

Physics
PAPER 2
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 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.

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.

A list of equations is included as a separate booklet and 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 This question is about electrical circuits.

**(a) Look at the diagram for Question 1(a) in the Diagram Booklet. Draw ONE straight line from each circuit symbol to its description.
(3 marks)**

(b) Look at Figure 1 for Question 1(b) in the Diagram Booklet. It shows a lamp in a circuit.

The lamp is switched on.

**(i) The current in the lamp is a flow of
(1 mark)**

☐ **A atoms**

☐ **B electrons**

☐ **C neutrons**

☐ **D protons**

(continued on the next page)

1 continued.

(ii) The current in the lamp is 0.21 A.

Calculate the charge that flows through the lamp in a time of 300 s.

**State the unit of charge.
(3 marks)**

Use the equation

charge = current \times time

charge = _____ unit _____

(Total for Question 1 = 7 marks)

- 2 (a) Look at Figure 2 for Question 2(a) in the Diagram Booklet. It shows four items of equipment that can be used in investigations.**

**In which of these does a force cause rotation?
(1 mark)**

(continued on the next page)

2 continued.

(b) Look at Figure 3 for Question 2(b) in the Diagram Booklet. It shows a force, F , acting on a ruler.

The ruler has a pivot at one end.

Calculate the moment of the force, F , around the pivot.

**Give your answer in units of Nm.
(2 marks)**

Use the equation

moment of a force = force \times distance from pivot

moment = _____ Nm

2 continued.

(c) A 20 cm ruler has a pivot at its centre.

The ruler is balanced when no forces act on the ruler.

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

Use the principle of moments to show that the ruler in Figure 4 is balanced.

(2 marks)

(continued on the next page)

2 continued.

- (d) Look at Figure 5 for Question 2(d) in the Diagram Booklet. It shows an arrangement of three gears, P, Q and R.**

P and R have the same number of teeth.

P rotates in the direction shown.

State how the speed AND direction of rotation of R compare with the speed and direction of rotation of P.

(2 marks)

speed

direction

(Total for Question 2 = 7 marks)

Turn over

- 3 (a) Look at Figure 6 for Question 3(a) in the Diagram Booklet. It shows helium gas inside a container.**
- (i) Draw an arrow on Figure 6 to show the direction of the force due to the helium gas, at the point labelled X.**
(1 mark)
- (ii) Explain, in terms of particles, why the helium gas exerts a force on the sides of the container.**
(2 marks)

(continued on the next page)

3 continued.

- (b) The container of helium is moved from a cold room to a warmer room.**

State the effect of an increase in temperature on the helium gas particles inside the container.

(1 mark)

(continued on the next page)

3 continued.

- (c) A fixed mass of helium gas is compressed into a container, with no change in temperature.**

Look at the table in Figure 7 for Question 3(c) in the Diagram Booklet. It shows the pressure P_1 and volume V_1 before the gas is compressed, and the volume V_2 after the gas is compressed.

- (i) Calculate the pressure P_2 after the gas is compressed.
(2 marks)**

Use the equation

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

pressure $P_2 =$ _____ kPa

(continued on the next page)

Turn over

3 continued.

(ii) A shop sells a container of helium gas.

The container of helium gas can be used to fill party balloons.

A filled party balloon has a volume of 0.07 m^3 at a pressure of 105 kPa .

The shop claims that you can fill at least 30 party balloons using the gas from the container.

Comment on the shop's claim.

**Use information about the volume of the gas at a pressure of 105 kPa as shown in the table in Figure 7 in the Diagram Booklet.
(3 marks)**

(continued on the next page)

Turn over

3 continued.

(Total for Question 3 = 9 marks)

- 4 (a) Look at Figure 9 for Question 4(a) in the Diagram Booklet. A teacher prepares some equipment to demonstrate electromagnetism. Figure 9 shows the equipment.

The teacher wants to show that iron filings

- are picked up by the metal rod when the switch is closed
- fall off the metal rod when the switch is opened again.

- (i) Suggest a suitable metal for the rod.
(1 mark)

(continued on the next page)

4 continued.

**(ii) Give TWO reasons for your choice.
(2 marks)**

1 _____

2 _____

(continued on the next page)

4 continued.

- (b) A student's mobile phone has an app to measure a magnetic field.**

The student places the phone on a table and rotates the phone until it is pointing north.

There are no magnets near to the phone.

Look at Figure 10 for Question 4(b)(i) in the Diagram Booklet. It shows the display on the screen of the phone.

- (i) State why the strength of the magnetic field shown is not zero.
(1 mark)**

(continued on the next page)

4 continued.

The student places a magnet near to the phone on the table.

Look at Figure 11 for Question 4(b)(ii) in the Diagram Booklet. It shows the magnet and the new display on the screen.

- (ii) State TWO changes in the magnetic field measured by the phone from Figure 10 to Figure 11.
(2 marks)**

1 _____

2 _____

(continued on the next page)

4 continued.

- (iii) Describe how the student could use the mobile phone to investigate the strength of the magnetic field at different distances from the magnet.
(3 marks)**

(Total for Question 4 = 9 marks)

- 5 (a) An electric water pump is powered by the 230 V mains supply.

Look at Figure 12 for Question 5(a) in the Diagram Booklet. It shows the inside of the plug on the cable to the pump.

- (i) One wire in the plug is the earth wire.

The other two wires are
(1 mark)

- ☐ A live and negative
- ☐ B live and neutral
- ☐ C positive and negative
- ☐ D positive and neutral

(continued on the next page)

5 continued.

- (ii) Describe the purpose of the component labelled X.
(2 marks)**

(continued on the next page)

5 continued.

- (b) The 230 V mains supply transfers 9000 J of energy to the pump motor in 1 minute.**

**Calculate the current in the pump motor.
(3 marks)**

Use the equation

$$I = \frac{E}{V \times t}$$

current = _____ A

(continued on the next page)

5 continued.

- (c) The system transfers 8400 J of useful kinetic energy to the water passing through the pump in 1 minute.**

Look at Figure 13 for Question 5(c) in the Diagram Booklet. It shows a diagram of the energy transfers.

- (i) Explain why the useful energy transferred to the water is different from the total energy supplied to the pump.
(2 marks)**

(continued on the next page)

5 continued.

- (ii) Calculate the efficiency of the pump.
(2 marks)**

Use the equation

$$\text{efficiency} = \frac{\text{useful energy transferred by the pump}}{\text{total energy supplied to the pump}}$$

efficiency = _____

(Total for Question 5 = 10 marks)

6 Three students carry out an investigation to determine their powers when running up stairs.

(a) Look at Figure 14 for Question 6(a) in the Diagram Booklet. It shows a diagram of the stairs with four distances, A, B, C and D, marked.

The students need to calculate the work done against gravity.

**Which distance should be used in the calculation?
(1 mark)**

☐ **A Distance A**

☐ **B Distance B**

☐ **C Distance C**

☐ **D Distance D**

(continued on the next page)

6 continued.

- (b) They take turns to run up the stairs and use a stopwatch to measure the time taken.**

The students estimate their own weight.

Look at Figure 15 for Question 6(b) in the Diagram Booklet. It shows a table of their results.

The table is not complete.

- (i) State the unit for work done.
(1 mark)**

unit for work done is _____

- (ii) Use the data for student B to calculate his estimated weight.
(2 marks)**

weight = _____ N

(continued on the next page)

6 continued.

- (iii) Use the data for student C to calculate the time she takes.
(2 marks)**

time taken = _____ s

- (iv) Use the data for all three students to calculate the average power of the students.
(2 marks)**

average power = _____ W

(continued on the next page)

6 continued.

- (c) Identify a significant source of error in the investigation and state how this error can be reduced.
(2 marks)**

source of error

can be reduced by

(Total for Question 6 = 10 marks)

- 7 (a) Look at the diagrams for Question 7(a) in the Diagram Booklet. Which of the following shows the electric field around a point charge?**

(1 mark)

- (b) State ONE way of giving a plastic rod a static electric charge.**

(1 mark)

(continued on the next page)

7 continued.

- (c) A cleaning company uses an electric sprayer to produce a cloud of disinfectant inside a bus.**

The sprayer gives a negative electric charge to each droplet in the cloud of disinfectant.

- (i) The droplets in the cloud of disinfectant have a negative charge because the sprayer
(1 mark)**

- ☐ **A adds electrons to the droplets**
- ☐ **B adds protons to the droplets**
- ☐ **C removes electrons from the droplets**
- ☐ **D removes protons from the droplets**

(continued on the next page)

7 continued.

- (ii) Look at Figure 16 for Question 7(c)(ii) in the Diagram Booklet. It shows the shape of the clouds of droplets in the disinfectant from two sprayers.**

Sprayer 1 gives a negative charge to each droplet.

Sprayer 2 does not give any charge to the droplets.

**Explain the difference in the shape of the two clouds.
(2 marks)**

(continued on the next page)

7 continued.

- (iii) Look at Figure 17 for Question 7(c)(iii) in the Diagram Booklet. It shows a cloud of disinfectant, containing charged droplets, moving towards a seat in the bus.**

Explain how charging the droplets in the cloud of disinfectant makes sure that every part of the seat is disinfected.

(2 marks)

(continued on the next page)

7 continued.

- *(d) When an aeroplane is refuelled, the fuel passes through a pipe into fuel tanks in the wings.**

The fuel is very flammable.

A build-up of static electric charge can be dangerous while the aeroplane is being refuelled.

Explain

- **why the build-up of static electric charge would be dangerous**
- **how the danger is reduced.**

(6 marks)

7 continued.

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Turn over

7 continued.

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(Total for Question 7 = 13 marks)

- 8 (a) Look at Figure 19 for Question 8(a) in the Diagram Booklet. It shows a lamp connected to a d.c. power supply.

The power supply provides a potential difference (voltage) of 4.5 V.

The current in the lamp is 0.30 A.

- (i) Calculate the resistance of the lamp.
(1 mark)

Use the equation

$$R = \frac{V}{I}$$

resistance = _____ Ω

(continued on the next page)

8 continued.

- (ii) Calculate the power supplied to the lamp.
(2 marks)**

power = _____ W

(continued on the next page)

8 continued.

- (b) Look at Figure 20 for Question 8(b) in the Diagram Booklet. Another IDENTICAL lamp is added to the circuit, as shown in Figure 20.**

The power supply provides the same potential difference as it provided in the circuit in Figure 19.

State and explain the difference between the brightness of the lamp in Figure 19 and the brightness of a lamp in Figure 20.

(3 marks)

(continued on the next page)

Turn over

8 continued.

- (c) A student is given a low voltage power supply and 1 m of resistance wire.**

The student uses these and other pieces of equipment to measure the resistance of just 50 cm of the resistance wire.

Draw a diagram of the circuit that the student should use.

Your circuit diagram should identify the pieces of equipment that the student uses.

(3 marks)

(continued on the next page)

Turn over

8 continued.

- (d) Describe the difference between direct current (d.c.) and alternating current (a.c.) in electrical circuits.
(2 marks)**

(Total for Question 8 = 11 marks)

- 9 (a) When water boils and turns into steam, there are changes in the arrangement of particles and the density.

Which of these shows the changes?
(1 mark)

	space between particles in steam	density of steam
<input type="checkbox"/> A	bigger than in water	greater than water
<input type="checkbox"/> B	bigger than in water	less than water
<input type="checkbox"/> C	smaller than in water	greater than water
<input type="checkbox"/> D	smaller than in water	less than water

(continued on the next page)

9 continued.

- (b) Look at Figure 21 for Question 9(b) in the Diagram Booklet. It shows some water in a measuring cylinder and a lump of iron.**

The lump of iron is lowered fully into the water.

The water level in the measuring cylinder rises to 530 cm³.

The density of iron is 7.9 g/cm³.

Calculate the mass of the lump of iron.

Use the equation

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

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

(continue your answer on the next page)

Turn over

9 continued.

mass = _____ g

(continued on the next page)

9 continued.

- (c) A piece of wood has a similar shape and volume to the lump of iron.**

The density of the wood is 0.82 g/cm^3 .

The density of water is 1.00 g/cm^3

**Explain why the method used in part (b) cannot be used to determine the mass of the piece of wood.
(2 marks)**

(continued on the next page)

9 continued.

- *(d) A student needs to determine the specific heat capacity of water.**

Look at Figure 22 for Question 9(d) in the Diagram Booklet. It shows some of the equipment the student uses.

Describe the method the student should use to determine the specific heat capacity of water.

Your description should include, with reasons,

- any other equipment needed**
- the measurements needed.**

**You may draw a diagram if it helps your answer.
(6 marks)**

9 continued.

9 continued.

[illegible]

(continued on the next page)

Turn over

9 continued.

[illegible]

(Total for Question 9 = 13 marks)

10 (a) A donkey has a weight of 2500 N.

The area of each hoof is 0.022 m^2 .

- (i) Calculate the average pressure that the donkey exerts on the ground.
(2 marks)

Use the equation

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

average pressure = _____ Pa

(continued on the next page)

10 continued.

- (ii) Look at Figure 24 for Question 10(a)(ii) in the Diagram Booklet. It shows how the shape of a camel's hoof is different from the shape of a donkey's hoof.**

The camel and the donkey have the same mass.

Explain how a camel's hoof is a more suitable shape than a donkey's hoof for walking on soft ground.

(2 marks)

(continued on the next page)

10 continued.

- (b) A student carries out an investigation to show how pressure varies with depth in water.**

A pressure sensor is attached to a rule.

Look at Figure 25 for Question 10(b) in the Diagram Booklet. The rule and pressure sensor are lowered into the water in a tank, as shown in Figure 25.

The depth of the pressure sensor below the surface of the water is read from the scale on the rule.

The pressure is displayed on the student's mobile phone which receives a signal from the pressure sensor.

Figure 26 gives some of the readings.

FIGURE 26

depth in m	pressure in kPa
0·050	99·15
0·100	99·70
0·150	100·15
0·200	100·70
0·250	101·15
0·300	101·70

(continued on the next page)

Turn over

10 continued.

Look at Figure 27 for Question 10(b) in the Diagram Booklet. It shows a graph with some of the results plotted, but two of the points are missing.

- (i) Plot the two missing points on the graph.
(2 marks)**
- (ii) Draw a line of best fit through the points on the graph.
(1 mark)**
- (iii) Which of the following equations represents the variation of pressure with depth of water below the surface?
(1 mark)**

☐ **A** $y = ax^2 + b$

☐ **B** $y = mx$

☐ **C** $Y = mc - x$

☐ **D** $y = mx + c$

(continued on the next page)

10 continued.

- (iv) Use the graph in Figure 27 to predict the pressure at the surface of the water.
(1 mark)**

pressure at the surface of the water =

_____ kPa

(continued on the next page)

10 continued.

- (c) The student repeats the investigation in part (b) using seawater and draws a graph of the results.**

The seawater is more dense than the water used in part (b).

**Compare the graph for seawater with the graph in Figure 27.
(2 marks)**

(Total for Question 10 = 11 marks)

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