A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

COMBINED SCIENCE: SYNERGY

F

Foundation Tier

Paper 4 Physical sciences

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

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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

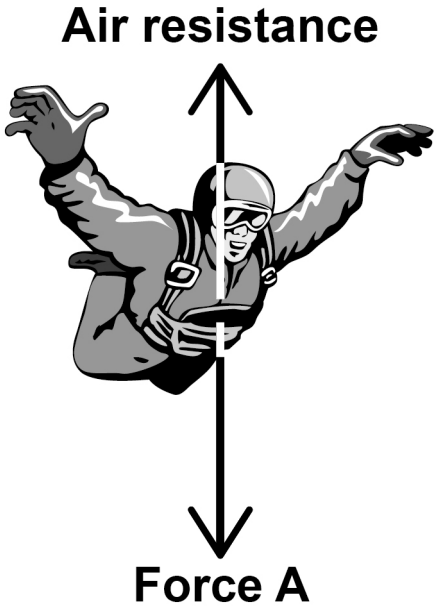
- **The maximum mark for this paper is 100.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

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**

[Turn over]

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

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

[Turn over]

0 2 **The National Grid supplies electricity to consumers in the UK.**

0 2 . 1 **Complete the sentences.**

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.

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 _____

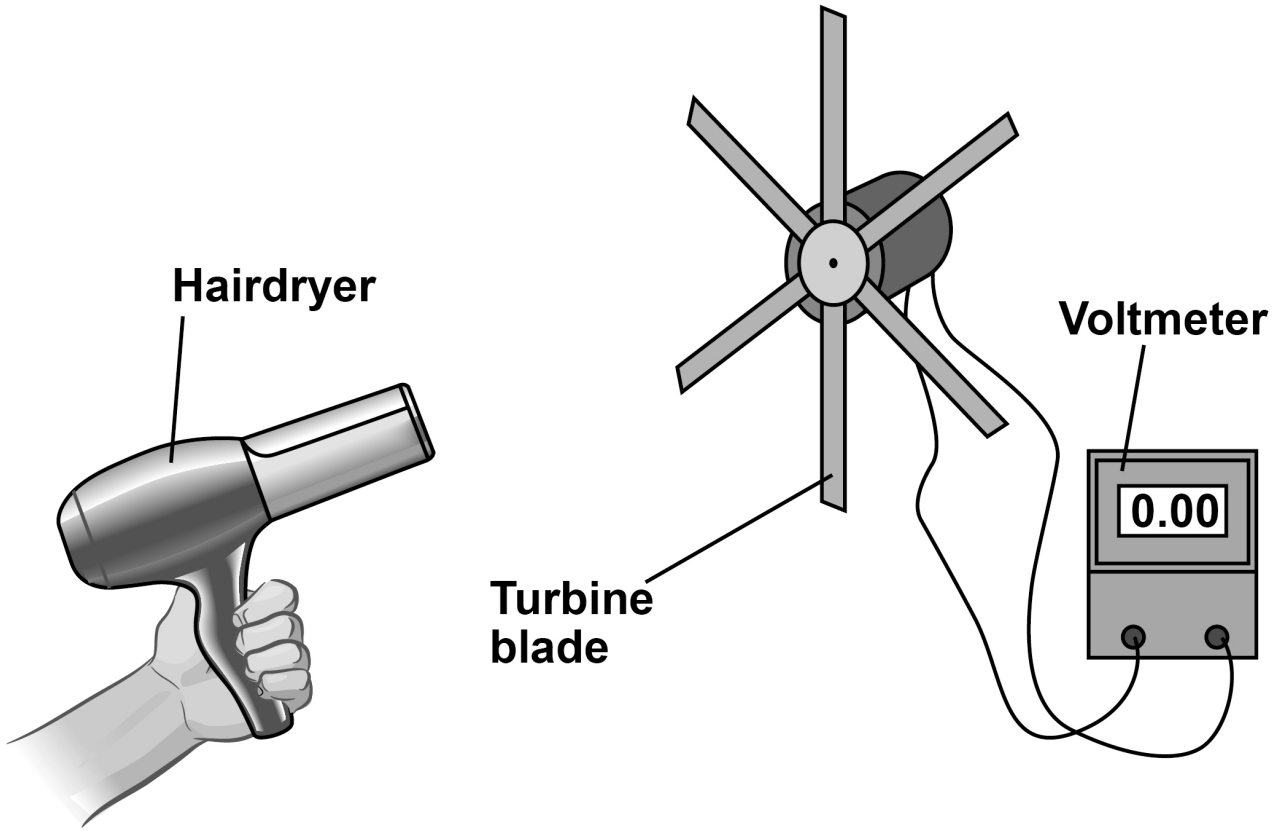
_____

_____

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

FIGURE 2 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**

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]

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.

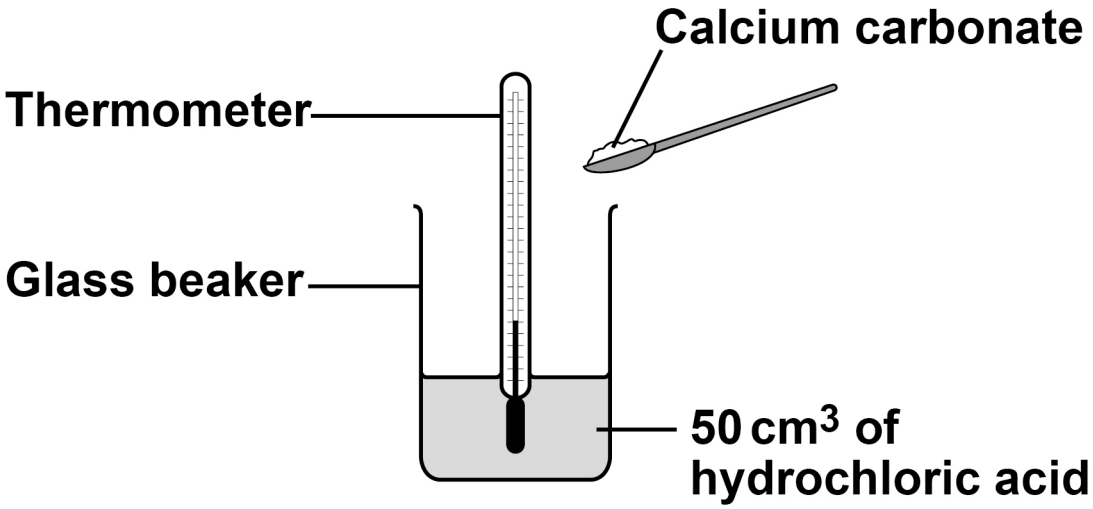
- ☐ **3**
- ☐ **4**
- ☐ **5**
- ☐ **6**

[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.

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[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**

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]

$$2\ Al_2O_3 \longrightarrow \_\_\_\_\_\ Al + \_\_\_\_\_\ O_2$$

[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 _____

14

[Turn over]

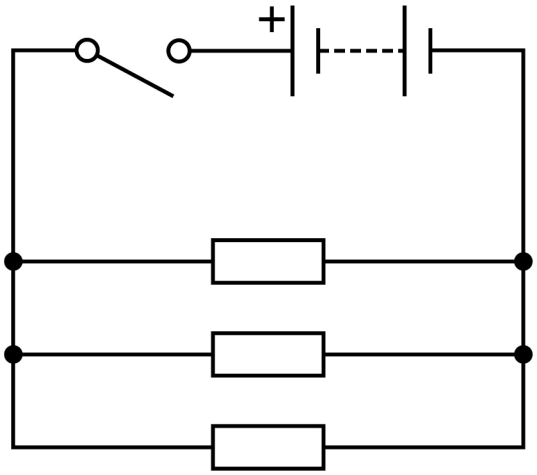
0 5 **A student investigated electrical circuits.**

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.

☐



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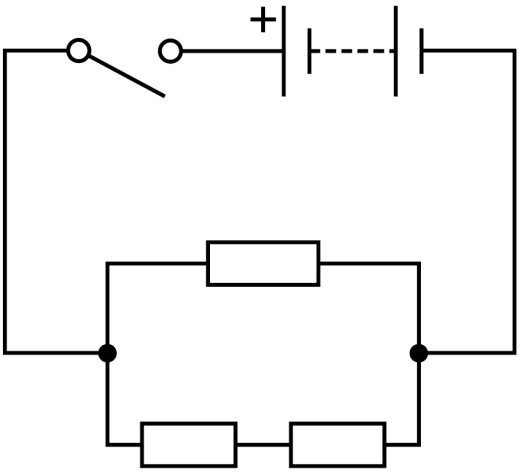

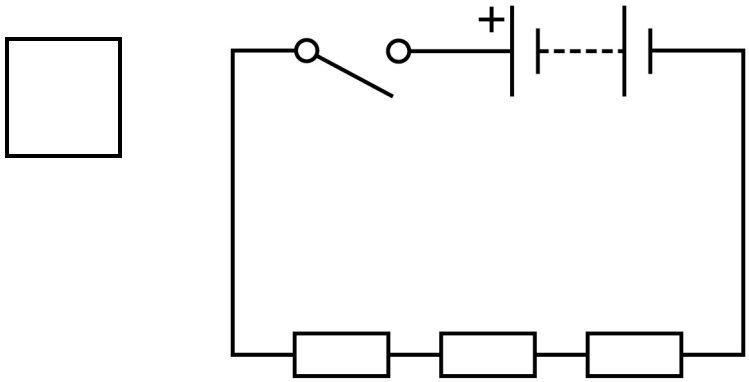

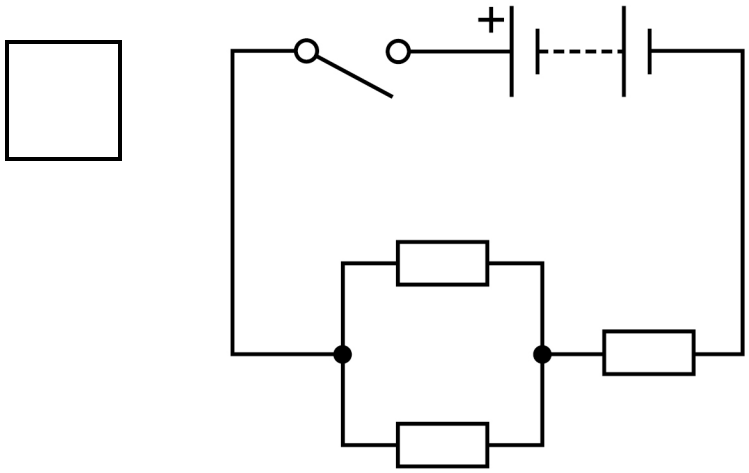

[Turn over]

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**

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

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

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[Turn over]

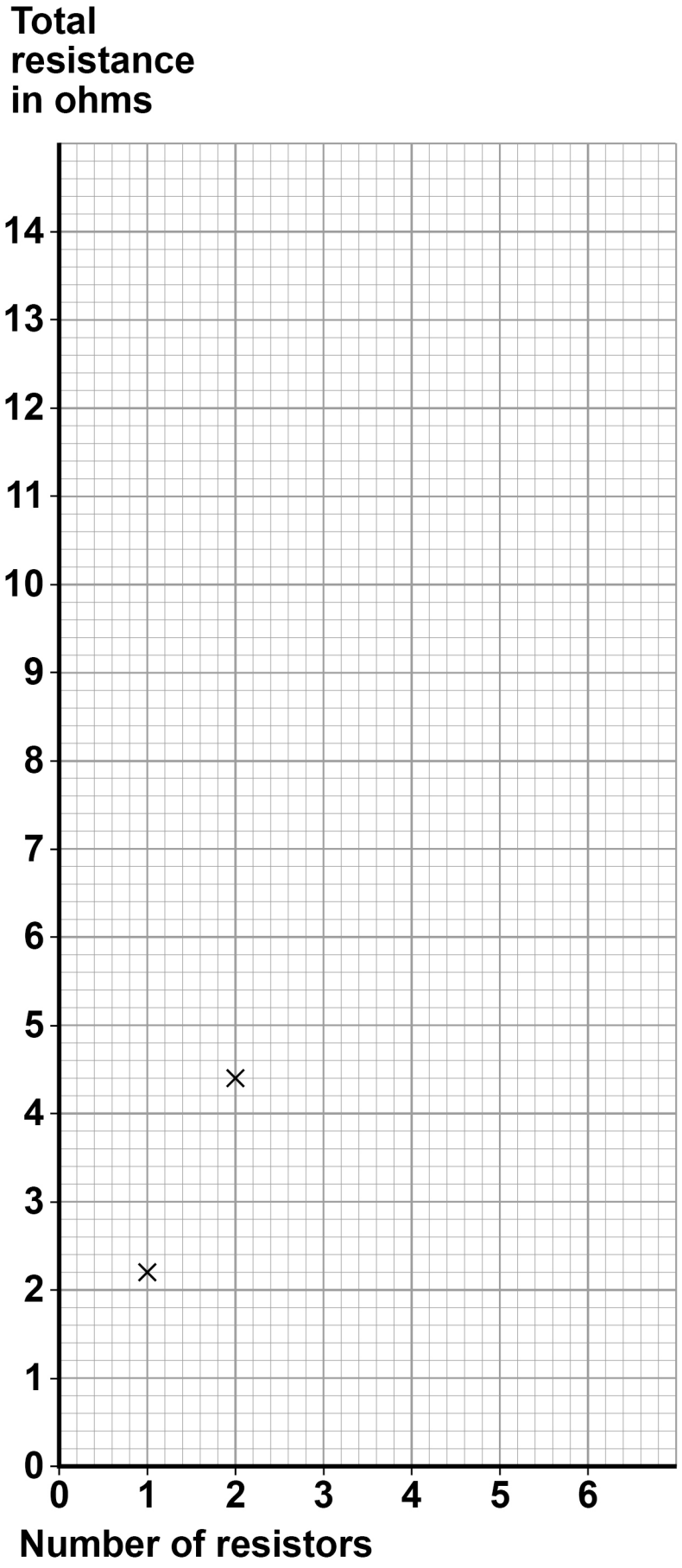
0 5 . 4 **Complete FIGURE 4 opposite using data from TABLE 4 on page 36.**

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:

$$CuSO_4.5H_2O(s) \rightleftharpoons CuSO_4(s) + 5H_2O(g)$$

hydrated anhydrous

0 6 . 1 How does the equation show that this is a reversible reaction? [1 mark]

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[Turn over]

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

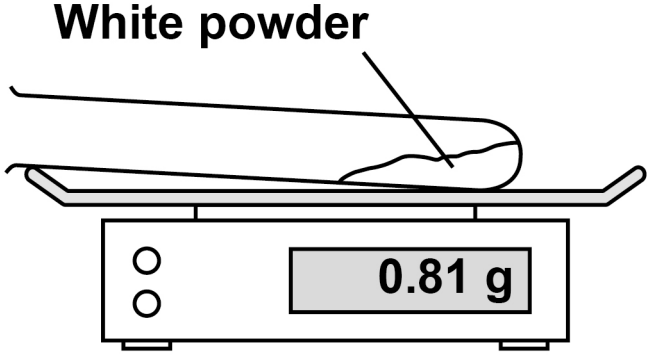


TABLE 5 shows some of the student's results.

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 and TABLE 5. [2 marks]

_____

_____

_____

X = _____ **g**

Y = _____ **g**

[Turn over]

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**

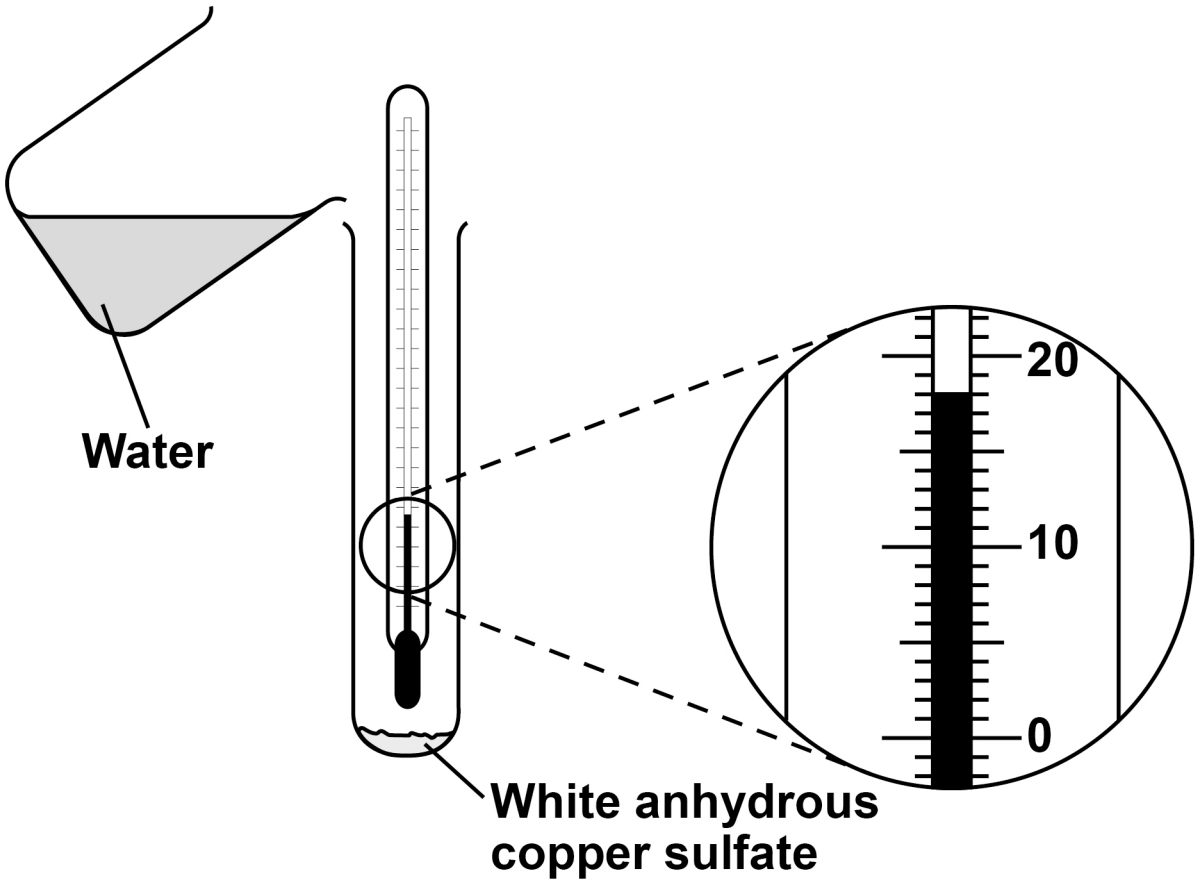
The student then investigated the reverse reaction.

The student added water to anhydrous copper sulfate.

This reaction is exothermic.

FIGURE 6 shows the apparatus used.

FIGURE 6



[Turn over]

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 on page 47? [1 mark]**

Temperature = _____ °C

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

_____ .

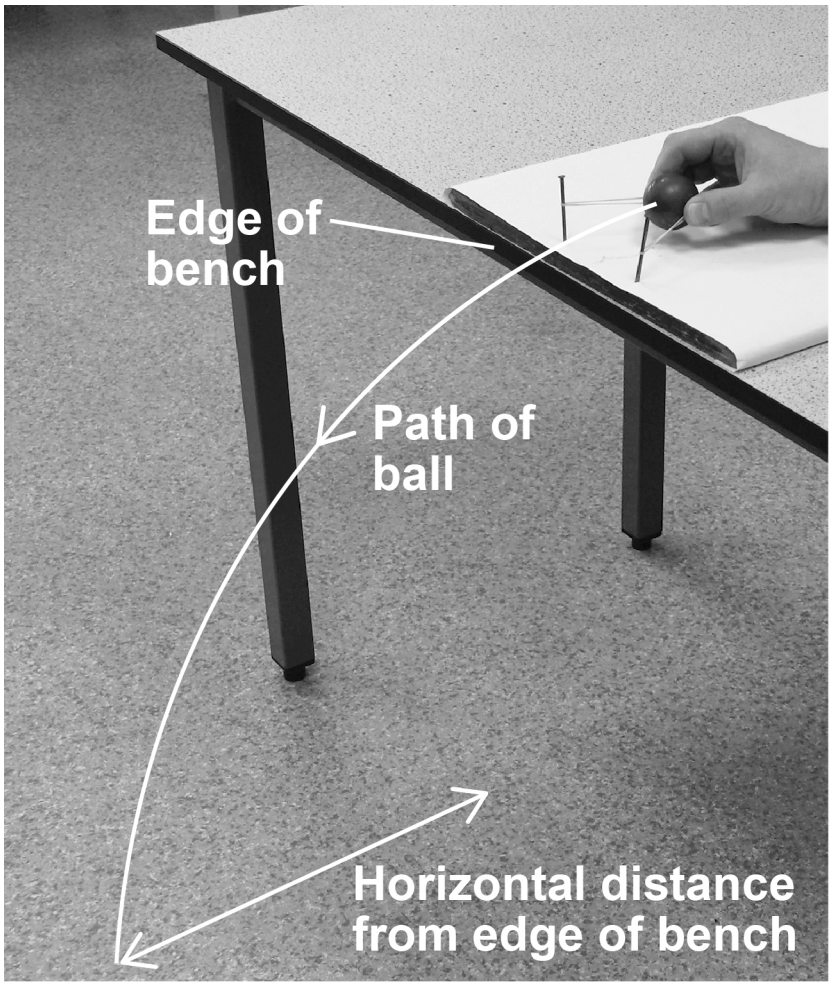
7

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 shows the equipment the student used.

FIGURE 7



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]**

[Turn over]

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 _____

_____

_____

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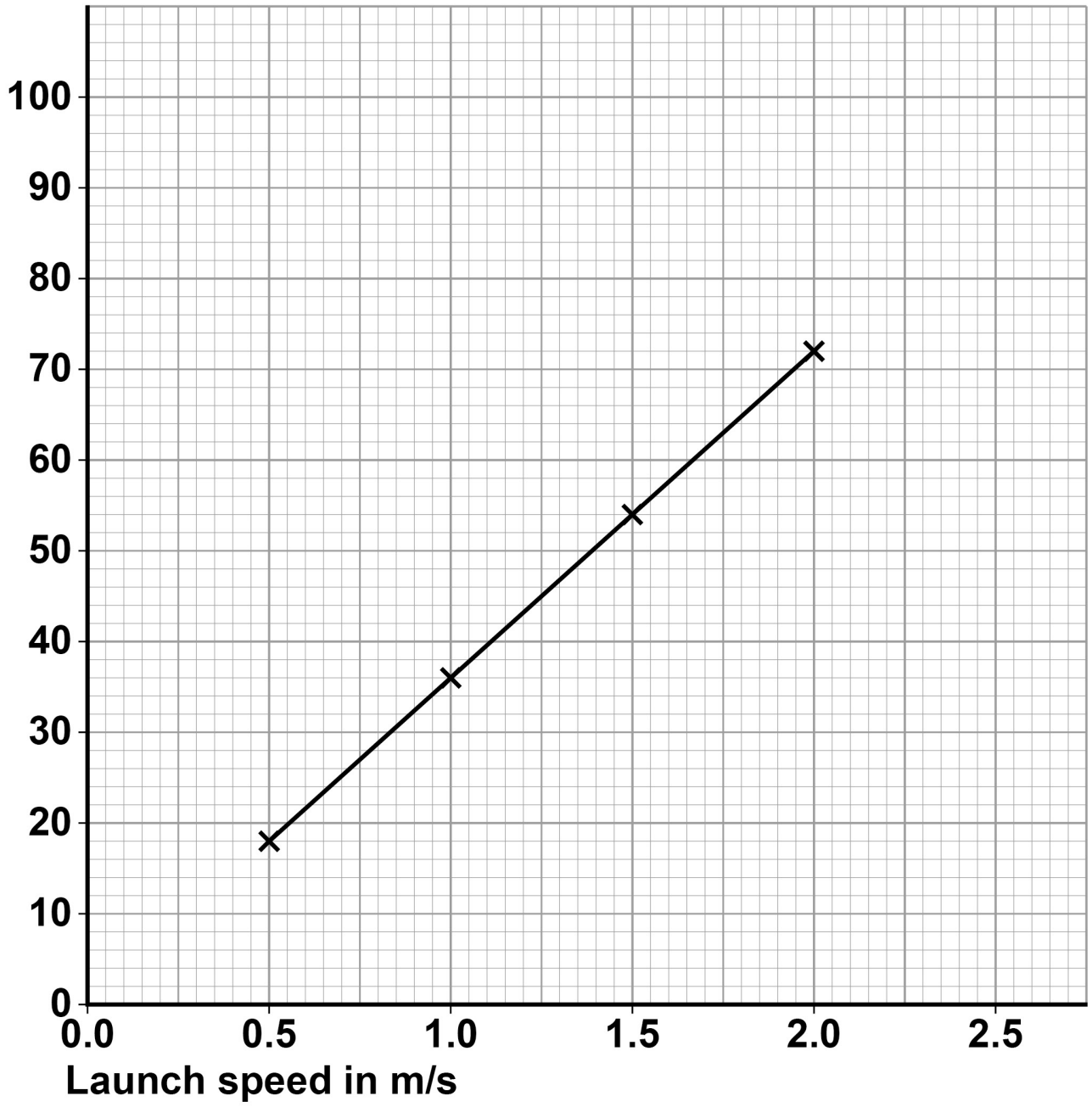
[Turn over]

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

FIGURE 8 shows the results.

FIGURE 8



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[Turn over]

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 on page 54. [1 mark]

Horizontal distance travelled = _____ cm

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

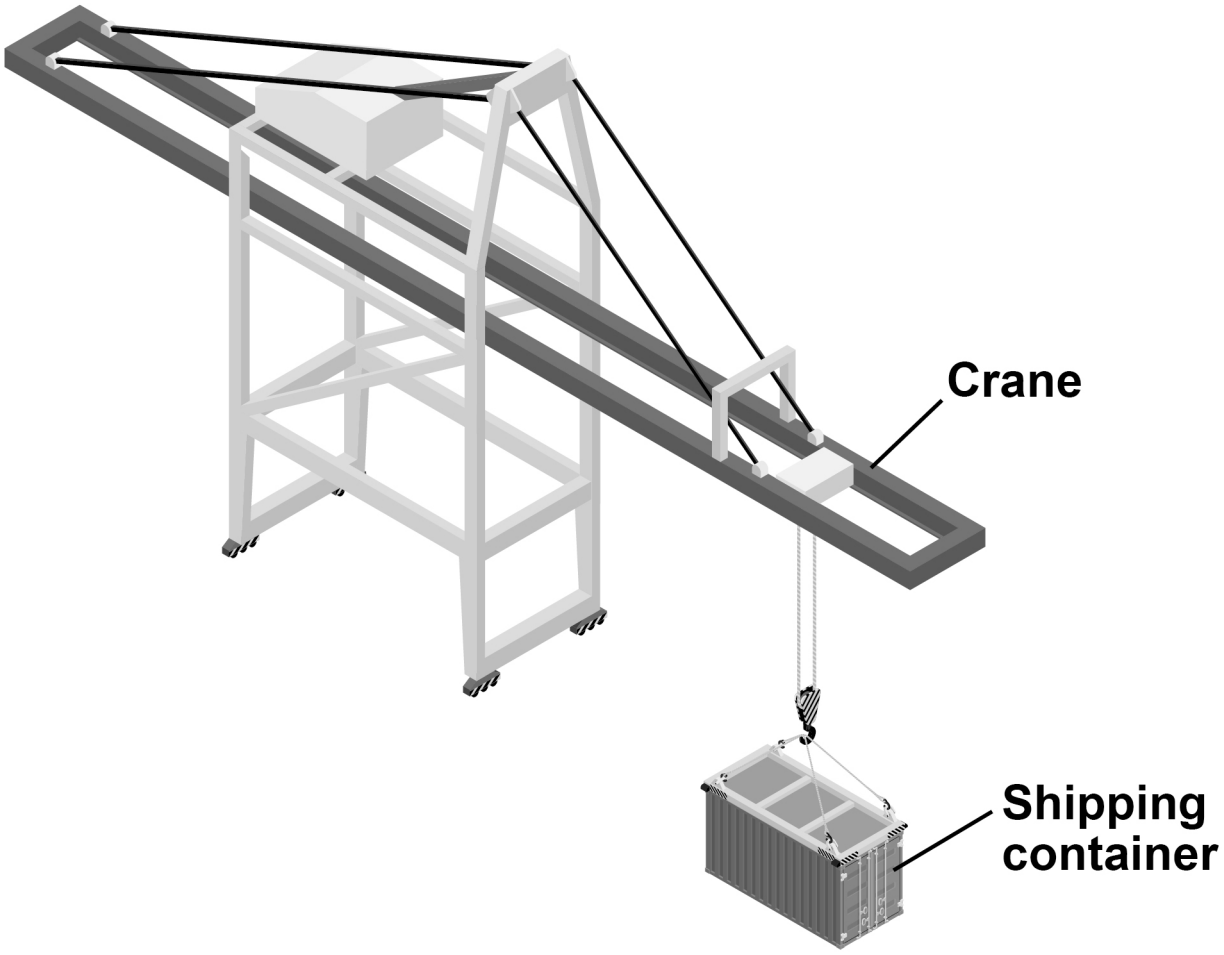
Give your answer to 2 significant figures.
[3 marks]

Kinetic energy = _____ J

11

0 8 **FIGURE 9 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 _____

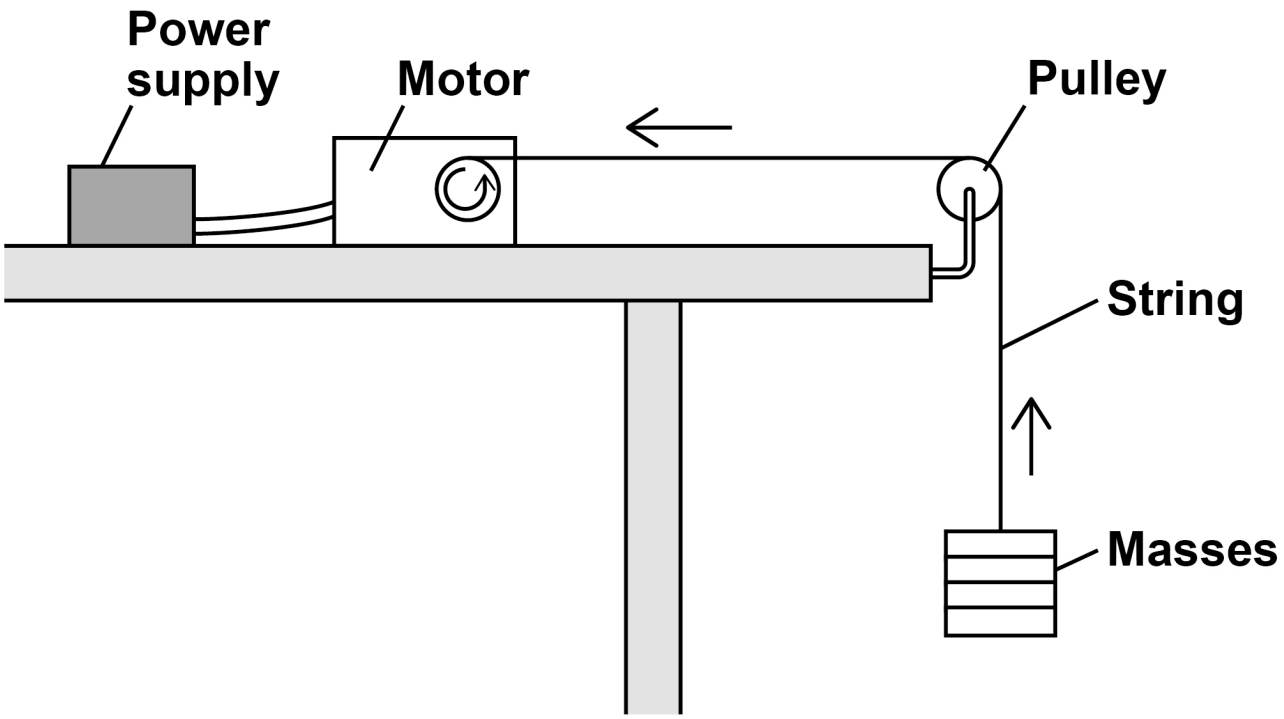
9

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 shows the apparatus used.

FIGURE 10



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**

[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]**

[Turn over]

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]

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

[Turn over]

1 0 . 3 **TABLE 6 gives information about the Life Cycle Assessments (LCAs) of two types of drinks containers.**

TABLE 6

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

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[Turn over]

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
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