Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

COMBINED SCIENCE: SYNERGY

Foundation Tier

Paper 3 Physical sciences

F

8465/3F

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]

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

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

The reaction produced a gas.

0 1 . 1

Which gas is produced in the reaction?
[1 mark]

Tick (✓) ONE box.

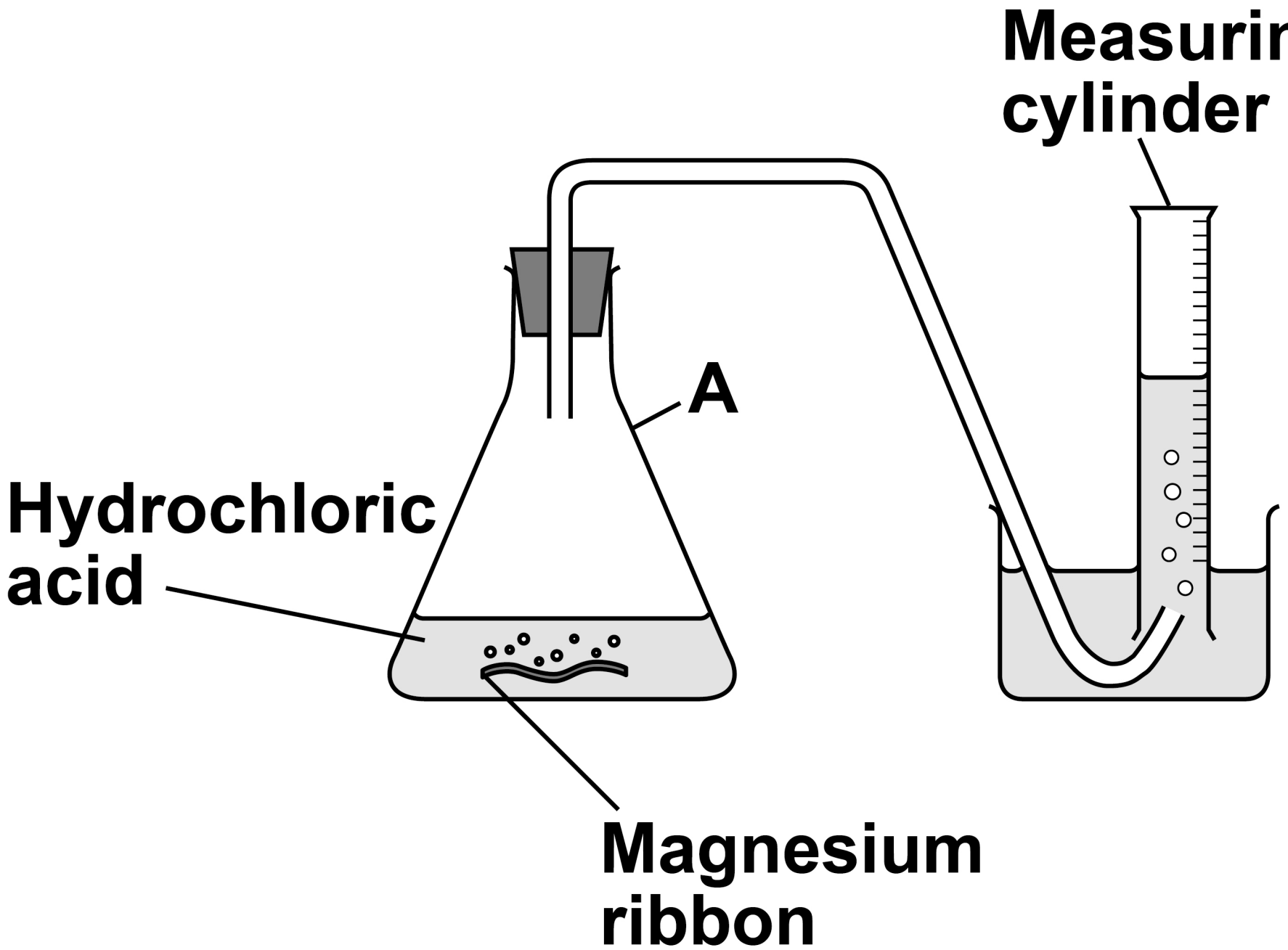
- ☐ **Carbon dioxide**
- ☐ **Chlorine**
- ☐ **Hydrogen**
- ☐ **Oxygen**

[Turn over]

0 1 . 2

FIGURE 1 shows the apparatus used.

FIGURE 1



What is the piece of equipment labelled A? [1 mark]

Tick (✓) ONE box.

- ☐ **Conical flask**
- ☐ **Delivery tube**
- ☐ **Glass beaker**
- ☐ **Test tube**

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0 1 . 3

The student saw that a chemical reaction was taking place.

Give TWO observations that would show a chemical reaction was taking place.
[2 marks]

1

2

0 1 . 4

At the start of the investigation the volume of gas in the measuring cylinder was zero.

The student measured the volume of gas collected every 20 seconds for 2 minutes.

The 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

Complete TABLE 1, on the opposite page. [3 marks]

TABLE 1

TIME IN SECONDS	
0	0
	24
	44
	59
	70
	76
	79

[Turn over]

0 1 . 5

How could the student make the reaction faster? [1 mark]

Tick (✓) ONE box.

- ☐ **Dilute the hydrochloric acid**
- ☐ **Replace magnesium ribbon with magnesium powder**
- ☐ **Use a larger measuring cylinder**
- ☐ **Use a smaller volume of hydrochloric acid**

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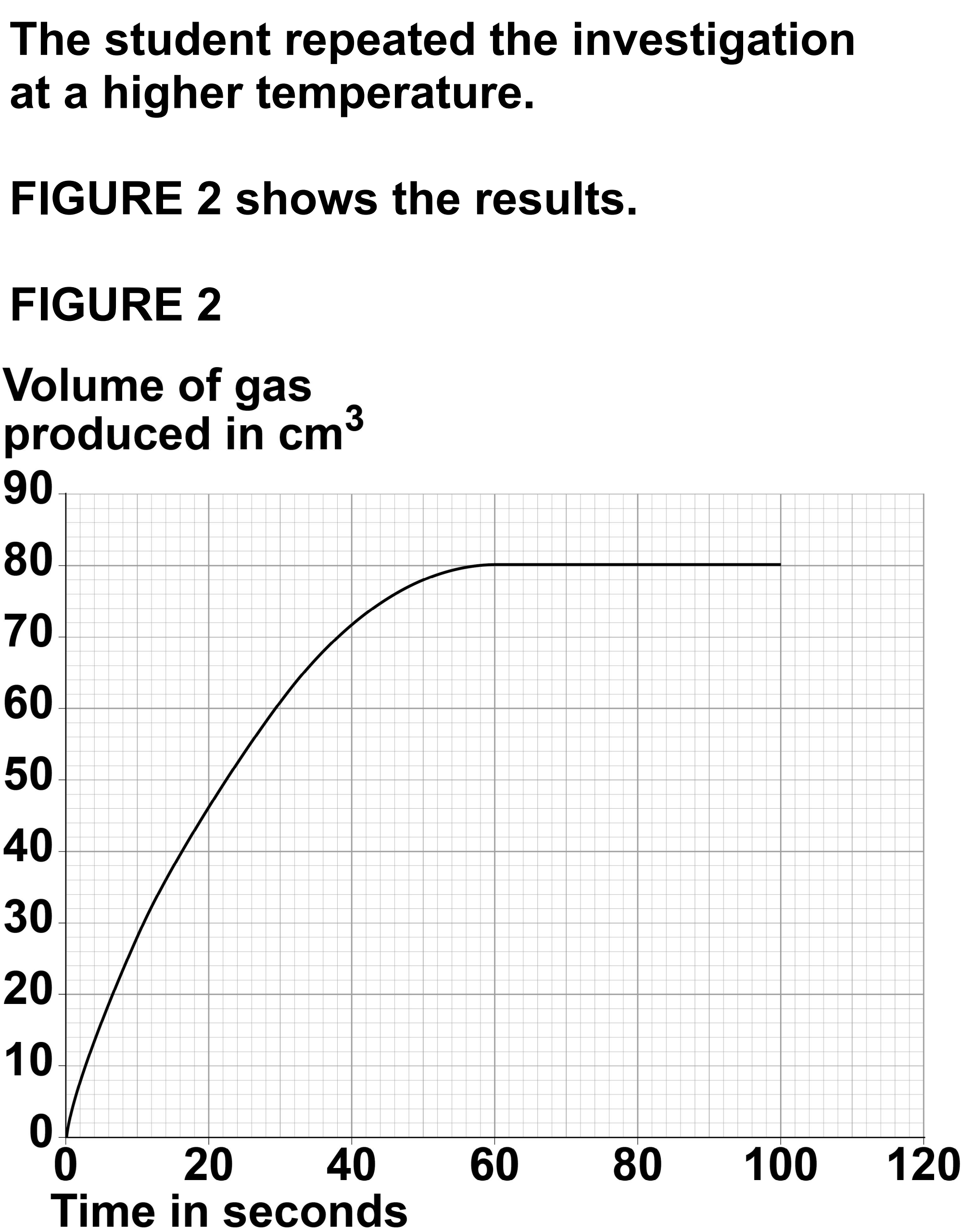
[Turn over]

The student repeated the investigation at a higher temperature.

FIGURE 2 shows the results.

FIGURE 2



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[Turn over]

0 1 . 6

Determine the mean rate of reaction for the first 10 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas formed}}{\text{time taken}}$$

Give the unit.

Choose the unit from the list below.
[3 marks]

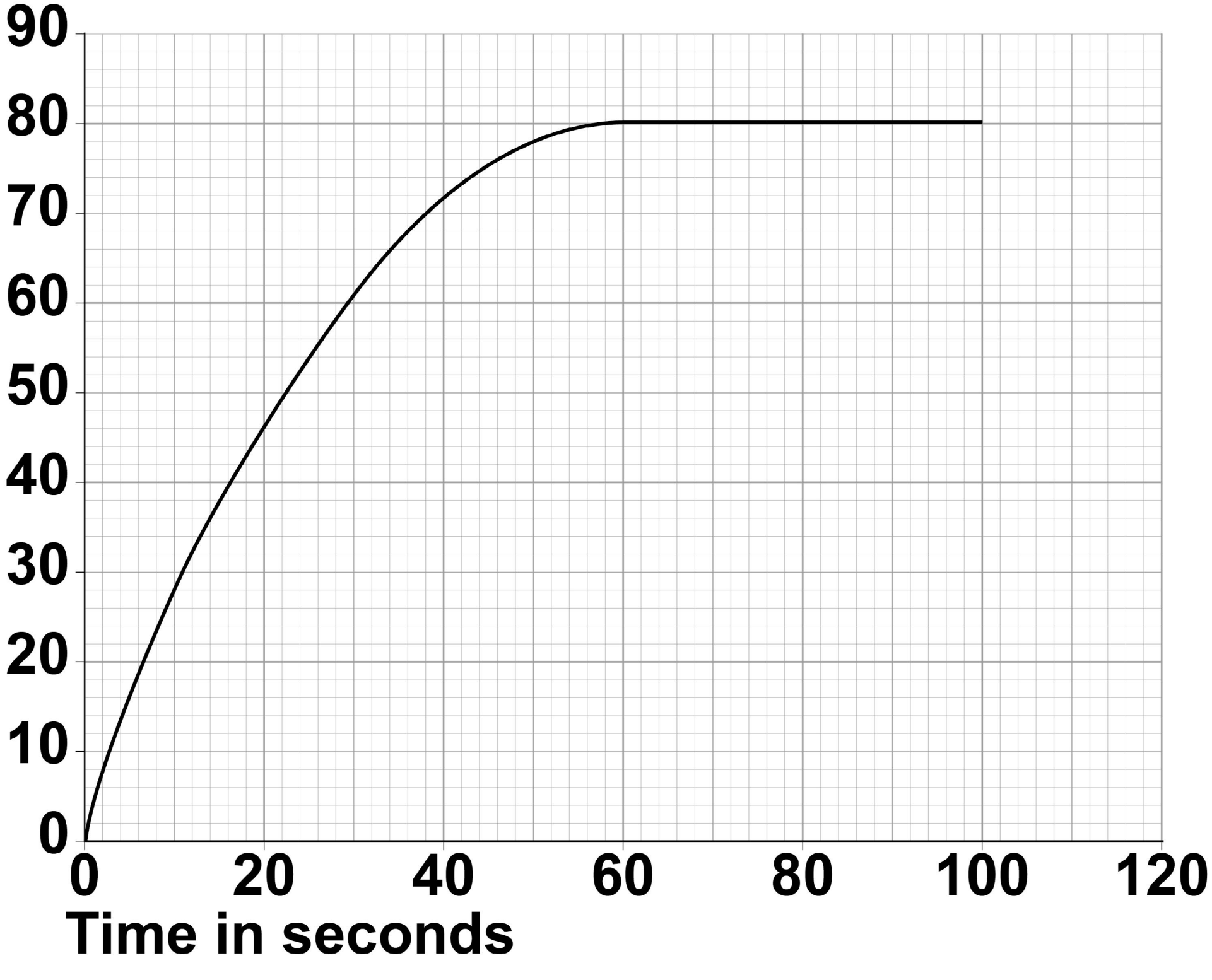
- **cm^3 / s**
- **g / s**
- **s / cm^3**
- **s / g**

Mean rate of reaction = _____

Unit _____

[Turn over]

Repeat of FIGURE 2



0 1 . 7

Determine the time at which the reaction finished and no more gas was produced.

Use FIGURE 2. [1 mark]

Time = _____ s

0 1 . 8

Why does the rate of reaction increase when the temperature is higher?
[2 marks]

Tick (✓) TWO boxes.

- ☐ **Concentration of particles increases**
- ☐ **Particles collide more often**
- ☐ **Particles have more energy**
- ☐ **Particles increase in size**
- ☐ **Particles move more slowly**

[Turn over]

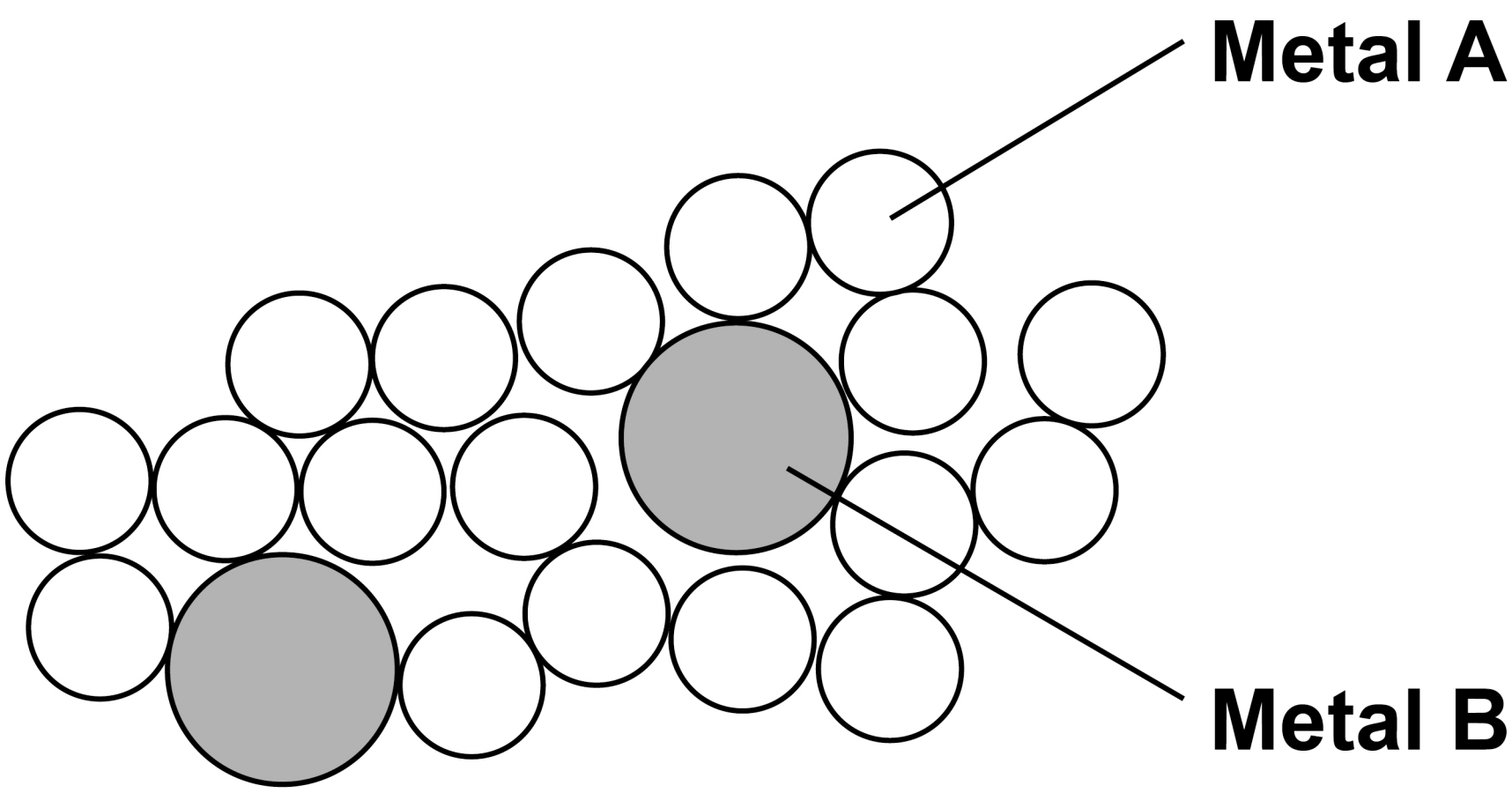
14

0 2

A 1 kilogram mass is made from a mixture of metal A and metal B.

FIGURE 3 represents part of the structure of the 1 kilogram mass.

FIGURE 3



0 2 . 1

What is the ratio of metal A atoms to metal B atoms in FIGURE 3? [1 mark]

Ratio of A:B atoms = _____ : _____

0 2 . 2

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

Tick (✓) ONE box.

☐ **A polymer**

☐ **A salt**

☐ **An alkene**

☐ **An alloy**

[Turn over]

0 2 . 3

A silicon sphere has a mass of 1 kilogram.

The largest impurity in the silicon sphere is copper.

There are 7×10^{-5} g of copper in the silicon sphere.

What is the mass of copper in kilograms in the silicon sphere? [1 mark]

Tick (✓) ONE box.

☐ **7×10^{-2} kg**

☐ **7×10^{-4} kg**

☐ **7×10^{-6} kg**

☐ **7×10^{-8} kg**

0 2 . 4

An atom of silicon has 14 electrons.

What is the electronic structure of silicon? [1 mark]

Tick (✓) ONE box.

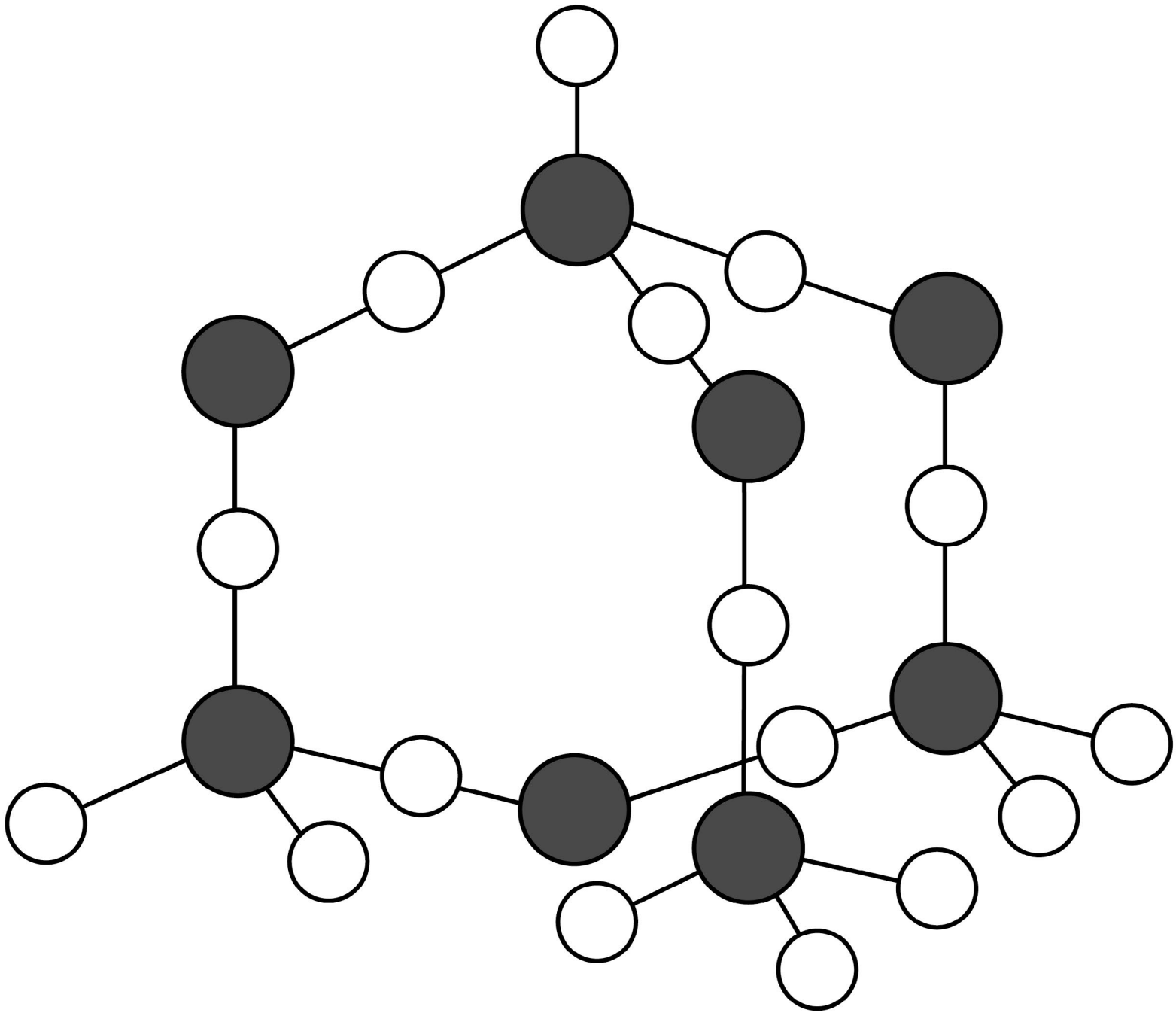
- ☐ **2,4,8**
- ☐ **2,8,4**
- ☐ **4,2,8**
- ☐ **8,4,2**

[Turn over]

Silicon dioxide is a compound of silicon and oxygen.

FIGURE 4 represents part of the giant structure of silicon dioxide.

FIGURE 4



KEY

Oxygen atom

Silicon atom

0 2 . 5

Which TWO words describe the bonding in silicon dioxide? [2 marks]

Tick (✓) TWO boxes.

- ☐ **Covalent**
- ☐ **Intermolecular**
- ☐ **Ionic**
- ☐ **Metallic**
- ☐ **Strong**

[Turn over]

0 2 . 6

How many silicon atoms are bonded to each oxygen atom in silicon dioxide?
[1 mark]

Use FIGURE 4, on page 24.

Tick (✓) ONE box.

- ☐ **1**
- ☐ **2**
- ☐ **3**
- ☐ **4**

0 2 . 7

Which symbol represents the state of silicon dioxide at room temperature?
[1 mark]

Tick (✓) ONE box.

- ☐ **(aq)**
- ☐ **(g)**
- ☐ **(l)**
- ☐ **(s)**

8

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[Turn over]

0 3

Some new cars have an electric motor that is powered by a battery.

0 3 . 1

A battery supplies direct current.

What is direct current? [1 mark]

Tick (✓) ONE box.

- ☐ **Current that always passes in the same direction**
- ☐ **Current that changes direction 50 times each second**
- ☐ **Current that does not have a direction**

[Turn over]

There are different types of battery available.

TABLE 2 shows the maximum distance a car can travel before the battery needs recharging.

TABLE 2

Type of battery	Maximum distance in km
Lead-acid	130
Lithium-ion	480
Nickel-metal hydride	200

0 3 . 2

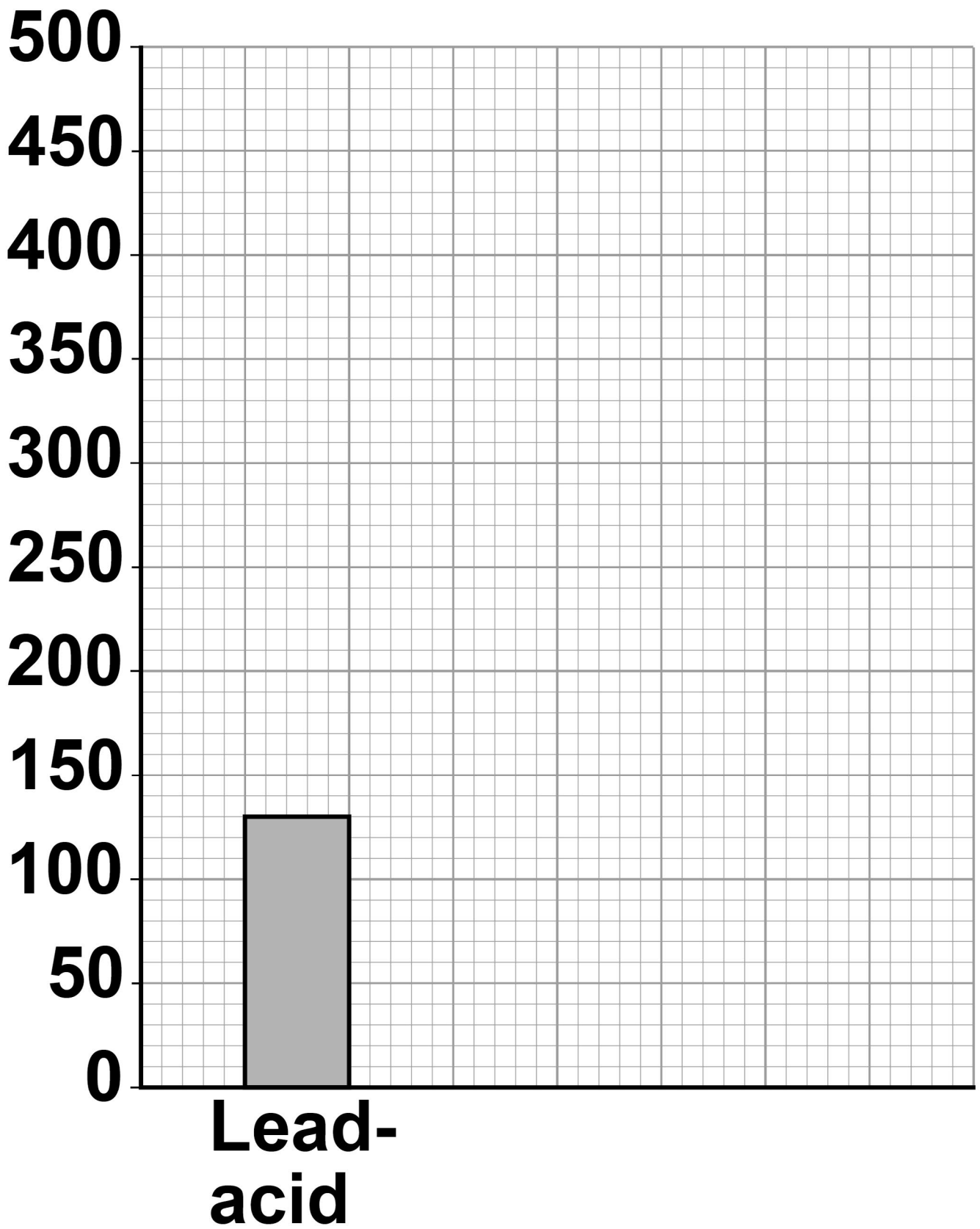
Complete FIGURE 5, on the opposite page.

You should:

- label the x-axis
- label the y-axis
- plot the data from TABLE 2.

[4 marks]

FIGURE 5



[Turn over]

0 3 . 3

A car with a lead-acid battery travels 80% of the maximum distance it can travel before the battery needs recharging.

Determine the distance the car travels.

[2 marks]

Distance = _____ km

0 3 . 4

A lithium-ion battery is put on charge for 1800 s

The current is 40 A

Calculate the total charge flow during this time.

Use the equation:

charge flow = current × time

[2 marks]

Charge flow = _____ C

[Turn over]

0 3 . 5

The driver of a car saw an obstacle in the road. He applied the brakes until the car stopped.

The thinking distance was 9.0 m

The braking distance was 13.5 m

Calculate the stopping distance of the car. [1 mark]

_____

_____

Stopping distance = _____ m

0 3 . 6

The driver had been drinking alcohol. The car had worn brakes.

Explain why these factors would increase the stopping distance of the car. [4 marks]

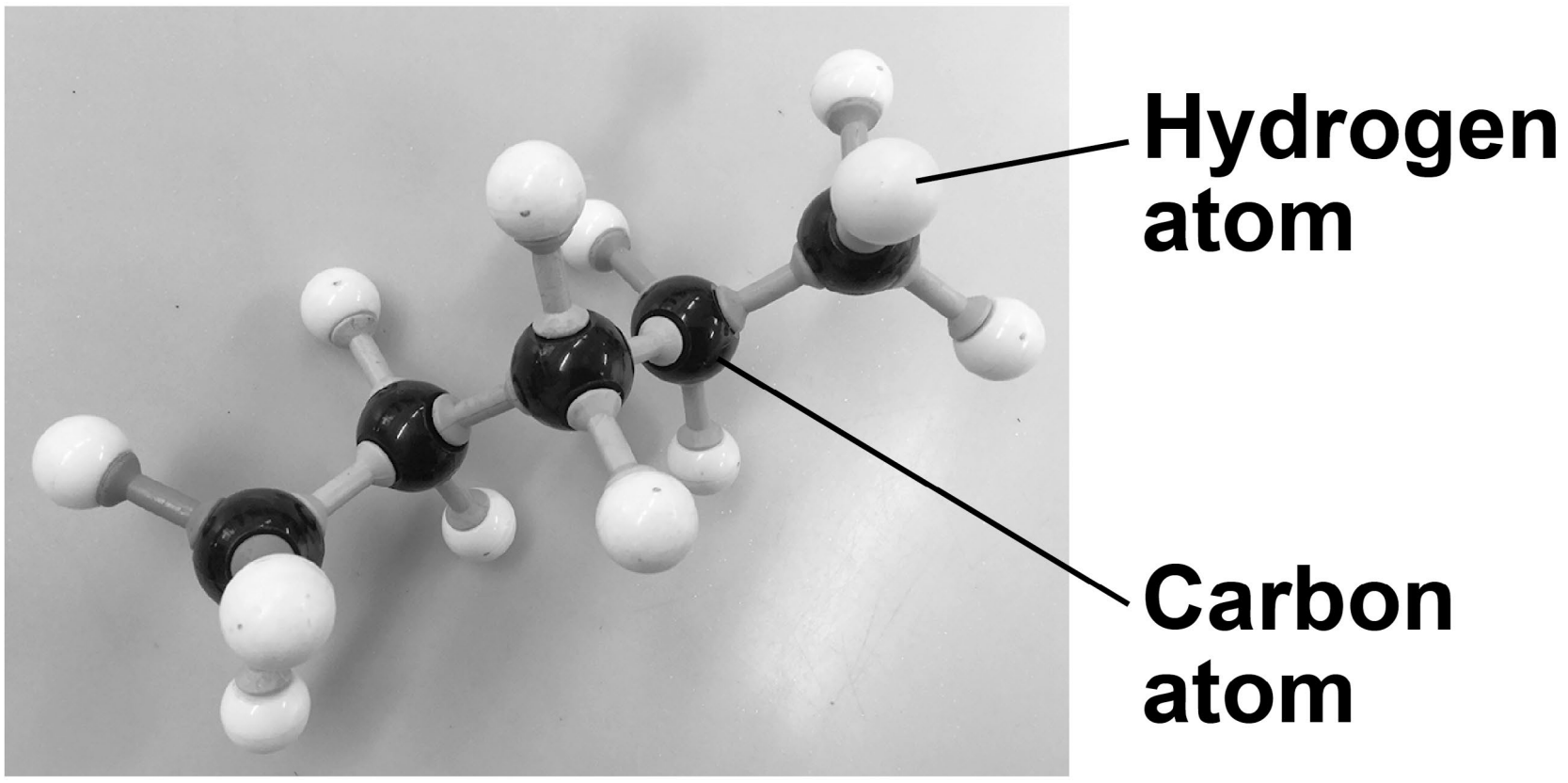
[Turn over]

0 4

This question is about hydrocarbons.

FIGURE 6 represents hydrocarbon A.

FIGURE 6



0 4 . 1

Complete the chemical formula of hydrocarbon A. [1 mark]

C_5

0 4 . 2

What do the links between the atoms in FIGURE 6 represent? [1 mark]

0 4 . 3

Hydrocarbon A is a fuel. Hydrocarbon A is completely combusted in air.

Which TWO substances are produced? [2 marks]

Tick (✓) TWO boxes.

- ☐ **Carbon dioxide**
- ☐ **Ethene**
- ☐ **Nitrogen**
- ☐ **Oxygen**
- ☐ **Water**

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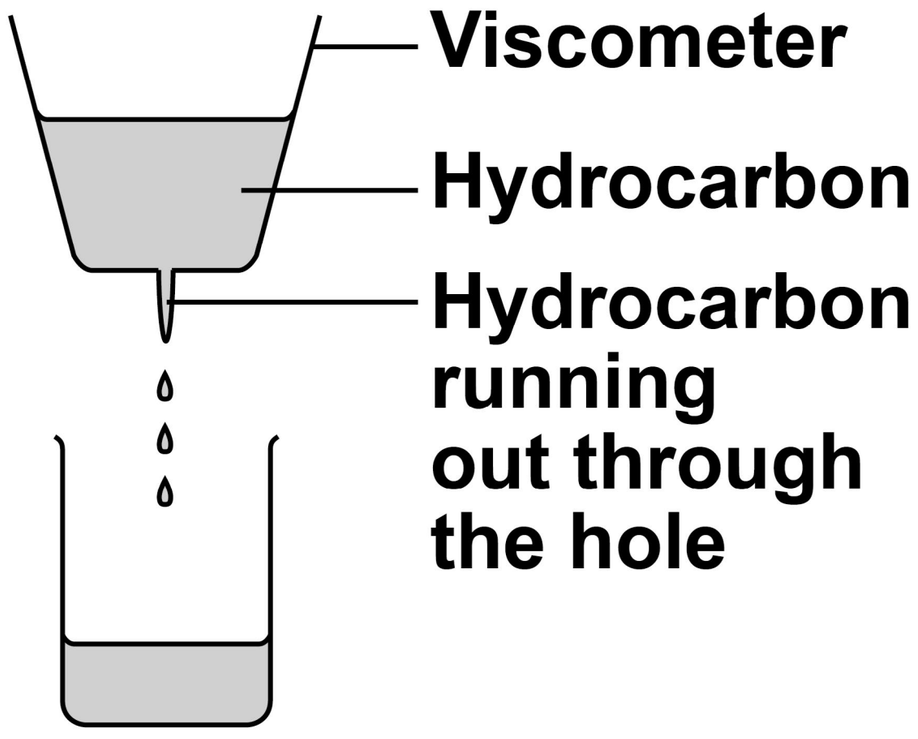
[Turn over]

Some students investigated how changing the temperature of a hydrocarbon affects the viscosity of the hydrocarbon.

FIGURE 7 shows the apparatus used.

FIGURE 7



The students recorded the time it took for 25 cm^3 of the hydrocarbon to flow through the hole in the viscometer.

[Turn over]

0 4 . 4

TABLE 3 shows a student's results at 60 °C

TABLE 3

Temperature in °C	Time to flow through the viscometer in s				
	Trial 1	Trial 2	Trial 3	Trial 4	Mean
60	21	20	24	23	X

Calculate the mean value X. [1 mark]

_____

_____

_____

Mean value X = _____ **s**

[Turn over]

Another student investigated a different hydrocarbon.

TABLE 4 shows the results.

TABLE 4

Temperature in °C	Time to flow through the viscometer in s
20	66
25	50
30	40
40	30
50	25

0 4 . 5

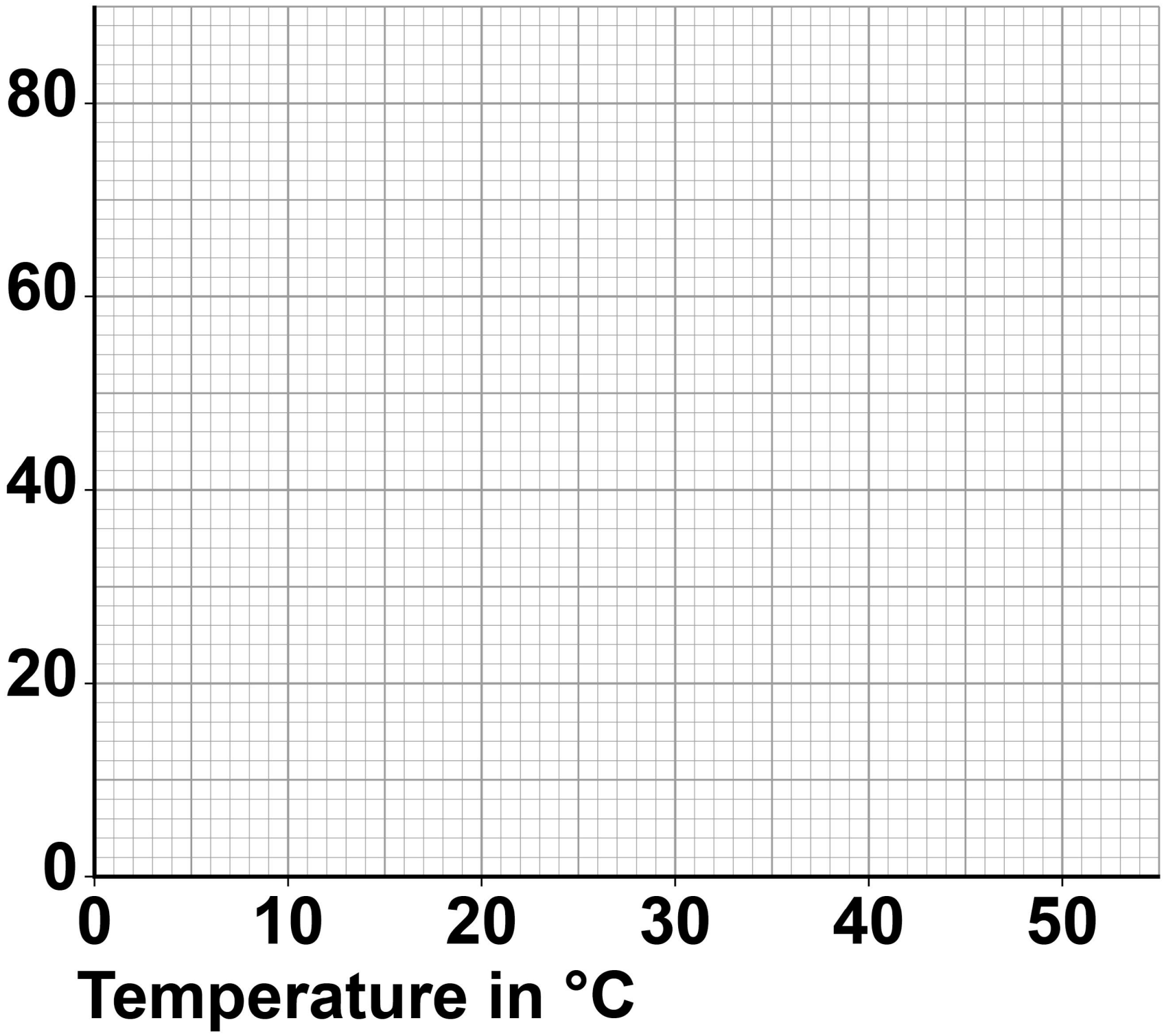
Complete FIGURE 8, on the opposite page.

You should:

- plot the data from TABLE 4
- draw a line of best fit.

[3 marks]

FIGURE 8



[Turn over]

0 4 . 6

Describe the pattern shown on FIGURE 8, on page 45. [1 mark]

0 4 . 7

The viscosity of a substance is linked to how fast the substance flows.

The lower the viscosity, the faster the substance flows.

Complete the sentence.

Choose the answer from the list below.
[1 mark]

- **decreases**
- **increases**
- **stays the same**

As the temperature increases, the viscosity of the hydrocarbon

_____ .

10

0 5

This question is about copper sulfate.

0 5 . 1

The formula of copper sulfate is $CuSO_4$

TABLE 5 shows information about the atoms in copper sulfate.

Complete TABLE 5. [3 marks]

TABLE 5

Element	Symbol	Relative number of atoms in $CuSO_4$
	Cu	
Sulfur		
		4

Copper oxide and sulfuric acid react to produce copper sulfate and water.

0 5 . 2

Complete the word equation for this reaction. [1 mark]

_____ **+** _____ ⟶ _____ **+ water**

0 5 . 3

What type of substance is copper oxide? [1 mark]

Tick (✓) ONE box.

- ☐ **A base**
- ☐ **A metal**
- ☐ **A salt**
- ☐ **An acid**

A student planned to make blue copper sulfate crystals.

This is the method the student used.

1. **Add 25 cm^3 of dilute sulfuric acid to a conical flask.**

2. **Gently warm the dilute sulfuric acid.**

3. **Add 2 g of black copper oxide to the dilute sulfuric acid.**

4. **Stir the mixture.**

5. **Evaporate some of the water from the mixture using an electric heater.**

6. **Leave the mixture to cool.**

Not all the copper oxide reacted. The student did not remove the excess copper oxide.

0 5 . 4

What would the product look like after step 6? [1 mark]

Tick (✓) ONE box.

- ☐ **Black powder only**
- ☐ **Blue crystals and black powder**
- ☐ **Blue crystals only**
- ☐ **Blue solution only**

[Turn over]

0 5 . 5

The student should have filtered the mixture after step 4.

Draw a diagram of the apparatus the student could use.

You should label:

- **the pieces of equipment used**
- **where the excess copper oxide collects.**

[3 marks]

0 5 . 6

What equipment should the student use to measure:

- **2 g of copper oxide**
- **25 cm^3 of dilute sulfuric acid?**

Draw ONE line from each measurement to the most suitable piece of equipment.
[2 marks]

MEASUREMENT	EQUIPMENT
	Balance
2 g of copper oxide	Beaker
25 cm^3 of dilute sulfuric acid	Measuring cylinder
	Metre rule
	Thermometer

[Turn over]

0 5 . 7

1 g of copper sulfate is dissolved in water to make 25 cm^3 of copper sulfate solution.

Calculate the concentration of the copper sulfate solution in g/dm^3
[2 marks]

Concentration = _____ g/dm^3

13

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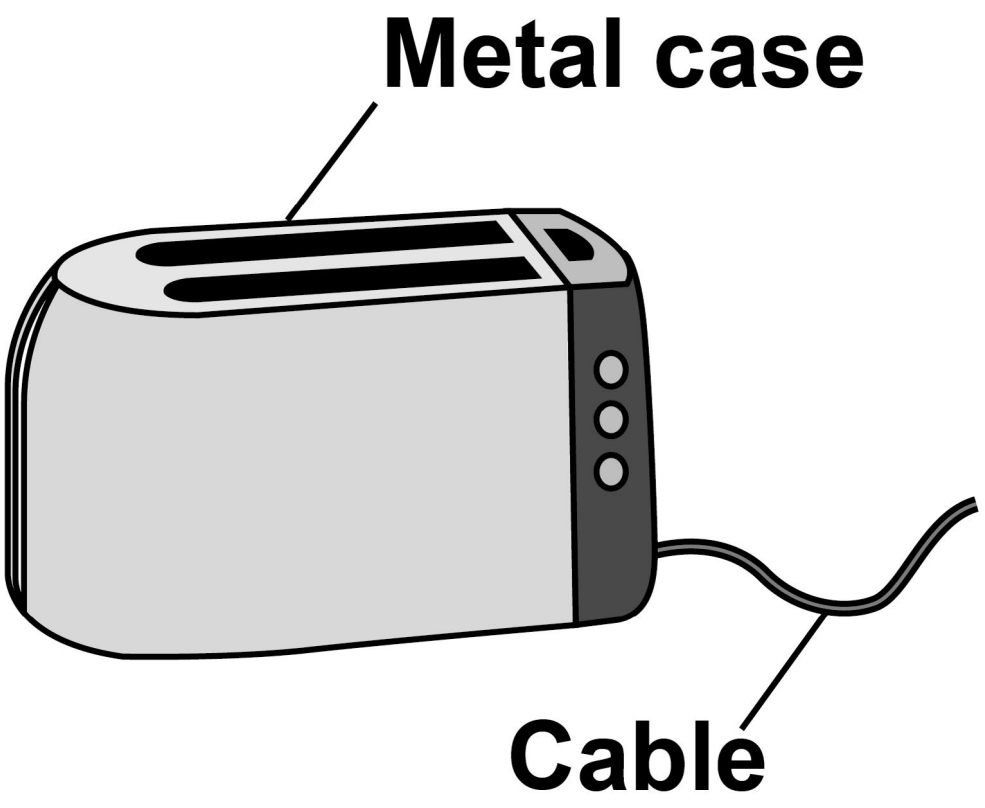
[Turn over]

0 6

FIGURE 9 shows a toaster.

FIGURE 9



A three-core cable connects the toaster to the mains electricity supply.

0 6 . 1

Which material could be used for the wires in the three-core cable? [1 mark]

Tick (✓) ONE box.

- ☐ **Copper**
- ☐ **Diamond**
- ☐ **Iodine**
- ☐ **Poly(ethene)**

[Turn over]

0 6 . 2

What is the potential of the earth wire?
[1 mark]

Tick (✓) ONE box.

- ☐ **0 V**
- ☐ **1.5 V**
- ☐ **12 V**
- ☐ **230 V**

The wires and the cable are covered with a plastic material.

0 6 . 3

The plastic material covering each wire is a different colour.

Draw ONE line from each wire to the colour of the plastic material. [2 marks]

WIRE	COLOUR OF PLASTIC MATERIAL
	Blue
Live	Blue and yellow
	Brown
Neutral	Green
	Green and yellow

[Turn over]

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0 6 . 4

The plastic material covering the wires and cable is a type of polymer.

Explain how the plastic material acts as a safety feature if a person touches the cable. [2 marks]

0 6 . 5

When the toaster is switched on the current is 4.0 A

The resistance of the toaster is 60 Ω

Calculate the power of the toaster.

Use the equation:

$$\text{power} = (\text{current})^2 \times \text{resistance}$$

Give the unit.

Choose the unit from the list below.
[4 marks]

- **coulomb**
- **joule**
- **volt**
- **watt**

Power = _____

Unit _____

[Turn over]

10

0 7

Catalase is an enzyme.

0 7 . 1

What type of molecule is an enzyme?

[1 mark]

0 7 . 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 7 . 3

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

_____

_____

_____

_____

_____

_____

_____

TABLE 6 shows the results.

TABLE 6

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 7 . 4

What is the optimum pH for catalase in this reaction?

Use TABLE 6. [1 mark]

Optimum pH = _____

0 7 . 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 7 . 6

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

10

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[Turn over]

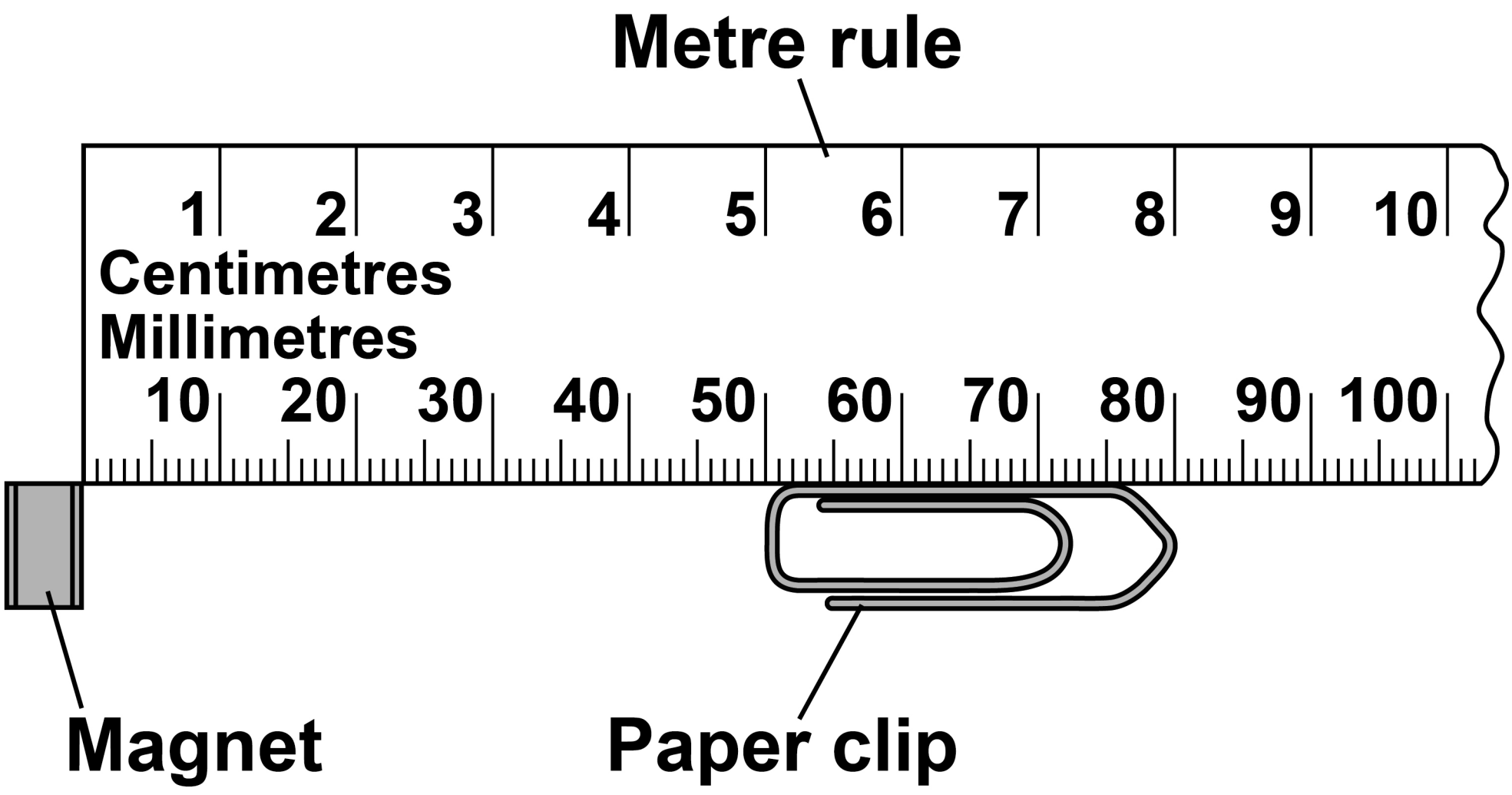
0 8

A student investigated magnets.

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

FIGURE 10 shows the apparatus with one magnet.

FIGURE 10



0 8 . 1

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

Resolution = _____

0 8 . 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 8 . 3

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

TABLE 7 shows the results of the investigation.

TABLE 7

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 8 . 4

Predict the value X in TABLE 7. [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 8 . 5

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

0 8 . 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 8 . 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 8 . 8

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

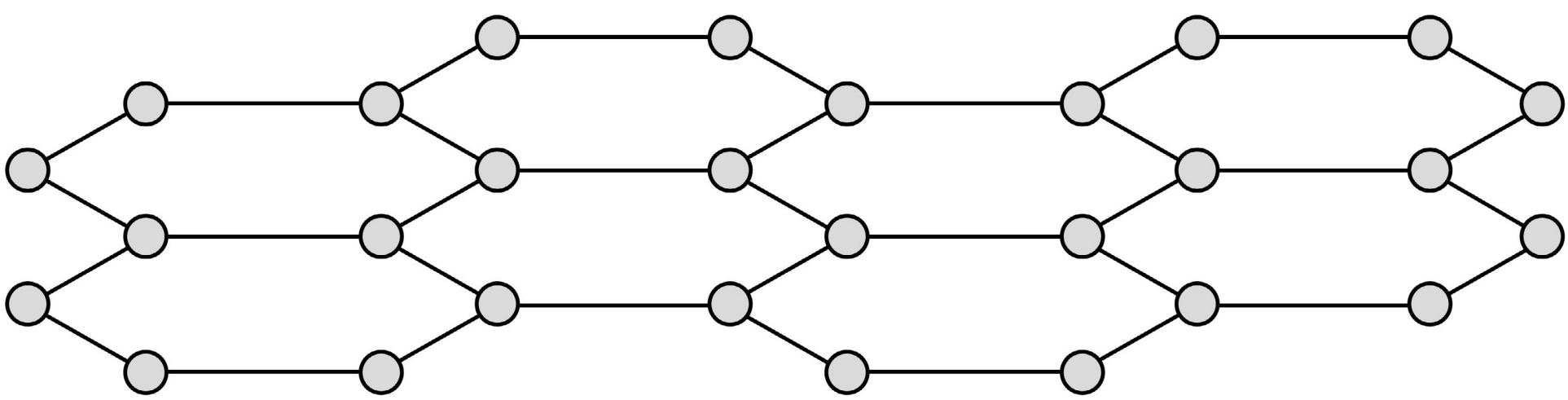
0 9

This question is about graphene and graphite.

Graphene is a single layer of graphite.

FIGURE 11 represents part of the structure of graphene.

FIGURE 11



0 9 . 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?

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

Tick (✓) ONE box.

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

[Turn over]

0 9 . 2

Which is ONE use of graphene? [1 mark]

Tick (✓) ONE box.

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

0 9 . 3

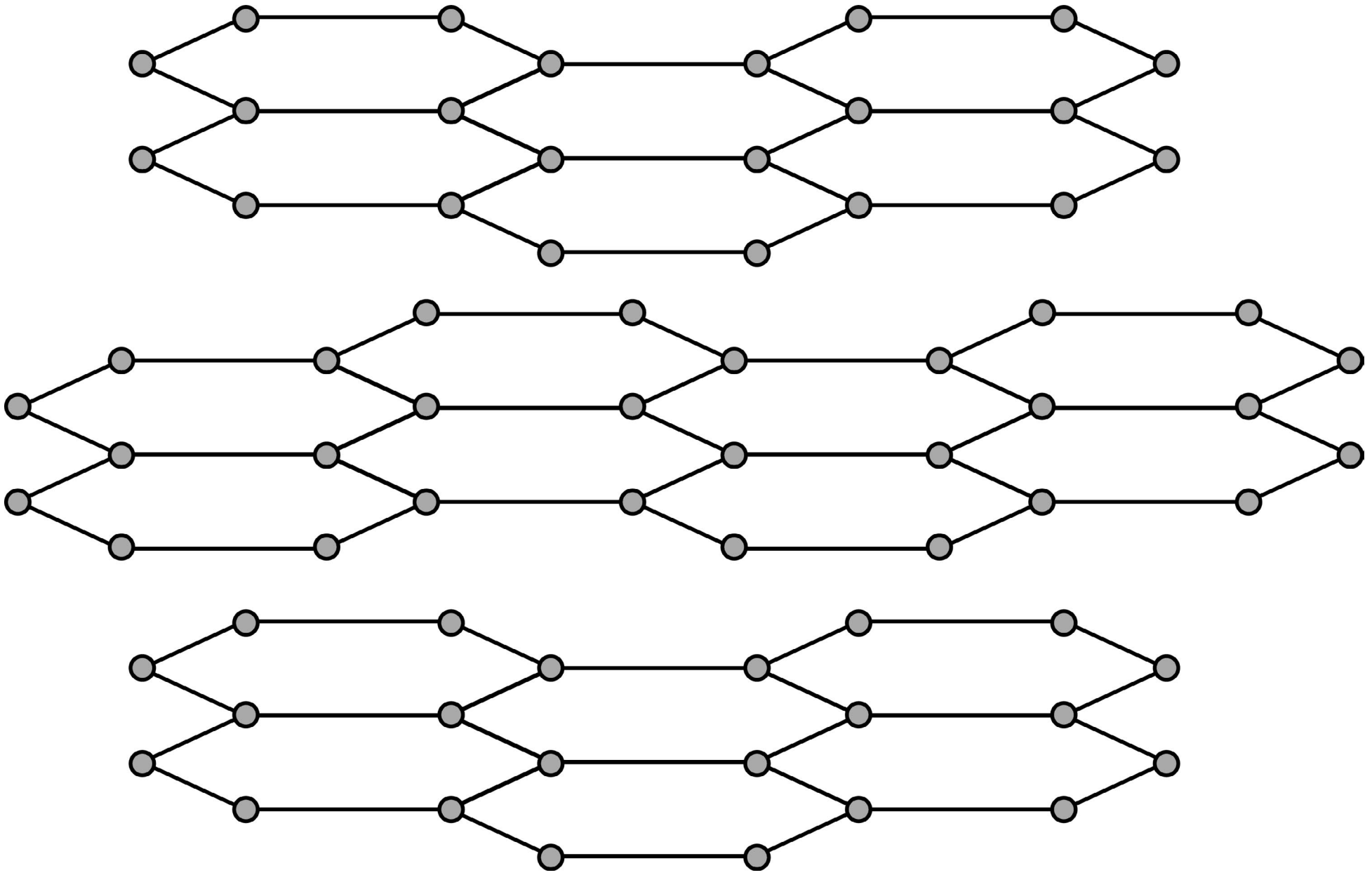
Graphene and graphite are used in electronics.

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

0 9 . 4

FIGURE 12 represents part of the structure of graphite.

FIGURE 12



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]

END OF QUESTIONS

9

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For Examiner's Use	
Question	Mark
1	
2	
3	
4	
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6	
7	
8	
9	
TOTAL	