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)

Wednesday 22 May 2024

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 you make are related or follow on from each other where appropriate.

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 (a) Nuclear fusion is a process that releases energy.

Which of these statements applies to a nuclear fusion reaction?

(1)

☐ **A** it emits daughter nuclei

☐ **B** it is a controlled chain reaction

☐ **C** it produces radioactive waste

☐ **D** it requires high temperature and pressure

(b) In the Sun, four protons start the process of nuclear fusion.

These protons combine and finally produce a helium nucleus.

The helium nucleus has a smaller mass than the four protons.

This difference in mass is converted to energy.

Four protons have a total mass of 6.69×10^{-27} kg.

A helium nucleus has a mass of 6.64×10^{-27} kg.

Calculate the percentage of the original mass that has been converted to energy.

(3)

percentage of mass converted to energy .... %

P 7 4 4 8 6 A 0 2 3 6

(c) Figure 1 shows the spectrum of an element detected in the light from a distant galaxy, from a nearby galaxy and from a source on Earth.

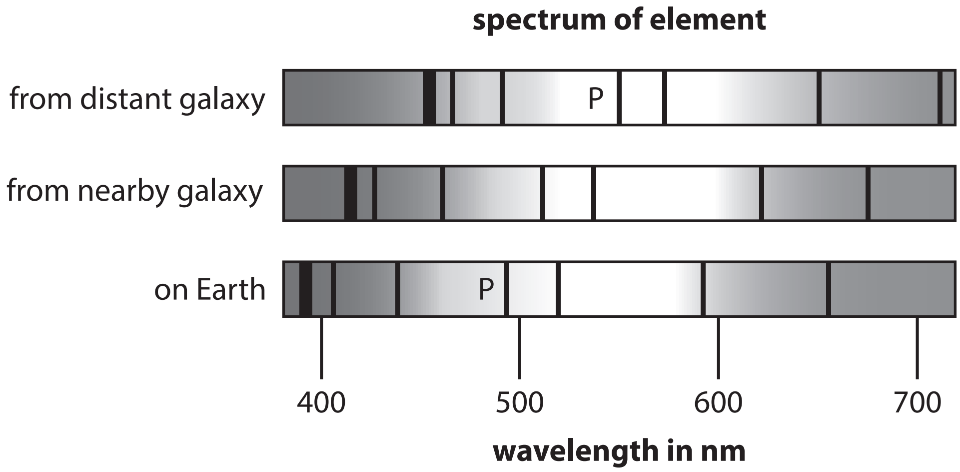

Figure 1

(i) Estimate the difference between the wavelength of line P in the spectrum from the distant galaxy and the wavelength of line P in the spectrum on Earth.

(1)

difference in wavelength = ... nm

(ii) Scientists have discovered that light from almost all distant galaxies has spectral lines shifted towards the red end of the spectrum.

Explain how red shift in light, received from galaxies at different distances from the Earth, supports the idea that the Universe is expanding.

(3)

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(Total for Question 1 = 8 marks)

2 Figure 2 shows a person on a skateboard at the top of a ramp.

At P, the person is not moving.

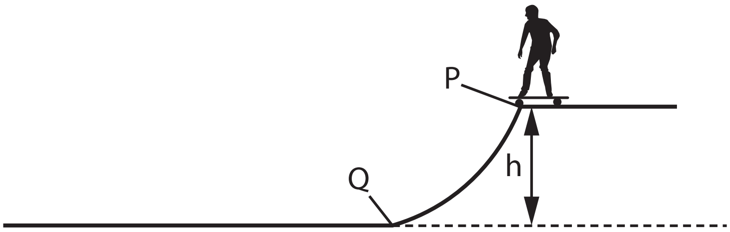

Figure 2

(a) The person rides the skateboard down the ramp from P to Q.

The gravitational potential energy of the person decreases by 980 J.

The mass of the person is 35 kg.

Calculate h, the height of the ramp.

Use g = 10 N/kg.

Use the equation

$$\text{change in gravitational potential energy} = m \times g \times h$$

(2)

h = ... m

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(b) The kinetic energy, KE, of the person at Q is 950 J.

The mass of the person is 35 kg.

Calculate the velocity of the person at Q.

Use the equation

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

(3)

velocity = ... m/s

P 7 4 4 8 6 A 0 5 3 6

(c) Figure 3 is a diagram that represents energy changes from P to Q.

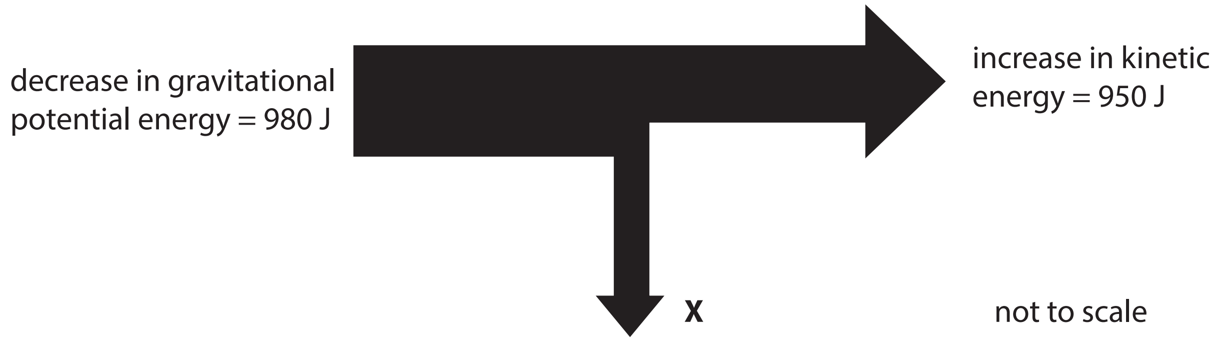

Figure 3

(i) State what is represented by **X**.

(1)

....

....

(ii) Calculate the value of **X**.

(1)

value of **X** = ... J

(iii) Calculate the efficiency of the system represented in Figure 3.

(2)

efficiency = ...

(Total for Question 2 = 9 marks)

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3 (a) Two people, L and M, have a 100 m race.

L starts running before M.

Figure 4 shows a distance/time graph of the race.

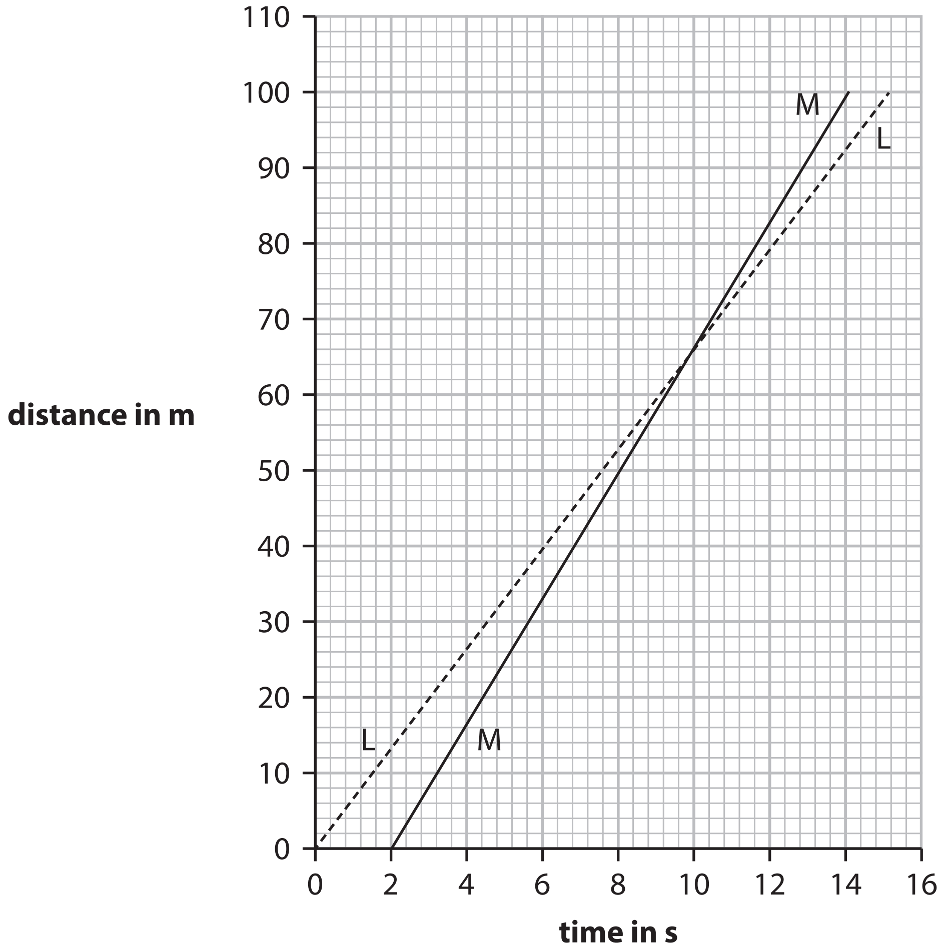

Figure 4

(i) State the **distance** that L has run when M overtakes.

(1)

distance = ... m

(ii) Calculate the velocity of L when running the 100 m race.

(2)

velocity = ... m/s

(b) A motorcycle is travelling at a velocity of 6.2 m/s.

The motorcycle accelerates at 2.5 m/s^2 until its velocity is 10 m/s.

(i) Calculate the time taken for this acceleration.

Use the equation

$$\text{time taken} = \frac{\text{change in velocity}}{\text{acceleration}}$$

(2)

time taken = ... s

(ii) The motor cycle now decelerates (slows down) from 10 m/s to a stop.

The deceleration is at a constant rate of 4.4 m/s^2.

Calculate the distance the motorcycle travels as it slows down to a stop.

Use the equation

$$v^2 - u^2 = 2 \times a \times x$$

(2)

distance = ... m

(c) A car collides with a barrier on a road.

The time of the collision is very short.

Explain **one** factor, other than the time of the collision, that would affect the force on the car in the collision.

Your explanation should refer to an equation in the Equation Booklet.

(2)

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(Total for Question 3 = 9 marks)

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4 (a) Radiation is used to treat tumours (cancer).

The source of the radiation can be inside or outside the human body.

Which of these has a radiation source that can be positioned inside the body to treat tumours?

(1)

- ☒ **A** gamma rays
- ☒ **B** x-rays
- ☒ **C** radio waves
- ☒ **D** microwaves

(b) Figure 5 shows a PET scanner used to detect cancerous tumours.

A radioactive isotope is injected into a patient.

The isotope is absorbed by the tumour.

The isotope emits positrons from the location of the tumour.

The ring of radiation detectors rotates around the person.

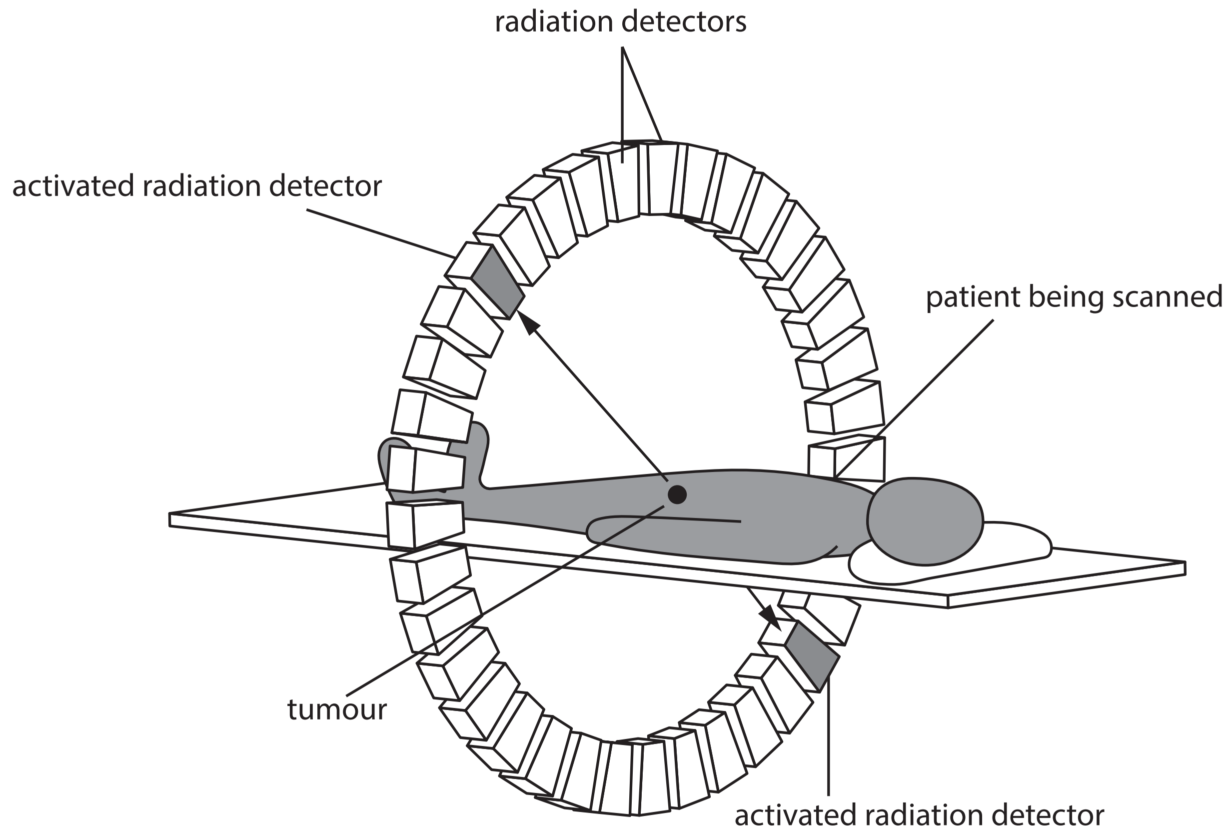

Figure 5

P 7 4 4 8 6 A 0 1 2 3 6

(i) Explain how the scan can give the location of the tumour.

(3)

(ii) Explain why the radioactive isotope injected into the patient must be produced near to the place where it is to be used.

(2)

(c) Radiotherapy can involve irradiation of patients.

Radioactive tracers can involve contamination of patients.

State **two** differences between irradiation and radioactive contamination.

(2)

1

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(d) Figure 6 shows the decay curves of two different isotopes, Q and P.

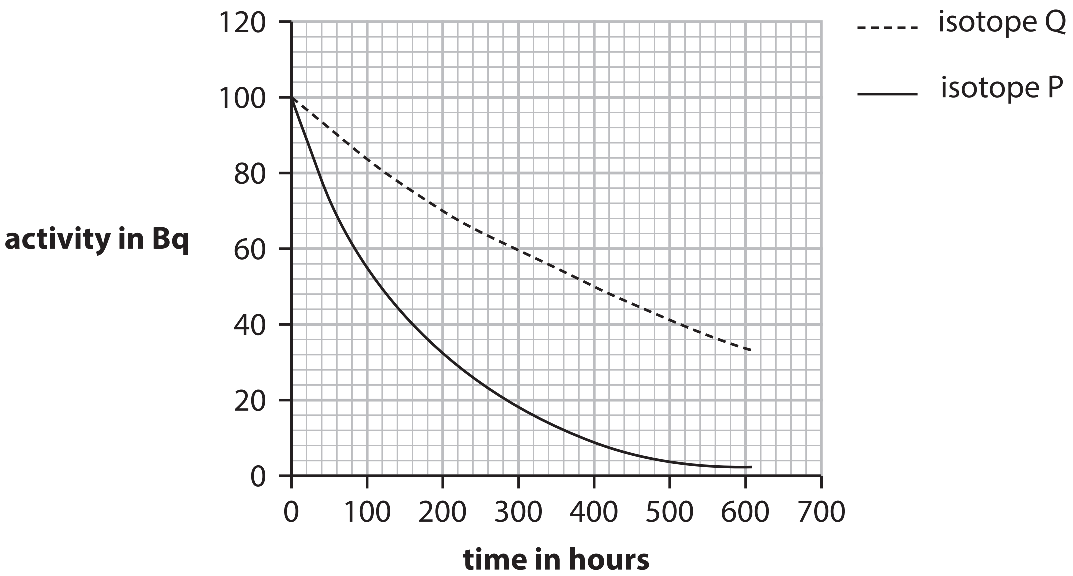

Figure 6

(i) Use the graph in Figure 6 to determine the half-life of isotope P.

(2)

half-life of isotope P = ... hours

(ii) Suggest a reason why the sample of isotope Q could be more dangerous to humans than the sample of isotope P.

(1)

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(Total for Question 4 = 11 marks)

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P 7 4 4 8 6 A 0 1 4 3 6

5 Ultraviolet (UV) waves from the Sun travel towards the Earth.

Ultraviolet waves can be grouped by wavelength.

The three groups of wavelengths are UVA, UVB and UVC.

Figure 7 shows, for each group,

- the wavelength range
- the effect of the Earth's atmosphere on each type of UV wave.

	UVA	**UVB**	**UVC**
wavelength range	400 nm to 315 nm	314 nm to 280 nm	279 nm to 100 nm
% energy absorbed by the Earth's atmosphere	5%	95%	100%

Figure 7

(a) (i) Explain why UVC is potentially the most dangerous ultraviolet radiation but does not cause harm to people.

(2)

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(ii) The speed of electromagnetic radiation is 3.00×10^8 m/s.

Calculate the frequency of the shortest wavelength of UVB radiation.

(3)

frequency = ... Hz

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(b) UV radiation of wavelength 365 nm is used to detect forged banknotes.

In a genuine banknote there are marks that **cannot** be seen using visible light. These marks **can** be seen using UV radiation.

Explain why the marks can be seen when the UV radiation shines on the banknote.

Your answer should refer to the energy of electrons in atoms.

You may draw a diagram to help with your answer.

(4)

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(Total for Question 5 = 9 marks)

6 (a) (i) The law of reflection of light applies to reflections from

(1)

- ☒ **A** all surfaces
- ☒ **B** only shiny surfaces
- ☒ **C** only rough surfaces
- ☒ **D** only smooth surfaces

(ii) A student uses a mirror to demonstrate that the angle of incidence is equal to the angle of reflection.

Figure 8 shows the apparatus the student uses.

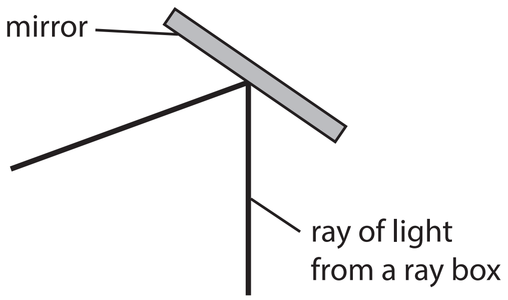

Figure 8

Describe the procedure the student should use with the ray and mirror in the position shown in Figure 8.

You should include any extra equipment needed.

You may add to Figure 8 to help your answer.

(3)

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(b) Figure 9 shows a ray of light from a ray box passing through a semi-circular glass block.

A student uses the apparatus in Figure 9 to determine the critical angle for glass.

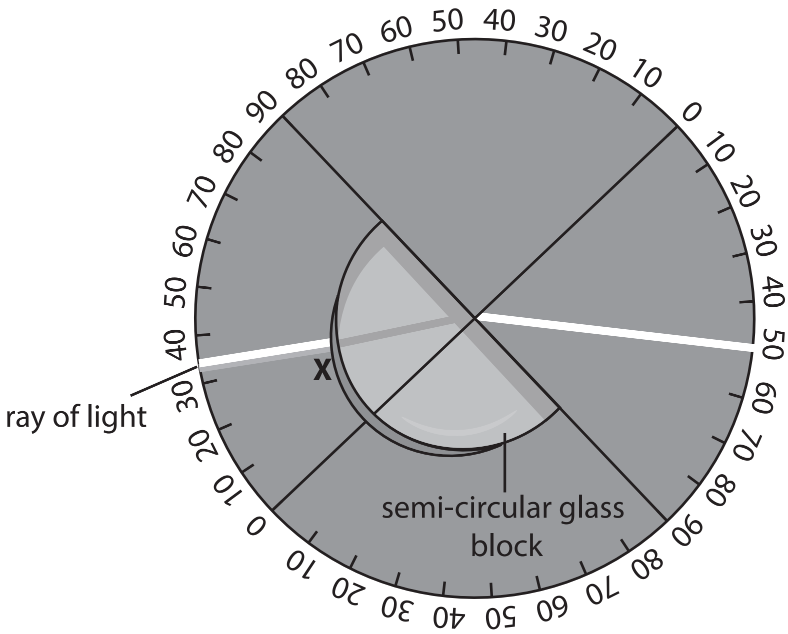

Figure 9

(i) State why the ray of light does not change direction as it enters the glass block at **X**.

(1)

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....

(ii) Describe how the critical angle for glass can be determined using the apparatus shown in Figure 9.

(3)

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(c) Figure 10 shows a ray diagram of the **virtual image** produced by a diverging lens.

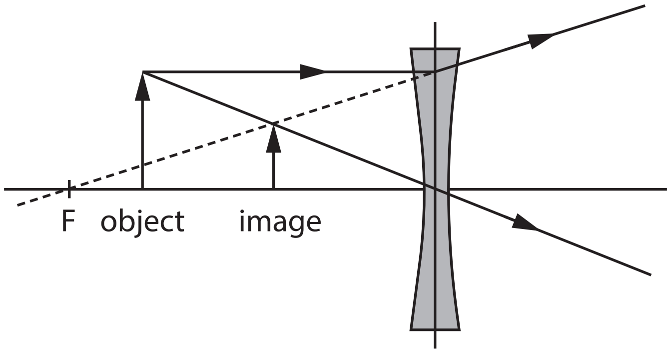

Figure 10

State what is meant by the term **virtual image**.

(1)

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....

(Total for Question 6 = 9 marks)

7 (a) A car starts from rest and then travels for 70 s as shown on the graph in Figure 11.

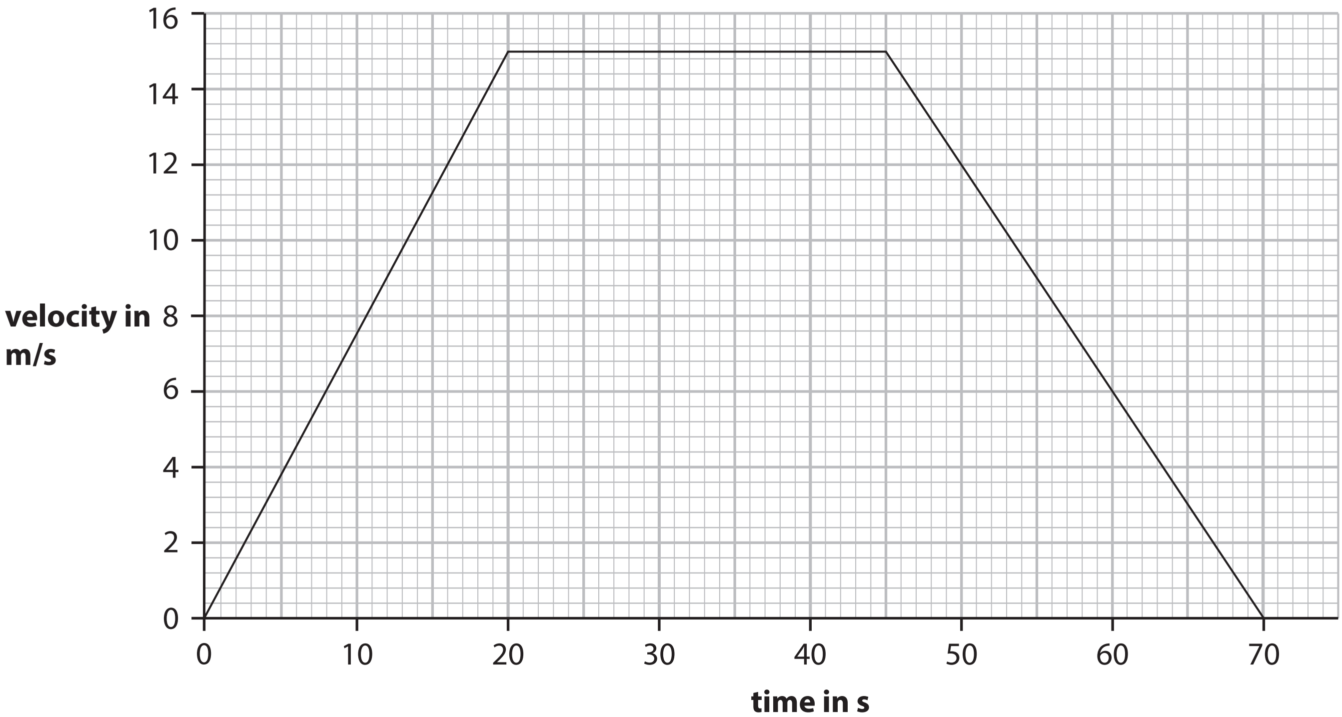

Figure 11

(i) Complete the sentence using data from Figure 11.

(1)

The car is travelling at constant velocity from .... s

to .... s.

(ii) Use data from the graph in Figure 11 to show that the car travels a total distance of about 710 m in 70 s.

(3)

(iii) Calculate the average speed of the car for the total distance travelled.

(1)

average speed = ... m/s

(b) The **inertial** mass of an object is a measure of how difficult it is to change the velocity of the object.

A force of 450 N acts on a car to give the car an acceleration of 0.35 m/s^2.

Calculate the **inertial** mass of the car.

(2)

inertial mass of car .... kg

(c) Figure 12 shows a different velocity/time graph.

This straight line graph can be represented by the equation

$$y = mx + c$$

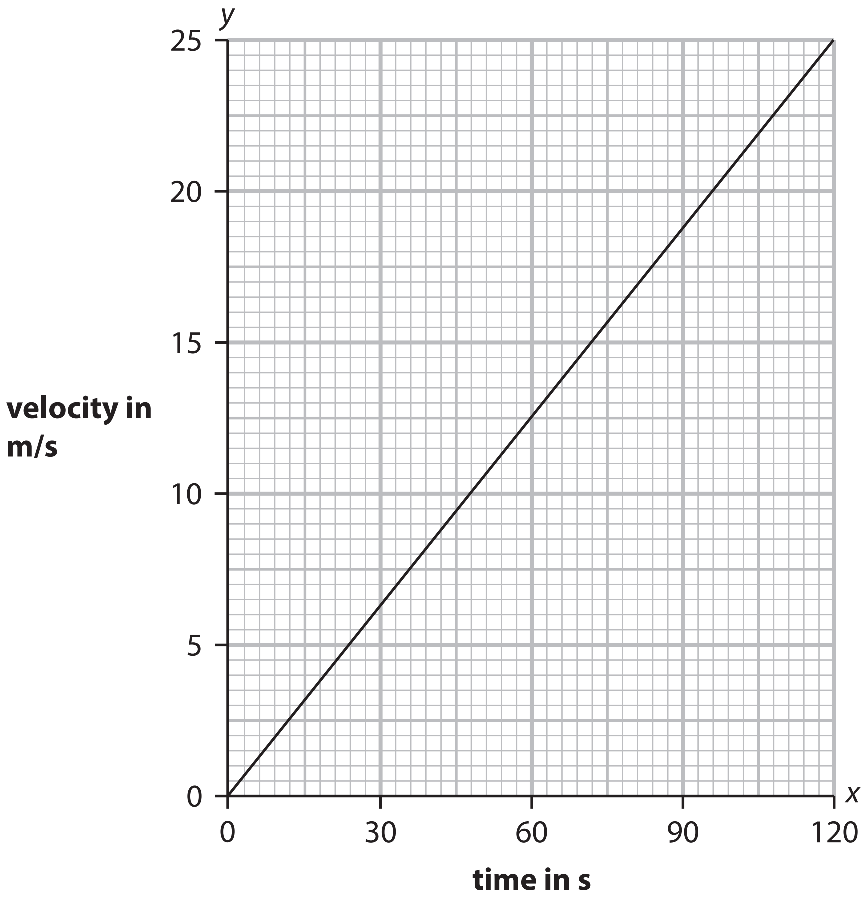

Figure 12

(i) Give the quantities that *x* and *y* represent in the equation.

(1)

x represents ....

y represents ....

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(ii) Calculate the value of *m* from the graph in Figure 12.

(2)

m = ... m/s^2

(iii) State the value of *c* from the graph in Figure 12.

(1)

value of c = ...

(Total for Question 7 = 11 marks)

8 (a) An electron has a charge of –1.

The charge on an alpha particle is

(1)

☒ **A** –2

☒ **B** 0

☒ **C** +1

☒ **D** +2

(b) Alpha, beta and gamma are all **ionising** radiations.

Give the meaning of the term **ionising**.

(1)

....

....

(c) A teacher determines the background radiation count rate in a laboratory.

Explain how to determine a value for the background radiation count rate.

(3)

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(d) The teacher now investigates the absorption of beta radiation by different thicknesses of aluminium.

The apparatus available is

- a source of beta radiation
- a Geiger–Müller (G-M) tube and counter
- 10 pieces of aluminium, each 0.5 mm thick
- a metre rule.

(i) Sketch a labelled diagram showing the positions of the apparatus when the measurements are being taken.

(2)

(ii) Give the independent variable in this investigation.

(1)

....

(iii) Name a quantity that must be kept constant during the investigation.

(1)

....

....

(iv) Strontium-90 is the source of beta minus radiation in this investigation.

Complete the nuclear equation for this emission of beta minus radiation.

(2)

$$^{90}_{38}\mathrm{Sr} \longrightarrow {}^{0}_{\square}\beta + {}^{90}_{\square}\mathrm{Y}$$

(Total for Question 8 = 11 marks)

9 (a) Figure 13 shows a ball being rotated in a horizontal circle.

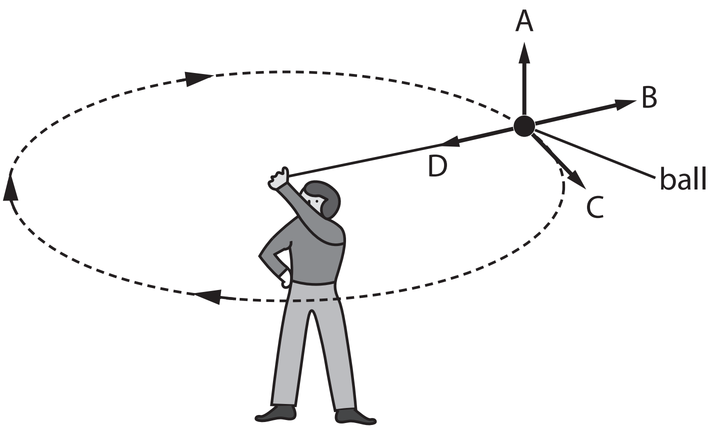

Figure 13

(i) Which arrow in Figure 13 shows the direction of the centripetal force on the ball?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(ii) The ball is moving at constant speed. Give **one** reason why the velocity of the ball is continuously changing.

(1)

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....

(b) Figure 14 shows a gymnast landing on a mat and coming to rest.

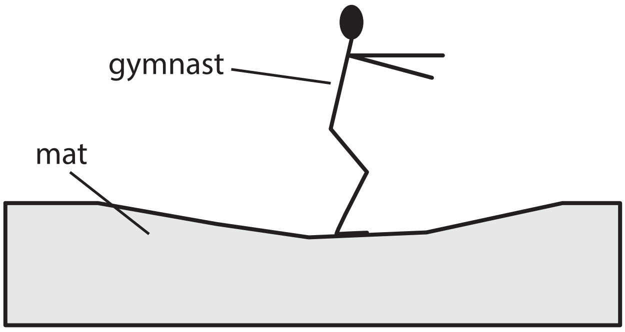

Figure 14

The gymnast has a mass of 53 kg.

The gymnast lands on the mat with a velocity of 4.0 m/s.

The average force exerted by the mat on the gymnast is 3500 N.

Calculate the time taken for the gymnast to come to rest.

Give your answer to an appropriate number of significant figures.

Use the equation

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

(3)

time = ... s *(c) Figure 15 shows two trolleys, **P** and **Q**, moving at the same speed, v, directly towards each other.

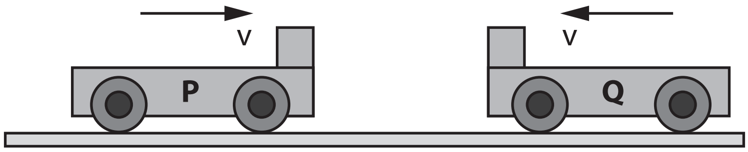

Figure 15

The trolleys have the same mass.

When the trolleys collide, they stick together and stop.

Explain how momentum and energy are both conserved in this collision.

(6)

(Total for Question 9 = 11 marks)

10 (a) Which row of the table shows two transverse waves?

(1)

☒ **A**	infrasound	infrared
☒ **B**	infrared	ultraviolet
☒ **C**	ultrasound	infrasound
☒ **D**	ultraviolet	ultrasound

(b) Figure 16 is an energy diagram for a sound wave incident on a sound-insulating board.

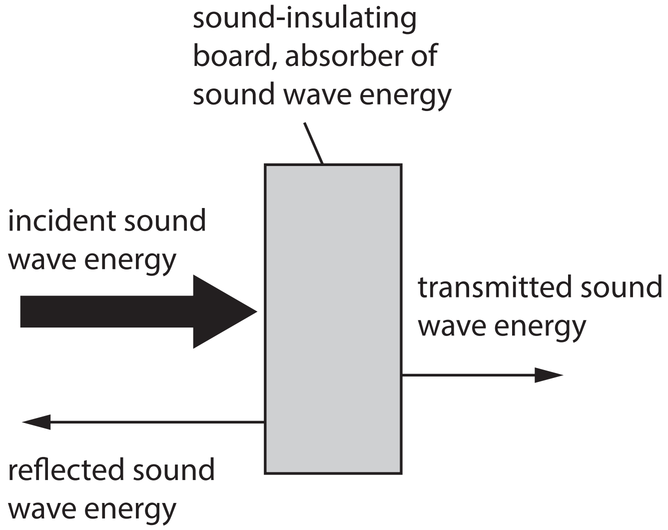

Figure 16

(i) The incident energy is 0.25 J.

The absorbed energy is 67 % of the incident energy.

The reflected energy is 15 % of the incident energy.

Calculate the amount of the transmitted energy.

(2)

transmitted energy = ... J

(ii) Give **one** way to reduce the percentage of energy transmitted through the sound-insulating board.

(1)

....

....

(c) The ratio of the absorbed energy E_a to incident energy E_i is the coefficient of absorption of sound α.

$$\alpha = \frac{E_a}{E_i}$$

The table in Figure 17 gives the coefficient of absorption for various materials.

material	$\alpha = \frac{E_a}{E_i}$
curtains	0.55
painted walls	0.02
wood floors	0.10
carpeted floors	0.60

Figure 17

Explain why rooms with carpets and curtains are less noisy than rooms without them.

Use the information given in Figure 17 in your answer.

(2)

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....

....

....

*(d) Explain how sound waves can be used to determine the depth of the ocean directly underneath a boat.

You may draw a diagram to help with your answer.

(6)

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS

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

Wednesday 22 May 2024

Paper reference **1PH0/1H**

Physics
PAPER 1

Higher Tier

Equation Booklet
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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 × (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 = (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	$\boldsymbol{\frac{\textit{potential difference across primary coil}}{\textit{potential difference across secondary coil}} = \frac{\textit{number of turns in primary coil}}{\textit{number of turns in secondary coil}}}$	$\boldsymbol{\frac{V_p}{V_S} = \frac{N_p}{N_S}}$
	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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