 V

The total energy stored when the battery is fully charged is 0.81 MJ

The average current used to charge the battery is 3.00 A

Calculate the time taken to fully charge the battery. [6 marks]

Time taken = _____ s

[Turn over]

0 9 . 4

The charger is plugged into the mains electricity supply.

This is an alternating supply.

Give TWO other properties of the UK mains electricity supply. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

15

END OF QUESTIONS

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For Examiner's Use	
Question	Mark
1	
2	
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4	
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6	
7	
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9	
TOTAL	