AQA

SPECIMEN MATERIAL

GCSE
PHYSICS

F

Foundation Tier Paper 1F

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.
- When answering questions 05.2, 06.1 and 10 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

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 Energy resources can be renewable or non-renewable.

0 1 . 1 Coal is a non-renewable energy resource.

Name **two** other non-renewable energy resources.

[2 marks]

1 oil

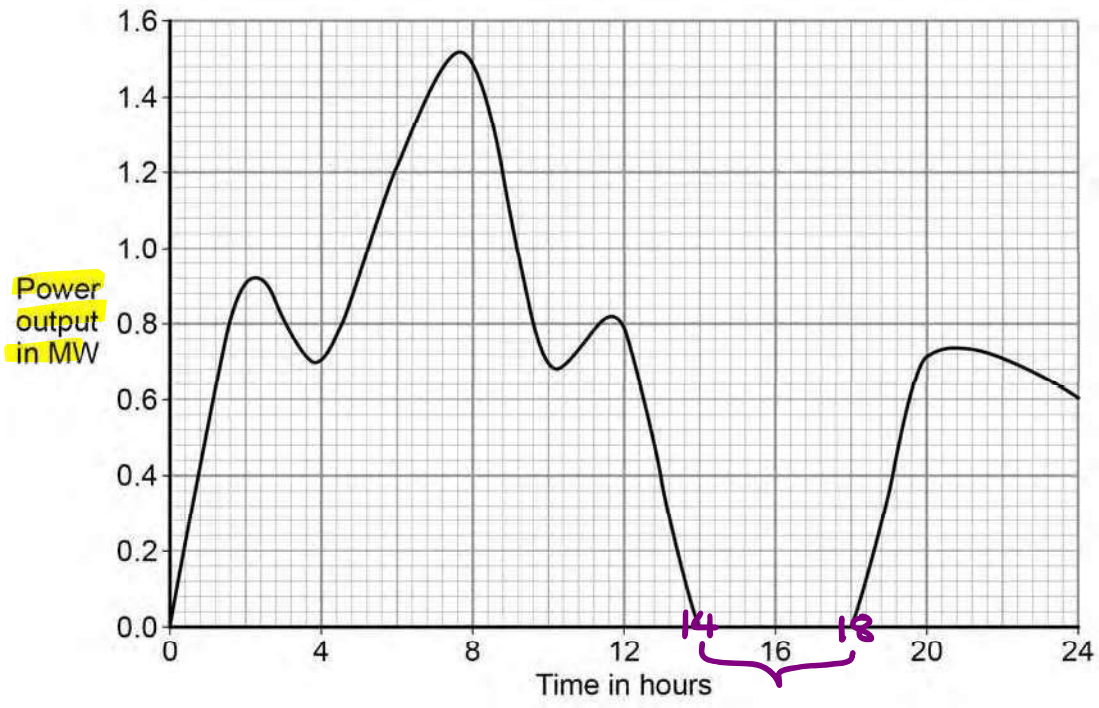
2 gas

+ nuclear

Wind turbines are used to generate electricity.

Figure 1 shows how the power output of a wind turbine changes over one day.

Figure 1



0 1 . 2 A wind turbine does not generate electricity constantly.

For how many hours did the wind turbine generate no electricity?

[1 mark]

18 − 14 = 4

Time = 4 hours

0 1 . 3 Electrical power is transferred from power stations to the National Grid.

What is the National Grid?

system of cables & transformers

consumers ↔ power stations

Tick **one** box.

[1 mark]

- ✗ a system of cables and pylons ☐
- ✓ a system of cables and transformers ☑
- ✗ a system of cables, transformers and power stations ☐

0 1 . 4 An island has a large number of wind turbines and a coal-fired power station.

The island needs to use the electricity generated by the coal-fired power station at certain times.

Choose **one** reason why.

[1 mark]

Tick **one** box.

why use coal then?

- ✗ Wind is a renewable energy resource. ☐
- ✗ Wind turbine power output is constant. ☐
- ✓ The power output of wind turbines is unpredictable. ☑
- ✗ The fuel cost for wind turbines is very high. ☐

0 1 . 5 A wind turbine has an average power output of 0.60 MW.

A coal-fired power station has a continuous power output of 1500 MW.

Calculate how many wind turbines would be needed to generate the same power output as one coal-fired power station.

[2 marks]

$\frac{1500\text{MW}}{0.60\text{MW}} = 2500$

Number of wind turbines = 2500

0 1 . 6 It is important that scientists develop new energy resources.

Choose **one** reason why.

[1 mark]

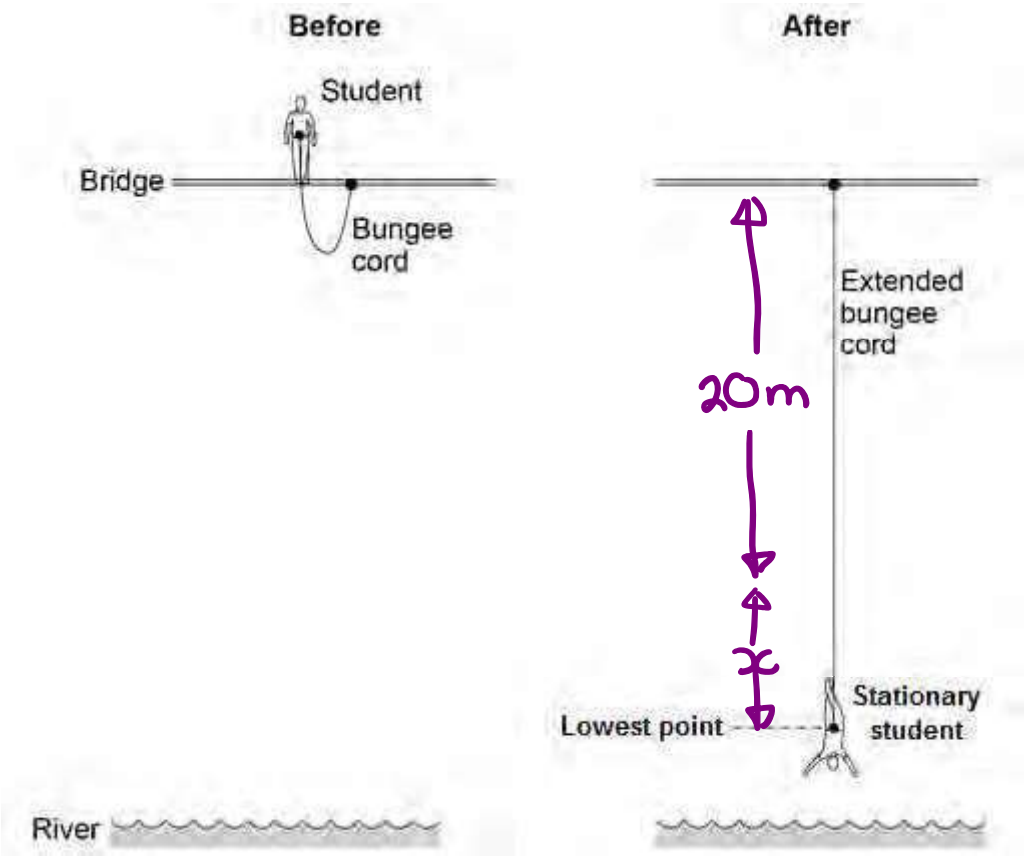
Tick **one** box.

- ~~All~~ energy resources are running out. ☐
- ~~All~~ energy resources are used to generate electricity. ☐
- Most energy resources have negative environmental effects. ☑

0 2 **Figure 2** shows a student before and after a bungee jump.

The bungee cord has an unstretched length of 20 m.

Figure 2



0 2 . 1 For safety reasons, it is important that the bungee cord used is appropriate for the student's weight.

Give **two** reasons why.

F=kx

[2 marks]

1 extension too great

2 cord might snap

0 2 . 2 The student jumps off the bridge.

Complete the sentences to describe the energy transfers.

Use answers from the box.

[3 marks]

elastic potential	gravitational potential	kinetic	sound	thermal

Before the student jumps from the bridge he has a store of

gravitational potential energy.

When he is falling, the student's store of kinetic energy increases.

When the bungee cord is stretched, the cord stores energy as

elastic potential energy.

0 2 . 3 At the lowest point in the jump when the student is stationary, the extension of the bungee cord is 35 metres.

The bungee cord behaves like a spring with a spring constant of 40 N/m.

Calculate the energy stored in the stretched bungee cord.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

$E = \frac{1}{2} k x^2$

$= \frac{1}{2} \times 40 \times 35^2$

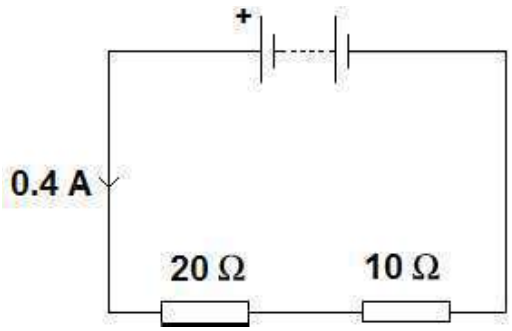
$= 24,500$

Energy = 24,600 J

0 3 An electrical circuit is shown in **Figure 3**.

Current is the same everywhere in series.
$I = 0.4\,A$
$R_T = R_1 + R_2$
$= 20 + 10$
$= 30\,\Omega$

Figure 3



0 3 . 1 The current in the circuit is direct current.

What is meant by direct current?

[1 mark]

Tick **one** box.

- ✗ Current that continuously changes direction. AC ☐
- ✗ Current that travels directly to the component. ☐
- ✓ Current that is always in the same direction. DC ☑

0 3 . 2 The equation which links current, potential difference and resistance is:

potential difference = current x resistance

Calculate the potential difference across the battery in the circuit in **Figure 3.**

[3 marks]

total resistance = 20 + 10 = 30 Ω ✓

p.d = 0.4 x 30 = 12 V ✓

Potential difference = 12 V

0 3 . 3 The equation which links current, potential difference and power is:

power = current x potential difference

Calculate the power output of the battery in **Figure 3.**

Give your answer to one significant figure.

[2 marks]

= 0.4 A x 12 V = 4.8 W ✓

Power = 5 ✓ W

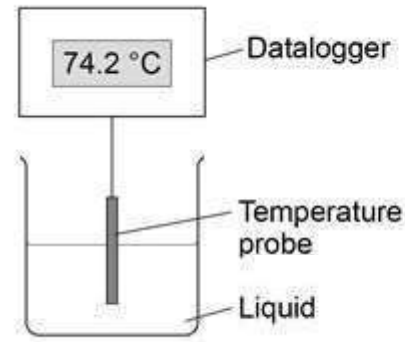
0 4 Two students investigated the change of state of stearic acid from liquid to solid.

They measured how the temperature of stearic acid changed over 5 minutes as it changed from liquid to solid.

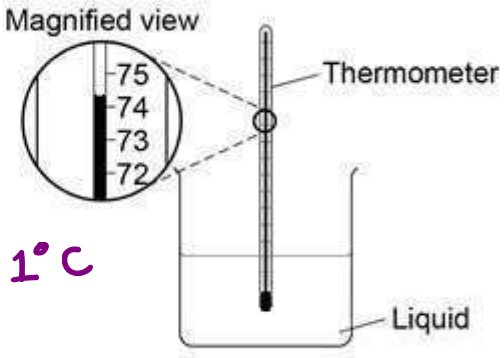
Figure 4 shows the different apparatus the two students used.

Figure 4

Student A's apparatus



Student B's apparatus



0 4 . 1 Choose **two** advantages of using student **A**'s apparatus.

[2 marks]

Tick **two** boxes.

- Student **A**'s apparatus made sure the test was fair. ☐
- Student **B**'s apparatus only measured categoric variables. ☐
- Student **A**'s measurements had a higher resolution. ☑
- Student **B** was more likely to misread the temperature. ☑

0 4 . 2 Student **B** removed the thermometer from the liquid each time he took a temperature reading.

What type of error would this cause?

Tick **one** box.

[1 mark]

consistently ↑ or ↓ set amount

- A systematic error ☐
- A random error ☑
- A zero error ☐

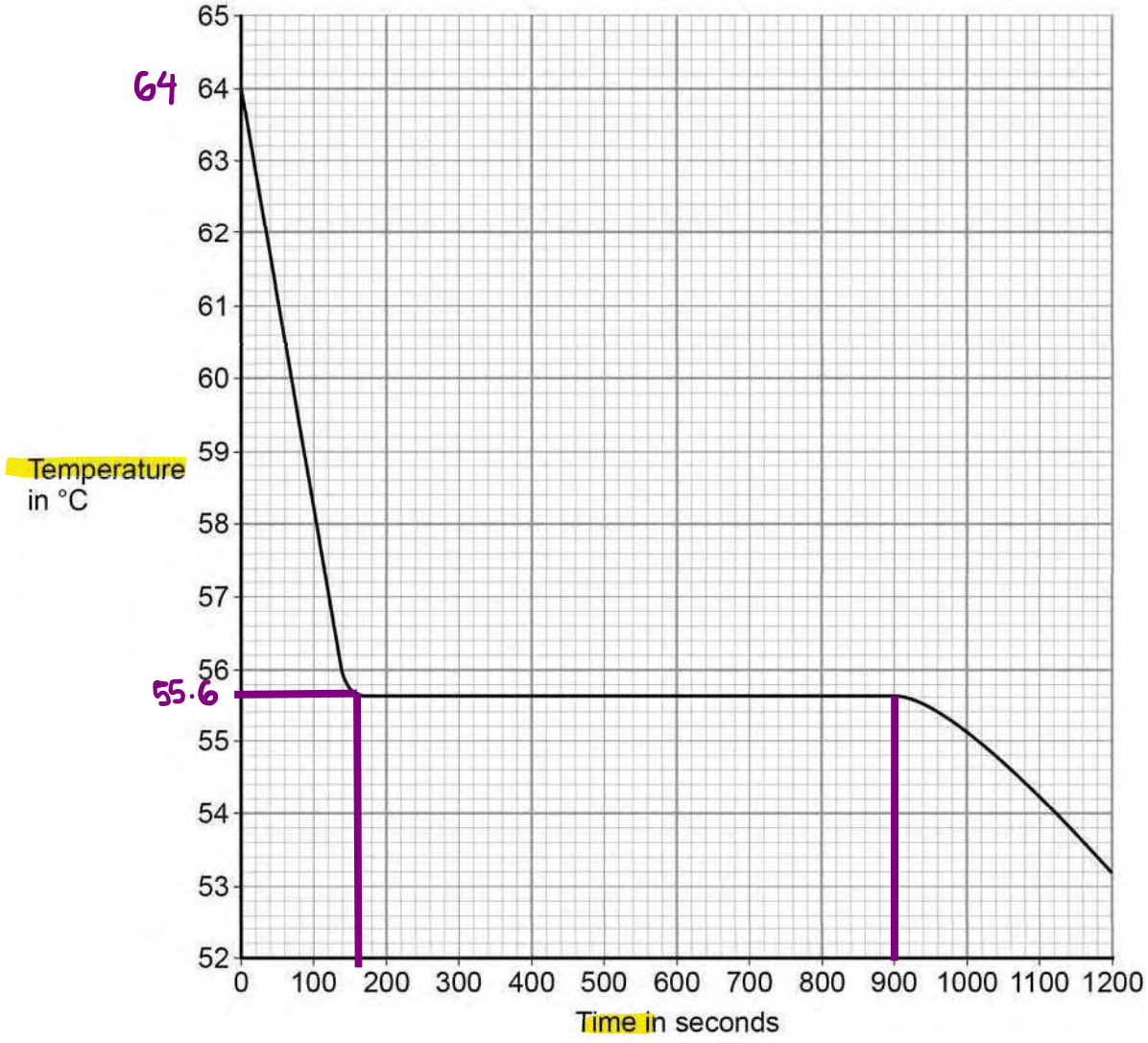
faulty equipment doesn't reset to zero

Question 4 continues on the next page

When something changes state, there is no change in temperature

Student **A**'s results are shown in **Figure 5**.

Figure 5



0 4 . 3 What was the decrease in temperature between 0 and 160 seconds?

[1 mark]

Tick **one** box.

$\Delta T = \text{temp}_{160s} - \text{temp}_{0s}$

$= 55.6 - 64 = -8.4$

- 8.2 °C ☐
- 8.4 °C ☑
- 53.2 °C ☐
- 55.6 °C ☐

0 4 . 4 Use **Figure 5** to determine the time taken for the stearic acid to change from a liquid to a solid.

[1 mark]

900 − 160

Time = 740 seconds

0 4 . 5 Calculate the energy transferred to the surroundings as 0.40 kg of stearic acid changed state from liquid to solid.

energy transferred to change state 1kg sub solid ⇄ liquid without temp change

The specific latent heat of fusion of stearic acid is 199 000 J/kg.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

$E = mL_F$

$= 0.4\text{kg} \times 199{,}000\text{ J/kg}$ ✓

$= 79{,}600\text{ J}$

Energy = 79,600 ✓ J

0 4 . 6 After 1200 seconds the temperature of the stearic acid continued to decrease.

Explain why.

[2 marks]

Stearic acid has a higher temperature than it's surrounding ✓. Temperature will decrease until it's the same as the temperature of the surroundings ✓.

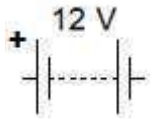
53.2°C ⇄ 22°C

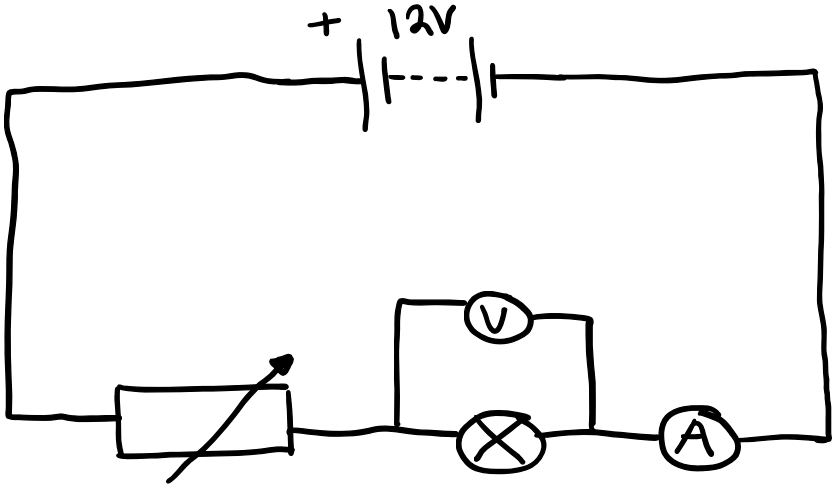
Heat transferred from hot objects to cold objects, until they are the same temp.

0 5 A student wants to investigate how the current through a filament lamp affects its resistance.

0 5 . 1 Use the circuit symbols in the boxes to draw a circuit diagram that she could use.

[2 marks]

12 V battery	variable resistor	filament lamp	voltmeter	ammeter
				



$V = IR$

$\frac{V}{I} = R$

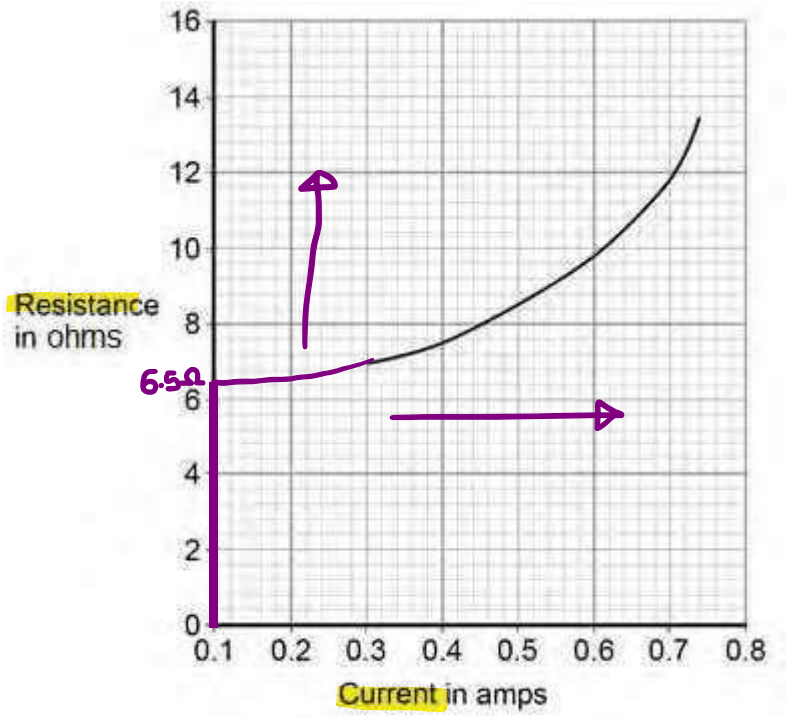
0 5 . 2 Describe how the student could use her circuit to investigate how the current through a filament lamp affects its resistance.

[4 marks]

Use an ammeter to measure current. Use voltmeter to measure pd across filament lamp, so that we can calculate resistance using $R = \frac{V}{I}$. Change the resistance of the variable resistor, so we can change the current through the filament lamp. Resistance needs to be calculated, over a large range of currents so conclusions are valid.

The student's results are shown in **Figure 6**.

Figure 6



0 5 . 3 Describe how the resistance of the filament lamp changes as the current through it increases.

[1 mark]

Resistance increases. ✓

0 5 . 4 Use **Figure 6** to estimate the resistance of the filament lamp when a current of 0.10 A passes through the lamp.

[1 mark]

Resistance = 6.5 Ω

6.3 – 6.9

The current–potential difference graphs of three components are shown in **Figure 7**.

0 5 . 5 Use answers from the box to identify each component.

[3 marks]

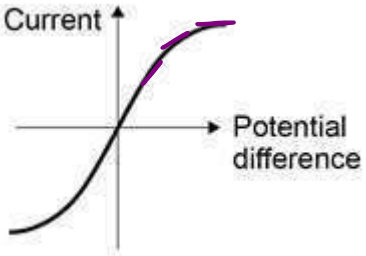
diode	**filament lamp**	**light dependent resistor**
resistor at constant temperature		**thermistor**

grad: $\frac{I}{V}$ $R = \frac{V}{I}$

grad: $\frac{1}{R}$

Figure 7

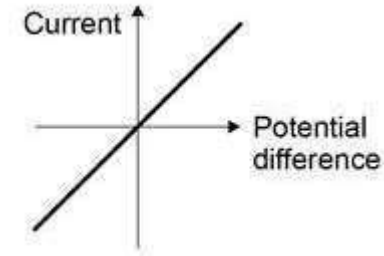
Graph A



- ohmic-conductor
- As temperature increases resistance increase

filament lamp

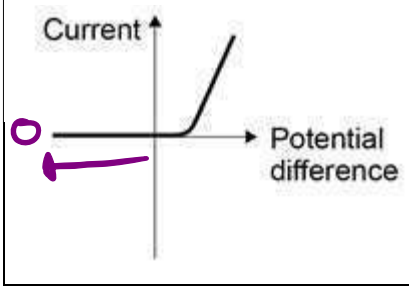
Graph B



- $I \propto V$ so ohmic-conductor

resistor at constant temp

Graph C



- Current can only flow in one direction
- Resistance low in forwards direction

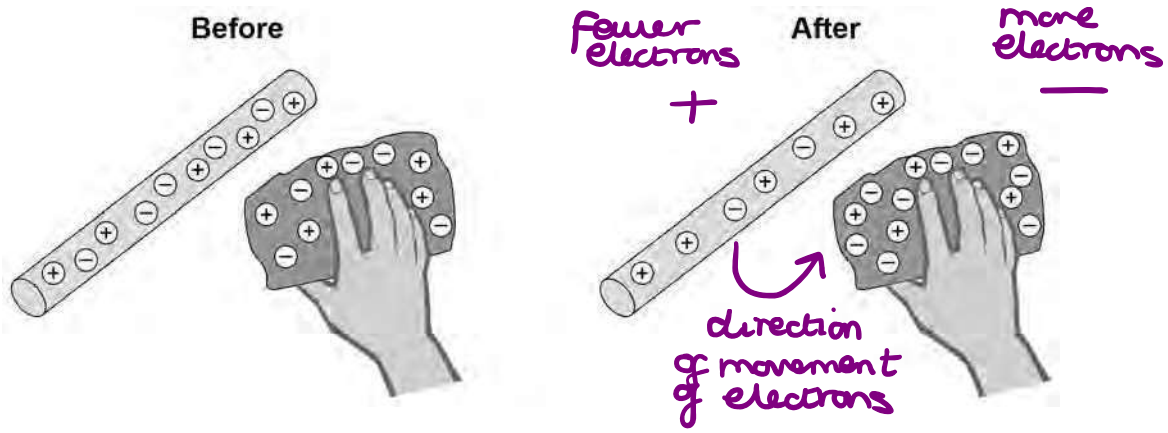
diode

Both insulators

0 6 A student rubs an acetate rod with a cloth.

Figure 8 shows the charges on the acetate rod and cloth before and after rubbing.

Figure 8



0 6 . 1 Explain how rubbing an acetate rod with a cloth causes the rod and cloth to become charged.

[4 marks]

The friction between the rod and the cloth, causes electrons to move, from the acetate rod to the cloth. Net charge on the cloth is now negative, and the net charge on the rod is now positive.

For 4 marks:
- detailed & coherent explanation
- logical links
- clearly identified, relevant points

0 6 . 2 After charging them, the student moves the acetate rod and the cloth closer together.

+ −

like charges repel

unlike charges attract

Which statement is correct?

Tick **one** box.

There is no force between the acetate rod and the cloth. ☐

There is a force of attraction between the acetate rod and the cloth. ☑

There is a force of repulsion between the acetate rod and the cloth. ☐

Give a reason for your answer.

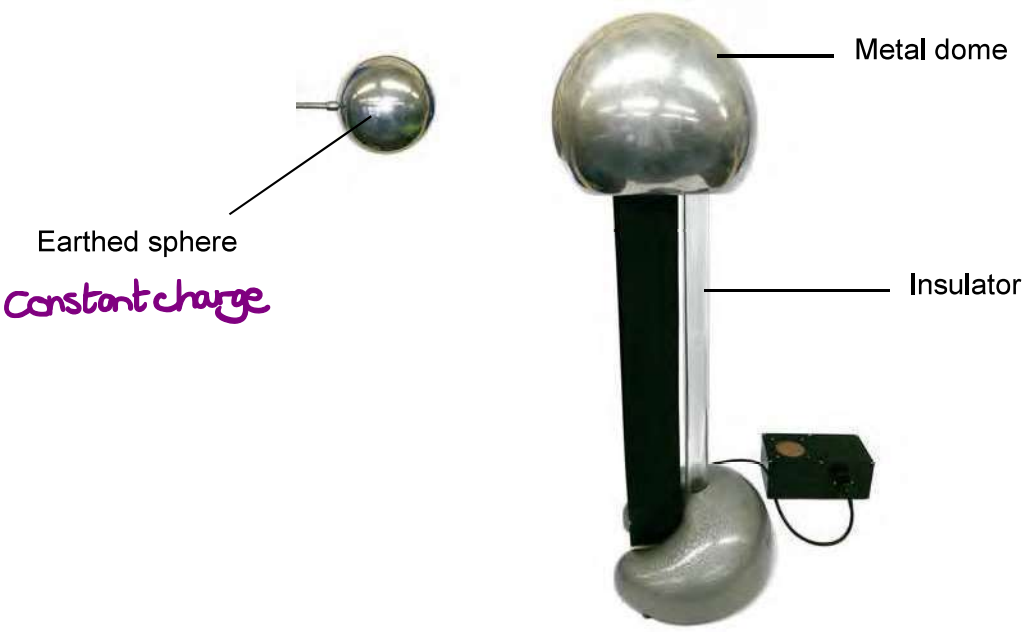
[2 marks]

Unlike charges attract.

Question 6 continues on the next page

Figure 9 shows a Van de Graaff generator, which is used to generate static electricity.

Figure 9



Constant charge

0 6 . 3 The longer the Van de Graaff generator is switched on, the more charge is stored on the metal dome.

Use an answer from the box to complete the sentence.

[1 mark]

decrease	**increase**	**stay the same**

The amount of charge on the metal dome is increased, which causes the potential difference between the metal dome and the earthed sphere to increase .

Earthed sphere
constant charge

Metal dome
Charge increases

so difference in charge increases

1kV = 1000V
60kV = 60,000V

0 6 . 4 When the potential difference between the Van de Graaff generator and the earthed sphere is 60 kV, a spark jumps between the metal dome and the earthed sphere.

The spark transfers 0.000025 coulombs of charge to the earthed sphere.

The equation which links charge, energy and potential difference is:

J C V

$$\text{energy transferred} = \text{charge} \times \text{potential difference}$$

Calculate the energy transferred by the spark.

[2 marks]

$= 0.000025C \times 60{,}000V$

$= 1.5J$

Energy transferred = 1.5 J

Turn over for the next question

0 7 Alpha, beta and gamma are types of nuclear radiation.

0 7 . 1 Draw **one** line from each type of radiation to what the radiation consists of.

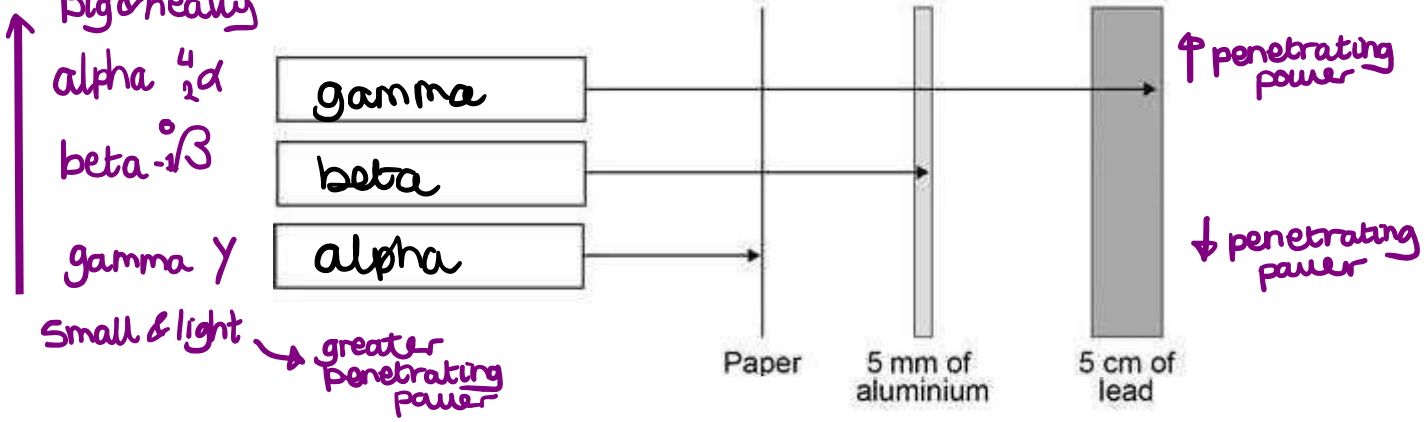
[3 marks]

Type of radiation	What radiation consists of
Alpha	Two protons and two neutrons
Beta	Electron from the nucleus
Gamma	Electromagnetic radiation
	Neutron from the nucleus

A teacher demonstrates the penetration of alpha, beta and gamma radiation through different materials.

The demonstration is shown in **Figure 10.**

Figure 10



0 7 . 2 Complete **Figure 10** by writing the name of the correct radiation in each box.

[2 marks]

0 7 . 3 Give **two** safety precautions the teacher should have taken in the demonstration.

[2 marks]

1 gloves ✓

2 not pointing radioactive source at students ✓

half life = time taken for count rate to half

Table 1 shows how the count rate from a radioactive source changes with time.

Table 1

Time in seconds	0	40	80	120	160
Count rate in counts / second	400	283	200	141	100

+80, +80 → 200; 141 → 71; ÷2

0 7 . 4 Use **Table 1** to calculate the count rate after 200 seconds.

[2 marks]

half life = 80s ✓

$\frac{141}{2} = 70.5 \simeq 71$

count rate after 200s = 71 counts/sec ✓ (2sf)

0 7 . 5 The half-life of the radioactive source used was very short.

lots of half lives → much smaller count rate

Give **one** reason why this radioactive source would be much less hazardous after 800 seconds.

[1 mark]

Very small amount of radiation emitted

0 8 An electrician is replacing an old electric shower with a new one.

The inside of the old shower is shown in **Figure 11**.

Figure 11

0 8 . 1 The electrician should **not** change the shower unless he switches off the mains electricity supply.

Explain why.

[2 marks]

If he touches a live wire, he may be electrocuted.

power potential difference

0 8 . 2 The new shower has a power output of 10 690 W when it is connected to the 230 V mains electricity supply.

The equation which links current, potential difference and power is:

$$\text{current} = \frac{\text{power}}{\text{potential difference}}$$ ✓

Calculate the current passing through the new shower.

Give your answer to two significant figures.

[4 marks]

$I = \frac{10\,690\text{W}}{230\text{V}} = 46.478...$ ✓ ✓

1 2 x x x

Current = 46 ✓ A

0 8 . 3 The new shower has a higher power rating than the old shower.

How does the power of the new shower affect the cost of using the shower?

Give a reason for your answer.

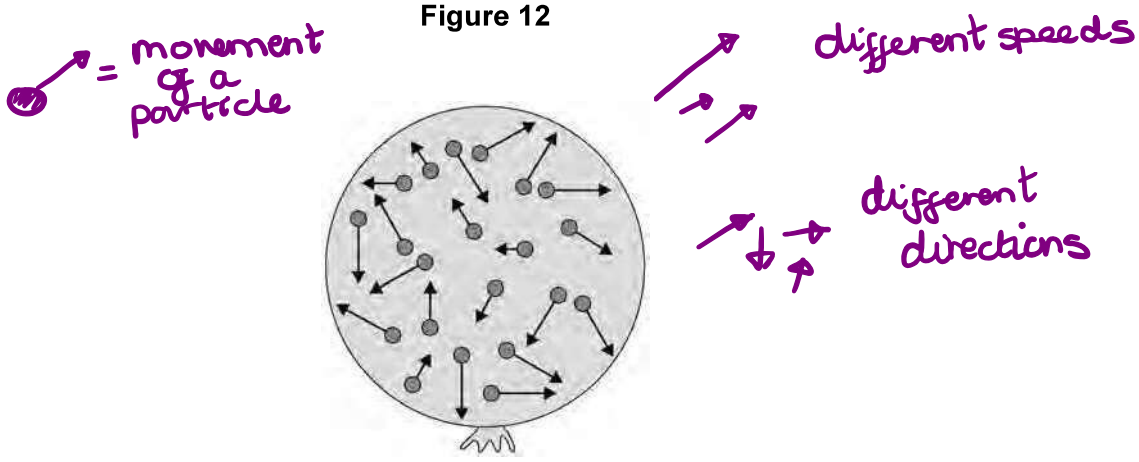
[2 marks]

Higher power rating means more energy ✓ will be used per unit time, meaning it will have a higher cost ✓.

power = $\frac{\text{energy}}{\text{time}}$

0 9 **Figure 12** shows a balloon filled with helium gas.

Figure 12



0 9 . 1 Describe the movement of the particles of helium gas inside the balloon.

[2 marks]

Moving with a range of speeds, in different directions.

0 9 . 2 What name is given to the total kinetic energy and potential energy of all the particles of helium gas in the balloon?

[1 mark]

Tick **one** box.

Never heard of before!

- X External energy ☐
- ✓ Internal energy ☑
- X Movement energy ☐ — This is Kinetic energy

Internal energy = total energy in the kinetic energy store and potential energy store of the particles in a substance.

0 9 . 3 Write down the equation which links density, mass and volume.

density = mass / volume

kg/m³ (mass, volume)

[1 mark]

0 9 . 4 The helium in the balloon has a mass of 0.00254 kg. (3sf)

The balloon has a volume of 0.0141 m^3. (3sf)

Calculate the density of helium. Choose the correct unit from the box.

[3 marks]

m^3 / kg	kg / m^3	kg m^3

density = mass / volume

= 0.00254kg / 0.0141m³ = 0.18014180...

= 0.180 kg/m³ (3sf)

Density = 0.180 Unit kg/m³

Turn over for the next question

1 0 Scientists sometimes replace one scientific model with a different model.

For example, in the early 20th Century the plum pudding model of the atom was replaced by the nuclear model of the atom.

Explain what led to the plum pudding model of the atom being replaced by the nuclear model of the atom.

[6 marks]

- detailed + logical
- clear and coherent
- deep knowledge

In the plum pudding model, mass and charge are spread throughout the atom. Rutherford's alpha-scattering experiment meant that the plum pudding model was replaced. He fired alpha particles at gold foil. Most of the alpha particles passed straight through the gold foil. This showed that most of an atom is empty space. Some particles were deflected, showing that there is a charged nucleus. A few bounced back, showing nucleus has a large mass. These observations contradicted plum pudding model so it had to be replaced.

Rutherford alpha-scattering experiment

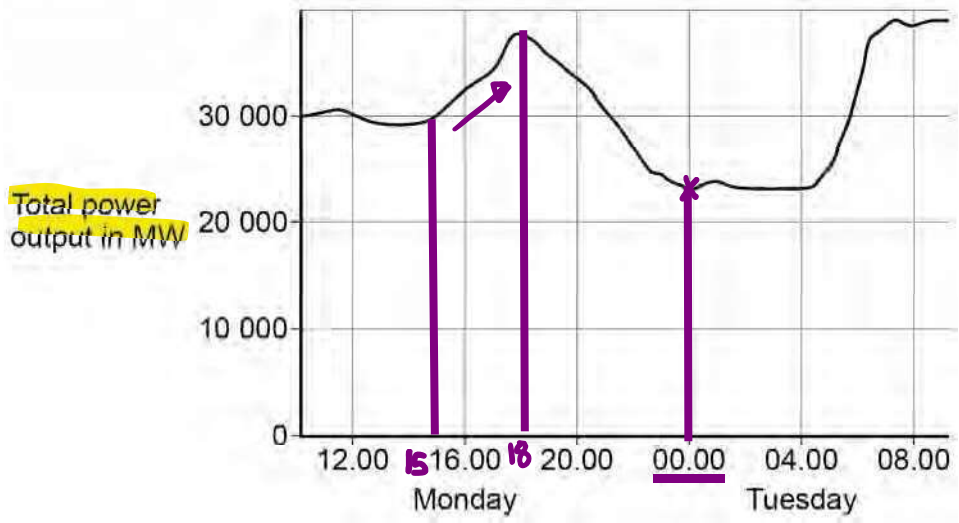
- Plum?
- Rutherford?
- Observations?
- Findings?

- most passed straight through → mostly empty space
- some deflected → charged nucleus
- a few bounced back → nucleus has mass

1 1 The National Grid ensures that the supply of electricity always meets the demand of the consumers.

Figure 13 shows how the output from fossil fuel power stations in the UK varied over a 24-hour period.

Figure 13



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

[1 mark]

There is a sharp increase in the total power output, because people come home from school and work.

1 1 . 2 Gas fired power stations reduce their output when demand for electricity is low.

Suggest **one** time on **Figure 13** when the demand for electricity was low.

[1 mark]

00:00 midnight

1 1 . 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 Producing more electricity than we need, unnecessarily damages the environment. ✓

2 Spare capacity if a power station shut down. ✓

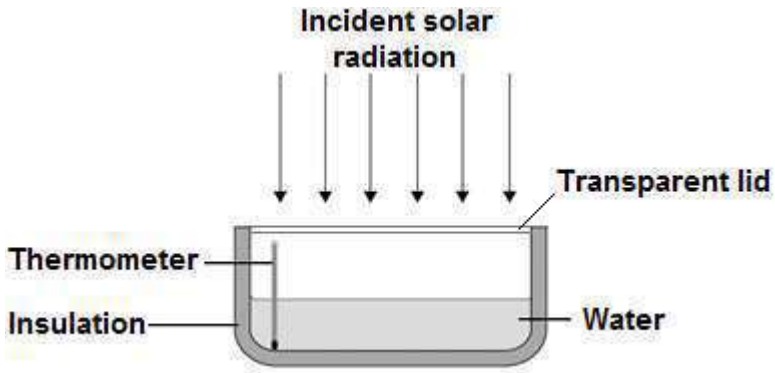
Turn over for the next question

1 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 0.6 °C.

The apparatus she used is shown in **Figure 14**.

Figure 14



1 2 . 1 Choose the most appropriate resolution for the thermometer used by the student. **[1 mark]**

smallest change in a value that can be detected

Tick **one** box.

- 0.1 °C ✓
- 0.5 °C
- 1.0 °C

0.6°C

J

The energy transferred to the water was 1050 J.

The time taken for the water temperature to increase by 0.6 °C was 5 minutes.

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

power is the rate of work done

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

[1 mark]

$$\text{power} = \frac{\text{energy transfered}}{\text{time}}$$

12.3 Calculate the mean power supplied by the Sun to the water in the pan.

[2 marks]

$$\text{power} = \frac{\text{energy transfered}}{\text{time}} = \frac{1050\text{J}}{300\text{s}} = 3.5$$

5 minutes = 5 × 60 = 300s (60s in a minute)

Average power = 3.5 W

12.4 Calculate the mass of water the student used in her investigation.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

mass E t Δθ c

$$\text{energy transfered} = mc\Delta\theta$$

$$m = \frac{E}{c\Delta\theta} = \frac{1050\text{J}}{4200\text{J/kg°C} \times 0.6\text{°C}} = \frac{5}{12}$$

Mass = 0.417 3sf kg

12.5 The student's results can only be used as an estimate of the mean power at her location.

Not all energy transferred to water.

Give **one** reason why.

[1 mark]

Some energy would be transferred to the pan instead of the water

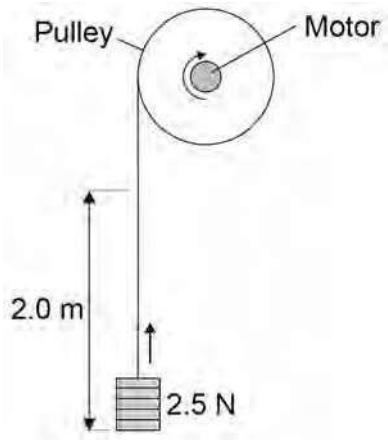
mean power = energy transfered to the location / time

What she calculated = energy transfered to the water in her location / time

$E = mc\Delta\theta$

1 3 A student investigated the efficiency of a motor using the equipment in **Figure 15**.

Figure 15



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.

kept constant

1 3 . 1 Give **one** variable that the student controlled in his investigation.

[1 mark]

weight

+height

1 3 . 2 Give **two** reasons for taking repeat readings in an investigation.

[2 marks]

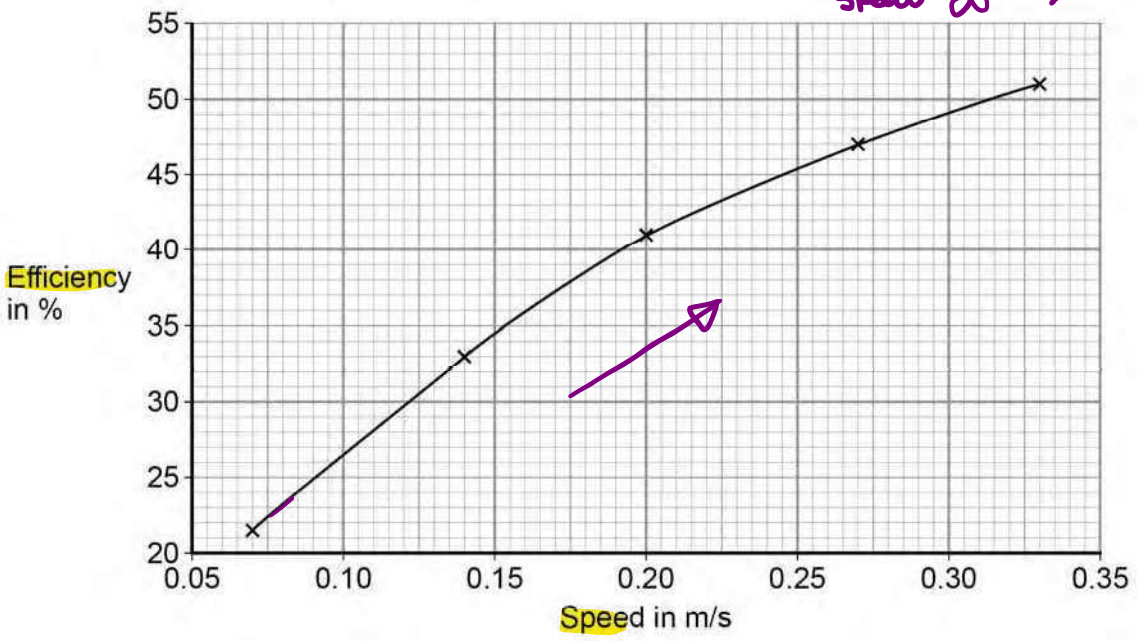
1 Identify anomalies.

2 Calculate a mean.

→ Reducing the effect of random errors.

Figure 16 shows a graph of the student's results.

Figure 16



1 3 . 3 Give **two** conclusions that could be made from the data in **Figure 16**.

[2 marks]

✓ As speed increases, efficiency increases.

Graph tends towards a constant value. (100%)

Because if it were a straight line, you would get efficiency >100%. which is not possible.

1 3 . 4 Give the main way that the motor is likely to waste energy.

[1 mark]

Heating the surroundings.

1 3 . 5 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]

$W = Fd$ $d = 0$ $W = 0$

$\text{output power} = \frac{W}{t} = 0$

Efficiency = 0 %

$\text{efficiency (\%)} = \frac{\text{output power}}{\text{input power}} \times 100$ $\frac{0}{5} \times 100 = 0$