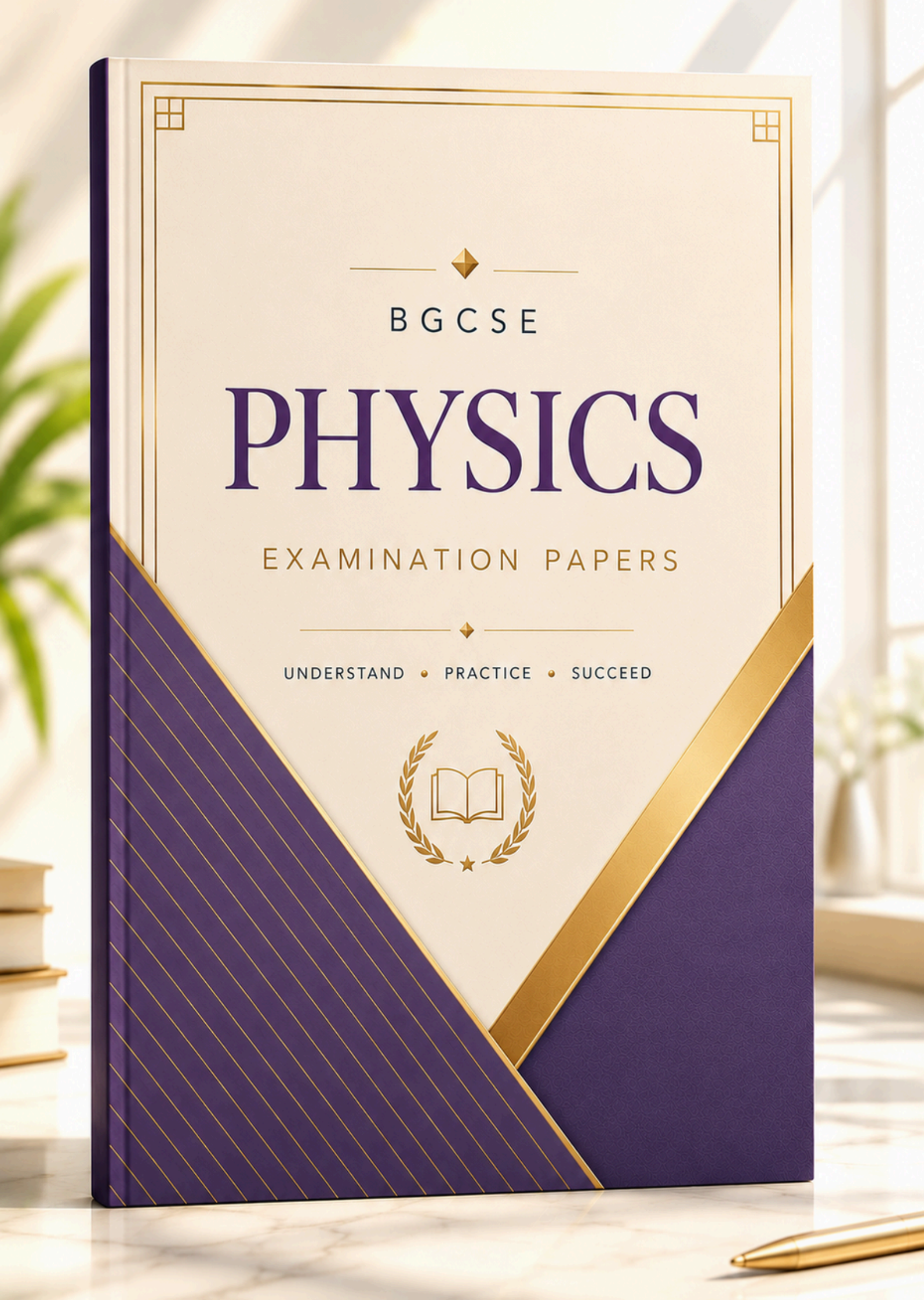
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PAPER 3 3117/3

Wednesday 7 JUNE 2023 12:30 P.M.–2:00 P.M.

Additional materials:
None

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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 15 printed pages and 5 lined pages.

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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 = $\frac{\text{charge}}{\text{potential difference}}$	$C = \frac{Q}{\mathrm{V}}$
charge = current × time	$Q = It$
potential difference = $\frac{\text{work done}}{\text{charge moved}}$	$V = \frac{W}{\mathrm{Q}}$
resistance = $\frac{\text{potential difference}}{\text{current}}$	$R = \frac{V}{\mathrm{I}}$
total resistance in series, R_T	$R_T = R_1 + R_2$
total resistance in parallet, 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	$n = \frac{\sin \mathrm{i}}{\sin \mathrm{r}}$; $n = \frac{\text{real depth}}{\text{apparent depth}}$
magnification, m = $\frac{\text{image distance}}{\text{object distance}}$	$m = \frac{\mathrm{v}}{\mathrm{u}}$

SECTION A

Answer **all** questions in this section.

1. This question is about electromagnetism.

(a) (i) Give the meaning of the term electromagnetic induction.

_____

_____ [2]

(ii) State **two** factors that affect the magnitude of the voltage induced.

1 _____

2 _____ [2]

(b) **Fig. 3.1** shows a simplified diagram of some of the components in a cellular phone charger. The input to the cell phone charger is 120 V a.c. The step-down transformer reduces this voltage to 12 V a.c.

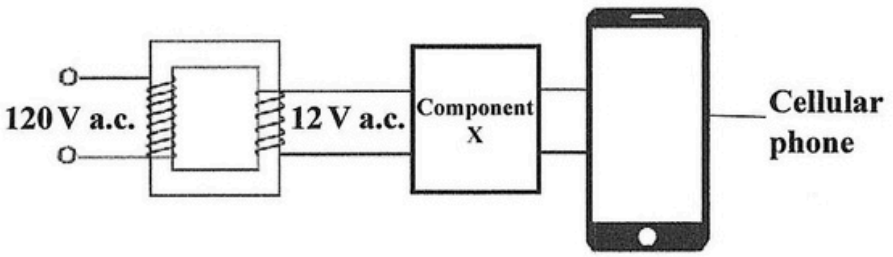


Fig. 3.1

(i) The transformer has 240 coils in the primary. Calculate the number of secondary coils.

[2]

(ii) The charging current in the secondary coils is 2.4 A.

Given that the transformer is an ideal one, calculate the current in the primary coils.

[2]

(iii) Determine the power in the primary and secondary coils of the transformer. (Show working.)

[2]

TOTAL MARKS [10]

2. **Fig. 1.1** shows a car travelling at 30 m/s, when the driver sees a van at the traffic light and slows uniformly to 10 m/s.

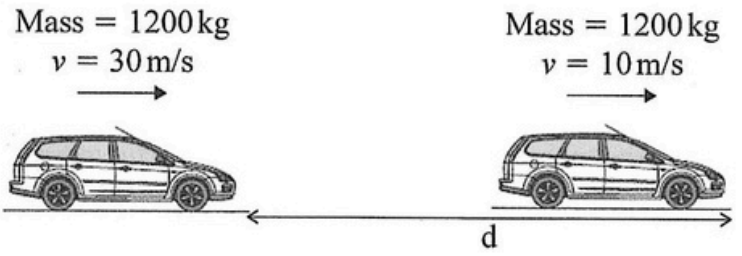


Fig. 1.1

(a) (i) It took 0.8 seconds for the car to slow from 30 m/s to 10 m/s.

Calculate the acceleration of the car.

[2]

(ii) Calculate the distance d, travelled by the car in 0.8 seconds.

[2]

(b) State the principle of conservation of momentum

_____

_____

_____ [2]

(c) The car, still travelling at 10 m/s, collides with the van which had stopped at the traffic light. **Fig. 1.2** shows just before and just after the car collided with the van.

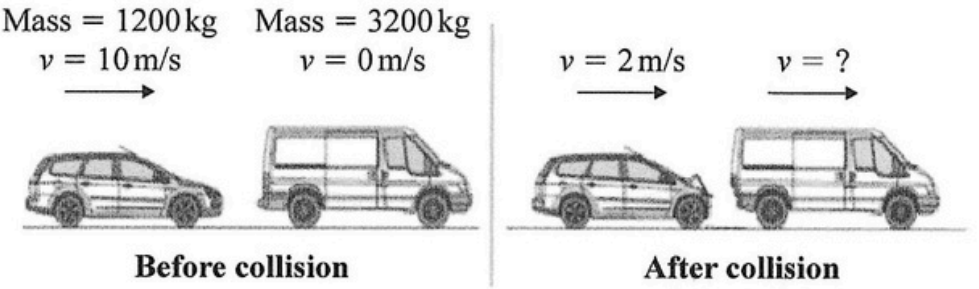


Fig. 1.2

(i) Use the information in the diagram to calculate the change in momentum of the car. Clearly show your working and the unit of your answer.

[2]

(ii) It took 0.4 seconds from the time of the collision for the car to slow to 2 m/s. Calculate the average force exerted on the car and the driver.

[2]

TOTAL MARKS [10]

3. A rigid cylinder with a movable piston, contains a fixed mass of gas. This is shown in **Fig. 2.1**.

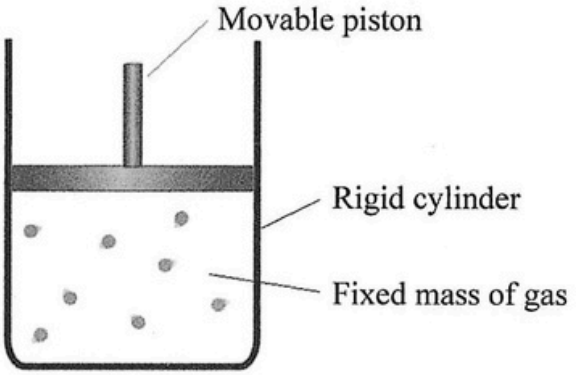


Fig. 2.1

(a) Explain, in terms of momentum of the molecules, how the gas in the cylinder exerts a pressure.

_____

_____ [2]

(b) Explain, in terms of the gas molecules, why the pressure of the gas decreases when the volume of the gas increases and the temperature is being kept constant.

_____

_____ [2]

(c) The cylinder is initially at sea level. The pressure at depth X is 302000 Pa in sea water of density 1030 kg/m^3, shown in **Fig. 2.2** (acceleration due to gravity is 9.8 m/s^2)

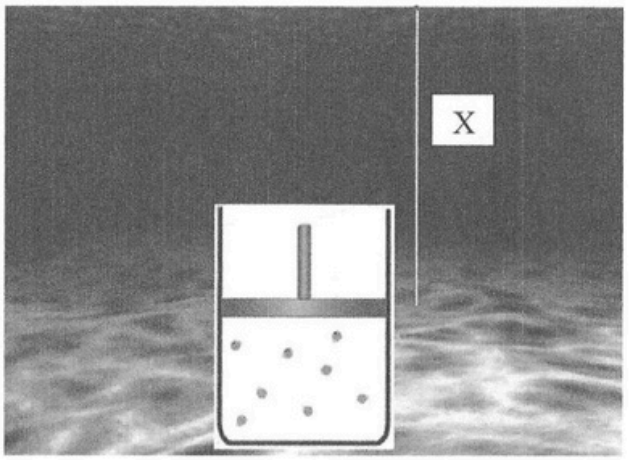


Fig. 2.2

(i) Calculate the depth, X, of the cylinder.

[2]

(ii) At sea level the volume of gas in the cylinder was 250 cm^3, the pressure 101 325 Pa and the temperature 25 °C.

Calculate the new volume of gas in the cylinder when it is at the depth X and the temperature is 5 °C.

[4]

TOTAL MARKS [10]

4. This question is about waves.

Fig. 4.1 shows a simplified diagram of an optical fibre (not drawn to scale). The passage of a light ray through the optical fibre is shown.

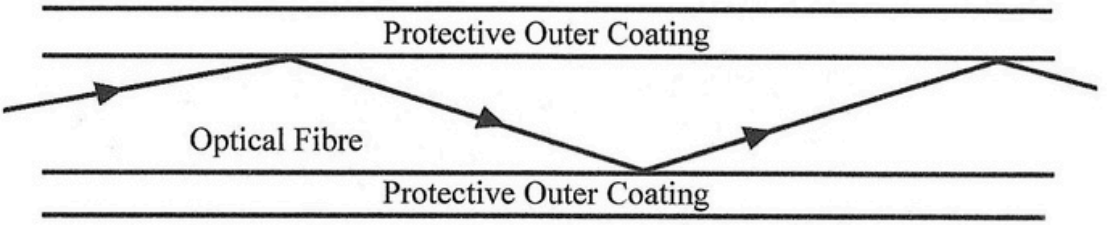


Fig. 4.1

(a) The speed of light in a vacuum is 3×10^8 m/s. When the light enters the optical fibre, its speed reduces to 2×10^8 m/s.

(i) State **one** property of light that remains the same in the optical fibre.

_____ [1]

(ii) State the name of the phenomenon occurring in the optical fibre.

_____ [1]

(iii) Give **two** practical applications for optical fibres.

- _____

_____

- _____

_____ [2]

(b) State how a longitudinal wave is different from a transverse wave.

_____

_____ [2]

(c) (i) The electromagnetic waves used in a microwave oven has a frequency of 2.45×10^9Hz.

The speed of the waves is 3.00×10^8 m/s.

Calculate the wavelength of the wave.

[3]

(ii) Microwaves are used in microwave ovens for cooking and reheating foods.

Give one other use for microwaves.

_____ [1]

TOTAL MARKS [10]

SECTION B

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

5. This question is about machines and moments.

(a) The diagram shows a clock on a trolley.

The trolley is being used to move a clock

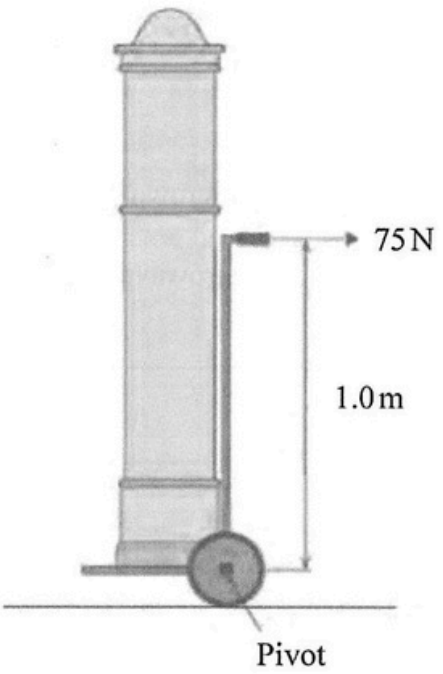


Fig. 5.1

(i) State the Principle of Moments. [1]

(ii) The trolley is a type of simple machine.

Name the simple machine. (Include its specific classification.) [2]

(iii) Calculate the moment of the force about the pivot. [2]

(iv) The worker later uses another trolley of similar weight and dimensions to transport the same clock. The perpendicular distance from the effort to the pivot of the trolley is now 0.8 m.

Without any further calculation state the effect this shorter distance will have on the effort. [1]

(b) **Fig. 5.2** shows an inclined plane used by a second food store worker to raise a 550 N cartoon to a height of 3.0 m.

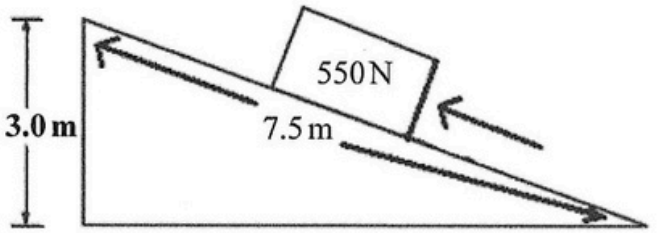


Fig. 5.2

Calculate the:

(i) useful work done by the load after being raised 3.0 m. [2]

(ii) total work done by the effort in pushing the cartoon up the incline given that friction along the incline is 90 N. [2]

(iii) effort used in pushing the 550 N cartoon along the incline. [2]

(c) State the equation to determine the efficiency of a machine. [2]

(d) A third worker uses the pulley shown in **Fig. 5.3** to raise a 450 N load to a height of 6.5 m.

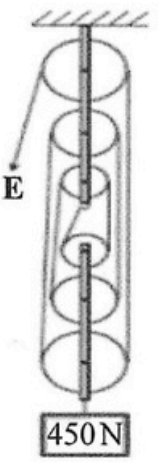


Fig. 5.3

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

(ii) Calculate the distance moved by the effort, E. [2]

(iii) Calculate the effort used to raise the load if the pulley has an efficiency of 89%. [3]

TOTAL MARKS [20]

6. This question is about waves.

Fig. 6.1 shows parallel light wave fronts approaching a barrier with two apertures that are close to each other.

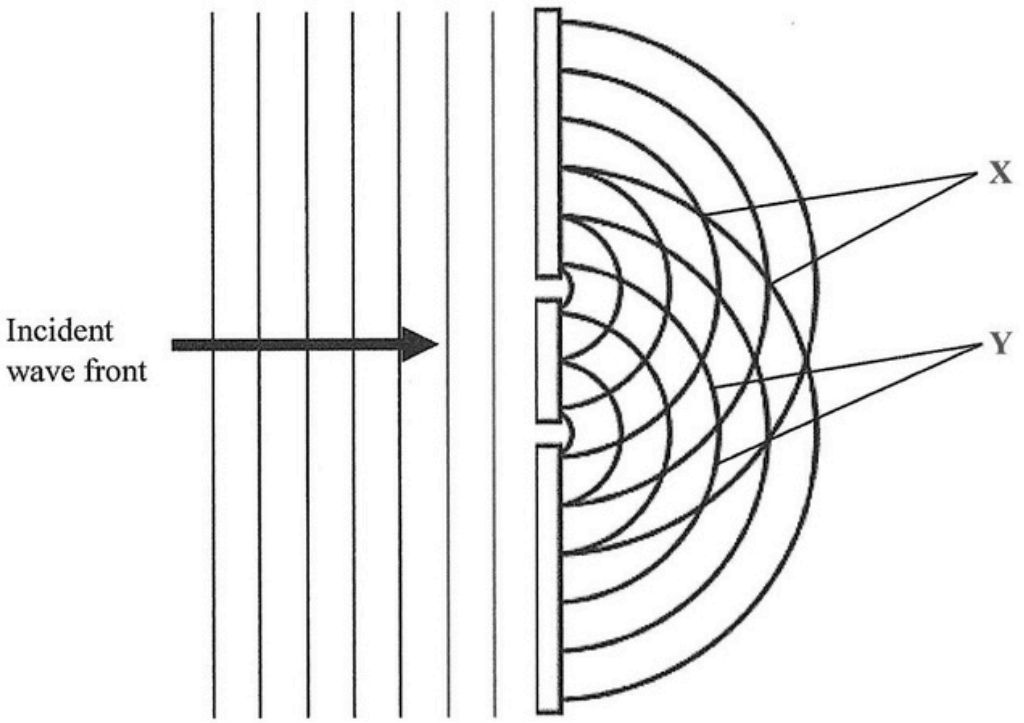


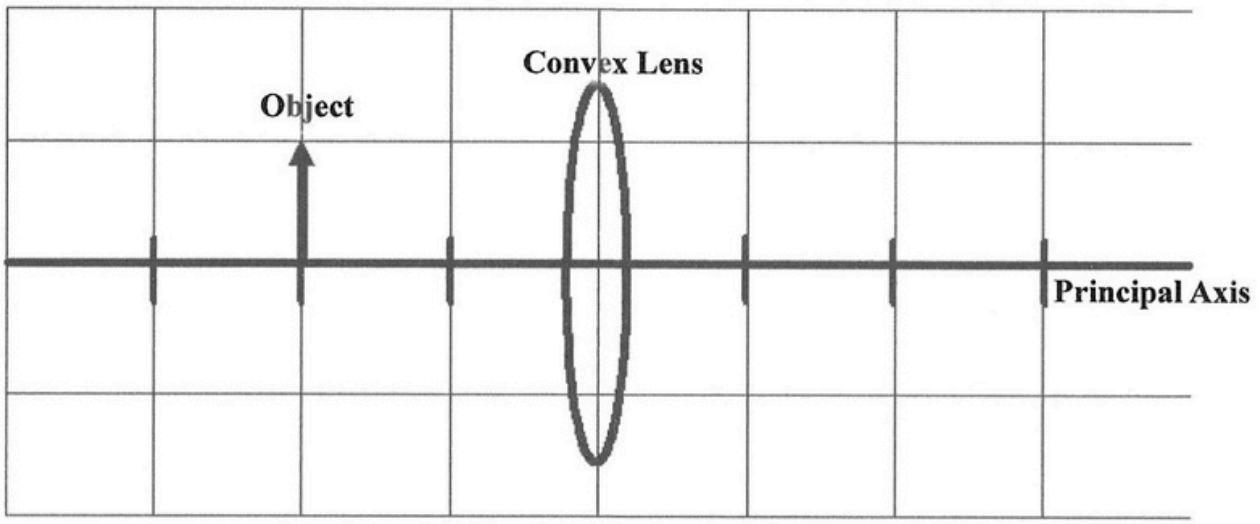
Fig. 6.1

After the wave passes through the two apertures, it diffracts.

(a) State what would be observed at points **X** and **Y**. [2]

(b) Explain why diffraction of light waves is rarely observed. Your answer should contain the words **aperture** and **wavelength**. [2]

(c) A thin convex lens is placed 2 cm in front of an object. The focal length of the lens is 1 cm.



Scale 1 unit = 1 cm

Fig. 6.3

On **Fig. 6.3**

(i) Label a focal point as **F**. [2]

(ii) Draw **two** light rays from the top of the object that pass through the lens. [2]

(iii) Mark the position of the image. [2]

(iv) State **two** properties of the image formed by this lens. [2]

(v) State **one** application of a convex lens. [1]

(d) A lightning storm creates both lightning and thunder. An observer sees the lightning almost immediately since light travels at 3×10^8 m/s. After seeing the lightning the observer counts 5 seconds and then hears the thunder.

Calculate the distance to the storm. (Assume the speed of sound is 340 m/s.) [3]

(e) (i) State **three** properties of electromagnetic waves. [3]

(ii) Identify the electromagnetic wave with the shortest wavelength. [1]

TOTAL MARKS [20]

7. This question is about energy.

(a) State the principle of conservation of energy. [2]

(b) The diagram shows a diver about to dive from a diving board.

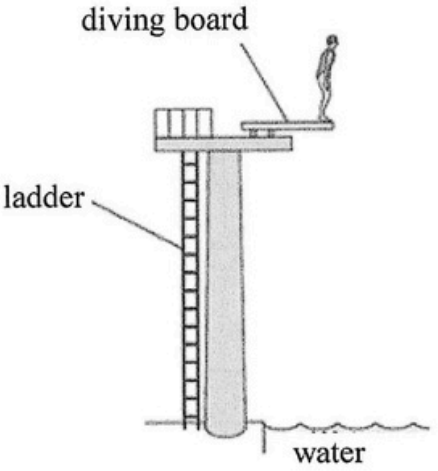


Fig. 7.1

At the instant the diver hits the water the kinetic energy of the diver is 5040 J. The speed of the diver is 12 m/s.

Calculate the mass of the diver [3]

(c) **Fig. 7.2** shows an elevator inside a building. The motor in the lift does 120,000 J of work in 8.0 secs.

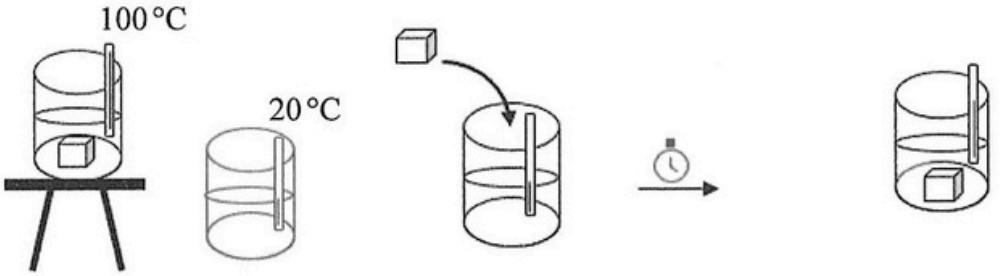
Fig. 7.2

(i) Calculate the power output of the motor in the lift. [2]

(ii) The lift goes up 15 m. The total mass of the people on the lift is 280 kg.

Calculate the increase in gravitational potential energy of the people in the lift. [2]

(d) A student conducts an experiment, shown in **Fig. 7.3** to determine the specific heat capacity of an unknown metal. Data was collected as shown in the diagrams. (Assume no heat was lost during the experiment.)



(a)
A Bunsen burner is used to gently heat a 100 g metal cube in a water bath from 20 °C to 100 °C.

(b)
The 100 g metal block is quickly transferred to a calorimeter containing 200 g of water at 20 °C and gently stirred.

(c)
The final temperature of the water in the calorimeter is measured.

Fig. 7.3

Data Collected	Water	Metal
Mass (m)	200 g	100 g
Initial temperature (T_1)	20 °C	100 °C
Final temperature(T_2)	50 °C	50 °C
Specific heat capacity (c)	4.18 $J/g^{-1}°C^{-1}$	?

(i) Calculate the thermal energy gained by the water. Show clearly how you arrive at your answer. [3]

(ii) Calculate the specific heat capacity of the metal. [4]

(iii) Give **two** reasons why the boiling point of water is sometimes greater than 100 °C. [2]

(e) Define latent heat of fusion. [2]

TOTAL MARKS [20]

End]