Please check the examination details below before entering your candidate infor on

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Thursday 25 May 2023

Morning (Time: 2 hours)

Paper reference 4PH1/1PR 4SD0/1PR

Physics

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

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

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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 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.*

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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P 7 1 9 5 6 A 0 1 3 2

Pearson

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 $p_1 \times V_1 = p_2 \times V_2$

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

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 the electromagnetic spectrum.

(a) The table gives some statements about the electromagnetic spectrum.

Place three ticks (✓) in the table to show which statements are correct.

(3)

Statement	Correct
all electromagnetic waves are longitudinal	
all electromagnetic waves travel at the same speed in free space	
radio waves have the longest wavelength in the electromagnetic spectrum	
x-rays have the highest frequency in the electromagnetic spectrum	
all electromagnetic waves transfer energy	
all electromagnetic waves can cause cancer	

(b) Electromagnetic waves can be useful, but can also be harmful.

(i) Give one use and one harmful effect of microwaves.

(2)

use

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harmful effect

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(ii) Give one use and one harmful effect of gamma rays.

(2)

use

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harmful effect

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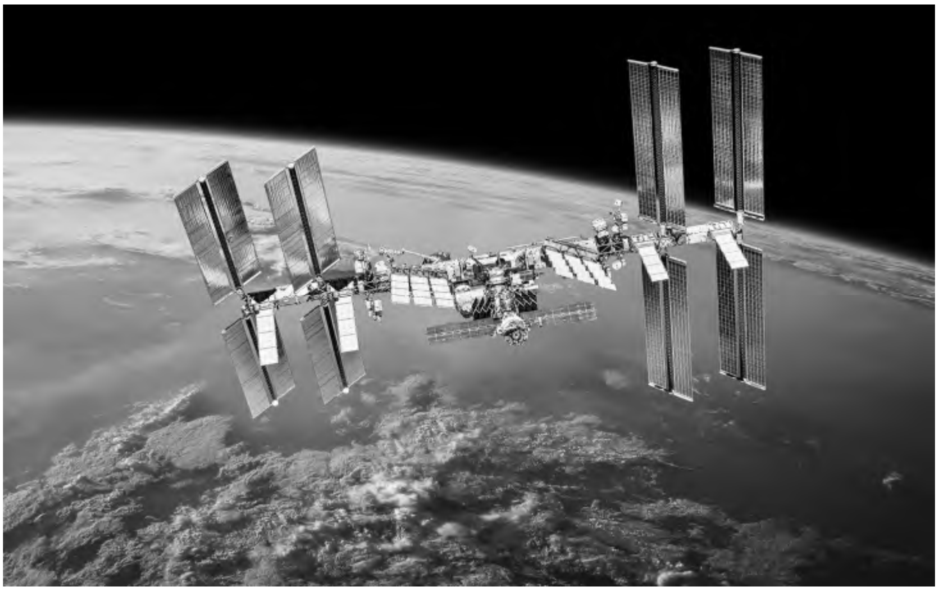
(Total for Question 1 = 7 marks)

2 The photograph shows the International Space Station (ISS) in orbit around the Ea



(Source: © Dima Zel/Shutterstock)

(a) The ISS orbits the Earth in a circular orbit.

Which of these also orbits the Earth?

(1)

☒ **A** a comet

☒ **B** Mars

☒ **C** the Moon

☒ **D** the Sun

(b) Which of these forces causes the ISS to orbit the Earth?

(1)

☒ **A** air resistance

☒ **B** electrostatic

☒ **C** friction

☒ **D** gravitational

(c) The ISS completes one orbit of the Earth in a time period of 93 minutes.

(i) The orbital radius of the ISS is 6.8×10^3 km.

Calculate the orbital speed of the ISS in km / s.

(3)

orbital speed = ... km / s

(ii) Show that the ISS completes approximately 15 orbits of the Earth each day.

(2)

(Total for Question 2 = 7 marks)

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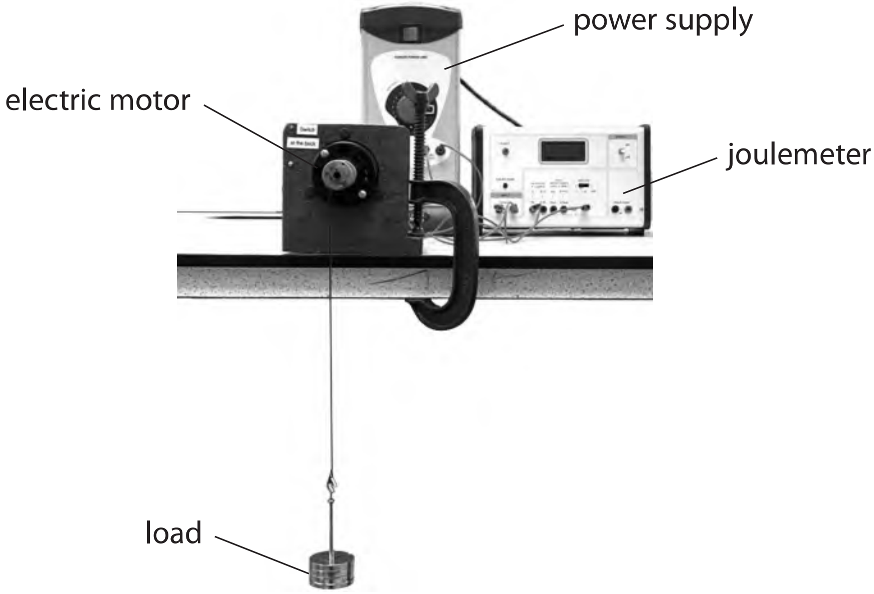
3 A model electric motor is used to lift a load through a vertical height.



(a) The load has a mass of 400 g and gains 3.2 J of energy in its gravitational store when lifted.

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

(1)

(ii) Calculate the height the load is lifted.

(3)

height = ... m

(iii) State the amount of useful work done on the load by the motor when the load is lifted through this height.

(1)

work done = ... J

(b) The load is lifted at a constant speed.

Diagram 1 shows the lifting force acting on the load as it is lifted.

Draw a labelled arrow on diagram 1 to show the other force acting on the load.

Ignore the effects of air resistance.

(2)

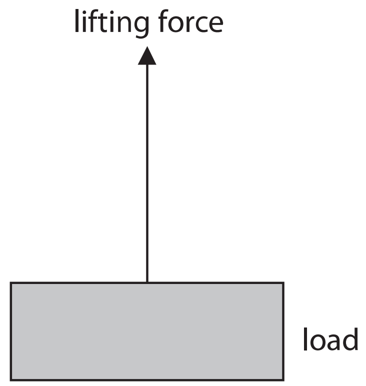


Diagram 1

(c) A joulemeter measures the amount of energy transferred electrically to the motor as the motor lifts the load.

The joulemeter displays a reading of 11.0 J when the load has gained 3.2 J of energy in its gravitational store.

(i) Calculate the efficiency of the motor.

(3)

efficiency = ...

(ii) Justify why 7.8 J of energy must be dissipated into the thermal store of the surroundings as the load is lifted.

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(iii) Diagram 2 is an incomplete Sankey diagram.

Complete the Sankey diagram to show the energy transferred by the motor.

(3)

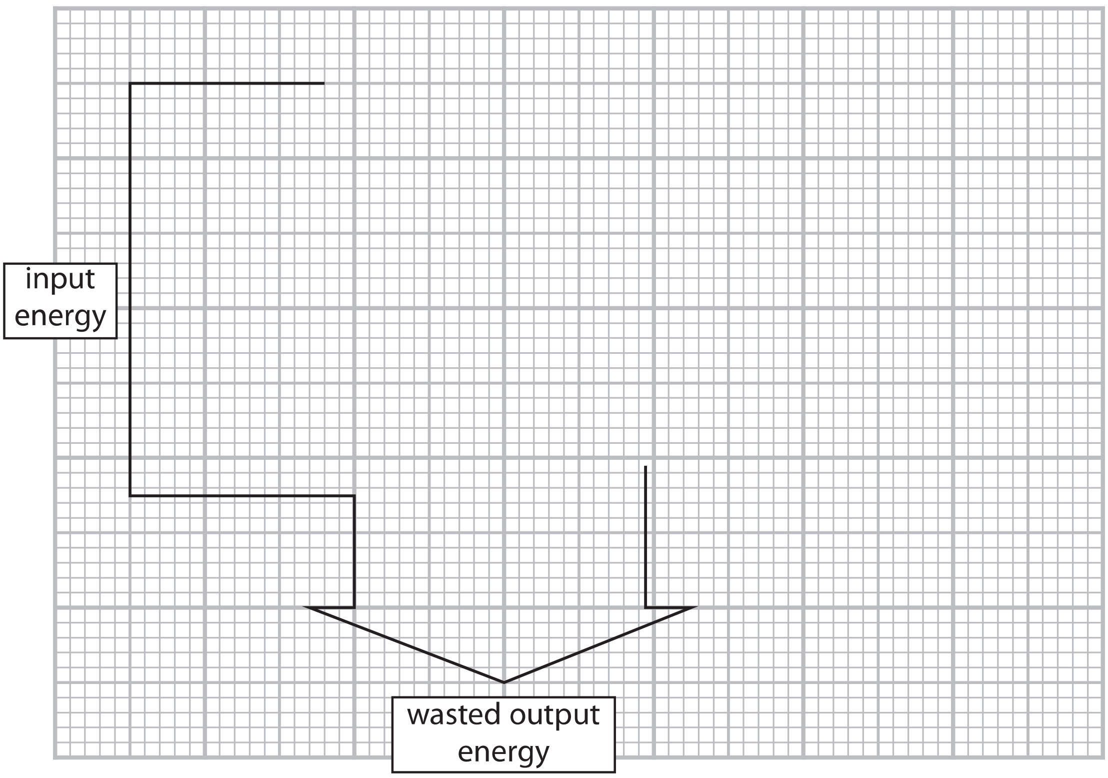

Diagram 2

(Total for Question 3 = 15 marks)

4 This question is about magnets.

(a) Which of these substances is **not** attracted to a bar magnet?

(1

☒ **A** cobalt

☒ **B** copper

☒ **C** iron

☒ **D** nickel

(b) Diagram 1 shows a bar magnet.

Diagram 1

Draw magnetic field lines on diagram 1 to show the shape and direction of the magnetic field around the bar magnet.

(3)

(c) Some bar magnets are made of steel.

Explain why steel is a good material for making bar magnets.

(2)

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(d) Diagram 2 shows a cross-section through a wire placed between two magnetic poles.

The direction of the current in the wire is out of the page.

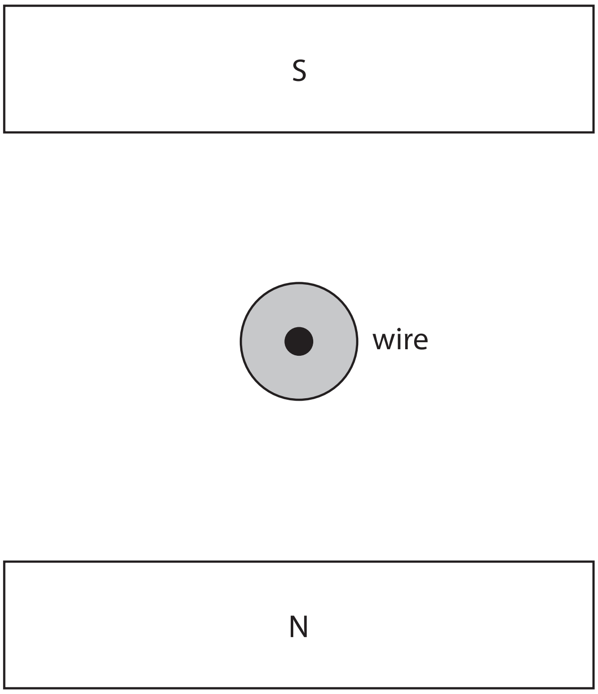

Diagram 2

(i) Draw an arrow on diagram 2 to show the direction of the force on the wire due to the magnetic field.

Assume that the magnetic field is uniform.

(2)

(ii) State two changes that could be made that would decrease the magnitude of the force on the wire in diagram 2.

(2)

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2 ....

(Total for Question 4 = 10 marks)

5 A car is travelling in a straight line along a road. The car passes a person standing a the side of the road.

Before passing the person, the driver of the car presses the car's horn. The horn makes a loud sound of constant frequency.

The horn continues to make a sound until after the car has passed the person.

Discuss the differences in the frequencies of the sound heard by

- the driver of the car
- the person at the side of the road

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(Total for Question 5 = 6 marks)

6 A student investigates how the current in a 60 Ω resistor varies with the voltage across the resistor.

(a) The student has access to this equipment

- 12 V battery
- ammeter and voltmeter
- 60 Ω resistor
- variable resistor
- switch
- connecting wires

Draw a circuit diagram to show how the student could connect this equipment to carry out the investigation.

(4)

(b) Describe a suitable method the student could use for this investigation.

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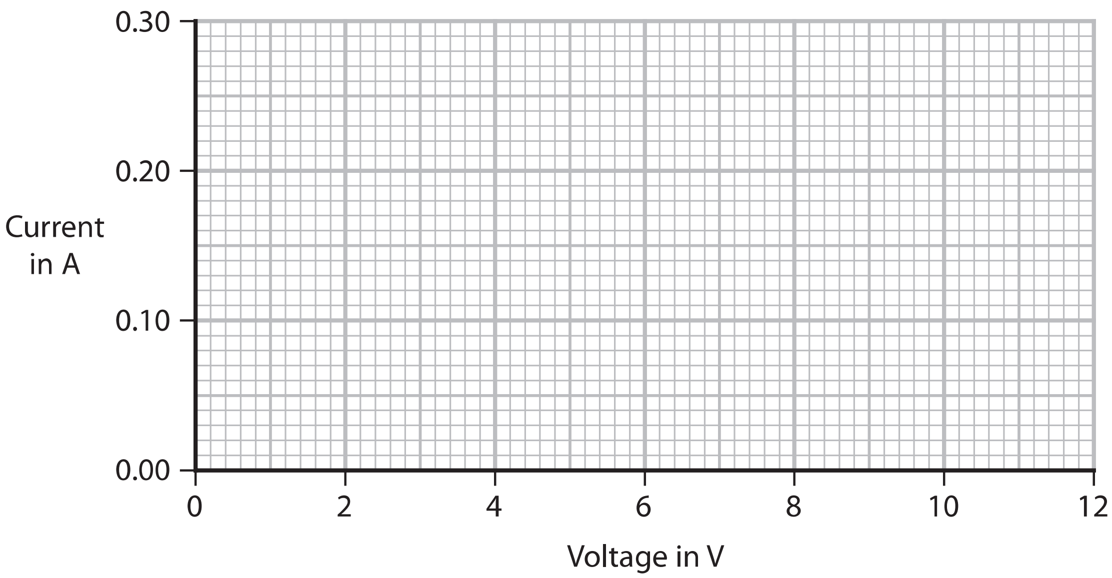
(3)

(c) (i) Complete the current–voltage graph by drawing a line that shows the expected results of the investigation.



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(ii) The student repeats their investigation with a 120 Ω resistor.

Explain how a current–voltage graph for a 120 Ω resistor compares with the current–voltage graph for the 60 Ω resistor.

(3)

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(Total for Question 6 = 14 marks)

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7 Protactinium is an element with several different radioactive isotopes.

(a) Protactinium-234 has a half-life of 6.7 hours.

A sample of protactinium-234 has an initial activity of 800 units.

(i) Give a suitable unit for activity.

(1)

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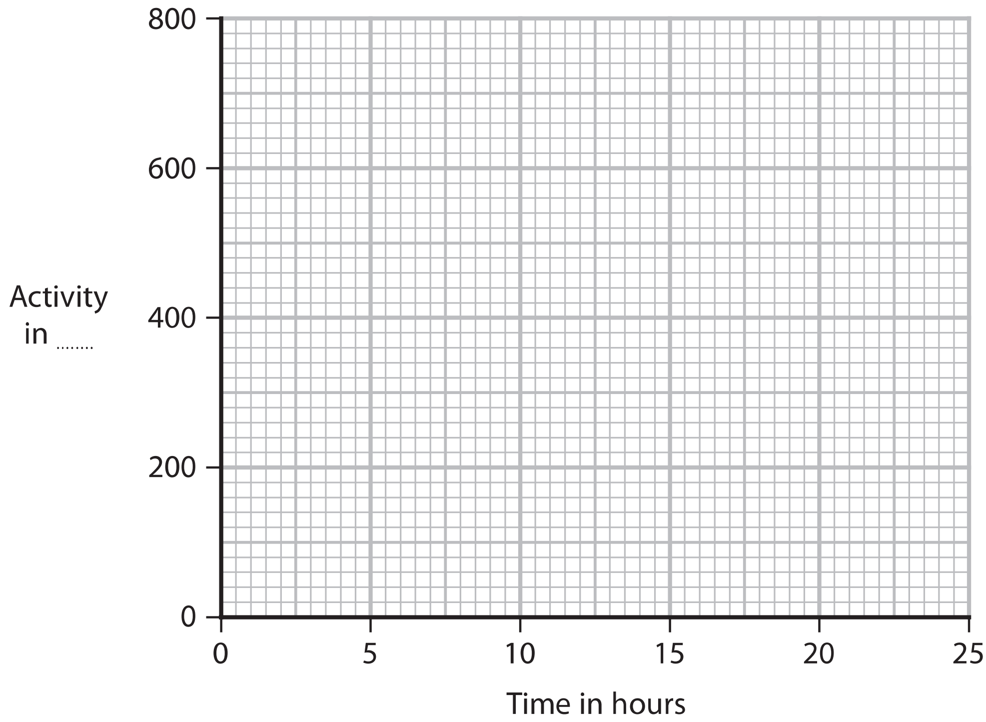
(ii) On the axes below, sketch a graph for the decay of the sample of protactinium-234 during its first three half-lives.

(3)



(iii) When protactinium-234 undergoes beta (β^-) decay it becomes uranium-234.

The incomplete nuclear equation shows this process.

$$^{234}_{\square}\text{Pa} \longrightarrow {}^{234}_{92}\text{U} + {}^{\square}_{\square}\beta$$

Complete the nuclear equation to show the beta decay of protactinium-234.

Write your answers in the dashed boxes.

(2)

(b) A student suggests an experiment to determine the type of radiation emitted a different isotope of protactinium, protactinium-231.

This is the suggested method.

Step 1 connect a suitable radiation detector to a radiation counter

Step 2 place a source of protactinium-231 at a fixed distance of 3 cm from the radiation detector

Step 3 record the count of detected radiation for a time of one minute

Step 4 place a sheet of paper between the source and detector

Step 5 record the count of detected radiation for a time of one minute

Step 6 repeat Steps 4 and 5 using a sheet of aluminium and then a sheet of lead instead of the sheet of paper

The table shows the results of the investigation when it is done by a teacher.

Material between source and detector	**Count**
no material	261
paper	14
aluminium	11
lead	13

(i) Which of these is the dependent variable in the investigation?

(1)

- ☒ **A** count measured by the detector
- ☒ **B** distance between source and detector
- ☒ **C** material between source and detector
- ☒ **D** time the count is measured

(ii) The student's method does not allow for background radiation.

Describe how the student's method should be modified to allow for background radiation.

(3)

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(iii) Describe how the student's method could be modified to improve the reliability of the results.

(2)

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(iv) Evaluate the data from the experiment to conclude the type of radiation emitted by protactinium-231.

(3)

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(Total for Question 7 = 15 marks)

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8 Diagram 1 shows a set of masses attached to a spring, which is suspended from a support.

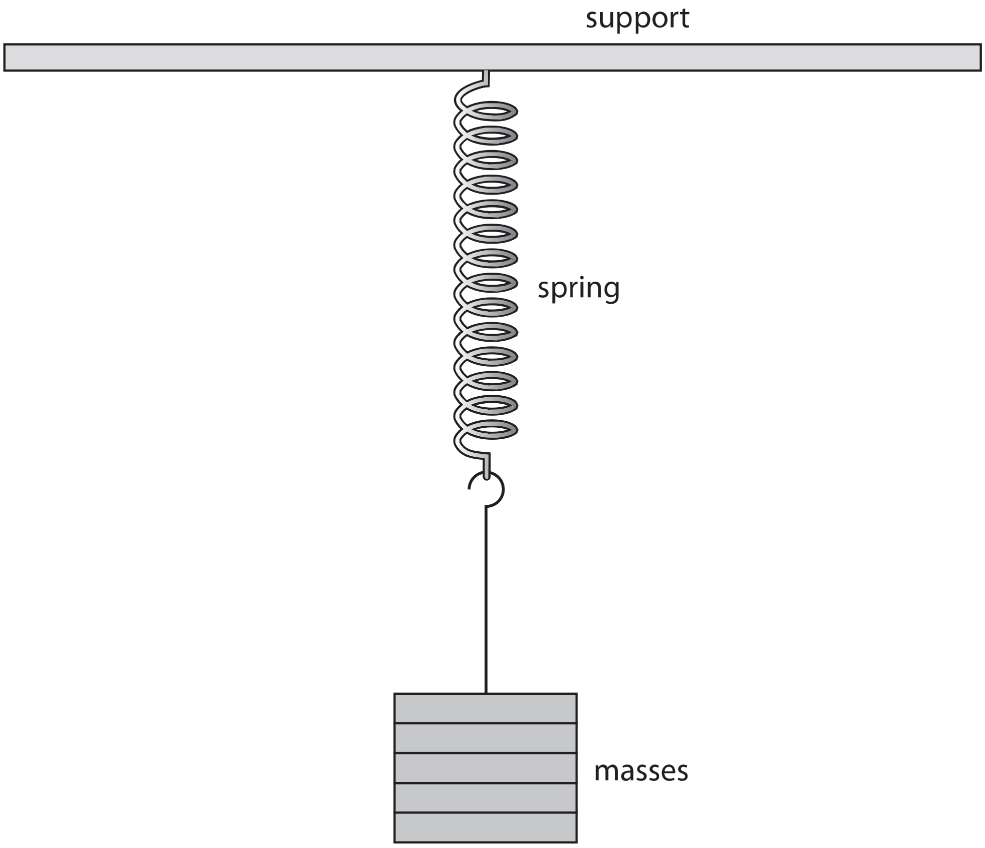


Diagram 1

(a) After the masses are added, the length of the spring is 14.6 cm.

The student measures the extension of the spring as 11.5 cm.

(i) Calculate the original length of the spring.

(1)

original length = ... cm

(ii) The student removes the masses and notices that the spring does **not** show elastic behaviour.

Predict a value for the new length of the spring after the masses have been removed.

(1)

new length of spring = ... cm

(b) The student puts the masses back on the spring.

The student then pulls the masses down and releases them.

The masses vibrate up and down in a vertical direction, as shown in diagram 2.

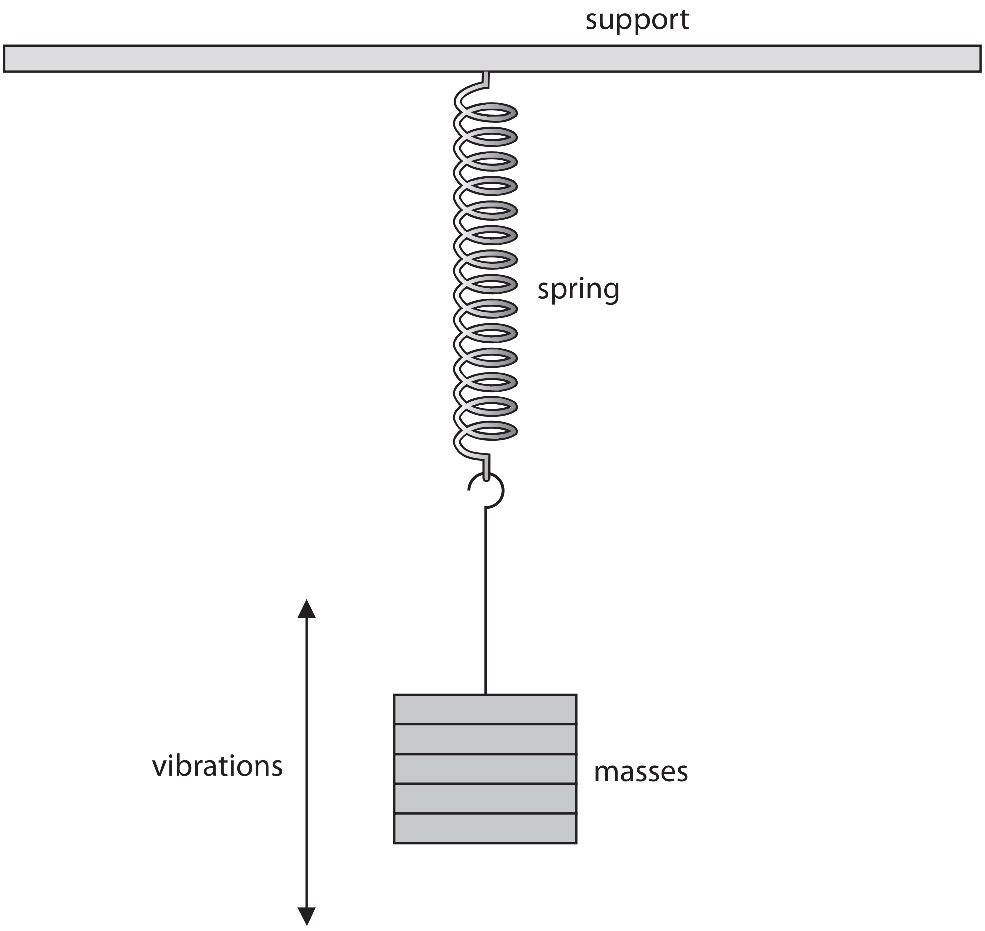
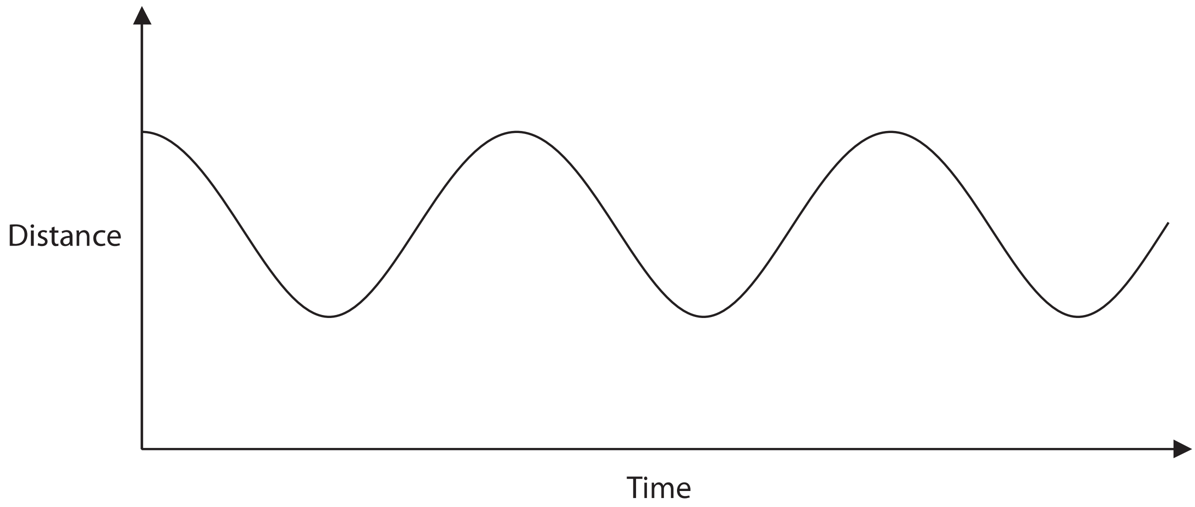


Diagram 2

The distance–time graph shows how the distance between the top of the mas and the support changes with time as the masses vibrate.



(i) Explain how the gradient of the graph shows that the masses accelerate as they vibrate.

(3)

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(ii) Add crosses (☓) to the distance–time graph to show all the times when the masses are not moving.

(2)

(Total for Question 8 = 7 marks)

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9 The driver of a racing car makes a pit stop during a race to change the tyres on the racing car.

The area where the tyres are changed is called the pit lane.

(Source: © Hafiz Johari/Shutterstock)

(a) Before entering the pit lane, the speed of the car must decrease for safety reasons.

(i) The mass of the racing car is 830 kg.

The maximum braking force is 41 000 N.

Show that the maximum deceleration of the racing car is approximately 50 m / s^2.

(3)

(ii) The racing car is travelling at an initial speed of 72 m / s.

Calculate the minimum distance needed to decrease the speed of the racing car from 72 m / s to 26 m / s.

(3)

distance = ... m

(b) The racing car slows down using its brakes.

The brakes work using friction.

The brakes become very hot when the racing car slows down.

Using ideas about energy, explain why the brakes become hot.

(3)

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(c) The tyres of the racing car also get very hot during a race.

A mechanic has to handle the hot tyres during the pit stop.

They wear protective gloves which have several layers of insulating materials.

Explain how the layers of insulating materials in the gloves reduce the risk of the mechanic burning their hands on the hot tyres.

(2)

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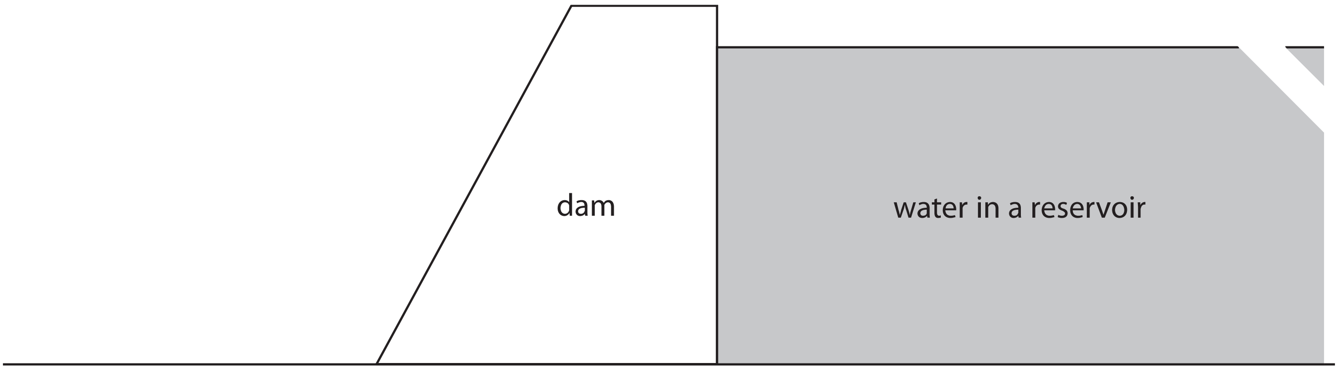
(Total for Question 9 = 11 marks)

10 A dam is a structure designed to hold water in a reservoir.



(a) The water in the reservoir has a depth of 35 m.

(i) State the formula linking pressure difference, height, density and *g*.

(1)

(ii) Atmospheric pressure at the surface of the reservoir is 100 kPa.

Calculate the total pressure at the bottom of the reservoir.

[for water, density = 1000 kg / m^3]

(3)

pressure = ... kPa

(b) An underwater camera is used in the water reservoir.

The camera lens experiences a force of 430 N at a pressure of 260 kPa.

(i) State the formula linking pressure, force and area.

(1)

(ii) Calculate the area of the camera lens.

Give a suitable unit.

(4)

area = ... unit ....

(c) Sea water has a density of 1030 kg / m^3.

Explain how the design of the dam would need to be changed to hold the same depth of sea water safely.

(2)

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(Total for Question 10 = 11 marks)

11 The gravitational field strength of a planet decreases with increasing distance from the planet.

The table shows the value of the gravitational field strength of Mars at different distances from the centre of Mars.

Distance from centre of Mars in km	Gravitational field strength in N / kg
4000	2.66
5000	1.70
6000	1.18
7000	0.87
8000	0.67
9000	0.53

(a) A student finds this formula in a textbook, which links distance from the centre of a planet to its gravitational field strength

$$\text{gravitational field strength} \times \text{distance}^2 = \text{constant}$$

Use data from the table to justify this formula.

(4)

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(b) Olympus Mons is the tallest mountain on Mars.

The distance between the centre of Mars and the peak of Olympus Mons is 3410 km.

Calculate the gravitational field strength at the peak of Olympus Mons.

(3)

gravitational field strength = ... N / kg

(Total for Question 11 = 7 marks)

TOTAL FOR PAPER = 110 MARKS

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Pearson Edexcel International GCSE (9–1)

Thursday 25 May 2023

Morning (Time: 2 hours)

Paper reference	4PH1/1PR 4SD0/1PR

Physics

UNIT: 4PH1

Science (Double Award) 4SD0

PAPER: 1PR

Equation Booklet

Do not return this Booklet with the question paper.

Turn over

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Pearson

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(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 $= \dfrac{1}{2} \times \text{mass} \times \text{speed}^2$	$KE = \dfrac{1}{2} \times m \times v^2$
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	$p = h \times \rho \times g$
$\dfrac{\text{pressure}}{\text{temperature}} = \text{constant}$	$\dfrac{p_1}{T_1} = \dfrac{p_2}{T_2}$
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 2 and 2PR.

1. Forces and Motion

momentum = mass × velocity $\quad p = m \times v$

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

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

$$\frac{\text{input (primary) voltage}}{\text{output (secondary) voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}$$

input power = output power $\quad V_p I_p = V_s I_s$

for 100% efficiency

8. Astrophysics

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

END OF EQUATION LIST