Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
PHYSICS

Higher Tier Paper 1

H

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 boxesat the top of this page.
- Answer allquestions in the spacesprovided.
- Do not write outsidethe 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	

Answer all questions in the spaces provided.

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0 1 Figure 1 shows a large wind farm off the coast of the UK.

Figure 1

The mean power output of the wind farm is 696 MW, which is enough power for 580 000 homes.

0 1 . 1 Calculate the mean power needed for 1 home.

Give your answer in watts.

[2 marks]

P = 696 000 000 (W)

P = 1200 (W)

Mean power needed for 1 home = 1200 W

Do not write outside the box

0 1 . 2 On one day the demand for electricity in the UK was 34 000 MW.

Suggest two reasons why wind power was not able to meet this demand.

[2 marks]

1 Wind is unreliable

2 Wind turbines don't turn when the wind is too strong/weak

0 1 . 3 Some of the energy from the wind used to rotate a wind turbine is wasted.

An engineer oils the mechanical parts of a wind turbine.

Explain how oiling would affect the efficiency of the wind turbine.

[3 marks]

The efficiency would increase because the percentage amount of energy usefully transferred would increase

0 1 . 4 In most homes in the UK there are many different electrical devices.

Explain why people should be encouraged to use energy efficient electrical devices.

[2 marks]

More efficient devices waste less energy which would minimise the energy demand

9

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0 2 Figure 2 shows a rock found by a student on a beach.
To help identify the type of rock, the student took measurements to determine its density.

Figure 2

0 2 . 1 Describe a method the student could use to determine the density of the rock.

[6 marks]

• Measure mass using a balance / scales
• Part fill a measuring cylinder with water and measure initial volume
• Place rock in water and measure final volume
• Volume of rock = final volume − initial volume
• Fill a displacement / eureka can with water level with spout
• Place rock in water and collect displaced water
• Measuring cylinder used to determine volume of displaced water
• Volume of rock = volume of displaced water
• Use mass and volume to calculate density

use of density = mass / volume

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The student determined the density of the rock to be 2.55 ± 0.10 g/cm3.

0 2 . 2 What are the maximum and minimum values for the density of the rock?

[1 mark]

Maximum density = 2.65 g/cm3

Minimum density = 2.45 g/cm3

0 2 . 3 Table 1 gives the density of five different types of rock.

Table 1

Type of rock	Density in g/cm3
Basalt	2.90 ± 0.10
Chalk	2.35 ± 0.15
Flint	2.60 ± 0.10
Sandstone	2.20 ± 0.20
Slate	2.90 ± 0.20

Which two types of rock in Table 1 could be the type of rock the student had?

[1 mark]

Tick (✓) one box.

- Basalt or chalk ☐
- Chalk or flint ☑
- Flint or sandstone ☐
- Sandstone or slate ☐

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 The student only took one set of measurements to determine the density of the rock.

Explain why taking the measurements more than once may improve the accuracy of the density value.

[2 marks]

A mean can be calculated.
Which reduces the effect of random errors

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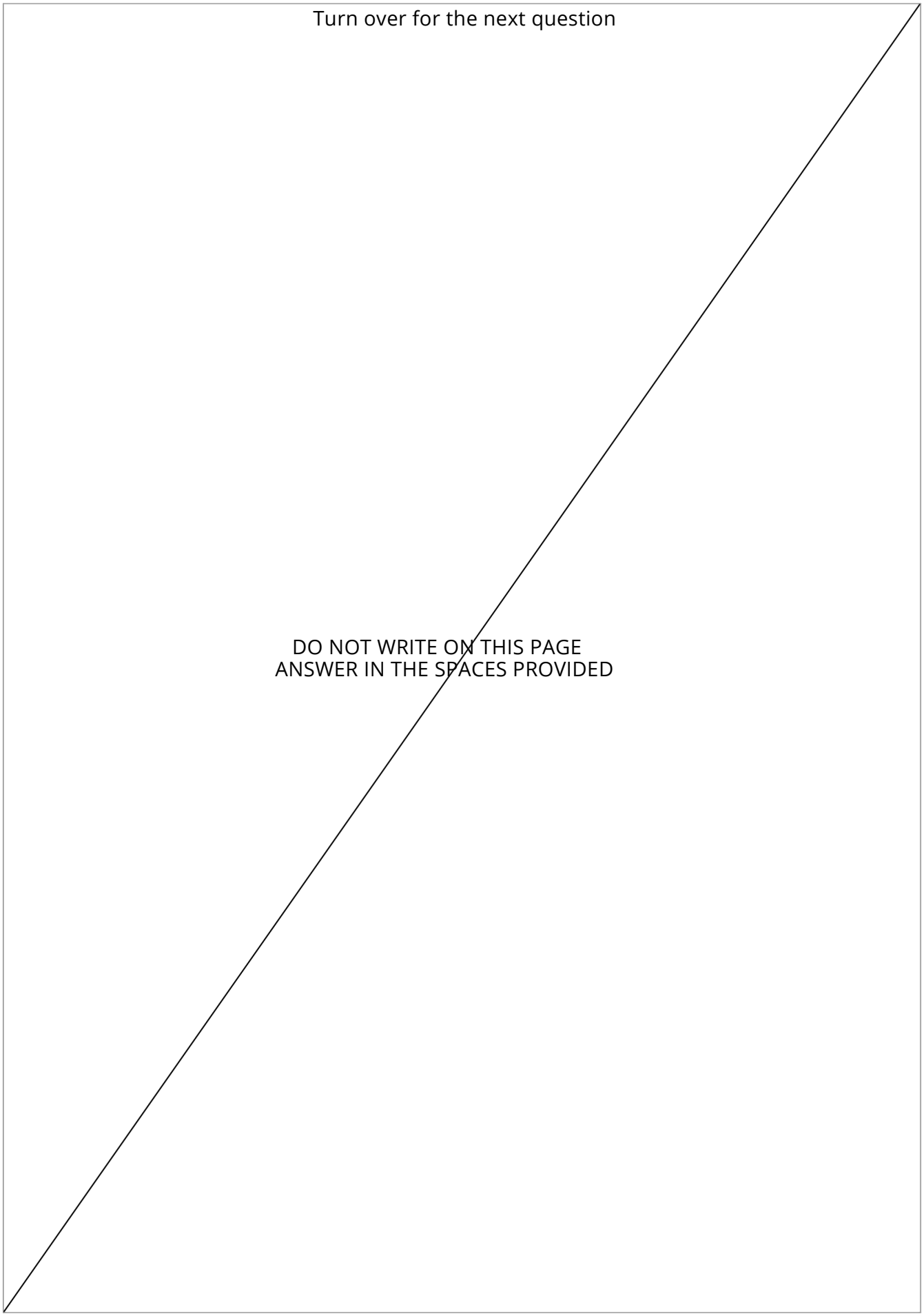

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0 3 An engineering company has invented pavement tiles that generate electricity as people walk on them.
Figure 3 shows someone walking on the pavement tiles.

Figure 3

Use the Physics Equations Sheet to answer questions 03.1 and 03.2.

0 3 . 1 What equation links current (I), potential difference (V) and power (P)?

[1 mark]

Tick (✓) one box.

$P = \frac{V}{I}$ ☐

$P = V \times I$ ☑

$I = P \times V$ ☐

$V = I^2 \times P$ ☐

Do not write outside the box

0 3 . 2 When a person walks on a tile, a potential difference of 40 V is induced across the tile.

The power output of the tile is 4.4 W.

Calculate the current in the tile.

[3 marks]

$4.4 = 40 \times I$

$I = \frac{4.4}{40}$

Current = 0.11 A

Question 3 continues on the next page

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Use the Physics Equations Sheet to answer questions 03.3 and 03.4.

0 3 . 3 What equation links efficiency, total power input and useful power output?

[1 mark]

Tick (✓) one box.

Efficiency = $\frac{\text{useful power output}}{\text{total power input}}$ ✓

Efficiency = $\frac{\text{total power input}}{\text{useful power output}}$

Efficiency = useful power output × total power input

0 3 . 4 The tiles are used to power LED lights in the pavement.

An LED light has a total power input of 4.0 W.

The efficiency of the LED light is 0.85

Calculate the useful power output of the LED light.

[3 marks]

$0.85 = \frac{P}{4.0}$

$P = 0.85 \times 4.0$

Useful power output = 3.4 W

8

Turn over for the next question

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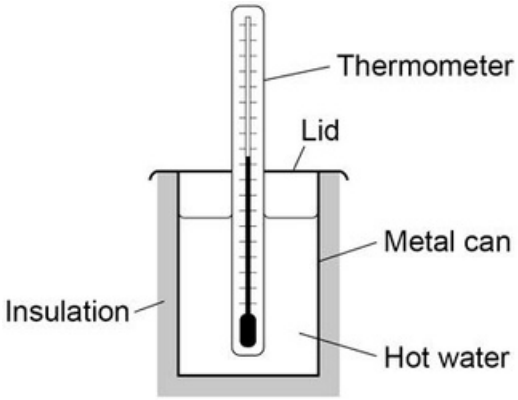
0 4 A student investigated the insulating properties of different materials.

Figure 4 shows some of the equipment used by the student.

Figure 4



This is the method used:

1. Wrap insulating material around the can.
2. Put a fixed volume of boiling water in the can.
3. Place the lid on the top of the can.
4. Measure the time taken for the temperature of the water to decrease by a fixed amount.
5. Repeat steps 1–4 using the same thickness of different insulating materials.

0 4 . 1 Identify the independent variable and the dependent variable in this investigation.

[2 marks]

Independent variable type of insulation material

Dependent variable time

Do not write outside the box

The student used two different types of thermometer to measure the temperature changes.
Figure 5 shows a reading on each thermometer.

Figure 5

0 4 . 2 What is the resolution of thermometer B?

[1 mark]

Resolution = 0.1 °C

0 4 . 3 Thermometer A is more likely to be misread.

Give one reason why.

[1 mark]

Viewing angle affects measurement

Question 4 continues on the next page

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0 4 . 4 For one type of insulating material, the temperature of the water decreased from 85.0 °C to 65.0 °C.

The energy transferred from the water was 10.5 kJ.

specific heat capacity of water = 4200 J/kg °C

Calculate the mass of water in the can.

Use the Physics Equations Sheet.

[3 marks]

$E = 10500$

$m = \frac{10500}{4200 \times (85-65)}$

Mass = 0.125 kg

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0 4 . 5 Table 2 shows the results for two insulating materials.

Table 2

Material	Time for temperature to decrease by 20 °C in seconds
X	450
Y	745

Explain how the results in Table 2 can be used to compare the thermal conductivity of the two materials.

[2 marks]

Same temperature decrease in a shorter time means a higher thermal conductivity because the rate of energy transfer is higher

9

Turn over for the next question

Do not write outside the box

0 5 A student rubbed a plastic rod with a cloth.

The rod became negatively charged and the cloth became positively charged.

0 5 . 1 Explain why the clothbecamepositivelycharged.

[3 marks]

Electrons transferred from the cloth to the rod. Electrons are negatively charged so there are more positive charges than negative charges on the cloth

Figure 6 shows the negatively charged rod on abalance.

Figure 6

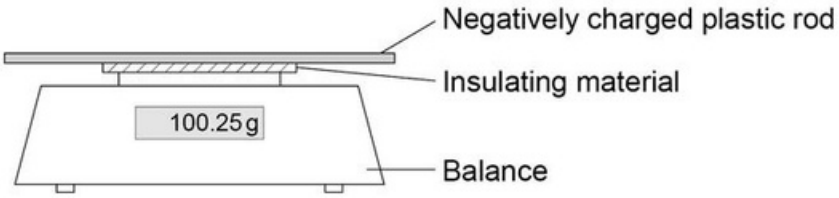
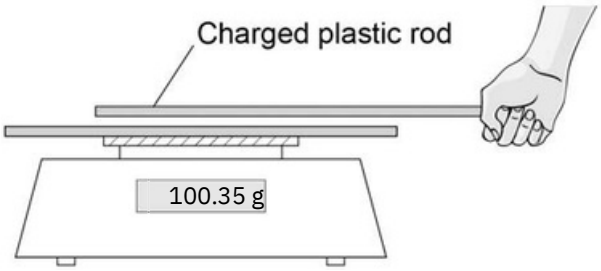


Figure 7shows another charged rod being held stationary above the rod on the balance.
The rods do not touch each other.

Figure 7



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0 5 . 2 Explain why the reading on the balance increases.

[3 marks]

There is an additional downwards force on the balance increasing the mass reading. Because the held rod is negatively charged and rods with like charges repel.

0 5 . 3 The balance had a zero error.

The zero error is not important in this experiment.

Give the reason why.

[1 mark]

Only the change in mass is being observed

0 5 . 4 A negatively charged rod is held near an earthed conductor.

Explain why a spark jumps between the negatively charged rod and the earthed conductor.

[3 marks]

The large potential difference between the two objects causes negative electrons charges to move through the air , from the rod to the conductor.

10

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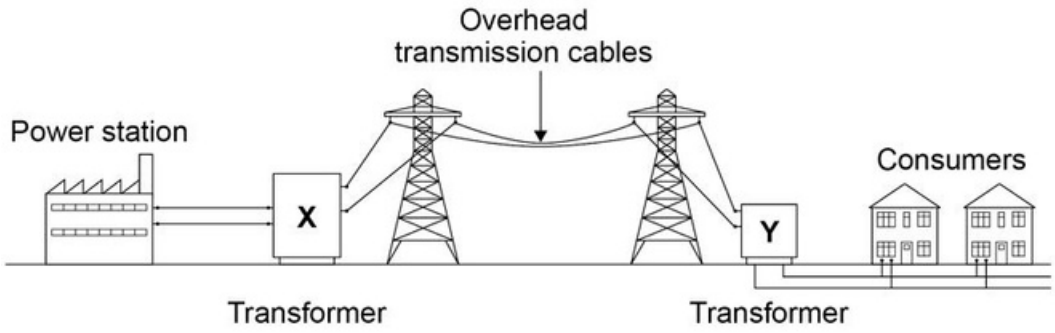
0 6 Figure 8 shows how electricity is supplied to consumers by the National Grid.

Figure 8



0 6 . 1 Explain why transformer X is used in the National Grid.

[4 marks]

Transformer X increases potential difference and decreases current , reducing thermal energy transfer to surrounding.

0 6 . 2 Explain why transformer Y is used in the National Grid.

[2 marks]

Transformer Y decreases the potential difference to a safer value

Do not write outside the box

0 6 . 3 The town of Hornsdale in Australia has electricity supplied by a huge battery.

On one day the battery transferred 3.24 × 1011 J of energy to the town.

The potential difference of the town's electricity supply is 230 V.

Calculate the charge flow to the town on this day.

Use the Physics Equations Sheet.

Give your answer to 3 significant figures.

[4 marks]

$230 \times Q = 3.24 \times 10^{11}$

$Q = \frac{3.24 \times 10^{11}}{230} = 1408695652$

Charge flow (3 significant figures) = 1.41×10^{9} C

10

Turn over for the next question

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0 7 Alpha particles,beta particlesand gamma raysare types of nuclear radiation.

0 7 . 1 What does an alpha particle consist of?

[1 mark]

Two protons and two neutrons

0 7 . 2 A krypton (Kr) nucleusdecays into a rubidium (Rb) nucleus by emitting a beta particle.

Complete the nuclear equationfor this decayby writing the missing number in each box.

[2 marks]

$$^{85}_{36}Kr \longrightarrow {}^{85}_{37}Rb + {}^{0}_{-1}e$$

0 7 . 3 Internal contamination of the human body means radioactive material is inside the human body.

Explain how the risk from internal contaminationis different tothe risk from external irradiation by a source of alpharadiation.

[5 marks]

Alpha radiation has a low penetrating ability.
so externally alpha radiation is stopped by skin so is low risk.
Internally, alpha radiation is absorbed by living organs
As alpha radiation is highly ionising internal contamination will cause greater risk of harm to organs.

8

Turn over for the next question

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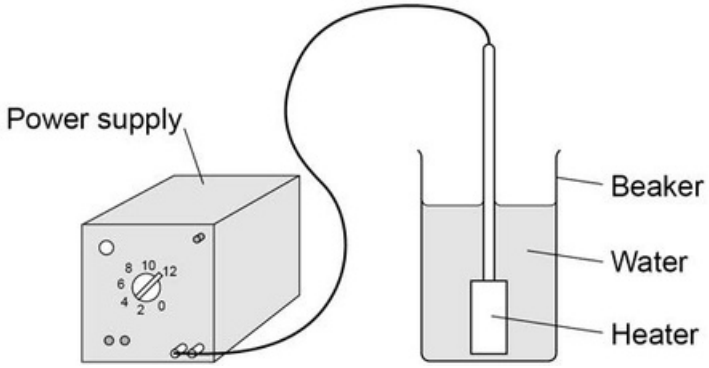
0 8 A student determined the specific latent heat of vaporisation of water.

Figure 9 shows some of the equipment used.

Figure 9



This is the method used:

1. Put 50 cm3 of water in a beaker.
2. Measure the mass of the beaker and water.
3. Use a heater to boil the water and keep it boiling for 600 seconds.
4. Measure the mass of the beaker and water after 600 seconds.

0 8 . 1 What measuring instrument should be used to measure the volume of water?

[1 mark]

measuring cylinder

0 8 . 2 What is a hazard in the student's investigation?

[1 mark]

Tick (✓) one box.

burns ☐

boiling water ☑

heatproof gloves ☐

safety goggles ☐

Do not write outside the box

0 8 . 3 The initial mass of the beaker and water was 0.080 kg.

The final mass of the beaker and water was 0.071 kg.

The energy transferred by the immersion heater as the water boiled was 25 200 J.

Calculate the specific latent heat of vaporisation of water given by the student's data.

Give the unit.

Use the Physics Equations Sheet.

[5 marks]

Change in mass = 0.009kg

$25200 = 0.009L$

$L = \frac{25200}{0.009}$

$= 2.8 \times 10^{6}$

Specific latent heat of vaporisation = 2.8×10^{6} Unit J/kg

Question 8 continues on the next page

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0 8 . 4 Some thermal energy was transferred to the surroundings while the water was being heated.
Explain how this affected the student's value for the specific latent heat of vaporisation of water.

[2 marks]

Less energy than 25200 J was transferred to the water.
So student's value of L was too high.

0 8 . 5 Some of the water evaporated before its temperature reached 100 °C.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

[2 marks]

The measured change in mass is too high for the energy supplied.
So student's value of L is too low.

11

Turn over for the next question

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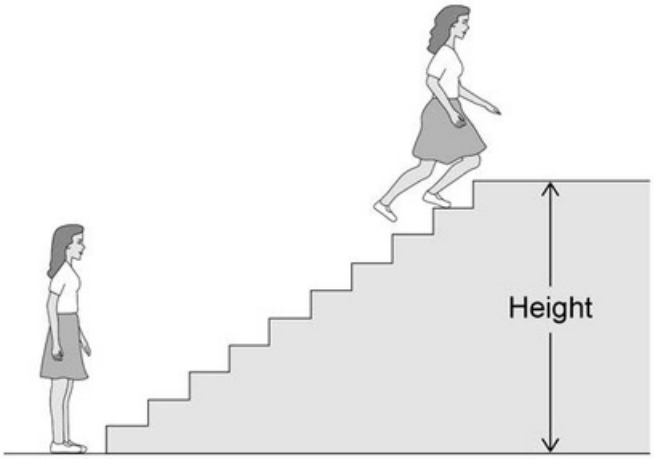
0 9 Figure 10 shows a girl doing an experiment to determine her power output by running to the top of some stairs.

Figure 10



0 9 . 1 The mass of the girl was 60.0 kg.

The height of the stairs was 175 cm.

The girl ran to the top of the stairs in 1.40 s.

gravitational field strength = 9.8 N/kg

Calculate the power output of the girl.

Use the Physics Equations Sheet.

[5 marks]

h = 1.75m

Ep = 60 × 9.8 × 1.75

Ep = 1029 J

$P = \frac{1029}{1.40}$

Power = 735 W

Do not write outside the box

0 9 . 2 The total power output of the girl was greater than the answer to question 09.1.

Suggest two reasons why.

[2 marks]

1 Girl increases her kinetic energy as well as increa sing her gravitational potential energy.

2 Some energy is wasted in her muscles.

0 9 . 3 A boy took more than 1.40 s to run up the same stairs.

The power output of the boy was the same as the power output of the girl.

What conclusion can be made about the boy's mass?

[1 mark]

Tick (✓) one box.

The boy's mass was greater than the girl's mass. ☑

The boy's mass was lower than the girl's mass. ☐

The boy's mass was the same as the girl's mass. ☐

8

Turn over for the next question

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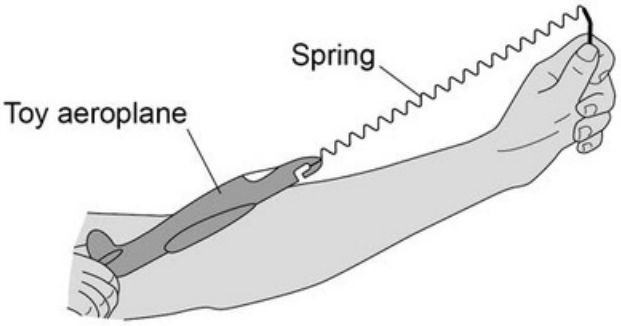
1 0 Figure 11 shows a student launching a toy aeroplane.
To launch the aeroplane, the student pulls on it to stretch the spring and then releases it.

Figure 11



1 0 . 1 Just before the toy aeroplane is released, the spring has an extension of 0.12 m.

mass of aeroplane = 0.020 kg

spring constant of the spring = 50 N/m

Calculate the maximum speed of the toy aeroplane just after it is launched.

Use the Physics Equations Sheet.

Give the unit.

[6 marks]

$E_e = 0.5 \times 50 \times 0.12^2$

$E_e = 0.36\text{J}$

$0.36 = 0.5 \times 0.020 \times v^2$

$v^2 = \frac{0.36}{0.5 \times 0.020}$

$v^2 = 36$

Speed = 6 Unit m/s

Do not write outside the box

1 0 . 2 Complete the sentence.

[1 mark]

As the aeroplane moves upwards through the air there is a decrease

in the kinetic energy of the aeroplane.

1 0 . 3 Give one factor which would increase the distance the toy aeroplane travels horizontally before hitting the ground.

[1 mark]

Increasing the extension of the spring

8

Turn over for the next question

Do not write outside the box

1 1 Figure 12 shows some hair straighteners.

Hair straighteners contain heating elements.

Figure 12

1 1 . 1 When the hair straighteners reach normal operating temperature, an LED turns on.

Draw the circuit symbol for an LED in the box.

[1 mark]

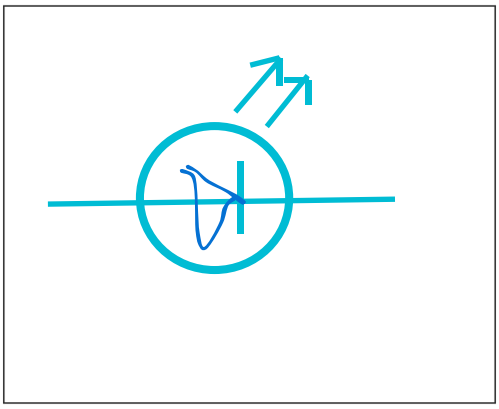


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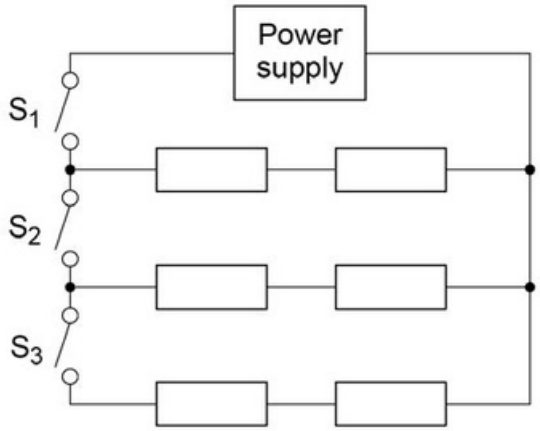
Figure 13shows the circuit diagram for the hair straighteners.

Each resistor represents a heating element.

The power output of the hair straighteners can be changed by closing different switches.

Figure 13



1 1 . 2 Why do the hair straighteners not turn on when only switch S2is closed?

[1 mark]

There is a gap in the circuit.

Question 11 continues on the next page

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1 1 . 3 The hair straighteners have a maximum power output of 120 W.

The energy transferred to the hair straighteners to reach normal operating temperature is 3.6 kJ.

Calculate the time taken for the hair straighteners to reach normal operating temperature when operating at maximum power.
Use the Physics Equations Sheet.

[4 marks]

$E = 3600\,J$

$3600 \times 120 \times t$

$t = \frac{3600}{120} = 30\,s$

Time = 30 seconds

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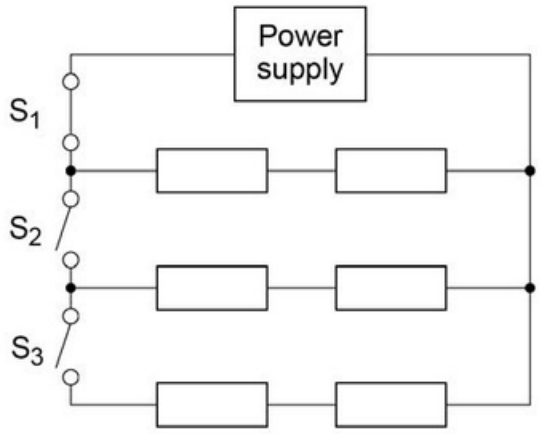
1 1 . 4 Figure 14 shows the hair straighteners circuit with switch S1closed.

Figure 14



Switch S2and switch S3are then closedat the same time.

Explain what happens to the power output of the power supply.

[3 marks]

The total resistance of the circuit decreases so the current increases.
Which increases the power output.

9

END OF QUESTIONS

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