Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____
I declare this is my own work.

GCSE
PHYSICS

F

Foundation Tier Paper 1

Wednesday 22 May 2024 Morning Time allowed: 1 hour 45 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or 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.

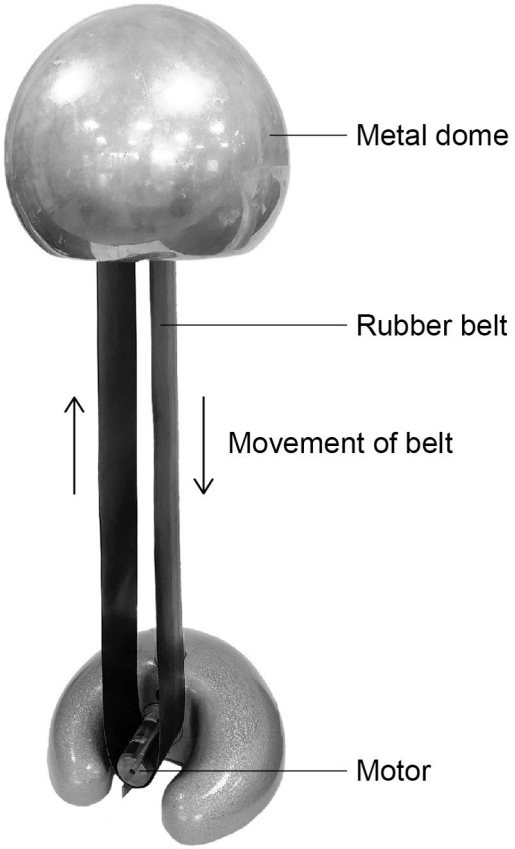
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

Do not write outside the box

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.

Do not write outside the box

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 box.

[1 mark]

negative	**neutral**	**positive**

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

Question 1 continues on the next page

Do not write outside the box

0 1 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

attraction	**gravity**	**repulsion**

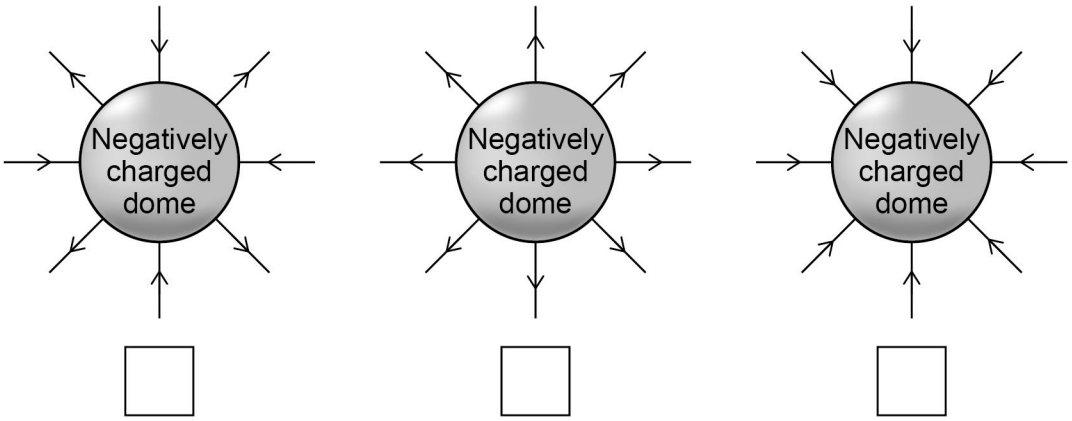
The hair on the student's head stands up because the strands of hair experience

forces of _____.

0 1 . 3 Which of the following diagrams shows the electric field pattern around the negatively charged metal dome?

[1 mark]

Tick (✓) **one** box.

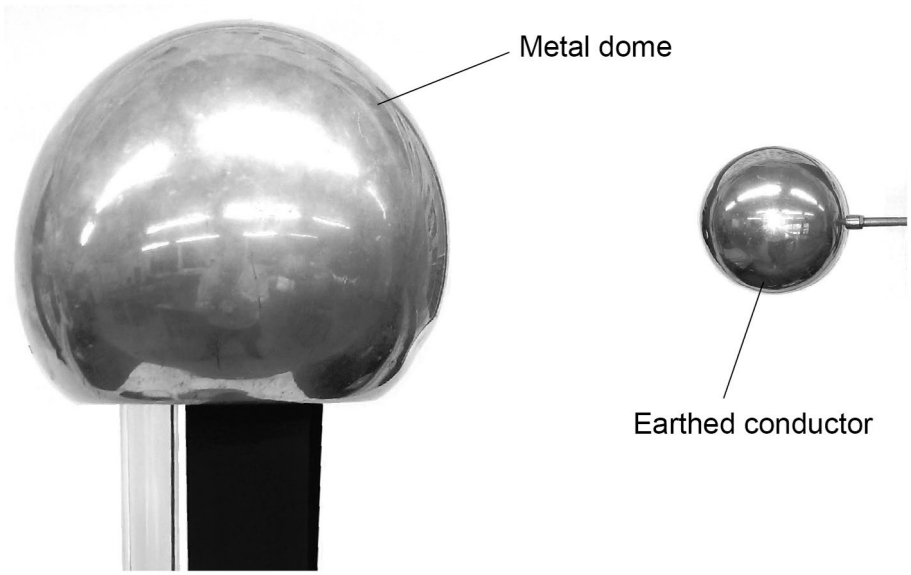


☐ ☐ ☐

Do not write outside the box

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 box.

[1 mark]

efficiency	**resistance**	**temperature**

The air between the dome and the earthed conductor has

a high _____.

Question 1 continues on the next page

Do not write outside the box

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 box.

[1 mark]

earthed	**ionised**	**neutral**

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 ☐

Do not write outside the box

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

8

Turn over for the next question

Do not write outside the box

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 ☐

Do not write outside the box

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 ☐

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.

Calculate the resistance of the coin.

Use the equation:

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

[2 marks]

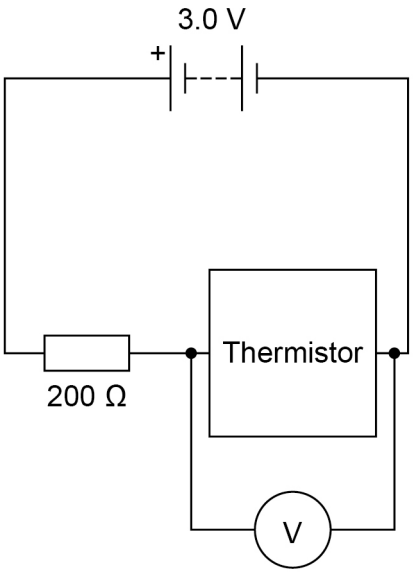
Resistance = _____ Ω

Do not write outside the box

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

Figure 5 shows part of the circuit.

Figure 5

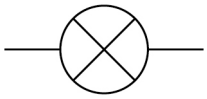


0 2 . 4 The circuit symbol for the thermistor is wrong.

What is the circuit symbol for a thermistor?

[1 mark]

Tick (✓) **one** box.



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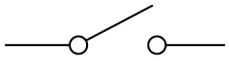

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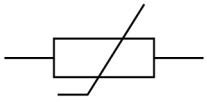


☐

Do not write outside the box

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 ☐

0 2 . 6 At one temperature, the thermistor in **Figure 5** 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 ☐

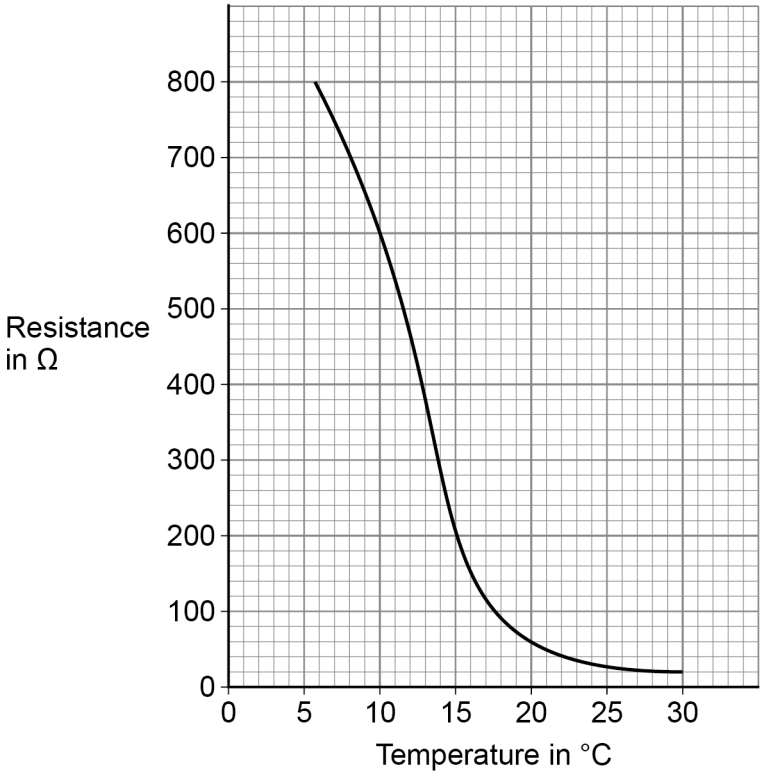
Reason _____

_____

Do not write outside the box

Figure 6 shows how the resistance of the thermistor varies with temperature.

Figure 6



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

10

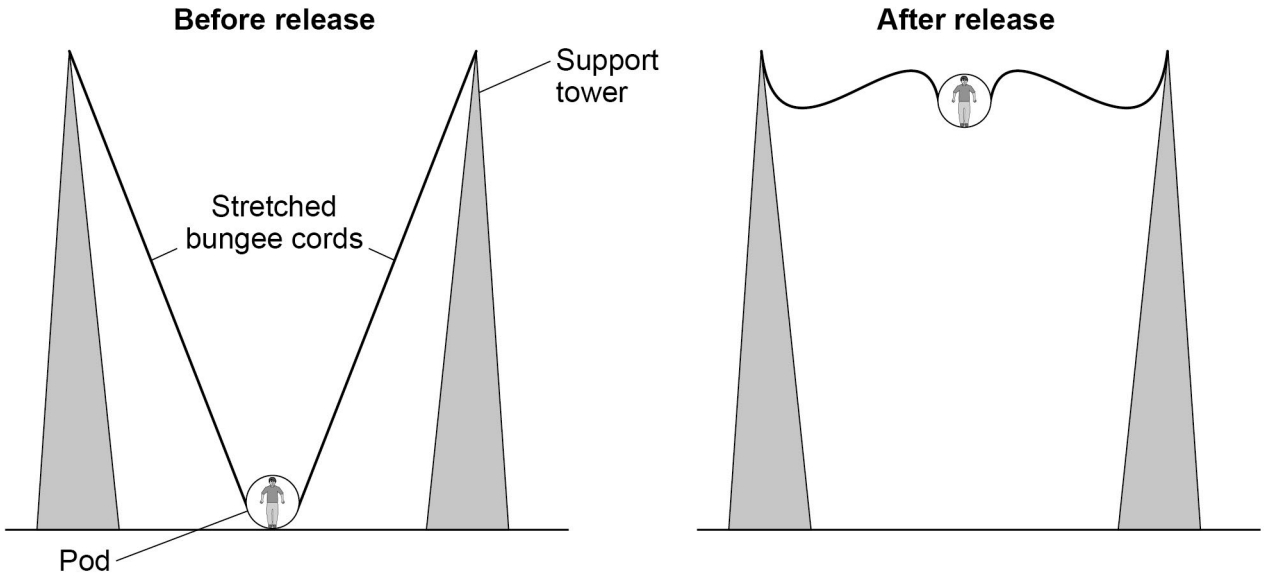
Do not write outside the box

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 shows a person using the ride.

Figure 7



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 ☐

Do not write outside the box

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

Do not write outside the box

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.

$E_p = \frac{m \times g}{h}$ ☐

$E_p = \frac{m}{g \times h}$ ☐

$E_p = m \times g \times h$ ☐

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

Question 3 continues on the next page

Do not write outside the box

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. ☐

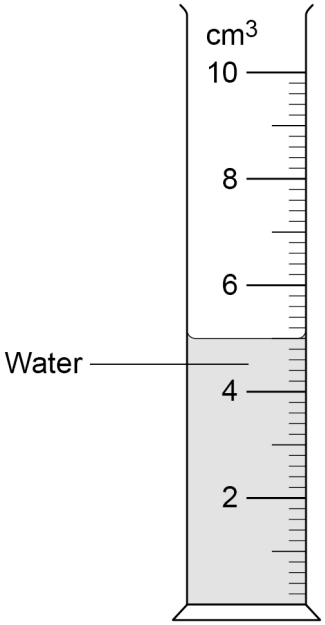
Work is done by the person in the pod. ☐

11

Do not write outside the box

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 ☐

Question 4 continues on the next page

Do not write outside the box

A student used the measuring cylinder 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. ☐

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

Do not write outside the box

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. ☐

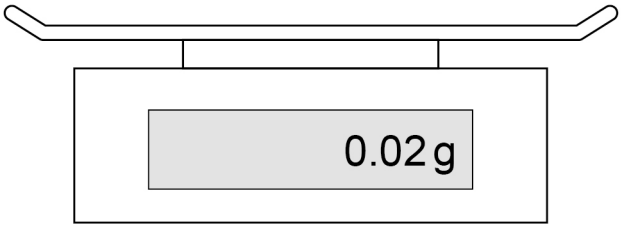
Question 4 continues on the next page

Do not write outside the box

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 ☐

Do not write outside the box

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

9

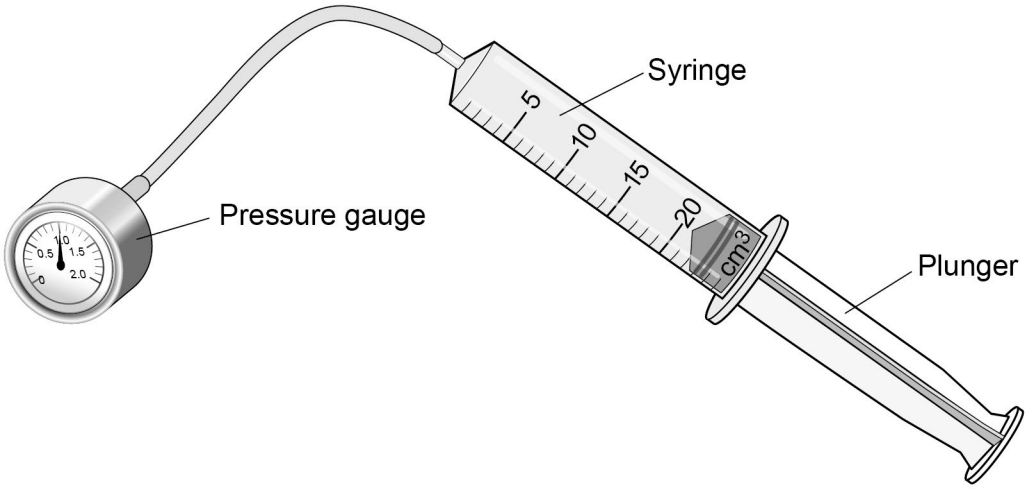
Turn over for the next question

Do not write outside the box

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. ☐

Do not write outside the box

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. ☐

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. ☐

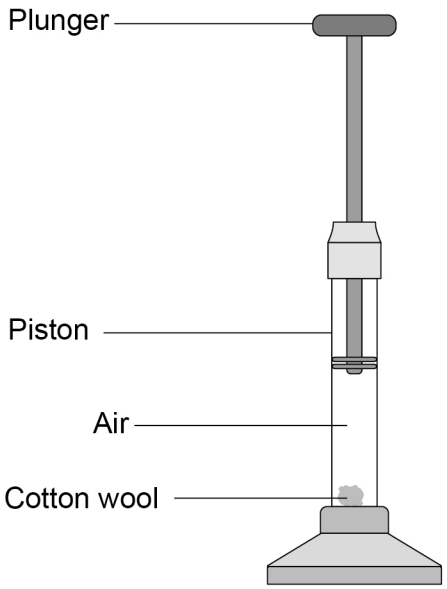
The air pressure increased. ☐

Do not write outside the box

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. ☐

Do not write outside the box

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

8

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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		

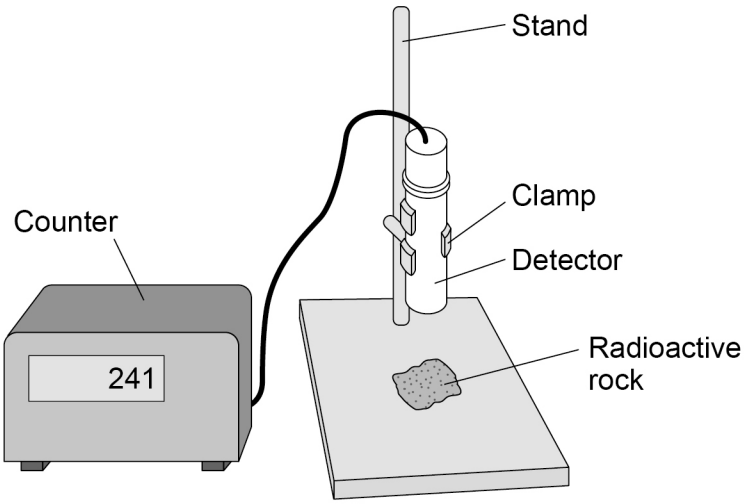
Question 6 continues on the next page

Do not write outside the box

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

Figure 12 shows the equipment used.

Figure 12



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

Do not write outside the box

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 _____

_____

0 6 . 3 Which radioactive rock emitted only beta radiation?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Rock **A** ☐

Rock **B** ☐

Rock **C** ☐

Rock **D** ☐

Reason _____

_____

Do not write outside the box

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 ☐

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. ☐

Do not write outside the box

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. ☐

9

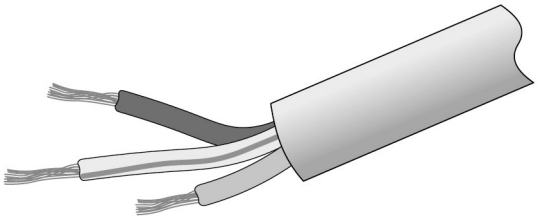
Turn over for the next question

Do not write outside the box

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 ☐

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 ☐

Do not write outside the box

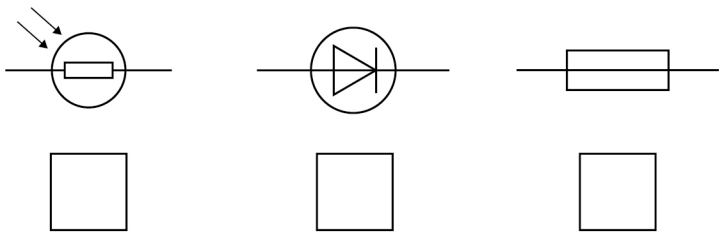
The plug connected to the cable contains a fuse.

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.



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

Question 7 continues on the next page

Do not write outside the box

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

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. ☐

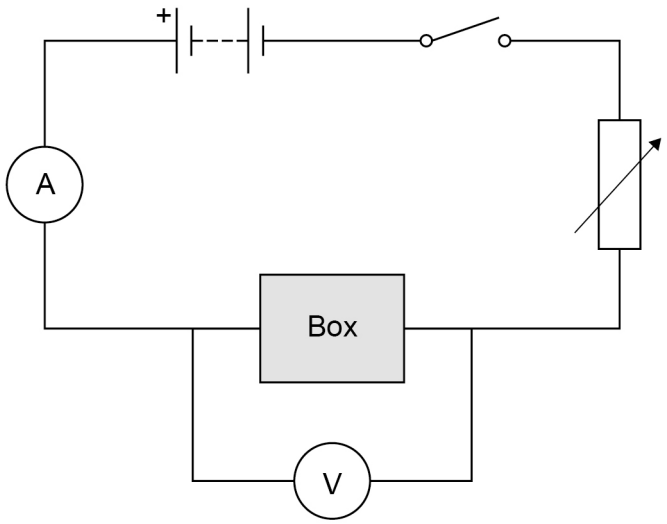
9

Do not write outside the box

0 8 A student had an unknown electrical component inside a sealed box.

Figure 14 shows the circuit the student used to identify the component.

Figure 14



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]

_____

_____

_____

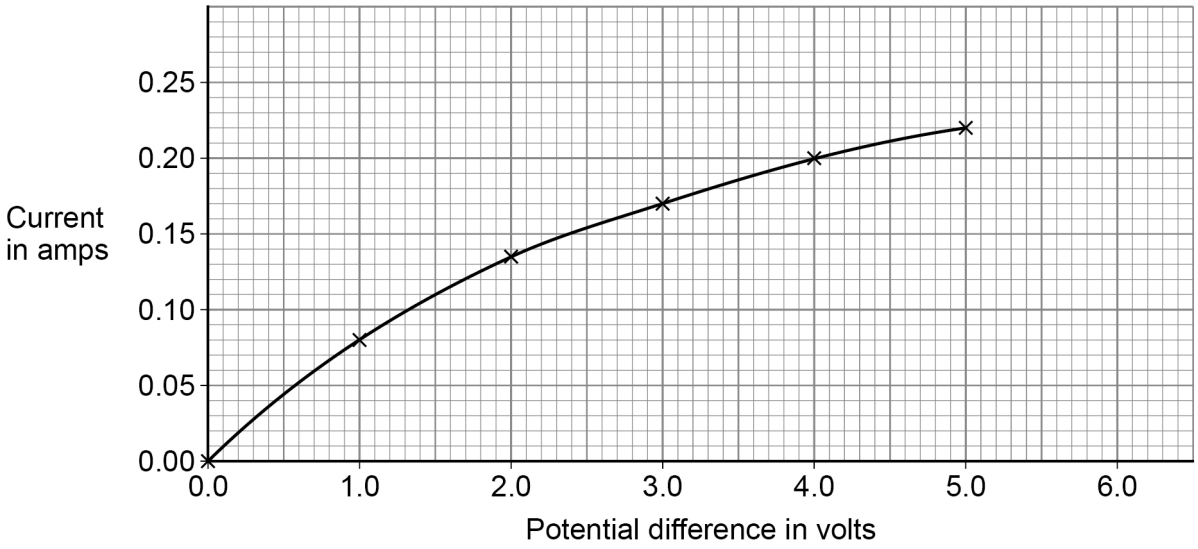
X = _____ A

Turn over ►

Do not write outside the box

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

Do not write outside the box

0 8 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

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

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 ☐

7

Turn over for the next question

Do not write outside the box

0 9 **Figure 16** shows a wind turbine.

Figure 16

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]

_____

Do not write outside the box

0 9 . 3 **Table 4** shows information about the two methods of storing energy.

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

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

Include calculations in your answer.

[4 marks]

Question 9 continues on the next page

Do not write outside the box

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 _____

_____

_____

_____

_____

10

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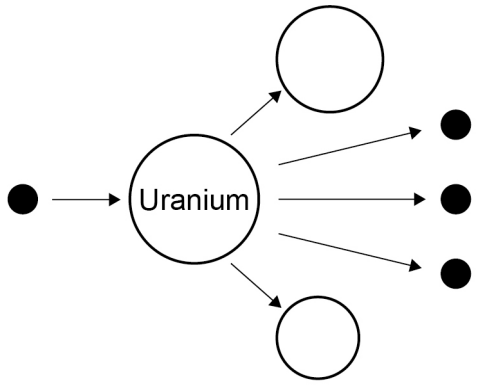
1 0 The process of nuclear fission is used in nuclear power stations.

Figure 17 shows the process of nuclear fission.

Figure 17



1 0 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

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

In nuclear power stations, energy is released from

uranium _____.

The uranium in **Figure 17** splits into two parts and

releases three _____.

The process of nuclear fission releases electromagnetic radiation in the

form of _____.

Do not write outside the box

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

1 0 . 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

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]

_____

_____

_____

Do not write outside the box

1 0 . 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 = _____

10

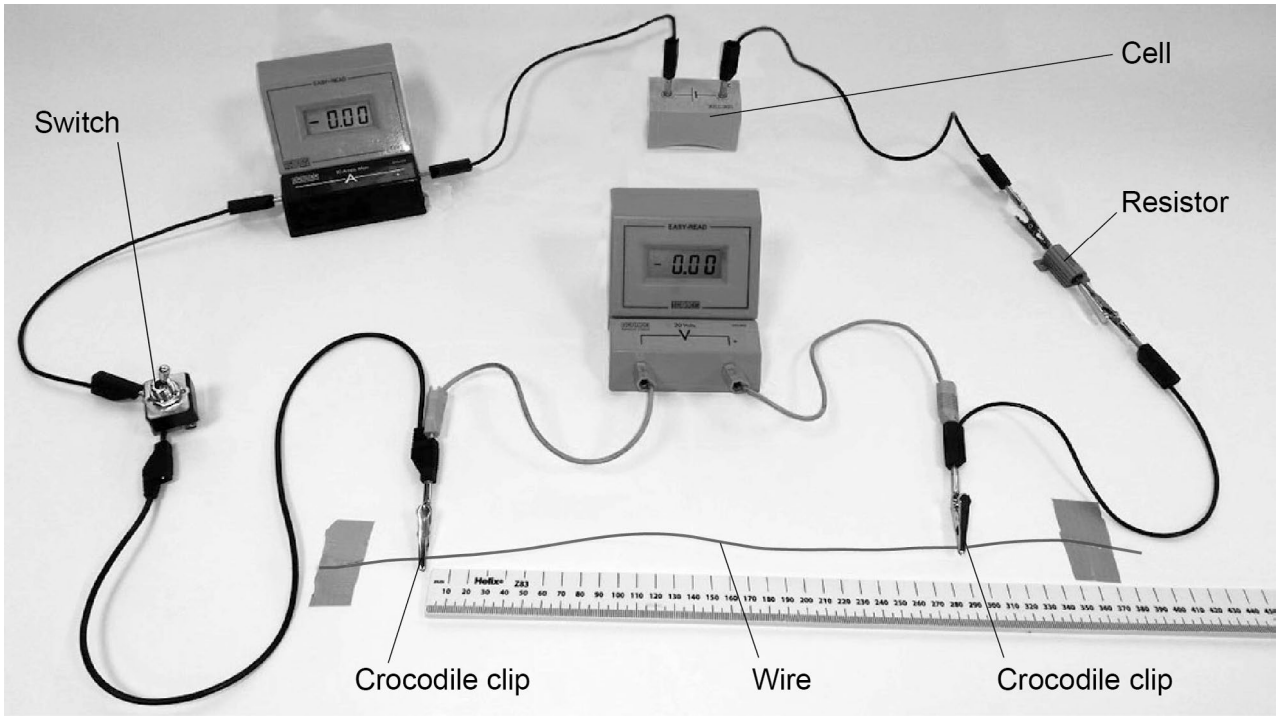
Turn over for the next question

Do not write outside the box

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.

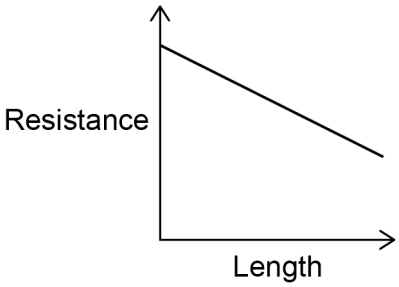
[6 marks]

Do not write outside the box

1 1 . 2 Which graph shows the relationship between the resistance of a wire at constant temperature and its length?

[1 mark]

Tick (✓) **one** box.



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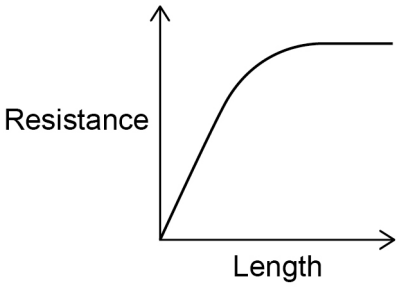

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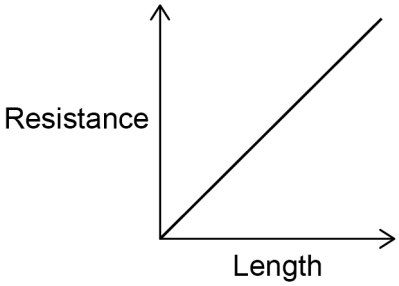

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Question 11 continues on the next page

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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]

_____

_____

_____

_____

9

END OF QUESTIONS

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