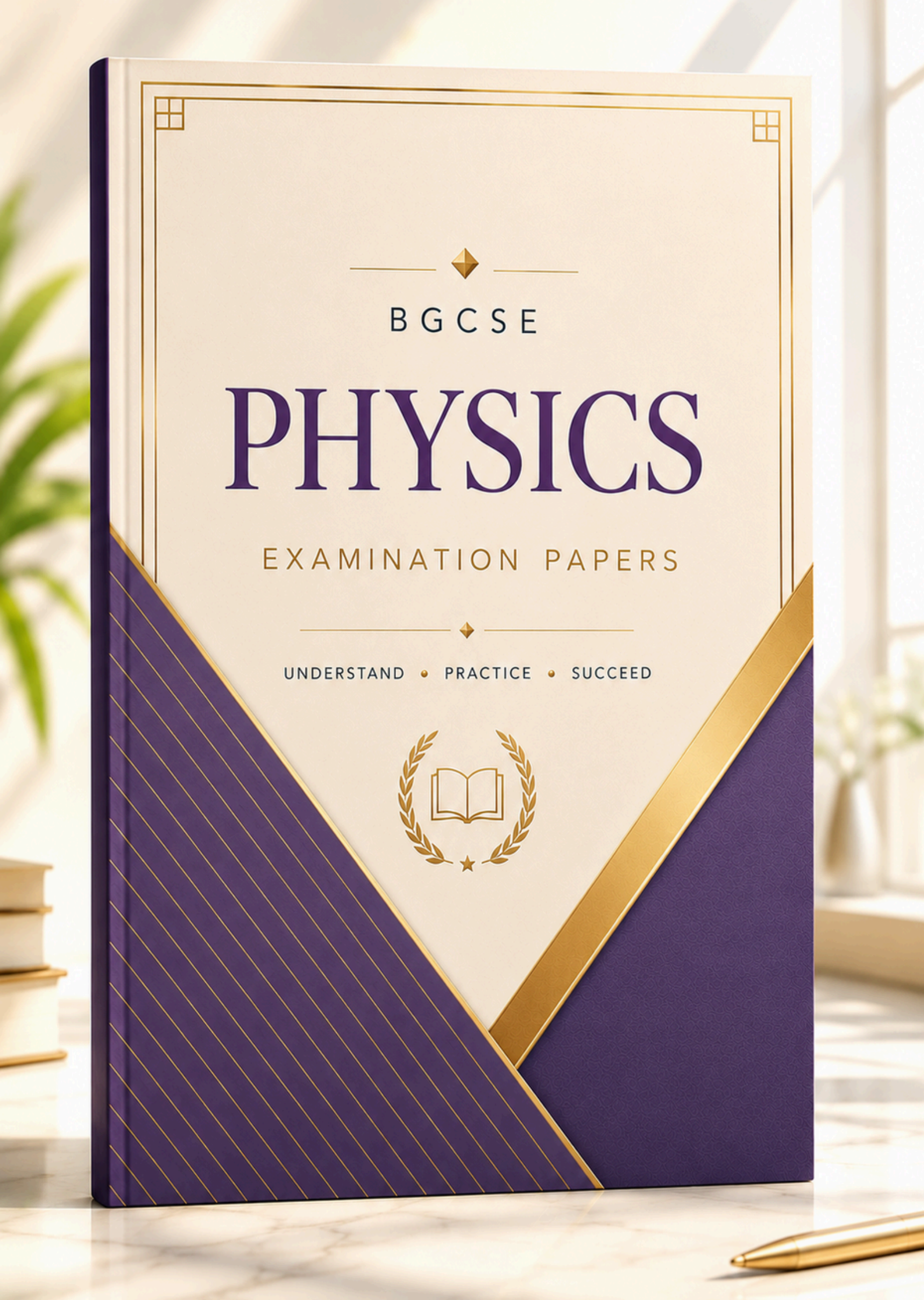
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PHYSICS

PAPER 3 3117/3

Thursday 4 JUNE 2020 12:30 P.M.–2:00 P.M.

Additional materials:
Graph paper

MINISTRY OF EDUCATION
NATIONAL EXAMINATIONS

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/graph paper provided at the back of this question booklet.

Calculators may be used in this paper.

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

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

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

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	$F = ma$
$\text{pressure} = \frac{\text{normal force}}{\text{area}}$	$p = \frac{F}{A}$
pressure due to a liquid = depth × gravity × density	$p = \varrho gh$
$\text{average speed} = \frac{\text{distance travelled}}{\text{time taken}}$	$s = \frac{d}{t}$
$\text{average velocity} = \frac{\text{distance travelled in a given direction}}{\text{time taken}}$	$v = \frac{d}{t}$
$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$	$a = \frac{v - u}{t}$
$\text{density} = \frac{\text{mass}}{\text{volume}}$	$D = \frac{m}{v}$
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	$PE = wh$
$\text{power} = \frac{\text{energy}}{\text{time}}$	$P = \frac{E}{t}$
$\text{efficiency} = \frac{\text{work output}}{\text{work input}}$	
$\text{efficiency} = \frac{\text{power output}}{\text{power input}}$	
wave speed = frequency × wavelength	$v = f\lambda$
energy = mass × specific heat capacity × temperature change	$W = mc\Delta\theta$
$\text{capacitance} = \frac{\text{charge}}{\text{potential difference}}$	$C = \frac{Q}{V}$
charge = current × time	$Q = It$
$\text{potential difference} = \frac{\text{work done}}{\text{charge moved}}$	$V = \frac{W}{Q}$
$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$	$R = \frac{V}{I}$
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	$P = VI$
$\frac{\text{voltage across primary coil}}{\text{number of turns on primary coil}} = \frac{\text{voltage across secondary coil}}{\text{number of turns on secondary coil}}$	$\frac{V_P}{n_P} = \frac{V_S}{n_S}$
refractive index of a medium, n	$n = \frac{\sin i}{\sin r}; n = \frac{\text{real depth}}{\text{apparent depth}}$
$\text{magnification, } m = \frac{\text{image distance}}{\text{object distance}}$	$m = \frac{v}{u}$

SECTION A

1. This question is about simple electronic devices and circuitry.

(a) A student set up a simple electronic circuit as shown in **Fig. 1.1**.

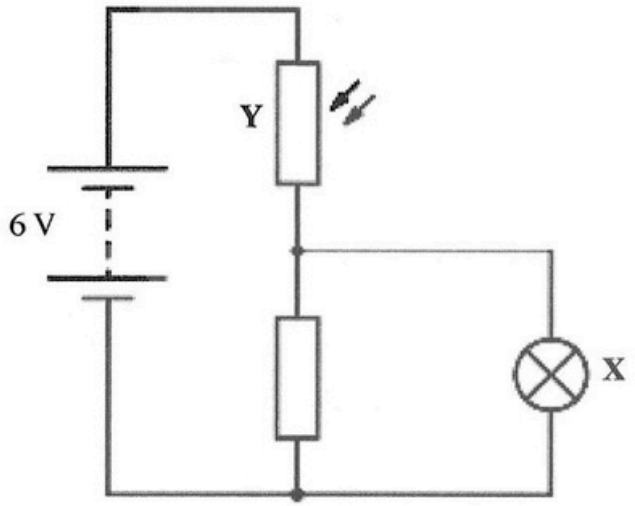


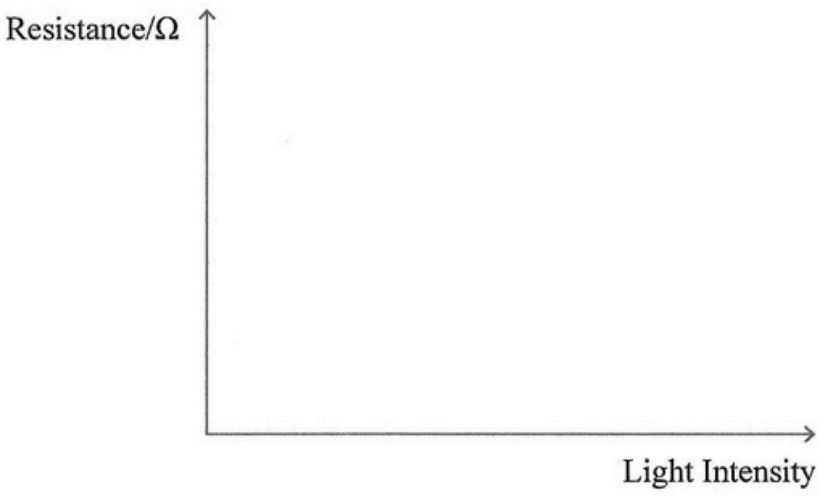
Fig. 1.1

(i) Lamp **X** is not glowing brightly. Explain what must happen to component **Y** to make lamp **X** glow brightly?

_____

_____ [2]

(ii) Sketch a graph of resistance against light intensity for component Y.



[2]

(b) Light dependent resistors (LDR) are commonly used for automatic street lighting.

Fig. 1.2 shows a simplified circuit diagram of automatic lighting.

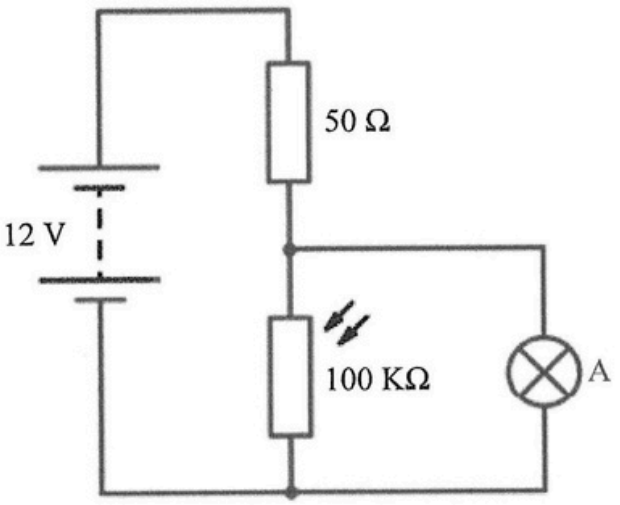


Fig. 1.2

(i) Given that the resistance of lamp **A** is 10 Ω, calculate the current flowing through the battery.

[4]

(ii) Apart from automatic street lights, state **TWO** other applications of LDRs.

_____

_____ [2]

TOTAL MARKS [10]

2. This question is about refraction of light rays and optical equipment.

Fig. 2.1 shows a simplified diagram of the internal view of a binocular, with a magnified view of the glass prisms it contains. The refractive index of glass is 1.5.

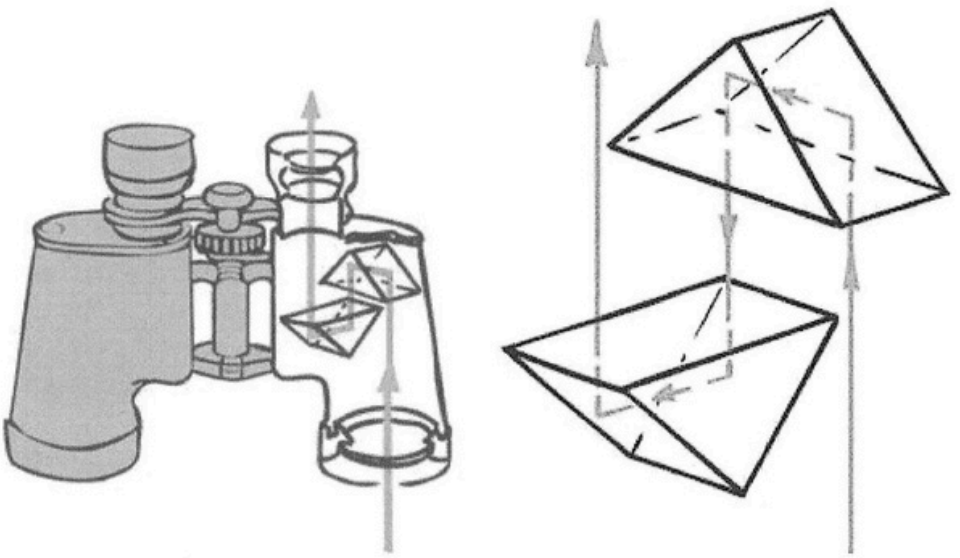


Fig. 2.1

(a) (i) Give the name of the phenomenon occurring in the glass prisms.

_____ [1]

(ii) Explain how this process occurs.

_____

_____ [1]

(iii) Determine the critical angle of the glass prisms used in the binoculars.

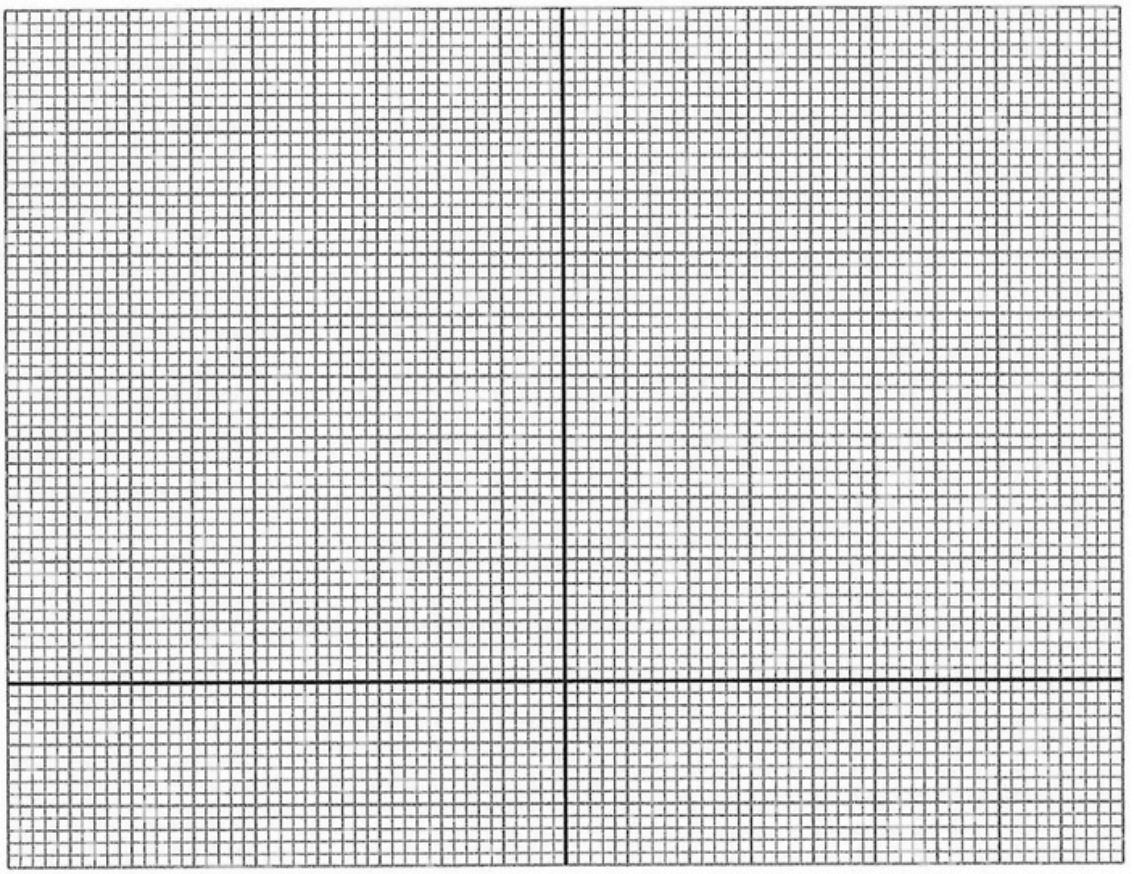
[2]

(iv) State **ONE** function of using glass prisms in binoculars.

_____ [1]

(b) A magnifying glass can be used to provide an upright, enlarged view of an object placed within its focal length.

(i) A converging lens of focal length 4.0 cm is being used as a magnifying glass. Draw a ray diagram on the grid below for an object 3.0 cm tall, placed 2.0 cm from the lens.



[3]

(ii) Calculate the magnification produced by the converging lens.

[2]

TOTAL MARKS [10]

3. This question is about momentum and Newton's Laws of Motion

A student of mass 60kg is standing on a skateboard of mass 2kg, both are at rest. His friend throws him a basketball of mass 3kg, he catches it and starts to move.

(a) State and explain which law of motion is being displayed by the student on the skateboard, immediately upon catching the basketball.

_____ [2]

(b) After catching the basketball, the student and the skateboard, starts rolling with a speed of 1.2 m/s. Calculate the initial speed of the basketball.

[3]

(c) After being caught it takes 2 seconds to reach a speed of 1.2m/s, calculate the acceleration of the ball.

[2]

(d) Explain the change in velocity of:

(i) the ball before and after it was caught by the student

[2]

(ii) the student standing on the skateboard before and after he caught the ball

[2]

TOTAL MARKS [10]

4. This question is about electromagnetic force and induced current.

(a) The diagram below shows a bar magnet being introduced to a coil of wire connected to a galvanometer.

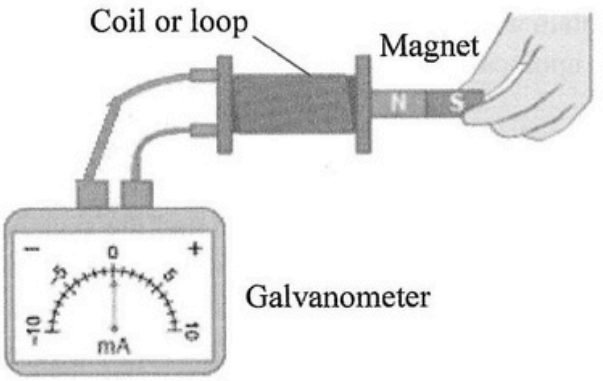


Fig. 4.1

(i) State what happens to the needle of the galvanometer when the magnet is inserted into the coil.

_____ [2]

(ii) State what happens to the needle of the galvanometer when the magnet is withdrawn from the coil.

_____ [1]

(b) State how an e.m.f can be induced in a coil of wire or a conductor.

_____

_____

_____ [1]

(c) The induced e.m.f in a coil by a moving magnet can be increased by which three actions?

_____

_____

_____ [3]

(d) A current flows through a wire positioned between two poles of a magnet as shown below

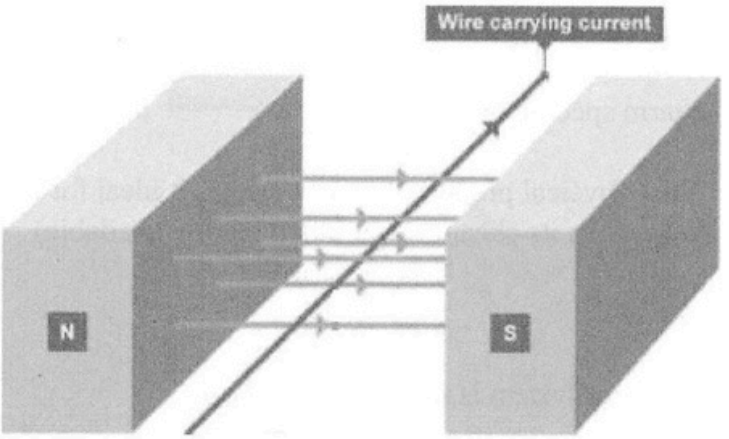


Fig. 4.2

(i) Draw on the diagram the direction of the force that will be exerted on the wire. [1]

(ii) What will happen if the poles of the magnet were reversed?

_____

_____ [1]

(e) Which electric device is based on the configuration of figure 4.2?

_____ [1]

TOTAL MARKS [10]

SECTION B

5. This question is about heat energy.

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

(b) (i) What physical property of water makes it ideal for use as a coolant in radiators? (other than its cheapness or being readily available) [1]

Give a reason why:

(ii) a cooling system is usually pressurised [1]

(iii) car radiators are normally painted black [1]

(c) (i) What happens to the volume of water during freezing and why would this be a problem in automobile engines? [2]

(ii) State the term used to describe this phenomenon. [1]

(iii) Coolants used in radiators are mixtures of water and antifreeze. Ethylene glycol, used as a coolant in automotive engines has a specific heat capacity of 2420 J/Kg °C. Calculate the quantity of heat removed when 4 kg of ethylene glycol is cooled from 120 °C to 85 °C. [4]

(d) Explain, with the aid of a labeled diagram, how convectional air currents form at the boundary of the sea and land on a hot summer day. Please show clearly the direction of these air currents. Also, the specific heat capacity of sea water is assumed to be higher than that of the land. [4]

(e) Coolants used in radiators are often mixtures of water and antifreeze. A mechanical engineering student wishes to investigate which of two coolants is better suited for use in the cooler system of a car, by comparing their specific heat capacities. Describe an appropriate method that could be used for this investigation. Include the following:

– the materials/apparatus needed

– an outline of the procedure to be followed

– observations to be made [6]

TOTAL MARKS [20]

6. This question is about pulley systems.

(a) (i) In the Physics laboratory, a student sets up a pulley systems shown in **Fig. 6.1**.

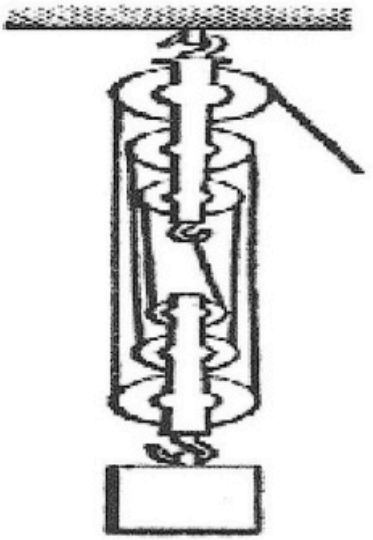


Fig. 6.1

The student measured and recorded the effort needed to lift varying loads using this pulley system. A graph of the results is shown in **Fig. 6.2**.

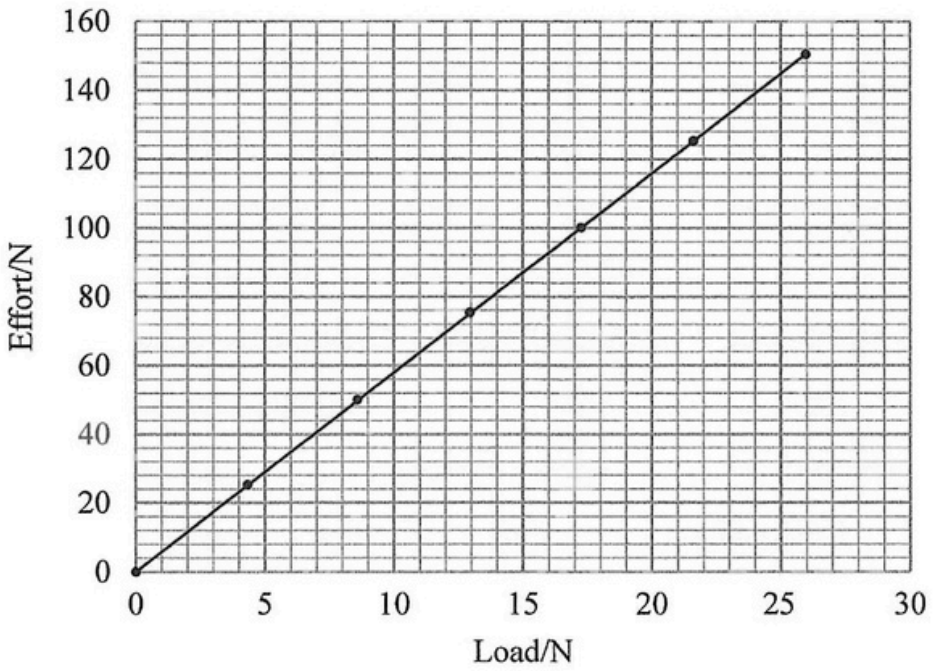


Fig. 6.2

(i) From the graph, determine the mechanical advantage of the pulley. [3]

(ii) Determine the efficiency of the pulley. [3]

(b) The student then repeated the experiment with the pulley system shown in **Fig. 6.3**.

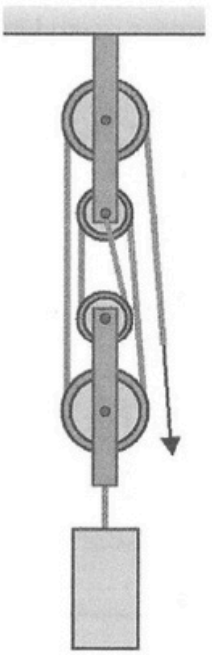


Fig. 6.3

(i) Assuming the pulley system is ideal with an efficiency of 100%, what is the theoretical value of its mechanical advantage? [1]

(ii) Give a reason why the value of the mechanical advantage is lower in practice for multiple pulley systems. [1]

(c) **Fig.6.4** shows another **pulley system** which is used to lift a load of 600 N to a height of 4.0 m.

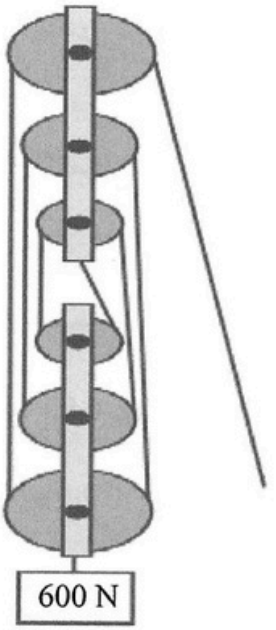


Fig. 6.4

(i) What is the velocity ratio of the **pulley system**? [1]

(ii) Calculate the distance moved by the effort in raising the load to the required height. [2]

(iii) Calculate the useful work done on the load after being raised to the required height. [2]

(d) **Fig. 6.5** shows an inclined plane used for raising a load of 600 N to a height of 4 m.

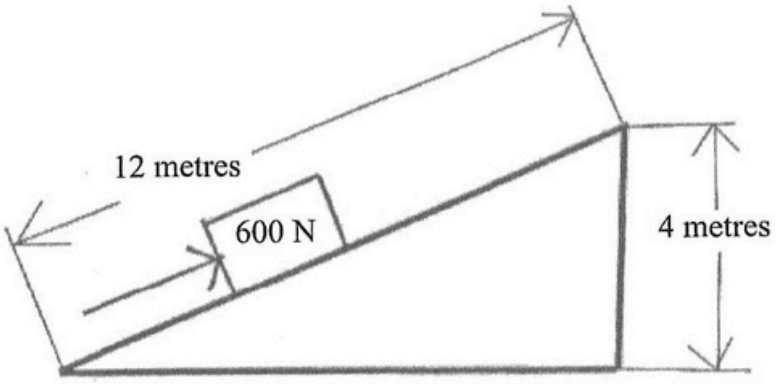


Fig. 6.5

(i) Calculate the effort used in pushing the load along the incline if 600 J of energy is wasted along the slope. [3]

(ii) Determine the efficiency of the inclined plane. [2]

(iii) Give a reason for this inefficiency and state where the lost/wasted energy is dissipated. [2]

TOTAL MARKS [20]

7. This question is about atomic structure and radioactivity.

Spent radioactive material is taken from a nuclear reactor and is being carried to a decommissioning factory. The graph below shows the decay curve for the material.

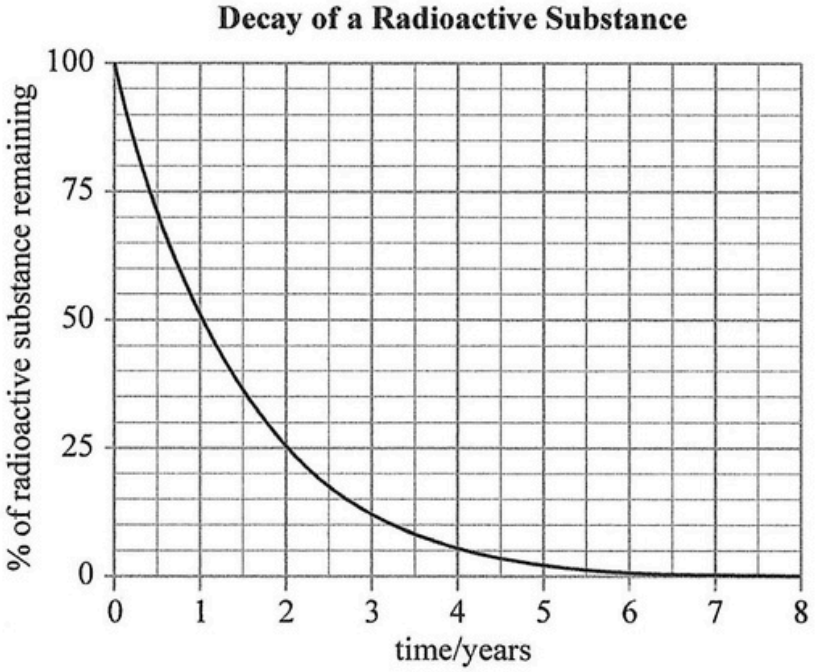


Fig 7.1

(a) Define the term half-life.

_____

_____ [2]

(b) Calculate the half-life of the sample from the graph above. Show clearly on the graph how you arrive at your value.

_____ [2]

(c) What is the percentage of the original mass of the sample remaining after 6 years? Show clearly how you arrived at your answer.

_____ [2]

(d) The workers at the factory need to be able to identify the type of radiation the sample is emitting. Design an experiment that can identify the type of radiation present. Identify materials to be used and their proper placement.

[6]

(e) An important variable to consider is background radiation. Define the term "background radiation".

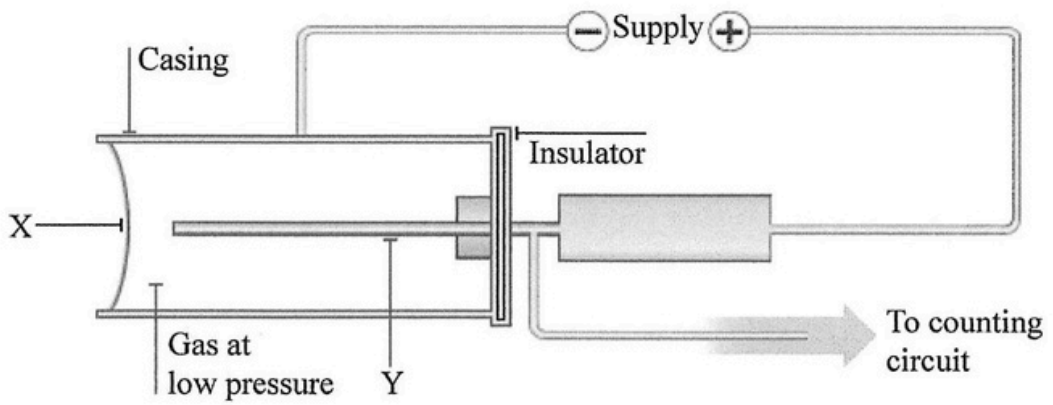
[2]

(f) Place an X in each box in the table below, that correctly describes properties of the different types of radioactive emission.

	Alpha	Beta	Gamma
Most Ionising			
Most Penetrating			
Affected by magnetic and electric fields			

[4]

(g) Below is a schematic diagram of a Geiger-Mueller tube. Please state the names of the parts labelled X and Y



X _____

Y _____

[2]

(h) Explain how the Geiger-Mueller tube works.

_____

_____

_____ [2]

TOTAL MARKS [20]