A

AQA

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Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

COMBINED SCIENCE: SYNERGY

Foundation Tier

Paper 4 Physical sciences

F

8465/4F

Wednesday 12 June 2019 Morning

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 4F01

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.**

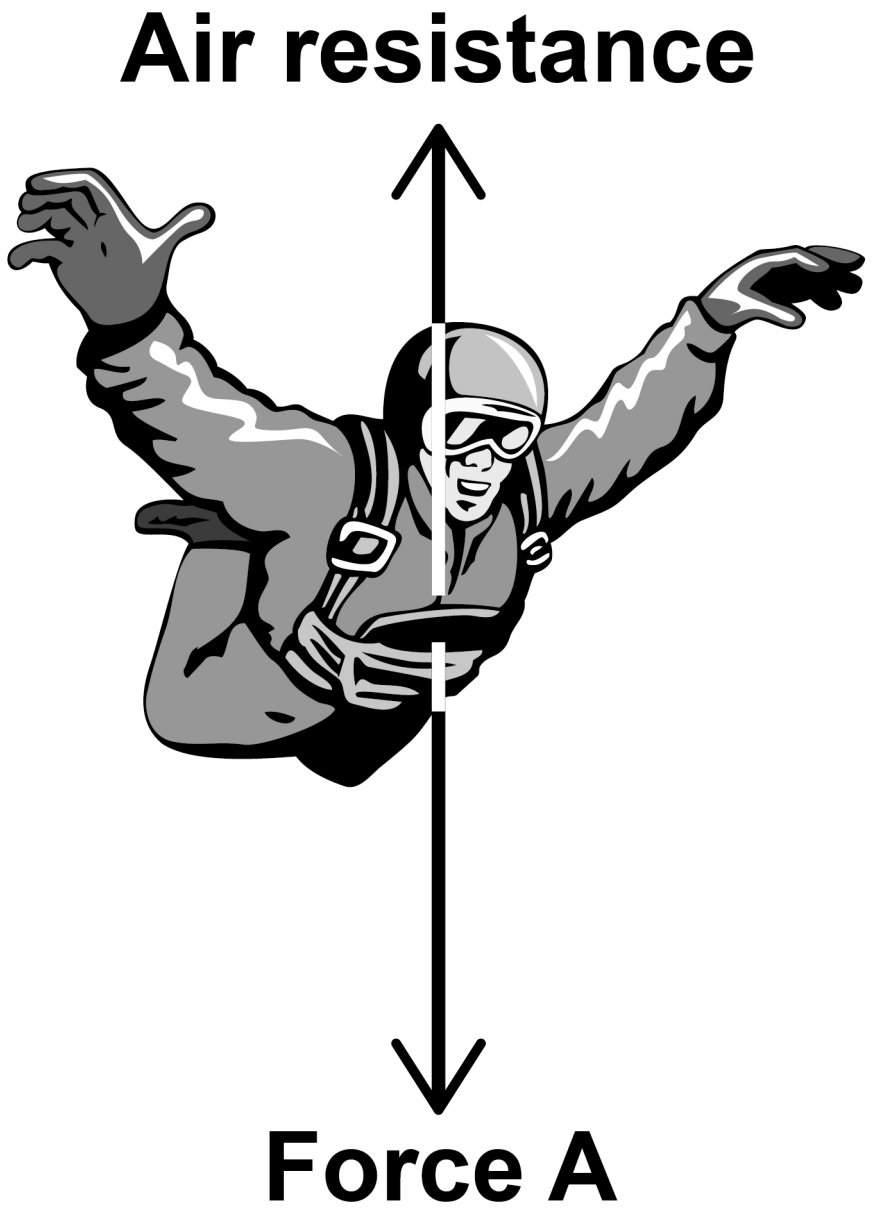
DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions in the spaces provided.

0 1

FIGURE 1 shows the forces acting on a skydiver falling through the air at a constant velocity.

FIGURE 1



0 1 . 1

What is the name of force A? [1 mark]

Tick (✓) ONE box.

- ☐ **Electrostatic force**
- ☐ **Friction**
- ☐ **Magnetic force**
- ☐ **Weight**

0 1 . 2

The skydiver is falling at a constant velocity.

What name is given to this velocity?
[1 mark]

Tick (✓) ONE box.

- ☐ **Braking velocity**
- ☐ **Minimum velocity**
- ☐ **Resultant velocity**
- ☐ **Terminal velocity**

0 1 . 3

The skydiver travels downwards at a speed of 56 m/s for 40 s

Calculate the distance travelled during this time.

Use the equation:

distance travelled = speed × time

[2 marks]

Distance travelled = _____ m

[Turn over]

0 1 . 4

The total mass of the skydiver and equipment is 85 kg

Calculate the weight of the skydiver and equipment.

Use the equation:

weight =
mass × gravitational field strength

gravitational field strength = 9.8 N/kg

[2 marks]

Weight = _____ N

0 1 . 5

The skydiver opens her parachute.

The velocity of the skydiver decreases.

Why does the velocity decrease when the parachute opens? [1 mark]

Tick (✓) ONE box.

- ☐ **Air resistance decreases**
- ☐ **Air resistance increases**
- ☐ **Air resistance stays the same**

7

0 2

The National Grid supplies electricity to consumers in the UK.

0 2 . 1

Complete the sentences on the opposite page.

Choose answers from the list below.
[3 marks]

- **current**
- **efficiency**
- **energy**
- **force**
- **frequency**

Step-up transformers are used to increase the potential difference, which causes a decrease in the

_____ .

This means that the temperature of the cables is lower, so there is less wasted

_____ .

This increases the _____ of the power transmission process.

[Turn over]

BLANK PAGE

0 2 . 2

What is the frequency of the UK mains electricity supply? [1 mark]

Tick (✓) ONE box.

- ☐ **20 Hz**
- ☐ **50 Hz**
- ☐ **230 Hz**
- ☐ **20 000 Hz**

[Turn over]

Electricity supplied to the National Grid is generated in different ways.

TABLE 1 shows the percentage of UK electricity generated from different energy resources in 2017.

TABLE 1

Energy resource	Percentage of UK electricity generated
Coal	7
Natural gas	41
Nuclear	X
Wind	12
Other resources	17

0 2 . 3

Calculate value X in TABLE 1. [1 mark]

_____

_____

X = _____ **%**

0 2 . 4

Explain why generating electricity using natural gas causes environmental problems. [2 marks]

_____

_____

_____

_____

_____

_____

[Turn over]

0 2 . 5

Give ONE advantage and ONE disadvantage of using wind turbines to generate electricity. [2 marks]

Advantage _____

Disadvantage _____

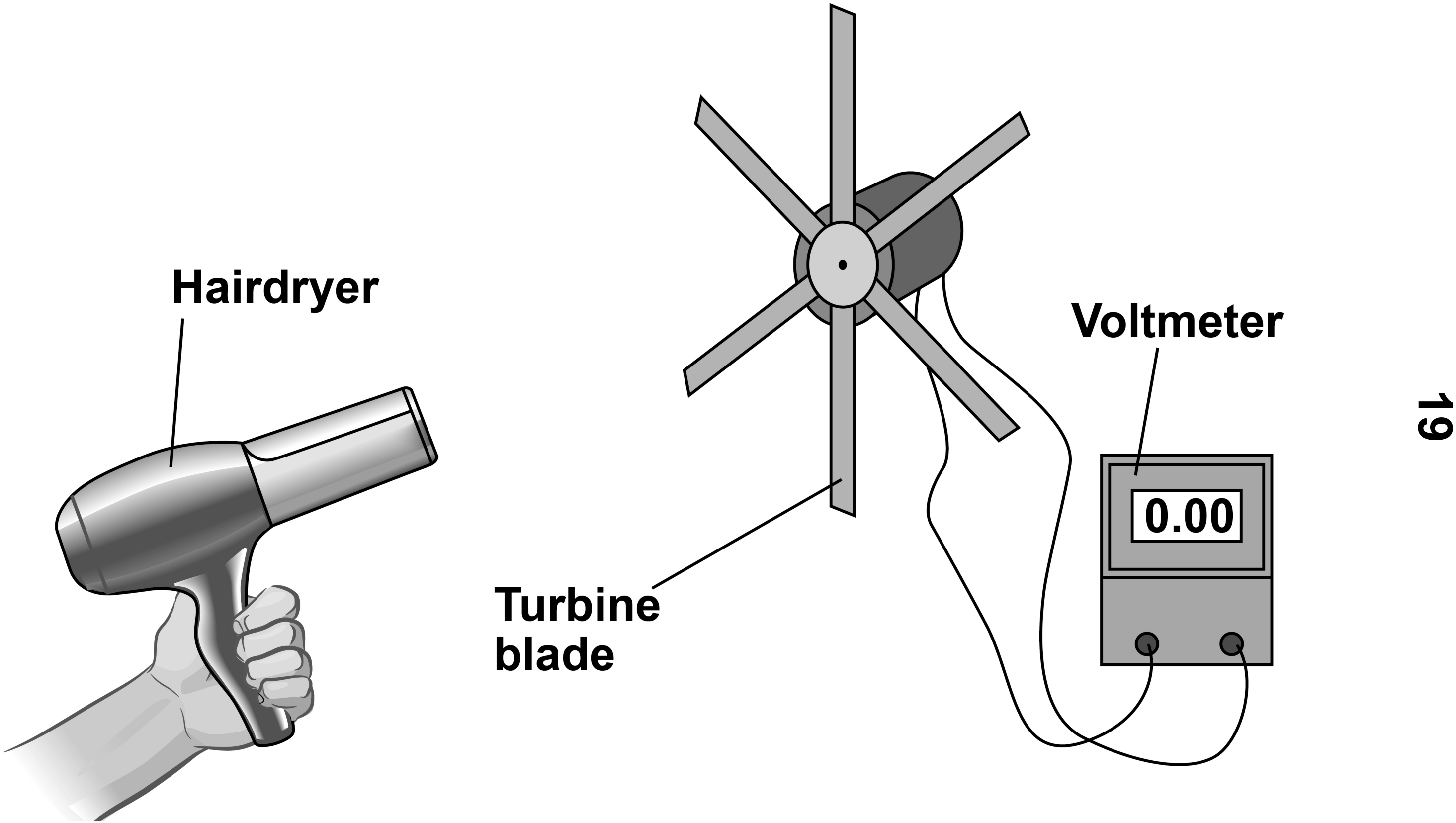
BLANK PAGE

[Turn over]

A student investigated how the output potential difference of a model wind turbine was affected by the length of the turbine blades.

FIGURE 2, on the opposite page, shows the equipment the student used.

FIGURE 2



[Turn over]

TABLE 2 shows the student's results.

TABLE 2

Length of turbine blades in cm	Output potential difference in volts			
	Test 1	Test 2	Test 3	Mean
8	0.13	0.12	0.11	0.12
6	0.15	0.14	0.16	0.15
4	0.27	0.25	0.23	0.25
2	0.26	0.30	0.12	X

0 2 . 6

Calculate value X in TABLE 2.

Do NOT include the anomalous result.
[2 marks]

_____

_____

_____

X = _____ **volts**

0 2 . 7

What type of error caused the variation in this student's repeat readings?
[1 mark]

Tick (✓) ONE box.

- ☐ **Random error**
- ☐ **Systematic error**
- ☐ **Zero error**

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0 2 . 8

Another student did the same investigation but used a clamp stand to hold the hairdryer.

Explain how this would improve the results. [2 marks]

[Turn over]

0 3

TABLE 3 shows the mass of each ingredient in an indigestion tablet.

TABLE 3

Ingredient	Mass in milligrams
Calcium carbonate	522
Magnesium carbonate	68
Sodium hydrogencarbonate	64
Other substances	146

0 3 . 1

Calculate the mass of the indigestion tablet in grams. [2 marks]

Mass of tablet in milligrams =

Mass of tablet in grams =

[Turn over]

0 3 . 2

Calcium carbonate in the indigestion tablet reacts with hydrochloric acid in the stomach.

Which gas is produced? [1 mark]

Tick (✓) ONE box.

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

0 3 . 3

Sodium hydrogencarbonate has the chemical formula $NaHCO_3$

How many different elements are in sodium hydrogencarbonate? [1 mark]

Tick (✓) ONE box.

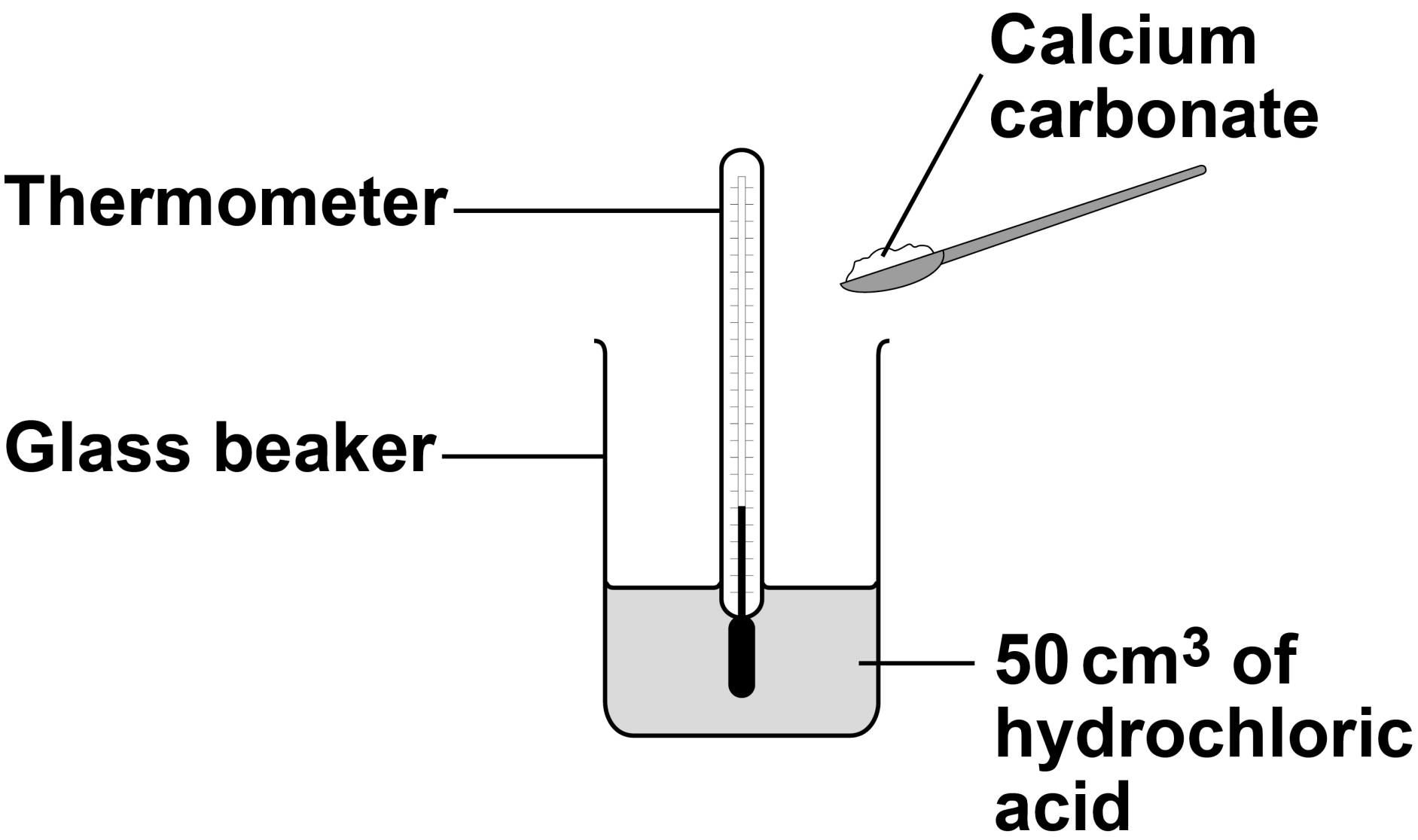
- ☐ **3**
- ☐ **4**
- ☐ **5**
- ☐ **6**

[Turn over]

A student investigated the temperature change when different masses of calcium carbonate were reacted with 50 cm^3 of hydrochloric acid.

FIGURE 3 shows the apparatus used.

FIGURE 3



This is the method used.

1. **Add 50 cm^3 of hydrochloric acid to a glass beaker.**
2. **Record the temperature of the hydrochloric acid.**
3. **Add 1 g of calcium carbonate to the hydrochloric acid.**
4. **Stir the mixture.**
5. **Record the highest temperature of the mixture.**
6. **Repeat steps 1–5 with different masses of calcium carbonate.**

[Turn over]

0 3 . 4

Which TWO changes would increase the accuracy of the results? [2 marks]

Tick (✓) TWO boxes.

- ☐ **Add a lid to the top of the glass beaker**
- ☐ **Add indicator to the hydrochloric acid**
- ☐ **Use 100 cm^3 of hydrochloric acid**
- ☐ **Use a polystyrene cup instead of the glass beaker**
- ☐ **Use a thermometer with intervals of 5 °C instead of 1 °C**

0 3 . 5

The student added different masses of calcium carbonate to the hydrochloric acid.

Which TWO terms describe the mass of calcium carbonate in this investigation?

[2 marks]

Tick (✓) TWO boxes.

- ☐ **Categoric variable**
- ☐ **Continuous variable**
- ☐ **Control variable**
- ☐ **Dependent variable**
- ☐ **Independent variable**

8

[Turn over]

0 4

The country Iceland is a major producer of aluminium.

Aluminium is extracted from aluminium oxide using electrolysis.

Electrolysis requires a large amount of electricity.

Iceland generates all of its electricity from renewable resources.

0 4 . 1

Which of the following is a renewable resource? [1 mark]

Tick (✓) ONE box.

- ☐ **Coal**
- ☐ **Crude oil**
- ☐ **Hydroelectricity**
- ☐ **Nuclear fuel**

[Turn over]

0 4 . 2

Why is aluminium produced in Iceland?
[1 mark]

Tick (✓) ONE box.

- ☐ **Conserves aluminium ore**
- ☐ **Plentiful supply of cheap electricity**
- ☐ **Uses up non-renewable resources**

0 4 . 3

Aluminium is extracted from aluminium oxide.

Complete the balanced equation for the reaction. [2 marks]

[Turn over]

0 4 . 4

What type of reaction takes place when oxygen is removed from aluminium oxide? [1 mark]

Tick (✓) ONE box.

- ☐ **Combustion**
- ☐ **Neutralisation**
- ☐ **Reduction**

0 4 . 5

During electrolysis, aluminium ions (Al^{3+}) move towards the negative electrode.

Explain why aluminium ions move towards the negative electrode.

[2 marks]

0 4 . 6

At the negative electrode, an aluminium ion (Al^{3+}) gains electrons to become an aluminium atom.

How many electrons does each aluminium ion gain? [1 mark]

Number of electrons = _____

0 4 . 7

The positive electrode is made of carbon.

Oxygen is produced at the positive electrode.

The oxygen reacts with the carbon.

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

carbon + oxygen → _____

0 4 . 8

Why do the positive electrodes need to be replaced regularly? [1 mark]

0 4 . 9

A ceramic material can be used as the positive electrode in the electrolysis of aluminium oxide.

The ceramic material has the following properties:

- **high melting point**
- **unreactive.**

Explain why each property is important when the ceramic material is used in the electrolysis of aluminium oxide.
[4 marks]

High melting point

Unreactive

[Turn over]

0 5

A student investigated electrical circuits.

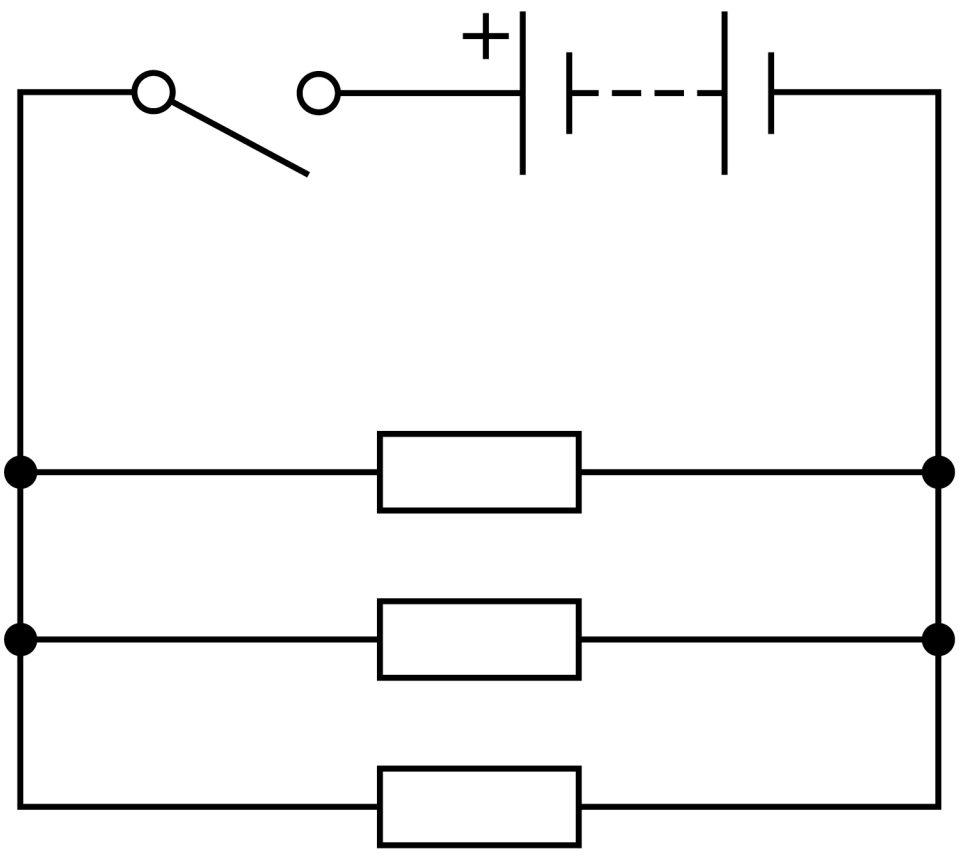
The student built a circuit with three resistors in series.

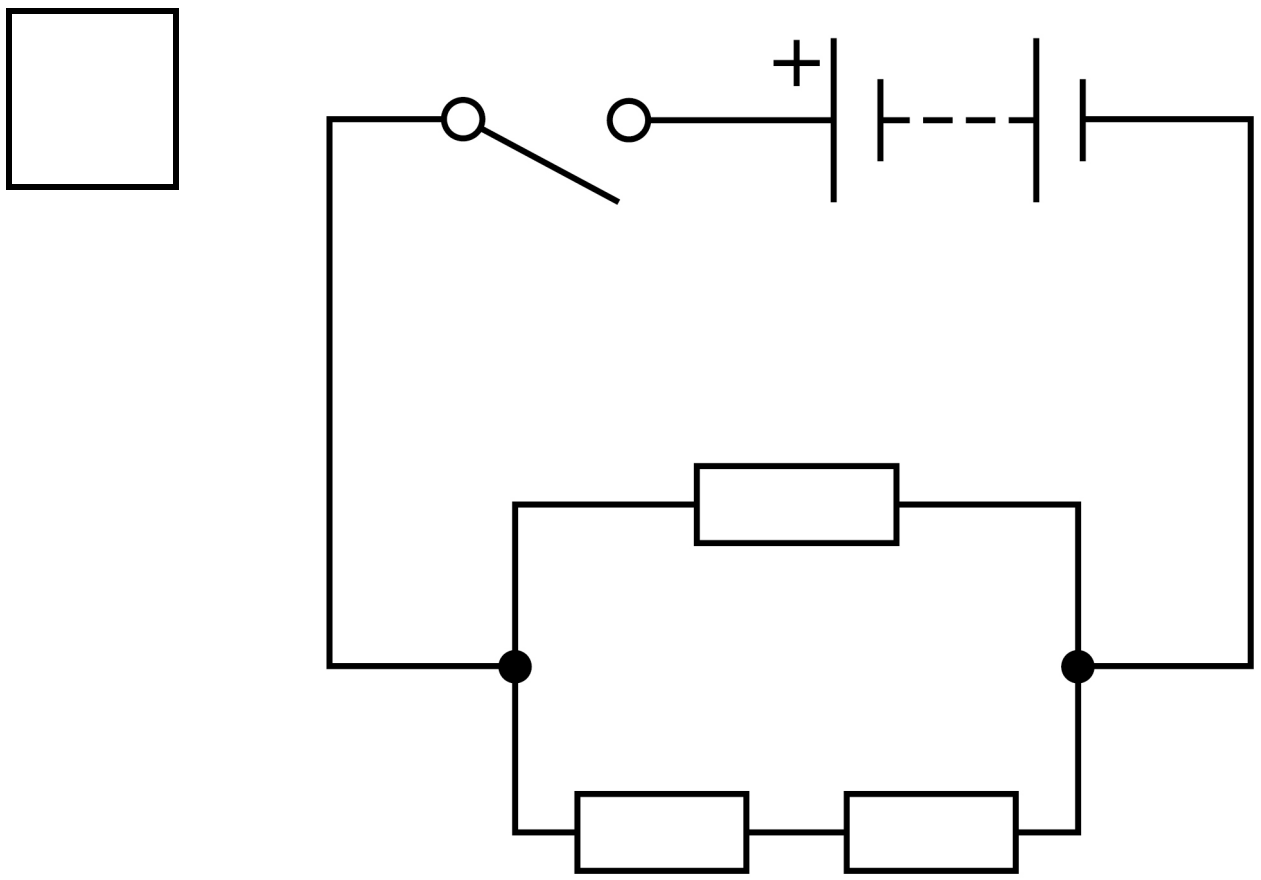
0 5 . 1

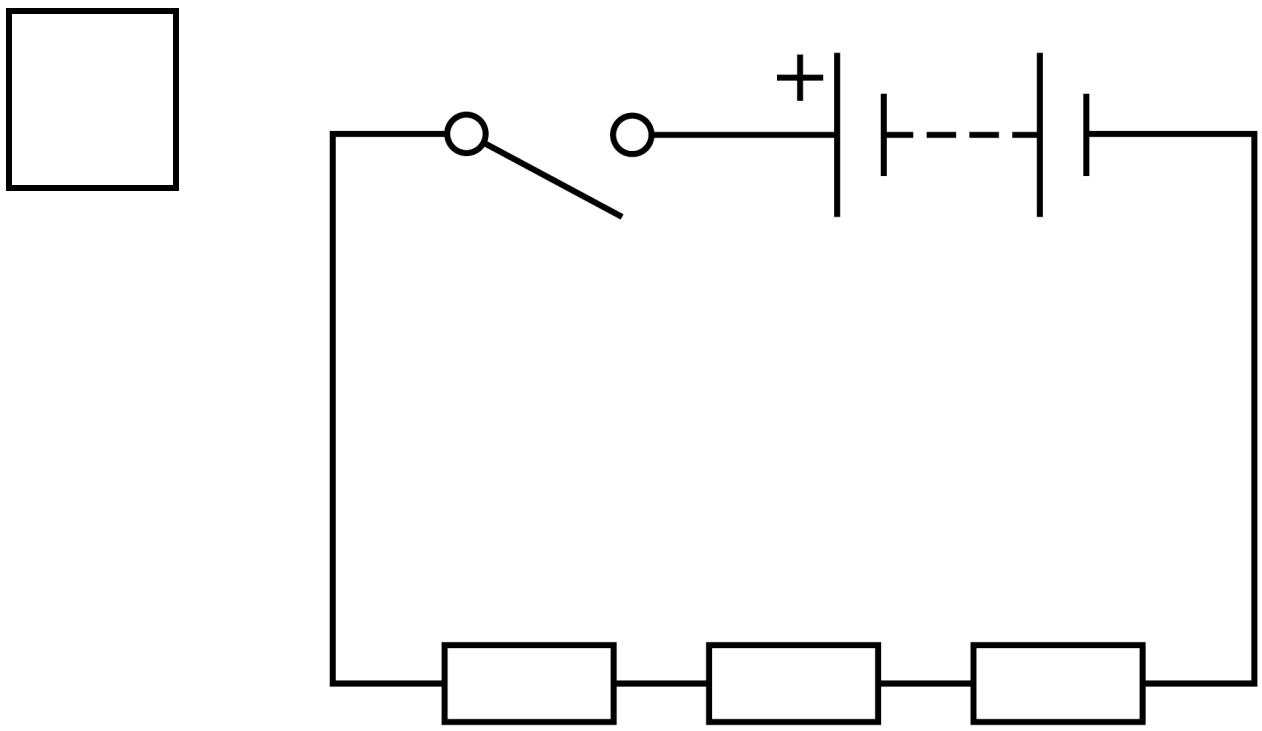
Which circuit diagram shows a circuit containing three resistors in series?
[1 mark]

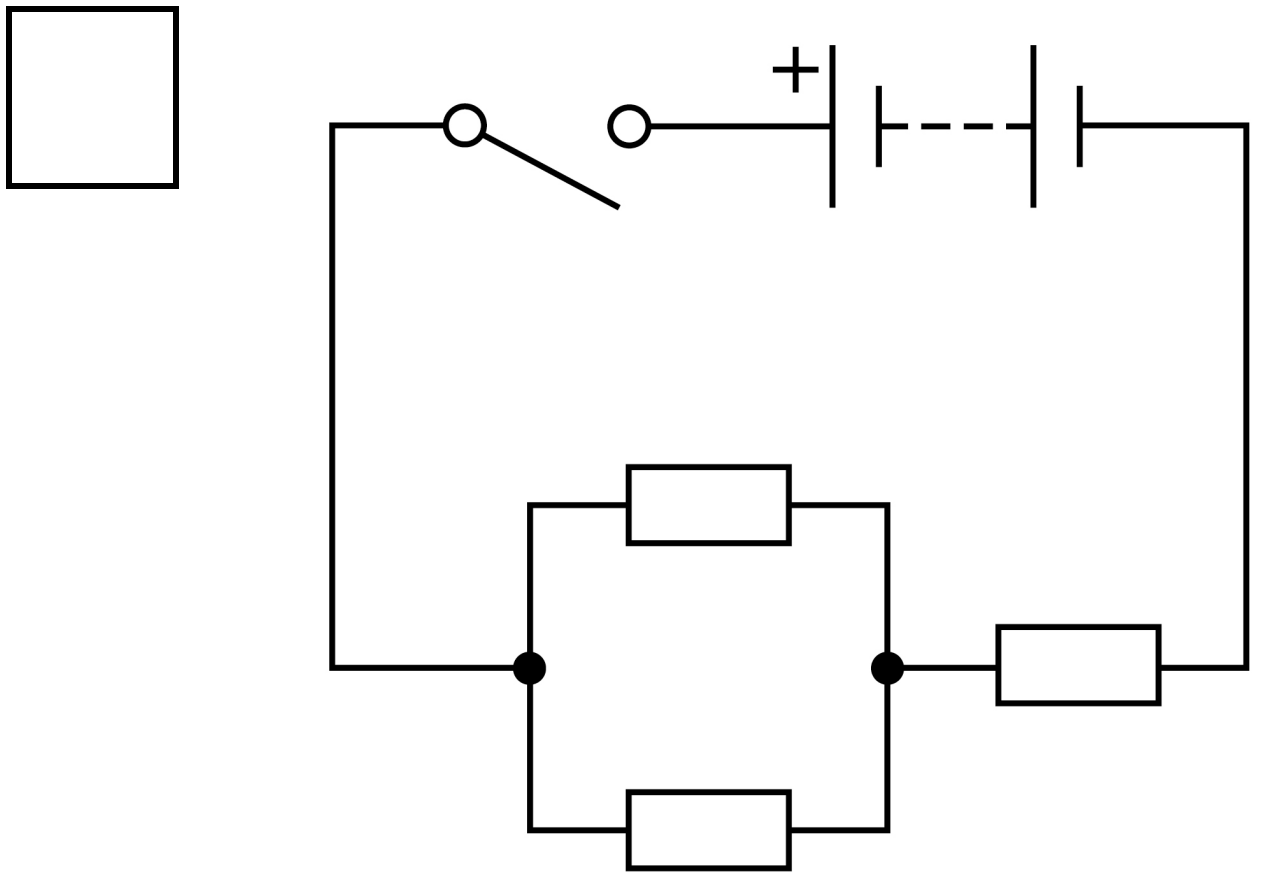
Tick (✓) ONE box.

☐









[Turn over]

0 5 . 2

The student determined the total resistance of the circuit.

To determine the resistance, the student needed extra components in the circuit.

Which TWO components did the student need? [2 marks]

Tick (✓) TWO boxes.

- ☐ **Ammeter**
- ☐ **Diode**
- ☐ **Fuse**
- ☐ **Variable resistor**
- ☐ **Voltmeter**

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[Turn over]

The student built circuits with different numbers of resistors in series.

All the resistors used were identical.

0 5 . 3

The student switched the circuits off between readings.

Why did the student need to switch the circuits off? [1 mark]

Tick (✓) ONE box.

☐ So the battery could recharge

☐ So the current would increase

☐ So the potential difference would increase

☐ So the temperature of the resistors would remain constant

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[Turn over]

TABLE 4 shows the student's results.

TABLE 4

Number of resistors	Total resistance in ohms
1	2.2
2	4.4
3	6.6
4	8.8
5	11.0
6	13.2

0 5 . 4

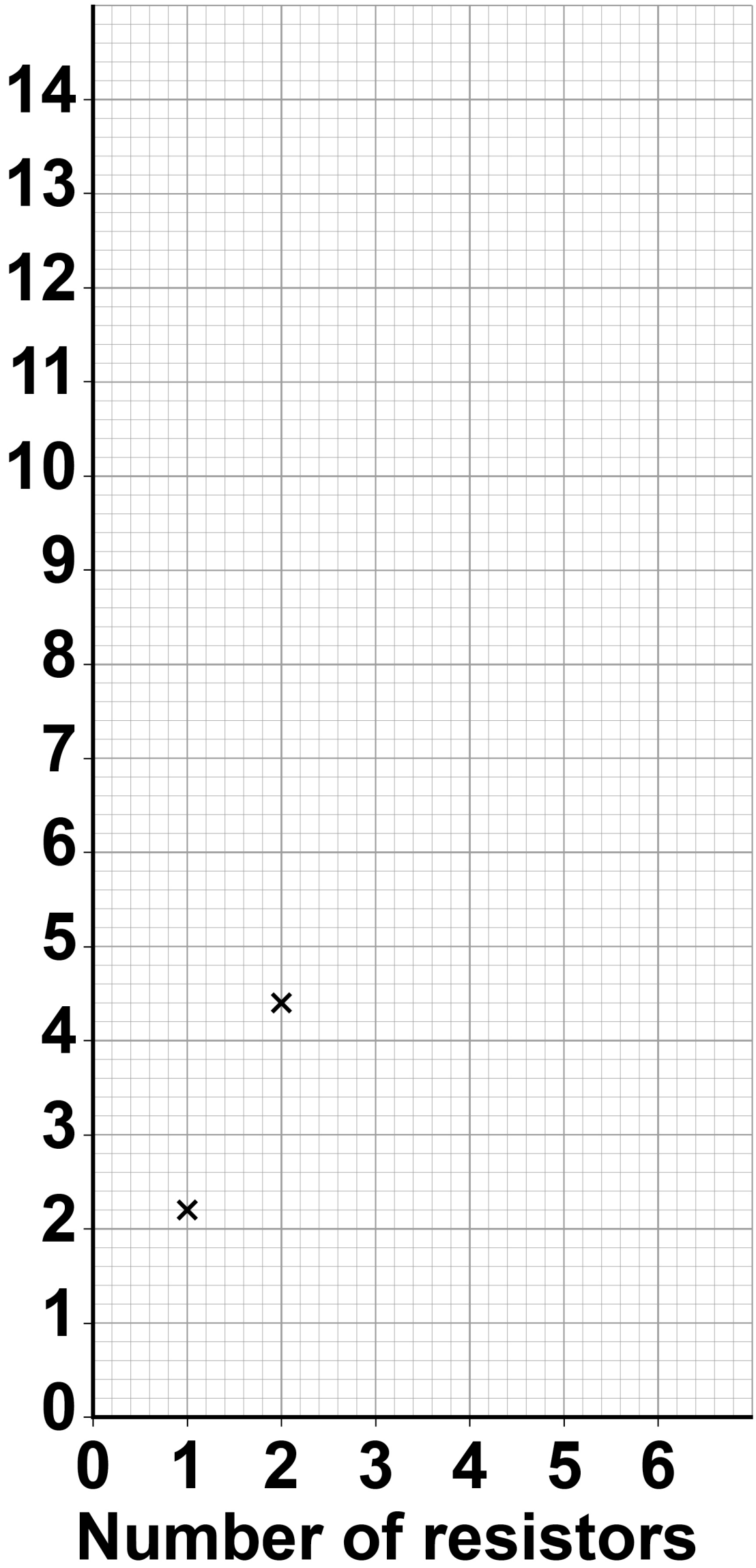
Complete FIGURE 4 opposite using data from TABLE 4.

You should:

- **plot the rest of the results**
- **draw a line of best fit.**

[3 marks]

FIGURE 4


Total resistance in ohms
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0 1 2 3 4 5 6
Number of resistors

0 5 . 5

The student concluded that there was a linear relationship between resistance and the number of resistors.

How do the results support this conclusion? [1 mark]

0 5 . 6

The student could have connected the resistors in parallel instead of in series.

How would the total resistance of three resistors in parallel compare with the total resistance of three resistors in series? [1 mark]

Tick (✓) ONE box.

- ☐ Higher
- ☐ Lower
- ☐ The same

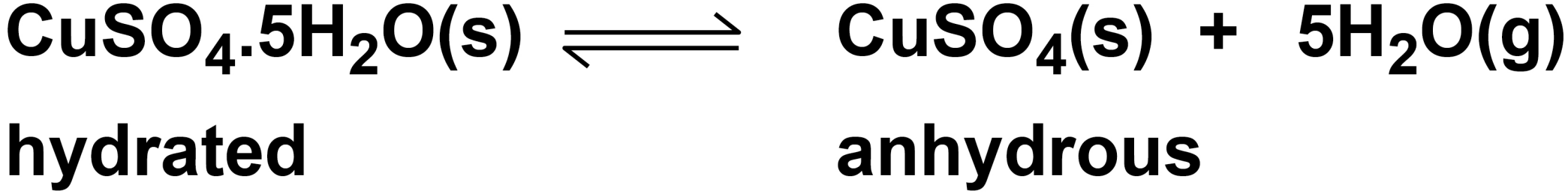
9

0 6

This question is about reversible reactions.

When blue hydrated copper sulfate is heated, white anhydrous copper sulfate and water are produced.

The equation for the reaction is:



0 6 . 1

How does the equation show that this is a reversible reaction? [1 mark]

A student investigated the forward reaction.

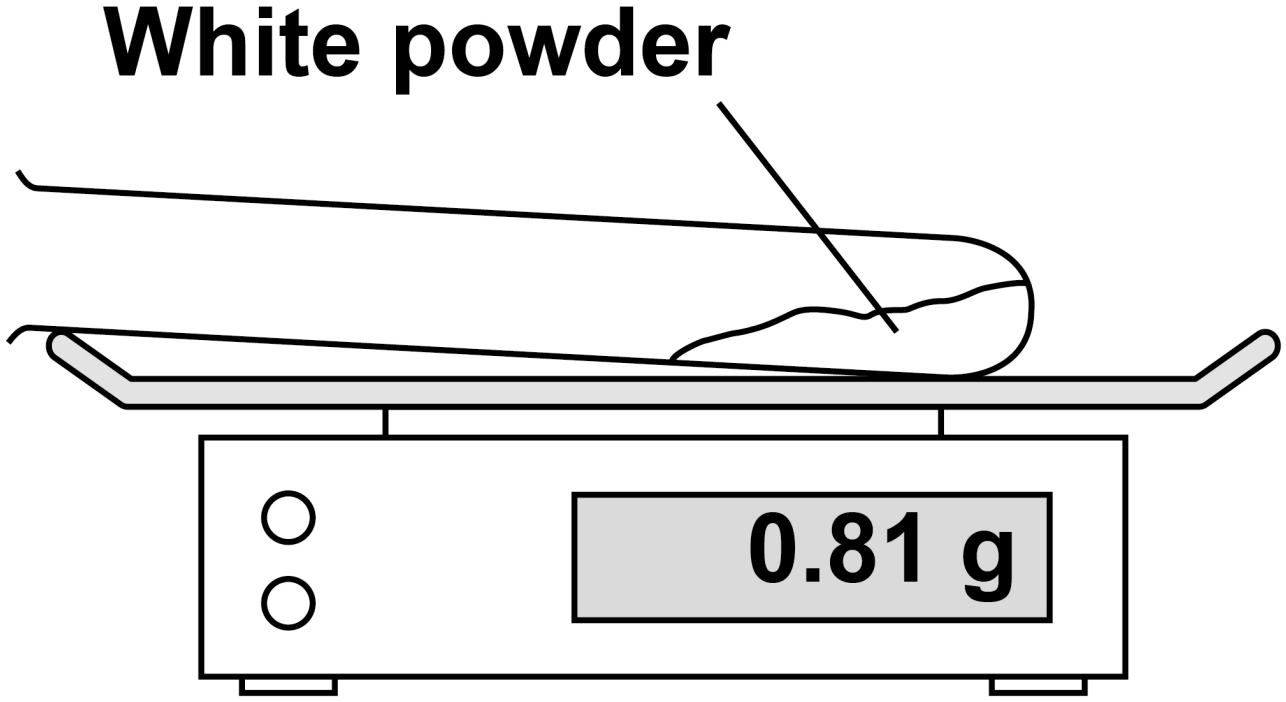
This is the method used.

1. **Place an empty test tube on a balance.**
2. **Zero the balance with the test tube on it.**
3. **Add 1.26 g of hydrated copper sulfate to the test tube.**
4. **Heat the test tube and contents for 5 minutes.**
5. **Measure the mass of the solid left in the test tube.**
6. **Repeat steps 4–5 until the mass of the solid is constant.**

0 6 . 2

FIGURE 5 shows the test tube on the balance at the end of the investigation.

FIGURE 5



[Turn over]

TABLE 5 shows some of the student's results.

TABLE 5

Substance	Mass of substance in g
Hydrated copper sulfate	1.26
Anhydrous copper sulfate	X
Water	Y

Determine the values X and Y.

Use FIGURE 5, on page 55, and TABLE 5. [2 marks]

X = _____ g

Y = _____ g

0 6 . 3

Why did the student keep heating the test tube and its contents until the mass was constant? [1 mark]

Tick (✓) ONE box.

- ☐ **To make more hydrated copper sulfate**
- ☐ **To make sure all the water was removed**
- ☐ **To melt the anhydrous copper sulfate**

[Turn over]

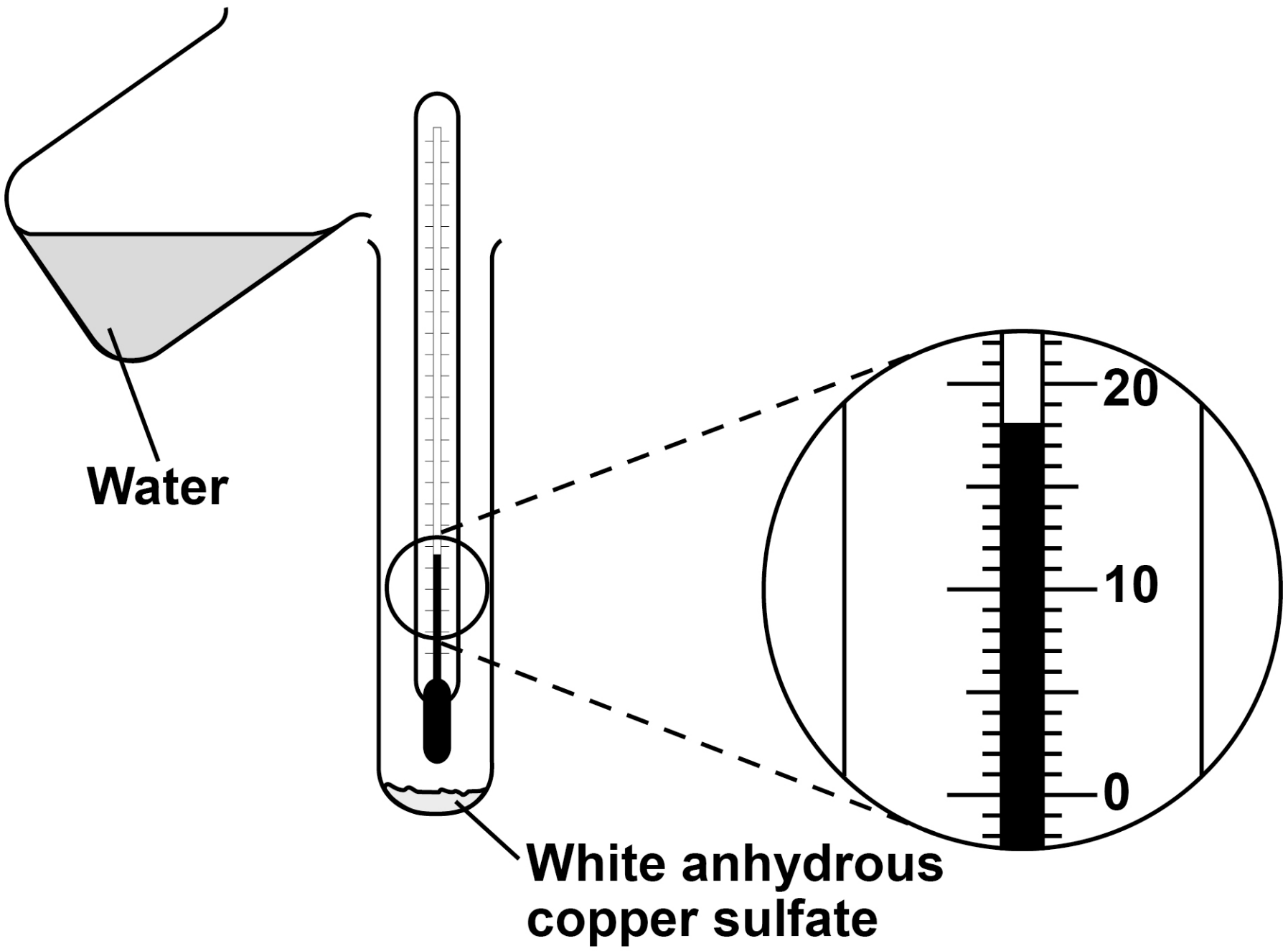
The student then investigated the reverse reaction.

The student added water to anhydrous copper sulfate.

This reaction is exothermic.

FIGURE 6 shows the apparatus used.

FIGURE 6



0 6 . 4

What is an exothermic reaction?
[1 mark]

Tick (✓) ONE box.

- ☐ **A reaction where there is no energy change**
- ☐ **A reaction that gives out energy to the surroundings**
- ☐ **A reaction that takes in energy from the surroundings**

0 6 . 5

What is the temperature shown on the thermometer in FIGURE 6? [1 mark]

Temperature = _____ °C

[Turn over]

0 6 . 6

The student measured the temperature during the reaction.

Complete the sentence.

Choose the answer from the list below.

[1 mark]

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

When water is added to anhydrous copper sulfate, the temperature

_____ .

7

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[Turn over]

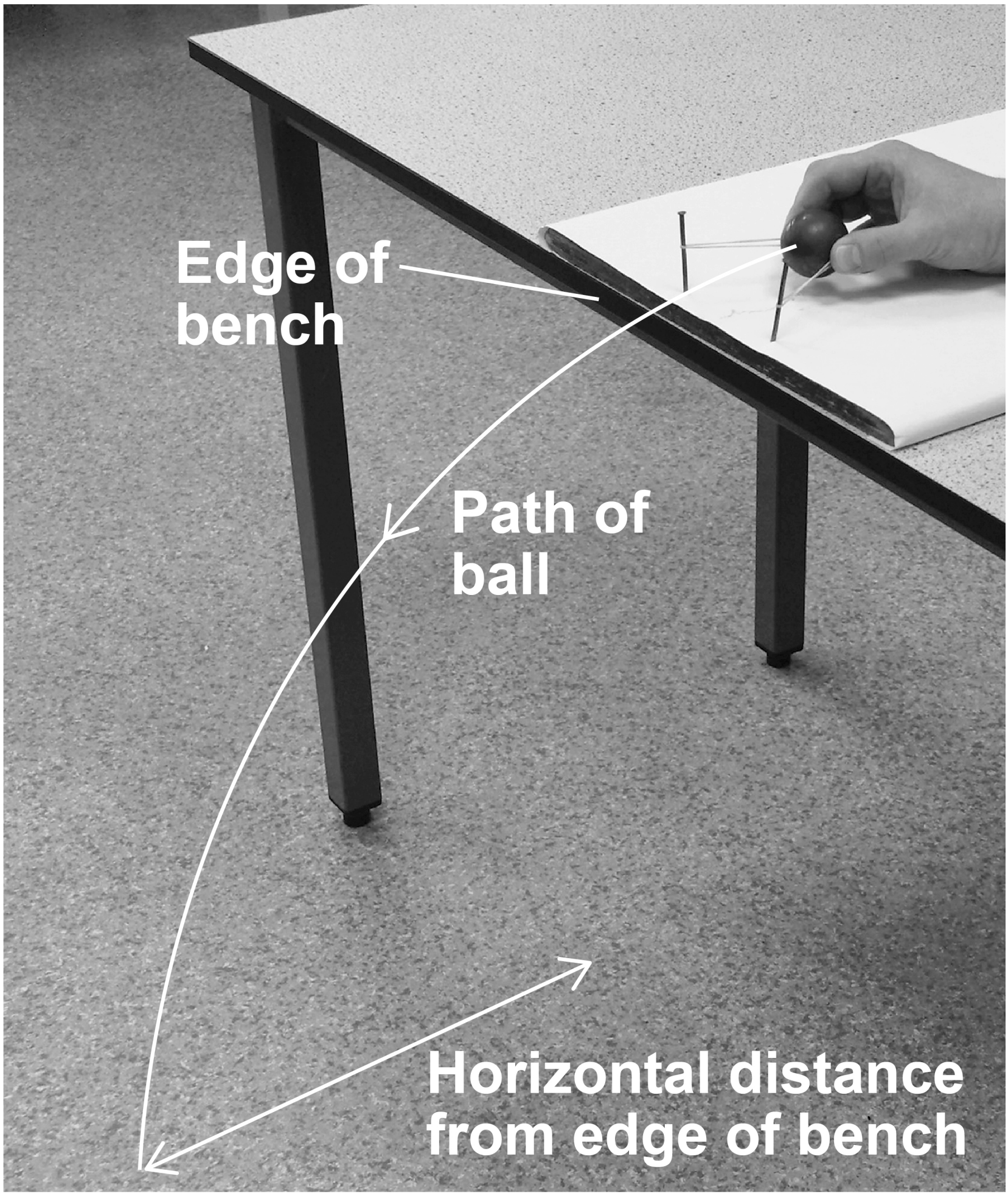
0 7

A student investigated how the horizontal distance travelled by a metal ball varied with launch speed.

The student used an elastic band to launch the ball at different speeds from a bench.

FIGURE 7, on the opposite page, shows the equipment the student used.

FIGURE 7



[Turn over]

0 7 . 1

What piece of apparatus could the student use to measure the horizontal distance travelled by the ball? [1 mark]

0 7 . 2

Suggest how the student could use the elastic band to increase the launch speed. [1 mark]

0 7 . 3

Suggest ONE variable which should be kept the same for this investigation.
[1 mark]

0 7 . 4

Suggest ONE hazard to the student and ONE precaution to avoid the hazard.
[2 marks]

Hazard _____

Precaution _____

[Turn over]

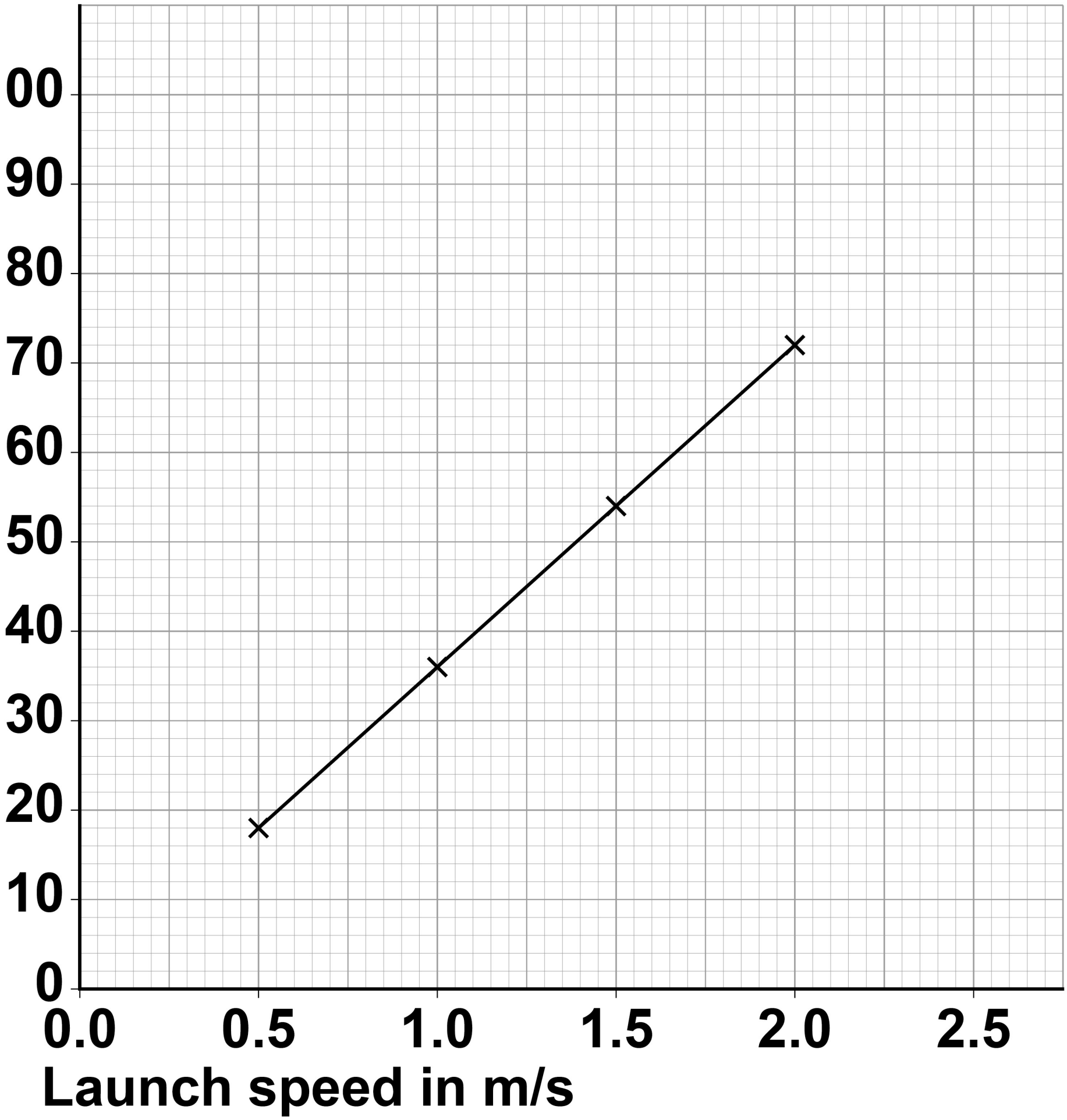
The student measured the horizontal distance travelled for a range of launch speeds.

FIGURE 8, on page 68, shows the results.

BLANK PAGE

[Turn over]

FIGURE 8


Horizontal distance travelled in centimetres
100
90
80
70
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
2.5
Launch speed in m/s

0 7 . 5

What range of launch speeds did the student use in the investigation?
[1 mark]

From _____ m/s to _____ m/s

0 7 . 6

Predict the horizontal distance travelled for a launch speed of 2.5 m/s

Use FIGURE 8. [1 mark]

Horizontal distance travelled =

_____ cm

[Turn over]

0 7 . 7

Write the equation which links kinetic energy, mass and speed. [1 mark]

0 7 . 8

The mass of the ball was 0.0044 kg

Calculate the kinetic energy of the ball when the speed was 1.6 m/s

Give your answer to 2 significant figures. [3 marks]

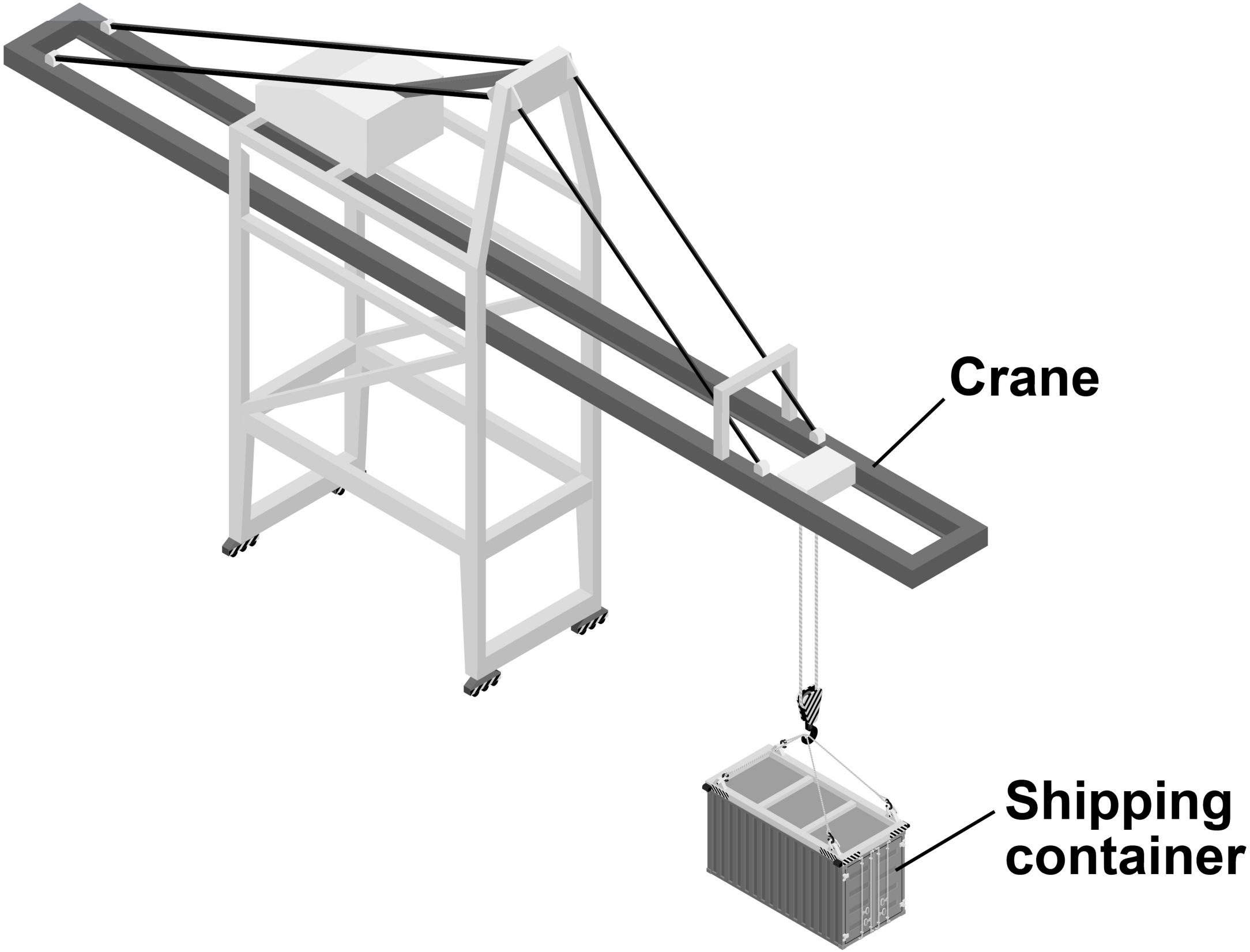
Kinetic energy = _____ J

11

0	8

FIGURE 9, on the opposite page, shows a crane being used to lift a shipping container.

FIGURE 9



0 8 . 1

Write the equation which links distance, force and work done. [1 mark]

0 8 . 2

The container was lifted a height of 14 m

The crane did 3 430 000 J of work on the container.

Calculate the force exerted by the crane on the container. [3 marks]

Force = _____ N

[Turn over]

0 8 . 3

Write the equation which links power, time and work done. [1 mark]

0 8 . 4

The power of the crane was 68 600 W

Calculate the time taken for the crane to do 3 430 000 J of work.

Give the unit. [4 marks]

Time taken = _____

Unit _____

[Turn over]

9

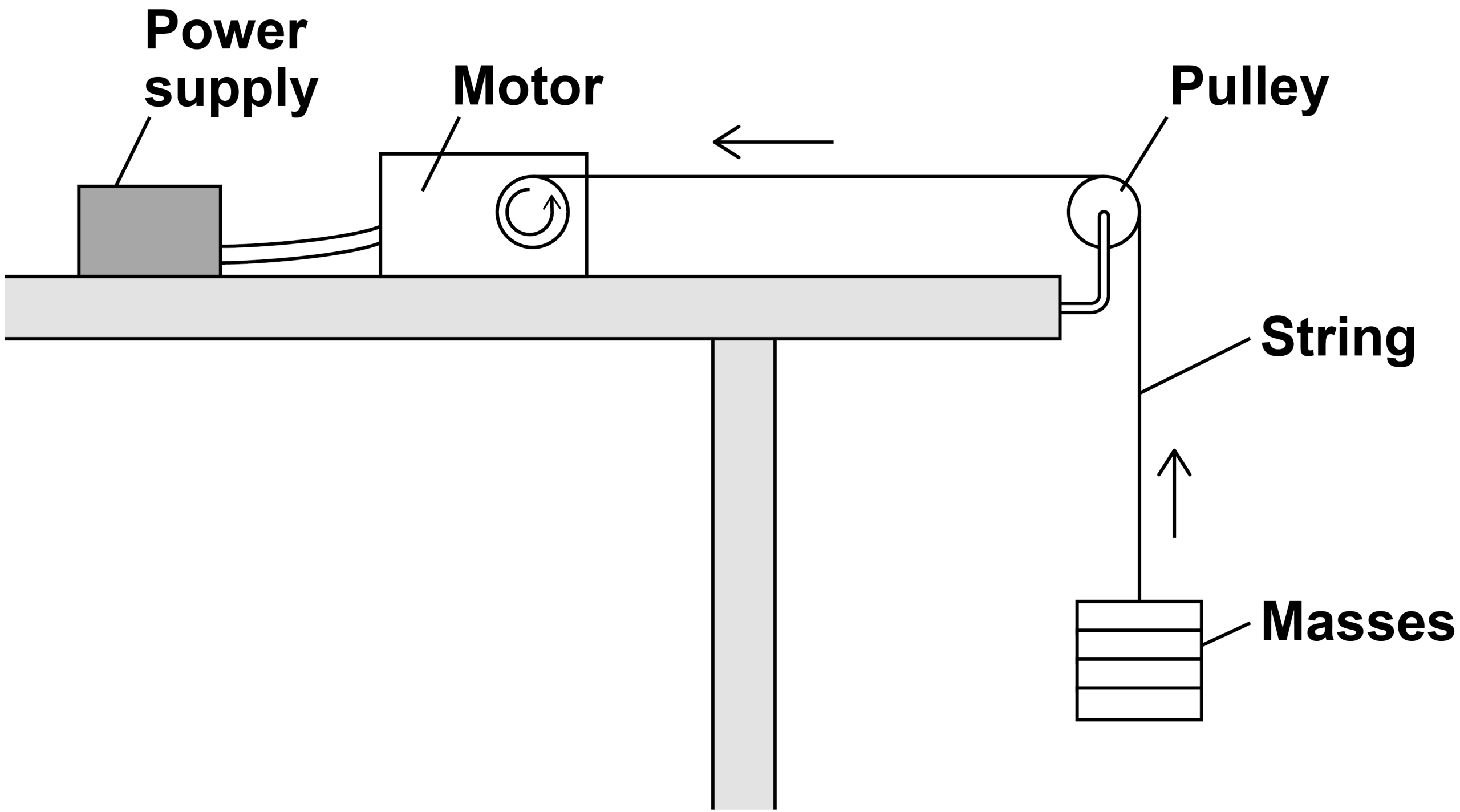
0 9

A student used an electric motor to lift a mass.

He investigated how the efficiency of the motor varied with the mass lifted.

FIGURE 10, on the opposite page, shows the apparatus used.

FIGURE 10



[Turn over]

0 9 . 1

Energy is transferred to the electric motor by the power supply.

Why is the energy transferred to the motor greater than the gravitational potential energy gained by the mass?

[2 marks]

Tick (✓) TWO boxes.

- ☐ **Energy is not conserved**
- ☐ **Friction in the motor causes energy transfer to the surroundings**
- ☐ **The temperature of the motor increases**
- ☐ **Thermal energy from the surroundings is transferred to the mass**
- ☐ **Wasted energy is destroyed**

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[Turn over]

0 9 . 2

The student calculated the gravitational potential energy gained by different masses as they were lifted.

The student used the equation:

gravitational potential energy = mass × 9.8 × height

Describe how the student could make accurate measurements to use in the calculations. [4 marks]

0 9 . 3

Write the equation which links efficiency, total input energy transfer and useful output energy transfer.
[1 mark]

0 9 . 4

The efficiency of the motor was 15%.

The student calculated that the useful output energy transfer was 1.20 J

Calculate the total input energy transfer.

[4 marks]

Total input energy transfer =

_____ **J**

11

[Turn over]

1 0

Some drinks containers are made from aluminium. Other drinks containers are made from a polymer called PET.

Both aluminium and PET can be recycled.

1 0 . 1

FIGURE 11 shows the recycling symbol for PET.

FIGURE 11

Suggest why this symbol is used on a PET bottle. [1 mark]

_____

_____

_____

[Turn over]

1 0 . 2

50 000 000 kg of aluminium are used each year to make drinks cans.

70% of these aluminium cans are recycled.

Calculate the mass of aluminium that is recycled each year from drinks cans.

Give your answer in standard form.
[3 marks]

Mass = _____ kg

1 0 . 3

TABLE 6, on pages 90 and 91, gives information about the Life Cycle Assessments (LCAs) of two types of drinks containers.

[Turn over]

TABLE 6

The following table cannot be reproduced due to third-party copyright restrictions.

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[Turn over]

9 1

Evaluate the use of aluminium compared with the use of PET for drinks containers.

Your answer should include supporting calculations. [6 marks]

END OF QUESTIONS

10

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For Examiner's Use	
Question	Mark
1	
2	
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7	
8	
9	
10	
TOTAL	