

Physics  
PAPER 2  
Foundation Tier

Total Marks
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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.**

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**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)**

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- 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  $9.0\text{ N}$  force acting on a ruler.**

**Calculate the moment of the  $9.0\text{ N}$  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 =  $2.4 \text{ Nm}$**

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

**moment of force  $G$  = \_\_\_\_\_  $\text{Nm}$**

**(continued on the next page)**

**2(c) continued.**

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

**The moment of force  $F$  about the pivot =  
 $2.4 \text{ Nm}$**

**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)**

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**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)**

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**(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)**

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**(Total for Question 3 = 8 marks)**

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**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)**

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**(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)**

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**(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)**

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**(Total for Question 4 = 9 marks)**

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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)**

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**(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,  $\Delta\text{GPE}$ , 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  $2.0\text{ m}$**

**This takes a time of  $5.0\text{ s}$**

**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)**

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**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)**

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**(Total for Question 6 = 11 marks)**

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- 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 = \_\_\_\_\_  $\text{cm}^3$

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

(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.**

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**Turn over**

**7(c) continued.**

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**Turn over**

**7(c) continued.**

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**(Total for Question 7 = 13 marks)**

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- 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 = \_\_\_\_\_  $\Omega$

**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)**

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**(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)**

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

The density,  $\rho$ , of copper is **8.96 g/cm<sup>3</sup>**

Calculate the volume of the copper wire.

Use the equation

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

(3 marks)

volume = \_\_\_\_\_ cm<sup>3</sup>

(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)**

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**(continued on the next page)**

**9 continued.**

**(c) A student boils some water.**

**Calculate the amount of thermal energy needed to change  $60.0\text{ g}$  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  $-20^{\circ}\text{C}$**

**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.**

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**Turn over**

**9(d) continued.**

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**Turn over**

**9(d) continued.**

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**(Total for Question 9 = 13 marks)**

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- 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 =  $4.8 \times 10^7$  Pa**

**area of blade in contact with ice =  $1.2 \times 10^{-5}$  m<sup>2</sup>**

**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)**

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**(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)**

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**(Total for Question 10 = 11 marks)**

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