

Physics
PAPER 2
Foundation Tier

Total Marks

Friday 16 June 2023 – Morning

Time: 1 hour 45 minutes

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Calculator, ruler, Equation Booklet (enclosed)

YOU WILL BE GIVEN

Diagram Booklet, Formulae Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.

Any diagrams may NOT be accurately drawn, unless otherwise indicated.

You must show all your working out with your answer clearly identified at the end of your solution.

Calculators may be used.

INFORMATION

The total mark for this paper is 100.

In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

(continued on the next page)

INFORMATION continued.

A list of equations is included as a separate booklet.

There may be spare copies of some diagrams.

ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ~~☒~~ and then mark your new answer with a cross ☒.

1 This question is about static electricity.

- (a) Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows a plastic comb picking up small pieces of paper.**

**The comb picks up the paper because the comb has extra
(1 mark)**

- ☐ **A magnetism**
- ☐ **B charge**
- ☐ **C resistance**
- ☐ **D weight**

(continued on the next page)

1 continued.

- (b) Look at Figure 2 for Question 1(b) in the Diagram Booklet. It shows a person touching a charged dome.**

The person's hair is standing on end.

- (i) Explain how electric charge causes the hair to spread out, as shown in Figure 2.
(2 marks)**

(continued on the next page)

1(b) continued.

(ii) The person lets go of the charged dome.

The charge on the person's hair is $10\mu\text{C}$.

The charge on the dome is $25\mu\text{C}$.

Calculate the percentage of charge on the hair compared with on the dome.

(2 marks)

Use the equation

$$\text{percentage of charge on the hair} = \frac{\text{charge on hair}}{\text{charge on dome}} \times 100$$

percentage of charge on the hair =

_____ %

1 continued.

- (c) Look at the diagram for Question 1(c) in the Diagram Booklet. Draw ONE straight line from each example of electrostatic charges in action to their descriptions.
(3 marks)**

(Total for Question 1 = 8 marks)

- 2 (a) Look at Figure 3 for Question 2(a) in the Diagram Booklet. It shows the parts in an electrical circuit.**

Draw the circuit diagram of this electrical circuit in the space provided on page 8 of the Diagram Booklet.

The battery symbol and some of the connecting wires have been drawn for you.

(4 marks)

(continued on the next page)

2 continued.

(b) Look at Figure 4 for question 2(b) in the Diagram Booklet. It shows the current flowing into and out of point P in part of a circuit.

**Which of these is the value of current I?
(1 mark)**

☐ **A 2A**

☐ **B 5A**

☐ **C 7A**

☐ **D 9A**

(continued on the next page)

2 continued.

(c) (i) There is a current of 0.46A in a lamp.

Calculate the total charge that flows through the lamp in 30 seconds.

(2 marks)

Use the equation

charge = current \times time in seconds

charge = _____ C

(continued on the next page)

2(c) continued.

(ii) The voltage across the lamp is 6.0 V.

The current in the lamp is 0.46 A.

Calculate the energy transferred to the lamp in one minute.

(2 marks)

Use the equation

energy transferred = current \times voltage \times time in seconds

energy transferred = _____ J

(Total for Question 2 = 9 marks)

- 3 (a) Look at Figure 5 for Question 3(a) in the Diagram Booklet. It shows the apparatus used to investigate the melting of some crushed ice.**
- (i) Suggest ONE safety precaution needed when using the electrical heater.**
(1 mark)

- (ii) Suggest ONE way of heating the crushed ice without using electricity.**
(1 mark)

(continued on the next page)

3 continued.

- (b) Look at Figure 6 for Question 3(b) in the Diagram Booklet. It shows a graph produced from the data collected by the data logger in Figure 5.**

Labels P, Q, R and S have been added.

At the start, P, the beaker contains crushed ice at -8°C .

Describe what happens to the crushed ice during the next 15 minutes.

**You may use labels P, Q, R and S to help your answer.
(3 marks)**

Answer space continues on the next page.

3(b) continued.

(continued on the next page)

3 continued.

- (c) Look at Figure 7 for Question 3(c) in the Diagram Booklet. It shows bubbles of air that a diver breathes out.**

The bubbles rise towards the surface.

- (i) Which row of the table is correct as one bubble rises?
(1 mark)**

	the air pressure in the bubble	the volume of the bubble
<input type="checkbox"/> A	decreases	decreases
<input type="checkbox"/> B	decreases	increases
<input type="checkbox"/> C	increases	decreases
<input type="checkbox"/> D	increases	increases

(continued on the next page)

3(c) continued.

**(ii) Which of these is a unit of pressure?
(1 mark)**

☐ **A g/cm^3**

☐ **B J**

☐ **C kg/cm**

☐ **D Pa**

**(iii) The diver measures air pressure
in atmospheres.**

**A bubble has an initial volume, V_1 ,
of 0.50 litres, at a pressure, P_1 , of
3.30 atmospheres.**

**The bubble rises towards the surface
of the water, where the pressure, P_2 , is
1.07 atmospheres.**

(continued on the next page)

3(c)(iii) continued.

Calculate the volume, V_2 , of the bubble near the surface.

(2 marks)

Use the equation

$$V_2 = \frac{P_1 \times V_1}{P_2}$$

volume, V_2 , of the bubble =

_____ litres

(Total for Question 3 = 9 marks)

4 This question is about magnets and magnetism.

(a) Look at Figure 8 for Question 4(a) in the Diagram Booklet. It shows a magnet that has picked up three paper clips.

(i) The poles of the lowest paper clip are labelled.

Label the poles of the other two paper clips in Figure 8.

(2 marks)

(ii) Complete the sentence, by choosing a word from below, to describe the type of magnetism that these paper clips have.

(1 mark)

alternated

earthed

induced

transformed

These paper clips have

_____ magnetism.

(continued on the next page)

4(a) continued.

- (iii) Suggest a material that these paper clips in Figure 8 could be made from.
(1 mark)**

- (iv) When the paper clips were pulled off the magnet they fell separately to the table.**

**Describe how you could test whether any of the paper clips had kept any magnetism.
(2 marks)**

(continued on the next page)

4 continued.

(b) Look at Figure 9 for Question 4(b) in the Diagram Booklet. It shows the magnetic field around a wire carrying a current.

**(i) State how you can tell from Figure 9 that the strength of the field is greater at P than at Q.
(1 mark)**

(continued on the next page)

4(b) continued.

- (ii) The magnetic field strength is measured at P for different values of current in the wire.**

The results of this investigation are shown in Figure 10 in the Diagram Booklet.

Describe the relationship between magnetic field strength and current.

(2 marks)

(Total for Question 4 = 9 marks)

- 5 Look at Figure 11 for Question 5 in the Diagram Booklet. It shows part of the UK National Grid system for the supply of electricity to homes.**

**(a) Electricity supplied to homes has a frequency of
(1 mark)**

☐ **A 0.02 Hz**

☐ **B 20 Hz**

☐ **C 50 Hz**

☐ **D 500 Hz**

**(b) Explain why the National Grid uses high voltages with small currents to transfer electricity from power stations.
(2 marks)**

5 continued.

(c) Look at Figure 12 for Question 5(c) in the Diagram Booklet. It shows details of a transformer.

**(i) Calculate the power in the primary coil
(2 marks)**

Use the equation

$$\mathbf{P = V \times I}$$

power in the primary coil =

_____ W

(continued on the next page)

5(c) continued.

- (ii) Calculate the following for the transformer in Figure 12.
(2 marks)**

$$\frac{\text{number of turns in secondary coil}}{\text{number of turns in primary coil}}$$

(continued on the next page)

5(c) continued.

**(iii) For the transformer in Figure 12, evaluate, in its simplest form, the ratio
(2 marks)**

secondary voltage : primary voltage

_____ : _____

(Total for Question 5 = 9 marks)

6 This question is about energy transfers.

Look at Figure 13 for Question 6 in the Diagram Booklet. It shows the apparatus used for investigating the transfer between gravitational potential energy and kinetic energy.

A metal ball is attached to a thread.

The ball is released from a starting position and swings on the thread.

The ball cuts a light beam at the bottom of its swing.

When the ball cuts the light beam, the speed of the ball is recorded by the data logger.

The ball was released 3 times from the same height and the speed measured each time.

(continued on the next page)

6 continued.

The measurements of speed are given in Figure 14.

FIGURE 14

speed in m/s	1.31	1.27	1.16
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- (a) Calculate the mean speed.
(2 marks)

mean speed = _____ m/s

6 continued.

(b) Suggest ONE reason why the measurements of speed were repeated.

(1 mark)

(continued on the next page)

6 continued.

(c) The mass of the ball is 0.052 kg.

The ball falls through a vertical height (Δh) of 5.0 cm as it swings.

The gravitational field strength, g , is 10 N/kg.

Calculate the change in the gravitational potential energy of the ball.

(3 marks)

Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

change in gravitational potential energy =

_____ J

(continued on the next page)

Turn over

6 continued.

(d) Look at Figure 15 for Question 6(d) in the Diagram Booklet. It shows an end-on view of the ball's swing from its starting position.

- (i) To measure the change in vertical height, Δh , through which the ball moves, a ruler could be used.**

**Draw a ruler on Figure 15, placed in a position to measure the change in vertical height Δh .
(1 mark)**

(continued on the next page)

6(d) continued.

- (ii) Look at Figure 16 for Question 6(d)(ii) in the Diagram Booklet. It shows a set square.**

Describe how the measurement of the change in vertical height, Δh , could be improved using the set square.

You may add to Figure 15 or Figure 16 to help your description.

(2 marks)

(Total for Question 6 = 9 marks)

7 (a) Which of these is a vector?
(1 mark)

- ☐ **A distance**
- ☐ **B force**
- ☐ **C mass**
- ☐ **D work done**

(b) Look at Figure 17 for Question 7(b) in the Diagram Booklet. It shows a balanced seesaw with two children on it.

The pivot is at the centre of the seesaw.

The seesaw is balanced with no children sitting on it.

Child P has a weight of 150 N.

(continued on the next page)

7(b) continued.

- (i) Calculate the moment of the weight of child P about the pivot in N m.
(2 marks)**

Use the equation

moment of a force = force \times distance to pivot

moment = _____ N m

(continued on the next page)

7(b) continued.

- (ii) Look at Figure 18 for Question 7(b)(ii) in the Diagram Booklet. It shows the same balanced seesaw, with the distance of child Q to the pivot labelled as well.**

**Calculate the value of W , the weight of child Q.
(3 marks)**

**Use the idea of moments and the equation
the moment of W = the moment of the weight of child P**

Give your answer to 2 significant figures.

$W =$ _____ N

(continued on the next page)

7 continued.

***(c) Look at Figure 19 for Question 7(c) in the Diagram Booklet. It shows a crowbar being used to lift a heavy weight.**

Explain how the crowbar enables a person to lift a heavy weight.

You should include the idea of moments in your answer.

**It may help to label some distances in Figure 19 and use those distances in your explanation.
(6 marks)**

Answer space continues on the next page.

Turn over

7(c) continued.

[illegible]

Turn over

7(c) continued.

(Total for Question 7 = 12 marks)

- 8 (a) The voltage (potential difference) across a length of wire is 1.5 V.

A charge of 0.042 C flows through the wire.

Calculate the energy transferred.
(2 marks)

Use the equation

$$E = Q \times V$$

$$E = \underline{\hspace{4cm}} \text{ J}$$

(continued on the next page)

8 continued.

- (b) Look at Figure 20 for Question 8(b) in the Diagram Booklet. It shows some of the apparatus that students use to determine the resistance of a piece of iron wire.**

Add connecting wires, a voltmeter and an ammeter to complete the circuit in Figure 20 so that the students can determine the resistance of the piece of iron wire.

(2 marks)

(continued on the next page)

8 continued.

(c) The students extend the investigation to determine how the resistance of the iron wire changes with its length.

**(i) Give the name of ONE additional piece of apparatus the students would need.
(1 mark)**

(continued on the next page)

8(c) continued.

- (ii) Look at Figure 21 for Question 8(c)(ii) in the Diagram Booklet. It shows a graph of the results.**

**Draw a straight line of best fit on Figure 21.
(1 mark)**

- (iii) Use Figure 21 to estimate the resistance of a 100 cm length of the iron wire.
(1 mark)**

resistance = _____ Ω

(continued on the next page)

8(c) continued.

- (iv) The variable resistor shown in Figure 20 is used to prevent the iron wire from becoming too hot.**

**Explain how the variable resistor is used to prevent the iron wire from becoming too hot.
(2 marks)**

(continued on the next page)

8 continued.

- (d) The potential difference (voltage) across another piece of wire is 1·56 V.**

The current in the wire is 0·45 A.

**Calculate the resistance of this piece of wire.
(2 marks)**

Use the equation

$$\mathbf{V = I \times R}$$

resistance = _____ Ω

(Total for Question 8 = 11 marks)

- 9 (a) Which of these means changing state from solid directly to gas?
(1 mark)

☐ A condensing

☐ B freezing

☐ C melting

☐ D sublimating

(continued on the next page)

9 continued.

- (b) An object has a mass of $7.22 \times 10^{-2} \text{ kg}$ and a volume of $2.69 \times 10^{-5} \text{ m}^3$.**

**Calculate the density, ρ , of the object.
(3 marks)**

Use the equation

$$\rho = \frac{m}{V}$$

State the unit.

density = _____ unit _____

(continued on the next page)

9 continued.

(c) Aluminium has a melting point of 660°C .

The absolute zero of temperature is -273°C .

- (i) Calculate the melting point of aluminium
in kelvin.
(1 mark)**

melting point of aluminium = _____ K

(continued on the next page)

9(c) continued.

- (ii) Describe the motion of particles in liquid aluminium (above 660 °C).
(2 marks)**

(continued on the next page)

9 continued.

***(d) The table shows some properties of two materials used as thermal insulation.**

The higher the R-value, the better the thermal insulating properties of the material.

material	R-value	fire resistance
fibreglass, made from sand	R-3·3	non-flammable
polystyrene, made from petroleum oil	R-4·0	melts at 270 °C and spreads fire very quickly

Assess which of these materials may be the more suitable to use as thermal insulation in a building.

**Your answer should compare the properties of fibreglass and polystyrene given in the table.
(6 marks)**

Answer space continues on the next 2 pages.

9(d) continued.

[illegible]

Turn over

9(d) continued.

(Total for Question 9 = 13 marks)

10 This question is about pressure.

- (a) Look at Figure 22 for Question 10(a) in the Diagram Booklet. It shows windows in an aeroplane.**

The aeroplane is high above the Earth's surface.

The atmospheric pressure outside the aeroplane is 23 000 Pa.

The air pressure inside the aeroplane is 80 000 Pa.

- (i) Calculate the pressure difference between inside and outside of the aeroplane.
(1 mark)**

pressure difference = _____ Pa

10(a) continued.

(ii) The surface area of the window is 0.094 m^2 .

Calculate the size of the force on the window
due to the cabin air pressure of $80\,000 \text{ Pa}$.
(2 marks)

Use the equation

$$P = \frac{F}{A}$$

force = _____ N

(continued on the next page)

10(a) continued.

- (iii) On the same aeroplane, a different window has a smaller surface area.**

**Explain how the force due to the air pressure inside the cabin on the small window differs from the force on the larger window.
(2 marks)**

(continued on the next page)

10(a) continued.

- (iv) Look at Figure 23 for Question 10(a)(iv) in the Diagram Booklet. It shows a cross-section through the aeroplane including one window.**

Draw an arrow on Figure 23 to show the direction of the resultant force due to the air pressure inside the cabin on the window at point X.

(2 marks)

- (b) Look at Figure 24 for Question 10(b) in the Diagram Booklet. It shows the atmospheric pressure at different heights above the Earth's surface.**

- (i) Describe how the atmospheric pressure changes with height above the Earth's surface.**

Use data from Figure 24 to support your answer.

(3 marks)

Answer space continues on the next page.

10(b)(i) continued.

- (ii) Suggest ONE reason why the atmospheric pressure changes with height above the Earth's surface.
(1 mark)**

(Total for Question 10 = 11 marks)

**TOTAL FOR PAPER = 100 MARKS
END OF PAPER**