

Physics
PAPER 2
Foundation Tier

Total Marks

Friday 14 June 2024 – Afternoon

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

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.

Calculators may be used.

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.

INFORMATION

The total mark for this paper is 100.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

(continued on the next page)

Turn over

INFORMATION continued.

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.

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 (a) Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows a circuit containing a battery and FOUR other components.**

**Look at the word list for Question 1(a) in the Diagram Booklet. Label the FOUR components in Figure 1.
(4 marks)**

A _____

B _____

C _____

D _____

(continued on the next page)

1 continued.

(b) The circuit in Figure 1 is switched on.

A charge of 1.2 C leaves the battery in a time of 4.0 s

Calculate the current in the circuit.

Use the equation

$$\text{current} = \frac{\text{charge}}{\text{time}}$$

(2 marks)

current = _____ A

(Total for Question 1 = 6 marks)

- 2 (a) Look at Figure 2 for Question 2(a) in the Diagram Booklet. It shows two gear wheels, **P** and **Q**.

P has 20 teeth.

Q has 10 teeth.

- (i) **P** rotates once.

How many times does **Q** rotate when **P** rotates once?

(1 mark)

- ☐ A 200 times
- ☐ B 20 times
- ☐ C 10 times
- ☐ D 2 times

(continued on the next page)

2(a) continued.

(ii) A third gear wheel is added to the system in Figure 2 so that this third wheel rotates in the opposite direction to Q but at the same speed as Q.

- 1. Draw an X on Figure 2 to show the position of this third gear wheel.**
- 2. State how many teeth this third gear wheel has.
(2 marks)**

number of teeth = _____

(continued on the next page)

2 continued.

- (b) Look at Figure 3 for Question 2(b) in the Diagram Booklet. It shows a 9.0 N force acting on a ruler.**

Calculate the moment of the 9.0 N force about the pivot.

Use the equation

**moment = force \times perpendicular distance of force from pivot
(2 marks)**

moment = _____ Nm

(continued on the next page)

2 continued.

(c) Another ruler is balanced at its midpoint.

Look at Figure 4 for Question 2(c) in the Diagram Booklet. It shows two forces, F and G , acting on this ruler.

The ruler is balanced (in equilibrium).

The moment of force F about the pivot = 2.4 N m

- (i) Use the principle of moments to state the moment of force G about the pivot.
(1 mark)**

moment of force G = _____ N m

(continued on the next page)

2(c) continued.

(ii) Force $F = 8.0 \text{ N}$

The moment of force F about the pivot =
 2.4 Nm

Calculate the distance, d , of force F from
the pivot.

Use the equation

moment = force \times perpendicular distance of
force from pivot
(2 marks)

distance = _____ m

(Total for Question 2 = 8 marks)

3 A student rubs TWO balloons with a dry cloth.

The balloons become positively charged.

**Look at Figure 5 for Question 3 in the Diagram Booklet.
The student hangs the charged balloons using strings,
as shown in Figure 5.**

**(a) Look at the word list for Question 3(a) in the
Diagram Booklet. Use words from the list to
complete the sentences.**

(4 marks)

The balloons have the same charge.

This means that these balloons

_____ each other.

**The charged particles transferred from the balloons
to the cloth are called _____.**

The cloth is left with a _____ charge.

The unit of charge is the _____.

(continued on the next page)

3 continued.

(b) Look at Figure 6 for Question 3(b) in the Diagram Booklet. One of the charged balloons is moved so it nearly touches a wall, as shown in Figure 6.

The balloon then sticks to the wall.

Explain why the balloon sticks to the wall.

**You may add to the diagram to help your answer.
(2 marks)**

(continued on the next page)

3 continued.

- (c) Look at Figure 7 for Question 3(c) in the Diagram Booklet. It shows a positively charged metal sphere above the ground.**

The metal sphere can be discharged by connecting the sphere to the ground with a metal wire.

**Explain how this would discharge the sphere.
(2 marks)**

(Total for Question 3 = 8 marks)

- 4 (a) Look at Figure 8 for Question 4(a) in the Diagram Booklet. It shows the shape of the magnetic field lines around a bar magnet.
- (i) Draw ONE arrow on a magnetic field line in Figure 8 to show the direction of that magnetic field line.
(1 mark)
- (ii) Draw an X on Figure 8 to show where the magnetic field is strongest.
(1 mark)
- (iii) Give a reason why Figure 8 shows the magnetic field is strongest at point X.
(1 mark)

(continued on the next page)

4 continued.

(b) A student places two magnets on a smooth bench.

Look at Figure 9 for Question 4(b) in the Diagram Booklet. The student holds the magnets close to each other, as shown in Figure 9.

(i) Draw some magnetic field lines on Figure 9 to show the shape of the magnetic field BETWEEN the two magnets.

(2 marks)

(ii) The student is holding the two magnets on the smooth bench.

State what would happen if the student let go of one of the magnets.

(1 mark)

(continued on the next page)

4 continued.

- (c) Look at Figure 10 for Question 4(c) in the Diagram Booklet. A student is given two permanent magnets and some paper clips, as shown in Figure 10.**

The paper clips are NOT magnets, but they are made from a magnetic material.

- (i) Which of these is a magnetic material?
(1 mark)**

☐ **A aluminium**

☐ **B iron**

☐ **C plastic**

☐ **D wood**

(continued on the next page)

4(c) continued.

- (ii) Describe how the student could use the paper clips to find out which of the two permanent magnets is the stronger magnet.
(2 marks)**

(Total for Question 4 = 9 marks)

5 (a) Look at Figure 11 for Question 5(a) in the Diagram Booklet. It shows a truck on a horizontal road.

(i) A force of **1200 N** pulls the truck along the road for a distance of **8.0 m**

Calculate the work done by the **1200 N** force.

Use the equation

work done = force \times distance moved in the direction of the force

State the unit of work done.

(3 marks)

work done = _____

unit _____

5(a) continued.

- (ii) At 8.0 m the force is removed and the truck slows down until it stops.**

Describe the energy transfers as the truck slows down.

(2 marks)

(continued on the next page)

5 continued.

(b) A box has a mass of **90 kg**

Which of these is the weight of the box?
(1 mark)

- ☐ A 9 N
- ☐ B 90 N
- ☐ C 900 N
- ☐ D 9000 N

(c) Look at Figure 12 for Question 5(c) in the Diagram Booklet. It shows a truck lifting a different box.

A student calculates the change in gravitational potential energy, ΔGPE , for the box at different heights.

(continued on the next page)

5(c) continued.

- (i) Look at Figure 13 for Question 5(c) in the Diagram Booklet. It shows the results of the student's calculations.**

The student has made one incorrect calculation.

On Figure 13, draw a circle round the ● for this incorrect calculation.

(1 mark)

(continued on the next page)

5(c) continued.

- (ii) The truck lifts the box from the ground to a height of **2.0 m**

This takes a time of **5.0 s**

Using data from the graph in Figure 13,
calculate the power needed to lift the box.
(3 marks)

Use the equation

$$\text{power} = \frac{\Delta \text{GPE}}{\text{time}}$$

power = _____ W

(Total for Question 5 = 10 marks)

Turn over

6 Look at Figure 14 for Question 6 in the Diagram Booklet. It shows a saucepan of milk being heated on an electric cooker.

(a) Look at Figure 15 for Question 6(a) in the Diagram Booklet. It shows a table of data about the milk being heated.

**(i) Using data from the table in Figure 15, calculate the increase in temperature of the milk.
(1 mark)**

increase in temperature = _____ °C

(continued on the next page)

6(a) continued.

- (ii) Using data from the table in Figure 15, calculate the specific heat capacity of the milk.

Use the equation

$$\text{specific heat capacity} = \frac{\text{change in thermal energy}}{\text{mass} \times \text{increase in temperature}}$$

(2 marks)

specific heat capacity = _____ J/kg °C

(continued on the next page)

6 continued.

(b) The cooker supplies **130 000 J** of energy in a time of **87 s**

(i) Calculate the power supplied by the cooker.

Use the equation

$$P = \frac{E}{t}$$

Give your answer to 2 significant figures.
(3 marks)

power = _____ W

(continued on the next page)

Turn over

6(b) continued.

- (ii) The cooker supplies **130 000 J** of energy but only **96 000 J** of this energy is used to heat the milk.

Calculate the efficiency of heating the milk using this cooker.

Use the equation

$$\text{efficiency} = \frac{\text{useful energy transferred}}{\text{total energy supplied}}$$

(2 marks)

efficiency = _____

(continued on the next page)

6 continued.

(c) The wiring for the cooker has safety features.

(i) Which of these wires would help to protect a person from getting an electric shock if a fault developed in the cooker?

(1 mark)

- ☐ **A earth**
- ☐ **B live**
- ☐ **C negative**
- ☐ **D positive**

(continued on the next page)

6(c) continued.

- (ii) Explain how a fuse can prevent overheating of the wiring for the cooker.
(2 marks)**

(Total for Question 6 = 11 marks)

- 7 (a) A technician is investigating the pressure and volume of some gas trapped in a container.**

Look at Figure 16 for Question 7(a) in the Diagram Booklet. It shows the results from the investigation.

Look at Figure 17 for Question 7(a) in the Diagram Booklet. It shows a graph of the results.

- (i) One point has not been plotted on the graph in Figure 17.**

The values for this point are shaded in the results table in Figure 16.

**Plot the missing point on the graph in Figure 17.
(1 mark)**

- (ii) Draw a smooth curve through the points on the graph in Figure 17.
(1 mark)**

(continued on the next page)

7(a) continued.

- (iii) Use the graph in Figure 17 to estimate the volume at a pressure of **120 kPa**
(1 mark)

volume = _____ cm^3

- (iv) The temperature of the gas in the container is **293 K**

Which of these is the same temperature as **293 K**?
(1 mark)

- ☐ A $-20\text{ }^{\circ}\text{C}$
- ☐ B $0\text{ }^{\circ}\text{C}$
- ☐ C $20\text{ }^{\circ}\text{C}$
- ☐ D $273\text{ }^{\circ}\text{C}$

(continued on the next page)

7 continued.

- (b) (i) Look at Figure 18 for Question 7(b)(i) in the Diagram Booklet. It shows a cylinder containing some gas.**

The cylinder of gas warms up and the temperature of the gas increases.

**Complete the following sentence to describe what happens as the gas warms up.
(1 mark)**

Thermal energy transfers to

**_____ energy of the
gas particles.**

(continued on the next page)

7(b) continued.

- (ii) Look at Figure 19a for Question 7(b)(ii) in the Diagram Booklet. It shows a container of gas.

The gas has a pressure of P_1 and volume V_1

Look at Figure 19b for Question 7(b)(ii) in the Diagram Booklet. It shows the same container after the gas has been compressed.

The pressure is now P_2 and the volume is V_2

The temperature of the gas does not change.

Use data from Figure 19a and Figure 19b to calculate the pressure P_2 of the gas in Figure 19b.

Use the equation

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

(2 marks)

$P_2 =$ _____ kPa

7 continued.

- *(c) Some gas is trapped in a container similar to the container in Figure 19a. The gas is compressed at a constant temperature.**

Explain, in terms of gas particles, why the pressure of the gas increases when the volume decreases.

Your answer should refer to

- how the gas particles exert a pressure**
- why the pressure increases when the volume decreases.**

(6 marks)

Answer space continues on the next 2 pages.

Turn over

7(c) continued.

[illegible]

Turn over

7(c) continued.

(Total for Question 7 = 13 marks)

- 8 (a) Look at Figure 20 for Question 8(a) in the Diagram Booklet. It shows a circuit diagram.

The current at **P** is
(1 mark)

☐ A 0.05 A

☐ B 0.10 A

☐ C 0.15 A

☐ D 0.20 A

(continued on the next page)

8 continued.

(b) Some students investigate resistors in parallel.

The students set up a circuit containing FOUR identical resistors.

Look at Figure 21 for Question 8(b) in the Diagram Booklet. It shows the circuit used.

The students measure the current from the power supply and the voltage (p.d.) across the resistors.

**(i) On Figure 21 for Question 8(b) in the Diagram Booklet, draw a voltmeter connected to measure the voltage (p.d.) across the resistors.
(1 mark)**

The students remove one resistor and measure the current and voltage again with only 3 resistors in the circuit.

They repeat the measurements of current and voltage with only 2 resistors in the circuit and then with only 1 resistor in the circuit.

(continued on the next page)

8(b) continued.

- (ii) Look at Figure 22 for Question 8(b) in the Diagram Booklet. It shows a table of their results.

Using data from the table in Figure 22, predict the current from the power supply when there are 4 resistors in the circuit.

(1 mark)

current = _____ mA

- (iii) Look again at Figure 22 for Question 8(b) in the Diagram Booklet. Using data from the table in Figure 22, calculate the resistance of ONLY 1 resistor.
(3 marks)

resistance = _____ Ω

8(b) continued.

- (iv) Look again at Figure 22 for Question 8(b) in the Diagram Booklet. Using data from the table in Figure 22, explain what happens to the **total resistance of the circuit** as the number of resistors in parallel decreases.
(3 marks)

(continued on the next page)

8 continued.

- (c) An electric fire is connected to a **230 V** mains supply.

A current of **9.0 A** is supplied to the fire.

Calculate the power supplied to the fire.

Use the equation

power = current \times voltage
(2 marks)

power = _____ W

(Total for Question 8 = 11 marks)

- 9 (a) A coil of copper wire has a mass of **14.1 g**

The density, ρ , of copper is **8.96 g/cm³**

Calculate the volume of the copper wire.

Use the equation

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

(3 marks)

volume = _____ cm³

(continued on the next page)

9 continued.

- (b) Look at Figure 23 for Question 9(b) in the Diagram Booklet. It gives information about the density of aluminium.**

Explain the difference between the density of solid aluminium and the density of liquid aluminium in terms of the arrangement of particles.

(2 marks)

(continued on the next page)

9 continued.

(c) A student boils some water.

Calculate the amount of thermal energy needed to change **60.0 g** of water to steam at its boiling point.

The specific latent heat of vaporisation of water, **L**, is **$2.26 \times 10^6 \text{ J/kg}$**

Use the equation

$$Q = m \times L$$

(2 marks)

amount of thermal energy = _____ J

(continued on the next page)

9 continued.

***(d) A student is investigating the melting of ice.**

The student has some crushed ice in a beaker at a temperature of -20°C

The student heats the beaker and its contents for 20 minutes.

Look at Figure 24 for Question 9(d) in the Diagram Booklet. It shows a graph of the student's results.

Using information from the graph, describe the changes that take place in the 20 minutes shown on the graph.

Your answer should refer to

- **data from the graph**
 - **the state (solid, liquid or gas) of the contents of the beaker.**
- (6 marks)**

Answer space continues on the next 2 pages.

Turn over

9(d) continued.

[illegible]

Turn over

9(d) continued.

(Total for Question 9 = 13 marks)

- 10 (a) Look at Figure 25 for Question 10(a) in the Diagram Booklet. It shows an object at the bottom of a beaker of water.**

Look at the diagrams for Question 10(a) in the Diagram Booklet. Which diagram shows the direction of the force exerted by the water on the object at point X?

(1 mark)

- ☐ **Diagram A**
- ☐ **Diagram B**
- ☐ **Diagram C**
- ☐ **Diagram D**

(continued on the next page)

10 continued.

- (b) Look at Figure 26 for Question 10(b) in the Diagram Booklet. It shows an ice skater standing on one skate.**

Calculate the force the skate exerts on the ice.

pressure of skate on ice = 4.8×10^7 Pa

area of blade in contact with ice = 1.2×10^{-5} m²

Use the equation

force = pressure \times area

Give your answer to 2 significant figures.

(3 marks)

force = _____ N

10 continued.

(c) Look at Figure 27 for Question 10(c) in the Diagram Booklet. It shows how atmospheric pressure changes with height above sea level.

**(i) Using the graph, describe how atmospheric pressure changes with height above sea level.
(2 marks)**

(continued on the next page)

10(c) continued.

- (ii) The top of Mount Everest is **8850 m** above sea level.

Using the graph, estimate the atmospheric pressure at the top of Mount Everest.

(1 mark)

pressure = _____ kPa

- (iii) On a different day, the pressure at sea level is **104 kPa** and the pressure at a height of **2500 m** is **74 kPa**

Calculate the percentage change in pressure from sea level to the height of **2500 m**

(2 marks)

percentage change = _____ %

(continued on the next page)

Turn over

10 continued.

- (d) Look at Figure 28 for Question 10(d) in the Diagram Booklet. It shows a model representing molecules of the Earth's atmosphere.**

Use Figure 28 to explain how the density of the air varies with height above sea level.

(2 marks)

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS
END OF PAPER