

Physics  
PAPER 1  
Foundation Tier

Total Marks
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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**

## **YOU WILL BE GIVEN**

**Diagram Booklet, Additional Equations Insert**

## **INSTRUCTIONS**

**Answer ALL questions.**

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

## **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.**

**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.**

**Lists of equations are provided as a separate booklet and as an additional insert.**

**There may be spare copies of some diagrams.**

**Turn over**

**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 how the visible spectrum of white light is shown on a screen.

(i) Which of these is the best piece of equipment to produce the white light?  
(1 mark)

☐ A ray box

☐ B ruler

☐ C measuring cylinder

☐ D ammeter

(continued on the next page)

**1 continued.**

**(ii) Which colour is seen between yellow and blue in the spectrum on the screen?**  
**(1 mark)**

☐ **A red**

☐ **B orange**

☐ **C green**

☐ **D violet**

**(continued on the next page)**

**1 continued.**

- (b) Look at FIGURE 2 for Question 1(b) in the Diagram Booklet. It shows the main parts of the electromagnetic spectrum.**

**Complete the following sentences using information from Figure 2. Each part of the electromagnetic spectrum may be used once, more than once or not at all.**

- (i) The part of the electromagnetic spectrum used to detect broken bones is  
(1 mark)**
- 

- (ii) The part of the electromagnetic spectrum used in thermal imaging is  
(1 mark)**
- 

**(continued on the next page)**

**1 continued.**

**(iii) The part of the electromagnetic spectrum that**

- **is used to cook food**

**AND**

- **has a shorter wavelength than microwaves is**  
**(1 mark)**
- 

**(iv) The part of the electromagnetic spectrum that**

- **is used to sterilise medical equipment**

**AND**

- **has a shorter wavelength than x-rays is**  
**(1 mark)**
- 

**(Total for Question 1 = 6 marks)**

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**2 This question is about waves.**

**(a) Look at FIGURE 3 for Question 2(a) in the Diagram Booklet. It is a diagram of a WATER WAVE in a ripple tank.**

**(i) State the number of crests of the wave between P and Q.  
(1 mark)**

**number of crests = \_\_\_\_\_**

**(continued on the next page)**

**2 continued.**

**(ii) The distance between P and Q is 42 cm.**

**Calculate the wavelength of the water wave  
in Figure 3.  
(2 marks)**

**wavelength = \_\_\_\_\_ cm**

**(continued on the next page)**

**2 continued.**

**(iii) Describe how a student could determine the wave speed of the water wave in Figure 3.  
(3 marks)**

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**(continued on the next page)**

2 continued.

- (b) (i) Which row of the table is correct for **SOUND WAVES**?  
(1 mark)

	sound waves are	can sound waves transfer energy?
<input type="checkbox"/> A	longitudinal	yes
<input type="checkbox"/> B	longitudinal	no
<input type="checkbox"/> C	transverse	yes
<input type="checkbox"/> D	transverse	no

(continued on the next page)

**2 continued.**

- (ii) A sound wave has a frequency of 440 Hz and a wavelength of 0.75 m.**

**Calculate the wave speed of the sound wave.  
(2 marks)**

**wave speed = \_\_\_\_\_ m/s**

**(Total for Question 2 = 9 marks)**

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**3 This question is about reflection and refraction of light.**

- (a) (i) Look at FIGURE 4 for Question 3(a)(i) in the Diagram Booklet. It shows a ray of light travelling to a plane mirror.**

**On Figure 4, draw the ray of light after it REFLECTS off the mirror surface.  
(2 marks)**

- (ii) Look at FIGURE 5 for Question 3(a)(ii) in the Diagram Booklet. It shows a ray of light in air travelling to a glass block.**

**On Figure 5, draw the ray of light after it REFRACTS at the surface of the glass block.  
(2 marks)**

- (iii) Look at FIGURE 6 for Question 3(a)(iii) in the Diagram Booklet. It shows a ray of light in water, travelling to the surface of the water.**

**The angle marked X is greater than the critical angle.**

**On Figure 6, draw the ray of light after it reaches the surface of the water.  
(2 marks)**

**(continued on the next page)**

**Turn over**

**3 continued.**

**(b) A converging lens has a focal length of 40 cm.**

**Calculate the power of this lens in dioptres.  
(3 marks)**

**Use the equation**

$$\text{power in dioptres} = \frac{1}{\text{focal length IN METRES}}$$

**power of the lens = \_\_\_\_\_ diptres**

**(Total for Question 3 = 9 marks)**

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- 4 (a) Look at FIGURE 7 for Question 4(a) in the Diagram Booklet. It shows a truck lifting a box.

The box has a mass of 57 kg.

The truck lifts the box through a vertical height of 2.1 m.

The gravitational field strength,  $g = 10 \text{ N/kg}$

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

(2 marks)

Use the equation

$$\Delta \text{GPE} = m \times g \times \Delta h$$

change in gravitational potential energy =

\_\_\_\_\_ J

(continued on the next page)

Turn over

**4 continued.**

- (b) A cyclist of mass 70 kg travels at a constant velocity of 8 m/s.**

**Calculate the kinetic energy of the cyclist.  
(3 marks)**

**kinetic energy of the cyclist = \_\_\_\_\_ J**

**(continued on the next page)**

**4 continued.**

- (c) Look at FIGURE 8 for Question 4(c) in the Diagram Booklet. It shows a trolley at the top of a slope.**

**A student gently pushes the trolley until it just starts to roll down the slope.**

**The student measures the time it takes for the trolley to roll down the slope.**

**The student repeats this for different values of the angle  $\alpha$ .**

**Look at FIGURE 9 for Question 4(c)(i) in the Diagram Booklet. It is a graph of the student's results.**

- (i) Use the graph in Figure 9 to find the time the trolley takes to roll down the ramp when the angle  $\alpha = 45^\circ$ .  
(1 mark)**

**time = \_\_\_\_\_ s**

**(continued on the next page)**

**Turn over**

**4 continued.**

- (ii) Use the graph in Figure 9 to estimate the time the trolley takes to roll down the ramp when the angle  $\alpha = 80^\circ$ .**

**Show your working on the graph.  
(2 marks)**

**time = \_\_\_\_\_ s**

**(continued on the next page)**

**4 continued.**

**(iii) The student had a choice of how to measure the time the trolley takes to roll down the ramp.**

- 1. Use a hand-held stopwatch.**
- 2. Use light gates at the top and bottom of the slope.**

**The student chose to use the light gates.**

**Explain why this was the correct choice.**

**You should refer to the data on the time axis of Figure 9 in your answer.  
(2 marks)**

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**(Total for Question 4 = 10 marks)**

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**Turn over**

**5 This question is about stars.**

**(a) Use words from the list below to complete the following sentences.**

**black hole**

**main sequence**

**nebula**

**red giant**

**white dwarf**

**(i) Stars of similar mass to our Sun were formed from a cloud of gas and dust called a**

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**(1 mark)**

**(ii) Our Sun is a**

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**star.**

**(1 mark)**

**(continued on the next page)**

**5 continued.**

**(b) (i) Which will be the next stage in the evolution of our Sun?  
(1 mark)**

- ☐ **A red dwarf**
- ☐ **B red giant**
- ☐ **C white dwarf**
- ☐ **D white giant**

**(continued on the next page)**

**5 continued.**

**(ii) The core of a star with a much bigger mass than our Sun is most likely to end as a  
(1 mark)**

☐ **A white dwarf**

☐ **B red giant**

☐ **C protostar**

☐ **D black hole**

**(continued on the next page)**

**5 continued.**

**(c) A nuclear fusion reaction is happening in our Sun.**

**The nuclear fusion reaction produces helium and radiates energy.**

**(i) State ONE of the conditions necessary for this nuclear fusion reaction to start.  
(1 mark)**

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**(continued on the next page)**

**5 continued.**

- (ii) Describe what happens in this nuclear fusion reaction.  
(2 marks)**

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**(continued on the next page)**

**5 continued.**

**(iii) The intensity of the Sun's radiation in  $\text{W/m}^2$  on the surface of Earth is  $1.32 \times 10^3$ .**

**The intensity of the Sun's radiation in  $\text{W/m}^2$  on the surface of Mars is  $4.92 \times 10^2$ .**

**Calculate the ratio**

**intensity of the Sun's radiation on the surface of Earth  
intensity of the Sun's radiation on the surface of Mars**

**(2 marks)**

**ratio = \_\_\_\_\_**

**(Total for Question 5 = 9 marks)**

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**Turn over**

- 6 (a) (i) State ONE way that radioactivity can be dangerous to humans.  
(1 mark)**

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- (ii) State ONE piece of equipment that can be used to measure radioactivity.  
(1 mark)**

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**(continued on the next page)**

**6 continued.**

**(iii) Alpha ( $\alpha$ ) radiation and ultraviolet (UV) radiation are ionising radiations.**

**Give TWO other ionising radiations.  
(2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**6 continued.**

**(b) Sulfur-35 is a radioactive isotope of sulfur.**

**Look at FIGURE 11 for Question 6(b) in the Diagram Booklet. It represents a nucleus of sulfur-35.**

**Draw one line from each type of particle to the number of that type of particle in a nucleus of sulfur-35.**

**(3 marks)**

**(continued on the next page)**

**6 continued.**

- (c) A sample of a radioactive isotope has a mass of 520 g.**

**The half-life of the radioactive isotope is 18 days.**

- (i) Calculate the mass of the original radioactive isotope remaining after 18 days.  
(1 mark)**

**mass after 18 days \_\_\_\_\_g**

**(continued on the next page)**

**6 continued.**

- (ii) Calculate the mass of the original radioactive isotope remaining after 54 days.  
(2 marks)**

**mass after 54 days \_\_\_\_\_g**

**(Total for Question 6 = 10 marks)**

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7 (a) A rock on the surface of the Earth has a mass of 12 kg.

(i) Calculate the weight of this rock on the surface of the Earth.

The gravitational field strength on the surface of the Earth is 10 N/kg.  
(2 marks)

Use the equation

$$W = m \times g$$

weight on the Earth = \_\_\_\_\_ N

(continued on the next page)

**7 continued.**

- (ii) The weight of the same rock on the surface of the Moon is 20 N.**

**Calculate the gravitational field strength on the surface of the Moon.**

**(3 marks)**

**gravitational field strength on the Moon**

**\_\_\_\_\_ N/kg**

**(continued on the next page)**

**7 continued.**

- \*(b) Describe the Solar System in terms of the Sun, the planets, and the other objects which move in the Solar System.**

**Your answer should include the patterns of movement of the planets and the other objects in the Solar System.**

**You may draw a labelled diagram if it helps your answer.**

**(6 marks)**

**7 continued.**

[illegible]

**(continued on the next page)**

**Turn over**

**7 continued.**

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**(Total for Question 7 = 11 marks)**

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- 8 (a) Which statement describes conservation of energy in a closed system?  
(1 mark)

- ☐ A when there are energy transfers, the total energy reduces
- ☐ B when there are energy transfers, the total energy does not change
- ☐ C when there are no energy transfers, the total energy reduces
- ☐ D when there are no energy transfers, the total energy increases

(continued on the next page)

**8 continued.**

**(b) Look at FIGURE 12 for Question 8(b) in the Diagram Booklet.**

**A student uses the apparatus in Figure 12 to find out which of two materials, sand or sawdust, is the better insulator.**

**The student also has a kettle to boil water, a thermometer and a stop clock.**

- (i) On page 39 draw a labelled diagram to show how the student should set up the equipment to investigate which material is the better insulator.  
(3 marks)**

**(continued on the next page)**

8 continued.

(continued on the next page)

Turn over

**8 continued.**

**(ii) Give THREE factors that the student must control in this investigation.  
(3 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**3** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**8 continued.**

- (c) Expanded polystyrene, used to insulate buildings, has different densities.**

**Look at FIGURE 13 for Question 8(c) in the Diagram Booklet. It shows how the thermal conductivity of expanded polystyrene changes with the density of expanded polystyrene.**

**Using the graph in Figure 13, describe how the thermal conductivity of expanded polystyrene changes with the density of expanded polystyrene.  
(2 marks)**

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**8 continued.**

**(d) Look at FIGURE 14 for Question 8(d) in the Diagram Booklet. It is an energy diagram for an electric kettle, used to heat water.**

**(i) Calculate the amount of energy lost to the surroundings in one second.  
(1 mark)**

**energy lost to the surroundings in one second =**

**\_\_\_\_\_ J**

**(continued on the next page)**

8 continued.

- (ii) Calculate the efficiency of the kettle.  
(2 marks)

Use the equation

$$\text{efficiency} = \frac{\text{useful energy transferred by the kettle in one second}}{\text{total energy supplied to the kettle in one second}}$$

efficiency = \_\_\_\_\_

(Total for Question 8 = 12 marks)

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- 9 (a) Look at FIGURE 15 for Question 9(a) in the Diagram Booklet. It is a speed limit sign from a European motorway.**

**The speeds shown are in km/h  
(kilometres per hour).**

- (i) The sign tells drivers to drive at a slower speed in wet weather.**

**Explain why it is safer for drivers to drive at a slower speed in wet weather.  
(2 marks)**

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**(continued on the next page)**

**9 continued.**

- (ii) Show that a speed of 31 m/s is less than a speed of 130 km/h.  
(2 marks)**

**(continued on the next page)**

**9 continued.**

- (iii) The driver's reaction time is the time between the driver seeing an emergency and starting to brake.**

**A car is travelling at a speed of 31 m/s.**

**The car travels 46 m between the driver seeing an emergency and starting to brake.**

**Calculate the driver's reaction time.**

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

**driver's reaction time = \_\_\_\_\_ s**

**(continued on the next page)**

**Turn over**

**9 continued.**

**\*(b) Look at FIGURE 16 for Question 9(b) in the Diagram Booklet. It is a velocity/time graph for a toy train on a straight track for 7 seconds.**

**Using information from the graph, describe when and how the velocity and acceleration of the toy train change at different times during the 7 seconds shown on the graph.**

**(6 marks)**

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**(continued on the next page)**

**Turn over**

**9 continued.**

[illegible]

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

- 10 (a) Radioactive tracers can be used when scanning a person's kidneys.**

**A radioactive isotope is injected into a person's blood stream.**

**The isotope emits radiation.**

**As the blood flows through the kidneys, this radiation is detected outside the body by a scanner.**

- (i) What type of radiation travels from the kidney to the scanner?  
(1 mark)**

- ☐ **A alpha**
- ☐ **B beta plus**
- ☐ **C beta minus**
- ☐ **D gamma**

**(continued on the next page)**

**10 continued.**

- (ii) During the scan, a technician needs to take readings for about 30 minutes.**

**The half-life of the isotope used is about 6 hours.**

- 1. State why an isotope with a half-life of about 6 minutes is NOT suitable.  
(1 mark)**

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- 2. State why an isotope with a half-life of about 6 days is NOT suitable.  
(1 mark)**

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**(continued on the next page)**

**10 continued.**

**(iii) State TWO ways of reducing the radiation risks to the technician.  
(2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**10 continued.**

**(b) Look at FIGURE 17 for Question 10(b) in the Diagram Booklet. It is a diagram of a nuclear reactor.**

- (i) Explain how pushing the control rods further into the reactor slows down the nuclear chain reaction.  
(2 marks)**

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**(continued on the next page)**

**10 continued.**

- (ii) The moderator in a nuclear reactor slows down the neutrons so that the neutrons are more likely to start other fission reactions.**

**In a nuclear reactor,**

- the average speed of the fast neutrons is  $3.0 \times 10^7 \text{ m/s}$**
- the average speed of the slow neutrons is  $4.0 \times 10^3 \text{ m/s}$**

**Calculate the average speed of the slow neutrons as a percentage of the average speed of the fast neutrons.**

**(2 marks)**

\_\_\_\_\_ %

**(continued on the next page)**

**10 continued.**

**(iii) The nuclear reaction is the first stage in the process of generating electricity.**

**Describe how energy is transferred from the nuclear reaction to the next stage in the process.**

**(2 marks)**

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

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