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

# Physics

## UNIT: 4PH1

## PAPER: 2P

| Total Marks |
| --- |
| |

**Wednesday 22 November 2023 – Morning**

**Time: 1 hour 15 minutes**

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

| | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Surname | | | | | | |
| Other names | | | | | | |
| Centre Number | | | | | | |
| Candidate Number | | | | | | |

Q73429A

Pearson

**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.**

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**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 This question is about nuclear reactions.

(a) Nuclear fusion and nuclear fission release energy from the nuclear stores of atoms.

The table gives some statements about nuclear fusion and some statements about nuclear fission.

Place ticks (✓) in the table to show whether each statement applies to nuclear fusion or nuclear fission.
(3 marks)

| Statement | Nuclear fusion | Nuclear fission |
|---|---|---|
| happens in the cores of stars | | |
| happens when a nucleus absorbs a neutron | | |
| causes a large nucleus to split | | |
| produces radioactive daughter nuclei | | |
| uses hydrogen to produce helium | | |

(continued on the next page)

1 continued.

(b) In nuclear fusion, two positively charged nuclei must overcome the effects of the repulsive electrostatic force between them.

Explain the two conditions needed to overcome the effects of this repulsive force and achieve nuclear fusion.

(4 marks)

Answer space continues on the next page.

1 _____

_____

_____

_____

_____

_____

1(b) continued.

2 _____

_____

_____

_____

_____

**(Total for Question 1 = 7 marks)**

**2 This question is about moments.**

**Look at Diagram 1 for Question 2 in the Diagram Booklet. It shows the raised lower leg of a person.**

**(a) (i) The moment of the weight of the lower leg about the pivot is 19 N m.**

**A vertical force, F, is applied to the person's foot to keep the lower leg raised.**

**The lower leg does not move.**

**Calculate the magnitude of force F, using the formula**

**moment = force × perpendicular distance from pivot**

**(2 marks)**

**force F = _____ N**

**(continued on the next page)**

2(a) continued.

(ii) Which distance is used to calculate the moment of the weight of the lower leg about the pivot?
(1 mark)

☐ A 0·25 m

☐ B 0·28 m

☐ C 0·30 m

☐ D 0·55 m

(continued on the next page)

2 continued.

(b) Look at Diagram 2 for Question 2(b) in the Diagram Booklet. It shows the person resting their lower leg on two supports.

(i) The centre of gravity of the lower leg is 0·25 m away from support A and 0·35 m away from support B.

Explain whether force X or force Y is larger.

Ignore the weight of the upper leg.
(3 marks)

(continued on the next page)

**2(b) continued.**

**(ii) A bag of ice is placed on the lower leg, vertically above the centre of gravity.**

**This causes force X and force Y to increase.**

**The bag is then moved towards the person's foot.**

**Describe how force X and force Y change as the bag is moved towards the person's foot. (3 marks)**

**(Total for Question 2 = 9 marks)**

3 Look at the diagram for Question 3 in the Diagram Booklet. It shows some apparatus that can be used to determine the specific heat capacity of water.

(a) Describe how a student could use this apparatus to determine the specific heat capacity of water.

Include details of any additional equipment needed in your answer.

(6 marks)

Answer space continues on the next 2 pages.

**3(a) continued.**

3(a) continued.

(continued on the next page)

3 continued.

(b) (i) The table shows the student's results.

| | |
|---|---|
| energy transferred to the thermal store of the water in J | 54 000 |
| mass of water in kg | 0·56 |
| temperature change of water in °C | 22 |

Use the student's results to calculate the specific heat capacity of water.
(3 marks)

specific heat capacity of water =

_____ J/kg °C

(continued on the next page)

**3(b) continued.**

**(ii) Give two reasons why the energy from the heater is not all retained in the thermal store of the water.**
**(2 marks)**

**1** _____

_____

_____

**2** _____

_____

_____

**(Total for Question 3 = 11 marks)**

4 Look at the diagram for Question 4 in the Diagram Booklet. It shows a step-down transformer.

(a) The input power to the transformer is 16 W.

The transformer is used for 2·5 hours.

Calculate the energy transferred to the transformer during this time.

**(3 marks)**

energy transferred = _____ J

(continued on the next page)

4 continued.

(b) Explain how a transformer works.

In your answer, include reasons for using

- two coils
- the iron core
- an a.c. power supply

(6 marks)

Answer space continues on the next page.

**4(b) continued.**

(continued on the next page)

4 continued.

(c) State how the primary coil of the transformer can be changed to increase the output voltage.
(1 mark)

**(Total for Question 4 = 10 marks)**

5 A sample of steam (water in a gas state) is cooled using a very cold freezer.

(a) The steam is cooled from an initial temperature of 150 °C.

Calculate the initial temperature of the steam in kelvin (K).
(1 mark)

initial temperature = _____ K

(continued on the next page)

5 continued.

(b) Look at the graph for Question 5(b) in the Diagram Booklet. The temperature-time graph shows how the temperature of the steam changes during the cooling process.

The steam eventually becomes ice (water in a solid state).

(i) The graph shows five stages, A, B, C, D and E, of the cooling process.

State which stages of the cooling process show a change of state.
(1 mark)

(continued on the next page)

**5(b) continued.**

**(ii) Describe the differences in the arrangement of particles when the sample is in a gas state (steam) and a solid state (ice).**

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

**Answer space continues on the next page.**

**5(b)(ii) continued.**

**(continued on the next page)**

**5(b) continued.**

**(iii) Explain whether or not the energy in the kinetic store of the particles changes when the sample is changing state.**
**(3 marks)**

**(Total for Question 5 = 7 marks)**

6 This question is about momentum and forces.

(a) State the principle of conservation of momentum.
(1 mark)

(continued on the next page)

6 continued.

(b) Look at the diagram for Question 6(b) in the Diagram Booklet. It shows an air track that can be used to investigate motion without friction.

Air comes out through a series of small holes in the air track. The air lifts the glider slightly above the track.

A small spacecraft engine floats at rest on a cushion of air.

(i) State the momentum of the spacecraft engine when it is at rest.
(1 mark)

momentum = _____ kg m/s

(continued on the next page)

6(b) continued.

(ii) The spacecraft engine ejects large numbers of xenon ions to the left.

A mass of $2{\cdot}6 \times 10^{-8}$ kg of xenon ions leaves the engine with a mean speed of 26 km/s.

Calculate the momentum of all the ejected xenon ions.
(3 marks)

momentum = _____ kg m/s

(continued on the next page)

6(b) continued.

(iii) State the magnitude and direction of the spacecraft engine's momentum after these xenon ions leave the engine.
(2 marks)

magnitude of momentum = _____ kg m/s

direction of momentum = _____

(continued on the next page)

6(b) continued.

(iv) The ions exert a force of 2·6 mN on the spacecraft engine.

The spacecraft engine has a mass of 1·2 kg.

Calculate the acceleration of the engine.

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

acceleration = _____ $m/s^2$

(continued on the next page)

6 continued.

(c) The engine is designed to accelerate a spacecraft while the spacecraft is travelling through space.

The spacecraft carries a mass of 0·75 kg of xenon ions for the engine.

When the engine is used, $9{\cdot}9 \times 10^{-8}$ kg of xenon ions leave the engine each second.

A student suggests that this small spacecraft engine would not be useful because the acceleration it produces is very small.

Evaluate the student's suggestion.
(2 marks)

Answer space continues on the next page.

**6(c) continued.**

**(Total for Question 6 = 13 marks)**

7 Look at the diagram for Question 7 in the Diagram Booklet. It shows the screen of an oscilloscope when a sound wave is detected, and the oscilloscope settings.

(a) Give the name of the piece of equipment that is connected to the oscilloscope to detect the sound wave.
(1 mark)

(continued on the next page)

7 continued.

(b) (i) Use the trace on the oscilloscope to determine the time period of the detected sound wave.
(2 marks)

time period = _____ s

(ii) Calculate the frequency of the detected sound wave.
(1 mark)

frequency = _____ Hz

(continued on the next page)

7 continued.

(c) (i) State the formula linking energy transferred, charge and voltage.
(1 mark)

(continued on the next page)

7(c) continued.

(ii) The effective voltage of the oscilloscope trace can be calculated using the formula

$$\text{effective voltage} = \frac{\text{amplitude of trace in V}}{\sqrt{2}}$$

Use the effective voltage to calculate the energy transferred when $6{\cdot}3 \times 10^{-5}$ C of charge passes through the oscilloscope.
(3 marks)

energy transferred = _____ J

(Total for Question 7 = 8 marks)

8 This question is about red-shift.

(a) Look at the diagram for Question 8(a) in the Diagram Booklet. It shows two identical stars, A and B, orbiting each other.

Light from each star arrives at Earth.

As the stars move in their orbit, the wavelength of the light observed at Earth changes due to the Doppler effect.

Add an X to the diagram to show the position of star B when the light emitted from it shows maximum red-shift when detected on Earth.
(1 mark)

(continued on the next page)

8 continued.

(b) Light is received on Earth from a distant galaxy.

The longest wavelength of light arriving at Earth from the galaxy is 561 nm.

A lamp on Earth produces the same light with a wavelength of 550 nm.

Calculate the velocity of the galaxy.

[speed of light = $3{\cdot}0 \times 10^8$ m/s]
(4 marks)

Answer space continues on the next page.

8(b) continued.

velocity = _____ m/s

**(Total for Question 8 = 5 marks)**

**TOTAL FOR PAPER = 70 MARKS**

**END OF PAPER**