Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Thursday 25 May 2023

Morning (Time: 1 hour 45 minutes)

Paper reference **1PH0/1H**

Physics
PAPER 1

Higher Tier

You must have:
Calculator, ruler, 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.*

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.
- A list of equations is included at the end of this exam paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over

Pearson

Answer ALL questions. Write your answers in the spaces provided.

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 Figure 1 shows a bat and its prey.

not to scale

bat   prey

Figure 1

The bat emits a high frequency sound pulse to locate its prey.

The speed of sound in air is 330 m/s.

(a) The wavelength of the sound is 11 mm.

Calculate the frequency of the sound.

(2)

Use the equation

$$v = f \times \lambda$$

frequency = ... Hz

(b) The pulse returns to the bat after a time of 18 ms.

Calculate the distance from the bat to its prey.

(4)

distance = ... m

(Total for Question 1 = 6 marks)

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2 (a) Which of these is a scalar quantity?

(1)

- ☒ **A** acceleration
- ☒ **B** distance
- ☒ **C** force
- ☒ **D** weight

(b) A student has some cupcake cases.

One cupcake case is shown in Figure 2.

(Source: © Anton Starikov/Shutterstock)

Figure 2

The student drops a stack of cupcake cases with the base facing downwards, as shown in Figure 3.

(Source: © Elena Schweitzer/Shutterstock)

Figure 3

The speed of the falling stack of cupcake cases depends on the number of cupcake cases in the stack.

(i) The student also has a stop clock and a metre rule.

Describe an investigation to show how the speed of the falling stack of cupcake cases depends on the number of cupcake cases in the stack.

(4)

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(ii) A stack of cupcake cases has a mass of 0.005 kg.

Calculate the weight, in newtons, of the stack of cupcake cases.

Gravitational field strength = 10 N/kg

(2)

Use the equation

$$W = mg$$

weight = ... N

Figure 4 shows a cupcake case that is falling at a constant velocity.

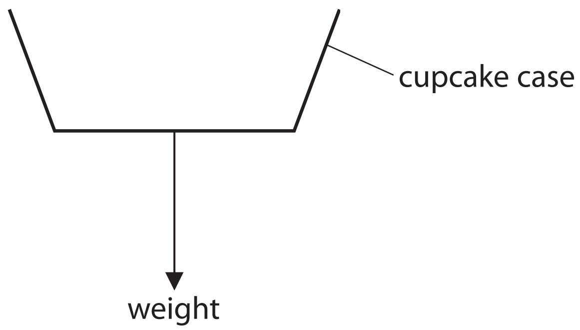

Figure 4

(iii) Draw an arrow on Figure 4 to show the force due to air resistance on the cupcake case.

(1)

(iv) State the value of the acceleration of the cupcake case when it is falling at a constant velocity.

(1)

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(Total for Question 2 = 9 marks)

3 (a) Figure 5 shows a football kicked against a wall.

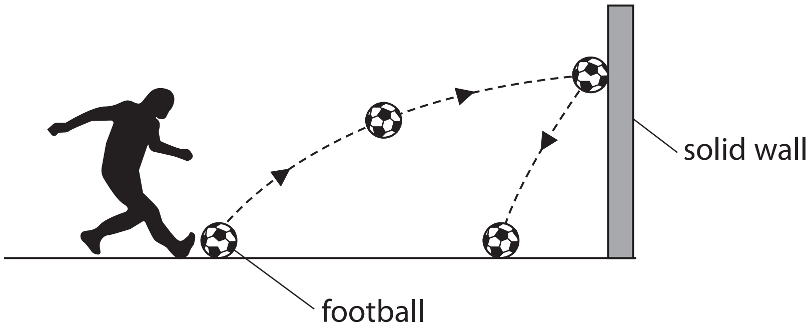

Figure 5

The football has a mass of 0.42 kg.

(i) The football gains 11 J of gravitational potential energy as it moves from the ground to the wall.

Calculate the height at which the ball hits the wall.

(3)

Gravitational field strength = 10 N / kg

Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

height = ... m

(ii) Calculate the kinetic energy of the football when it is moving at a velocity of 12 m / s.

(2)

Use the equation

$$KE = \frac{1}{2} \times m \times v^2$$

kinetic energy = ... J

(iii) Describe the energy transfers that happen when the ball hits the wall.

(2)

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(b) A stone is held at rest above the ground.

The stone is released and falls until its velocity is 17 m / s.

Calculate the distance the stone has fallen when its velocity has reached 17 m / s.

(2)

distance = ... m

(Total for Question 3 = 9 marks)

4 (a) Figure 6 shows two objects, **E** and **D**.

Figure 6

E emits a sound.

D detects the sound.

E is moving in the direction shown by the arrow, but **D** is not moving.

E emits a sound of wavelength 1.86 m.

D measures the wavelength of this sound as 1.98 m.

(i) Calculate the difference between the wavelength that **E** emits and the wavelength that **D** detects.

(1)

difference in wavelength = ... m

(ii) The velocity of sound is 330 m / s.

Calculate the velocity of **E**.

(2)

Use the equation

$$\text{velocity of } \mathbf{E} = \frac{\text{velocity of sound} \times \text{difference in wavelength}}{\text{wavelength } \mathbf{E} \text{ emits}}$$

velocity of **E** = ... m / s

(b) The wavelength of light emitted from distant galaxies is different when the light is detected on Earth.

Explain how this difference in wavelength shows that the Universe is expanding.

(2)

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(c) CMB radiation provides evidence that the Universe had a definite beginning.

Use the table in Figure 7 to give a typical value for the wavelength of CMB radiation.

type of radiation	typical wavelength
gamma rays	1.0×10^{-12} m
X-rays	3.0×10^{-11} m
ultraviolet	200 nm
visible	600 nm
infrared	4.0 μm
microwaves	1.0 mm
radio waves	50 m

Figure 7

(2)

wavelength = ...

(d) During the evolution of a star, the nebula collapses and becomes a main sequence star.

(i) State what causes the nebula to collapse.

(1)

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(ii) Explain why the nebula stops collapsing as it becomes a main sequence star.

(3)

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(Total for Question 4 = 11 marks)

5 Figure 8 is a velocity/time graph for a lift moving upwards in a tall building.

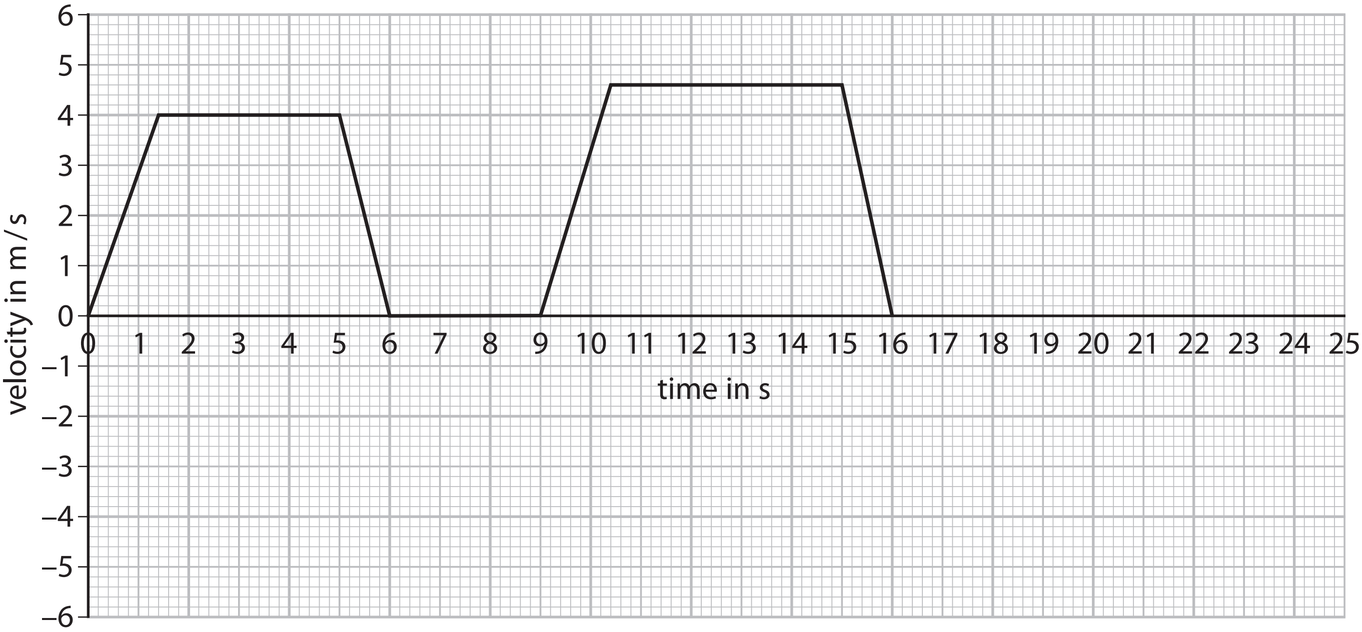

Figure 8

(a) For what length of time is the lift at rest during the first 16 s?

(1)

☒ **A** 1.4 s

☒ **B** 3.0 s

☒ **C** 3.6 s

☒ **D** 4.0 s

(b) Use the graph in Figure 8 to determine the maximum velocity of the lift during the first 16 s.

(1)

maximum velocity = ... m / s

(c) Use the graph in Figure 8 to determine the acceleration of the lift during the first 1.4 s.

(3)

acceleration = ... m/s^2

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P 7 2 5 7 3 A 0 1 2 3 2

(d) Use the graph in Figure 8 to determine the distance that the lift travelled during the first 6.0 s.

(3)

distance = ... m

(e) At 18 s, the lift starts to move downwards.

Sketch a line on the graph in Figure 8 to show the lift moving downwards after 18 s.

(1)

(Total for Question 5 = 9 marks)

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6 (a) Figure 9 shows two technicians, L and M, measuring the speed of sound in air.

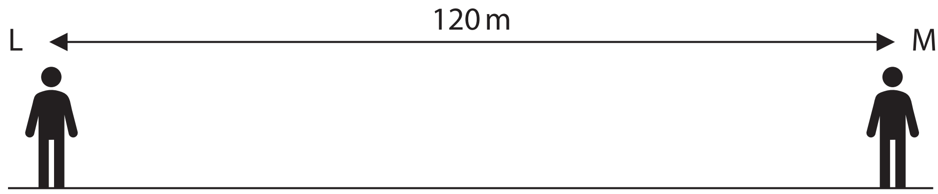

Figure 9

L fires a starting pistol.

M starts a stopwatch when first seeing the smoke from the starting pistol.

M stops the stopwatch when hearing the bang made by the starting pistol.

The distance between L and M is 120 m.

M's reaction time is 0.23 s.

The speed of sound in air is 330 m / s.

(i) Calculate M's reaction time as a percentage of the time sound takes to travel from L to M.

(3)

....%

(ii) Which of these would improve the technicians' measurement of the speed of sound?

(1)

☒ **A** Use a firework 'banger' instead of the starting pistol.

☒ **B** Use a stop clock that measures time in minutes.

☒ **C** Increase the distance between **L** and **M**.

☒ **D** Decrease the distance between **L** and **M**.

(b) Figure 10 shows the difference in refraction of sound waves and light waves when these waves travel from air into water.

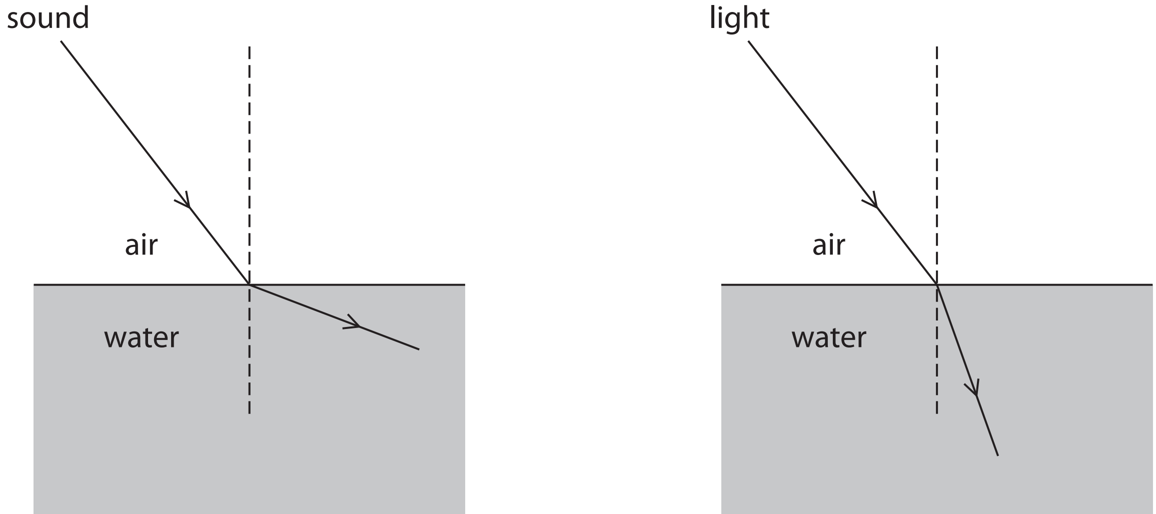

Figure 10

Explain why the refraction of the sound wave is different from the refraction of the light wave in Figure 10.

(3)

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(c) Light is one example of an electromagnetic wave.

Light can transfer energy from a lamp to the leaf of a plant, causing chemical reactions in the leaf.

Describe examples of **two** other electromagnetic waves transferring energy.

(4)

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(Total for Question 6 = 11 marks)

7 (a) Figure 11 is the symbol for a nucleus of americium-241.

$$^{241}_{95}\text{Am}$$

Figure 11

Americium-241 is a radioactive isotope of americium.

Americium-241 decays by emitting alpha (α) particles.

(i) Which of these is the symbol for another radioactive isotope of americium?

(1)

- ☒ **A** $^{241}_{97}\text{Am}$
- ☒ **B** $^{243}_{96}\text{Am}$
- ☒ **C** $^{245}_{95}\text{Am}$
- ☒ **D** $^{247}_{94}\text{Am}$

(ii) Which of these is the approximate maximum distance that alpha particles can travel in air at normal atmospheric pressure?

(1)

- ☒ **A** 5 mm
- ☒ **B** 5 cm
- ☒ **C** 5 m
- ☒ **D** 5 km

(iii) Complete the equation in Figure 12 for americium-241 decaying into neptunium (Np).

(3)

$$^{241}_{95}\text{Am} \rightarrow \,^{\dots\dots}_{\dots\dots}\alpha + \,^{\dots\dots}_{\dots\dots}\text{Np}$$

Figure 12

(b) The activity of a radioactive source is measured as 128 Bq.

This is shown as a point on the graph in Figure 13.

(3)

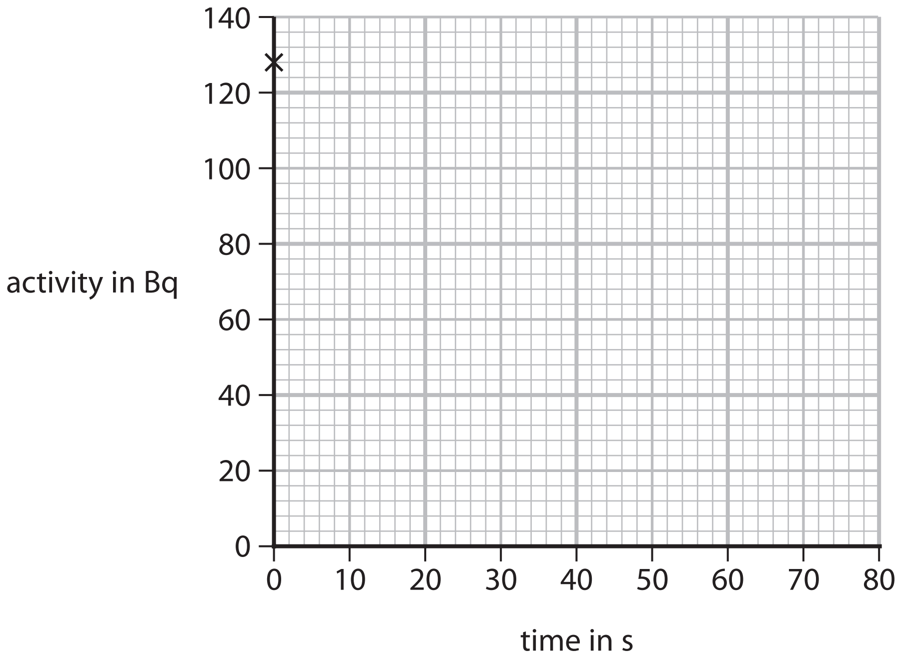

Figure 13

The half-life of this radioactive source is 17 s.

Use this information to plot three more points on the graph grid in Figure 13 to show how the activity of the source changes with time.

(c) Describe what happens in the nucleus of an atom when a positron is emitted.

(2)

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(Total for Question 7 = 10 marks)

8 (a) A student does an experiment to determine the critical angle for glass.

The student shines a ray of light into a semicircular glass block and measures the angles *i* and *r*, as shown in Figure 14.

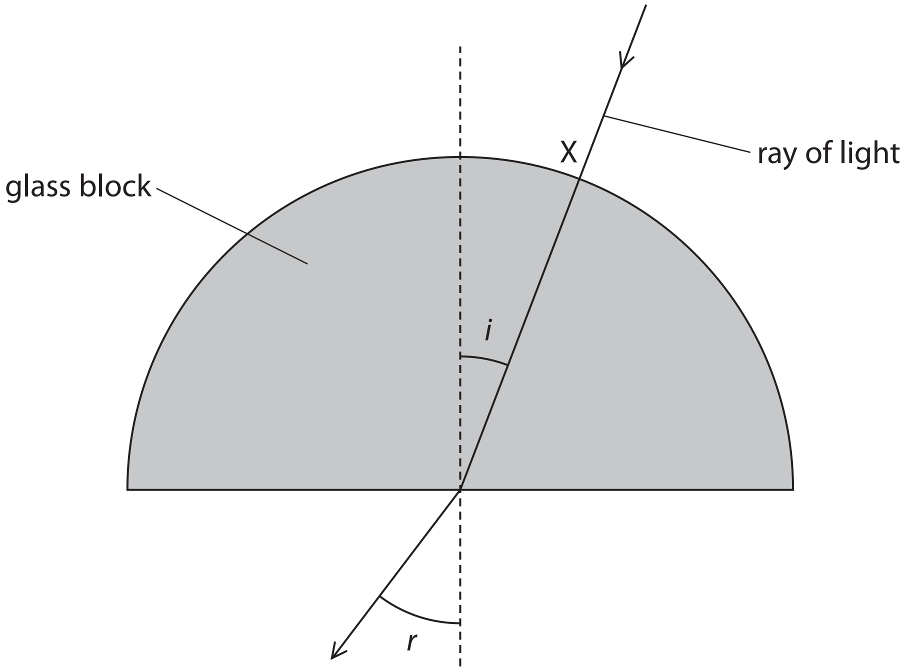

Figure 14

(i) The ray of light does not change direction when it enters the glass block at point **X**.

Which of these **explains** why the ray of light does not change direction when it enters the glass block at point **X**.

(1)

☒ **A** The ray enters along a normal to the edge of the block.

☒ **B** The ray enters at right angles to a normal to the edge of the block.

☒ **C** The ray speeds up as it enters the glass.

☒ **D** The ray slows down as it enters the glass.

(ii) The student repeats the procedure for different values of angle *i*.

Figure 15 is a graph of the student's results.

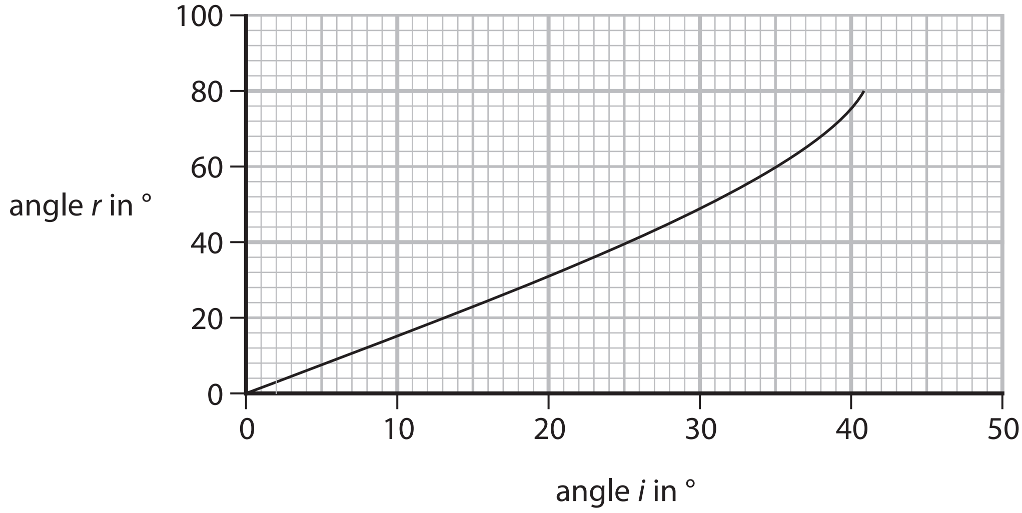

Figure 15

Describe how the student should use the graph in Figure 15 to determine the critical angle for glass.

(3)

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(b) Figure 16 shows two iron spheres, **P** and **Q**, near to a radiant heater.
P is painted black and **Q** is painted white.

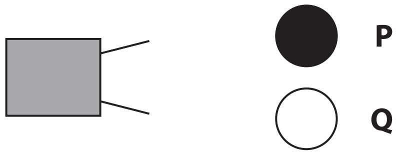

Figure 16

Each sphere is the same distance away from the heater.

The spheres have the same radius.

The heater is switched on and the spheres heat up.

The temperature of each sphere is monitored.

(i) Explain why the temperature of sphere **P** increases at a faster rate than the temperature of sphere **Q**.

(2)

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(ii) The heater remains switched on.

Figure 17 shows how the temperature of sphere **P** changes with time.

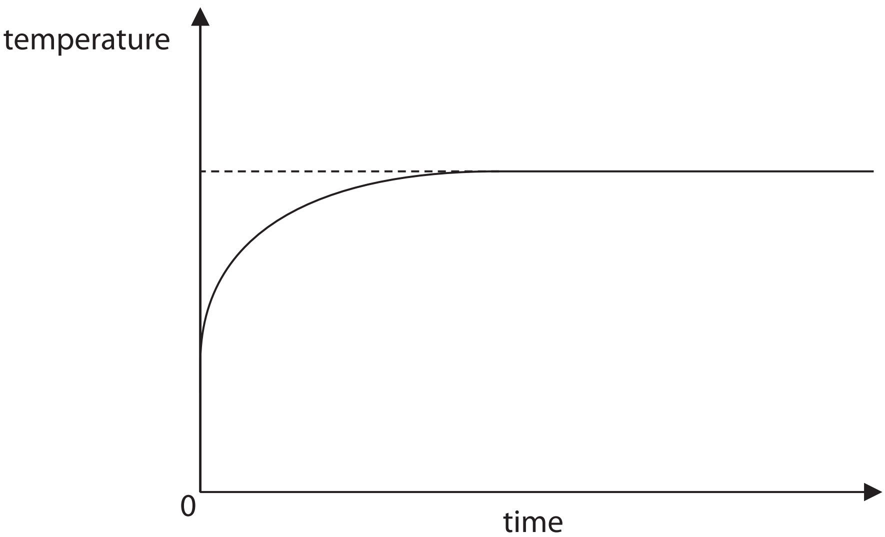

Figure 17

Explain why the temperature of **P** reaches a constant value, even though the heater remains switched on.

(4)

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(Total for Question 8 = 10 marks)

9 (a) An atom of mass 6.6×10^{-26} kg is moving with a velocity of 480 m/s.

Calculate the momentum of the atom.

(3)

momentum = ... kg m/s

(b) Figure 18 shows a ball before and after it collides with a wall.

The arrows show the direction of movement of the ball.

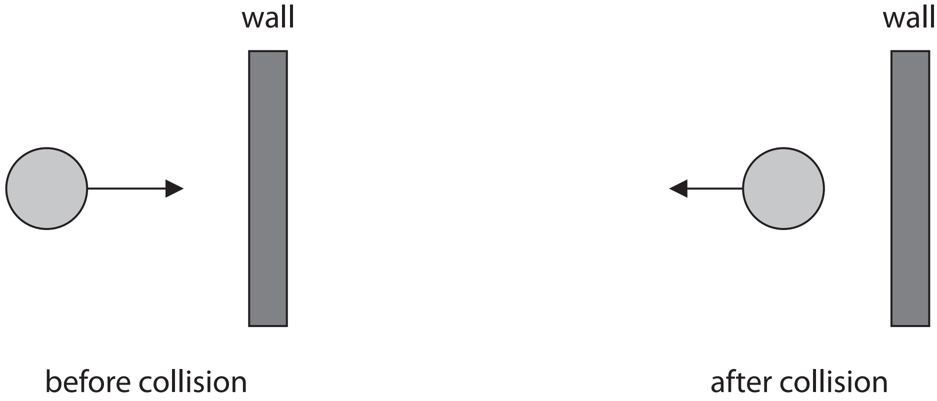

Figure 18

Before the collision, the momentum of the ball is 0.80 kg m/s.

After the collision, the momentum of the ball is 0.60 kg m/s in the opposite direction.

The ball is in contact with the wall for a time of 70 ms during the collision.

Calculate the force exerted on the ball by the wall.

(3)

Use an equation selected from the list of equations at the end of the paper.

force = ... N *(c) Newton's second law can be stated as

$$\text{force} = \text{mass} \times \text{acceleration}$$

A student is provided with a trolley and a runway on a bench, as shown in Figure 19, and access to other equipment.

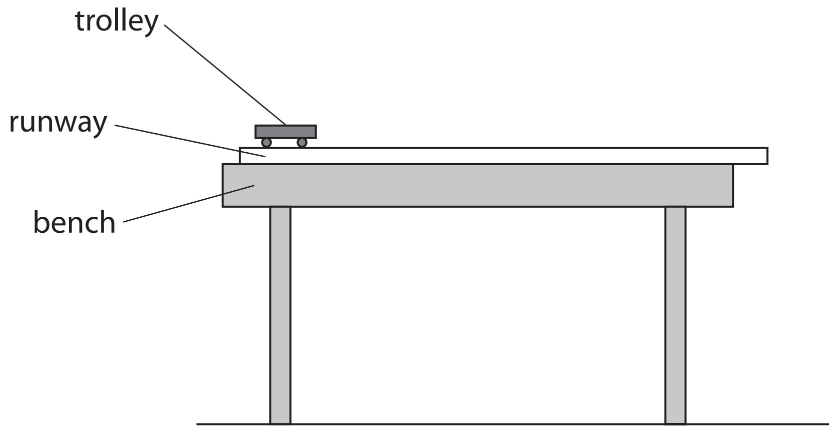

Figure 19

Describe a procedure the student could use to investigate how the acceleration of the trolley depends on the force applied to the trolley.

You may add to the diagram in Figure 19 to help your answer.

(6)

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(Total for Question 9 = 12 marks)

10 (a) Figure 20 shows a Mars rover, a vehicle used for exploring the surface of the planet Mars.

(Source: © BEST-BACKGROUNDS/Shutterstock)

Figure 20

The power supply in a Mars rover is called an RTG.

The RTG contains a radioactive isotope that releases thermal energy as it decays.

The RTG uses the thermal energy released in the decay to provide electrical power for the rover.

(i) An RTG has an efficiency rating of only 7%.

Calculate the useful energy transferred by the RTG when 1300 J of thermal energy is released in the decay.

(2)

Use the equation

$$\text{efficiency} = \frac{(\text{useful energy transferred by the device})}{(\text{total energy supplied to the device})} \times 100\%$$

useful energy transferred = ... J

(ii) Suggest, with a reason, **one** property the isotope must have to be suitable for use in the RTG.

(2)

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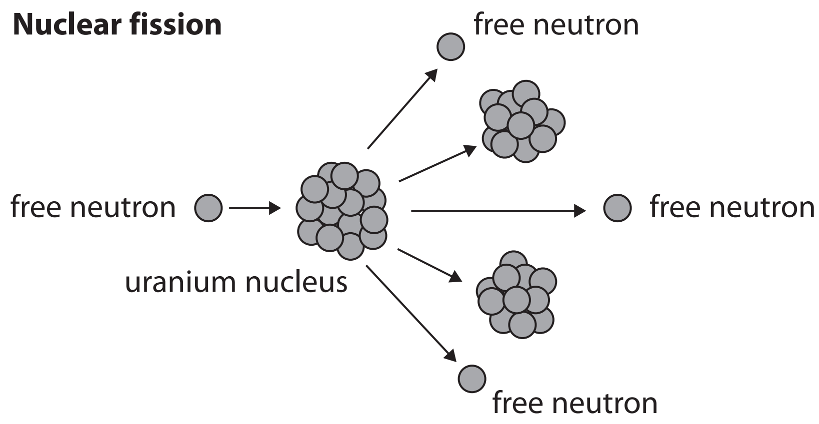
(b) Figure 21 shows the fission of a uranium nucleus.



(Source: adapted from © 1501926062/Shutterstock)

Figure 21

The total mass of all the particles after the reaction is less than the total mass of the particles before the reaction.

The energy released in the reaction comes from the change in mass.

This is shown in the equation

energy released = (change in mass) × (speed of light)^2

The energy released in one fission reaction = 1.49×10^{-10} J.

The speed of light = 3.00×10^{8} m / s.

Calculate the change in mass.

(3)

change in mass = ... kg

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*(c) The energy released in a single uranium fission is very small.

In a nuclear power station, the fission of uranium in the reactor releases large amounts of energy.

The energy released is enough to generate electricity for thousands of homes.

The demand for electricity varies.

Explain

- how large amounts of energy can be released in the reactor
- how the rate of energy release is controlled as the demand for electricity varies.

(6)

(Total for Question 10 = 13 marks)

TOTAL FOR PAPER = 100 MARKS

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Equations

(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance $v^2 - u^2 = 2 \times a \times x$
force = change in momentum ÷ time $F = \frac{(mv - mu)}{t}$
energy transferred = current × potential difference × time $E = I \times V \times t$
force on a conductor at right angles to a magnetic field carrying a current = magnetic flux density × current × length $F = B \times I \times l$
$\frac{\text{potential difference across primary coil}}{\text{potential difference across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$ $\frac{V_p}{V_s} = \frac{N_p}{N_s}$
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil $V_p \times I_p = V_s \times I_s$
change in thermal energy = mass × specific heat capacity × change in temperature $\Delta Q = m \times c \times \Delta\theta$
thermal energy for a change of state = mass × specific latent heat $Q = m \times L$
$P_1 V_1 = P_2 V_2$ to calculate pressure or volume for gases of fixed mass at constant temperature
energy transferred in stretching = 0.5 × spring constant × (extension)^2 $E = \frac{1}{2} \times k \times x^2$
pressure due to a column of liquid = height of column × density of liquid × gravitational field strength $P = h \times \rho \times g$

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Pearson Edexcel Level 1/Level 2 GCSE (9–1)

May–June 2023 Assessment Window

Paper reference **1PH0/1H**

Physics

PAPER 1

Higher Tier

Equation Booklet

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Turn over

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Pearson

If you're taking **GCSE (9–1) Combined Science** or **GCSE (9–1) Physics**, you will need these equations:

HT = higher tier

	distance travelled = average speed × time	
	acceleration = change in velocity ÷ time taken	$a = \frac{(v-u)}{t}$
	force = mass × acceleration	$F = m \times a$
	weight = mass × gravitational field strength	$W = m \times g$
HT	**momentum = mass × velocity**	$\boldsymbol{p = m \times v}$
	change in gravitational potential energy = mass × gravitational field strength × change in vertical height	$\Delta GPE = m \times g \times \Delta h$
	kinetic energy = 1/2 × mass × $(\text{speed})^2$	$KE = \frac{1}{2} \times m \times v^2$
	efficiency = $\frac{(\text{useful energy transferred by the device})}{(\text{total energy supplied to the device})}$	
	wave speed = frequency × wavelength	$v = f \times \lambda$
	wave speed = distance ÷ time	$v = \frac{x}{t}$
	work done = force × distance moved in the direction of the force	$E = F \times d$
	power = work done ÷ time taken	$P = \frac{E}{t}$
	energy transferred = charge moved × potential difference	$E = Q \times V$
	charge = current × time	$Q = I \times t$
	potential difference = current × resistance	$V = I \times R$
	power = energy transferred ÷ time taken	$P = \frac{E}{t}$
	electrical power = current × potential difference	$P = I \times V$
	electrical power = $(\text{current})^2$ × resistance	$P = I^2 \times R$
	density = mass ÷ volume	$\rho = \frac{m}{V}$

	force exerted on a spring = spring constant × extension	$F = k \times x$
	(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance	$v^2 - u^2 = 2 \times a \times x$
HT	**force = change in momentum ÷ time**	$\boldsymbol{F = \frac{(mv - mu)}{t}}$
	energy transferred = current × potential difference × time	$E = I \times V \times t$
HT	**force on a conductor at right angles to a magnetic field carrying a current = magnetic flux density × current × length**	$\boldsymbol{F = B \times I \times l}$
	For transformers with 100% efficiency, potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_P \times I_P = V_S \times I_S$
	change in thermal energy = mass × specific heat capacity × change in temperature	$\Delta Q = m \times c \times \Delta\theta$
	thermal energy for a change of state = mass × specific latent heat	$Q = m \times L$
	energy transferred in stretching = 0.5 × spring constant × (extension)^2	$E = \frac{1}{2} \times k \times x^2$

If you're taking **GCSE (9–1) Physics**, you also need these extra equations:

	moment of a force = force × distance normal to the direction of the force	
	pressure = force normal to surface ÷ area of surface	$P = \frac{F}{A}$
HT	***potential difference across primary coil / potential difference across secondary coil = number of turns in primary coil / number of turns in secondary coil***	$\boldsymbol{\frac{V_p}{V_S} = \frac{N_p}{N_S}}$
	to calculate pressure or volume for gases of fixed mass at constant temperature	$P_1 \times V_1 = P_2 \times V_2$
HT	**pressure due to a column of liquid = height of column × density of liquid × gravitational field strength**	$\boldsymbol{P = h \times \rho \times g}$

END OF EQUATION LIST

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