Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

PHYSICS

F

Foundation Tier Paper 1

8463/1FR

Wednesday 22 May 2024 Morning

Time allowed: 1 hour 45 minutes

[Turn over]

JUN248463 1FR01

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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 Physics Equations Sheet (enclosed).**

[Turn over]

INSTRUCTIONS

- **Use black ink or black ball-point pen. Pencil should only be used for drawing.**
- **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.**
- **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).**
- **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.**

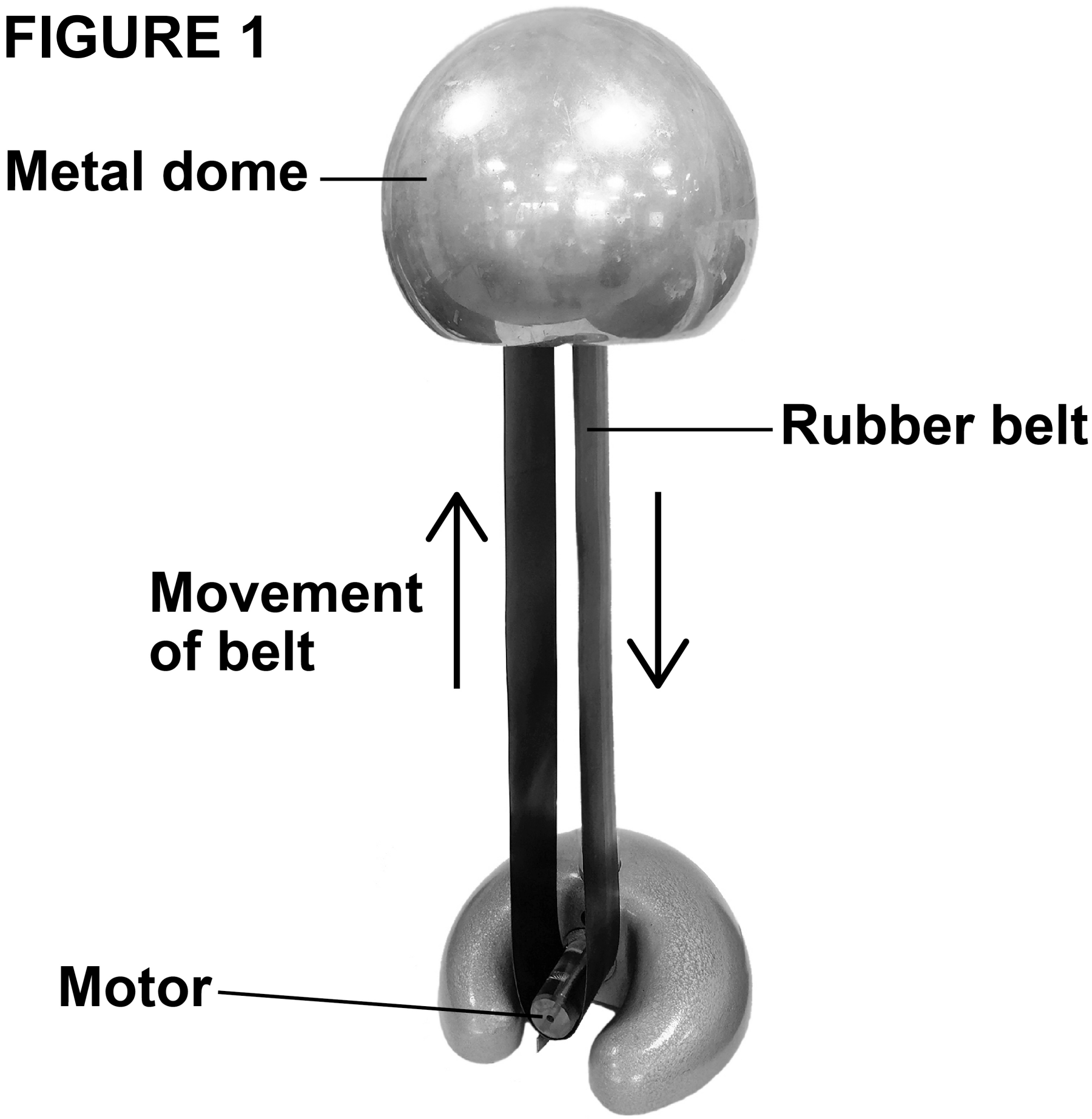
DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions in the spaces provided.

0 1

FIGURE 1 shows a static electricity generator.

FIGURE 1



The rubber belt is turned by a motor.

As the rubber belt moves, charge is transferred from the rubber belt to the metal dome.

[Turn over]

FIGURE 2 shows a student touching the metal dome of the static electricity generator.

The dome is negatively charged.

FIGURE 2

0 1 . 1

Complete the sentence.

Choose the answer from the list.

- **negative**
- **neutral**
- **positive**

[1 mark]

When the student touches the negatively charged metal dome the student's hair gains a _____ charge.

0 1 . 2

Complete the sentence.

Choose the answer from the list.

- **attraction**
- **gravity**
- **repulsion**

[1 mark]

The hair on the student's head stands up because the strands of hair experience forces of _____ .

BLANK PAGE

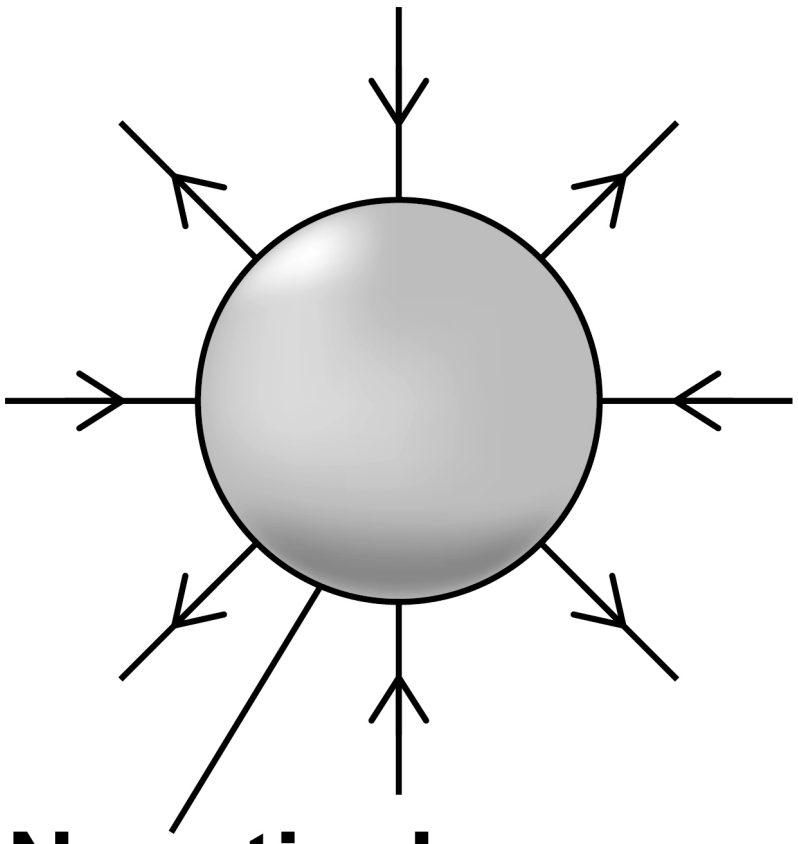
[Turn over]

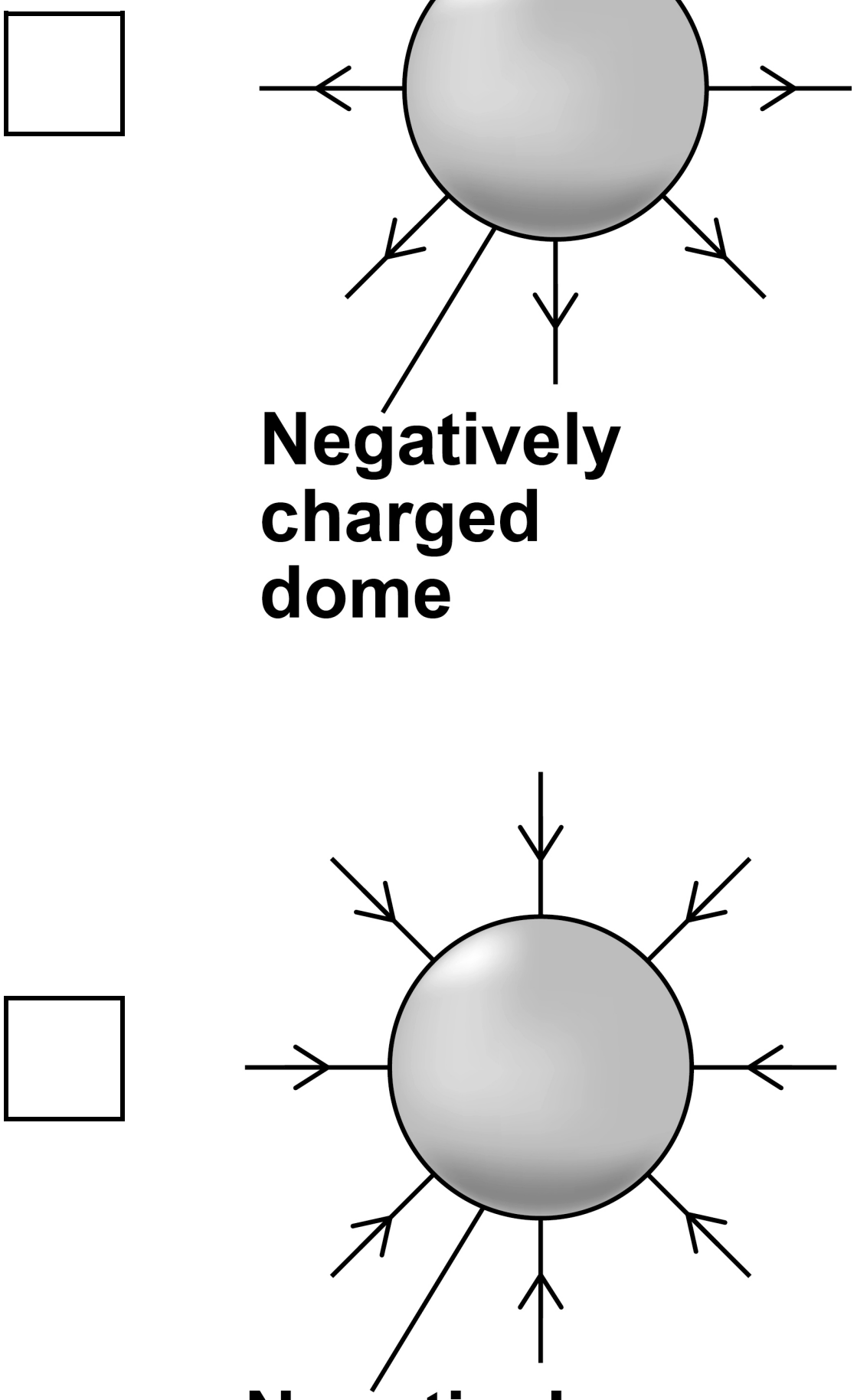
0 1 . 3

Which of the following diagrams, below and on the opposite page, shows the electric field pattern around the negatively charged metal dome?
[1 mark]

Tick (✓) ONE box.

☐





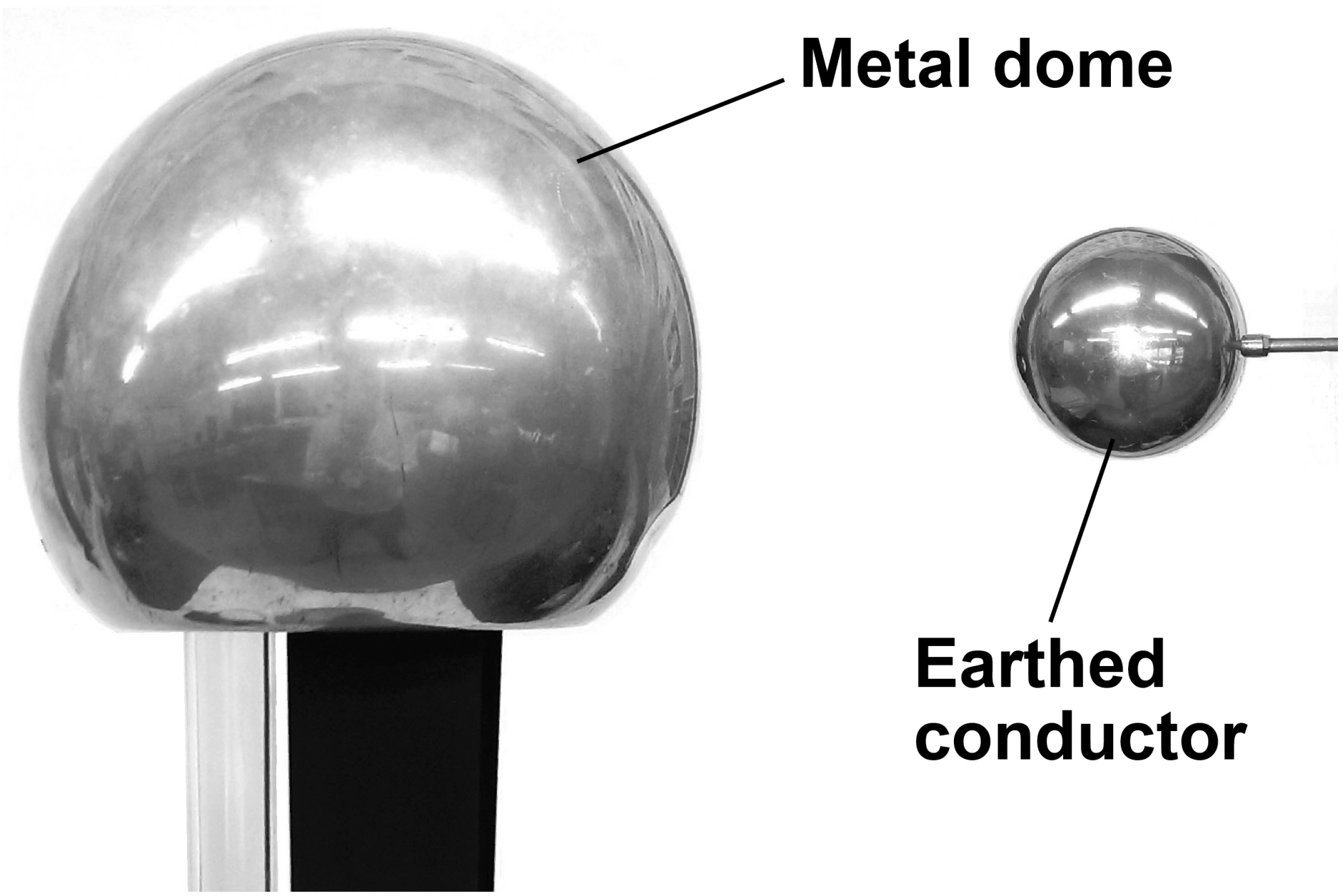
Negatively charged dome

Negatively charged dome

[Turn over]

FIGURE 3 shows the negatively charged metal dome and an earthed conductor.

FIGURE 3



0 1 . 4

The air between the dome and the earthed conductor is an insulator.

Complete the sentence.

Choose the answer from the list.

- **efficiency**
- **resistance**
- **temperature**

[1 mark]

The air between the dome and the earthed conductor has a high

_____ .

[Turn over]

The earthed conductor is moved closer to the metal dome.

A spark jumps from the dome to the earthed conductor.

0 1 . 5

Complete the sentence.

Choose the answer from the list.

- **earthed**
- **ionised**
- **neutral**

[1 mark]

The spark jumps because the air around the charged dome has become

_____ .

0 1 . 6

Which particles are transferred when the spark jumps from the negatively charged metal dome to the earthed conductor?
[1 mark]

Tick (✓) ONE box.

☐ **Electrons**

☐ **Neutrons**

☐ **Protons**

[Turn over]

0 1 . 7

The potential difference between the metal dome and earth is 300 000 V.

When the spark jumps there is a charge flow of 0.000 002 C.

Calculate the energy transferred by the spark.

Use the equation:

energy transferred =
charge flow × potential difference

[2 marks]

_____

_____

_____

Energy transferred = _____ J

[Turn over]

8

0 2

FIGURE 4 shows a student putting a coin into a vending machine that sells food.

FIGURE 4

The vending machine is connected to the mains electricity supply.

0 2 . 1

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

Tick (✓) ONE box.

- ☐ **50 hertz**
- ☐ **60 hertz**
- ☐ **100 hertz**

0 2 . 2

What is the potential difference of the mains electricity supply in the UK?
[1 mark]

Tick (✓) ONE box.

- ☐ **12 volts**
- ☐ **230 volts**
- ☐ **20 000 volts**

BLANK PAGE

[Turn over]

The vending machine identifies the value of the coin by measuring the resistance of the coin.

0 2 . 3

The machine applies a potential difference of 0.45 V across the coin.

The current in the coin is 0.75 A.

On the opposite page, calculate the resistance of the coin.

Use the equation:

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

[2 marks]

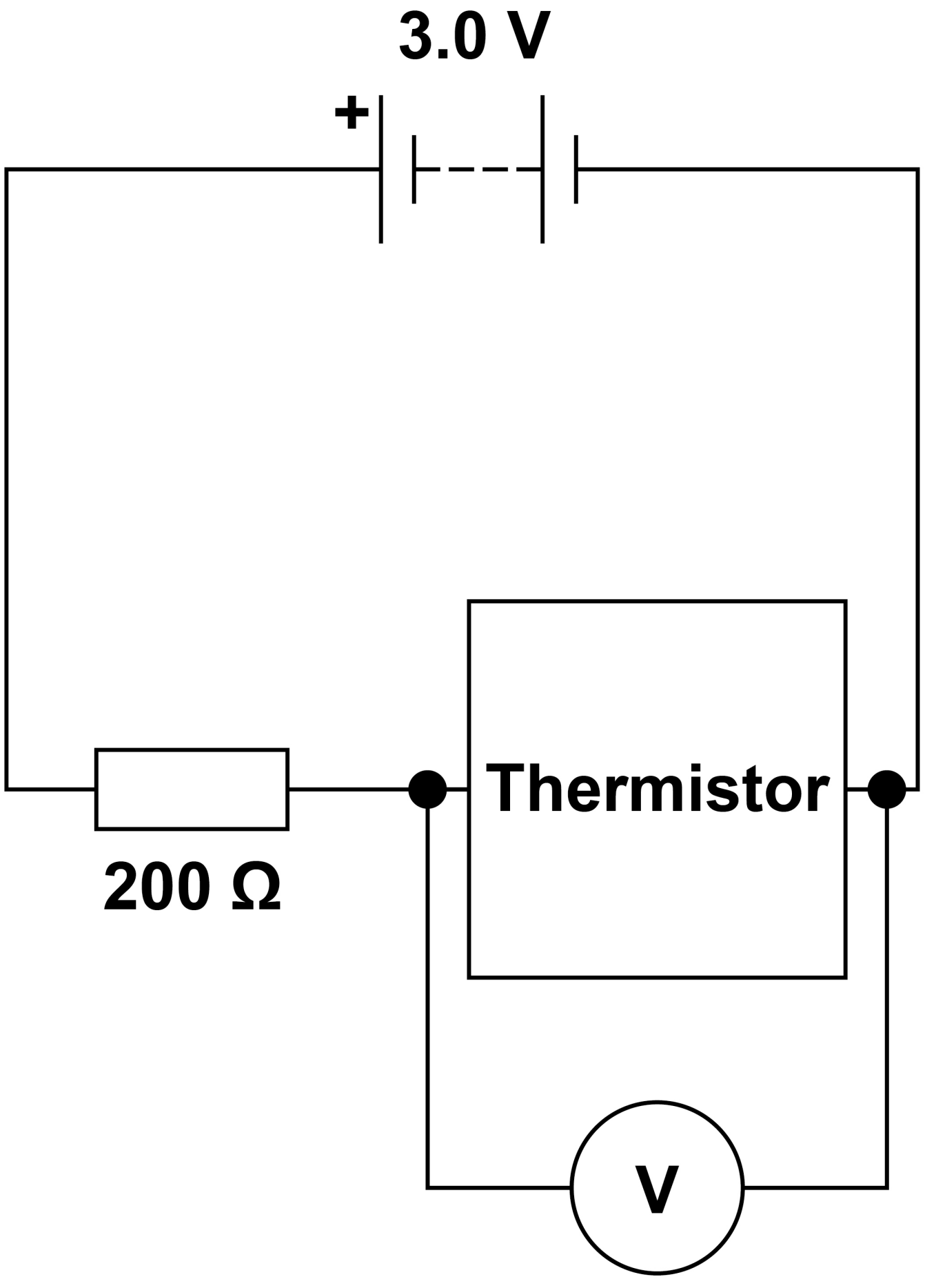
Resistance = _____ Ω

[Turn over]

The temperature inside the vending machine is monitored using an electrical circuit.

FIGURE 5 shows part of the circuit.

FIGURE 5

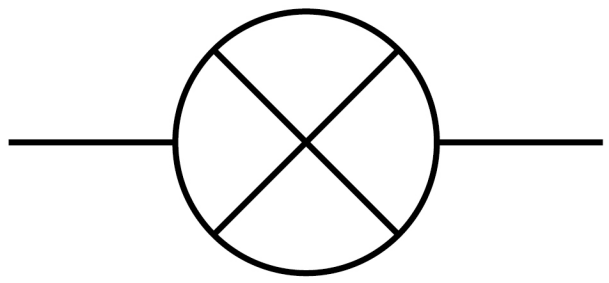


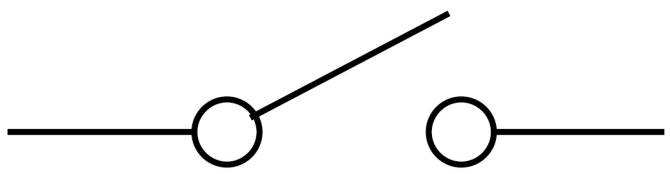
0 2 . 4

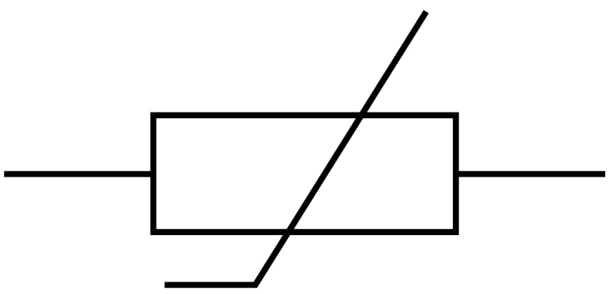
The circuit symbol for the thermistor is wrong.

What is the circuit symbol for a thermistor? [1 mark]

Tick (✓) ONE box.

☐ 

☐ 

☐ 

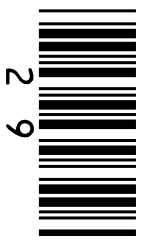
[Turn over]

0 2 . 5

How could the potential difference (pd) across the resistor be calculated? [1 mark]

Tick (✓) ONE box.

- ☐ **pd across battery − pd across thermistor**
- ☐ **pd across battery + pd across thermistor**
- ☐ **pd across battery × pd across thermistor**
- ☐ **pd across battery ÷ pd across thermistor**



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[Turn over]

0 2 . 6

At one temperature, the thermistor in FIGURE 5, on page 26, has a resistance of 200 Ω.

What is the potential difference across the thermistor at this temperature?

Give a reason for your answer. [2 marks]

Tick (✓) ONE box.

☐ **0.0 V**

☐ **1.0 V**

☐ **1.5 V**

☐ **2.0 V**

Reason _____

_____

_____

[Turn over]

FIGURE 6, on the opposite page, shows how the resistance of the thermistor varies with temperature.

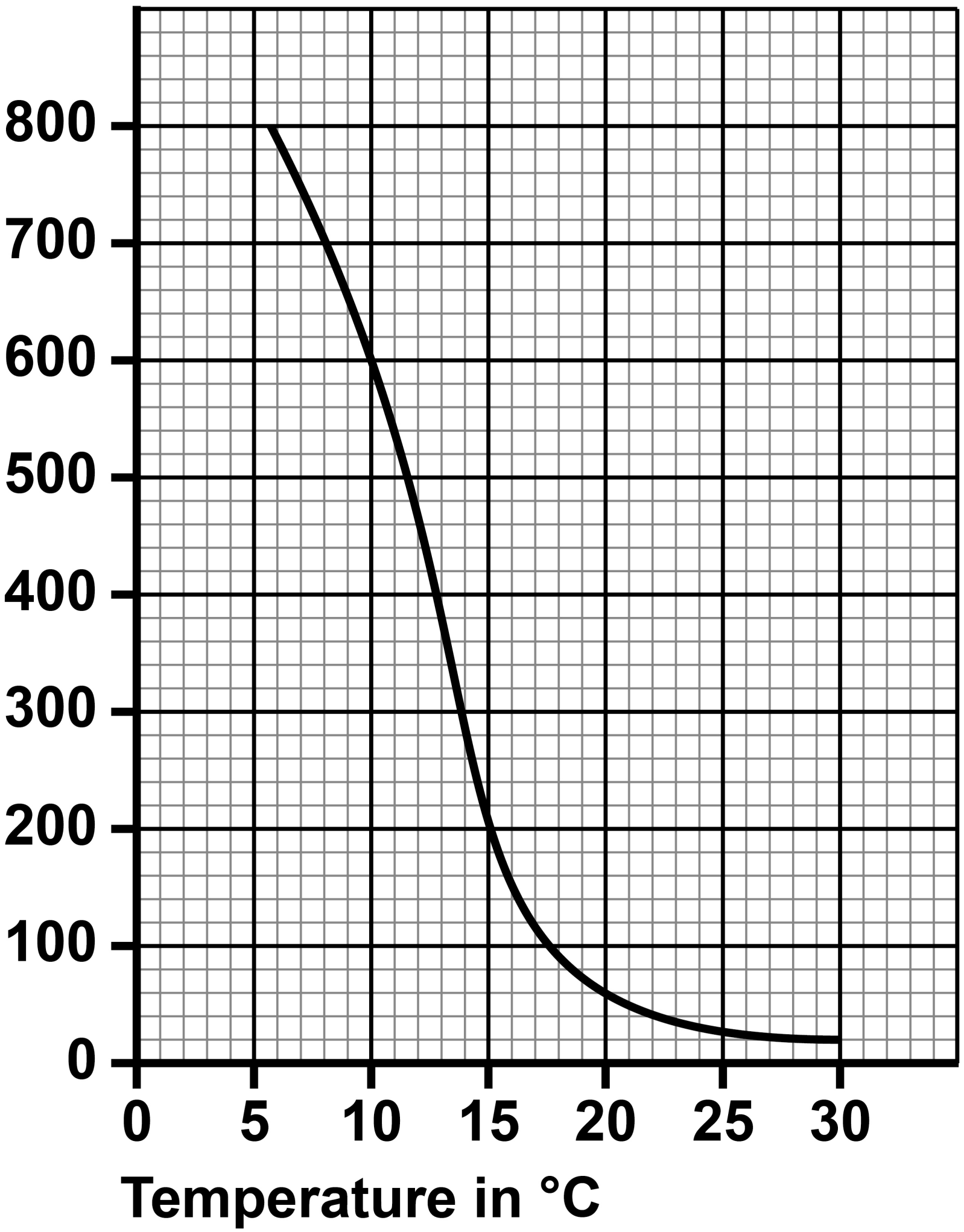
0 2 . 7

When the temperature of the thermistor is 10 °C, the resistance of the thermistor is 600 Ω.

Calculate the change in resistance when the temperature increased from 10 °C to 15 °C. [2 marks]

Change in resistance = _____ Ω

FIGURE 6


Resistance in Ω
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Temperature in °C

0	3

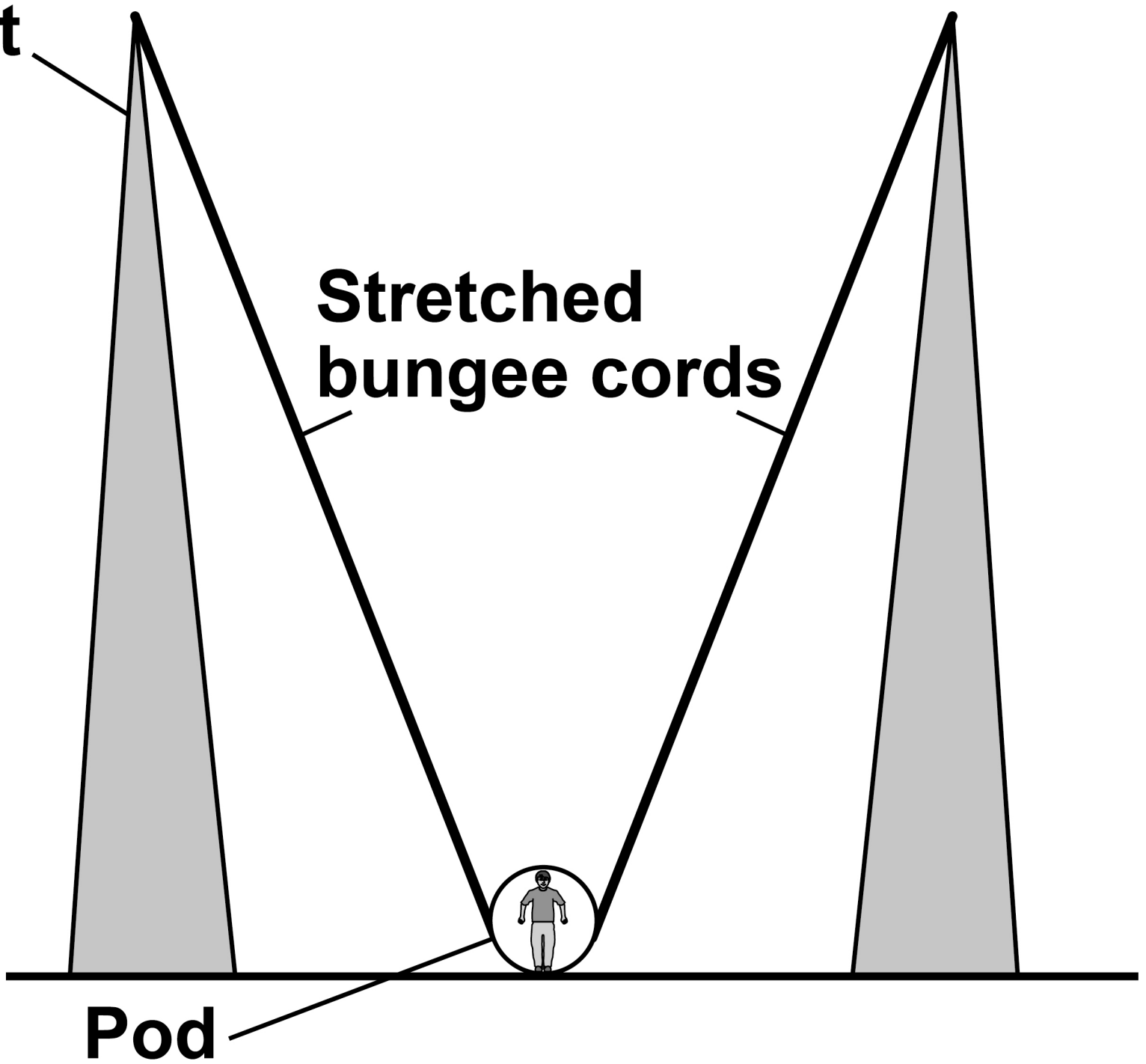
In a ride at a theme park, a person is strapped into a pod that is attached to two stretched bungee cords.

The bungee cords behave like springs.

FIGURE 7, on pages 35 and 36, shows a person using the ride.

FIGURE 7

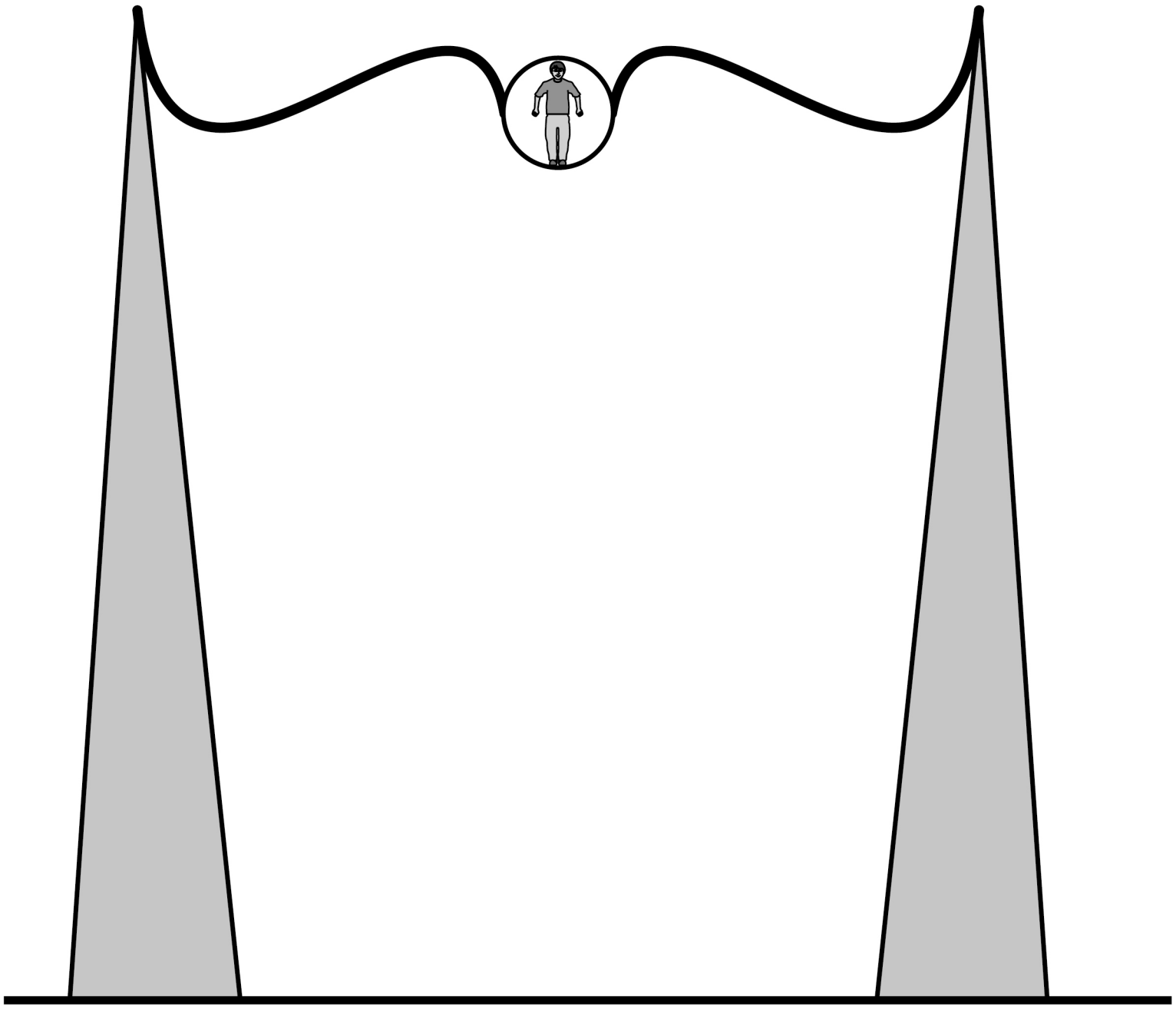
BEFORE RELEASE



[Turn over]

FIGURE 7 continued

AFTER RELEASE



0 3 . 1

How is the extension of each bungee cord calculated? [1 mark]

Tick (✓) ONE box.

- ☐ **stretched length + original length**
- ☐ **stretched length − original length**
- ☐ **stretched length × original length**
- ☐ **stretched length ÷ original length**

[Turn over]

0 3 . 2

Before the pod is released, the extension of each bungee cord is 7.5 m.

spring constant of the bungee cord = 800 N/m

Calculate the elastic potential energy stored in each stretched bungee cord.

Use the equation:

elastic potential energy =
0.5 × spring constant × (extension)^2

[2 marks]

Elastic potential energy = _____ J

0 3 . 3

The maximum speed of the pod is 15 m/s.

The mass of the pod is 240 kg.

Calculate the maximum kinetic energy of the pod.

Use the equation:

kinetic energy = 0.5 × mass × (speed)^2

[2 marks]

Maximum kinetic energy = _____ J

[Turn over]

Use the Physics Equations Sheet to answer questions 03.4 and 03.5.

0 3 . 4

Which equation links gravitational field strength (g), gravitational potential energy (E_p), height (h) and mass (m)?

[1 mark]

Tick (✓) ONE box.

☐ $E_p = \frac{m \times g}{h}$

☐ $E_p = \frac{m}{g \times h}$

☐ $E_p = m \times g \times h$

BLANK PAGE

[Turn over]

0 3 . 5

The pod has 24 000 J of gravitational potential energy when at its maximum height.

The mass of the pod is 240 kg.

gravitational field strength = 9.8 N/kg

Calculate the maximum height reached by the pod. [3 marks]

_____

_____

_____

Maximum height = _____ m

[Turn over]

0 3 . 6

Why is the maximum gravitational potential energy of the pod less than the initial elastic potential energy of the bungee cords? [2 marks]

Tick (✓) TWO boxes.

- ☐ **Energy is created.**
- ☐ **Energy is destroyed.**
- ☐ **Energy is transferred to the surroundings.**
- ☐ **Work is done against air resistance.**
- ☐ **Work is done by the force of gravity.**

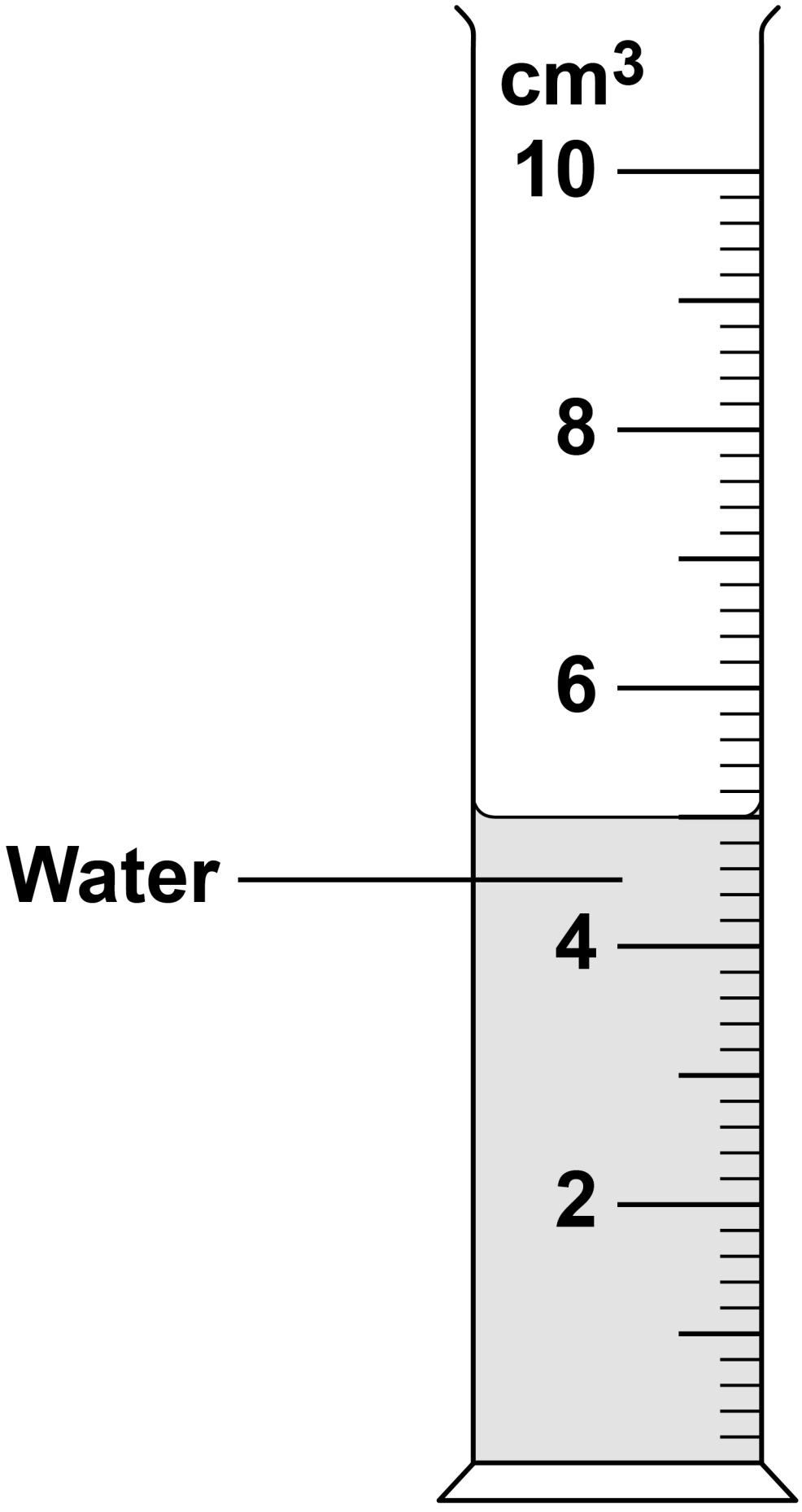
☐ Work is done by the person in the pod.

11

0	4

FIGURE 8 shows a measuring cylinder containing some water.

FIGURE 8



0 4 . 1

What range of volumes can be measured using the measuring cylinder? [1 mark]

Tick (✓) ONE box.

☐ **0.0 to 0.2 cm^3**

☐ **0.0 to 2.0 cm^3**

☐ **0.0 to 10.0 cm^3**

A student used the measuring cylinder, on page 46, to measure the volume of a metal ring.

0 4 . 2

The student tied the metal ring to some very thin string and lowered the ring into the measuring cylinder.

The student could have used thick string instead of thin string.

How would using thick string have affected the measured volume of the metal ring? [1 mark]

Tick (✓) ONE box.

- ☐ **The measured volume would be smaller.**
- ☐ **The measured volume would not be affected.**
- ☐ **The measured volume would be larger.**

[Turn over]

0 4 . 3

TABLE 1 shows the results.

TABLE 1

Volume of water in cm^3	Volume of water and ring in cm^3	Volume of ring in cm^3
5.0	5.4	X

Calculate value X in TABLE 1. [1 mark]

X = _____ cm^3

0 4 . 4

The student measured the volume of the ring three times.

The results were all the same.

Which of the following describes the student's results? [1 mark]

Tick (✓) ONE box.

☐ **The results are anomalies.**

☐ **The results are repeatable.**

☐ **The results contain random errors.**

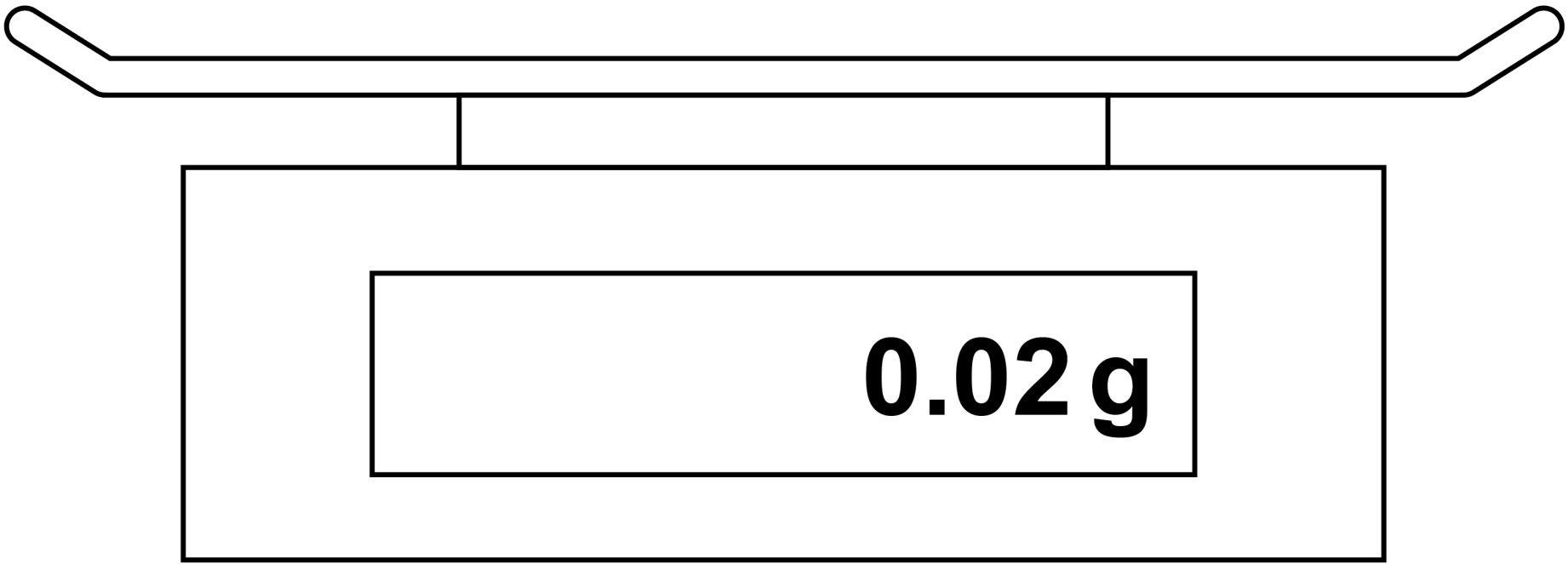
[Turn over]

0 4 . 5

The student used a balance to measure the mass of the ring.

FIGURE 9 shows the balance.

FIGURE 9



The student noticed that the balance had a reading of 0.02 g when there was no object on the balance.

How should the student correct this error AFTER the mass of the ring had been measured? [1 mark]

Tick (✓) ONE box.

- ☐ **Add 0.02 to the measurement**
- ☐ **Divide the measurement by 0.02**
- ☐ **Multiply the measurement by 0.02**
- ☐ **Subtract 0.02 from the measurement**

[Turn over]

Use the Physics Equations Sheet to answer questions 04.6 and 04.7.

0 4 . 6

Write down the equation which links density (ρ), mass (m) and volume (V). [1 mark]

0 4 . 7

A different metal ring has a volume of 0.3 cm^3.

The density of this ring is 22 g/cm^3.

Calculate the mass of this ring.

Give your answer in grams. [3 marks]

Mass = _____ g

[Turn over]

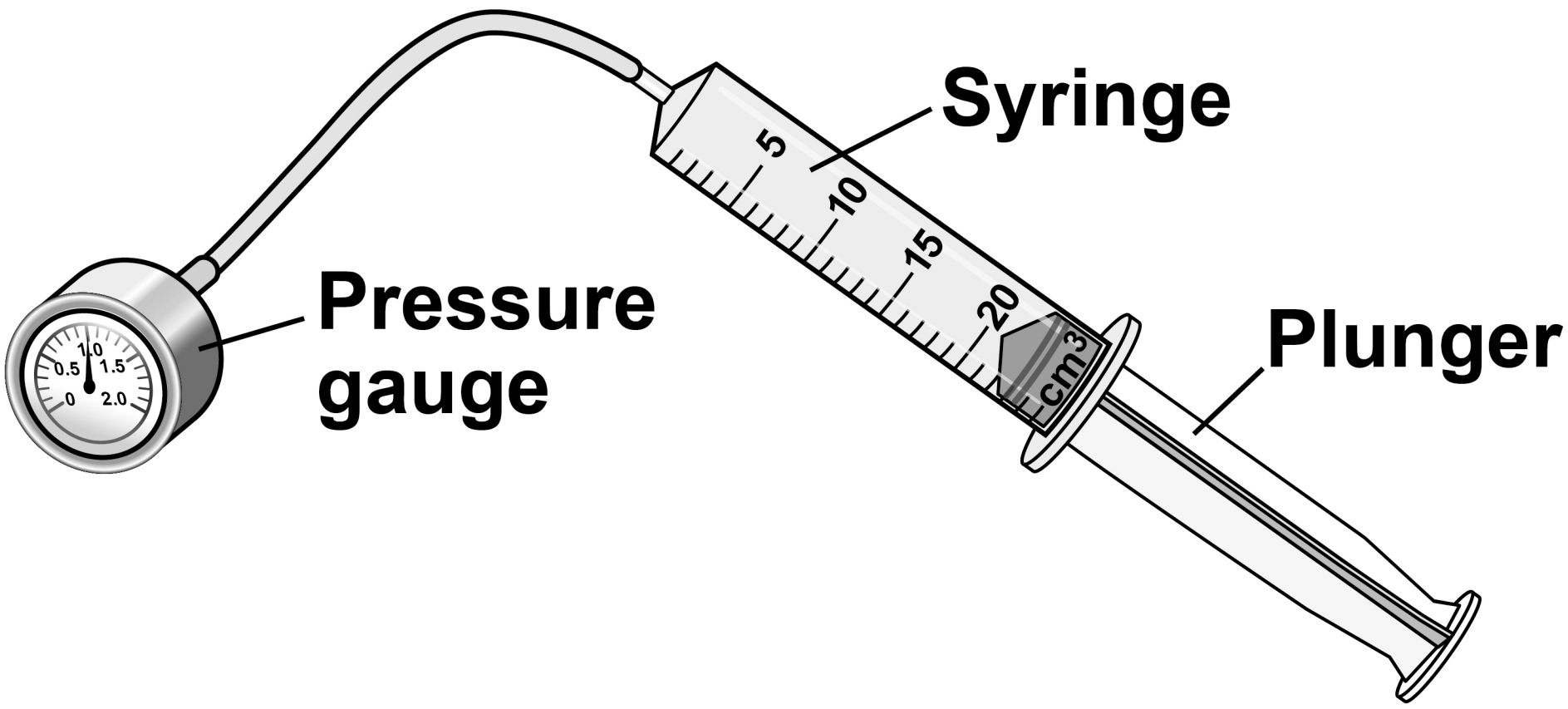
9

0 5

A student investigated how the pressure in a fixed mass of air varies with the volume of the air.

FIGURE 10 shows the equipment used.

FIGURE 10



When the plunger was pushed slowly into the syringe, the temperature of the air stayed the same.

0 5 . 1

How did pushing the plunger in affect the volume of air in the syringe? [1 mark]

Tick (✓) ONE box.

- ☐ **The volume decreased.**
- ☐ **The volume stayed the same.**
- ☐ **The volume increased.**

0 5 . 2

How did pushing the plunger in affect the distance between the air particles in the syringe? [1 mark]

Tick (✓) ONE box.

- ☐ **The distance decreased.**
- ☐ **The distance stayed the same.**
- ☐ **The distance increased.**

0 5 . 3

How did pushing the plunger in affect the frequency of collisions between the air particles and the syringe walls? [1 mark]

Tick (✓) ONE box.

☐ **The frequency of collisions decreased.**

☐ **The frequency of collisions stayed the same.**

☐ **The frequency of collisions increased.**

[Turn over]

0 5 . 4

How did pushing the plunger in affect the air pressure in the syringe? [1 mark]

Tick (✓) ONE box.

- ☐ **The air pressure decreased.**
- ☐ **The air pressure stayed the same.**
- ☐ **The air pressure increased.**

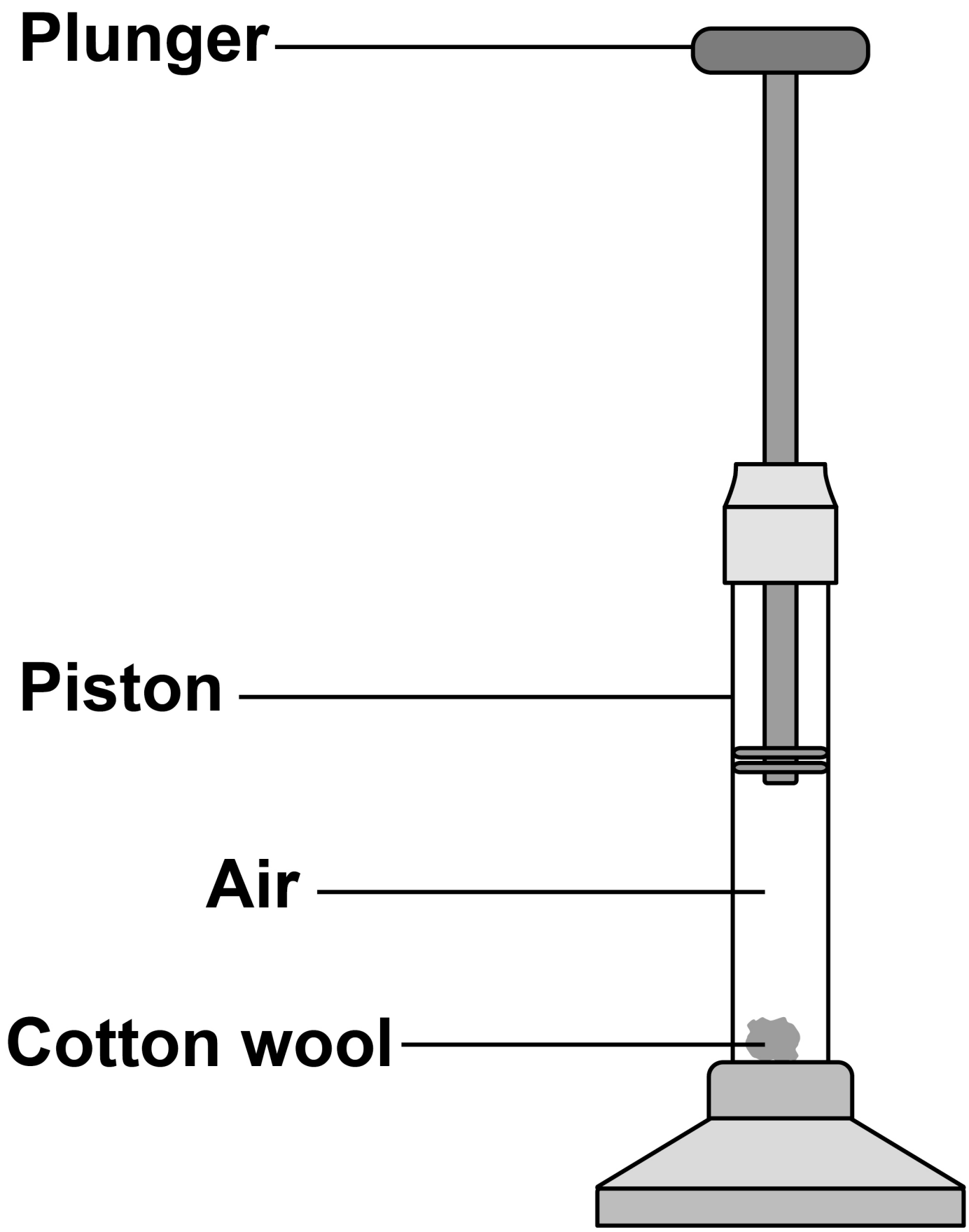
BLANK PAGE

[Turn over]

A fire piston is a special type of syringe that can be used to start fires.

FIGURE 11 shows a fire piston.

FIGURE 11



The plunger is pushed quickly downwards and compresses the air.

When the air is compressed quickly, the temperature of the air increases.

0 5 . 5

How does an increase in temperature affect the mean speed of the air particles inside the syringe? [1 mark]

Tick (✓) ONE box.

☐ The mean speed of the particles decreases.

☐ The mean speed of the particles does not change.

☐ The mean speed of the particles increases.

[Turn over]

0 5 . 6

When the air is hot enough, a small piece of cotton wool in the piston catches fire.

The energy transferred to the air in the piston is 0.0130 J.

The mass of air in the piston is 2.60×10^{-8} kg.

specific heat capacity of air = 1010 J/kg °C

Calculate the temperature change of the air.

Use the Physics Equations Sheet.
[3 marks]

Temperature change = _____ °C

[Turn over]

8

0 6

A teacher measured the background radiation in a laboratory.

0 6 . 1

Which sources of background radiation are natural and which are man-made?
[2 marks]

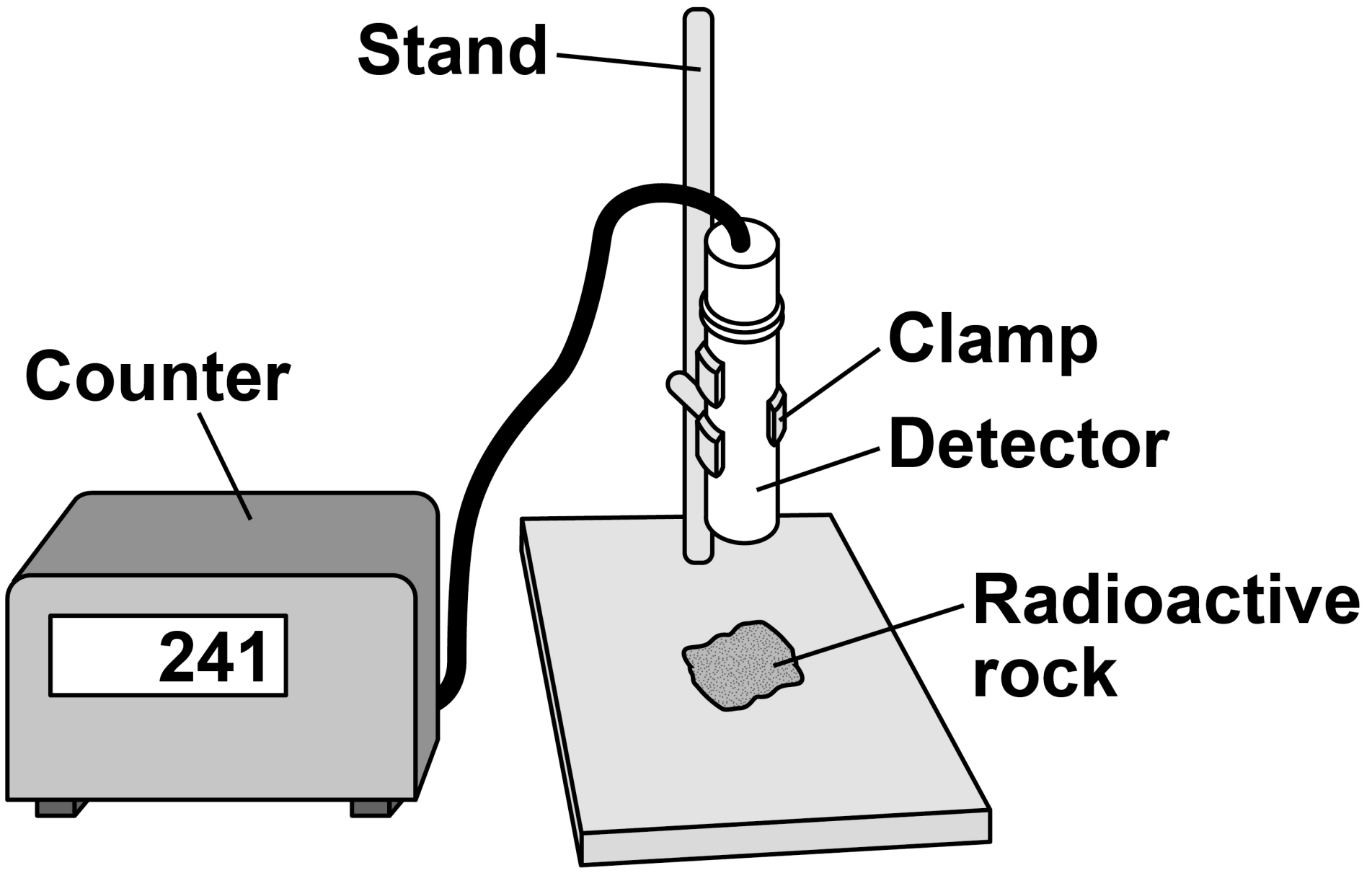
Tick (✓) ONE box in EACH row.

SOURCE OF BACKGROUND RADIATION	NATURAL	MAN-MADE
Cosmic rays		
Medical X-rays		
Nuclear accidents		
Radon gas		

The teacher measured the radiation emitted by four different types of radioactive rock.

FIGURE 12 shows the equipment used.

FIGURE 12



[Turn over]

Each radioactive rock was placed below the detector one at a time.

The radiation was recorded as the number of counts in 1 minute.

The experiment was repeated with different materials between each rock and the detector.

TABLE 2 shows the results.

TABLE 2

	NUMBER OF COUNTS IN 1 MINUTE		
	No material	One sheet of paper	Thick aluminium sheet
No rock	21	20	22
Rock A	450	448	18
Rock B	385	387	356
Rock C	870	21	20
Rock D	620	473	214

0 6 . 2

Which radioactive rock emitted only alpha radiation?

Give a reason for your answer. [2 marks]

Tick (✓) ONE box.

- ☐ **Rock A**
- ☐ **Rock B**
- ☐ **Rock C**
- ☐ **Rock D**

Reason _____

_____

_____

[Turn over]

0 6 . 3

Which radioactive rock, on page 68, emitted only beta radiation?

Give a reason for your answer. [2 marks]

Tick (✓) ONE box.

- ☐ **Rock A**
- ☐ **Rock B**
- ☐ **Rock C**
- ☐ **Rock D**

Reason _____

_____

_____

0 6 . 4

The teacher took safety precautions during the experiment.

Which precaution would prevent the teacher from becoming contaminated by the radioactive rocks? [1 mark]

Tick (✓) ONE box.

- ☐ **Displaying the radiation hazard symbol**
- ☐ **Handling the rocks with clean hands**
- ☐ **Wearing protective gloves**

[Turn over]

0 6 . 5

What is the activity of each rock after one half-life? [1 mark]

Tick (✓) ONE box.

- ☐ **The activity is a quarter of the original activity.**
- ☐ **The activity is half the original activity.**
- ☐ **The activity is double the original activity.**
- ☐ **The activity is zero.**

0 6 . 6

How does the activity of a radioactive source affect the risk of harm from the source? [1 mark]

Tick (✓) ONE box.

- ☐ **The smaller the activity, the greater the risk of harm.**
- ☐ **The activity does not affect the risk of harm.**
- ☐ **The greater the activity, the greater the risk of harm.**

[Turn over]

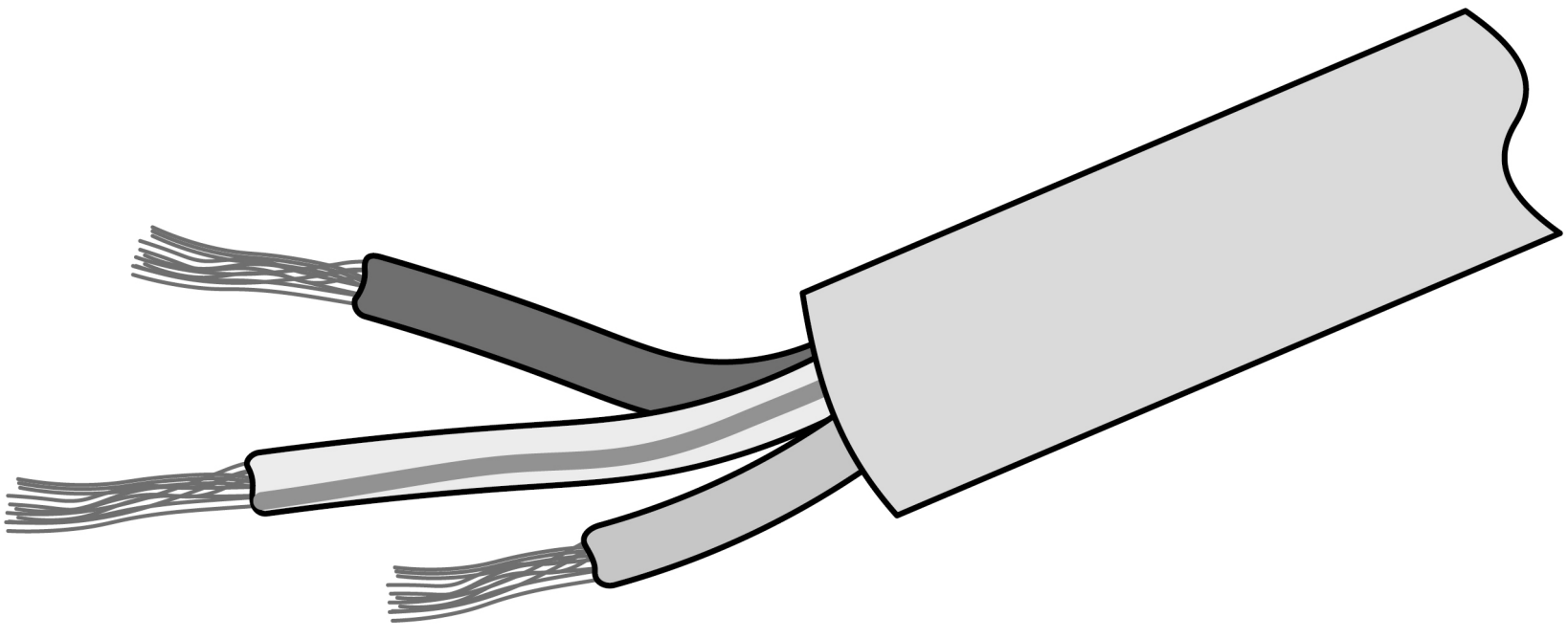
9

0 7

An electrical appliance is connected to the mains electricity supply using a three-core cable.

FIGURE 13 shows a three-core cable.

FIGURE 13



0 7 . 1

What colour is the insulation covering the live wire inside the cable? [1 mark]

Tick (✓) ONE box.

- ☐ **Blue**
- ☐ **Brown**
- ☐ **Green and yellow**
- ☐ **Orange**

[Turn over]

0 7 . 2

What colour is the insulation covering the neutral wire inside the cable?
[1 mark]

Tick (✓) ONE box.

- ☐ **Blue**
- ☐ **Brown**
- ☐ **Green and yellow**
- ☐ **Orange**

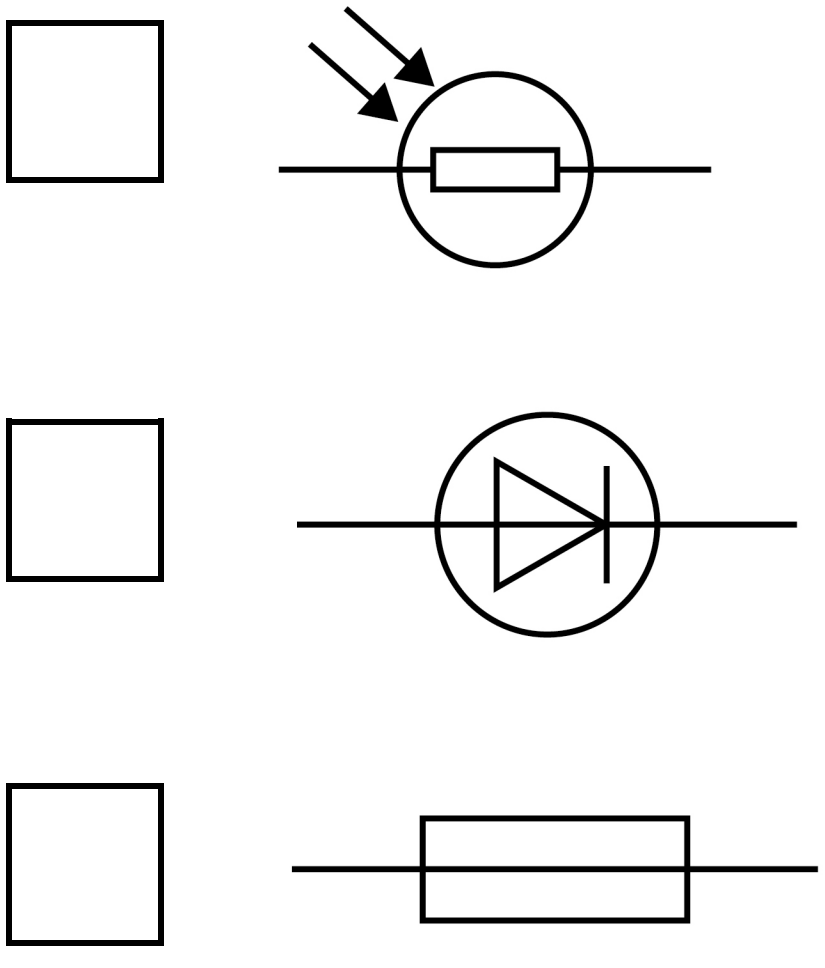
The plug connected to the cable contains a fuse.

A fuse contains a wire that is designed to melt when the current is too great.

0 7 . 3

What is the circuit symbol for a fuse?
[1 mark]

Tick (✓) ONE box.



[Turn over]

0 7 . 4

The wire in the fuse melts when there is a charge flow of 2.0 C in a time of 0.40 s.

Calculate the current in the wire when it melts.

Use the equation:

$$\text{current} = \frac{\text{charge flow}}{\text{time}}$$

[2 marks]

Current = _____ A

0 7 . 5

The mass of the wire is 0.016 g.

specific latent heat of fusion of the wire = 60 000 J/kg

Calculate the change in thermal energy needed to melt the wire.

Use the Physics Equations Sheet.
[3 marks]

Change in thermal energy = _____ J

[Turn over]

0 7 . 6

The fuse transfers some energy to the surroundings as it melts.

How does transferring energy to the surroundings affect the total energy needed to melt the fuse? [1 mark]

Tick (✓) ONE box.

- ☐ **The total energy will be smaller.**
- ☐ **The total energy will be the same.**
- ☐ **The total energy will be greater.**

9

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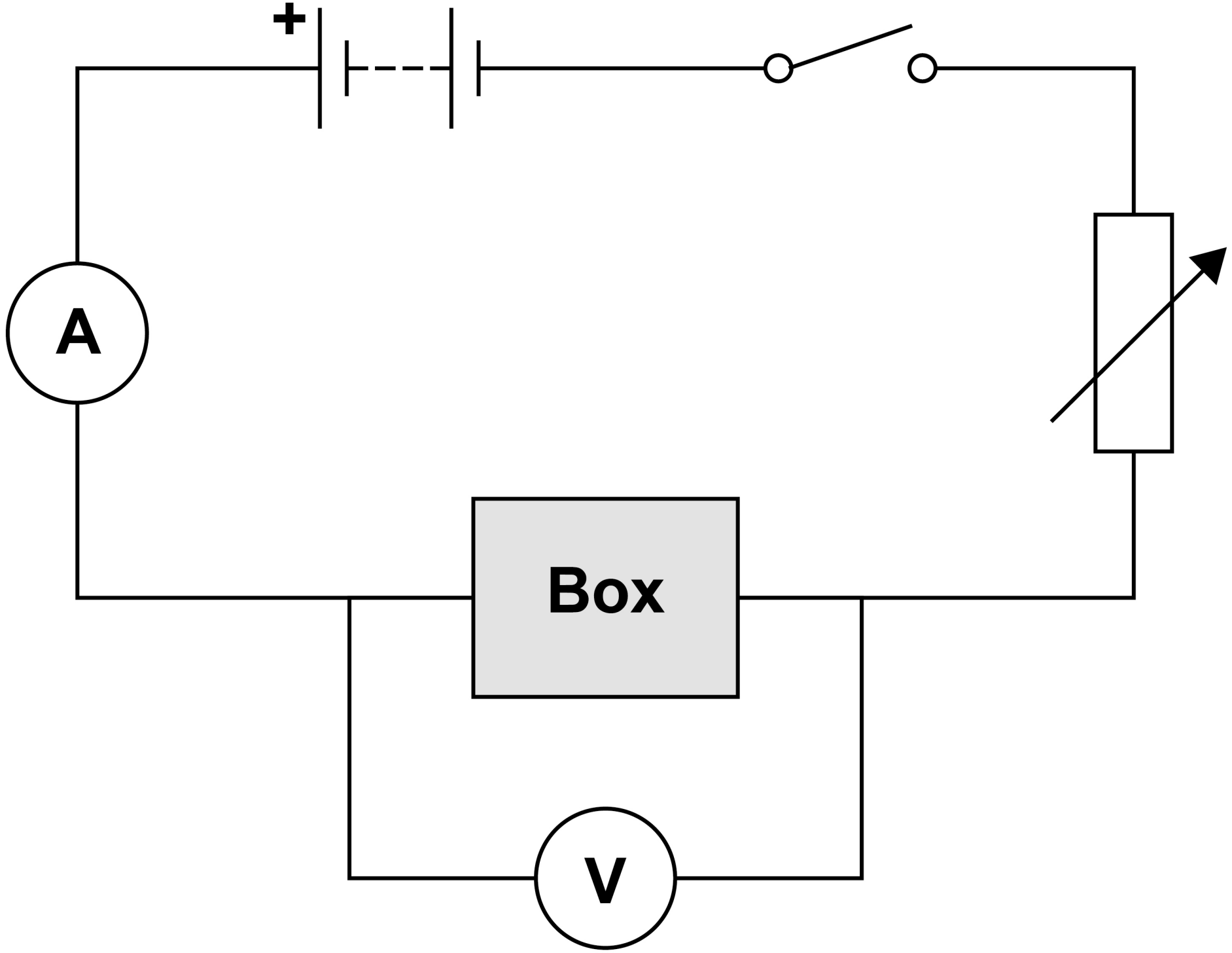
[Turn over]

0 8

A student had an unknown electrical component inside a sealed box.

FIGURE 14, on the opposite page, shows the circuit the student used to identify the component.

FIGURE 14



[Turn over]

The student varied the potential difference across the component and measured the current in the component.

TABLE 3 shows the results when the potential difference across the component was 6.0 V.

TABLE 3

POTENTIAL DIFFERENCE IN VOLTS	CURRENT IN AMPS			
	1st reading	2nd reading	3rd reading	MEAN
6.0	0.26	0.21	0.25	X

0 8 . 1

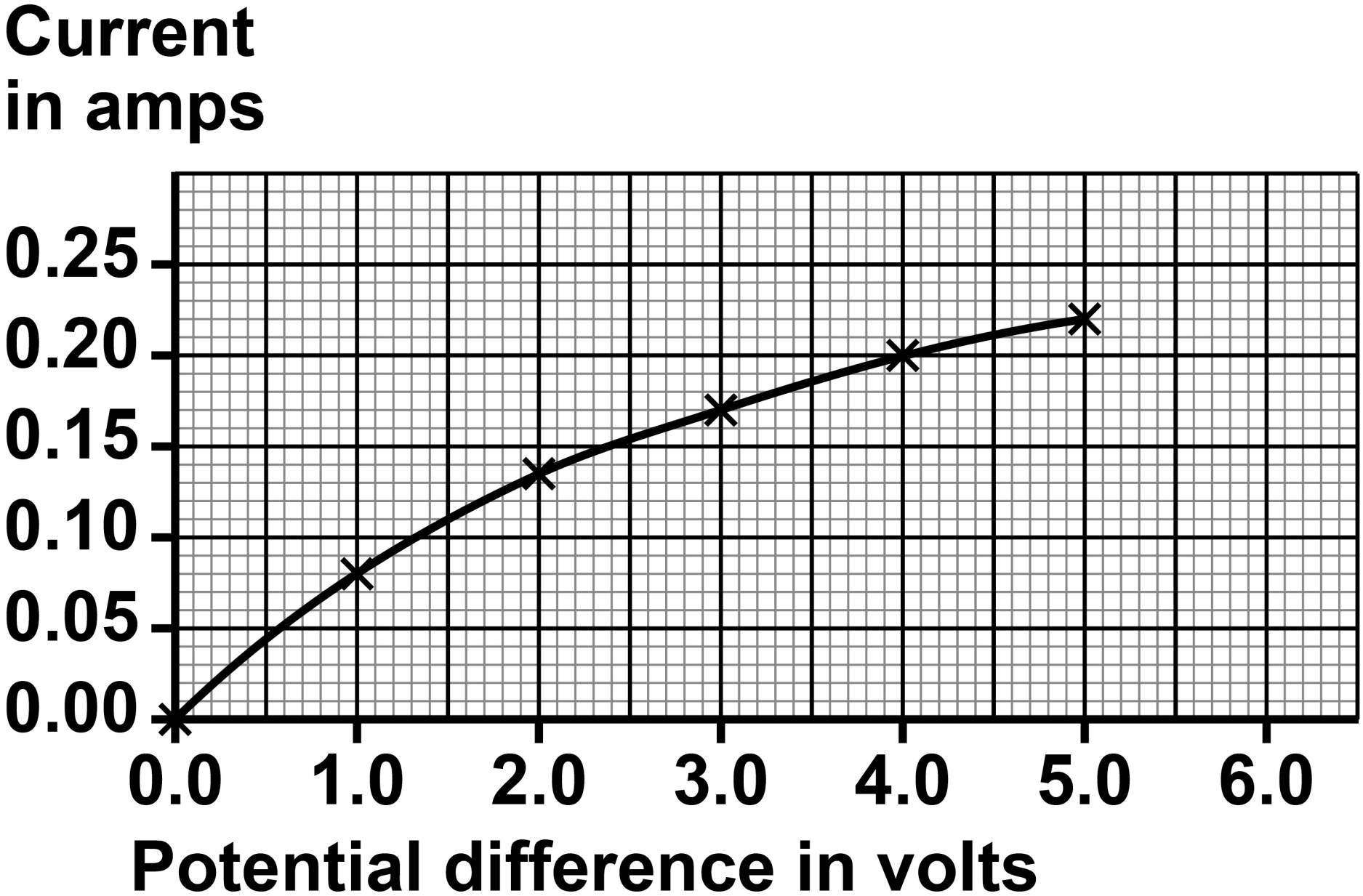
Calculate value X in TABLE 3. [2 marks]

X = _____ A

[Turn over]

FIGURE 15 shows the results.

FIGURE 15



0 8 . 2

Calculate the power of the component when the potential difference across the component is 3.0 V.

Use FIGURE 15 and the equation:

power = potential difference × current

[3 marks]

Power = _____ W

0 8 . 3

Complete the sentence.

Choose the answer from the list.

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

[1 mark]

As the potential difference across the component increases, the gradient of the graph _____ .

0 8 . 4

What is the component in the sealed box? [1 mark]

Tick (✓) ONE box.

- ☐ **Diode**
- ☐ **Filament lamp**
- ☐ **Resistor at constant temperature**

[Turn over]

7

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0 9

FIGURE 16 shows a wind turbine.

FIGURE 16

[Turn over]

Wind turbines may generate electricity when the electricity is not needed.

Two methods that can be used to store the energy from the turbine are:

METHOD A: Heating water to a high temperature.

METHOD B: Pumping water uphill into a reservoir.

0 9 . 1

Which energy store increases when water is heated? [1 mark]

0 9 . 2

Which energy store increases when water is pumped uphill into a reservoir? [1 mark]

[Turn over]

TABLE 4

METHOD	Energy stored per 100 kg of water in kJ	Percentage of stored energy wasted	Installation
A: Increasing water temperature by 80 °C	33 600	40%	Anywhere
B: Pumping water uphill to a height of 500 m	490	25%	High mountains

TABLE 4, on the opposite page, shows information about the two methods of storing energy.

Compare the advantages and disadvantages of the two methods of storing energy.

Include calculations in your answer. [4 marks]

[Turn over]

96

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[Turn over]

0 9 . 4

Decreasing the amount of carbon dioxide released by different activities will help slow down climate change.

Transport and generating electricity are the two activities that released the largest amounts of carbon dioxide in the UK in 2018.

Explain ONE change that would reduce the amount of carbon dioxide released by EACH activity. [4 marks]

Transport

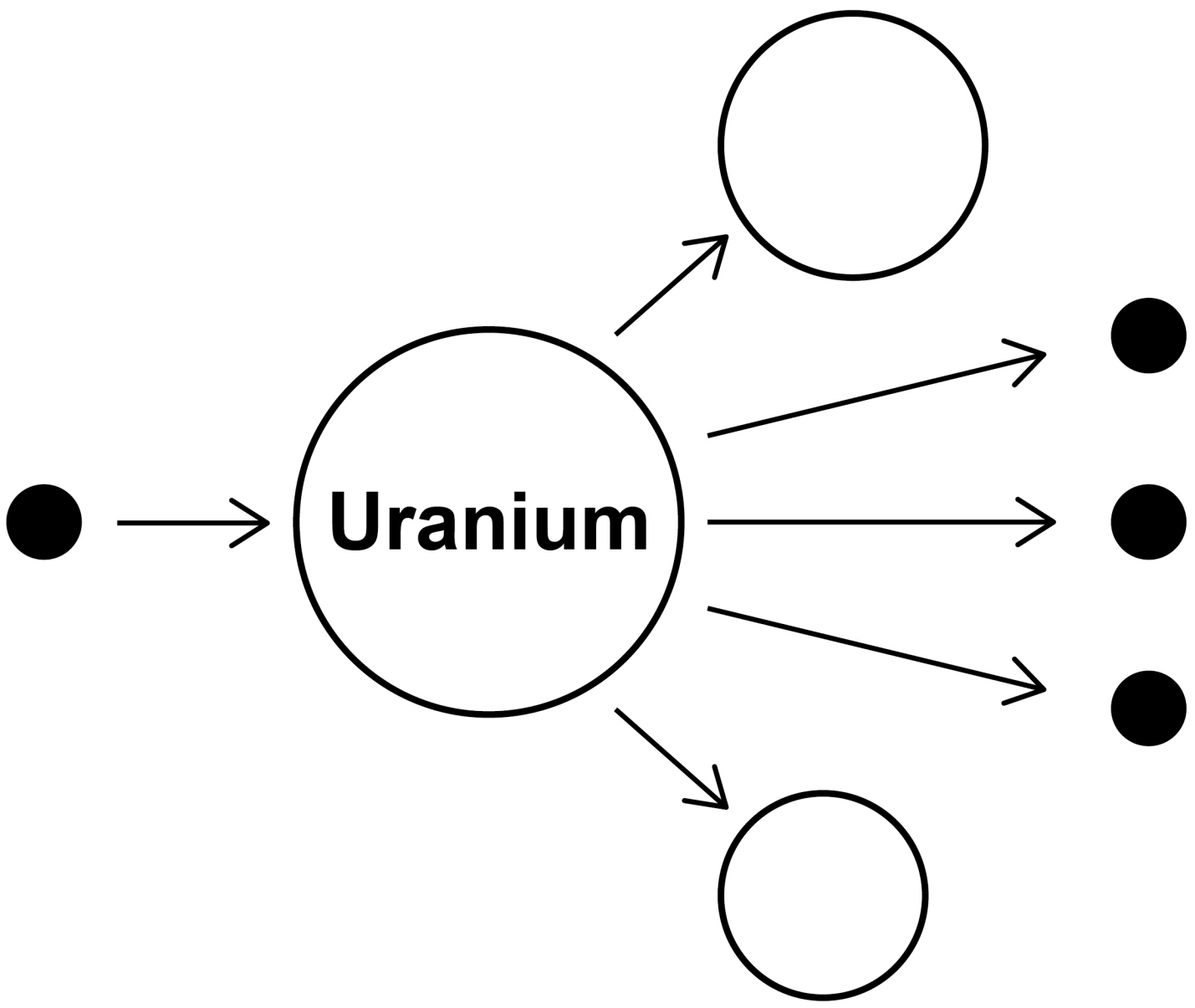
Generating electricity

1	0

The process of nuclear fission is used in nuclear power stations.

FIGURE 17 shows the process of nuclear fission.

FIGURE 17



1 0 . 1

Complete the sentences.

Choose answers from the list.

- **electrons**
- **gamma rays**
- **neutrons**
- **nuclei**
- **protons**

[3 marks]

In nuclear power stations, energy is released from uranium _____ .

The uranium in FIGURE 17 splits into two parts and releases three _____ .

[Turn over]

The process of nuclear fission releases electromagnetic radiation in the form of _____ .

Use the Physics Equations Sheet to answer questions 10.2 and 10.3.

10.2

Write down the equation which links energy (*E*), power (*P*) and time (*t*). [1 mark]

1 0 . 3

A nuclear power station has a power output of 500 MW.

Calculate the energy output in 3600 s.

Give your answer in J. [3 marks]

Energy output = _____ J

[Turn over]

1 0 . 4

Radioactive waste produced by nuclear power stations has a long half-life.

Suggest ONE precaution taken to reduce the hazard caused by radioactive waste from power stations. [1 mark]

10.5

Nuclear power stations do NOT generate electricity every day of the year.

One nuclear power station generated electricity for 92% of a year.

one year = 365 days

Calculate the number of days during the year that the nuclear power station generated electricity. [2 marks]

Number of days = _____

[Turn over]

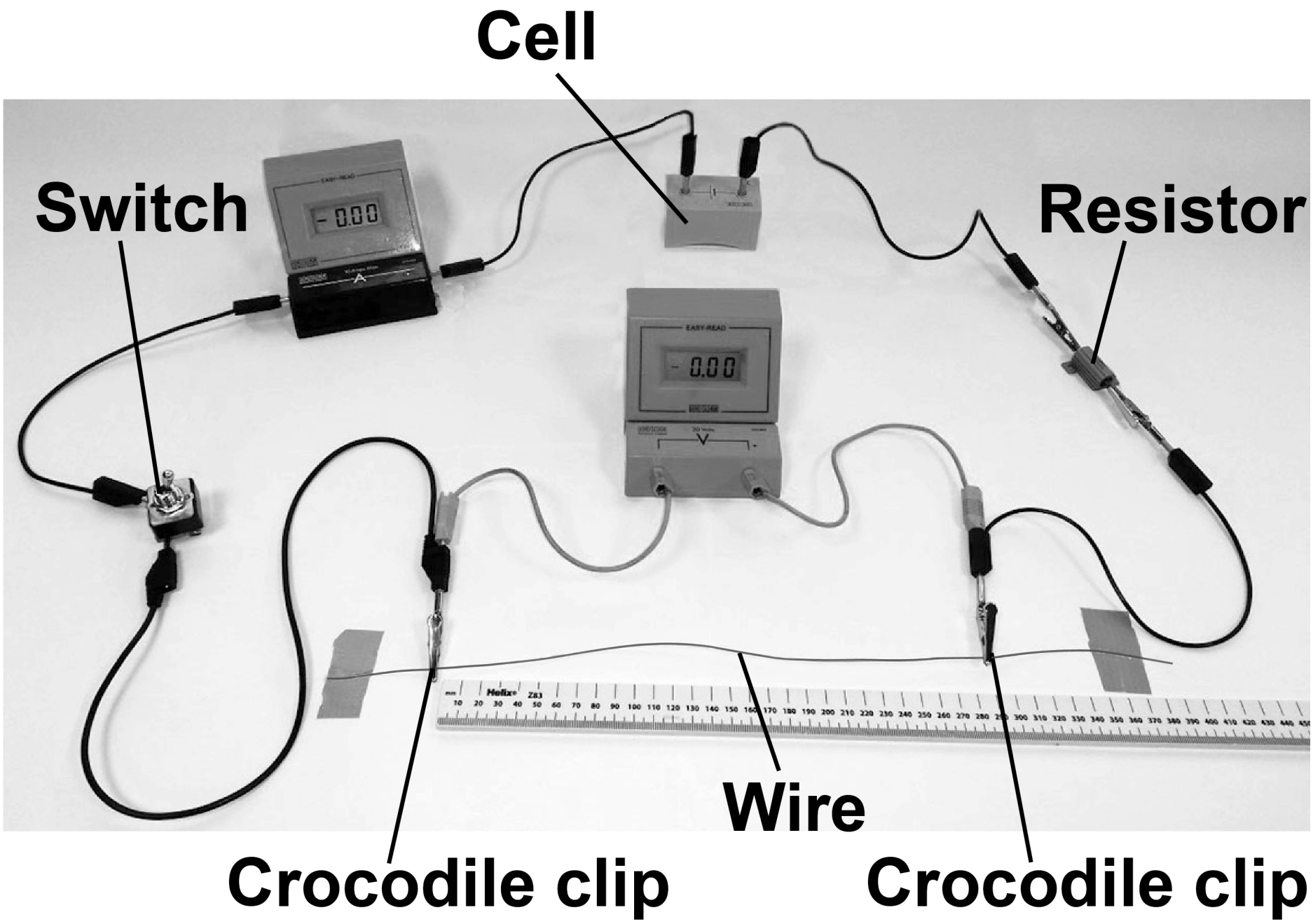
10

1	1

A student investigated how the length of a wire affects the resistance of the wire at constant temperature.

FIGURE 18 shows the circuit used.

FIGURE 18



1 1 . 1

The student plotted a graph of resistance against the length of wire.

Describe a method the student could have used to collect the data needed to plot the graph. [6 marks]

108

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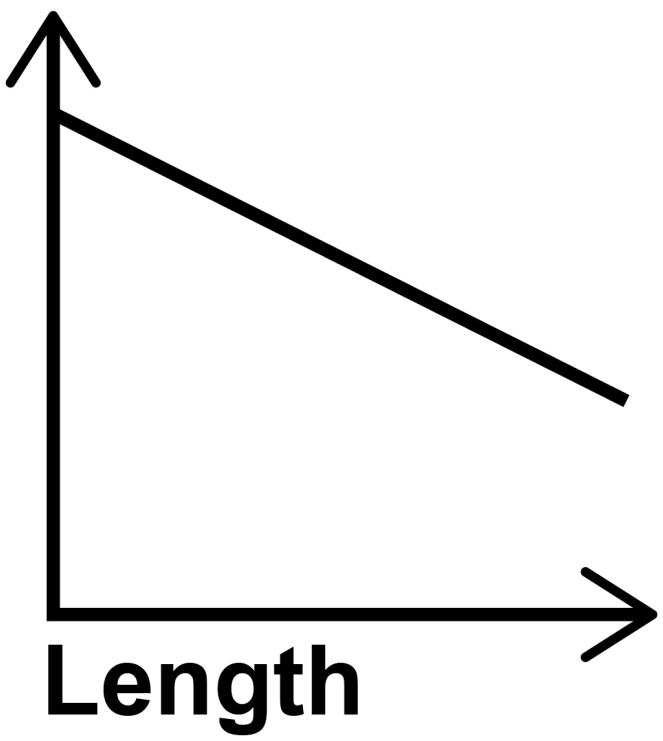
[Turn over]

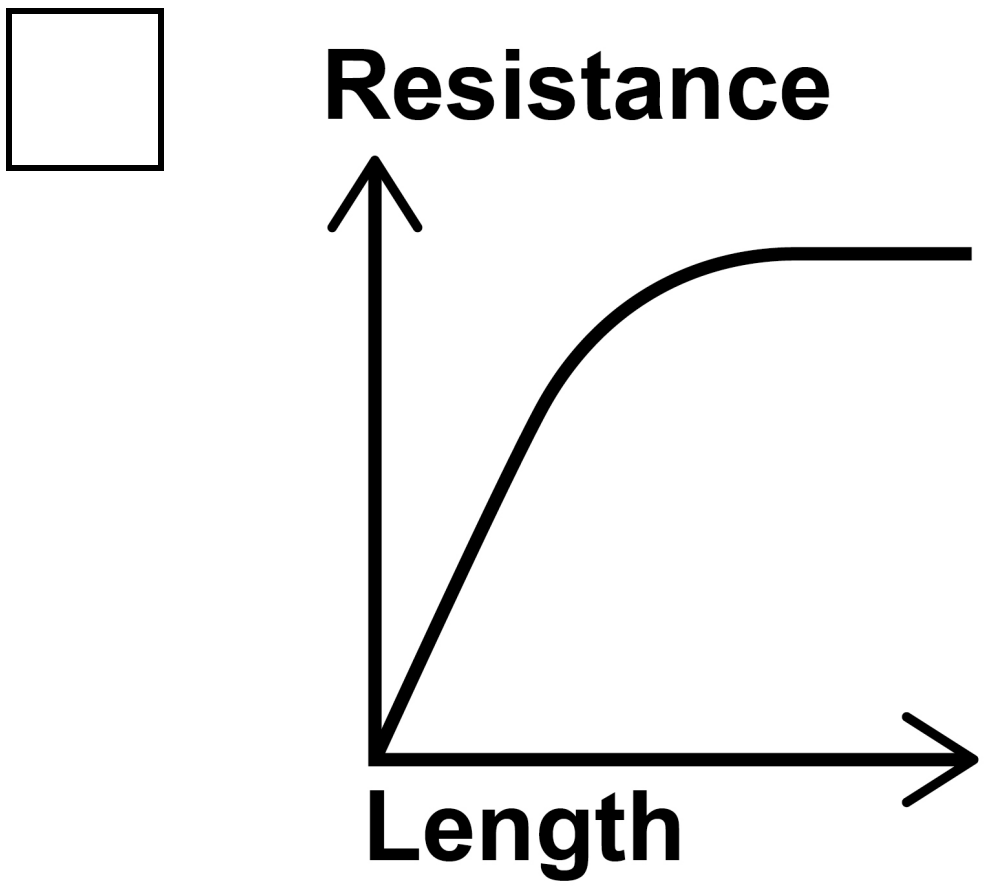
1 1 . 2

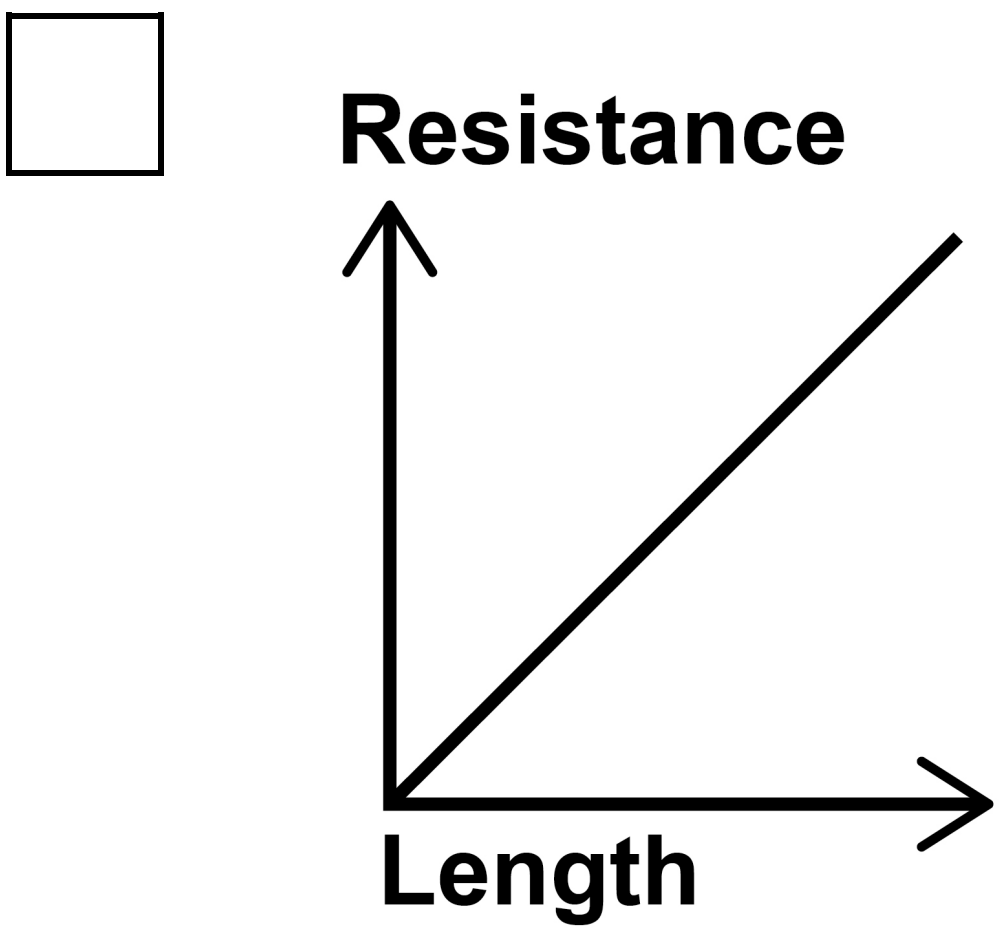
Which graph, below and on the opposite page, shows the relationship between the resistance of a wire at constant temperature and its length? [1 mark]

Tick (✓) ONE box.

☐







[Turn over]

1 1 . 3

The student used a cell that had a potential difference of 1.50 V.

Explain why the cell was NOT an electrical hazard to the student in the investigation. [2 marks]

END OF QUESTIONS

9

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.

Additional page, if required.

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For Examiner's Use	
Question	Mark
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