Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
PHYSICS

H

Higher 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	
TOTAL	

Answer **all** questions in the spaces provided.

Do not write outside the box

0 1 **Figure 1** shows a wind turbine.

Figure 1

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 1 . 1 Which energy store increases when water is heated?

[1 mark]

0 1 . 2 Which energy store increases when water is pumped uphill into a reservoir?

[1 mark]

Do not write outside the box

0 1 . 3 **Table 1** shows information about the two methods of storing energy.

Table 1

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 1 continues on the next page

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0 1 . 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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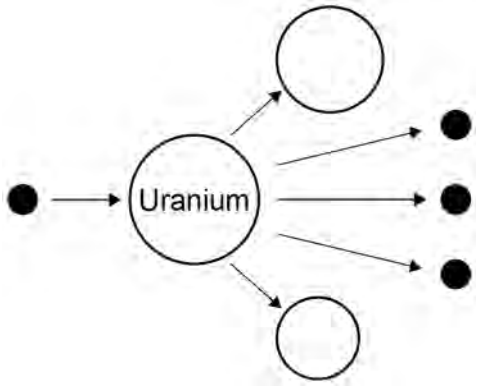
0 2 The process of nuclear fission is used in nuclear power stations.

Figure 2 shows the process of nuclear fission.

Figure 2



0 2 . 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 2** 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 **02.2** and **02.3**.

0 2 . 2 Write down the equation which links energy (*E*), power (*P*) and time (*t*).

[1 mark]

0 2 . 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

0 2 . 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

0 2 . 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

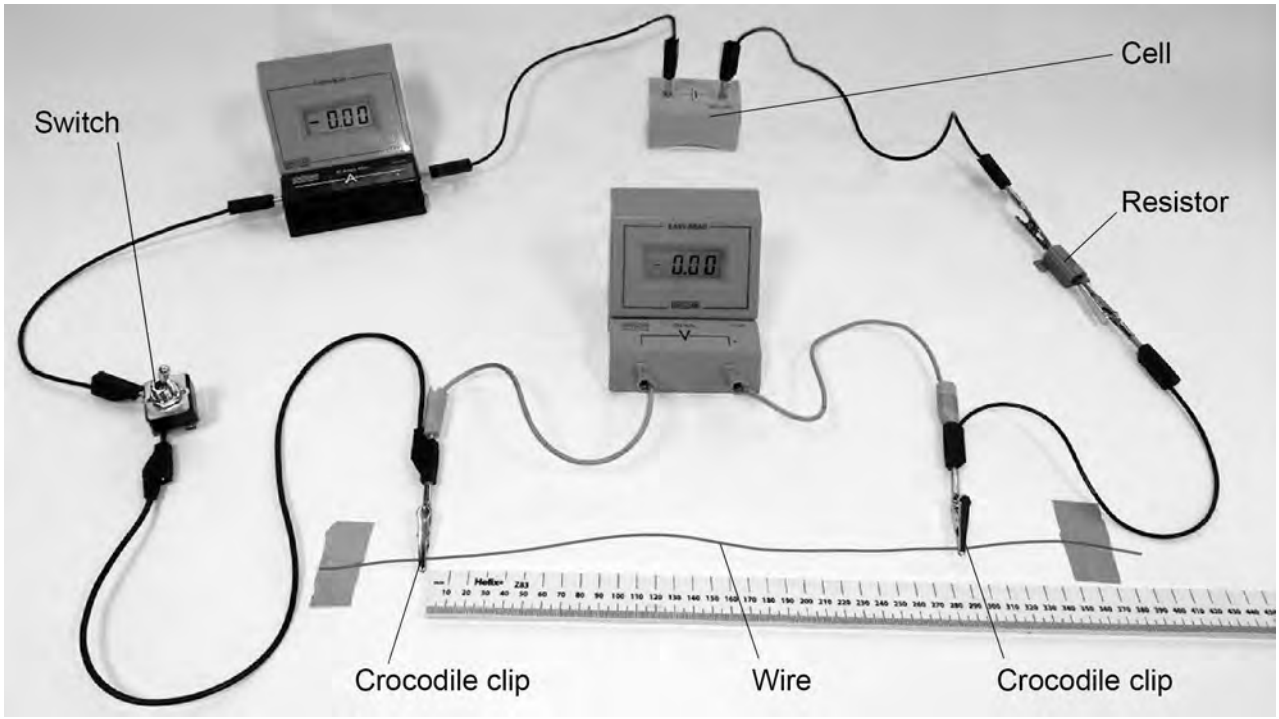
Turn over for the next question

Do not write outside the box

0 3 A student investigated how the length of a wire affects the resistance of the wire at constant temperature.

Figure 3 shows the circuit used.

Figure 3



0 3 . 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.

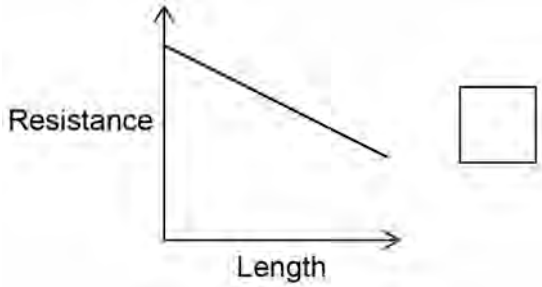
[6 marks]

Do not write outside the box

0 3 . 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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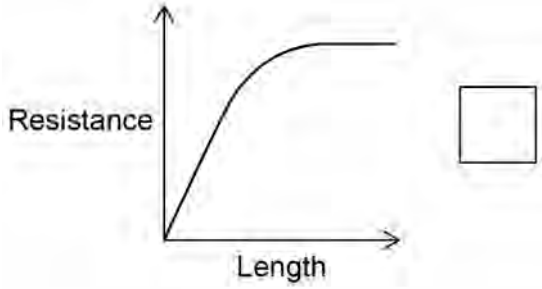

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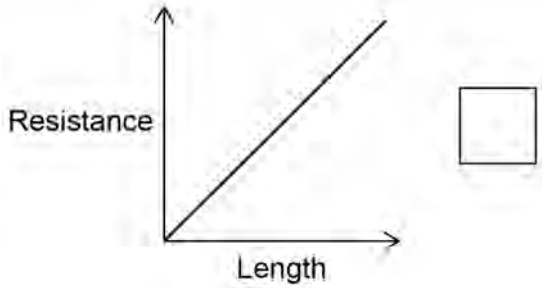


☐

Question 3 continues on the next page

Do not write outside the box

0 3 . 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.

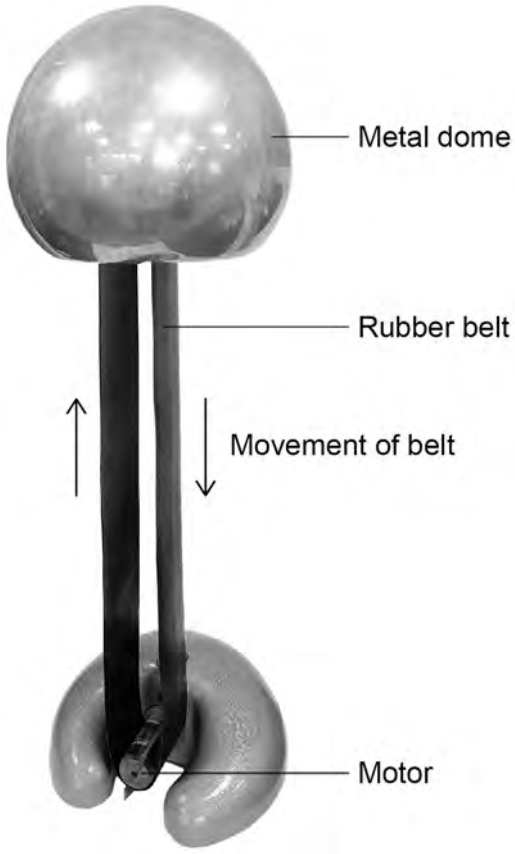
[2 marks]

9

Do not write outside the box

0 4 **Figure 4** shows a static electricity generator.

Figure 4



The rubber belt is turned by a motor.

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

Question 4 continues on the next page

Do not write outside the box

0 4 . 1 **Figure 5** shows a student touching the metal dome of the static electricity generator.

The dome is negatively charged.

Figure 5

Explain why the student's hair stands up on end.

[3 marks]

Do not write outside the box

The charged metal dome creates an electric field.

0 4 . 2 What is an electric field?

[1 mark]

0 4 . 3 How does the electric field strength vary as the distance from the charged metal dome increases?

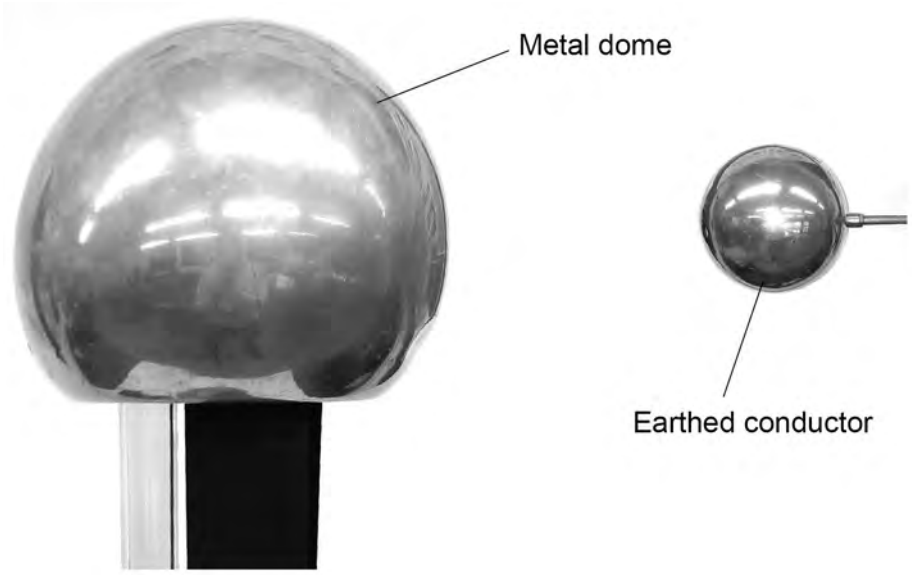
[1 mark]

Question 4 continues on the next page

Do not write outside the box

Figure 6 shows the negatively charged metal dome and an earthed conductor.

Figure 6



When the earthed conductor is moved towards the metal dome, there is a spark between the dome and the earthed conductor.

0 4 . 4 The spark transfers 0.60 J of energy, and 2.0 μC of charge is transferred from the dome to the earthed conductor.

Calculate the potential difference between the metal dome and the earthed conductor.

Use the Physics Equations Sheet.

[4 marks]

Potential difference = _____ V

Do not write outside the box

0 4 . 5 Which of the following changes would increase the distance a spark can jump between the dome and the earthed conductor?

[1 mark]

Tick (✓) **one** box.

Decreased charge on the metal dome ☐

Decreased electric field strength ☐

Decreased electrical resistance of air ☐

Decreased potential difference ☐

10

Turn over for the next question

Do not write outside the box

0 5 **Figure 7** shows a student putting a coin into a vending machine that sells food.

Figure 7

0 5 . 1 The vending machine is connected to the mains electricity supply.

What is the frequency and the potential difference of the mains electricity supply in the UK?

[2 marks]

Frequency = _____ Hz

Potential difference = _____ V

Do not write outside the box

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

0 5 . 2 The power dissipated by the coin is 340 mW when the current in the coin is 0.75 A.

Calculate the resistance of the coin.

Use the Physics Equations Sheet.

[4 marks]

Resistance = _____ Ω

0 5 . 3 Coins that are dirty are **not** recognised by the vending machine.

Suggest **one** reason why.

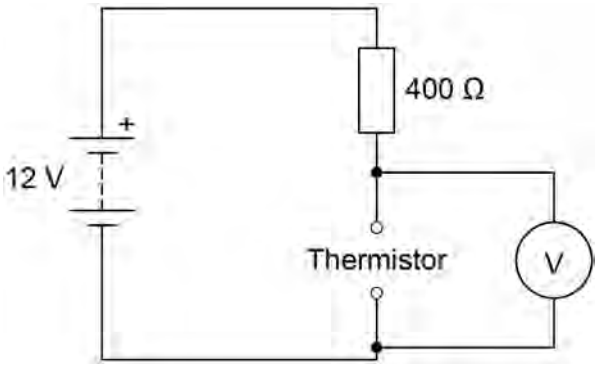
[1 mark]

Question 5 continues on the next page

Do not write outside the box

Figure 8 shows part of a different circuit that is used to monitor the temperature inside the vending machine.

Figure 8



0 5 . 4 The circuit symbol for a thermistor has not been included.

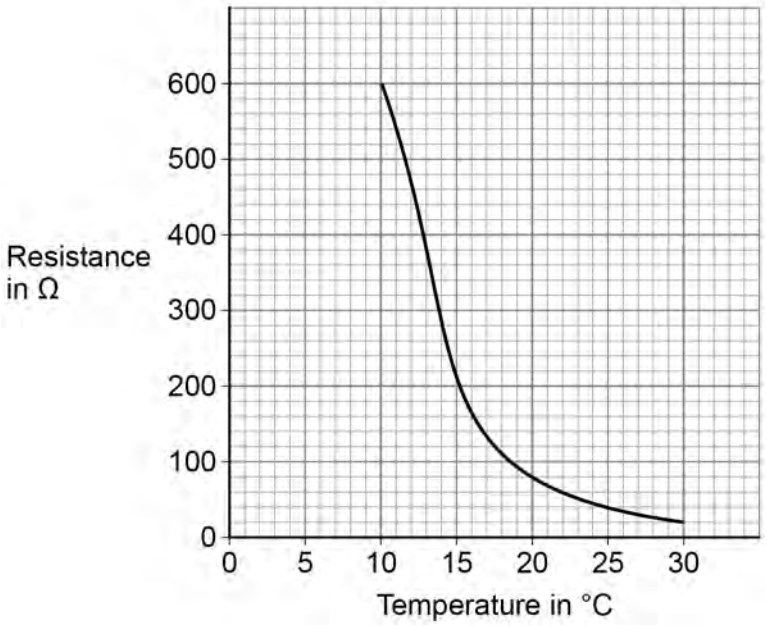
Draw the circuit symbol for a thermistor in the box below.

[1 mark]

Do not write outside the box

Figure 9 shows how the resistance of the thermistor varies with temperature.

Figure 9



0 5 . 5 The cooling system inside the vending machine turns on when the temperature of the thermistor is above 20 °C.

Determine the potential difference across the thermistor when the temperature is 20 °C.

Use the Physics Equations Sheet.

[5 marks]

Potential difference = _____ V

13

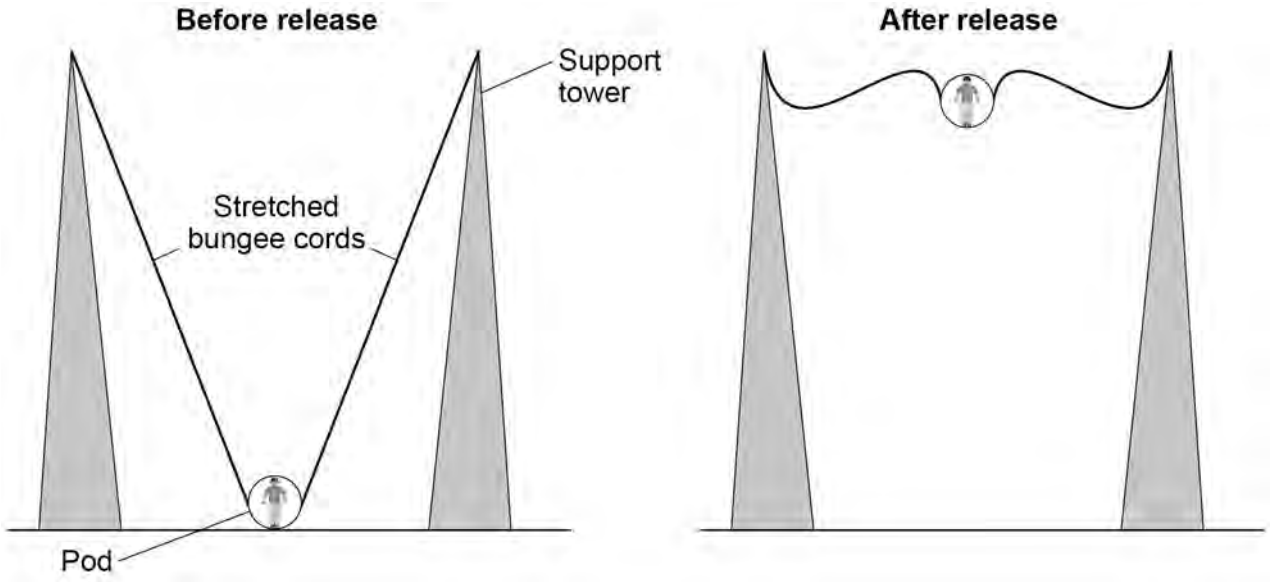
Do not write outside the box

0 6 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 10 shows a person using the ride.

Figure 10



0 6 . 1 Which energy store increases as the bungee cords are stretched?

[1 mark]

Do not write outside the box

0 6 . 2 When the pod is released, the pod accelerates upwards.

Before the pod is released the extension of **each** of the two bungee cords is 8.0 m.

The spring constant of each bungee cord is 735 N/m.

The mass of the pod is 240 kg.

gravitational field strength = 9.8 N/kg

Calculate the maximum height reached by the pod.

Use the Physics Equations Sheet.

[6 marks]

Maximum height = _____ m

0 6 . 3 The actual maximum height reached by the pod will be lower than the correct answer to Question **06.2**

Explain why.

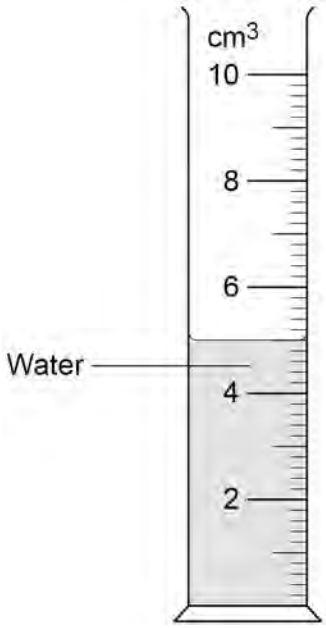
[2 marks]

9

Do not write outside the box

0 7 **Figure 11** shows a measuring cylinder containing some water, which a student used to measure the volume of a metal ring.

Figure 11



0 7 . 1 When measuring the volume, the student's eye was in line with the level of the water.

Which type of error would have been caused if the student's eye was **not** in line with the level of the water?

[1 mark]

Tick (✓) **one** box.

Random error ☐

Systematic error ☐

Zero error ☐

Do not write outside the box

0 7 . 2 The student tied a piece of thick string to the metal ring and lowered the ring into the water.

Suggest **one** reason why the student should have used thin string instead of thick string.

[1 mark]

Question 7 continues on the next page

Do not write outside the box

Table 2 shows the results.

Table 2

Volume of water in cm^3	Volume of water and ring in cm^3	Volume of ring in cm^3
5.0	5.4	0.4

0 7 . 3 The true volume of the ring was 0.44 cm^3.

Even without using the string, the measuring cylinder could not give an accurate value for the volume of the ring.

Give **one** reason why.

[1 mark]

0 7 . 4 The student used a balance to measure the mass of the ring.

After the ring was removed from the balance, the reading on the balance was 0.02 g.

How could the student use the readings from the balance to determine the correct mass of the ring?

[1 mark]

Do not write outside the box

0 7 . 5 The student determined that the density of the ring was 21 500 kg/m^3.

The volume of the ring was 0.44 cm^3.

Calculate the mass of the ring.

Use the Physics Equations Sheet.

Give your answer in kg.

[4 marks]

Mass = _____ kg

8

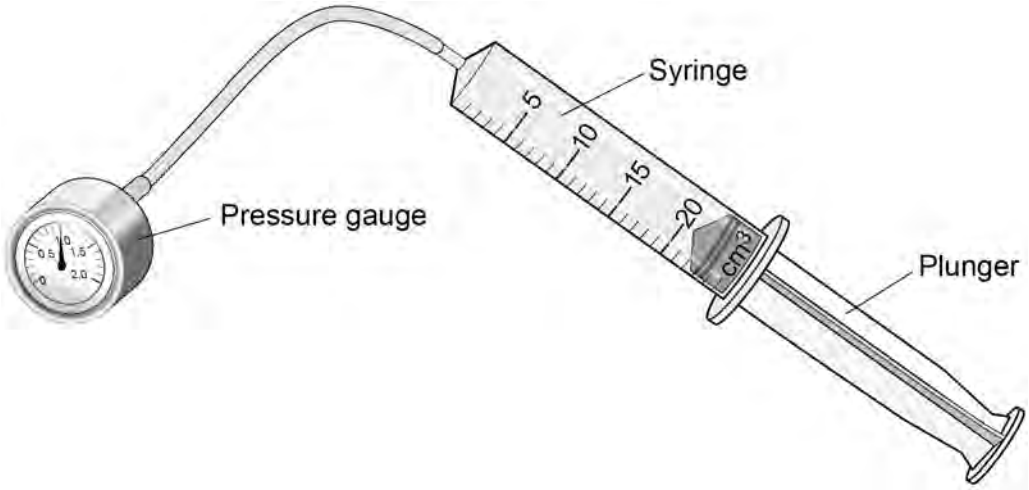
Turn over for the next question

Do not write outside the box

0 8 A student investigated how the pressure in a fixed mass of air varies with the volume of the air.

Figure 12 shows the equipment used.

Figure 12



0 8 . 1 When the plunger was pushed slowly into the syringe, the pressure in the syringe increased.

The temperature of the air remained constant.

Explain why the pressure increased.

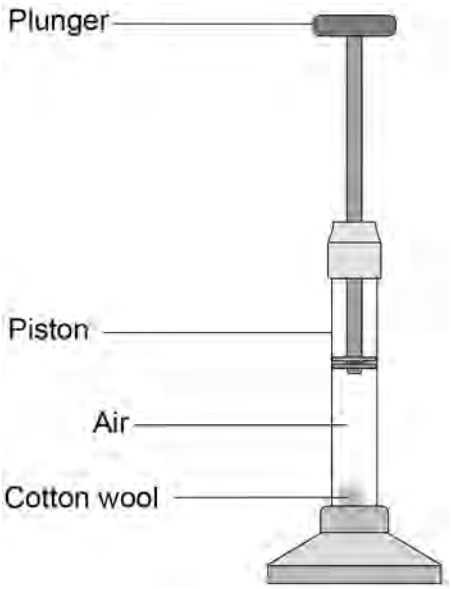
[3 marks]

Do not write outside the box

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

Figure 13 shows a fire piston.

Figure 13



The plunger is pushed quickly downwards and compresses the air.

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

0 8 . 2 How does an increase in temperature affect the air particles inside the piston?

[1 mark]

Tick (✓) **one** box.

The mean kinetic energy of the particles increases. ☐

The mean potential energy of the particles increases. ☐

The mean separation of the particles increases. ☐

Do not write outside the box

0 8 . 3 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 = 1.01 kJ/kg °C

Calculate the temperature change of the air.

Use the Physics Equations Sheet.

[4 marks]

Temperature change = _____ °C

8

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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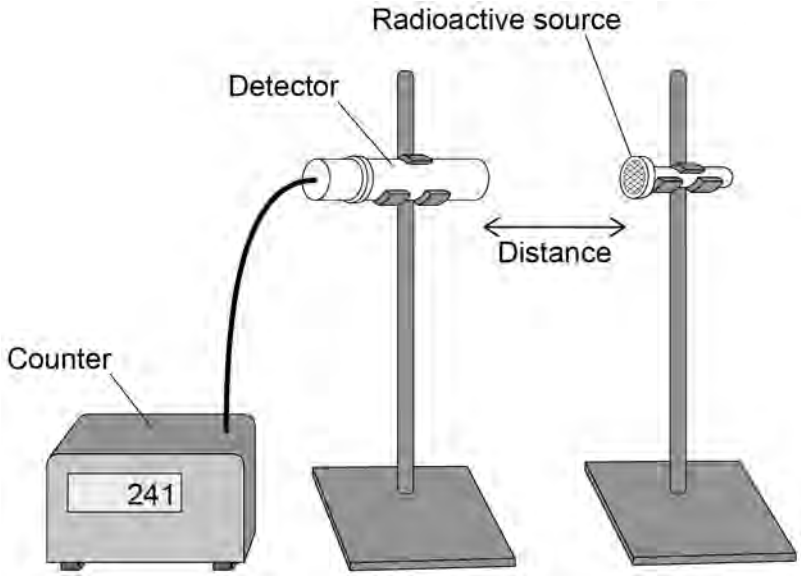
0 9 A teacher investigated the radiation emitted by two different radioactive sources, **A** and **B**.

Figure 14 shows a radiation detector positioned near one of the radioactive sources.

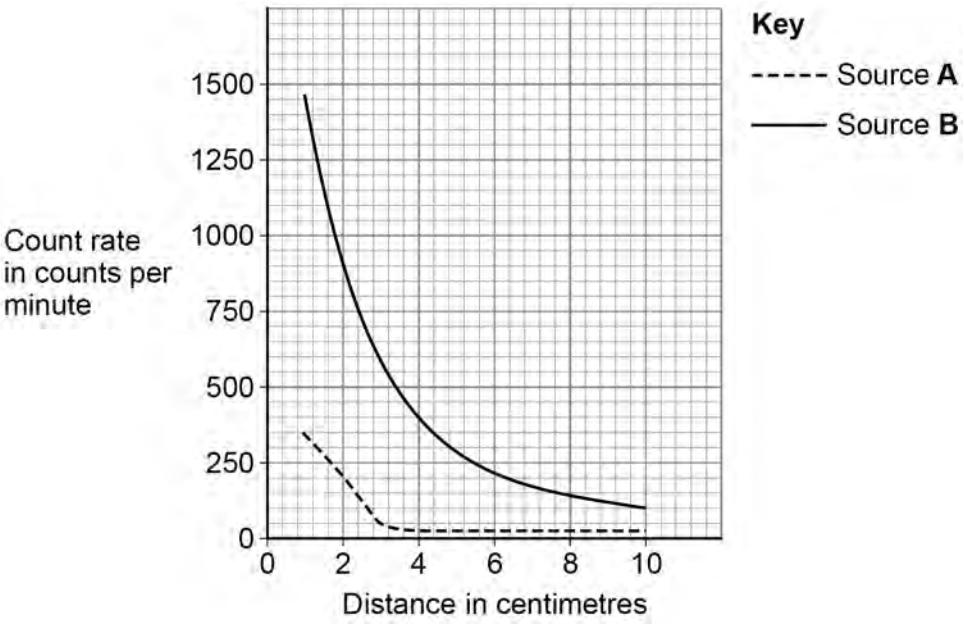
Figure 14



The teacher measured the count rate at different distances for each radioactive source.

Figure 15 shows the results.

Figure 15



Do not write outside the box

0 9 . 1 Explain how **Figure 15** shows that Source **A** only emits alpha radiation.

[3 marks]

0 9 . 2 **Figure 15** can **not** be used to determine if Source **B** emits beta radiation or gamma radiation.

Explain how an absorbing material could be used to show which type of radiation is emitted by Source **B**.

[2 marks]

Question 9 continues on the next page

Do not write outside the box

The teacher took safety precautions during the experiment.

0 9 . 3 Suggest **one** safety precaution the teacher would have taken to reduce the radiation dose the teacher received.

[1 mark]

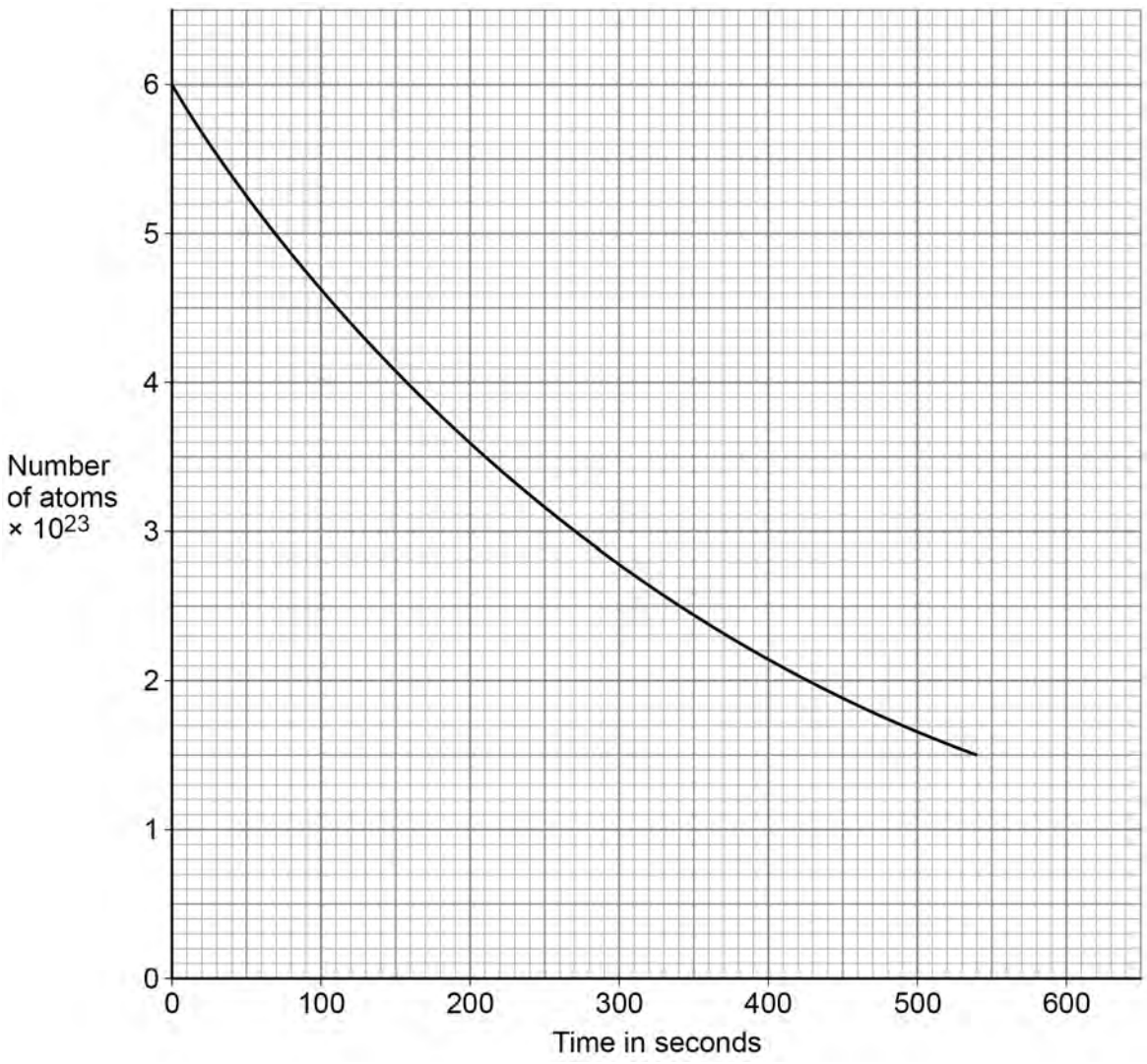
0 9 . 4 Suggest **one** safety precaution that the teacher would have taken to avoid becoming contaminated.

[1 mark]

Do not write outside the box

0 9 . 5 **Figure 16** shows how the number of atoms of a radioactive element in a sample varied with time.

Figure 16



Activity is the rate at which a source of unstable nuclei decays.

Determine the activity of the radioactive sample at 300 seconds.

Give the unit.

[4 marks]

Activity = _____ Unit _____

11

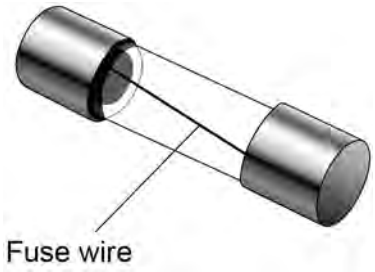
Do not write outside the box

1 0 The live wire in a three-core cable is connected to a fuse inside a plug.

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

Figure 17 shows a fuse.

Figure 17



1 0 . 1 What colour is the insulation covering the live wire in a three-core cable?

[1 mark]

1 0 . 2 Draw the circuit symbol for a fuse in the box below.

[1 mark]

Do not write outside the box

1 0 . 3 The fuse wire melts when there is a charge flow of 2.0 C for 400 ms.

Calculate the current in the fuse wire.

Use the Physics Equations Sheet.

[4 marks]

Current = _____ A

1 0 . 4 When the fuse wire is at its melting point, the additional energy needed to melt the wire is 1.02 J.

specific latent heat of fuse wire = 60 kJ/kg

Calculate the mass of the fuse wire.

Use the Physics Equations Sheet.

[4 marks]

Mass = _____ kg

Question 10 continues on the next page

Do not write outside the box

1 0 . 5 The calculation in Question **10.4** assumes there is no energy transferred to the surroundings.

How would the time taken for the wire to melt be affected if some energy was transferred to the surroundings?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Time taken would decrease ☐

Time taken would stay the same ☐

Time taken would increase ☐

Reason _____

_____

_____

12

END OF QUESTIONS

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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