Paper Reference(s) 4PH1/2PR
Pearson Edexcel International GCSE (9–1)

Physics

UNIT: 4PH1

PAPER: 2PR

Total Marks

Time: 1 hour 15 minutes

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

Surname						
Other names						
Centre Number						
Candidate Number						

Pearson

YOU MUST HAVE

Ruler, calculator, Equation Booklet

YOU WILL BE GIVEN

Diagram Booklet, Formulae Booklet

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.

Show all 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.

There may be spare copies of some diagrams.

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 diagram shows stars classified into different regions.**

(a) **Look at the boxes for Question 1(a) in the Diagram Booklet. They give four points, A, B, C and D, and four star classifications.**

Draw lines connecting each point to the correct star classification.
(4 marks)

(b) **Describe what is meant by the term ABSOLUTE MAGNITUDE.**
(2 marks)

(continued on the next page)

1 continued.

(Total for Question 1 = 6 marks)

2 (a) **Describe an investigation to determine the speed of sound.**

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

(continued on the next page)

2 continued.

(continued on the next page)

2 continued.

(continued on the next page)

2 continued.

(b) Look at the diagram for Question 2(b) in the Diagram Booklet. A microphone is connected to an oscilloscope.

A sound is detected by the microphone.

The diagram shows the oscilloscope trace.

(i) Determine the period of the sound wave. (3 marks)

period = _____ s

(continued on the next page)

2 continued.

(ii) Calculate the frequency of the sound wave.
(2 marks)

frequency = _____ Hz

(Total for Question 2 = 10 marks)

3 The SPS is a particle accelerator in Geneva.

The SPS can accelerate sulfur particles to speeds almost as fast as the speed of light.

(a) Neutral sulfur particles can become positively charged sulfur particles.

Describe the difference between a neutral sulfur particle and a positively charged sulfur particle. (2 marks)

(continued on the next page)

3 continued.

(b) Look at Diagram 1 for Question 3(b) in the Diagram Booklet. It shows a section of the SPS.

Positively charged sulfur particles are introduced at point P and accelerate to the right.

Explain why the positively charged sulfur particles accelerate.
(2 marks)

(continued on the next page)

3 continued.

(c) Look at Diagram 2 for Question 3(c) in the Diagram Booklet. The sulfur particles enter a large tube and complete a circular orbit.

Diagram 2 shows a sulfur particle, travelling with velocity v, in the tube.

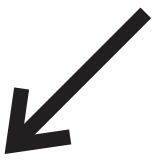
(i) A magnetic force acts on the positively charged sulfur particle.

This force makes the particle travel in a circle.

The force is labelled F.

Use the left-hand rule to determine the direction of the applied magnetic field.
(1 mark)

☐ A  opposite to the direction of the velocity

☐ B  along direction of force

☐ C  out of the page

☐ D  into the page

(continued on the next page)

3 continued.

(ii) The tube has a radius of 1·1 km and the sulfur particle has an orbital speed of $2{\cdot}9 \times 10^8$ m/s.

Calculate the orbital period of the sulfur particle.
(3 marks)

orbital period = _____ s

(Total for Question 3 = 8 marks)

4 A student heats a sample of water.

The student measures the temperature of the sample of water during heating.

(a) The sample of water has a mass of 0·45 kg.

Calculate the energy required to increase the temperature of the water from 16 °C to 100 °C.

[specific heat capacity of water = 4200 J / kg °C]

(3 marks)

energy = _____ J

(continued on the next page)

4 continued.

(b) Look at the graph for Question 4(b)(i) in the Diagram Booklet. It shows the temperature-time graph for the sample of water.

(i) Use the graph to determine the time taken from when the water started to boil to when the water stopped boiling.
(1 mark)

time taken = _____ minutes

(ii) The heater used to heat the water has a power rating of 2200 W.

Calculate the energy required to boil all of the water.
(3 marks)

energy = _____ J

(continued on the next page)

4 continued.

(c) Give a reason why the liquid water should be stirred during the heating.
(1 mark)

(d) When water boils, the liquid water becomes a gas called steam.

Describe the changes in arrangement and motion of the molecules in liquid water and the molecules in steam.
(4 marks)

(continued on the next page)

4 continued.

(Total for Question 4 = 12 marks)

5 Look at the diagram for Question 5 in the Diagram Booklet. It shows part of the National Grid.

(a) There is a step-up transformer at the power station end of a transmission line and a step-down transformer at a distant town.

Explain why step-up transformers and step-down transformers are used in this way.
(4 marks)

(continued on the next page)

5 continued.

(continued on the next page)

5 continued.

(b) (i) State the formula linking the input voltage, the output voltage and the turns ratio for a transformer.
(1 mark)

(ii) The primary coil on a step-up transformer has 3300 turns.

Calculate the number of turns required on the transformer's secondary coil to step up the voltage from 15 kV to 340 kV.
(3 marks)

number of turns = _____

(continued on the next page)

5 continued.

(c) Transformers in the National Grid have efficiencies less than 100%.

(i) Suggest which energy store of the transformer increases as a result of the efficiency being less than 100%.
(1 mark)

(continued on the next page)

5 continued.

(ii) The iron core of a transformer is an electrical conductor.

When the transformer is in use, the primary coil causes a changing magnetic field in the iron core. This causes a small current to be induced in the core.

Explain how a current is induced in the core of the transformer.
(3 marks)

(continued on the next page)

5 continued.

(Total for Question 5 = 12 marks)

6 The refractive index, n, of a material can be calculated using this formula.

$$n = \frac{\sin i}{\sin r}$$

(a) A student uses this method to determine the refractive index of a material.

- draw around a semi-circular block of material
- shine a light ray towards the centre of the straight edge of the semi-circular block
- use a pencil and a ruler to mark the positions of the incident ray and the refracted ray
- remove the block
- draw a normal where the ray was incident on the block
- measure the angle of incidence and angle of refraction
- calculate the refractive index using the formula

Repeat the method for different angles of incidence.

(continued on the next page)

6 continued.

(i) Name the independent variable in this investigation.
(1 mark)

(ii) The table shows the student's results for an angle of incidence of 40°.

Angle of refraction 1 (°)	Angle of refraction 2 (°)	Angle of refraction 3 (°)
22	23	67

Calculate the mean value for the angle of refraction.
(2 marks)

mean angle =

_____ degrees

(continued on the next page)

6 continued.

(iii) Describe how the student could improve their method to get a more accurate value for the refractive index.
(2 marks)

(continued on the next page)

6 continued.

(b) Look at Diagram 1 for Question 6(b) in the Diagram Booklet. It shows a ray of light refracted by a transparent block of material.

(i) Calculate the refractive index of this material. (2 marks)

refractive index = _____

(continued on the next page)

6 continued.

(ii) State the formula linking critical angle and refractive index.
(1 mark)

(iii) The refractive index of a different material is 1·7

Calculate the critical angle of this material.
(2 marks)

critical angle =

_____ degrees

(continued on the next page)

6 continued.

(c) Look at Diagram 2 for Question 6(c) in the Diagram Booklet. It shows a ray of light travelling through an optical fibre.

The optical fibre is made of a material with a refractive index of 1·7

Explain the path of the ray in the optical fibre.
(2 marks)

(Total for Question 6 = 12 marks)

7 Look at Diagram 1 for Question 7 in the Diagram Booklet. It shows a gate fitted with a spring mechanism.

The spring mechanism shuts the gate automatically.

(a) Look at the graph for Question 7(a) in the Diagram Booklet. It shows some data from an investigation into how the extension of the spring changes with an increasing force.

Describe the relationship shown by the graph. (2 marks)

(continued on the next page)

7 continued.

(b) Look at Diagram 2 for Question 7(b) in the Diagram Booklet. It shows the gate viewed from above.

The force the spring exerts on the gate is 480 N.

Show that the moment of the force the spring exerts on the gate is about 400 Nm.
(2 marks)

(c) The force, F, is the minimum force needed to start opening the gate.

Calculate the magnitude of force F.
(4 marks)

force F = _____ N

(continued on the next page)

7 continued.

(d) The spring is removed for testing.

Explain what will happen to the spring if the force applied to extend the spring is too large.
(2 marks)

(Total for Question 7 = 10 marks)

TOTAL FOR PAPER = 70 MARKS

END OF PAPER