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)

Wednesday 22 November 2023

Morning (Time: 1 hour 15 minutes)

Paper reference **4PH1/2P**

Physics
UNIT: 4PH1
PAPER: 2P

You must have:
Ruler, calculator, Equation Booklet (enclosed)

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.

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P 7 3 4 2 9 A 0 1 2 8

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FORMULAE

You may find the following formulae useful.

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

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

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

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

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

$(\text{final speed})^2 = (\text{initial speed})^2 + (2 \times \text{acceleration} \times \text{distance moved})$

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

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

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

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

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

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 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)

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		

(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)

1 ....

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2 ....

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(Total for Question 1 = 7 marks)

2 This question is about moments.

Diagram 1 shows the raised lower leg of a person.

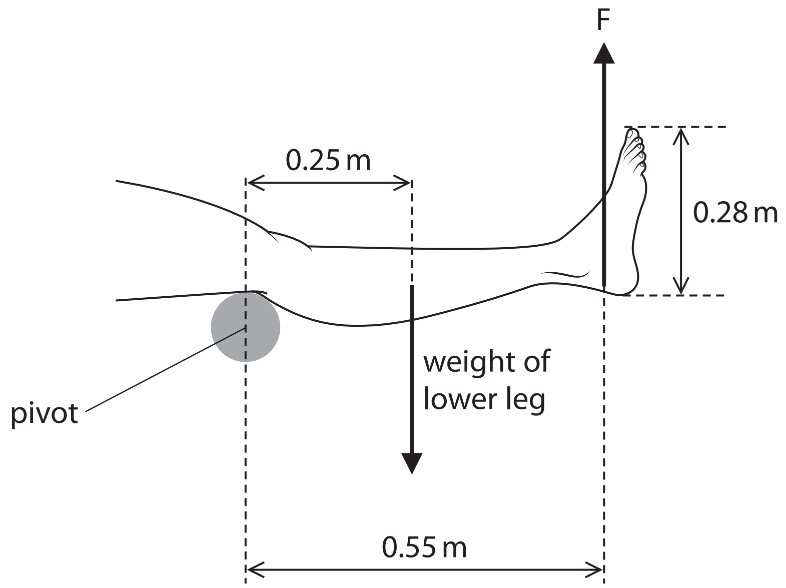

Diagram 1

(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)

force F = ... N

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

(1)

☒ **A** 0.25 m

☒ **B** 0.28 m

☒ **C** 0.30 m

☒ **D** 0.55 m

(b) Diagram 2 shows the person resting their lower leg on two supports.

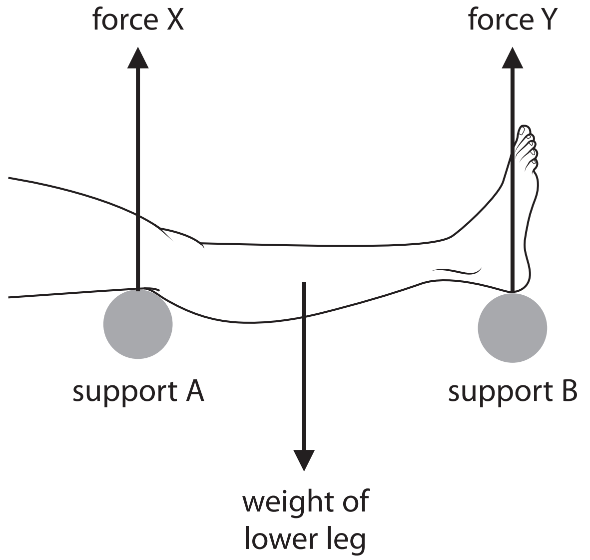

Diagram 2

(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)

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....

(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)

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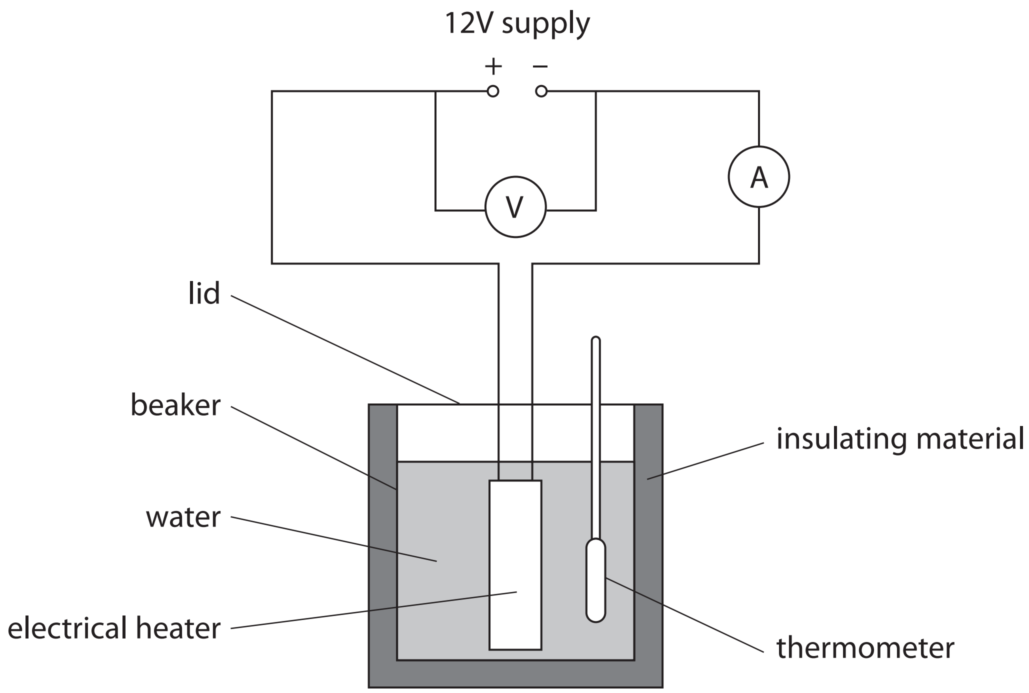
(Total for Question 2 = 9 marks)

3 The diagram 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)

(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)

specific heat capacity of water = ... J/kg °C

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

(2)

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2 ....

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(Total for Question 3 = 11 marks)

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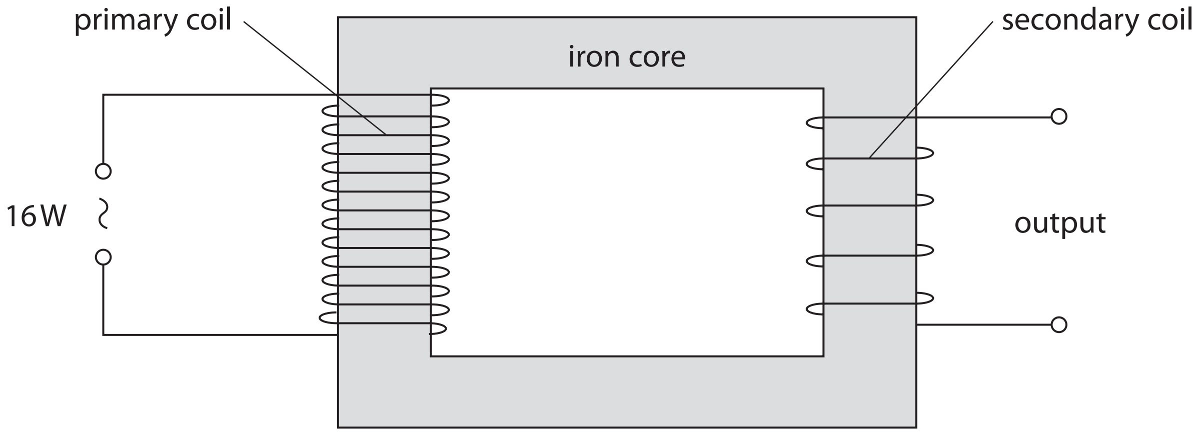
4 The diagram shows a step-down transformer.



(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)

energy transferred = ... J

(b) Explain how a transformer works.

In your answer, include reasons for using

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

(6)

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

(1)

(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.

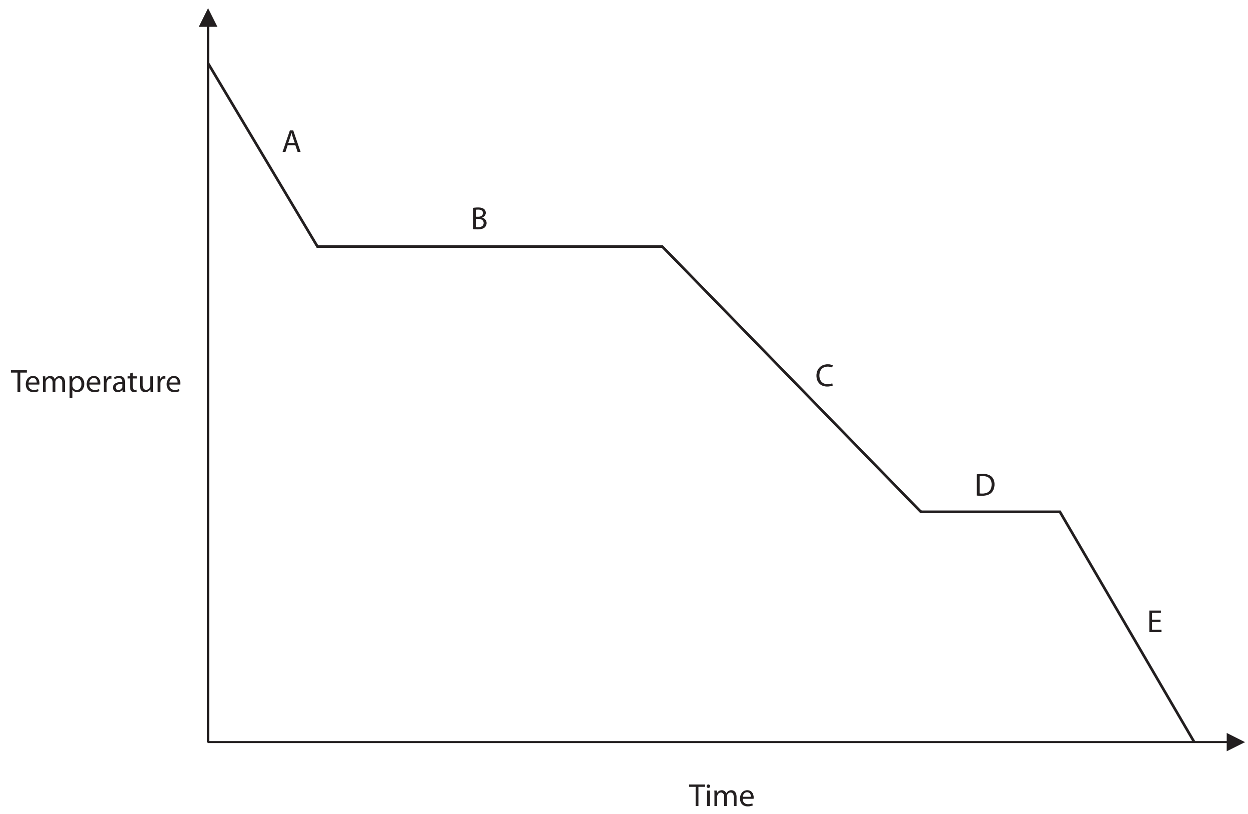
Calculate the initial temperature of the steam in kelvin (K).

(1)

initial temperature = ... K

(b) 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)

....

(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)

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

(3)

(Total for Question 5 = 7 marks)

6 This question is about momentum and forces.

(a) State the principle of conservation of momentum.

(1)

....

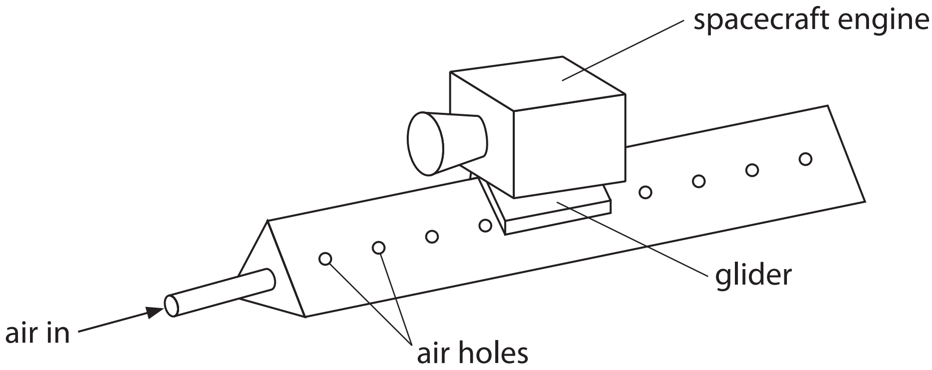
....

....

(b) The diagram 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)

momentum = ... kg m / s

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

A mass of 2.6×10^{-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)

momentum = ... kg m / s

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

(2)

magnitude of momentum = ... kg m/s

direction of momentum = ...

(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)

acceleration = ... m/s^2

(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, 9.9×10^{-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)

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(Total for Question 6 = 13 marks)

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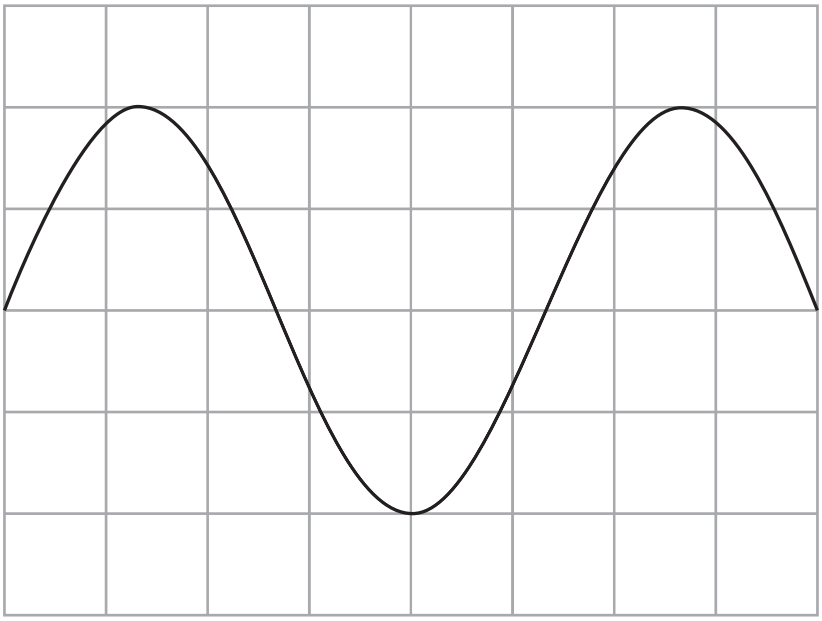
7 The diagram shows the screen of an oscilloscope when a sound wave is detected, and the oscilloscope settings.



oscilloscope settings:

y direction: 1 square = 5.0 V
x direction: 1 square = 0.0020 s

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

(1)

....

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

(2)

time period = ... s

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

(1)

frequency = ... Hz

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

(1)

(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 6.3×10^{-5} C of charge passes through the oscilloscope.

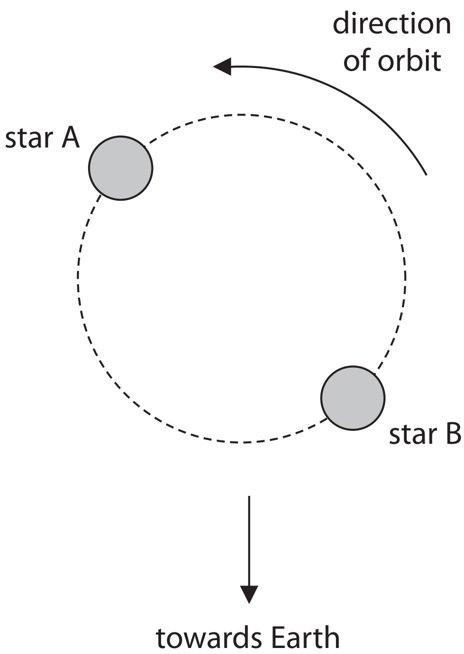
(3)

energy transferred = ... J

(Total for Question 7 = 8 marks)

8 This question is about red-shift.

(a) The diagram 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)

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(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 = 3.0×10^8 m / s]

(4)

velocity = ... m / s

(Total for Question 8 = 5 marks)

TOTAL FOR PAPER = 70 MARKS

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Pearson Edexcel International GCSE (9–1)

Wednesday 22 November 2023

Paper reference **4PH1/2P**

Physics

UNIT: 4PH1
PAPER: 2P

Equation Booklet

Do not return this Booklet with the question paper.

Turn over ▶

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P 7 3 4 2 9 A

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These equations may be required for both International GCSE Physics (4PH1) and International GCSE Combined Science (4SD0) papers.

1. Forces and Motion	
average speed = $\frac{\text{distance moved}}{\text{time taken}}$	
acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$	$a = \frac{(v-u)}{t}$
(final speed)^2 = (initial speed)^2 + (2 × acceleration × distance moved)	$v^2 = u^2 + (2 \times a \times s)$
force = mass × acceleration	$F = m \times a$
weight = mass × gravitational field strength	$W = m \times g$
2. Electricity	
power = current × voltage	$P = I \times V$
energy transferred = current × voltage × time	$E = I \times V \times t$
voltage = current × resistance	$V = I \times R$
charge = current × time	$Q = I \times t$
energy transferred = charge × voltage	$E = Q \times V$
3. Waves	
wave speed = frequency × wavelength	$v = f \times \lambda$
frequency = $\frac{1}{\text{time period}}$	$f = \frac{1}{T}$
refractive index = $\frac{\sin(\text{angle of incidence})}{\sin(\text{angle of refraction})}$	$n = \frac{\sin i}{\sin r}$
$\sin(\text{critical angle}) = \frac{1}{\text{refractive index}}$	$\sin c = \frac{1}{n}$

4. Energy resources and energy transfers	
efficiency = $\dfrac{\text{useful energy output}}{\text{total energy output}} \times 100\%$	
work done = force × distance moved	$W = F \times d$
gravitational potential energy = mass × gravitational field strength × height	$GPE = m \times g \times h$
kinetic energy = $\dfrac{1}{2}$ × mass × speed^2	$KE = \dfrac{1}{2} \times m \times v^2$
power = $\dfrac{\text{work done}}{\text{time taken}}$	$P = \dfrac{W}{t}$
5. Solids, liquids and gases	
density = $\dfrac{\text{mass}}{\text{volume}}$	$\rho = \dfrac{m}{V}$
pressure = $\dfrac{\text{force}}{\text{area}}$	$p = \dfrac{F}{A}$
pressure difference = height × density × gravitational field strength	$p = h \times \rho \times g$
$\dfrac{\text{pressure}}{\text{temperature}}$ = constant	$\dfrac{p_1}{T_1} = \dfrac{p_2}{T_2}$
pressure × volume = constant	$p_1 \times V_1 = p_2 \times V_2$
8. Astrophysics	
orbital speed = $\dfrac{2 \times \pi \times \text{orbital radius}}{\text{time period}}$	$v = \dfrac{2 \times \pi \times r}{T}$

The equations on the following page will only be required for International GCSE Physics.

These additional equations may be required in International GCSE Physics papers 2P and 2PR.

1. Forces and Motion	
momentum = mass × velocity	$p = m \times v$
force = $\dfrac{\text{change in momentum}}{\text{time taken}}$	$F = \dfrac{(mv - mu)}{t}$
moment = force × perpendicular distance from the pivot	
5. Solids, liquids and gases	
change in thermal energy = mass × specific heat capacity × change in temperature	$\Delta Q = m \times c \times \Delta T$
6. Magnetism and electromagnetism	
relationship between input and output voltages for a transformer	$\dfrac{\text{input (primary) voltage}}{\text{output (secondary) voltage}} = \dfrac{\text{primary turns}}{\text{secondary turns}}$
input power = output power	$V_p I_p = V_s I_s$ for 100% efficiency
8. Astrophysics	
$\dfrac{\text{change in wavelength}}{\text{reference wavelength}} = \dfrac{\text{velocity of a galaxy}}{\text{speed of light}}$	$\dfrac{\lambda - \lambda_0}{\lambda_0} = \dfrac{\Delta\lambda}{\lambda_0} = \dfrac{v}{c}$

END OF EQUATION LIST