Paper Reference(s) 4PH1/1P 4SD0/1P
Pearson Edexcel International GCSE (9–1)

Total Marks

Physics
UNIT: 4PH1
Science (Double Award) 4SD0
PAPER: 1P

Time: 2 hours

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

Surname						
Other names						
Centre Number						
Candidate Number						

V70951A

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 the steps in any calculations and state the units.

INFORMATION

The total mark for this paper is 110.

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. It shows a comet as it moves through part of its orbit around the Sun.

(a) (i) Add an S to the diagram to show the position of the Sun.
(1 mark)

(ii) Complete the diagram to show the orbit of the comet.
(2 marks)

(iii) Add an X to the diagram to show the position where the comet is moving fastest.
(1 mark)

(continued on the next page)

1 continued.

(b) Describe how the orbit of a comet compares with the orbit of a planet.
(3 marks)

(Total for Question 1 = 7 marks)

2 (a) Which statement describes the term ATOMIC NUMBER for a nucleus? (1 mark)

☐ A number of electrons in the nucleus

☐ B number of neutrons in the nucleus

☐ C number of protons in the nucleus

☐ D number of protons and neutrons in the nucleus

(continued on the next page)

2 continued.

(b) Which statement describes the term MASS NUMBER for a nucleus? (1 mark)

☐ A number of electrons in the nucleus

☐ B number of neutrons in the nucleus

☐ C number of protons in the nucleus

☐ D number of protons and neutrons in the nucleus

(continued on the next page)

2 continued.

(c) Which statement describes the term ISOTOPES?
(1 mark)

☐ A atoms with the same number of electrons but a different number of protons

☐ B atoms with the same number of neutrons but a different number of electrons

☐ C atoms with the same number of neutrons but a different number of protons

☐ D atoms with the same number of protons but a different number of neutrons

(continued on the next page)

2 continued.

(d) An atom contains 8 protons, 8 neutrons and 8 electrons.

Which of these would result in a negatively charged ion of the same element?

(1 mark)

☐ A adding an electron

☐ B adding a proton

☐ C removing an electron

☐ D removing a proton

(continued on the next page)

2 continued.

(e) It is not possible to predict exactly when a radioactive nucleus will decay.

Which feature of radioactive decay best explains this observation?
(1 mark)

☐ A radioactive decay can change the structure of the nucleus

☐ B radioactive decay happens at random

☐ C radioactive decay is irreversible

☐ D radioactive decay makes a nucleus more stable

(continued on the next page)

2 continued.

(f) Which of these is the correct unit for measuring the activity of a radioactive sample?
(1 mark)

☐ A becquerel (Bq)

☐ B coulomb (C)

☐ C joule (J)

☐ D watt (W)

(Total for Question 2 = 6 marks)

3 Look at the diagram for Question 3 in the Diagram Booklet. An ultrasonic distance-measuring device can be used to measure the length of a room.

The device emits a pulse of sound with a frequency of 40 kHz.

The device also emits a bright beam of red visible light.

(a) Explain what is meant by a frequency of 40 kHz.
(2 marks)

(continued on the next page)

3 continued.

(b) A sound wave from the device travels at 345 m/s.

(i) State the formula linking wave speed, frequency and wavelength. (1 mark)

(continued on the next page)

3 continued.

(ii) Calculate the wavelength of the sound wave.
(3 marks)

wavelength = _____ m

(continued on the next page)

3 continued.

(iii) The device emits a sound wave.

The sound wave travels to the wall, reflects back to the device and is received by the device.

The distance from the device to the wall is 2·35 m.

(continued on the next page)

3 continued.

Calculate the time between the sound wave being emitted and received by the device.
(4 marks)

time = _____ s

(continued on the next page)

3 continued.

(c) Suggest why the device emits visible light.
(1 mark)

(continued on the next page)

3 continued.

(d) Sound waves and light waves can have different frequencies and wavelengths.

Describe three other differences between sound waves and light waves.

You may draw diagrams to support your answer.
(3 marks)

(continue your answer on the next page)

3 continued.

(Total for Question 3 = 14 marks)

4 The table gives data for some of the planets in the solar system.

Planet	Gravitational field strength at surface in N/kg	Orbital radius in km	Orbital speed in km/s
Mercury	3·7	$57{\cdot}9 \times 10^6$	47·4
Venus	8·9	$108{\cdot}2 \times 10^6$	35·0
Jupiter	23·1	$778{\cdot}6 \times 10^6$	13·1
Saturn	9·0	$1433{\cdot}5 \times 10^6$	9·7
Uranus	8·7	$2872{\cdot}5 \times 10^6$	6·8
Neptune	12·7	$4495{\cdot}1 \times 10^6$	5·4

(a) Look at the grid for Question 4(a) in the Diagram Booklet. Plot a bar chart of the gravitational field strength for each planet.
(3 marks)

(continued on the next page)

4 continued.

(b) Suggest why planets have different gravitational field strengths at their surface.
(1 mark)

(continued on the next page)

4 continued.

(c) Give the relationship shown by the data in the table between the orbital radius and the orbital speed for the planets in the solar system.
(1 mark)

(continued on the next page)

4 continued.

(d) Calculate the time period of Mercury's orbit around the Sun.
(3 marks)

time period = _____ s

(Total for Question 4 = 8 marks)

5 A material called granite is used as a work surface in a kitchen.

(a) Granite is formed naturally and contains radioactive isotopes.

The granite work surface contributes to the background radiation in the kitchen.

Give another naturally occurring source of background radiation. (1 mark)

(continued on the next page)

5 continued.

(b) Granite contains the isotope thorium-232 ($^{232}_{90}Th$).

Thorium-232 decays by a sequence of alpha decays and beta decays to form radon-220 ($^{220}_{86}Rn$).

(i) State two differences between alpha radiation and beta radiation. (2 marks)

1 _____

_____

2 _____

_____

_____

(continued on the next page)

5 continued.

(ii) The incomplete nuclear decay equation summarises the decay sequence of thorium-232 into radon-220.

$$^{232}_{90}\mathrm{Th} \longrightarrow {}^{220}_{86}\mathrm{Rn} + \square\,{}^{4}_{2}\alpha + \square\,{}^{0}_{-1}\beta$$

Calculate the number of alpha particles and the number of beta particles emitted in this decay sequence.
(3 marks)

(continue your answer on the next page)

5 continued.

number of alpha particles = _____

number of beta particles = _____

(continued on the next page)

5 continued.

(c) Thorium-232 is a solid and remains in the work surface.

Radon-220 is a gas and is emitted from the work surface.

Thorium-232 and radon-220 both emit alpha radiation.

Discuss the hazards due to the granite work surface when a person is working in the kitchen.

Refer to contamination and irradiation in your answer.
(3 marks)

(continued on the next page)

5 continued.

(Total for Question 5 = 9 marks)

6 Look at the diagram for Question 6 in the Diagram Booklet. It shows a child on a zip-line ride.

During the ride the child slides along a metal wire with the velocity in the direction shown in the diagram.

The diagram also shows the tension force acting on the safety harness the child is wearing.

(a) Force and velocity are examples of vector quantities.

State what is meant by the term VECTOR QUANTITY.
(1 mark)

(continued on the next page)

6 continued.

(b) Draw labelled arrows on the diagram to show two other forces that act on the child.
(4 marks)

(Total for Question 6 = 5 marks)

7 (a) State what is meant by the term ELECTRIC CURRENT.
(1 mark)

(continued on the next page)

7 continued.

(b) Look at the Diagram 1 for Question 7(b) in the Diagram Booklet. It shows an electric circuit used to test a fuse.

(i) Give a reason why an LED is included in the circuit.
(1 mark)

(ii) Add another component to the circuit in diagram 1 to measure the current in the fuse.
(1 mark)

(continued on the next page)

7 continued.

(c) Look at the Diagram 2 for Question 7(c) in the Diagram Booklet. It shows a different electric circuit containing three different lamps.

(i) Calculate the current I_1.
(1 mark)

I_1 = _____ A

(ii) State the current I_2.
(1 mark)

I_2 = _____ A

(continued on the next page)

7 continued.

(iii) Explain which lamp is the brightest.
(3 marks)

(Total for Question 7 = 8 marks)

8 A homemade toy car is powered by an elastic band. When the toy car is pulled backwards, energy is stored in the elastic store as the rubber band is twisted.

When the car is released, some of the energy from the elastic store is transferred to the kinetic store of the car.

The remaining energy is transferred into the thermal store of the surroundings.

(a) State what is meant by the principle of conservation of energy.
(1 mark)

(continued on the next page)

8 continued.

(b) The car is pulled backwards so that there is 165 J of energy in its elastic store.

When the car is released, this energy is transferred to the car's kinetic energy store with an efficiency of 15%.

(continued on the next page)

8 continued.

(i) State the formula linking efficiency, useful energy output and total energy output.
(1 mark)

(continued on the next page)

8 continued.

(ii) Calculate the energy transferred into the thermal store of the surroundings.
(4 marks)

energy transferred
to thermal store = _____ J

(continued on the next page)

8 continued.

(iii) Draw a labelled Sankey diagram for this energy transfer.
(3 marks)

(continued on the next page)

8 continued.

(c) The car is pulled backwards again.

When released, 45 J of energy transfers into the car's kinetic store.

The car travels a distance of 7·5 m during this energy transfer.

(i) State the useful work done on the car.
(1 mark)

work done = _____ J

(continued on the next page)

8 continued.

(ii) Calculate the mean accelerating force acting on the car.
(3 marks)

accelerating force = _____ N

(Total for Question 8 = 13 marks)

9 (a) Look at Diagram 1 for Question 9(a) in the Diagram Booklet. It shows a plastic bottle containing water.

(i) State the formula linking pressure difference, height, density and gravitational field strength, g. (1 mark)

(continued on the next page)

9 continued.

(ii) The pressure difference between the surface of the water and the water at the bottom of the bottle is 2300 Pa.

Calculate the depth of water in the bottle.

(3 marks)

Give your answer in cm.
[density of water = 1000 kg/m^3]

depth = _____ cm

(continued on the next page)

9 continued.

(b) Three holes are made in the bottle at positions A, B and C.

Look at Diagram 2 for Question 9(b) in the Diagram Booklet. It shows the path of the water leaving the bottle from hole B.

(i) Draw a line on diagram 2 to show the path of the water leaving the bottle from hole A.
(1 mark)

(ii) Explain the path of the water leaving the bottle from hole A.
(2 marks)

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(iii) Hole C is at the same depth in the bottle as hole B but on the opposite side of the bottle.

Explain the shape of the path of the water leaving the bottle from hole C.
(3 marks)

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(iv) Suggest why there is a hole in the cap of the bottle.
(1 mark)

(Total for Question 9 = 11 marks)

10 Look at the image for Question 10 in the Diagram Booklet. It shows a vertical drop ride at an amusement park.

The car is pulled to the top of a vertical shaft and then released from rest.

The car then falls freely because of the force of gravity.

(a) Calculate the speed of the car when it has fallen 18 m.
(3 marks)

speed = _____ m/s

(continued on the next page)

10 continued.

(b) (i) State the formula linking kinetic energy, mass and speed.
(1 mark)

(continued on the next page)

10 continued.

(ii) The mass of the car and its passengers is 2·1 tonnes.

Calculate the kinetic energy of the car when it has fallen 18 m. (2 marks)

[1 tonne = 1000 kg]

kinetic energy = _____ J

(continued on the next page)

10 continued.

(c) The actual speed of the car when it has fallen 18 m is lower than the value calculated in (a).

Describe the energy transfers occurring from immediately before the car was released to when the car has fallen 18 m.

Refer to stores and transfers in your answer.
(4 marks)

(continued on the next page)

10 continued.

(Total for Question 10 = 10 marks)

11 Look at the diagram for Question 11 in the Diagram Booklet. A steel ball is fired from a launcher on an adjustable table.

A student investigates how the range of the steel ball varies with the height of the table.

(a) Describe a method for the student's investigation.

Your answer should include details of

- the variables in the investigation
- how the investigation will be valid (a fair test)
- how the range will be measured accurately

(6 marks)

(continued on the next page)

11 continued.

(continued on the next page)

11 continued.

(continued on the next page)

11 continued.

(continued on the next page)

11 continued.

(b) Look at the graph for Question 11(b) in the Diagram Booklet. It shows the student's results.

(i) Draw the curve of best fit.
(1 mark)

(ii) Estimate what the height of the table would be when the range of the projectile is 0·60 m.
(1 mark)

height = _____ m

(continued on the next page)

11 continued.

(iii) Justify why the student has plotted a line graph rather than a bar chart.
(1 mark)

(continued on the next page)

11 continued.

(iv) The range of the projectile is related to the table height by this formula

$$\text{range} = \text{launch speed} \times \sqrt{\frac{\text{table height}}{5}}$$

Using data from the graph, show that the launch speed of the projectile is approximately 3 m/s. (4 marks)

(continue your answer on the next page)

11 continued.

launch speed = _____ m/s

(Total for Question 11 = 13 marks)

12 (a) Look at Image 1a for Question 12(a) in the Diagram Booklet. It shows part of an ammeter that can measure very small currents.

A student moves a wire between the poles of a strong magnet and uses the ammeter to measure the induced current.

Look at Image 1b for Question 12(a) in the Diagram Booklet. It shows a close-up of part of the scale on the ammeter. Determine the current reading shown by the ammeter in Image 1b.
(1 mark)

current = _____ mA

(continued on the next page)

12 continued.

(b) (i) Predict a value for the current if the movement of the wire was repeated with the poles of the magnet reversed.
(1 mark)

current = _____ mA

(ii) Predict a value for the current if the wire is moved faster between the poles of the magnet.
(1 mark)

current = _____ mA

(continued on the next page)

12 continued.

(c) Look at Image 2 for Question 12(c) in the Diagram Booklet. It shows the structure of the ammeter.
The ammeter has a needle attached to a coil of wire which can move freely around a magnet.
When there is a current in the coil, the needle moves.
The larger the current, the more the coil turns.

Suggest how the design of the ammeter could be modified to increase its sensitivity.
(1 mark)

(continued on the next page)

12 continued.

(d) Look at Image 3 for Question 12(d) in the Diagram Booklet. It shows part of the ammeter after a student has adjusted the ammeter in error.

The needle on the ammeter does not point to zero when there is no current.

(i) Which of these factors has been decreased by the student's adjustment? (1 mark)

☐ A accuracy

☐ B precision

☐ C reliability

☐ D resolution

(continued on the next page)

12 continued.

(ii) Suggest how the student could correct the readings taken from this ammeter due to this error without adjusting the ammeter.
(1 mark)

(Total for Question 12 = 6 marks)

TOTAL FOR PAPER = 110 MARKS
END OF PAPER