

**MARKING SCHEME
SET 55/1/G**

Q. No.	Expected Answer / Value Points	Marks	Total Marks						
Section A									
Set1,Q1 Set2,Q5 Set3,Q2	Capacitive Reason: As current leads voltage (by phase angle $\frac{\pi}{2}$)	$\frac{1}{2}$ $\frac{1}{2}$	1						
Set1,Q2 Set2,Q4 Set3,Q5	X – Transmitter Y - Channel	$\frac{1}{2}$ $\frac{1}{2}$	1						
Set1,Q3 Set2,Q2 Set3,Q4	Focal length gets doubled. Power is halved.	$\frac{1}{2}$ $\frac{1}{2}$	1						
Set1,Q4 Set2,Q3 Set3,Q1	Copper wire is longer. Reason: $\rho_c l_c = \rho_m l_m$ (as $\rho l = \text{constant}$) $\therefore l_c > l_m \because \rho_m > \rho_c$	$\frac{1}{2}$ $\frac{1}{2}$	1						
Set1,Q5 Set2,Q1 Set3,Q3	Positive Reason: Negative charge moves from a point at a lower potential energy to one at a higher potential energy.	$\frac{1}{2}$ $\frac{1}{2}$	1						
Section B									
Set1,Q6 Set2,Q7 Set3,Q10	<table border="1" style="width: 100%;"> <tr> <td>Definition of Power loss</td> <td style="text-align: right;">$\frac{1}{2}$</td> </tr> <tr> <td>Form in which the power loss appear</td> <td style="text-align: right;">$\frac{1}{2}$</td> </tr> <tr> <td>Proof- (To minimise power loss in transmission cables Voltage should be high)</td> <td style="text-align: right;">1</td> </tr> </table> <p>Electrical energy lost per second in the resistor, is Power loss \therefore Power loss appears in the form of heat/ e. m. radiations.</p> <p>Consider a device ‘R’, to which power P is to be delivered via transmission cables having a resistance R_c, Let V be the voltage across ‘R’, and I be the current through it, then</p> $P = V I \quad \therefore I = \frac{P}{V}$ <p>Power dissipated in the cable (P_c) = $I^2 R_c$ $= \frac{P^2 R_c}{V^2}$ $\therefore P_c \propto \frac{1}{V^2}$</p> <p>$\therefore$ Energy transmission, at high voltage, minimizes the power loss.</p>	Definition of Power loss	$\frac{1}{2}$	Form in which the power loss appear	$\frac{1}{2}$	Proof- (To minimise power loss in transmission cables Voltage should be high)	1	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
Definition of Power loss	$\frac{1}{2}$								
Form in which the power loss appear	$\frac{1}{2}$								
Proof- (To minimise power loss in transmission cables Voltage should be high)	1								
Set1,Q7 Set2,Q10 Set3,Q8	<table border="1" style="width: 100%;"> <tr> <td>Formula</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Calculation of kinetic energy</td> <td style="text-align: right;">1</td> </tr> </table>	Formula	1	Calculation of kinetic energy	1				
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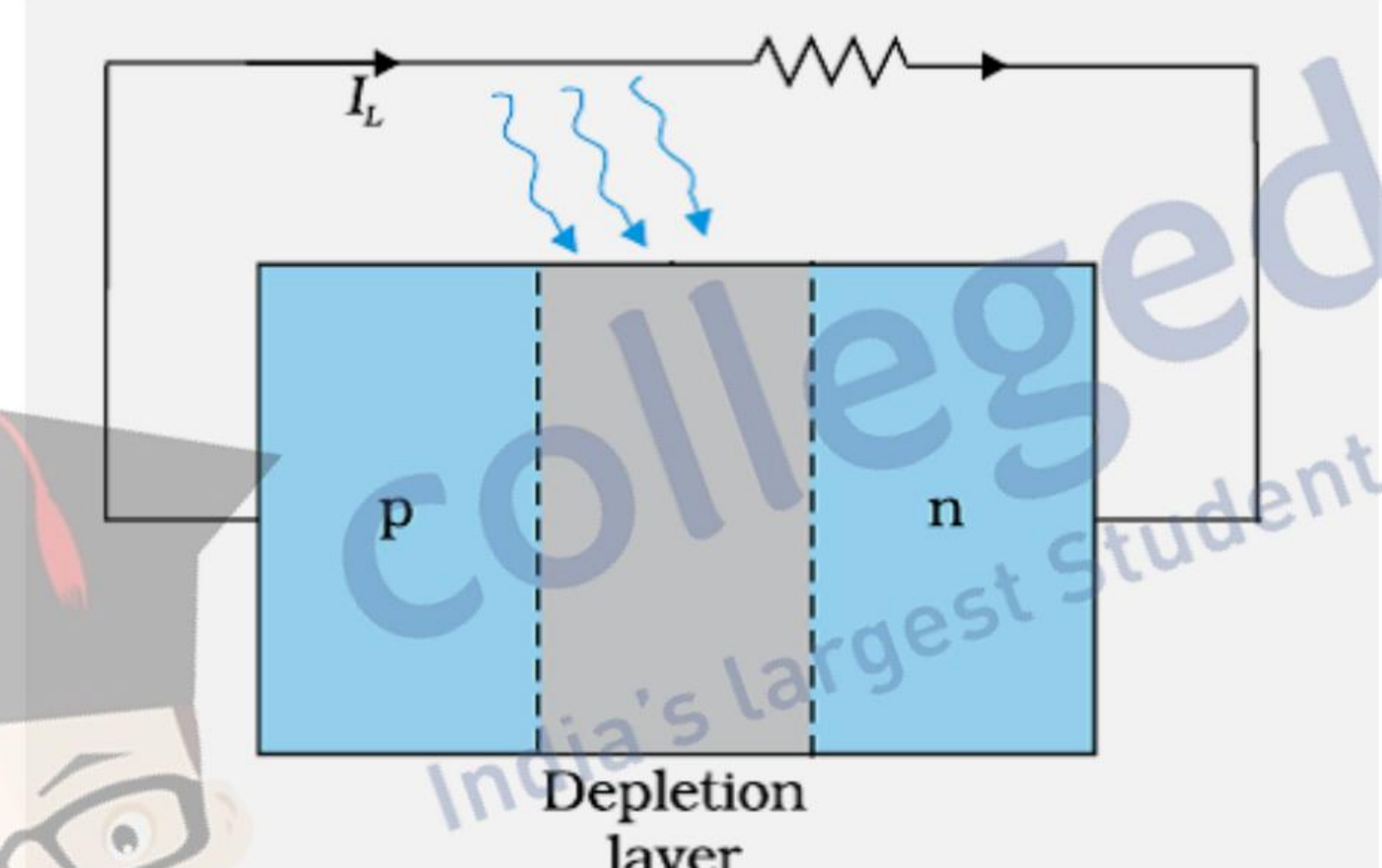
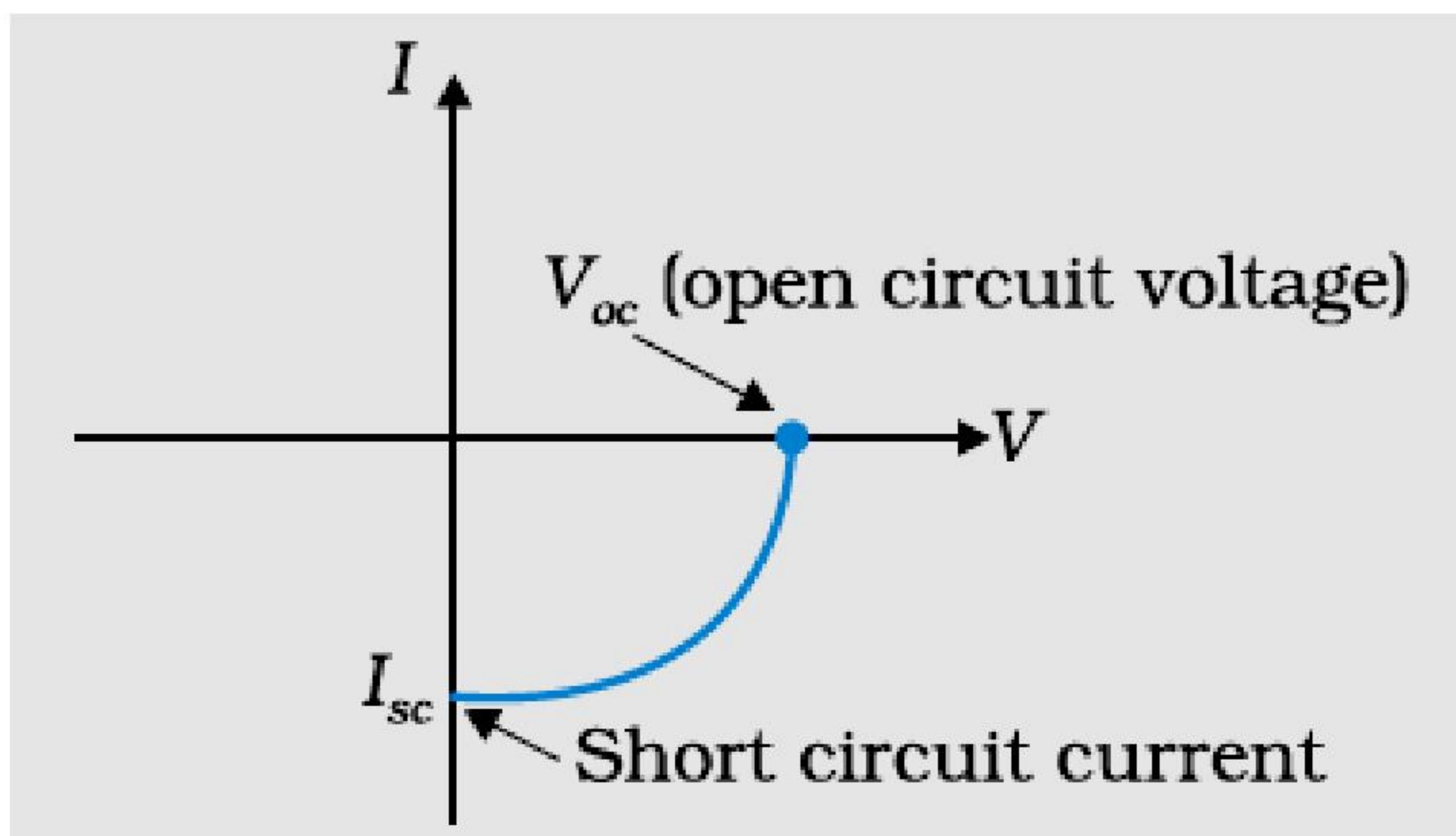
	$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2m E_k}}$ $\therefore \lambda^2 = \frac{h^2}{2m E_k}$ $E_k = \frac{(6.63 \times 10^{-34})^2}{2 \times 9.1 \times 10^{-31} \times (589 \times 10^{-9})^2} J$ $= 6.95 \times 10^{-25} J$ <p>Alternatively, $E_k = 4.35 \mu eV$</p>	<p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	2						
Set1,Q8 Set2,Q6 Set3,Q9	<table border="1"> <tbody> <tr> <td>Formula</td> <td>1/2</td> </tr> <tr> <td>Calculation & result</td> <td>1 1/2</td> </tr> </tbody> </table> $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ <p>(i) $\therefore \frac{1}{f} = \frac{1}{90-u} - \frac{1}{-u} = \frac{1}{90-u} + \frac{1}{u}$ -----(1)</p> <p>(ii) $\frac{1}{f} = \frac{1}{70-u} - \frac{1}{-(u+20)} = \frac{1}{70-u} + \frac{1}{u+20}$ -----(2)</p> <p>Solving eqⁿ (1) and (2), u=35 cm</p> <p>Using lens formula f = 21.4 cm (Alternatively if a candidate calculates the focal length by using the formula $4fD = D^2 - d^2$, award full marks.)</p>	Formula	1/2	Calculation & result	1 1/2	<p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	2		
Formula	1/2								
Calculation & result	1 1/2								
Set1,Q9 Set2,Q8 Set3,Q7	<table border="1"> <tbody> <tr> <td>(a) Value of Z</td> <td>1/2</td> </tr> <tr> <td>Value of A</td> <td>1/2</td> </tr> <tr> <td>(b) Explanation</td> <td>1</td> </tr> </tbody> </table> <p>(a) Z= 56 A=89</p> <p>(b) Difference in the total mass of the nuclei on the two sides of the reaction gets converted into energy or vice versa Alternatively. The number is conserved but the B.E./ nucleon can be different for different nuclei.</p>	(a) Value of Z	1/2	Value of A	1/2	(b) Explanation	1	<p>1/2</p> <p>1/2</p> <p>1</p>	2
(a) Value of Z	1/2								
Value of A	1/2								
(b) Explanation	1								
Set1,Q10 Set2,Q9 Set3,Q6	<table border="1"> <tbody> <tr> <td>Explanation (4 steps)</td> <td>1/2 x4=2</td> </tr> </tbody> </table> <p>Mobile telephony takes place in following ways:</p> <p>(i) Physical area is divided into smaller cell zones. 1/2</p> <p>(ii) Radio antenna in each cell receives and transmits radio signals, to and from, mobile phones. 1/2</p> <p>(iii) These radio antenna are connected to each other through a network. (Controlled and managed by a central control room called Mobile Telephone Switching Office (MTSO)) 1/2</p> <p>(iv) MTSO records the location and identifies the cell of the mobile phone. 1/2</p>	Explanation (4 steps)	1/2 x4=2	<p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	2				
Explanation (4 steps)	1/2 x4=2								

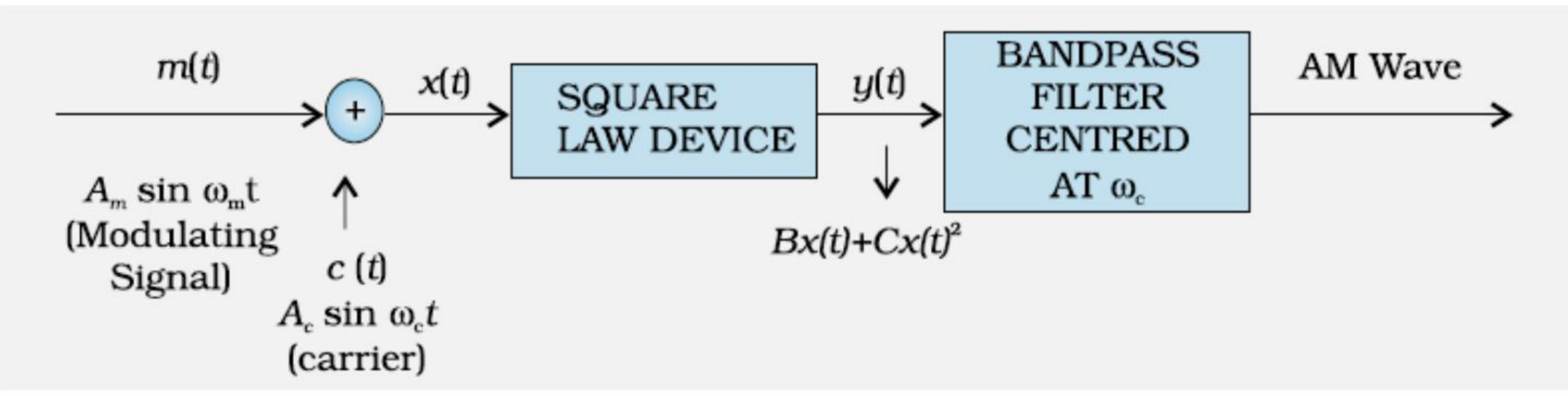


	OR										
	<table border="1"> <tbody> <tr> <td>Basic mode of communication</td> <td style="text-align: right;">1/2</td> </tr> <tr> <td>Type of mode</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Expression for d</td> <td style="text-align: right;">1/2</td> </tr> </tbody> </table>	Basic mode of communication	1/2	Type of mode	1	Expression for d	1/2				
Basic mode of communication	1/2										
Type of mode	1										
Expression for d	1/2										
	Line of sight / Broadcast Space wave $d = \sqrt{2Rh_1} + \sqrt{2Rh_2}$, R is radius of earth (Also accept if the student writes $d \propto \sqrt{h}$)	1/2 1 1/2	2								
Section C											
Set1,Q11 Set2,Q20 Set3,Q15	<table border="1"> <tbody> <tr> <td>(a) Equivalent capacitance</td> <td style="text-align: right;">1</td> </tr> <tr> <td>(b) Charge on each capacitor</td> <td style="text-align: right;">1+1</td> </tr> </tbody> </table>	(a) Equivalent capacitance	1	(b) Charge on each capacitor	1+1						
(a) Equivalent capacitance	1										
(b) Charge on each capacitor	1+1										
	(a) Equivalent capacitance $(C_n) = \frac{C}{3} + C$ $= \frac{4C}{3} = \frac{40}{3} \mu F$ (b) Charge on C_4 , $q_4 = C_4 \times V = 10 \times 500 \mu C$ $= 5 \times 10^{-3} C = 5 mC$ Charge on C_1, C_2, C_3 is same and is equal to $\frac{C}{3} \times V$ $= \frac{5}{3} \times 10^{-3} C$ $= 1.67 mC$	1/2 1/2 1/2 1/2 1/2	3								
Set1,Q12 Set2,Q21 Set3,Q16	<table border="1"> <tbody> <tr> <td>Current drawn from the source</td> <td style="text-align: right;">1</td> </tr> <tr> <td>P.D across C and D</td> <td style="text-align: right;">1</td> </tr> <tr> <td>P.D across one of the diagonals</td> <td style="text-align: right;">1</td> </tr> </tbody> </table>	Current drawn from the source	1	P.D across C and D	1	P.D across one of the diagonals	1				
Current drawn from the source	1										
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	Net resistance of the circuit, $R_{eq} = 3 \Omega$ \therefore Current, $I = \frac{V}{R_{eq}} = \frac{9}{3} = 3 A$ P.D across CD, $V_{CD} = I_{CD} \times R_{CD}$ $= \left(3 \times \frac{1}{4} A \right) \times 4 \Omega = 3V$ When the wire is stretched to double its length, each resistance becomes four times, i.e. 16Ω each. P.D across one of the diagonal, V_{AC} or $V_{BD} = \left(\frac{9}{12} \times \frac{1}{4} A \right) \times 32 \Omega = 6 V$	1/2 1/2 1/2 1/2 1/2 1/2	3								
Set1,Q13 Set2,Q22 Set3,Q17	<table border="1"> <tbody> <tr> <td>Path of the electron</td> <td style="text-align: right;">1/2</td> </tr> <tr> <td>Determination of frequency of revolution</td> <td style="text-align: right;">1 1/2</td> </tr> <tr> <td>Dependence of frequency on speed</td> <td style="text-align: right;">1/2</td> </tr> <tr> <td>Explanation / Reason</td> <td style="text-align: right;">1/2</td> </tr> </tbody> </table>	Path of the electron	1/2	Determination of frequency of revolution	1 1/2	Dependence of frequency on speed	1/2	Explanation / Reason	1/2		
Path of the electron	1/2										
Determination of frequency of revolution	1 1/2										
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Explanation / Reason	1/2										
	The force, on the electron, due to the magnetic field, at any instant is perpendicular to its instantaneous velocity.	1/2									



	<p>Alternatively, Because necessary centripetal force is provided by Lorentz magnetic force acting on the electron.</p> $v = \frac{qB}{2\pi m}$ $= \frac{1.6 \times 10^{-19} \times 6.5 \times 10^{-4}}{2 \times 3.14 \times 9.1 \times 10^{-31}} \text{ Hz}$ $= 1.8 \times 10^7 \text{ Hz}$ <p>No As $v = \frac{qB}{2\pi m}$ i.e. v is independent of v</p>	<p>1/2 1/2 1/2 1/2 1/2</p>	<p>3</p>
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<p>Set1,Q14 Set2,Q16 Set3,Q18</p>	<table border="1" style="width: 100%;"> <tr> <td style="width: 70%;">Circuit Diagram</td> <td style="width: 30%;">1/2</td> </tr> <tr> <td>Three basic processes</td> <td>1 1/2</td> </tr> <tr> <td>I-V characteristics of solar cell</td> <td>1/2</td> </tr> <tr> <td>Important criteria</td> <td>1/2</td> </tr> </table> <div style="text-align: center;">  </div> <p>Three basic processes which take place to generate the emf in a solar cell are:</p> <ol style="list-style-type: none"> (i) Generation of electron hole pairs due to the light incident close to the junction. (ii) Separation of electrons and holes due to the electric field of the depletion region. (iii) Collection of electrons and holes by n-side and p-side respectively. <p>I-V characteristics of solar cell</p> <div style="text-align: center;">  </div>	Circuit Diagram	1/2	Three basic processes	1 1/2	I-V characteristics of solar cell	1/2	Important criteria	1/2	<p>1/2 1/2 1/2 1/2 1/2</p>	
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Important criteria	1/2										

Set1,Q16 Set2,Q18 Set3,Q12	<table border="1" style="width: 100%;"> <tr> <td style="width: 70%;">Expression for K.E</td> <td style="width: 30%; text-align: right;">2</td> </tr> <tr> <td>Relation for P.E</td> <td style="text-align: right;">1</td> </tr> </table> <p>For an electron (mass 'm' and charge 'e') revolving in nth stable circular orbit of radius 'r_n', with velocity v_n, in the hydrogen atom (z=1), we have</p> $\frac{mv_n^2}{r_n} = \frac{1}{4\pi\epsilon_0} \frac{e^2}{r_n^2}$ $\therefore E_k = \frac{1}{2} mv_n^2 = \frac{e^2}{8\pi\epsilon_0 r_n}$ $\therefore E_p = \frac{1}{4\pi\epsilon_0} \frac{(+e) \times (-e)}{r_n}$ $= -\frac{e^2}{4\pi\epsilon_0 r_n}$	Expression for K.E	2	Relation for P.E	1	1/2 1/2 1 1/2 1/2	3																																								
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Set1,Q17 Set2,Q19 Set3,Q13	<table border="1" style="width: 100%;"> <tr> <td style="width: 70%;">Showing that AND gate followed by NOT gate is NAND gate</td> <td style="width: 30%; text-align: right;">1</td> </tr> <tr> <td>Truth table of NAND gate</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Why is NAND gate called universal gate?</td> <td style="text-align: right;">1</td> </tr> </table> <table border="1" style="width: 100%; margin-top: 10px;"> <thead> <tr> <th>A</th> <th>B</th> <th>Output of AND gate (Input of NOT gate)</th> <th>Output of NOT gate</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table> <table border="1" style="width: 100%; margin-top: 10px; text-align: center;"> <thead> <tr> <th colspan="3">Truth table of NAND Gate</th> </tr> <tr> <th>A</th> <th>B</th> <th>Y</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table> <p>NAND gate is called universal gate because all other basic gates like AND, OR, NOT gate, can be realised by using NAND gates only.</p>	Showing that AND gate followed by NOT gate is NAND gate	1	Truth table of NAND gate	1	Why is NAND gate called universal gate?	1	A	B	Output of AND gate (Input of NOT gate)	Output of NOT gate	0	0	0	1	0	1	0	1	1	0	0	1	1	1	1	0	Truth table of NAND Gate			A	B	Y	0	0	1	0	1	1	1	0	1	1	1	0	1 1 1	3
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Set1,Q18 Set2,Q11 Set3,Q14	<table border="1" style="width: 100%;"> <tr> <td style="width: 70%;">Block Diagram / Explanation of AM</td> <td style="width: 30%; text-align: right;">1</td> </tr> <tr> <td>Can AM wave be transmitted as such</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Explanation</td> <td style="text-align: right;">1</td> </tr> </table> <p>Block Diagram</p> 	Block Diagram / Explanation of AM	1	Can AM wave be transmitted as such	1	Explanation	1	1																																							
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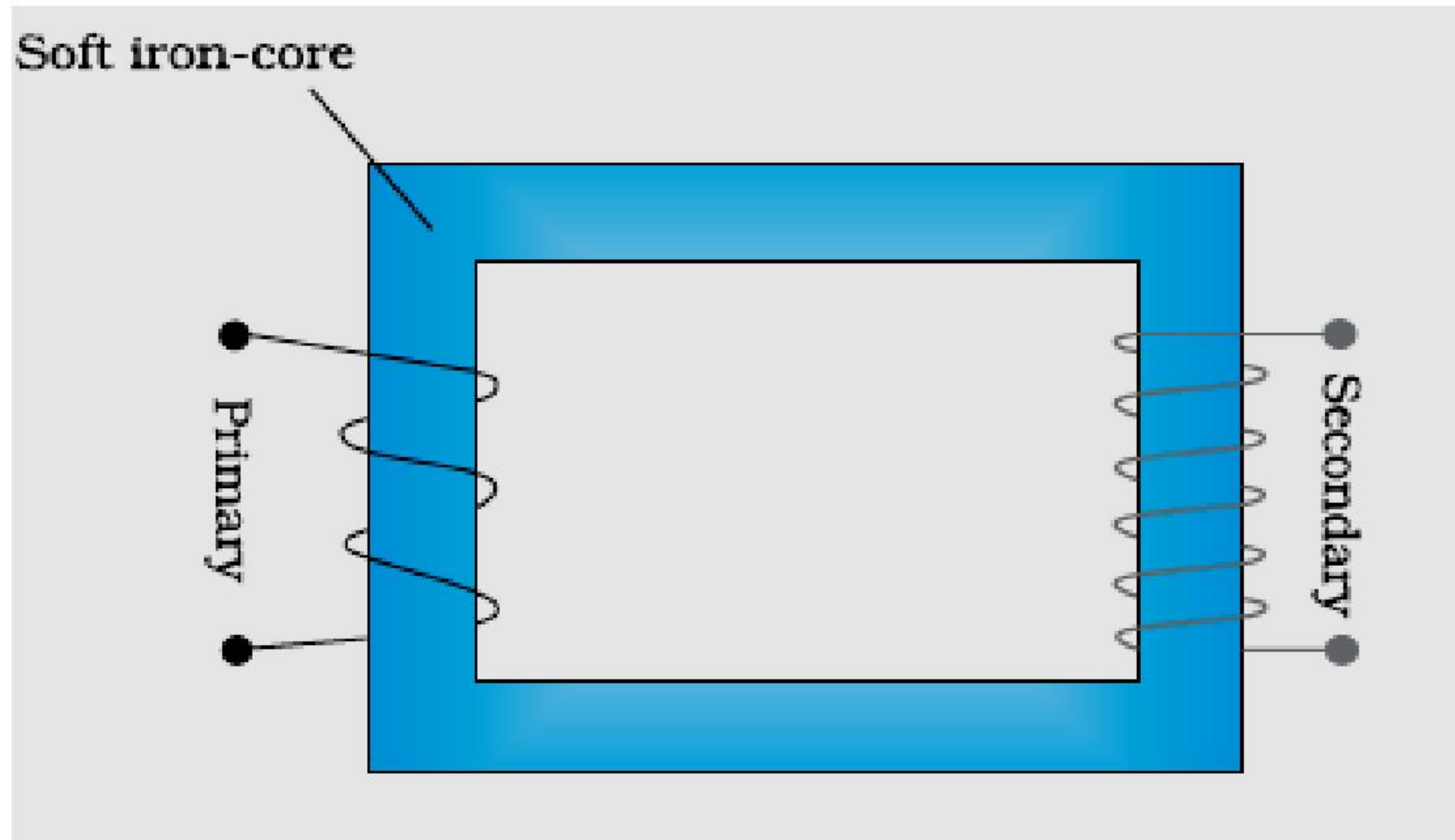
	<p>Alternatively, Explanation of Amplitude Modulation No / AM wave cannot be transmitted as such</p> <p>Explanation The A.M. wave has to be fed to power amplifier to provide the necessary power. It is then fed to the antenna for transmission.</p>	1	1	3								
Set1,Q19 Set2,Q12 Set3,Q21	<table border="1"> <tr> <td>(a) Formula</td> <td>1</td> </tr> <tr> <td>Calculation of number of photons per second</td> <td>1</td> </tr> <tr> <td>(b) Identification of Metal</td> <td>1/2</td> </tr> <tr> <td>Reason/explanation</td> <td>1/2</td> </tr> </table> <p>(a) $P = Nh\nu$</p> $N = \frac{2 \times 10^{-3}}{(6.63 \times 10^{-34} \times 6.0 \times 10^{14})}$ $N = 5.0 \times 10^{15} \text{ photons per second}$ <p>(b) Metal X ($K.E = h\nu - \phi_o$) / $\because \phi_y > \phi_x, \therefore (K.E)_x > (K.E)_y$</p>	(a) Formula	1	Calculation of number of photons per second	1	(b) Identification of Metal	1/2	Reason/explanation	1/2	1	1/2 1/2 1/2 1/2	3
(a) Formula	1											
Calculation of number of photons per second	1											
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Set1,Q20 Set2,Q13 Set3,Q22	<table border="1"> <tr> <td>(a) Formula</td> <td>1/2</td> </tr> <tr> <td>Calculation and Result</td> <td>1</td> </tr> <tr> <td>(b) Formula</td> <td>1/2</td> </tr> <tr> <td>Calculation and Result</td> <td>1</td> </tr> </table> <p>(a) $\Delta\theta = \frac{1.22\lambda}{D}$ $= \frac{1.22 \times 6 \times 10^{-7}}{2.5} \text{ radian}$ $\approx 2.9 \times 10^{-7} \text{ radian}$</p> <p>(b) $10 \frac{\lambda D}{d} = 2 \frac{\lambda}{a}$ $a = \frac{d}{5D} = \frac{10^{-3}}{5 \times 1} \text{ m}$ $= 2 \times 10^{-4} \text{ m} = 0.2 \text{ mm}$</p>	(a) Formula	1/2	Calculation and Result	1	(b) Formula	1/2	Calculation and Result	1	1/2 1/2 1/2 1/2 1/2 1/2		3
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Set1,Q21 Set2,Q14 Set3,Q19	<table border="1"> <tr> <td>(a) Derivation for induced emf</td> <td>2</td> </tr> <tr> <td>(b) Expression for power</td> <td>1</td> </tr> </table> <p>(a) Emf induced $= \int_0^l Bwrdr$ $= \frac{1}{2} B\omega l^2$ $\because \omega = 2\pi\nu$ $\therefore \varepsilon = \pi B\nu l^2$</p> <p>(b) $P = \frac{\varepsilon^2}{R} = \frac{(\pi B\nu l^2)^2}{R}$ $= \frac{\pi^2 B^2 \nu^2 l^4}{R}$</p>	(a) Derivation for induced emf	2	(b) Expression for power	1	1/2 1/2 1 1/2 1/2		3				
(a) Derivation for induced emf	2											
(b) Expression for power	1											



(a) Principle of working :

When the current through the primary coil changes , the magnetic flux linked with the secondary coil also changes . Hence an emf is induced across the ends of the secondary coil.

(If the student just writes , 'mutual induction' , award ½ mark)



$$(b) (i) \frac{V_S}{V_P} = \frac{-N_S \frac{d\phi}{dt}}{(-N_P) \frac{d\phi}{dt}} = \frac{N_S}{N_P}$$

$$(ii) V_S I_S = V_P I_P$$

$$\therefore \frac{I_S}{I_P} = \frac{N_P}{N_S}$$

(c) Main source of energy losses (any one)

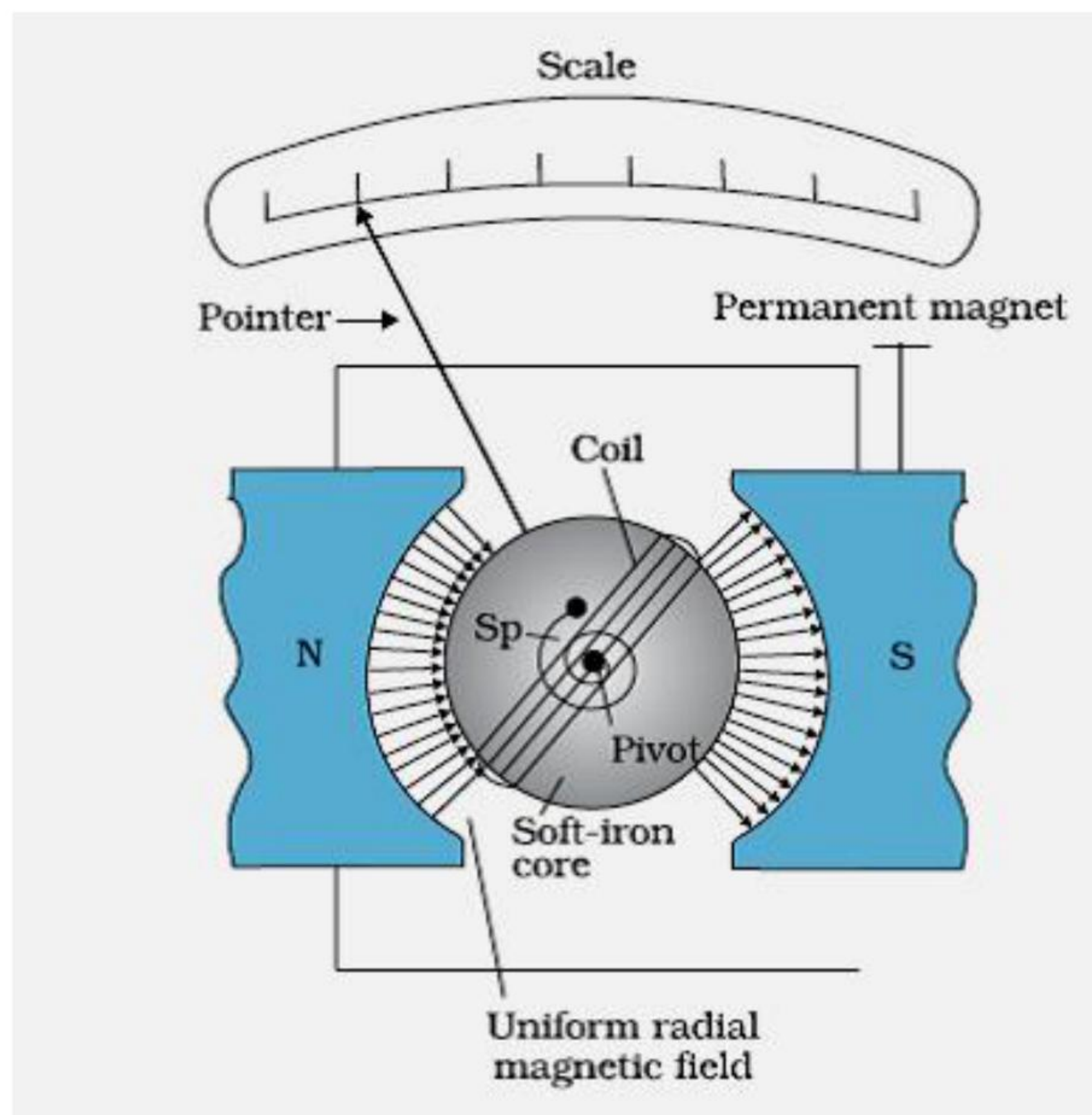
Flux leakage / Joule's loss / loss due to eddy currents / Hysteresis loss

How they are reduced (any one in the same order)

Winding the primary and secondary coils one over the other / using thick wires / having laminated core / using a magnetic material which has a low hysteresis loss

OR

(a) Labelled diagram of a moving coil galvanometer	1
Working Principle	½
Function of soft iron core	½
(b) Definition of	
(i) Current sensitivity	½
(ii) Voltage sensitivity	½
(c) Underlying Principle used in converting a galvanometer into	
(i) Voltmeter	1
(ii) Ammeter	1



Principle : When a current carrying coil is kept in a magnetic field , it experiences a torque .

Cylindrical soft iron core makes the magnetic field radial.

(b)(i) Current sensitivity : It is defined as deflection produced per unit current flowing through the galvanometer.

(ii) Voltage sensitivity : It is defined as deflection produced per unit voltage applied across the galvanometer.

(c) (i) Conversion of galvanometer, into a voltmeter, is based on the fact that the voltmeter should have very high resistance so that very little (negligible) current flows through it.

(ii) Conversion of galvanometer, into an ammeter, is based on the fact that the ammeter should have very little (negligible) resistance so that it does not reduce the current in the circuit.

Alternatively,

A galvanometer can be converted into

(i) a voltmeter by connecting a suitable high resistance in series with its coil.

(ii) an ammeter by connecting a suitable shunt (I_{av}) resistance parallel with its coil.

[Note: If the student just writes

$$(i) R = \left(\frac{V}{i_g} - G \right)$$

$$\text{and (ii) } S = \left(\frac{i_g}{I - i_g} \right) G$$

award ½ mark in each case]

1

½

½

½

½

1

1

5

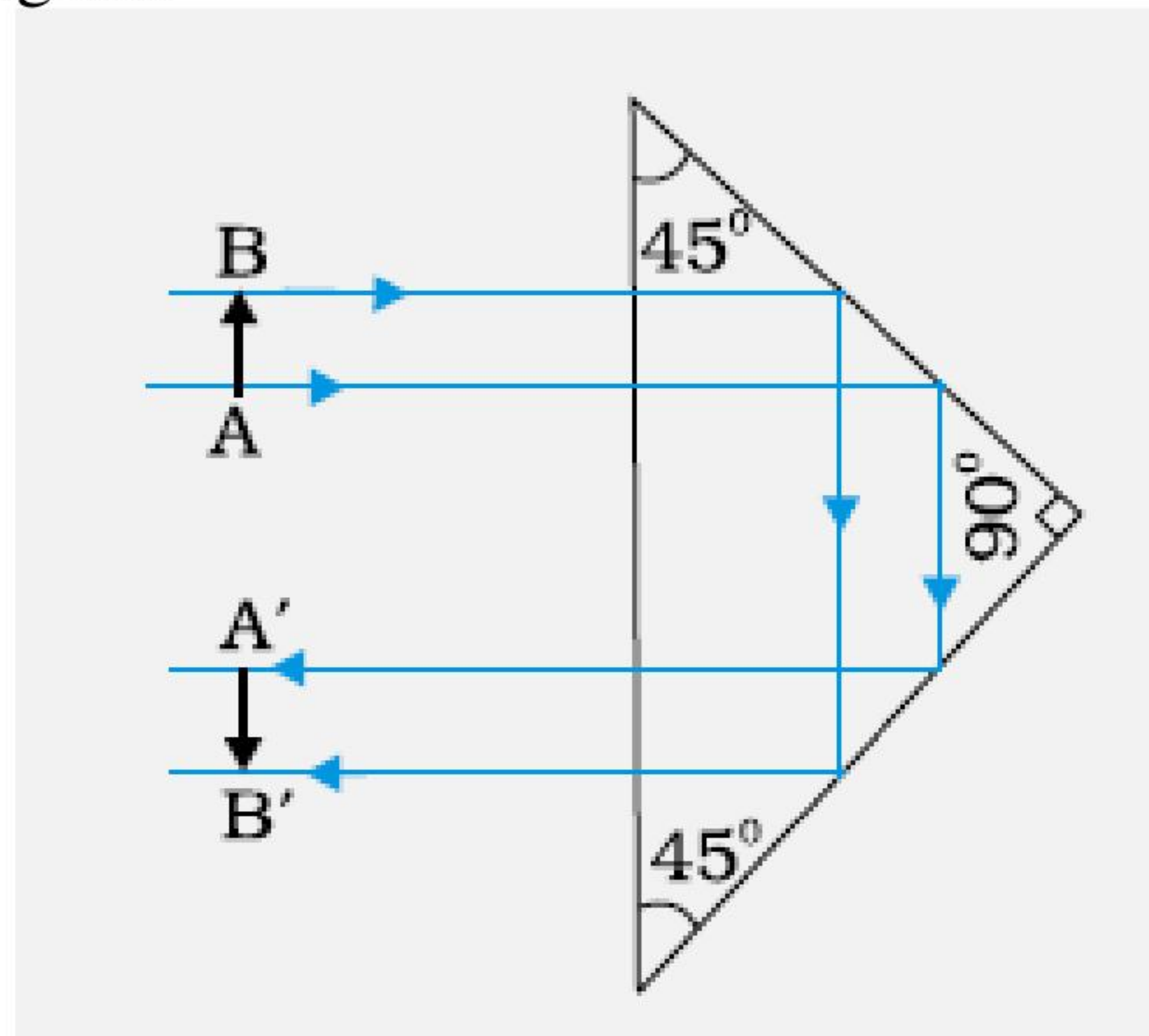
Set1,Q25
Set2,Q24
Set3,Q26

- | | |
|--|-----|
| (a) Two essential conditions for the phenomenon of total internal reflection | 1+1 |
| (b) Ray diagram | 1 |
| (c) Diagram with explanation | 1 ½ |
| Example to illustrate the use of optical fibre in transmission | ½ |

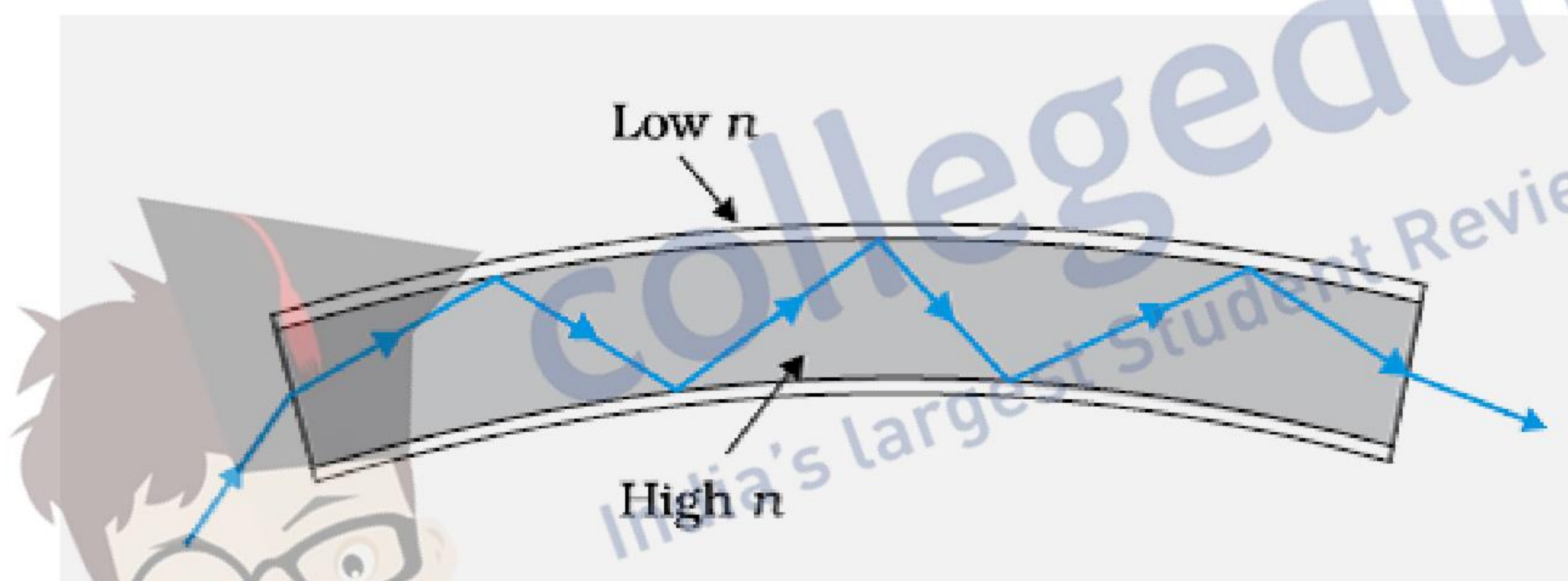
(a) Essential conditions

- (1) The ray should pass from an optically denser medium into an optically rarer medium.
- (2) Angle of incidence should be greater than the critical angle for the given pair of media.

(b) Ray Diagram



(c)



When ray of light enters into an optical fibre through one of its ends , it undergoes repeated total internal reflections along the length of the optical fibre as the angle of incidence at every point inside optical fibre is greater than the critical angle.

Example :

Optical fibres are used for transmitting and receiving optical signals to facilitate visual examination of internal organs of human body / for long distance communication through optical fibre cables. (any one)

OR

(a) Diagram demonstrating the location and shape of a wavefront using Huygen's principle	1
(b) Diagram	1
Verification of Snell's law	1 ½
Reasons for decrease of wavelength and speed but no change in frequency	1 ½

1

1

1

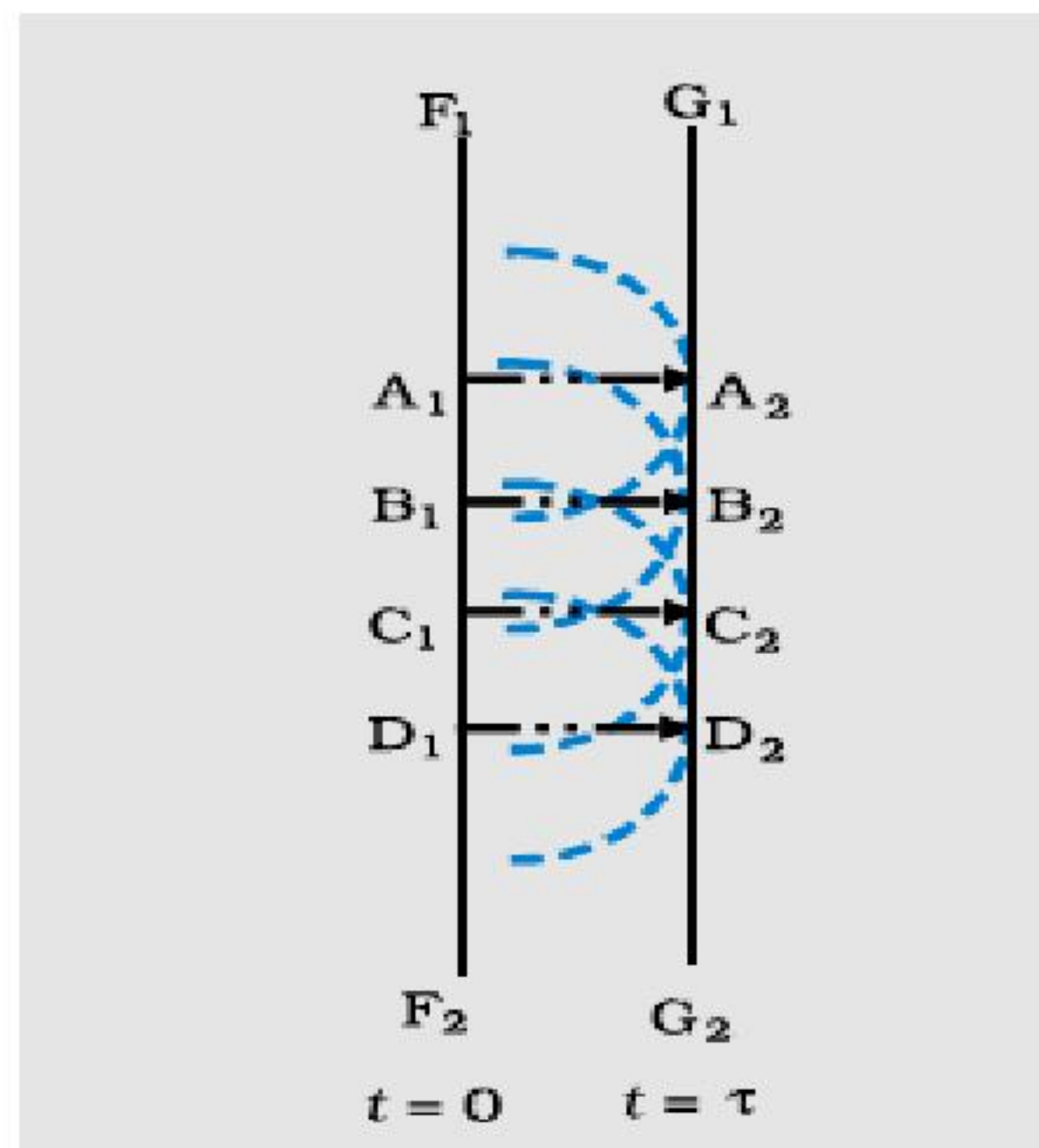
1

½

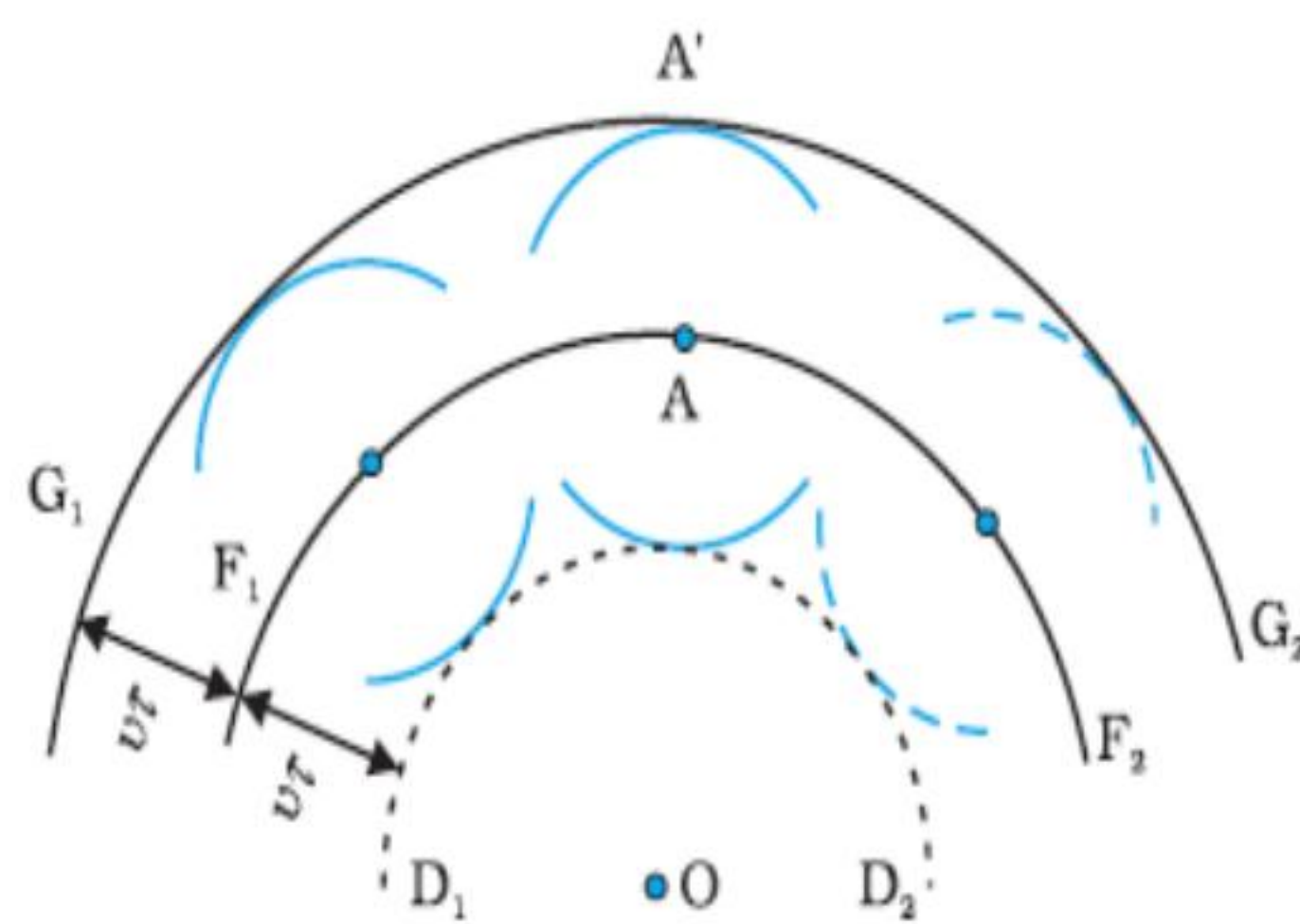
½

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(a)

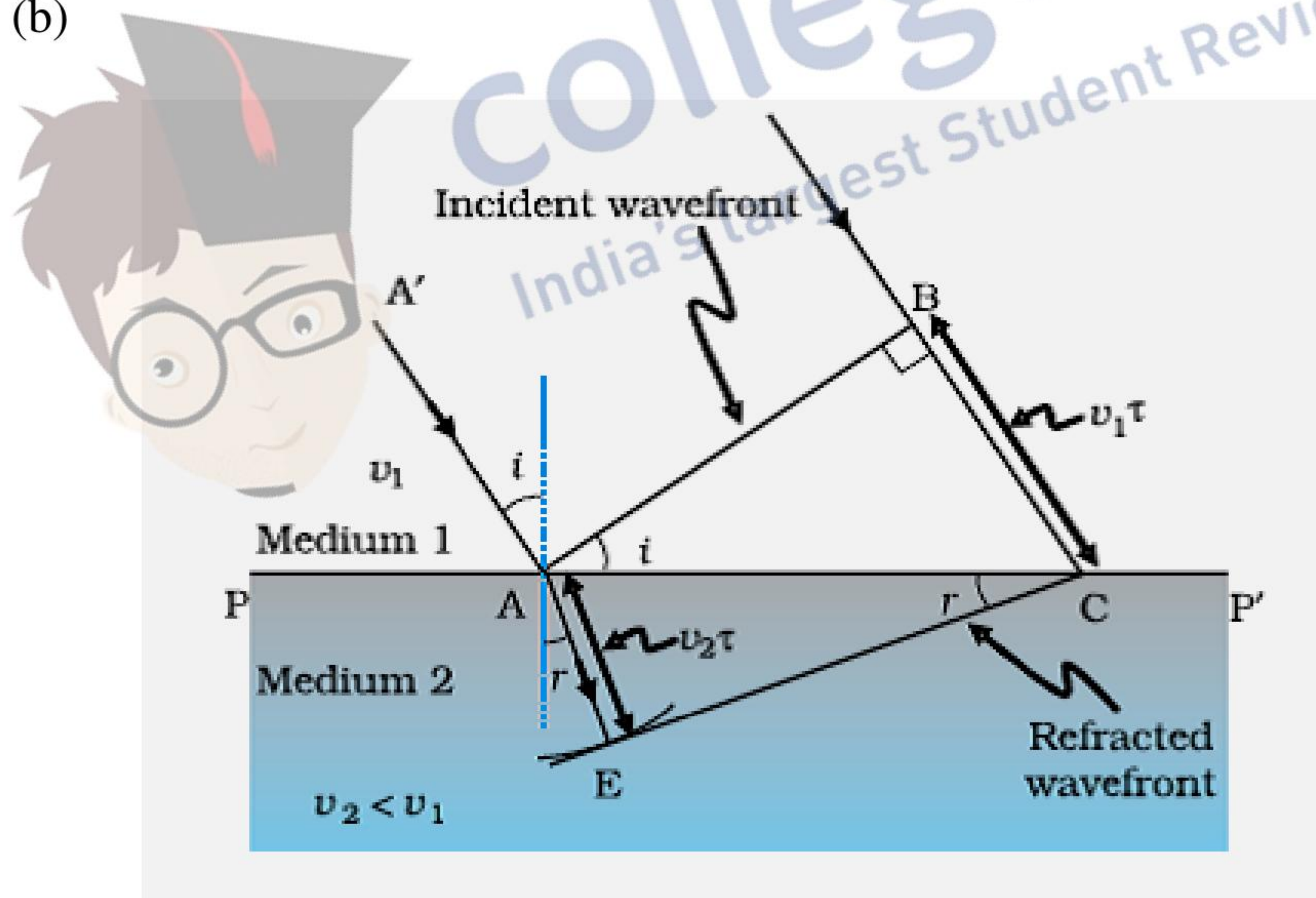


Alternatively,



(Any one of the above diagram)

(b)



Let t be the time taken by the wavefront to travel the distance BC in rarer medium and AE in the denser medium

$$\begin{aligned} \therefore BC &= v_1 t \text{ and } AE = v_2 t \\ \therefore \frac{\sin i}{\sin r} &= \frac{BC}{AC} \times \frac{AC}{AE} = \frac{v_1 t}{v_2 t} \\ &= \frac{v_1}{v_2} = \text{constant} \end{aligned}$$

This constant is called 'refractive index' of the denser medium with respect to the rarer medium. Thus, Snell's law is verified.

	<p>Reason : If λ_1 and λ_2 denote the wavelengths of light in medium 1 and medium 2 , then if $BC = \lambda_1$, $AE = \lambda_2$</p> $\frac{\lambda_1}{\lambda_2} = \frac{BC}{AE} = \frac{v_1}{v_2}$ <p style="text-align: center;">Or</p> $\frac{v_1}{\lambda_1} = \frac{v_2}{\lambda_2}$ <p>This equation implies that when a wave gets refracted into a denser medium , its wavelength and speed decrease but its frequency (v/λ)remains the same.</p>	<p>1/2</p> <p>1/2</p> <p>1/2</p>	<p>5</p>																				
<p>Set1,Q26 Set2,Q25 Set3,Q24</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">(a) Definition of Electric flux</td> <td style="text-align: right; padding: 5px;">1</td> </tr> <tr> <td style="padding: 5px;"> S.I unit</td> <td style="text-align: right; padding: 5px;">1/2</td> </tr> <tr> <td style="padding: 5px;">(b) Formula for Electric flux</td> <td style="text-align: right; padding: 5px;">1/2</td> </tr> <tr> <td style="padding: 5px;"> Calculation and result for net flux</td> <td style="text-align: right; padding: 5px;">2</td> </tr> <tr> <td style="padding: 5px;"> Formula and result for net charge</td> <td style="text-align: right; padding: 5px;">1/2 + 1/2</td> </tr> </table> <p>(a) Definition : Total number of electric field lines passing perpendicularly through a surface is called electric flux. (Also accept: $\phi = \oint_S \vec{E} \cdot \vec{ds}$) S.I unit of electric flux is Nm^2C^{-1}</p> <p>(b)From $\phi = \oint \vec{E} \cdot \vec{ds}$ Net flux through the cube (Φ) = Net flux through the two faces of the cube (Perpendicular to X-axis + perpendicular to Y-axis + Perpendicular to Z-axis)</p> <p>$\Phi = \phi_x + 0 + 0$ (As $\vec{E} \cdot \vec{ds}$ is (separately) zero for ($\vec{E} = \alpha x \hat{i}$) for the faces perpendicular to the y and the z-axis)</p> <p>$= EdS \cos 180^\circ + EdS \cos 0^\circ$</p> <p>$= [\alpha(a)(-1) + \alpha(2a)]a^2$ (Alternatively: $[\alpha (x)(-1)+\alpha (a + x)(+1)]a^2$) $= \alpha a^3$</p> <p>Net charge inside cube (Q)=$\Phi\epsilon_0$ $= \alpha a^3 \epsilon_0$</p> <p style="text-align: center;">OR</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">(a) Definition of equipotential surface</td> <td style="text-align: right; padding: 5px;">1</td> </tr> <tr> <td style="padding: 5px;"> Reason (Electric field directed normal to the surface)</td> <td style="text-align: right; padding: 5px;">1</td> </tr> <tr> <td style="padding: 5px;">(b) Diagram</td> <td style="text-align: right; padding: 5px;">1</td> </tr> <tr> <td style="padding: 5px;"> Reason</td> <td style="text-align: right; padding: 5px;">1</td> </tr> <tr> <td style="padding: 5px;">(c) Plot of V versus X</td> <td style="text-align: right; padding: 5px;">1</td> </tr> </table>	(a) Definition of Electric flux	1	S.I unit	1/2	(b) Formula for Electric flux	1/2	Calculation and result for net flux	2	Formula and result for net charge	1/2 + 1/2	(a) Definition of equipotential surface	1	Reason (Electric field directed normal to the surface)	1	(b) Diagram	1	Reason	1	(c) Plot of V versus X	1	<p>1</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	<p>5</p>
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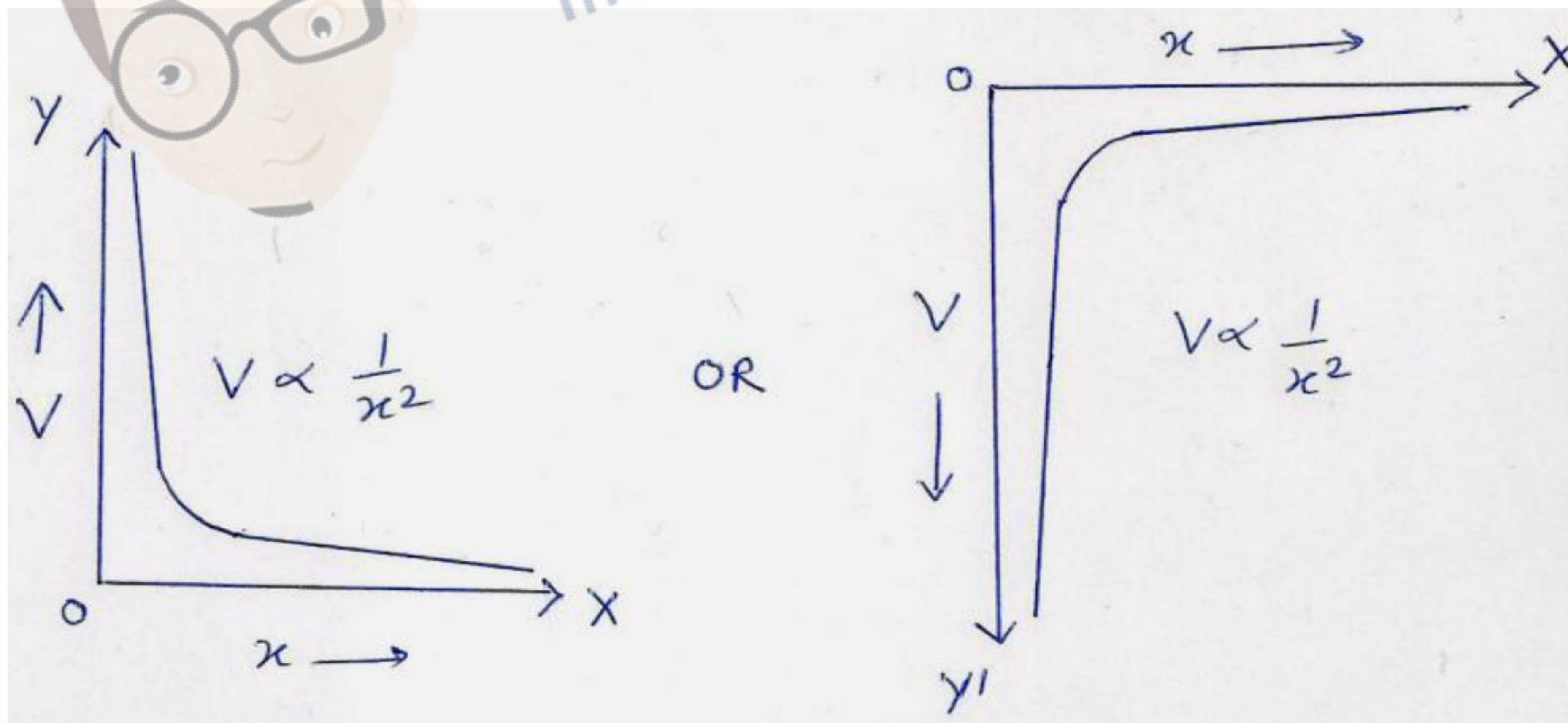
(a) A surface having same potential at all points on it , is called an equipotential surface. 1
 If the electric field were not normal to the equipotential surface , 1
 it will have a non-zero component along the surface . Hence,
 work
 will be done in moving a unit test charge from one point to
 another point on the surface against this component of the field ,
 which is not true.
Alternatively:
 Component of \vec{E} along the equipotential surface
 = - (rate of change of potential along the equipotential surface)
 = zero
 Hence \vec{E} has to be normal to the equipotential surface at all
 points.

(b)



Reason :
 Electric field decreases as the distance from the charges increases.
 Also, electric field component, in any direction, equals the negative
 of rate of change of potential in that direction.

(c)



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