

Physics
UNIT: 4PH1
PAPER: 2P

Total Marks

Friday 14 June 2024 – Afternoon

Time: 1 hour 15 minutes

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Ruler, calculator, Equation Booklet (enclosed)

YOU WILL BE GIVEN

Diagram Booklet, Formulae Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided – there may be more space than you need.

Show all the steps in any calculations and state the units.

INFORMATION

The total mark for this paper is 70.

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

ADVICE

Read each question carefully before you start to answer it.

Write your answers neatly and in good English.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions.

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 Look at the diagram for Question 1 in the Diagram Booklet. The Hertzsprung-Russell (HR) diagram shown can be used to classify stars.**

- (a) Three regions in the HR diagram are labelled P, Q and R.**

Look at the boxes for Question 1(a) in the Diagram Booklet. The boxes show the three regions and different astronomical objects.

Draw a straight line from each region to the type of astronomical object contained in that region.

(3 marks)

(continued on the next page)

1 continued.

**(b) Define the term ABSOLUTE MAGNITUDE.
(2 marks)**

(Total for Question 1 = 5 marks)

2 Look at Diagram 1 for Question 2(a) in the Diagram Booklet. A wrench is used to turn a nut.

(a) The force applied to the wrench is 28 N.

Calculate the moment applied by the wrench on the nut.

**Give a suitable unit.
(3 marks)**

moment = _____ unit = _____

(continued on the next page)

Turn over

2 continued.

- (b) State TWO changes that could be made to increase the size of the moment applied to the nut. (2 marks)**

1 _____

2 _____

(continued on the next page)

2 continued.

(c) Look at Diagram 2 for Question 2(c) in the Diagram Booklet. Diagram 2 shows the wrench as it is turned through 90° .

(i) The force is applied over a distance that is equal to a quarter of the circumference of a circle.

The circle has a radius of 15 cm.

Calculate the distance over which the force is applied.

**[circumference of circle = $2 \times \pi \times \text{radius}$]
(2 marks)**

distance = _____ cm

(continued on the next page)

Turn over

2(c) continued.

- (ii) Calculate the work done by the force as the wrench is turned through a quarter of the circumference of the circle.
(3 marks)**

work done = _____ J

(Total for Question 2 = 10 marks)

3 A student investigates how much infrared radiation is absorbed by different surfaces.

(a) Look at the diagram for Question 3(a) in the Diagram Booklet. The photograph shows some of the equipment available to the student.

The student pours some water into each bottle.

Describe a method the student could use to investigate how the colour of the bottle affects the amount of infrared radiation absorbed by the bottle.

**You may draw a diagram to help your answer.
(6 marks)**

Answer space continues on the next 2 pages.

3(a) continued.

3(a) continued.

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Turn over

3 continued.

- (b) Look at the graph for Question 3(b) in the Diagram Booklet. The student plots a graph to show how the temperature of the water in each bottle varies with time.**

Draw two curves to show the expected variation in temperature of the black bottle and the silver bottle during the investigation.

**Label your curves with the colour of each bottle.
(2 marks)**

(Total for Question 3 = 8 marks)

4 This question is about electrostatics.

(a) A polythene rod is rubbed with a cloth, which causes both the rod and the cloth to become charged.

**(i) Which of these is the force that causes the rod and the cloth to become charged?
(1 mark)**

- ☐ **A friction**
- ☐ **B gravitational**
- ☐ **C magnetic**
- ☐ **D tension**

(continued on the next page)

4(a) continued.

(ii) The polythene rod becomes negatively charged.

Which of these statements explains how the rod has become negatively charged?

(1 mark)

- ☐ **A the rod gains electrons**
- ☐ **B the rod loses electrons**
- ☐ **C the rod gains protons**
- ☐ **D the rod loses protons**

(continued on the next page)

4 continued.

(b) A student has rods made from different materials.

The student rubs each rod the same way with a cloth.

The student measures the charge gained by each rod three times.

Look at the table for Question 4(b) in the Diagram Booklet. The table shows the results.

(i) One of the readings for the polythene rod is anomalous.

Circle the anomalous result in the results table.

(1 mark)

(continued on the next page)

4(b) continued.

- (ii) State how the student should deal with the anomalous result.
(1 mark)**

- (iii) Calculate the mean charge for the polythene rod.
(2 marks)**

mean charge = _____ nC

(continued on the next page)

Turn over

4(b) continued.

- (iv) Describe how the student could use the rods to demonstrate that there are two different types of electric charge.
(3 marks)**

Answer space continues on the next page.

4(b)(iv) continued.

(Total for Question 4 = 9 marks)

5 This question is about sound.

(a) State which wave property determines the pitch of a sound.

(1 mark)

(continued on the next page)

5 continued.

- (b) Look at the bar chart for Question 5(b) in the Diagram Booklet. The bar chart shows the maximum frequency of sound heard by four animals and a human.**

Explain which of the bars is most likely to show the results for a human.

(2 marks)

(continued on the next page)

5 continued.

(c) A sound wave has a frequency of 500 Hz.

**(i) Show that the time period of the sound wave is 2·0 ms.
(3 marks)**

(ii) Look at the diagram for Question 5(c)(ii) in the Diagram Booklet. The diagram shows the screen of an oscilloscope.

The timebase of the oscilloscope is 0·50 ms per square.

**Draw the trace on the oscilloscope screen when the sound wave is detected.
(2 marks)**

(Total for Question 5 = 8 marks)

6 This question is about electromagnets.

- (a) Describe the construction of a simple electromagnet that is producing a magnetic field.**

**You may draw a diagram to help your answer.
(3 marks)**

Answer space continues on the next page.

6(a) continued.

(continued on the next page)

Turn over

6 continued.

- (b) Look at the diagram for Question 6(b) in the Diagram Booklet. A proton moves through a uniform magnetic field produced by a strong electromagnet.**

The area inside the square represents the magnetic field.

The initial velocity, v , of the proton is also shown.

- (i) Use the left-hand rule to determine the direction of the force acting on the proton.
(1 mark)**

(continued on the next page)

6(b) continued.

- (ii) Explain how the force on the proton changes as the proton moves through the magnetic field.**

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

(continued on the next page)

6(b) continued.

**(iii) Suggest why the velocity of the
proton changes.
(1 mark)**

(Total for Question 6 = 7 marks)

7 A hydroelectric power (HEP) station generates electricity from renewable energy resources.

(a) State what is meant by the term renewable energy resource.
(1 mark)

(b) Look at the diagram for Question 7(b) in the Diagram Booklet. The diagram shows the design of a HEP station.

Water flows from the upper lake to the lower lake through the turbine.

The turbine is connected to a generator, which generates electricity.

Describe the energy transfers involved in generating electricity in the HEP station.
(4 marks)

Answer space continues on the next page.

7(b) continued.

(continued on the next page)

7 continued.

(c) The HEP station is located near a large wind farm.

(i) Give one advantage of generating electricity using the HEP station rather than the wind farm.

(1 mark)

(continued on the next page)

7(c) continued.

- (ii) Give one disadvantage of generating electricity using the HEP station rather than the wind farm.
(1 mark)**

(continued on the next page)

7(c) continued.

- (iii) The HEP station has an electric pump that can pump water from the lower lake back to the upper lake.**

The pump can be powered using electricity generated by the wind farm.

**Explain how the HEP station and wind farm can be used together to maximise the effectiveness of generating electricity.
(3 marks)**

(Total for Question 7 = 10 marks)

Turn over

8 Look at the diagram for Question 8 in the Diagram Booklet. The diagram shows a water bath that a technician uses to heat some water.

(a) The water bath is filled with water at an initial temperature of 15 °C.

Calculate the initial temperature of the water in kelvin.

(1 mark)

initial temperature = _____ K

(continued on the next page)

8 continued.

(b) The technician heats the water to a final temperature of 60 °C.

**(i) Describe how the energy of the water molecules changes as the temperature of the water increases.
(2 marks)**

(continued on the next page)

8(b) continued.

- (ii) Look at the table for Question 8(b)(ii) in the Diagram Booklet. The table shows some information about the heating element in the water bath and the heating process.**

Calculate the energy transferred by the heating element in the water bath during the heating process.

(3 marks)

energy transferred = _____ J

(continued on the next page)

Turn over

8(b) continued.

(iii) Calculate the mass of water being heated.

Assume that all the energy is transferred to the thermal store of the water.

[for water,

specific heat capacity = $4200 \text{ J/kg } ^\circ\text{C}$]

(3 marks)

mass of water = _____ kg

(continued on the next page)

Turn over

8 continued.

(c) Some water evaporates as a gas from the water bath.

**(i) Describe the arrangement of particles in a gas.
(2 marks)**

(continued on the next page)

8(c) continued.

**(ii) Describe TWO differences between evaporation and boiling.
(2 marks)**

(Total for Question 8 = 13 marks)

**TOTAL FOR PAPER = 70 MARKS
END OF PAPER**