Collins

AQA

GCSE

PHYSICS

F

SET B – Paper 1 Foundation Tier

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Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a calculator.
- the Physics Equation Sheet (found at the end of the paper).

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 06 and 12.2 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.

Name: ....

01.1 Which type of nuclear radiation has the **greatest ionising power**?

Tick **one** box.

Alpha ☐

Beta ☐

Gamma ☐

[1 mark]

01.2 Which type of nuclear radiation has the **longest range in air**?

Tick **one** box.

Alpha ☐

Beta ☐

Gamma ☐

[1 mark]

01.3 Which type of nuclear radiation consists of **high speed electrons**?

Tick **one** box.

Alpha ☐

Beta ☐

Gamma ☐

[1 mark]

01.4 Which type of nuclear radiation does **not** consist of **charged particles**?

Tick **one** box.

Alpha ☐

Beta ☐

Gamma ☐

[1 mark]

01.5 Which type of nuclear radiation is **not** suitable for medical **exploration of internal organs**?

Tick **one** box.

Alpha ☐

Beta ☐

Gamma ☐

[1 mark]

01.6 Which type of nuclear radiation consists of **two protons** and **two neutrons**?

Tick **one** box.

Alpha ☐

Beta ☐

Gamma ☐

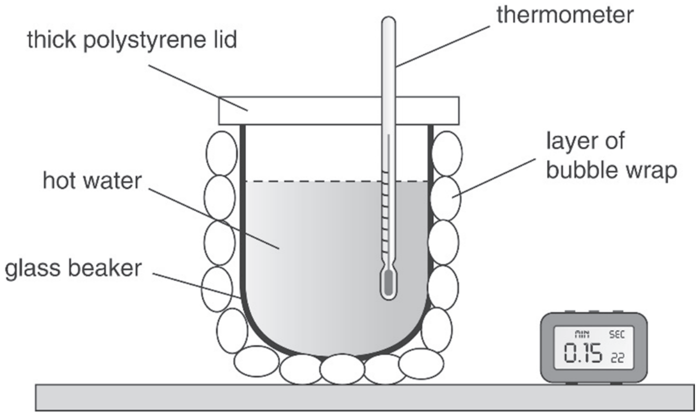
[1 mark]

Turn over >

02 A student wants to investigate how the thickness of bubble wrap affects its thermal insulation properties.

Figure 2.1 shows the apparatus that the student uses.

Figure 2.1



02.1 The student uses a volume of 100 cm^3 of hot water in the beaker.

He measures the time taken for the temperature of the hot water in the beaker to fall by 20°C, from 80°C to 60°C

He records time measurements for 1, 2, 3, and 4 layers of bubble wrap.

Identify **two control variables** in this investigation.

1. ....

2. .... **[2 marks]**

02.2 **Table 2.1** shows the student's measurements.

Table 2.1

Number of layers of bubble wrap	Time in seconds for temperature drop
1	220
2	340
3	440
4	560

Use the data in **Table 2.1** to help you to complete the sentences below.

Choose from the words in the box.

increases	decreases

Increasing the number of layers of bubble wrap around the beaker

.... the time taken for the temperature to drop from 80°C to 60°C

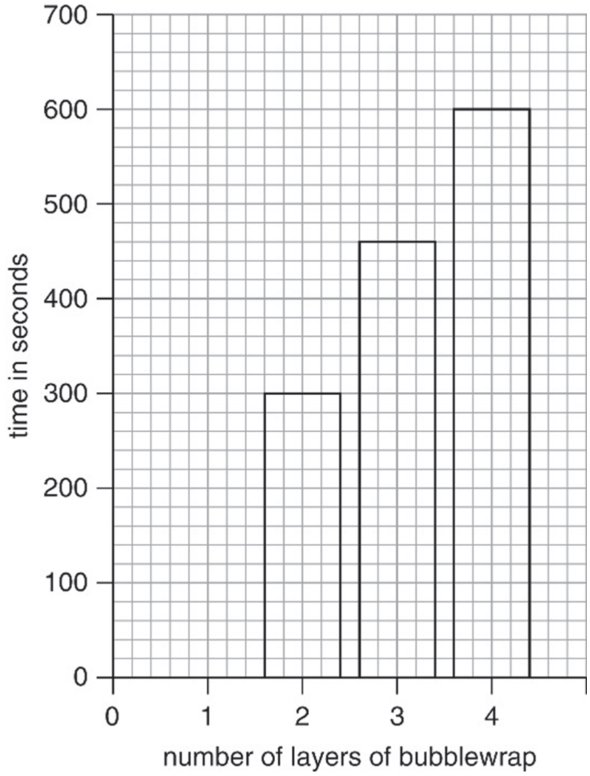
Increasing the number of layers of bubble wrap around the beaker

.... the thermal energy transferred to the surroundings each second. **[2 marks]**

Question 2 continues on the next page

02.3 **Figure 2.2** shows the student's data displayed in a bar chart.

Figure 2.2



The bar chart is incomplete.

Add the missing data.

[1 mark]

02.4 **Table 2.2** shows the thermal conductivity of three insulating materials.

Table 2.2

Material	Thermal conductivity in W/(m K)
Expanded polystyrene	0.03
Glass wool	0.04
Rock wool	0.045

Which material listed in **Table 2.2** is the **best thermal insulator**?

.... **[1 mark]**

03.1 Write down what is meant by a **renewable** energy source.

[1 mark]

03.2 Give an example of a renewable energy source that is used to generate electricity.

[1 mark]

03.3 In the UK, a system of cables and transformers links power stations to consumers.

What is the name of this system?

[1 mark]

Question 3 continues on the next page

03.4 In UK homes, cables that connect a mains socket to an appliance contain three wires with different colour schemes.

Draw a line from **each** wire to its colour scheme.

wire	colour scheme
Live	blue
Neutral	Green and yellow stripes
Earth	brown

[2 marks]

03.5 Which wire prevents the appliance from becoming live if there is a fault?

Tick **one** box.

Live ☐

Neutral ☐

Earth ☐

[1 mark]

03.6 The potential difference supplied by the mains in the UK is 230 V

When a toaster is plugged into the mains it draws an electric current of 3.0 A

Use the following equation to calculate the power of the toaster:

power = potential difference × current

Give the correct unit with your answer.

....

Power = ...

Unit: .... **[3 marks]**

04.1 What is the approximate radius of an atom?

Tick **one** box.

1×10^{-2} m ☐

1×10^{-5} m ☐

1×10^{-10} m ☐ **[1 mark]**

04.2 Experiments during the late 19th century and the early 20th century enabled scientists to develop the model of the atom.

They replaced the **plum pudding model** with the **nuclear model**.

Describe the main features of the plum pudding model of the atom.

....

....

.... **[2 marks]**

04.3 Describe the main features of the nuclear model of the atom.

....

....

.... **[2 marks]**

04.4 Further experiments showed that the atomic nucleus consists of two types of particle.

Name the **two** types of particle found in the nucleus.

1. ....

2. .... **[2 marks]**

Turn over >

05 A system is an object or a group of objects.

The way energy is stored in a system can change when the system changes.

05.1 Draw a line from **each** system change to the correct energy store change.

System change	Energy store change
	Gravitational potential energy to kinetic energy
A cup of tea cooling down	Elastic potential energy to thermal energy
A falling football	Thermal energy dissipated to the surroundings
A car braking	Kinetic energy to thermal energy
	Thermal energy to kinetic energy

[3 marks]

05.2 A student attaches a weight to a spring, causing the spring to stretch.

Name the energy store associated with the stretched spring.

.... **[1 mark]**

05.3 The weight extends the spring by 0.12 m

The spring constant of the spring is 25 N/m

Calculate the amount of energy stored in the spring.

Use the following equation.

$$\text{energy stored} = \frac{1}{2} \times \text{spring constant} \times (\text{extension})^2$$

....

....

Energy stored = ... J **[2 marks]**

06.1 A student uses the set-up in **Figure 6.1** to demonstrate the following to her class:

Two objects that carry the same type of charge repel

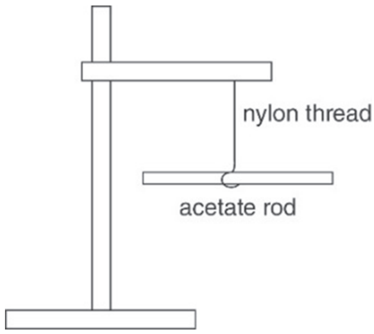
Two objects that carry different types of charge attract

The materials she has are:

- a piece of cloth
- two acetate rods
- two polythene rods

The apparatus that she has allows a rod to be suspended so that it can rotate freely.

Figure 6.1



The student knows that:

- polythene can gain a negative charge, and
- acetate can gain a positive charge.

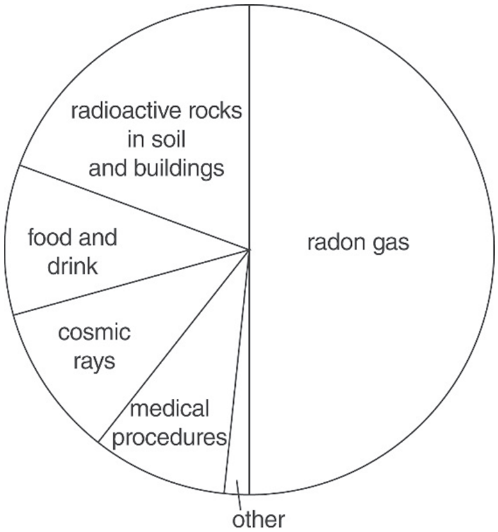
Describe the demonstration that she should carry out.

[4 marks]

Turn over >

07.1 **Figure 7.1** shows the main sources of background radiation at a specific location.

Figure 7.1



Typical contribution of different sources to background radiation

What are the **two largest sources** of background radiation at this location?

1. ....

2. .... **[2 marks]**

07.2 **Table 7.1** contains information about radon gas doses.

Table 7.1

Location	Dose in mSv
Annual average radon dose across the UK	1.3
Annual average radon dose in Cornwall	6.9

[Data from Public Health England]

Calculate **how many times greater** the radon dose is in Cornwall compared with the average dose across the UK.

....

Number of times greater = ... **[1 mark]**

07.3 A nucleus of an isotope of radon, $^{222}_{86}Rn$, undergoes radioactive decay by alpha emission to form a nucleus of polonium, Po.

Complete the nuclear equation showing the decay of radon-222

Add the **two** missing numbers to the equation.

$$^{222}_{86}Rn \rightarrow \, ^{218}_{\dots}Po + \, ^{\dots}_{2}He$$

[2 marks]

07.4 The polonium-218 nucleus undergoes radioactive decay by beta emission.

Complete the nuclear equation showing the decay of polonium-218

Add the **three** missing numbers to the equation.

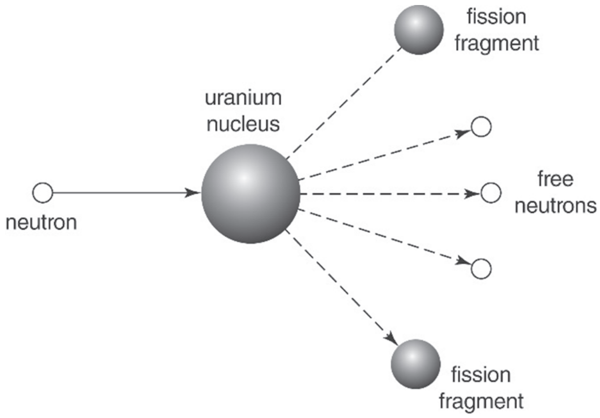
$$^{218}_{84}Po \rightarrow \, ^{\dots}_{\dots}At + \, ^{0}_{\dots}e$$

[3 marks]

Turn over >

08.1 **Figure 8.1** shows a uranium nucleus undergoing fission.

Figure 8.1



Describe what must happen for a chain reaction to start in a sample of uranium.

....

.... **[2 marks]**

08.2 What type of energy store do the products of the fission event have?

Tick **one** box.

Chemical ☐

Kinetic ☐

Sound ☐ **[1 mark]**

08.3 Give an example of where an **uncontrolled** fission chain reaction occurs.

.... **[1 mark]**

08.4 When a uranium nucleus undergoes fission it splits into smaller nuclei called fission fragments (**Figure 8.1**).

The fission fragments are unstable and undergo radioactive decay.

The fission fragments produced in a nuclear reactor form radioactive waste.

Table 8.1 lists some fission fragments and their half-life values.

Table 8.1

Fission fragment	Half-life
Barium-140	12 days
Caesium-137	30 years
Iodine-131	8 days
Krypton-85	11 years
Xenon-140	14 s

Which **two** fission fragments will need to be stored safely for hundreds of years?

1. ....

2. .... **[2 marks]**

08.5 Explain your answer to question 08.4

....

....

.... **[3 marks]**

08.6 **Figure 8.2** shows a proton colliding with a deuteron and creating a nucleus of an isotope of helium.

Figure 8.2

What is the name of the process shown in **Figure 8.2**?

.... **[1 mark]**

Turn over >

09 The specific heat capacity of a material can be measured by heating the material with an electrical heater.

09.1 Explain what is meant by **specific heat capacity**.

[1 mark]

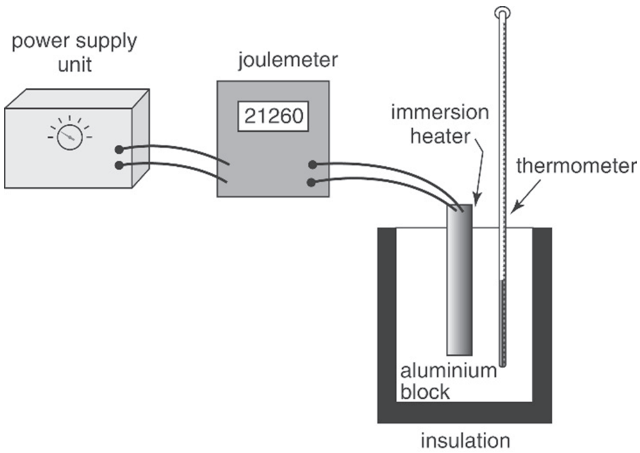
....

....

09.2 **Figure 9.1** shows apparatus used to determine the specific heat capacity of an aluminium block.

The joulemeter shows the amount of electrical energy supplied to the block over a specific amount of time.

Figure 9.1



The temperature of the block needs to be recorded before and after it is heated.

The temperature of the block is expected to rise by approximately 20°C

The room temperature of the laboratory is about 18°C

Table 9.1 lists some thermometers that are available.

Table 9.1

Thermometer	Range in °C	Value of one division in °C
A	–10 to 110	1
B	34 to 44	0.1
C	–10 to 50	0.5
D	–10 to 200	2

Choose the most suitable thermometer for the experiment.

Explain your answer.

Thermometer: ....

....

....

....

.... **[3 marks]**

09.3 Measurements taken using the apparatus in **Figure 9.1** are shown in **Table 9.2**

Table 9.2

Measurement	Value
Initial temperature of the block	18.5°C
Final temperature of the block	41.5°C
Energy supplied	21260 J
Mass of block	1.00 kg

Determine the specific heat capacity of aluminium.

Use the correct equation from the Physics Equation Sheet.

Give your answer to 3 significant figures.

....

....

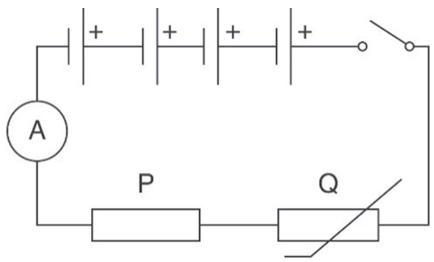
....

Specific heat capacity = ... J/kg °C **[5 marks]**

Turn over >

10.1 Name component **Q** in **Figure 10.1**

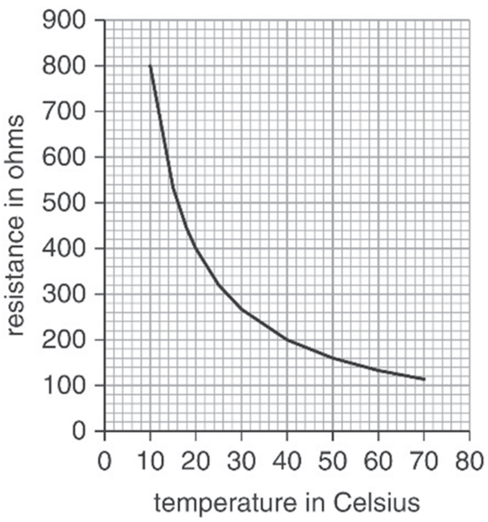
Figure 10.1



.... **[1 mark]**

10.2 **Figure 10.2** shows how the resistance of component **Q** changes as its temperature is changed.

Figure 10.2



Describe the trend shown by **Figure 10.2**

....

.... **[1 mark]**

10.3 Explain how the reading on the ammeter in **Figure 10.1** would change if the temperature of component **Q** increased.

....

....

.... **[2 marks]**

10.4 Use **Figure 10.2** to determine the resistance of component **Q** at temperature of 20°C

Resistance = ... Ω **[1 mark]**

10.5 Component **P** in the circuit of **Figure 10.1** is a fixed resistor of resistance of 800 Ω

Calculate the **total resistance** in the circuit when component **Q** is at 20°C

....

Total resistance = ... Ω **[1 mark]**

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

.... **[1 mark]**

10.7 The battery in **Figure 10.1** supplies a potential difference of 6.0 V

Calculate the current through the ammeter when component **Q** is at 20°C

....

....

Current = ... A **[3 marks]**

10.8 Write down the equation that links power, current and resistance.

.... **[1 mark]**

10.9 Calculate the power transferred by resistor **P**.

Give your answer in milliwatts.

....

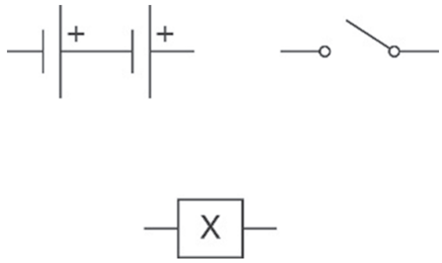
Power = ... mW **[3 marks]**

Turn over >

11 A student sets up a circuit to measure current and potential difference values for an unknown electrical component.

Figure 11.1 shows the component marked with an '**X**'.

Figure 11.1



11.1 A circuit is needed that allows **several different** measurements to be taken of current through **X** and potential difference across **X**.

Complete the circuit diagram in **Figure 11.1** to show a suitable circuit. **[3 marks]**

11.2 Write down the equation that links charge, current and time.

[1 mark]

....

11.3 The student sets up the circuit so that the current is 0.12 A

Calculate the charge that flows through component **X** in 10 s

....

Charge = ... C **[2 marks]**

11.4 Write down the equation that links energy transferred with charge flow and potential difference.

.... **[1 mark]**

11.5 When the current is 0.12 A, the student measures the potential difference across **X** to be 0.60 V

Calculate the energy transferred by component **X** in 10 s

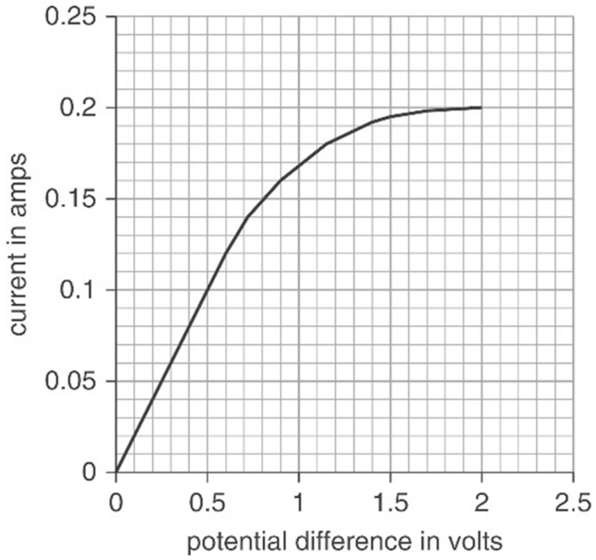
....

....

Energy transferred = ... J **[2 marks]**

11.6 **Figure 11.2** is a graph of the student's current and potential difference measurements for component **X**.

Figure 11.2



Explain how the resistance of the component varies as the potential difference is increased.

....

....

.... **[3 marks]**

Turn over >

12.1 **Table 12.1** shows the density of liquid water and water vapour.

Table 12.1

State of water	Density in g/cm^3
Liquid	0.998
Vapour (steam)	0.590

Explain what can be concluded from **Table 12.1** about the arrangement of molecules in liquid water compared with water vapour.

[3 marks]

12.2 A student is asked to measure the density of cooking oil.

Describe a plan for the student to follow.

Name any apparatus to be used.

[6 marks]

END OF QUESTIONS

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Physics Equation Sheet

Equation Number	Word Equation	Symbol Equation
1	$(\text{final velocity})^2 - (\text{initial velocity})^2 = 2 \times \text{acceleration} \times \text{distance}$	$v^2 - u^2 = 2\,a\,s$
2	elastic potential energy = 0.5 × spring constant × $(\text{extension})^2$	$E_e = \frac{1}{2}\,ke^2$
3	change in thermal energy = mass × specific heat capacity × temperature change	$\Delta E = m\,c\,\Delta\theta$
4	$\text{period} = \frac{1}{\text{frequency}}$	
5	$\text{magnification} = \frac{\text{image height}}{\text{object height}}$	
6	thermal energy for a change of state = mass × specific latent heat	$E = m\,L$
7	potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_p I_p = V_s I_s$
8	For gases: pressure × volume = constant	pV = constant