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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 2 hours

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

Physics

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

January 2022

You must have:
Ruler, protractor, 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 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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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 $\qquad p_1 \times V_1 = p_2 \times V_2$

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

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) Bismuth-207 is a gamma emitter and is represented by the symbol

$$^{207}_{83}Bi$$

How many neutrons are in the nucleus of an atom of bismuth-207?

(1)

☒ **A** 83

☒ **B** 124

☒ **C** 207

☒ **D** 290

(b) Which of these gives the best description of gamma radiation?

(1)

☒ **A** a helium nucleus

☒ **B** a high energy electron

☒ **C** a high frequency electromagnetic wave

☒ **D** a subatomic particle with mass, but with no charge

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(c) A technician uses this method to investigate the penetration power of gamma radiation.

- place a gamma emitting source at a fixed distance from a radiation detector
- measure the count using the detector, for a period of one minute
- place a thin sheet of lead between the source and the detector
- measure the new count using the detector, for a period of one minute
- increase the number of lead sheets between the source and detector and repeat this process

The table gives some of the variables from the technician's method.

Complete the table by placing a tick (✓) in each row to show whether each variable is an independent, a dependent or a control variable.

(3)

Variable	Independent variable	Dependent variable	Control variable
count measured using the detector			
distance between source and detector			
number of lead sheets			
time period for measuring the count			

(Total for Question 1 = 5 marks)

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2 X-rays and gamma rays are examples of ionising radiation.

(a) Which of these is another example of ionising radiation?

(1)

- ☒ **A** infrared
- ☒ **B** microwave
- ☒ **C** radio
- ☒ **D** ultraviolet

(b) Give one use of x-rays and one use of gamma rays.

(2)

x-rays

.....

.....

.....

gamma rays

.....

.....

.....

(c) (i) State the formula linking speed, frequency and wavelength of a wave.

(1)

(ii) Calculate the wavelength of a gamma ray with a frequency of 2.8×10^{19} Hz.

[speed of gamma ray = 3.0×10^{8} m/s]

(3)

wavelength = ... m

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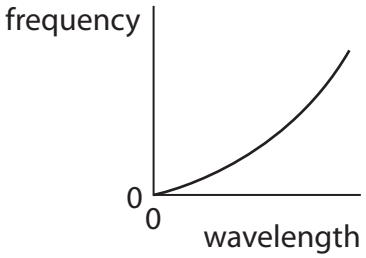
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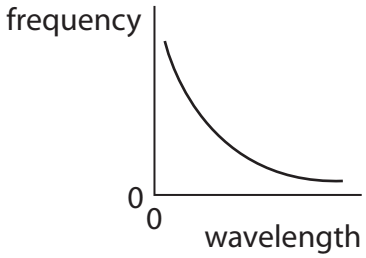
(d) X-rays and gamma rays are electromagnetic waves.

Which of these graphs is correct for waves travelling at a constant speed?

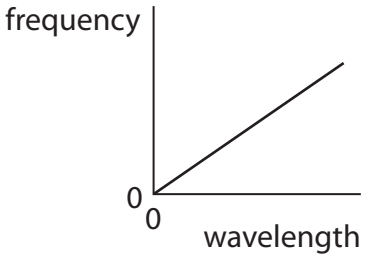
(1)



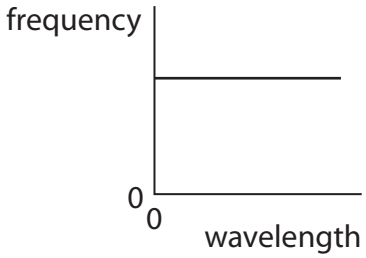
☒ **A**



☒ **B**



☒ **C**

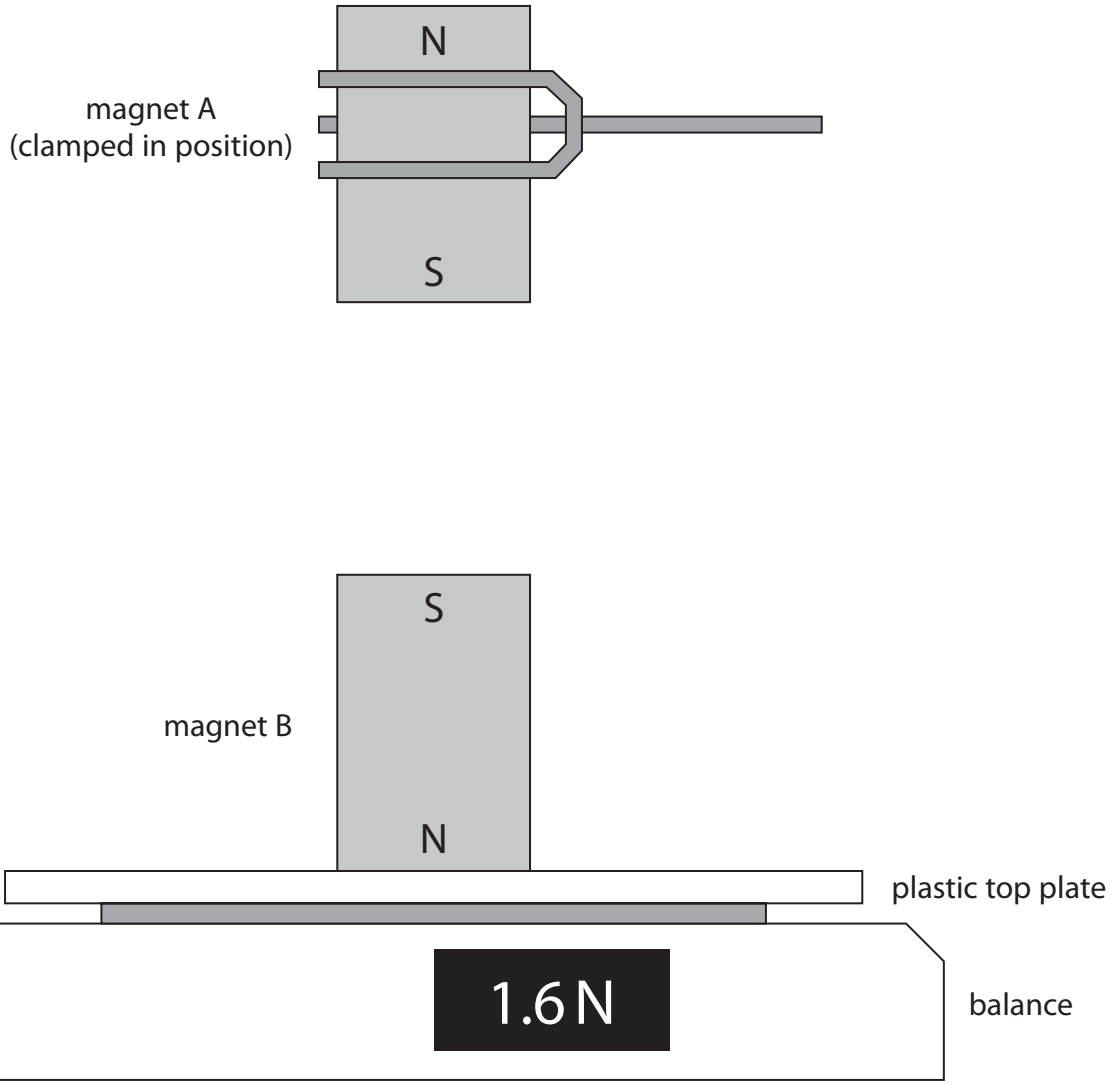


☒ **D**

(Total for Question 2 = 8 marks)

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3 A student uses this apparatus to measure the force of repulsion between magnet A and magnet B.



Magnet A is clamped in a fixed position.

Magnet B is resting on a balance.

(a) Give a reason why the two magnets shown in the diagram will repel each other.

(1)

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(b) Give a reason why the top plate of the balance is not affected by the magnetic fields of the magnets.

(1)

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(c) Complete the diagram by drawing the shape and direction of the magnetic field pattern between the magnets.

(2)

(d) In the position shown, the balance reading is 1.6 N.

(i) Explain how the balance reading will change if magnet A is brought closer to magnet B.

(2)

(ii) Explain how the balance reading will change if the poles of magnet A are reversed but the distance between the magnets remains constant.

(2)

(Total for Question 3 = 8 marks)

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4 This question is about scalar quantities and vector quantities.

(a) Give a similarity and a difference for scalar quantities and vector quantities.

(2)

similarity

.....

.....

difference

.....

.....

(b) The box gives some physical quantities.

Draw a circle around each physical quantity that is a scalar.

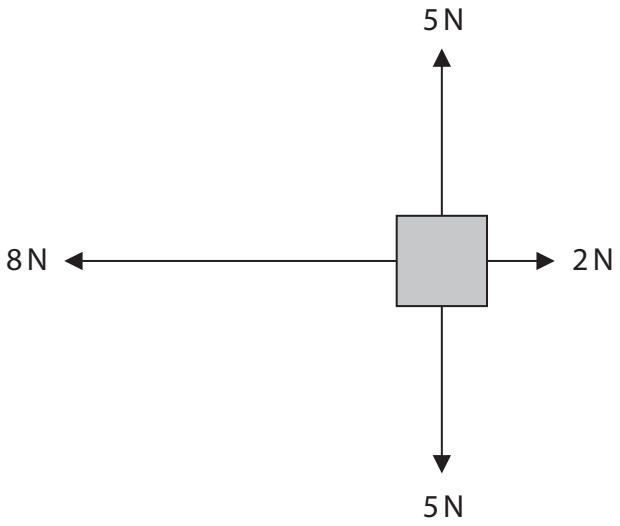
(3)

acceleration	charge	force	power
temperature	velocity	weight	

(c) The diagram shows four forces acting on an object.

Calculate the size and direction of the resultant force.

(2)



resultant force = ... N

direction = ...

(Total for Question 4 = 7 marks)

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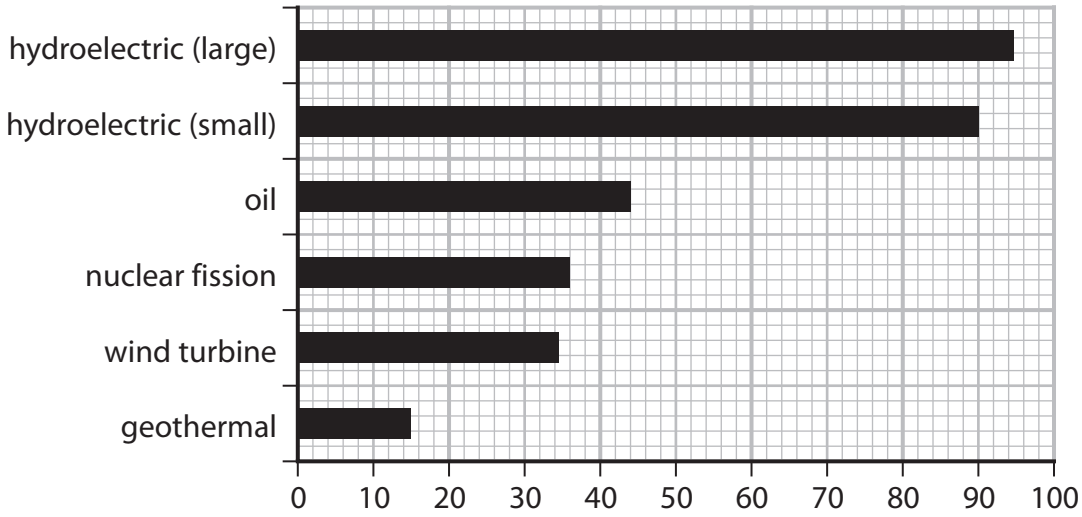
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5 The chart shows the efficiencies of different methods of generating electricity.



(a) The chart shows that the geothermal power station has an efficiency of 15%.

Explain what is meant by an efficiency of 15%.

(2)

.....

.....

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.....

(b) A small hydroelectric power station has a useful energy output of 6.0 kJ.

Calculate the total energy input for this power station using information from the chart.

(4)

total energy input = ... kJ

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(c) (i) Name a fuel used in the reactor of a nuclear power station.

(1)

.....

(ii) These sentences describe the process of nuclear fission.

Complete these sentences by writing a suitable word in each blank space.

(5)

A nucleus absorbs a ..... .

The nucleus formed splits because it is ..... .

The nucleus splits into two smaller nuclei called .....

nuclei and two or three ..... .

The energy released is transferred into the .....

energy store of the fission products.

(Total for Question 5 = 12 marks)

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6 This question is about stars.

(a) Table 1 gives some information about four stars.

Star	Colour	Mass relative to the Sun
61 Cygni A	orange	0.7
Antares A	red	12
Sirius B	blue	1.0
Vega	blue-white	2.1

Table 1

(i) Stars can be classified using their surface temperature.

Complete Table 2 by giving the four stars in order of increasing surface temperature.

(3)

Coolest	→		Hottest

Table 2

(ii) Name the star in Table 1 that does **not** follow a similar evolutionary path to the Sun.

(1)

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(b) The life cycle of a star begins in a nebula.

Describe how a main sequence star is formed from a nebula.

(3)

(c) Describe how a main sequence star becomes a white dwarf.

(4)

(Total for Question 6 = 11 marks)

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7 (a) Describe an experiment to determine the refractive index of a glass block.

In your answer you should include

- a labelled diagram
- the apparatus needed
- the method used

(6)

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(b) Give two uses of total internal reflection.

(2)

1 .....

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2 .....

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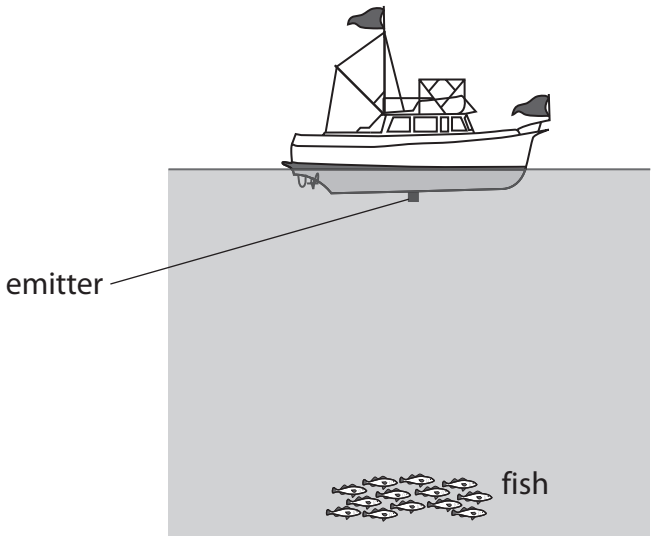
(Total for Question 7 = 8 marks)

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8 (a) The diagram shows a fishing boat fitted with a high frequency sound wave emitter.

The boat is above some fish.



The high frequency sound waves travel from the emitter to the fish and then back to the emitter, where they are detected.

(i) Name the wave behaviour that causes the sound waves to change direction when they reach the fish.

(1)

.....

(ii) The table gives some data about the sound waves used.

frequency of sound waves	4.0 MHz
speed of sound waves in water	1500 m/s
time between emission and detection of sound waves	43 ms

Calculate the distance between the sound wave emitter and the fish.

(4)

distance = ... m

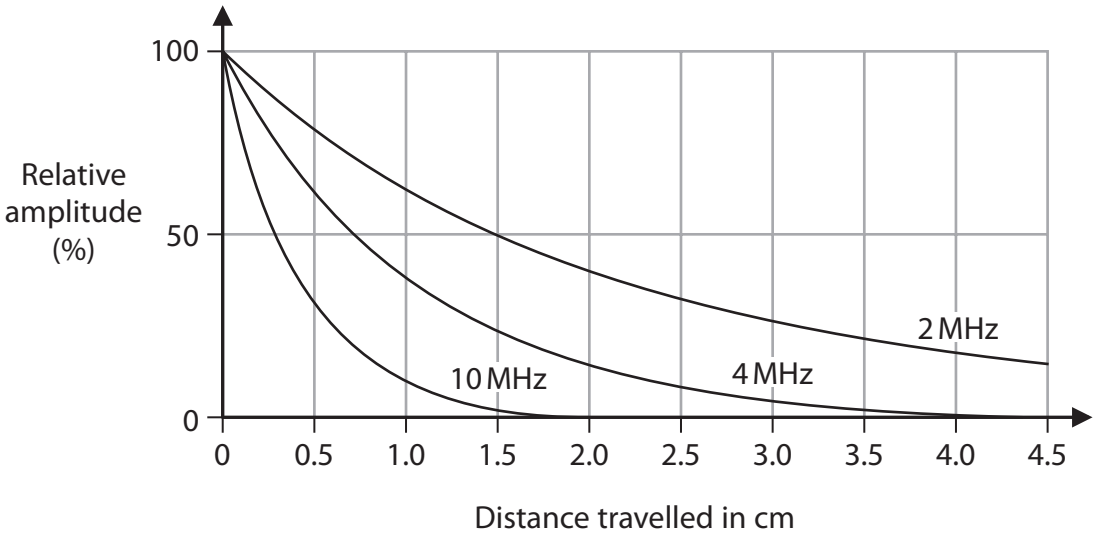
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(b) High frequency sound waves decrease in amplitude as they travel through soft tissue in the human body.

The graph shows this decrease in amplitude for three different high frequency sound waves.



(i) Estimate the distance travelled by a 2 MHz wave when its amplitude is 25% of its original value.

(1)

distance = ... cm

(ii) Describe what the graph shows about the penetrating ability of high frequency sound waves as they travel through soft tissue.

(3)

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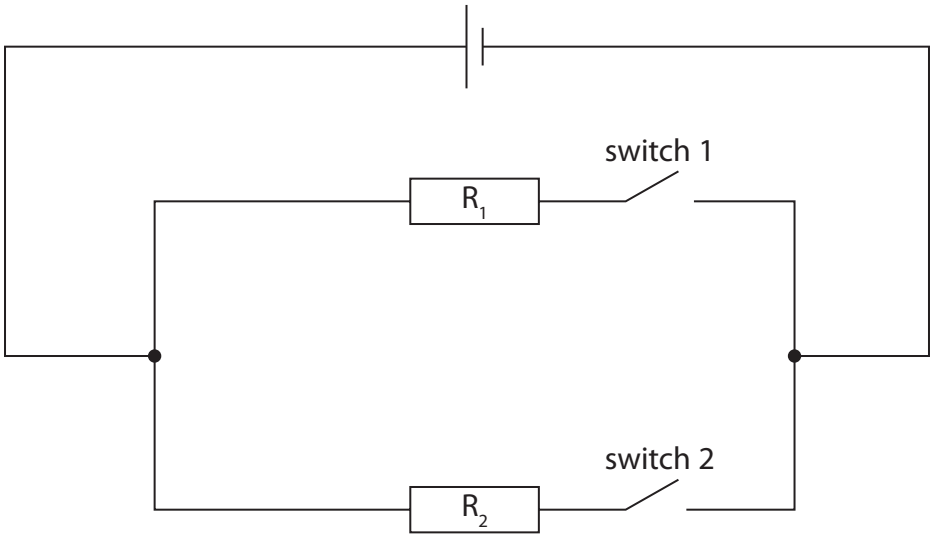
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(Total for Question 8 = 9 marks)

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9 The diagram shows a circuit containing a cell, two switches and two resistors, R_1 and R_2.



(a) A light emitting diode (LED) is represented using the symbol



Draw a LED on the circuit diagram that will indicate when there is a current in resistor R_1.

(2)

(b) Both switches in the circuit are now closed.

(i) Draw an ammeter on the circuit diagram that will measure the current in the cell.

(1)

(ii) The voltage across the cell is 4.5V.

Explain how the voltage across R_2 compares with the voltage across the cell.

(2)

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(c) Switch 1 is now opened whilst switch 2 remains closed.

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

(1)

(ii) The voltage across the cell stays constant at 4.5 V.

Calculate the charge transferred through the cell when the cell transfers 4.1 J of energy.

(3)

charge transferred = ... C

(iii) A student investigates how the current in resistor R_2 varies with the voltage across it.

Describe how the circuit could be modified for the student to do this investigation.

(3)

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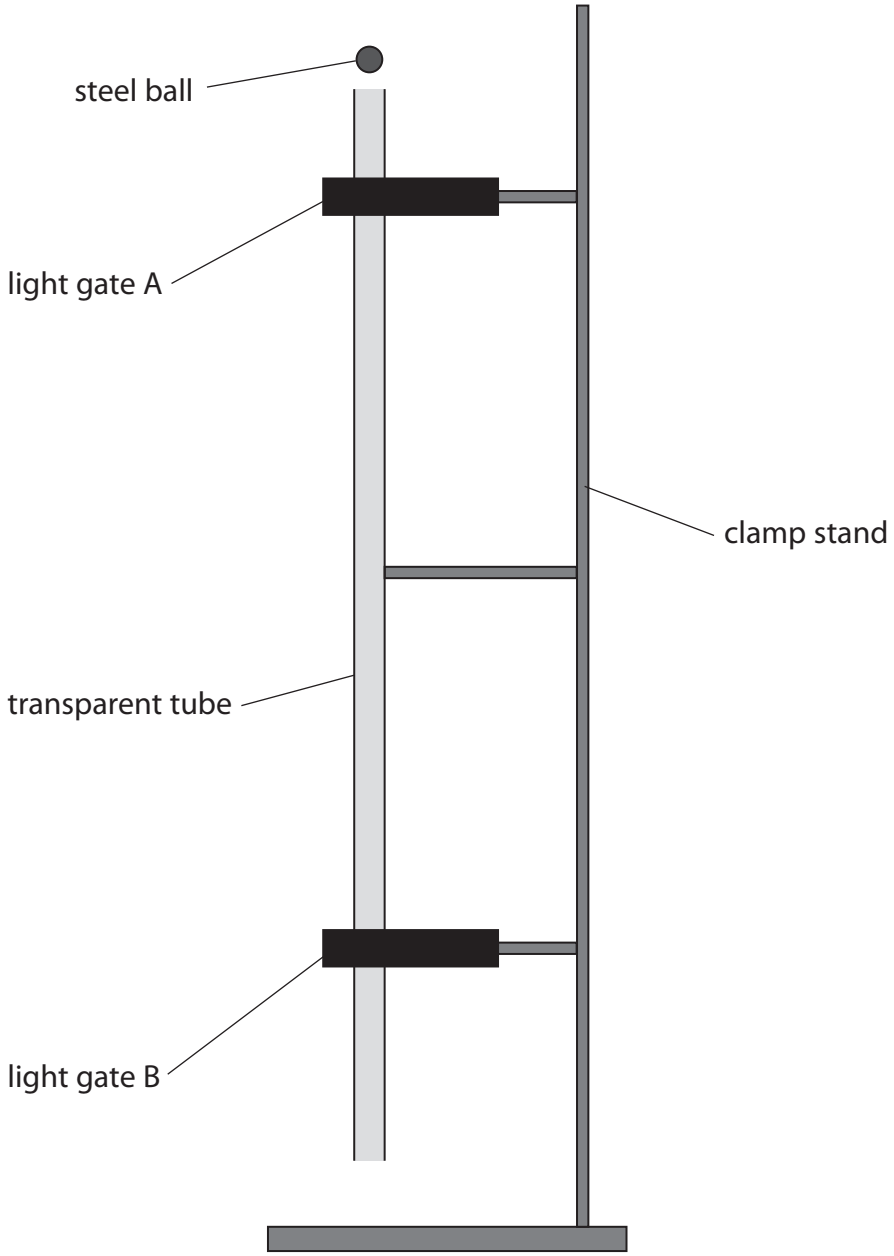
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(Total for Question 9 = 12 marks)

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10 A student does an experiment to determine the acceleration due to gravity, *g*.

The diagram shows the apparatus used.



This is the student's method.

- connect both light gates to a data logger
- drop a steel ball from rest at the top of the transparent tube
- record the speed of the ball at each light gate
- record the time taken for the ball to fall from light gate A to light gate B

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(a) The box shows the data recorded by the data logger.

speed at A = 1.45 m/s
speed at B = 4.20 m/s
time from A to B = 0.286 s

(i) Show that the acceleration of the steel ball is approximately 9.6 m/s^2.

(2)

acceleration = ... m/s^2

(ii) Explain why the student's value for the acceleration of the steel ball is lower than the accepted value for the acceleration due to gravity, *g*.

(2)

.....

.....

.....

.....

(iii) Calculate the distance between the light gates.

(3)

distance = ... m

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(b) The student changes the distance between the light gates by varying the position of light gate B.

The student measures the time taken for the steel ball to fall from light gate A to light gate B when the light gates are different distances apart.

The table shows the student's results.

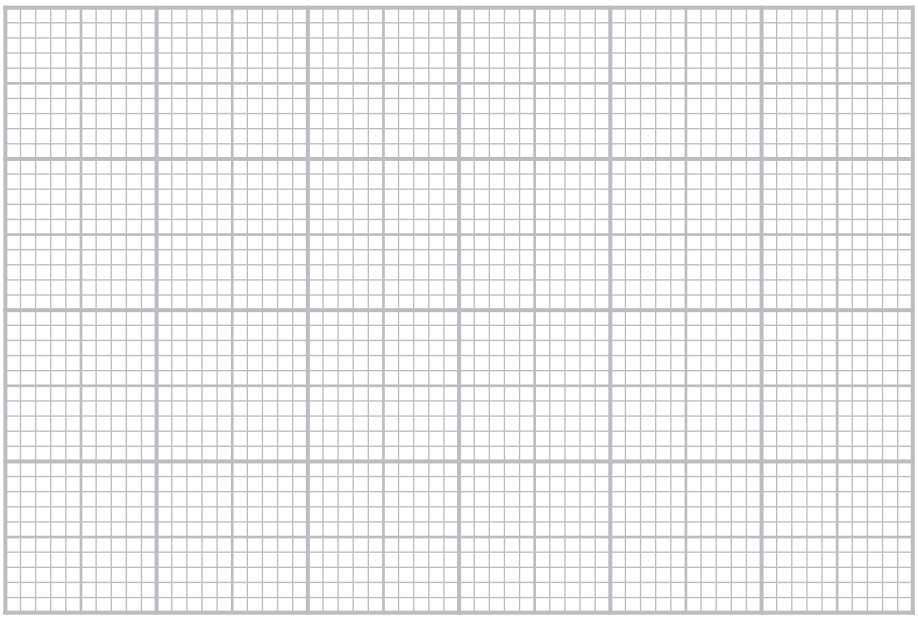
Distance between light gates in m	Time taken in s
0.10	0.058
0.20	0.103
0.30	0.141
0.40	0.175
0.50	0.205
0.60	0.233
0.70	0.260

(i) Plot a graph of the student's results on the grid.

(2)

(ii) Draw the curve of best fit.

(1)



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(iii) Explain how the graph shows that the steel ball is accelerating as it falls.

(3)

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(Total for Question 10 = 13 marks)

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11 The photograph shows a mechanic pumping air into a car tyre.



(Source: Rido/Shutterstock)

(a) Before being pumped into the tyre, some air has a volume of 0.0043 m^3 at a pressure of 100 kPa.

The pressure of this air inside the tyre is 270 kPa.

Calculate the volume of this air inside the tyre, assuming the temperature of the air does not change.

Give your answer in standard form.

(3)

volume = ... m^3

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(b) The car is fitted with a tyre pressure monitoring system.

A warning light will show in the car if the air pressure in the tyre falls below 250 kPa.

(i) Using ideas about particles, explain why the air pressure inside the tyre is lower on a cold winter day than on a warm summer day.

(3)

(ii) The air pressure in the tyre is 270 kPa when the air temperature is 20 °C.

On a cold winter day, the temperature is 2 °C.

Determine whether the tyre pressure warning light will show in the car on the cold winter day.

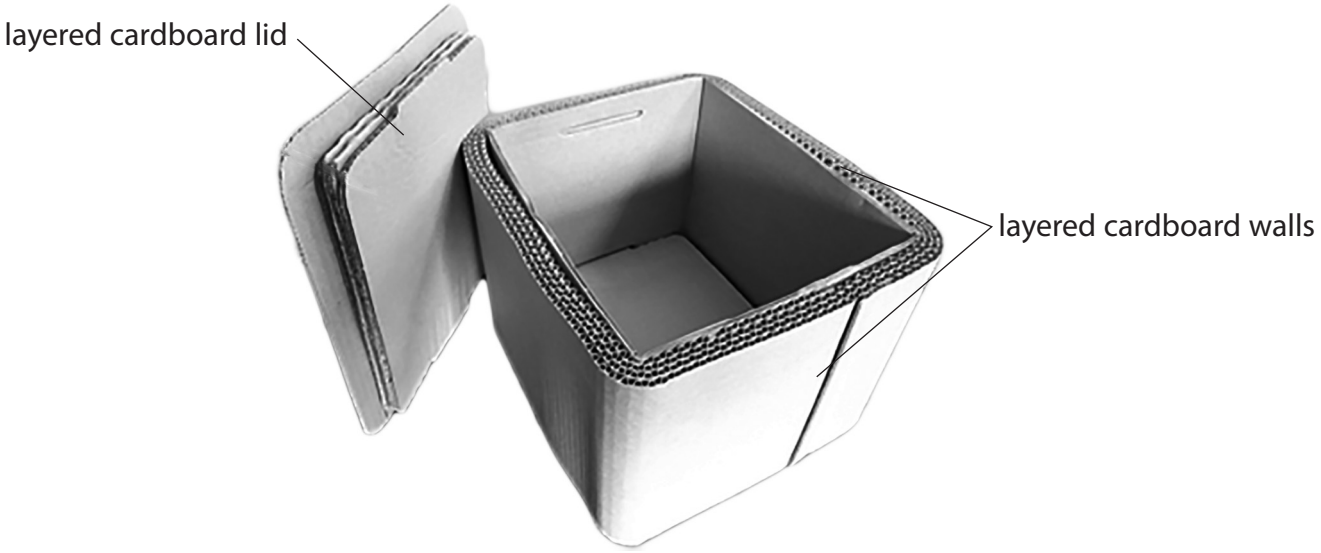
[assume tyre volume does not change]

(4)

(Total for Question 11 = 10 marks)

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12 The photograph shows a recyclable box designed for transporting cold food.



The box has these design features

- thick walls made from several layers of cardboard with air trapped between the layers
- a thick lid made from layers of cardboard

Cold food and ice packs are placed in the box.

(a) Give a reason why there is a net transfer of energy from the outside of the box to the inside of the box during transportation in a hot country.

(1)

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(b) Explain how the box is designed to reduce energy transfer by **conduction**.

(2)

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(c) Explain how the box is designed to reduce energy transfer by **convection**.

(2)

(d) A student suggests that painting the inner surfaces of the box a different colour would help to reduce the rate of energy transfer to the cold food.

Explain which colour the inner surfaces of the box should be painted.

(2)

(Total for Question 12 = 7 marks)

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