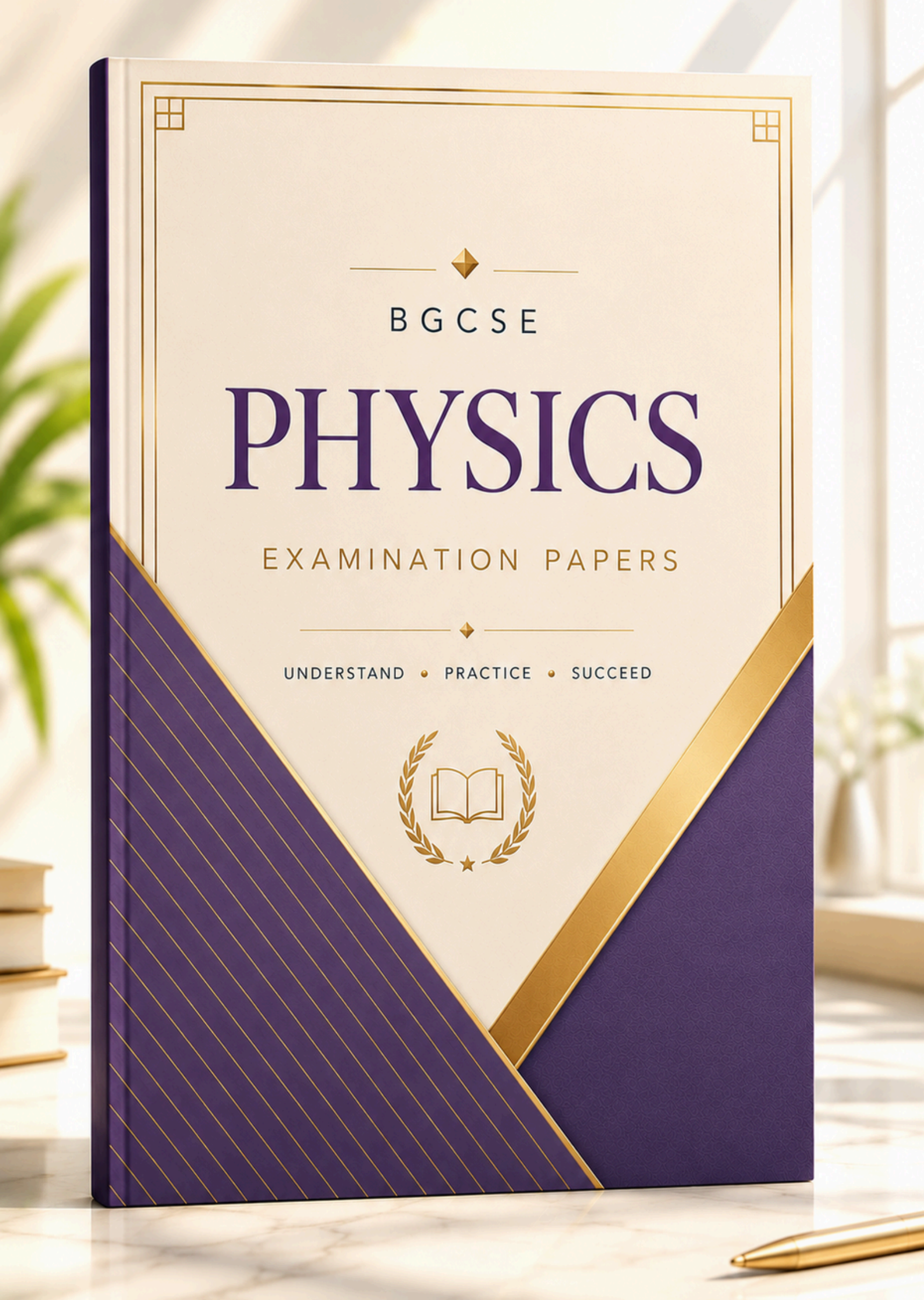
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PHYSICS

PAPER 3 3117/3

Thursday 6 JUNE 2024 12:30 P.M.–2:00 P.M.

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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 16 printed pages and 4 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. The National Grid is a system of devices that is responsible for safely delivering electricity to your home.

A summary of the power used in a home is shown in **Table 1.1**.

BIG POWER COMPANY		
Bill to: **John Kemp**	Meter Number: #123456	Billing Period: Jun 1st – Jun 30th
Consumer Type:	Domestic (House)	
Previous Reading (kWh)	**110440**	
Previous Reading (kWh)	**111360**	
Total number of kWh used for billing period (kWh)		
Total Amount Due:		

Table 1.1

Big Power Company charges customers \$0.05 per kilowatt hour for electricity use.

(a) Using the table determine:

(i) the total number of kilowatt hours used for the billing period.

[1]

(ii) the total amount due for the billing period. (Show working and give correct units.)

[2]

(iii) the billing time in hours.

[1]

(iv) the average power used in the home during the month of June. (Show working and give correct units.)

[3]

(b) A simple toaster is fitted with a 10 A fuse.

(i) The toaster conducts 2000 C of charge in 3 minutes.
Determine the working current of the toaster.

[2]

(ii) State whether or not the toaster will operate as intended.

_____ [1]

TOTAL MARKS [10]

2. (a) State Newton's First Law of Motion.

_____

_____

_____ [2]

(b) A car of mass 1000 kg travels along a flat, straight road. A resultant force of 1900 N acts on the car.

(i) Calculate the acceleration of the car. (Show working and give correct unit.)

[2]

(ii) The car then climbs a hill at 30° to the horizontal.
The weight of the car acting downwards is 10 000 N.
Calculate the component of the weight of the car that acts at right angles to the surface of the hill. (Show working and give correct unit.)

[2]

(c) The plane in **Fig. 2.1** begins taxiing from one end of a runway at 5.0 m/s and undergoes a uniform acceleration of 6.2 m/s^2 for 15 s just before taking off.

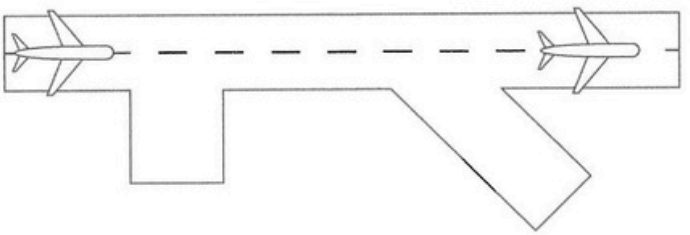

Fig. 2.1

(i) Calculate the plane's speed at the time of take-off.

[2]

(ii) Calculate the distance that the plane travelled just before take-off.

[2]

TOTAL MARKS [10]

3. A hot air balloon (which has a gondola attached with a man and equipment inside) is shown in **Fig. 3.1**. It is at sea level and contains 500 m^3 of air.
The density of air at sea level is 1.2 kg/m^3.
The temperature of the air at sea level is 25 °C.
The atmospheric pressure is 1.0×10^5 Pa.

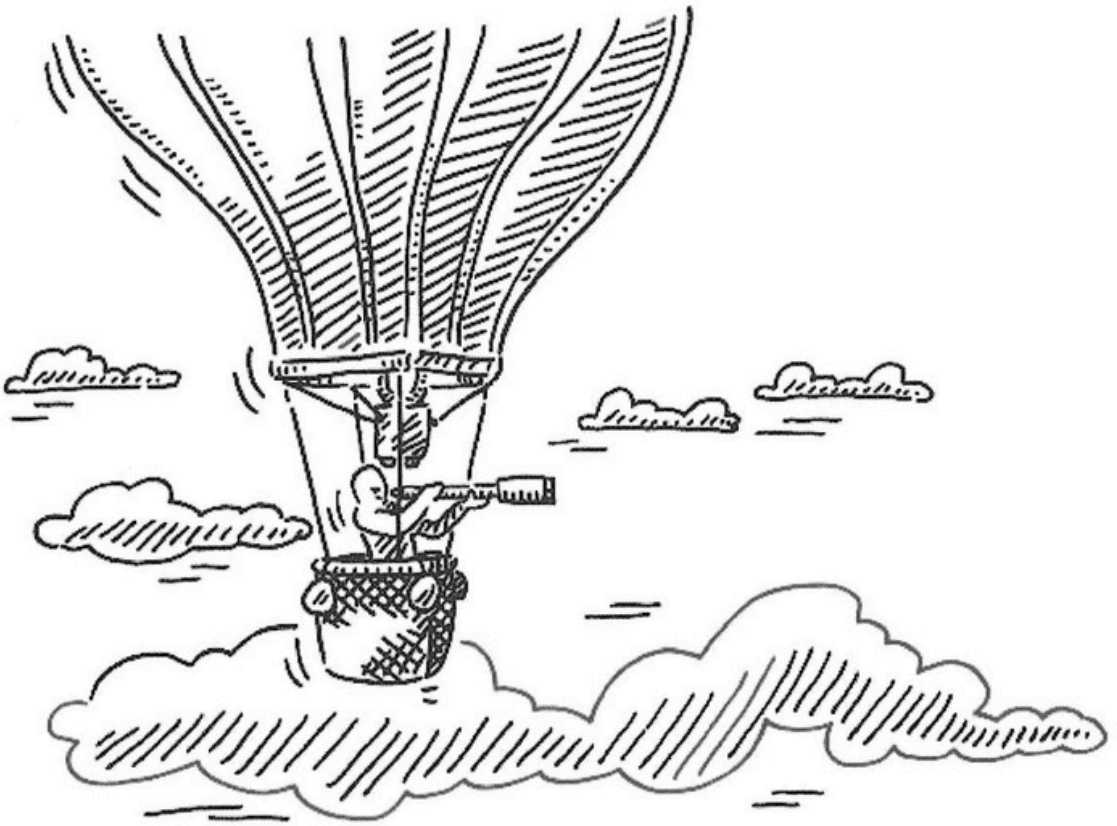

Fig. 3.1

(a) Calculate the mass of air contained inside the balloon.

[1]

(b) The air is heated by a propane heater causing the volume of the balloon to increase while keeping the pressure constant.

Calculate the new volume if 500 m^3 of air is heated from 25 °C to 50 °C.

[3]

(c) Calculate the new density of the air in the balloon.

[1]

(d) Give the name of the upward force exerted on the balloon.

_____ [1]

(e) Given that the balloon, the gondola and all of the equipment weighs 5000 N, calculate the mass in kg of the man operating the balloon assuming that the balloon is floating at equilibrium.

Assume that the upward force is equal to the weight of the displaced air calculated at (a). (When mass is 1 kg, g = 10 N/kg.)

[4]

TOTAL MARKS [10]

4. A student puts 50 g of ice cubes at 0 °C into a foam cup containing 1000 cm^3 of cola at room temperature of 25 °C as shown in **Fig. 4.1**.

The specific latent heat of fusion of ice is 3.3×10^5 J/kg.

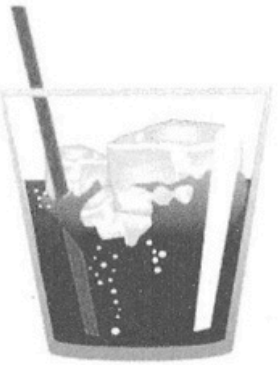

Fig. 4.1

(a) Assuming the ice is at a temperature of 0 °C, calculate the amount of energy needed to melt the ice.

[3]

(b) The heat energy required to melt the ice is drawn from the cola.

Name the method of heat transfer that governs the transfer of heat in liquids.

_____ [1]

(c) Cola has the density of 1.0 g/cm^3 and a specific heat capacity of 4200 J/(kg °C).

Calculate the new temperature of the soda after the ice melts.

(Assume that the heat needed to melt the ice is absorbed from the cola.)

[3]

(d) Calculate the mass of ice needed to reduce the temperature of 1.0 kg of cola from 25 °C to 0 °C.

(Assume that no heat is absorbed from the surroundings and that the ice is initially at 0 °C.)

[3]

TOTAL MARKS [10]

SECTION B

Answer **two** questions from this section.

5. This question is about waves.

(a) Waves may be either longitudinal or transverse.

Describe the difference between a longitudinal and a transverse wave. [2]

(b) A tsunami is a giant water wave which may be caused by an earthquake below the ocean. Waves from a certain tsunami have a wavelength of 1.8×10^5 m and a speed of 245 m/s Calculate the frequency of the tsunami wave. [2]

(c) A student conducts an experiment to determine the refractive index of glass. **Fig. 5.1** shows the apparatus the student uses to find the refractive index of glass.

Glass blocks of different heights are progressively placed vertically over an object, which is an X marked on a sheet of paper.

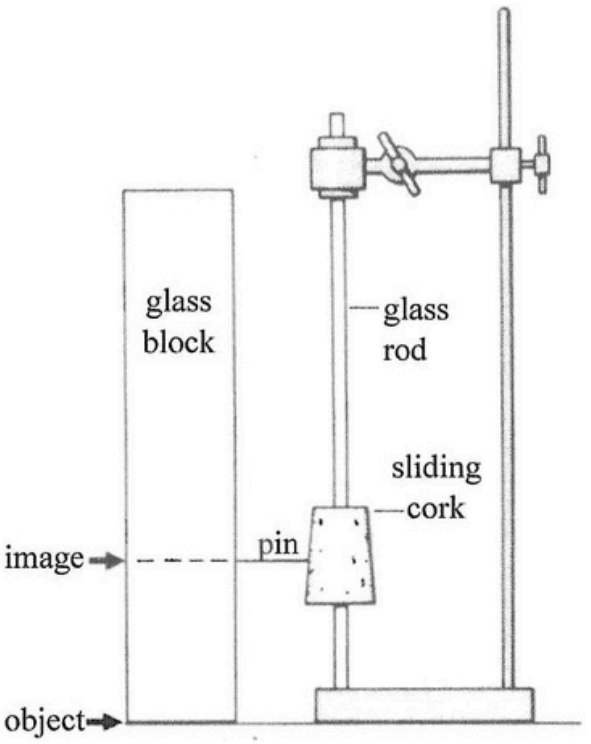

Fig. 5.1

(i) Describe an appropriate method the student may have followed to determine the refractive index of glass using the apparatus in **Fig. 5.1**. [3]

(ii) The following results were obtained by the student.

Real depth/cm	6.6	12.3	18.9	24.0	30.3	36.6
Apparent depth/cm	4.4	8.2	12.6	16.0	20.2	24.4

Plot a graph of the real depth (y-axis) against apparent depth (x-axis). [5]

(iii) Find the gradient of your graph in (ii) and hence determine a value for the refractive index of glass [3]

(d) In other practical studies, the student uses a ray box to direct light at different angles from a plastic semi-circular block in air as shown in **Fig. 5.2**.

The plastic semi-circular block has a refractive index of 1.45.

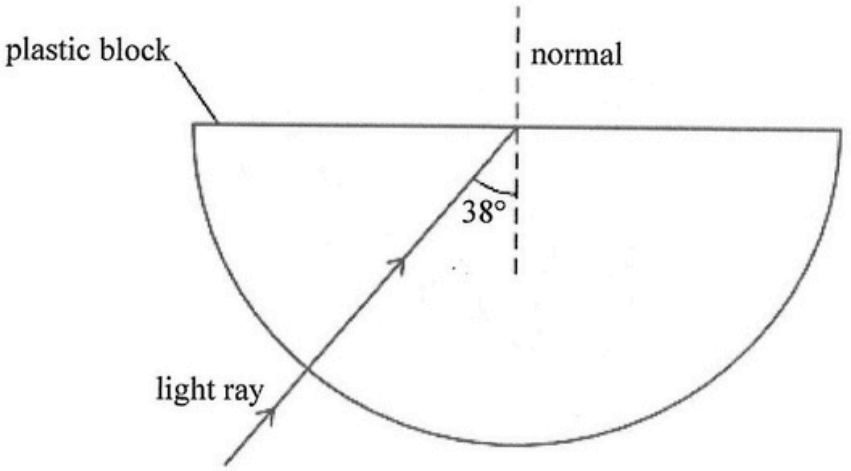

Fig. 5.2

(i) Explain why the ray of light does not change direction as it enters the plastic block along the circular surface. [1]

(ii) Calculate the angle of refraction of a light ray if it travels at an angle of incidence of 38° from air into the plastic block. [2]

(iii) State the change, if any, that occurs to the frequency and wavelength of the light ray when it leaves the plastic block and enters air. [2]

TOTAL MARKS [20]

6. This question is about magnetism and electromagnetism.

In a Physics laboratory, students conduct several experiments to investigate the action of motors and generators.

(a) State the useful energy transformation that occurs in:

(i) motors [1]

(ii) generators [1]

(b) **Fig. 6.1** shows the first circuit built by the group of students.

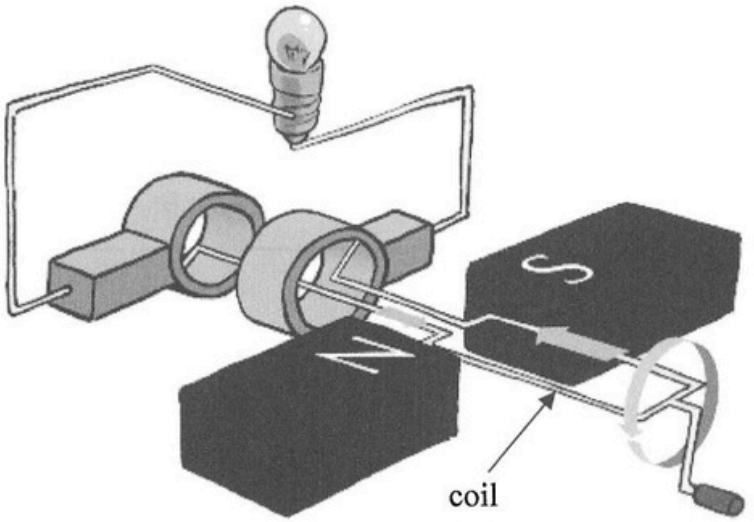

Fig. 6.1

(i) Name the process occurring in the circuit when the coil is manually rotated in the magnetic field. [1]

(ii) State what would happen if the coil is held stationary within the magnetic field. [1]

(iii) Suggest **three** modifications that increase the current output from the apparatus shown in **Fig. 6.1**. [3]

(c) In a second experiment, the students modified the circuit by replacing the slip rings, with a split ring commutator as shown in **Fig. 6.2**.

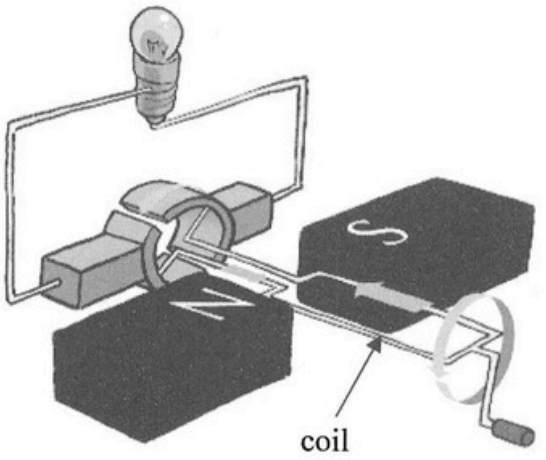

Fig. 6.2

Explain how this change affects the current output. [2]

(d) In a further experiment about electromagnetism, the students used a moving coil galvanometer to measure the current flowing through its coils.

Figure 6.3 shows a horizontal cross-section through the coil and the poles of the moving coil galvanometer. ⊕ represents the current moving into the plane of the diagram (away from you) and ⊙ represents current moving out of the plane of the diagram (towards you).

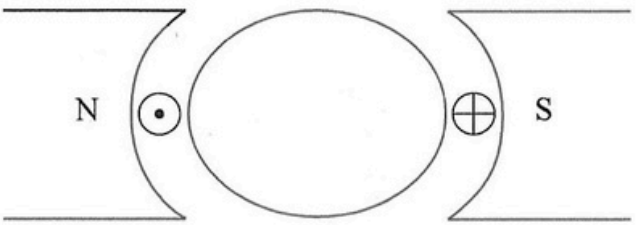

Fig. 6.3

(i) State and explain the principle of operation of the moving coil galvanometer. [2]

(ii) On **Fig. 6.3**, draw the magnetic field pattern between the pole pieces. [2]

(iii) Draw long arrows to show the direction of the forces on the coil carrying current into and out of the plane of the diagram. [2]

(iv) State the direction of the rotation of the coil. [1]

(v) State **two** modifications that change the direction of rotation of the coil. [2]

(vi) Give **two** applications in everyday life of the rotation of a coil caused by an electric current. [2]

TOTAL MARKS [20]

7. A construction worker uses the block and tackle pulley system as shown in **Fig. 7.1** to lift a concrete block off the ground onto an assembly belt using an effort force of 60 N.

The concrete block weighs 200 N.

The assembly belt is 0.75 meters above the ground.

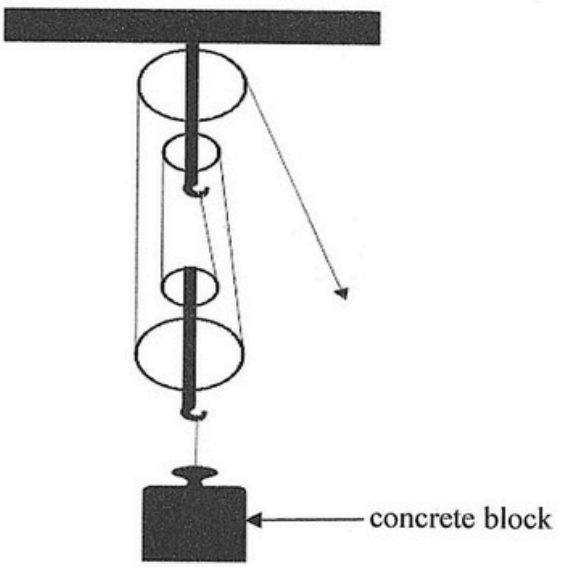

Fig. 7.1

(a) Define the term velocity ratio. [2]

(b) State the velocity ratio of the block and tackle pulley system shown in **Fig. 7.1** [1]

(c) Calculate

(i) the distance moved by the effort, in lifting the 200 N load through the height of 0.75 m. [2]

(ii) the work done by the construction worker as the effort force moves through the distance calculated in (i). [2]

(iii) the work done on the load as it is lifted through the height of 0.75 m. [3]

(iv) the mechanical advantage of the block and tackle pulley system. [2]

(v) the percentage efficiency of the block and tackle pulley system. [3]

(d) Another worker tried to lift the same block using the moveable pulley shown in **Fig. 7.2**.

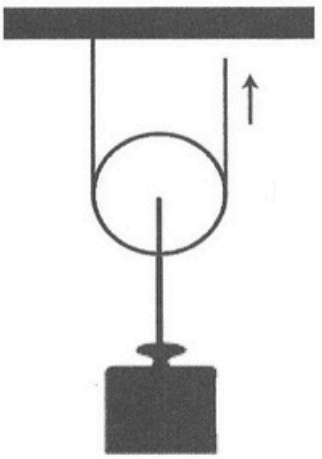

Fig. 7.2

(i) State the velocity ratio of the moveable pulley. [1]

(ii) Determine the minimum effort force required to move the 200 N block with a moveable pulley. [2]

(iii) State one reason why the efficiency of a machine is never 100 %. [1]

(iv) State one way the efficiency of machines can be increased. [1]

TOTAL MARKS [20]

End]

PHYSICS GRAPH PAPER

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