DRAFT SPECIMEN MATERIAL

GCSE PHYSICS

H

Higher Tier Paper 1H

Specimen 2018 Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a calculator
- the Physics Equation Sheet (enclosed).

Instructions

- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- There are 100 marks available on this paper.
- 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.

Advice

- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

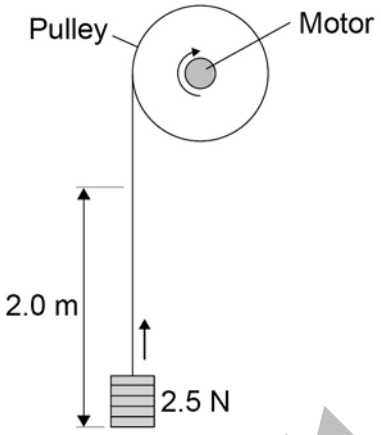
Surname

Forename(s)

Candidate signature _____

0 1 A student investigated the efficiency of a motor using the equipment in **Figure 1**.

Figure 1



He used the motor to lift a weight of 2.5 N a height of 2.0 m.

He measured the speed at which the weight was lifted and calculated the efficiency of the energy transfer.

He repeated the experiment to gain two sets of data.

0 1 . 1 Give **one** variable that the student controlled in his investigation.

[1 mark]

0 1 . 2 Give **two** reasons for taking repeat readings in an investigation.

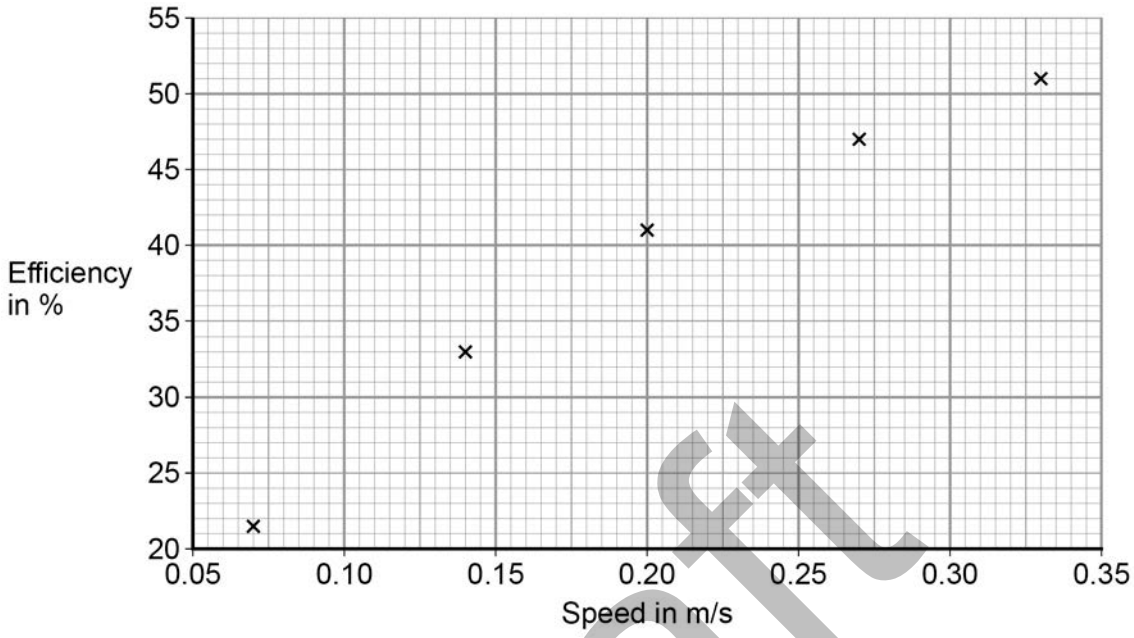
[2 marks]

1

2

Figure 2 shows a graph of the student's results.

Figure 2



0 1 . 3 Draw a line of best fit on the graph.

[1 mark]

0 1 . 4 What conclusions can be made from the data in **Figure 2**?

Explain your answer.

[3 marks]

0 1 . 5 Give **one** way that the motor is likely to waste energy.

[1 mark]

0 1 . 6 When the total power input to the motor was 5 W the motor could not lift the 2.5 N weight.

State the efficiency of the motor.

[1 mark]

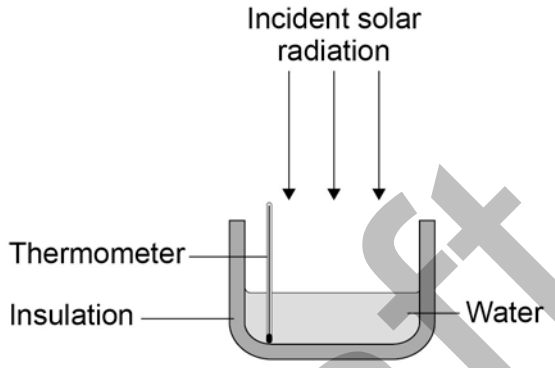
Efficiency = _____ %

0 2 A student investigated how much energy from the Sun was incident on the Earth's surface at her location.

She put an insulated pan of water in direct sunlight and measured the time it took for the temperature of the water to increase by 10 °C.

The apparatus she used is shown in **Figure 3**.

Figure 3



0 2 . 1 The student could have measured the time taken for the water to increase in temperature by 1 °C.

Suggest **one** reason why the student's method was better.

[1 mark]

Question 2 continues on the next page

The energy transferred to the water was 21 000 J.

The time taken for the water temperature to increase by 10 °C was 6000 seconds.

The specific heat capacity of water is 4200 J/kg °C.

0 2 . 2 Write down the equation which links energy transferred, power and time.

Calculate the average power supplied by the Sun to the water in the pan.

[3 marks]

Average power = _____ W

0 2 . 3 Calculate the mass of water the student used in her investigation.

Use the correct equation from the Physics Equation Sheet.

[2 marks]

Mass = _____ kg

0 2 . 4 The student's results can only be used as an estimate of the average power at her location.

Give **two** reasons why.

[2 marks]

1

2

0 3 **Figure 4** shows an old house with a tiled roof and single-glazed windows.

The house has solid stone walls and is heated using a coal fire.

Figure 4

Describe how the householder could improve the energy efficiency of the house.

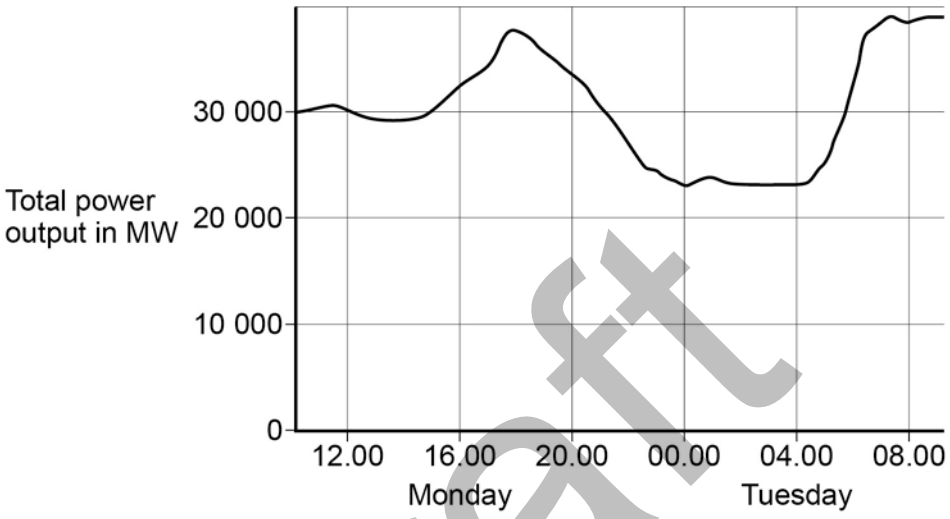
Explain how your chosen methods reduce the rate of energy transfer to the surroundings.

[6 marks]

0 4 The National Grid ensures that the supply of electricity always meets the demand of the consumers.

Figure 5 shows how the output from fossil fuel power stations in the UK varied over a 24-hour period.

Figure 5



0 4 . 1 Suggest **one** reason for the shape of the graph between 15.00 and 18.00 on Monday.

[1 mark]

0 4 . 2 At 18.00 on Monday, one power station stopped producing electricity.

How does **Figure 5** show this?

[1 mark]

0 4 . 3 The National Grid ensures that fossil fuel power stations in the UK only produce about 33% of the total electricity they could produce when operating at a maximum output.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

Turn over for the next question

0 5 **Figure 6** shows a Van de Graaff generator that is used to investigate static electricity.

Before it is switched on, the metal dome has no net charge.

After it is switched on, the metal dome becomes positively charged.

Figure 6

0 5 . 1 Explain how an uncharged object may become positively charged.

[3 marks]

Figure 7 shows a girl touching a Van de Graaff generator.

The girl becomes positively charged.

Figure 7

0 5 . 2 Explain why the girl's hair stands up as shown in **Figure 7**.

[2 marks]

Question 5 continues on the next page

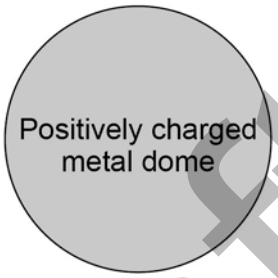
0 5 . 3 **Figure 8** shows a plan view of the positively charged metal dome of a Van de Graaff generator.

Draw the electric field pattern around the metal dome when it is isolated from its surroundings.

Use arrows to show the direction of the electric field.

[2 marks]

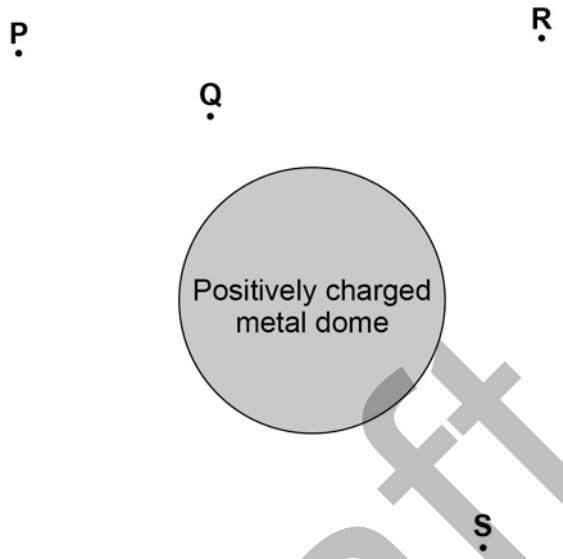
Figure 8



0 5 . 4 Another positively charged object is placed in the electric field.

Look at **Figure 9**.

Figure 9



In which position would the object experience the greatest force?

Tick **one** box.

[1 mark]

P ☐

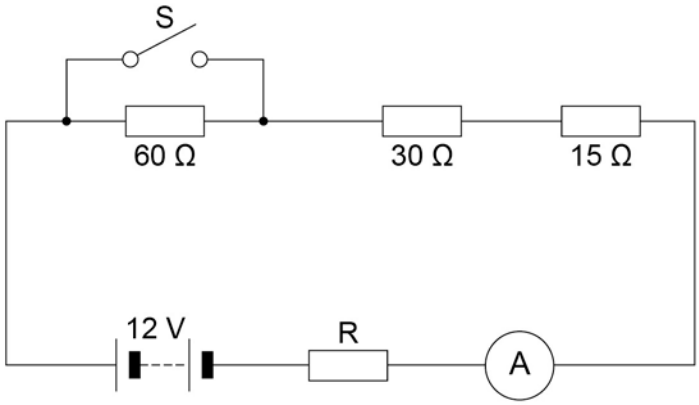
Q ☐

R ☐

S ☐

0 6 A student set up the electrical circuit shown in **Figure 10**.

Figure 10



0 6 . 1 The 12 V battery supplies **direct current** (d.c.) to the circuit.

State what is meant by direct current.

[1 mark]

0 6 . 2 The ammeter displays a reading of 0.10 A.

Write down the equation which links current, potential difference and resistance.

Calculate the total resistance of the circuit.

[3 marks]

Total resistance = _____ Ω

0 6 . 3 Use your answer to 06.2 to calculate the resistance of the resistor labelled R.

[1 mark]

Resistance of R = _____ Ω

0 6 . 4 State what happens to the total resistance of the circuit and the current through the circuit when switch S is closed.

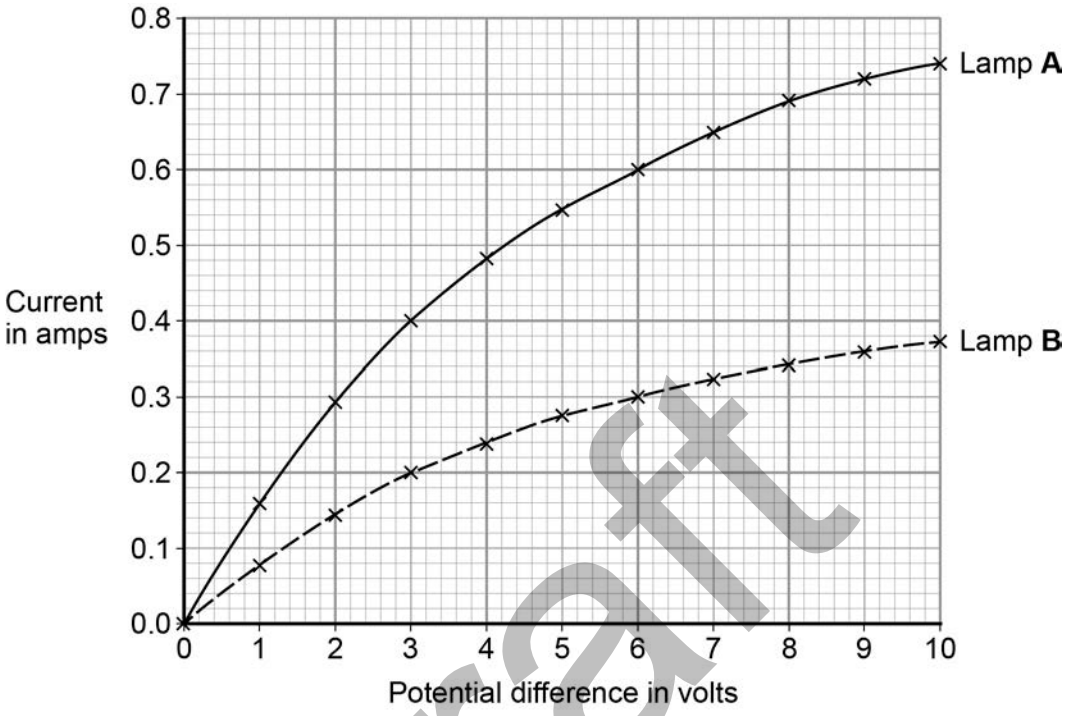
[2 marks]

Turn over for the next question

0 7 A student investigated how current varies with potential difference for two different lamps.

Her results are shown in **Figure 11**.

Figure 11



0 7 . 1 Complete the circuit diagram for the circuit that the student could have used to obtain the results shown in **Figure 11**.

[3 marks]

0 7 . 2 Lamp **A** will be the brighter lamp at any potential difference.

Explain how **Figure 11** shows this.

[2 marks]

0 7 . 3 Lamp **B** has the higher resistance at any potential difference.

Explain how **Figure 11** shows this.

[2 marks]

0 7 . 4 Both bulbs behave like ohmic conductors through a range of values of potential difference.

Use **Figure 11** to determine the range for these lamps.

Explain your answer.

[3 marks]

0 8 A student models the random nature of radioactive decay using 100 dice.

He rolls the dice and removes any that land with the number 6 facing upwards.

He rolls the remaining dice again.

The student repeats this process a number of times.

Table 1 shows his results.

Table 1

Roll number	Number of dice remaining
0	100
1	84
2	70
3	59
4	46
5	40
6	32
7	27
8	23

0 8 . 1 Give **two** reasons why this is a good model for the random nature of radioactive decay.

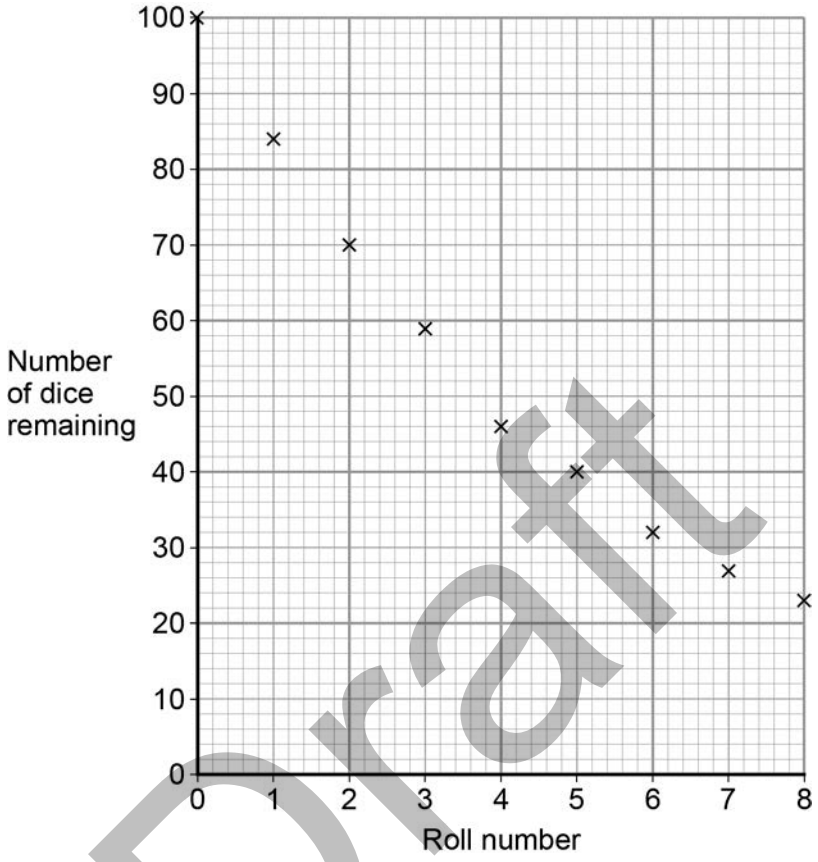
[2 marks]

1

2

The student's results are shown in **Figure 12**.

Figure 12



0 8 . 2 Draw a line of best fit on **Figure 12**.

[1 mark]

0 8 . 3 Use **Figure 12** to determine the half-life for these dice using this model.

Show on **Figure 12** how you work out your answer.

[2 marks]

Half-life = _____ rolls

A teacher uses a protactinium (Pa) generator to produce a sample of radioactive material that has a half-life of 70 seconds.

In the first stage in the protactinium generator, uranium (U) decays into thorium (Th) and alpha (α) radiation is emitted.

The decay can be represented by the equation shown in **Figure 13**.

Figure 13

$$^{238}_{92}U \longrightarrow {}^{\square}_{}Th + \alpha$$

0 8 . 4 Determine the atomic number of thorium (Th) 234.

[1 mark]

Atomic number = _____

When protactinium decays, a new element is formed and radiation is emitted.

The decay can be represented by the equation shown in **Figure 14**.

Figure 14

$$^{234}_{91}Pa \rightarrow {}^{234}_{92}X + radiation$$

0 8 . 5 When protactinium decays, a new element, **X**, is formed.

Use information from **Figure 13** and **Figure 14** to determine the name of element **X**.

[1 mark]

_____

0 8 . 6 Determine the type of radiation emitted as protactinium decays into a new element.

[1 mark]

0 8 . 7 The teacher wears polythene gloves as a safety precaution when handling radioactive materials.

The polythene gloves do **not** stop the teacher's hands from being irradiated.

Explain why the teacher wears polythene gloves.

[2 marks]

Turn over for the next question

0 9 Electricity is generated in a nuclear power station.

0 9 . 1 Fission is the process by which energy is released in the nuclear reactor.

Name **one** nuclear fuel.

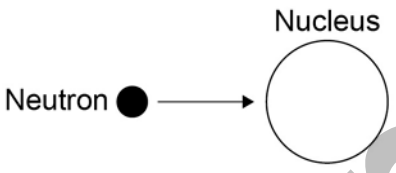
[1 mark]

0 9 . 2 **Figure 15** shows the first part of the nuclear fission reaction.

Complete **Figure 15** to show how the fission process starts a chain reaction.

[3 marks]

Figure 15



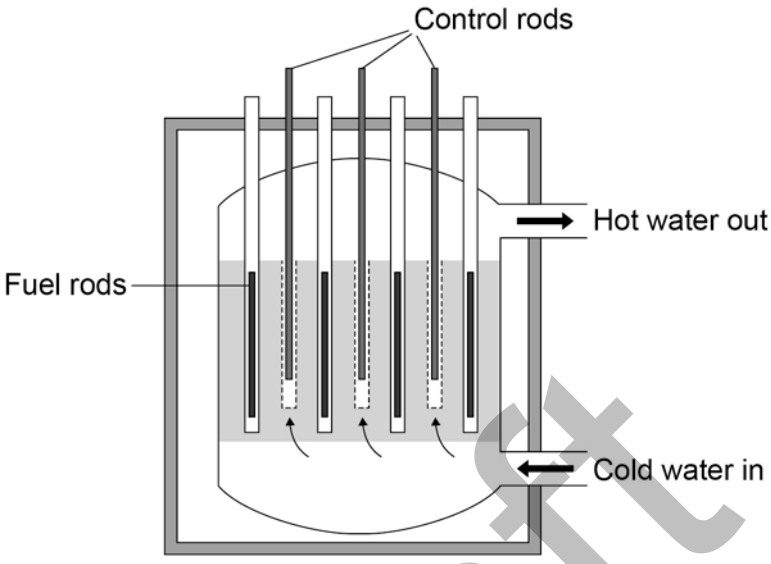
0 9 . 3 Neutrons are a product of nuclear fission.

Name **one** other product of nuclear fission.

[1 mark]

Figure 16 shows the inside of a nuclear reactor in a nuclear power station.

Figure 16



0 9 . 4 In a nuclear reactor a chain reaction occurs, which causes neutrons to be released.

The control rods absorb neutrons.

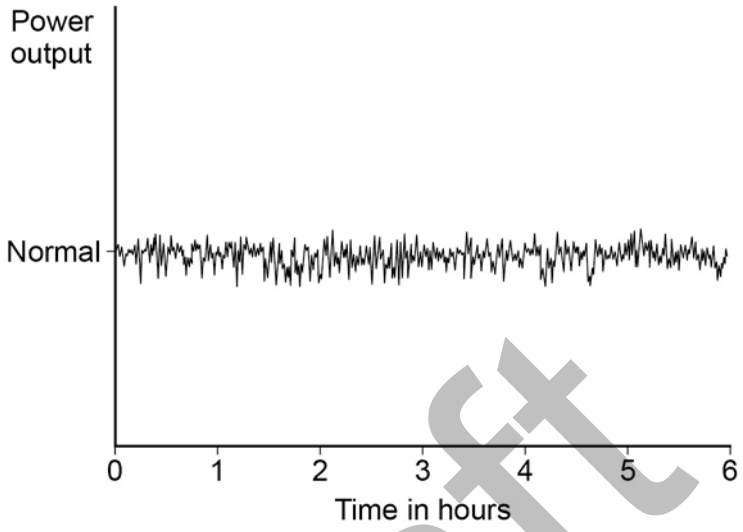
The control rods can be moved up and down.

Describe how the energy released by the chain reaction is affected by moving the control rods.

[3 marks]

Figure 17 shows how the energy released in a nuclear reactor varies when working under normal conditions.

Figure 17



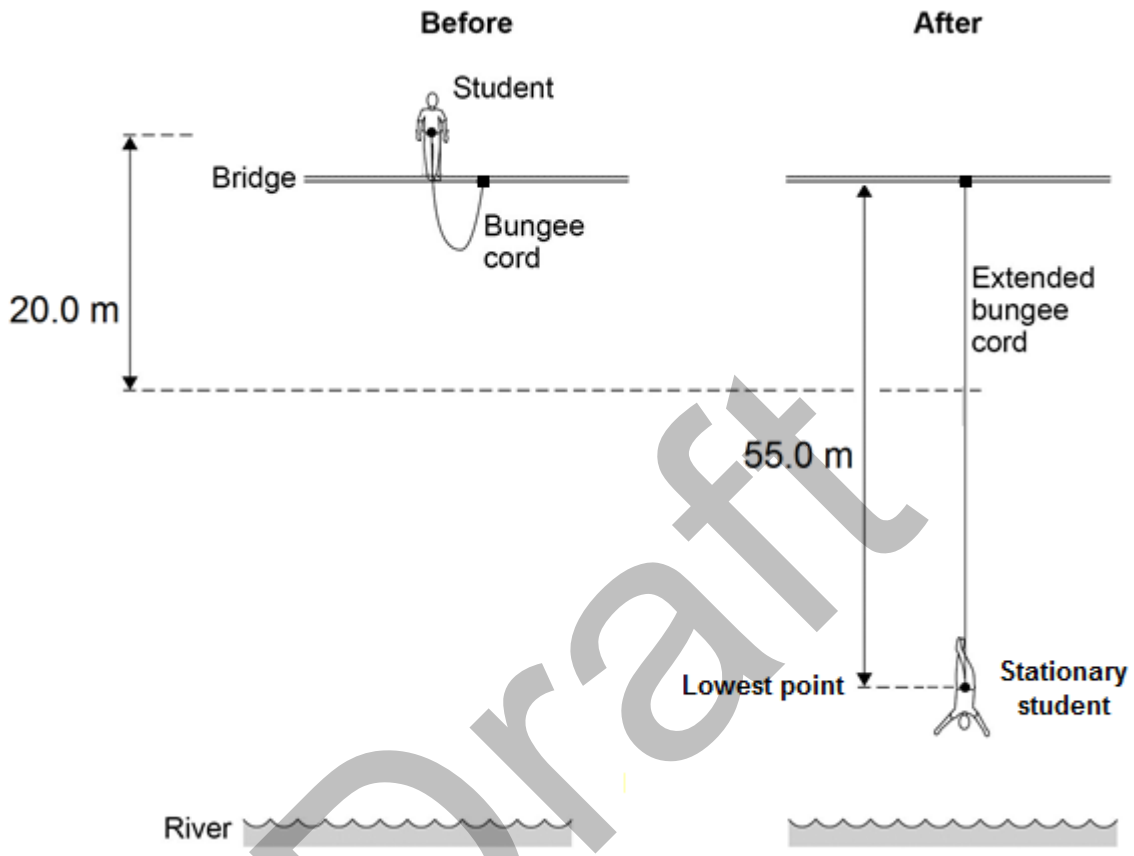
0 9 . 5 Draw a line on **Figure 17** to show how the energy released would change if the chain reaction became uncontrolled.

[2 marks]

1 0 **Figure 18** shows a student before and after a bungee jump.

The bungee cord has an unstretched length of 20 m.

Figure 18



1 0 . 1 The mass of the student is 50.0 kg.

The gravitational field strength is 10 N/kg.

Write down the equation which links gravitational field strength, gravitational potential energy, height and mass.

Calculate the change in gravitational potential energy from the position where the student jumps to the point 20.0 m below.

[3 marks]

Change in gravitational potential energy = _____ J

1 0 . 2 How much kinetic energy has the student gained after falling 20.0 m?

[1 mark]

Kinetic energy gained = _____ J

1 0 . 3 Write down the equation which links kinetic energy, mass and speed.

Calculate the speed of the student after falling 20.0 m.

[3 marks]

Speed = _____ m/s

1 0 . 4 At the lowest point in the jump, the energy stored by the stretched bungee cord is 24 500 J.

The bungee cord behaves like a spring.

Calculate the spring constant of the bungee cord.

Use the correct equation from the Physics Equation Sheet.

Give the unit.

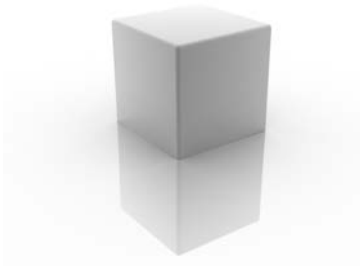
[4 marks]

Spring constant = _____

Unit = _____

1 1 A student wants to calculate the density of the two objects shown in **Figure 19**.

Figure 19



Metal cube

Small statue

Describe the methods that the student should use to calculate the densities of the two objects.

[5 marks]

1 2 An electrician is replacing an old electric shower with a new one.

The inside of the old shower is shown in **Figure 20**.

Figure 20

1 2 . 1 If the electrician touches the live wire he will receive an electric shock as charge passes through his body.

Explain why.

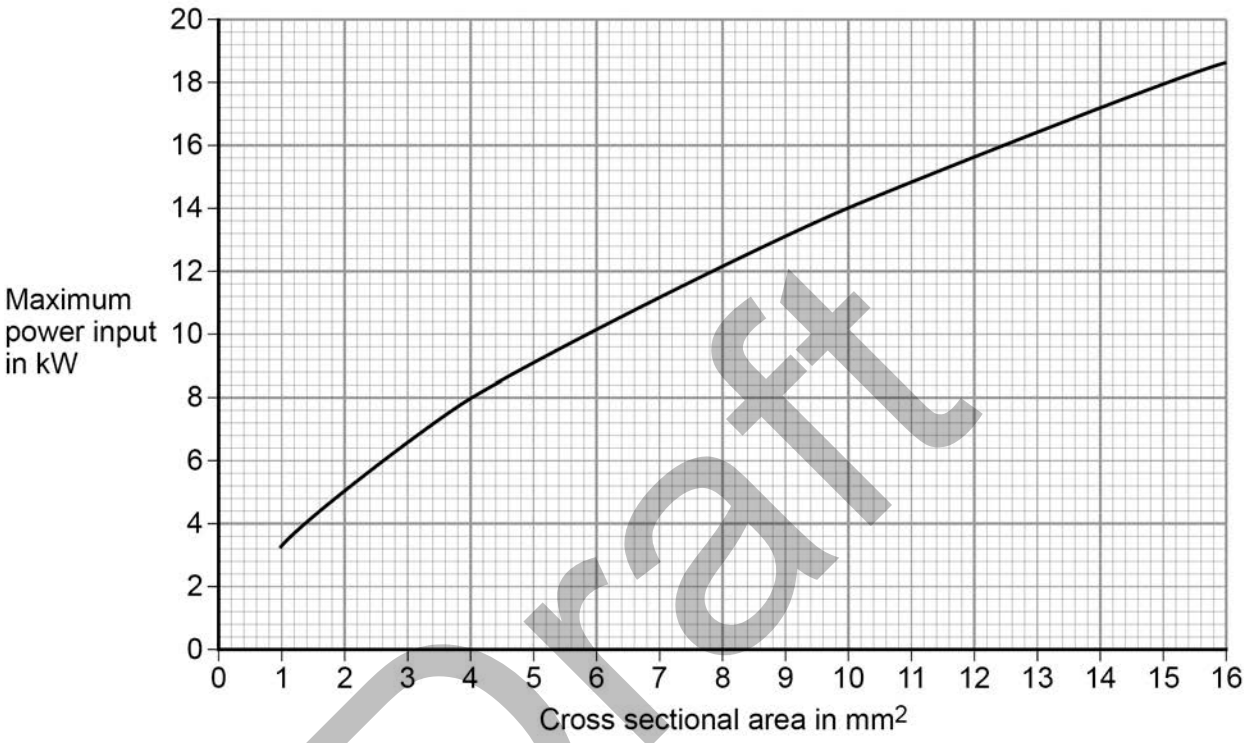
Refer to the potential of the live wire and the electrician's body in your answer.

[3 marks]

Different electrical wires need to have a cross-sectional area that is suitable for the power output.

Figure 21 shows the recommended maximum power input to wires of different cross-sectional areas.

Figure 21



1 2 . 2 The new electric shower has a power input of 13.8 kW.

Determine the minimum cross-sectional area of wire that should be used for the new shower.

[1 mark]

Minimum cross-sectional area = _____ mm^2

1 2 . 3 Suggest what might happen if a wire is used that has a cross-sectional area that is too small.

[1 mark]

_____

_____

Question 12 continues on the next page

The old electric shower had a power of 8.0 kW.

The new electric shower has a power of 13.8 kW.

1 2 . 4 Taking a shower using the new shower would cost more.

Explain why.

[2 marks]

1 2 . 5 The charge that flows through the new shower in 300 seconds is 18 000 C.

Calculate the resistance of the heating element in the new shower.

Write down the equations you use.

[5 marks]

Resistance = _____ Ω

END OF QUESTIONS