

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)

**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  $90^\circ$ .**

**(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.**

---

---

---

---

---

---

---

---

---

---

---

**Turn over**

**3(a) continued.**

[illegible]

**(continued on the next page)**

**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.**

[illegible]

**(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)

**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**