

Physics
PAPER 1
Foundation Tier

Total Marks

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.

(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.

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

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 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)**

(continued on the next page)

Turn over

1 continued.

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

(iii) The part of the electromagnetic spectrum that

- is used to cook food**

AND

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

(continued on the next page)

Turn over

1 continued.

(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)

Turn over

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)

Turn over

2 continued.

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

(continued on the next page)

Turn over

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)

Turn over

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)

Turn over

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)**

(continued on the next page)

3 continued.

(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)

3 continued.

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

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

Use the equation

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

(begin your answer on the next page)

3 continued.

power of the lens =

_____ diptres

(Total for Question 3 = 9 marks)

Turn over

- 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

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

(begin your answer on the next page)

4 continued.

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)

Turn over

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 α .

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

(continued on the next page)

4 continued.

- (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)

Turn over

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)**

(begin your answer on the next page)

Turn over

4 continued.

(Total for Question 4 = 10 marks)

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**

(1 mark)

(ii) Our Sun is a

star.

(1 mark)

(continued on the next page)

Turn over

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)

Turn over

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)

Turn over

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)**

(continued on the next page)

5 continued.

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

(continued on the next page)

5 continued.

(iii) The intensity of the Sun's radiation in W/m^2 on the surface of Earth is 1.32×10^3 .

The intensity of the Sun's radiation in W/m^2 on the surface of Mars is 4.92×10^2 .

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)

(begin your answer on the next page)

Turn over

5 continued.

ratio = _____

(Total for Question 5 = 9 marks)

Turn over

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

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

(continued on the next page)

6 continued.

**(iii) Alpha (α) radiation and
ultraviolet (UV) radiation are
ionising radiations.**

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

1 _____

2 _____

(continued on the next page)

Turn over

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)

Turn over

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)

Turn over

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)

Turn over

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)

Turn over

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)**

(begin your answer on the next page)

Turn over

7 continued.

(continued on the next page)

Turn over

7 continued.

(continued on the next page)

7 continued.

(Total for Question 7 = 11 marks)

**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 49 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)

Turn over

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)**

(continued on the next page)

Turn over

8 continued.

(continued on the next page)

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)

Turn over

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)

Turn over

- 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)

(continued on the next page)

Turn over

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)

Turn over

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)**

(begin your answer on the next page)

Turn over

9 continued.

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)**

(continued on the next page)

Turn over

9 continued.

(continued on the next page)

9 continued.

(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)

Turn over

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)**

(continued on the next page)

10 continued.

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

(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)

Turn over

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)**

(continued on the next page)

Turn over

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)**

(begin your answer on the next page)

10 continued.

_____ %

(continued on the next page)

Turn over

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)

(continued on the next page)

Turn over

10 continued.

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS
END OF PAPER