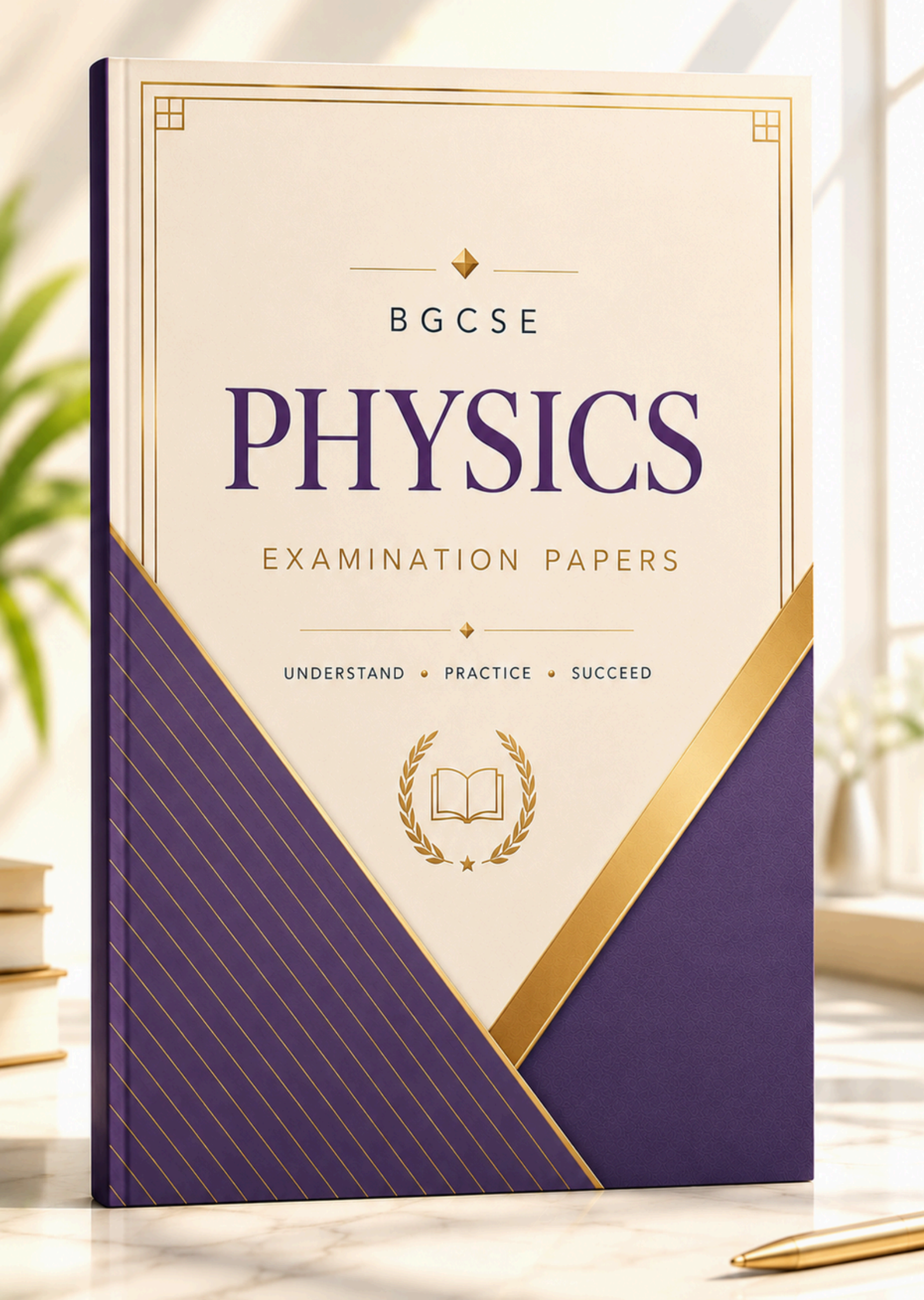
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PHYSICS

PAPER 3 3117/3

Thursday 5 JUNE 2025 12:30 P.M.–2:00 P.M.

Additional materials:
Graph paper

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BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION

INSTRUCTIONS AND INFORMATION TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your school number, candidate number, surname and initials at the top of this page as well as at the top of all lined paper submitted.

Answer **ALL** the questions in **Section A** in the spaces provided on this question booklet.

Answer **TWO** questions from **Section B** on the lined paper provided at the back of this question booklet.

Show **ALL** working when answering numerical questions.

Answers to numerical problems should be given to a suitable number of significant figures.

The intended marks for each question or part question are given in brackets [ ].

For Examiner's Use	
Section A	
1	
2	
3	
4	
Section B	
5	
6	
7	
Total	

This question paper consists of 17 printed pages and 3 lined pages.

LIST OF FORMULAE

weight = mass × gravitational field strength	$w = mg$
force = mass × acceleration	$F = ma$
pressure = $\frac{\text{normal force}}{\text{area}}$	$p = \frac{F}{A}$
pressure due to a liquid = depth × gravity × density	$p = hgp$
average speed = $\frac{\text{distance travelled}}{\text{time taken}}$	$s = \frac{d}{t}$
average velocity = $\frac{\text{distance travelled in a given direction}}{\text{time taken}}$	$v = \frac{d}{t}$
acceleration = $\frac{\text{change in velocity}}{\text{time}}$	$a = \frac{v - u}{t}$
density = $\frac{\text{mass}}{\text{volume}}$	$D = \frac{m}{v}$
combined gas laws equation	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
Charles' law equation	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$
kinetic energy = $\frac{1}{2}$ mass × *velocity*^{2}	$K.E. = \frac{1}{2}mv^2$
change in gravitational potential energy = weight × change in height	$PE = wh$
power = $\frac{\text{energy}}{\text{time}}$	$P = \frac{E}{t}$
efficiency = $\frac{\text{work output}}{\text{work input}}$	
efficiency = $\frac{\text{power output}}{\text{power input}}$	
wave speed = frequency × wavelength	$v = f\lambda$
energy = mass × specific heat capacity × temperature change	$W = mc\Delta\theta$
capacitance = $\frac{\text{charge}}{\text{potential difference}}$	$C = \frac{Q}{V}$
charge = current × time	$Q = It$
potential difference = $\frac{\text{work done}}{\text{charge moved}}$	$V = \frac{W}{Q}$
resistance = $\frac{\text{potential difference}}{\text{current}}$	$R = \frac{V}{I}$
total resistance in series, R_T	$R_T = R_1 + R_2$
total resistance in parallel, R_T	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$
power = potential difference × current	$P = VI$
$\frac{\textbf{voltage across primary coil}}{\textbf{number of turns on primary coil}} = \frac{\textbf{voltage across secondary coil}}{\textbf{number of turns on secondary coil}}$	$\frac{V_P}{n_P} = \frac{V_S}{n_S}$
refractive index of a medium, n	$n = \frac{\sin i}{\sin r}$; $n = \frac{\text{real depth}}{\text{apparent depth}}$
magnification, m = $\frac{\text{image distance}}{\text{object distance}}$	$m = \frac{v}{u}$

SECTION A

Answer **all** questions in this section.

1. This question is on simple machines.

Fig. 1.1 shows a pulley used to raise a 1500 N raft to a height of 5.0 m for storage.

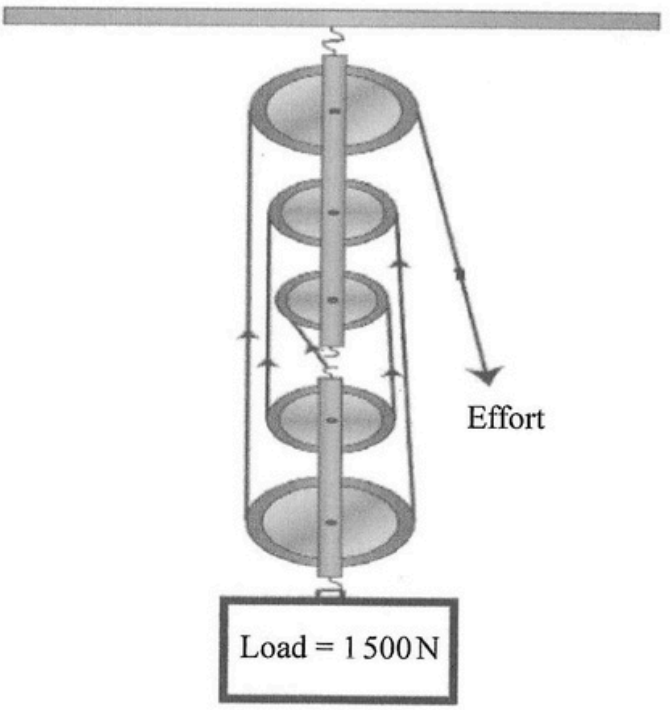


Fig. 1.1

(a) (i) State the velocity ratio of the pulley.

_____ [1]

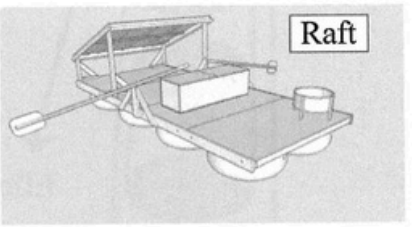
(ii) Calculate the distance moved by the effort in raising the 1500 N raft to the desired height of 5.0 m. Show your working.

[2]

(iii) The pulley system has an efficiency of 80%. Calculate the effort force needed to raise the 1500 N raft.

[3]

(b) One of the rafts being lifted falls into a pool of fresh water and floats as shown in **Fig. 1.2**.



Fresh Water

Fig. 1.2

(i) On **Fig. 1.2**, draw the vertical forces acting on the raft.

Label each force with its name and indicate the magnitude of each force. [3]

(ii) Determine the weight of the water displaced by the raft.

[1]

2. This question is about mechanical energy.

(a) (i) Define the term energy.

_____

_____ [1]

(ii) Complete the table below to show the type of energy contained in a stretched rubber band and an atom just before it emits an alpha particle.

		Type of energy
a	a stretched rubber band	
b	an atom just before it emits an alpha particle	

[2]

(b) **Fig. 2.1** below show three positions **A, B** and **C** for a 2000 kg roller coaster cart along its track. The cart starts from rest at position **A**.

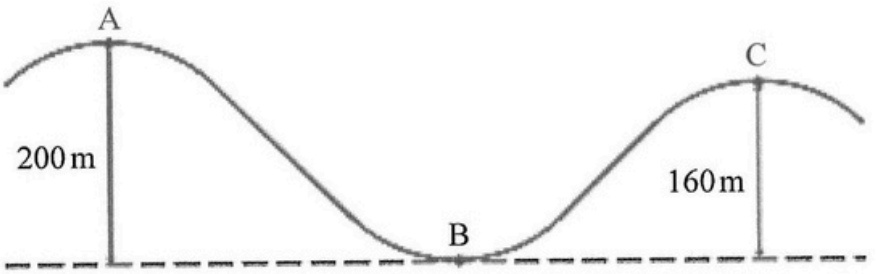


Fig. 2.1

(i) Suggest the position where the cart has the maximum gravitational potential energy.

_____ [1]

(ii) Calculate the gravitational potential energy possessed by the cart when it is at position **C**. (g = 9.8 N/kg)

[3]

(iii) Assuming, no energy is lost due to friction, calculate the speed of the cart when it arrives at position **B** from position **A**.

[3]

TOTAL MARKS [10]

3. This question is about electrical safety.

Fig. 3.1 shows a simplified model of a typical clothes dryer.

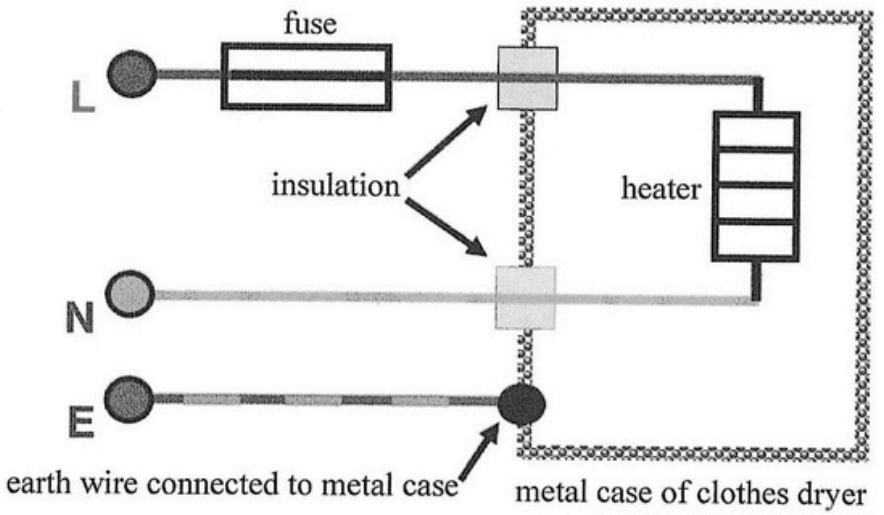


Fig. 3.1

(a) Appliances with metal cases such as clothes dryers are usually earthed.

If the live wire becomes loose inside the dryer and touches the metal case, explain how:

(i) the earth wire ensures safety.

_____

_____

_____ [2]

(ii) the fuse ensures safety.

_____

_____

_____ [2]

(b) Name an electromagnetic device that serves a similar function to a fuse in a building.

_____ [1]

(c) An electrical kettle with a power rating of 1.5 kW is shown in **Fig. 3.2**. The electrical kettle has a plastic case so there is no need for an earth wire connection in the plug.

Fig. 3.2

(i) Explain why the electrical kettle is safe to use even though there is no earth wire.

_____

_____

_____ [2]

(ii) Calculate the operational current of the electrical heater if its power rating is 1.5 kW and the potential difference is 120 V.

[3]

TOTAL MARKS [10]

4. Car **A** of mass 900 kg is travelling at a steady speed of 35 m/s against a resistive force of 2000 N as shown in **Fig. 4.1**.

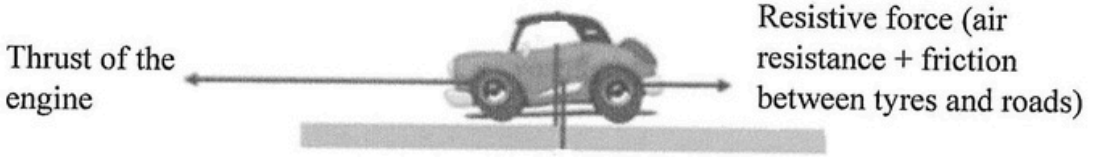


Diagram Not Drawn to Scale

Fig. 4.1

(a) State **one** difference between the **speed** and the **velocity** of the car.

_____ [1]

(b) If Newton's First Law of Motion is obeyed by the car, state the thrust produced by the engine.

_____ [1]

(c) Car **A**, with an initial speed of 35 m/s collides with a stationary car **B** of the same mass, on the side of a cliff. Car **A** comes to rest while in contact with car **B** in 1.2 seconds.

(i) Calculate the change in momentum of car **A**.

[2]

(ii) Calculate the average force exerted by car **B** on car **A**.

[2]

(iii) Car **B** falls off the cliff and hits the ground below 3.0 seconds later. Calculate the height of the cliff. ($g = 9.8\,\text{N/kg}$)

[2]

(iii) Calculate the vertical velocity of car **B** just before it hits the ground.

[2]

TOTAL MARKS [10]

SECTION B

Answer any **two** questions from this section.

5. This question is about heat energy.

(a) Define the term specific heat capacity. [1]

(b) (i) Vegetable oil and water have specific heat capacities of 3.23 kJ/kg °C and 4.20 kJ/kg °C respectively.

Equal masses of each are heated at the same rate and in the same metal container.

State and explain which has the faster rise in temperature. [2]

(ii) Give a reason why a cooling system is usually pressurised. [1]

(iii) Give a reason why car radiators are normally painted black. [1]

(c) (i) State what happens to the volume of water during freezing and explain why this would be a problem in plumbing during the winter. [2]

(ii) Name the term used to describe this phenomenon in (c) (i). [1]

(iii) A mixture of water and ethylene glycol is used as a coolant in automotive engines and has a specific heat capacity of 2 420 J/kg °C.

Calculate the quantity of heat removed from the engine when the temperature of 4.0 kg of this mixture increases from 85 °C to 120 °C. [3]

(iv) Why is the energy absorbed by the mixture less than that released by automotive engines? [1]

(v) The engine is turned off and cools to a temperature of 120 °C. As it cools, the energy released by the engine is the value obtained in (iii) plus an additional 360 000 J of heat energy.

The mass of the engine is 220 kg and its specific heat capacity of 450 J/kg °C.

Calculate the initial temperature of the engine. [3]

(d) A student determines the specific heat capacity of a coolant using an electrical method to provide energy.

(i) Draw a circuit diagram and describe how the amount of energy provided can be determined. [3]

(ii) Briefly state how the specific heat capacity of the coolant is calculated from the measurements. [2]

TOTAL MARKS [20]

6. (a) This question is about waves.

Fig. 6.1 shows a ray of light passing through a semi-circular glass block.

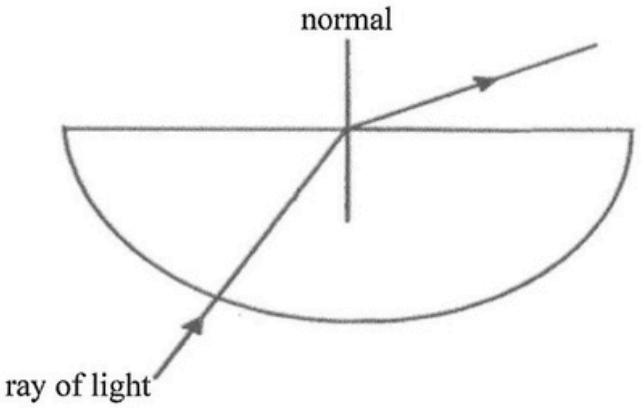


Fig. 6.1

(i) Explain why the ray of light does not change direction when it enters the glass block, but changes direction when it leaves the glass block. [2]

(ii) Apart from direction, state **TWO** other features of the light wave that change when it leaves the semi-circular glass block and enters air. [2]

(b) A student performs an experiment to investigate the refractive index n of the glass used to make the semi-circular glass block as shown in **Fig. 6.2**.

The student passes red light into the semi-circular block at various angles of incidence i and measured angles of refraction r.

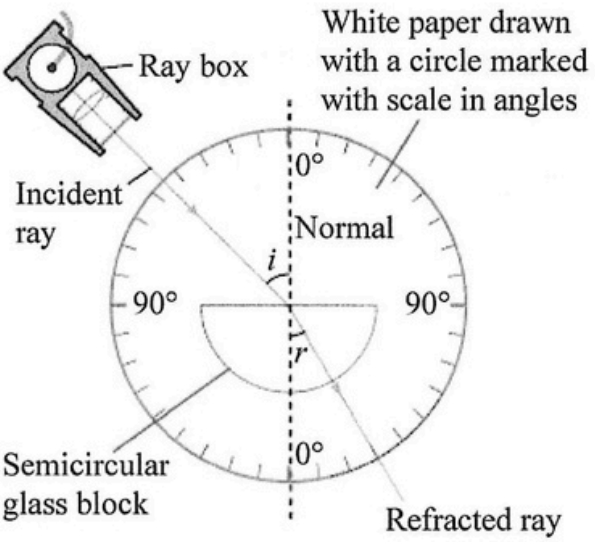


Fig. 6.2

In the practical conducted:

(i) Identify both the independent and dependent variables. [2]

(ii) Name **TWO** controlled variables. [2]

The student plots a graph of sin i against sin r as shown in **Fig. 6.3**.

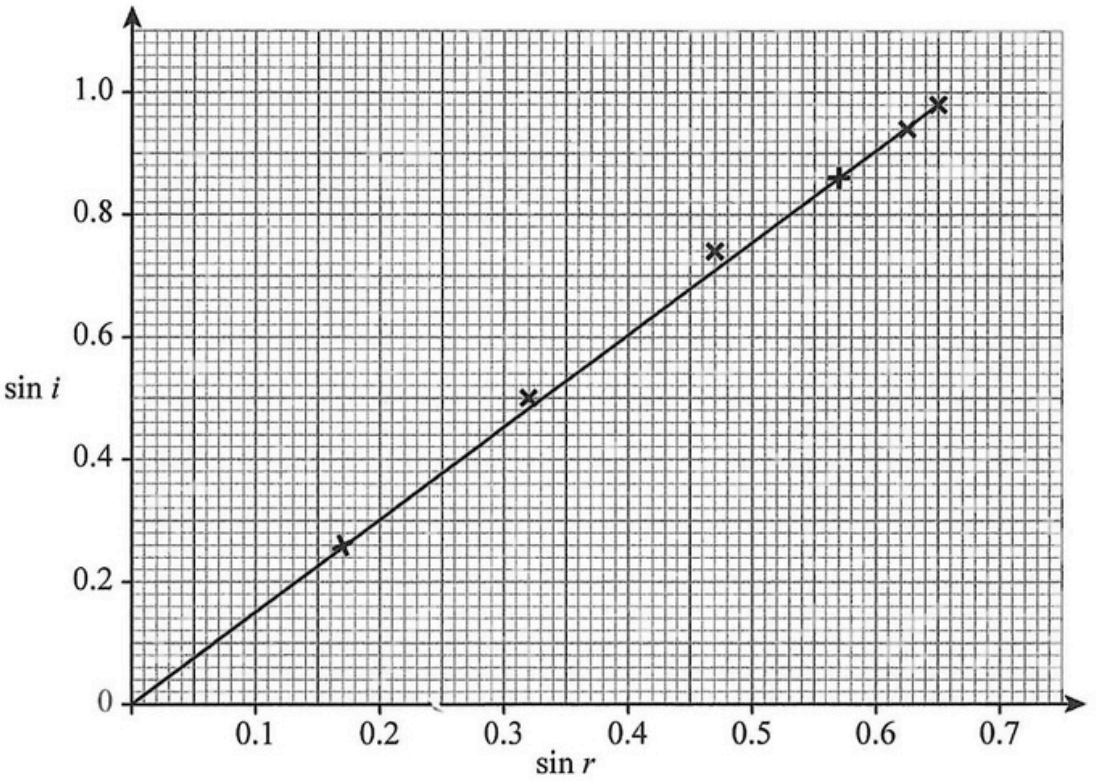


Fig. 6.3

(iii) Find the gradient of the graph and determine the refractive index of glass. [3]

(iv) Without using your calculated value in (b) (iii), use the graph to estimate the critical angle of the glass block. [3]

(c) An optical fibre is a thin flexible fibre with a glass core through which light signals can be sent. The glass from which the optical fibre is made has a refractive index of 1.44.

Fig. 6.4 shows a section of an optical fibre in air, with a ray of light incident on the fibre wall at **A**.

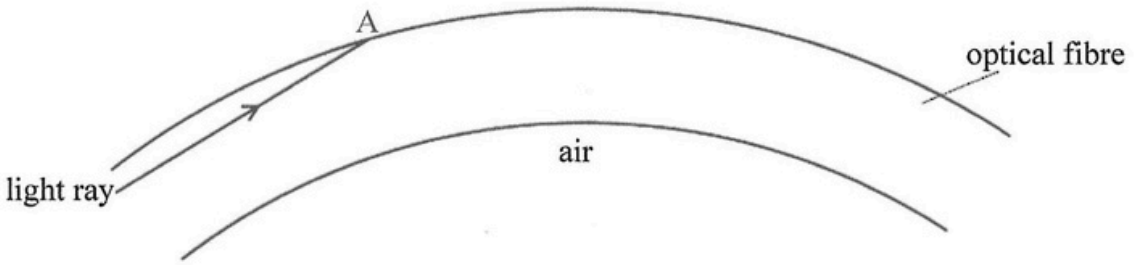


Fig. 6.4

(i) Calculate the critical angle of the optical glass fibre. [2]

(ii) On **Fig. 6.4**, complete the path of the light ray in the optical fibre until it reaches the end of the fibre. [1]

(iii) Name the process the light ray is undergoing in the optical fibre. [1]

(iv) State **TWO** uses of optical fibres. [2]

TOTAL MARKS [20]

7. This question is about radioactivity

Fig. 7.1 shows an experiment set up in a vacuum used to investigate the composition of gold atoms. A thin sheet of gold foil is surrounded by a circular fluorescent screen and bombarded with alpha particles from a radioactive source.

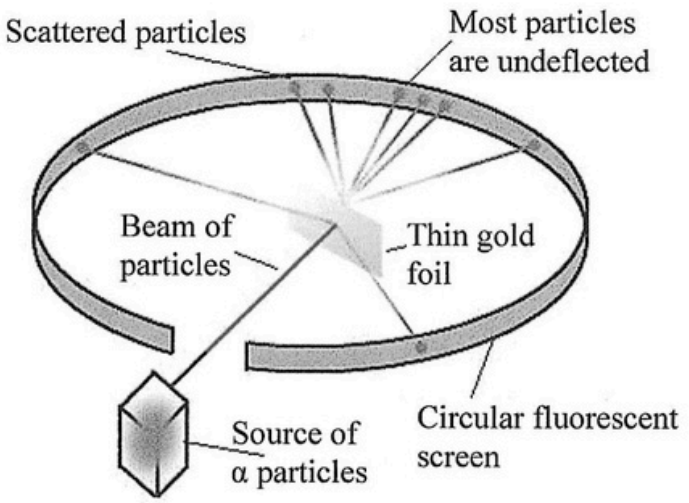


Fig. 7.1

(a) The following observations were made during the experiment.

1 *Most alpha particles pass through the gold foil undeflected.*
2 *A small number of alpha particles are deflected through large angles.*

(i) Name **one** of the scientists responsible for these experimental observations. [1]

(ii) State **two** properties of the gold atom that can be inferred based on these experimental observations. [2]

(b) Uranium-238 is a source of alpha particles.

(i) State **two** properties of an alpha particle. [2]

(ii) Complete the decay equation in **Fig. 7.2** for the alpha decay of Uranium-238.

$$^{238}_{92}\mathrm{U} \rightarrow \frac{\quad}{\quad}\alpha + \frac{\quad}{\quad}\mathrm{X}$$

Fig. 7.2

[2]

(c) Radioactive isotopes are used in medicine to diagnose and treat some medical conditions.

(i) Name **one** use of radioisotopes in medicine. [1]

(ii) State **two** (2) properties of a radioactive isotope that should be considered when planning for its use in a medical treatment.

Give a reason for each property that you suggest. [4]

(d) A Geiger-Muller tube is used to measure the count rate of a radioactive sample over time. The measurements obtained are shown in **Fig. 7.3**.

Count rate (cpm)	8000	6000	3500	1000	600	260	150
Time (minutes)	0	50	130	340	425	510	580

Fig. 7.3

(i) Plot a graph of count rate (y-axis) against time (x-axis). [5]

(ii) Using the graph, determine the half-life of the sample.

Indicate on your graph how you arrived at your answer. [2]

(iii) Using the graph, determine the count rate of the sample after 400 minutes. [1]

TOTAL MARKS [20]

Question .....
Write on both sides of the paper

Question .....
Write on both sides of the paper

Question .....
Write on both sides of the paper

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PHYSICS GRAPH PAPER

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