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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Time 1 hour 15 minutes

Paper reference **4PH1/2P**

Physics

UNIT: 4PH1
PAPER: 2P

January 2022

You must have:
Ruler, calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- 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.

Turn over ▶

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FORMULAE

You may find the following formulae useful.

energy transferred = current × voltage × time $\qquad E = I \times V \times t$

$$\text{frequency} = \frac{1}{\text{time period}} \qquad f = \frac{1}{T}$$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{power} = \frac{\text{energy transferred}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{orbital speed} = \frac{2\pi \times \text{orbital radius}}{\text{time period}} \qquad v = \frac{2 \times \pi \times r}{T}$$

(final speed)^2 = (initial speed)^2 + (2 × acceleration × distance moved)

$$v^2 = u^2 + (2 \times a \times s)$$

pressure × volume = constant $\qquad p_1 \times V_1 = p_2 \times V_2$

$$\frac{\text{pressure}}{\text{temperature}} = \text{constant} \qquad \frac{p_1}{T_1} = \frac{p_2}{T_2}$$

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken}} \qquad F = \frac{(mv - mu)}{t}$$

$$\frac{\text{change of wavelength}}{\text{wavelength}} = \frac{\text{velocity of a galaxy}}{\text{speed of light}} \qquad \frac{\lambda - \lambda_0}{\lambda_0} = \frac{\Delta\lambda}{\lambda_0} = \frac{v}{c}$$

change in thermal energy = mass × specific heat capacity × change in temperature

$$\Delta Q = m \times c \times \Delta T$$

Where necessary, assume the acceleration of free fall, $g = 10\ \text{m/s}^2$.

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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 (a) Which of these is a device used to measure force?

(1)

☒ **A** newton meter

☒ **B** ruler

☒ **C** thermometer

☒ **D** voltmeter

(b) Airbags are safety devices used in cars to protect the driver if there is a crash.

(i) State the formula linking momentum, mass and velocity.

(1)

(ii) A person inside a car has a mass of 72 kg and a velocity of 13 m/s.

Show that the momentum of the person is about 900 kg m/s.

(1)

(iii) The person experiences a crash and comes to rest in 0.29 s.

Calculate the force on the person.

(2)

force = ... N

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(iv) Which statement explains how airbags protect the driver?

(1)

- ☒ **A** increase the force acting on the driver
- ☒ **B** increase the time taken for the driver to stop
- ☒ **C** increase the kinetic energy store of the driver
- ☒ **D** increase the momentum of the driver

(Total for Question 1 = 6 marks)

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2 (a) Describe the arrangement and motion of particles in a solid.

You may draw a diagram to help your answer.

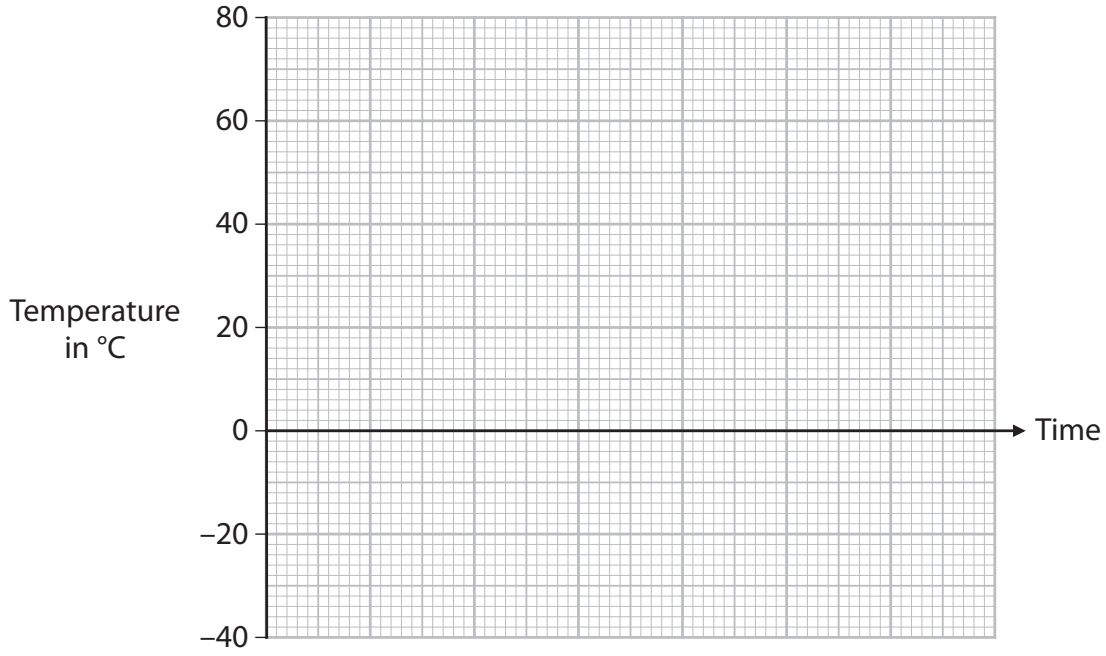
(3)

(b) A solid changes state by melting at a certain temperature.

For phosphorus, this change of state occurs at 44 °C.

Sketch how the temperature of a sample of phosphorus changes when it is heated at a constant rate from –40 °C to 80 °C.

(3)



(Total for Question 2 = 6 marks)

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3 Nuclear fusion is a process that occurs in the core of stars.

(a) Which is the best description of nuclear fusion?

(1)

- ☒ **A** large nucleus splitting into two smaller nuclei
- ☒ **B** nucleus emitting an electromagnetic wave
- ☒ **C** nucleus releasing a beta particle
- ☒ **D** two smaller nuclei joining together to form a larger nucleus

(b) Two nuclei are close together and stationary.

Explain why these nuclei will move apart.

(2)

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(c) Describe the conditions needed for fusion to occur in the core of a star.

(2)

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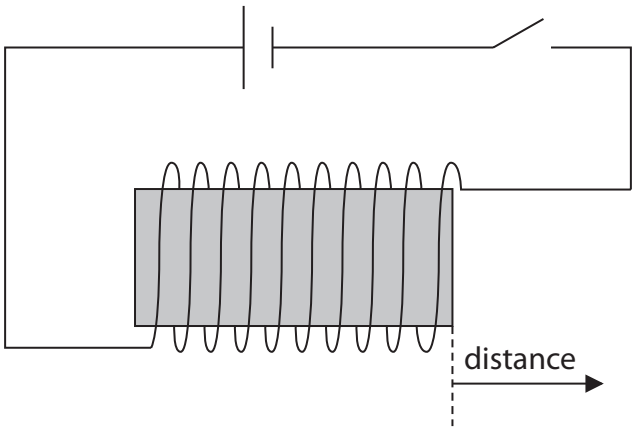
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(Total for Question 3 = 5 marks)

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4 A student investigates how the strength of the magnetic field from a solenoid changes with distance from the end of the solenoid.

The diagram shows the solenoid connected to a power supply.



(a) The student uses a device called a Hall probe, which can be placed anywhere in the magnetic field to measure its strength at that point.

Design a suitable method for the investigation.

Your answer should include

- any extra measuring equipment needed
- details of the independent variable, dependent variable and any control variables

You may include a diagram to help your answer.

(5)

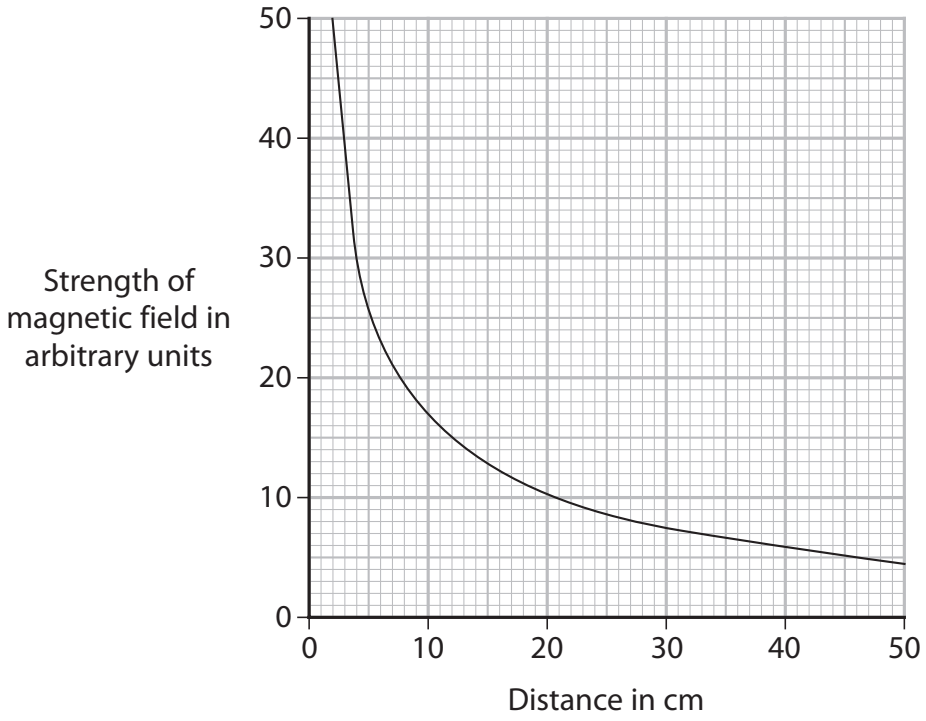
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(b) The graph shows the results of the student's investigation.



The student suggests that the relationship linking the strength of the magnetic field and the distance from the end of the solenoid is

$$\text{strength of magnetic field} \times (\text{distance})^3 = \text{constant}$$

Use readings from the graph to deduce whether the results of the student's investigation support this relationship.

(4)

(Total for Question 4 = 9 marks)

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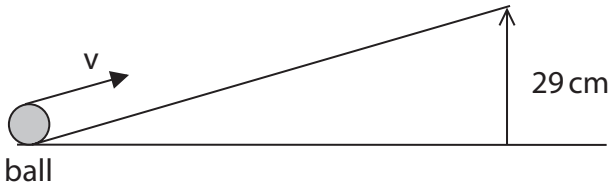
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5 The diagram shows a ball at the bottom of a ramp. The ball moves up the ramp with an initial speed v.



(a) State the formula linking gravitational potential energy (GPE), mass, gravitational field strength (*g*) and height.

(1)

(b) The ball has a mass of 14 g.

Show that when the ball reaches a height of 29 cm above the bottom of the ramp, the GPE gained by the ball is about 4×10^{-2} J.

(3)

(c) At the bottom of the ramp, the 14 g ball has a kinetic energy (KE) of 5.1×10^{-2} J.

Calculate the speed of the ball at the bottom of the ramp.

(3)

speed = ... m/s

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(d) The ball is stationary when it reaches the top of the ramp. There is a difference between the KE of the ball at the bottom of the ramp and the GPE of the ball at a height of 29 cm above the bottom of the ramp.

Explain why the work done by friction between the ball and the ramp is equal to this difference.

(2)

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(Total for Question 5 = 9 marks)

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6 Magnetic Resonance Imaging (MRI) machines can take scans of the inside of a patient.

(a) There is an electromagnet inside the MRI machine.

Describe the construction of an electromagnet.

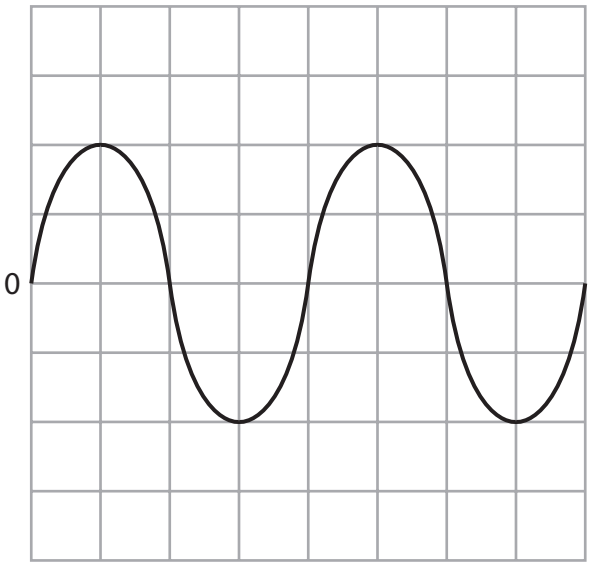
You may draw a diagram to help your answer.

(4)

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(b) During the scan, music can be played through a loudspeaker to the patient.

The oscilloscope trace in the diagram represents a sound played to the patient.



Oscilloscope settings:

y direction: 1 square = 0.5 V

x direction: 1 square = 0.5 ms

(i) Determine the period of the sound wave.

(3)

period = ... s

(ii) Calculate the frequency of the sound wave.

(2)

frequency = ... Hz

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(iii) Deduce whether humans can hear the sound wave.

(2)

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(iv) The current in the loudspeaker is alternating current (a.c.).

Give the evidence from the oscilloscope trace to support this statement.

(2)

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(v) Draw the circuit symbol for an a.c. power supply.

(1)

(Total for Question 6 = 14 marks)

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7 The photographs show two large-scale electrical production methods

- a hydroelectric power (HEP) station
- a wind farm



(Source: © Bryan Busovicki/Shutterstock)

Hydroelectric power station



(Source: © Tom Buysse/Shutterstock)

Wind farm

(a) Discuss the advantages and disadvantages of using hydroelectric power stations compared with wind farms for large-scale electricity production.

(4)

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(b) Describe the energy transfers that are involved in generating electricity in a hydroelectric power station.

(3)

(Total for Question 7 = 7 marks)

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8 (a) (i) A galaxy moves away from the Earth at a speed of 3.9×10^4 km/s.

The speed of light is 3.0×10^5 km/s.

Light from the galaxy is emitted with a wavelength of 6.2×10^{-7} m.

Calculate the change in the wavelength of the light that is received by an observer on the Earth.

(3)

change in wavelength = ... m

(ii) Calculate the wavelength of light that is received by an observer on the Earth.

(1)

wavelength = ... m

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(b) One of the pieces of evidence for the Big Bang theory is the red-shift of galaxies.

Explain how the red-shift of galaxies supports the Big Bang theory.

(3)

(Total for Question 8 = 7 marks)

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9 A student uses a small iron nail and a beaker of water to estimate the temperature of a flame. The diagram shows some of the equipment used.



This is the student's method

- place a thermometer into the beaker of water
- record the temperature of the water
- heat the nail in the flame for a long period of time
- quickly move the nail into the beaker of water
- record the highest temperature of the water

(a) State a safety precaution the student should take.

(1)

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(b) While in the water, the thermal energy store of the nail decreases and the thermal energy store of the water increases until their temperatures are the same.

The energy lost from the nail is equal to the energy gained by the water.

The table shows the student's results.

Mass of water in g	138
Specific heat capacity of water in J/kg °C	4200
Temperature change of water in °C	5.0
Mass of nail in g	4.8
Specific heat capacity of iron in J/kg °C	450

(i) Show that the energy gained by the water is approximately 3000 J.

(2)

(ii) Calculate the temperature change of the nail.

(3)

Temperature change = ... °C

(iii) Give a reason why the calculated temperature change of the nail is lower than the actual temperature change.

(1)

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(Total for Question 9 = 7 marks)

TOTAL FOR PAPER = 70 MARKS

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