

MARKING SCHEME

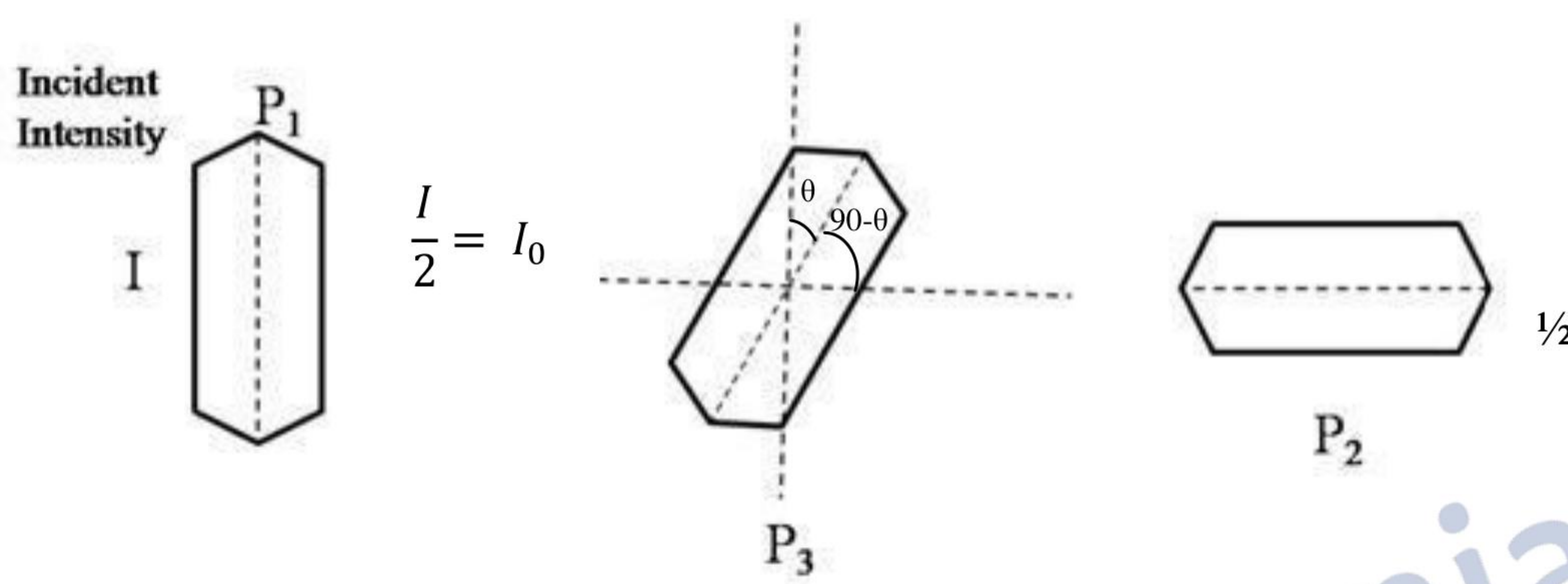
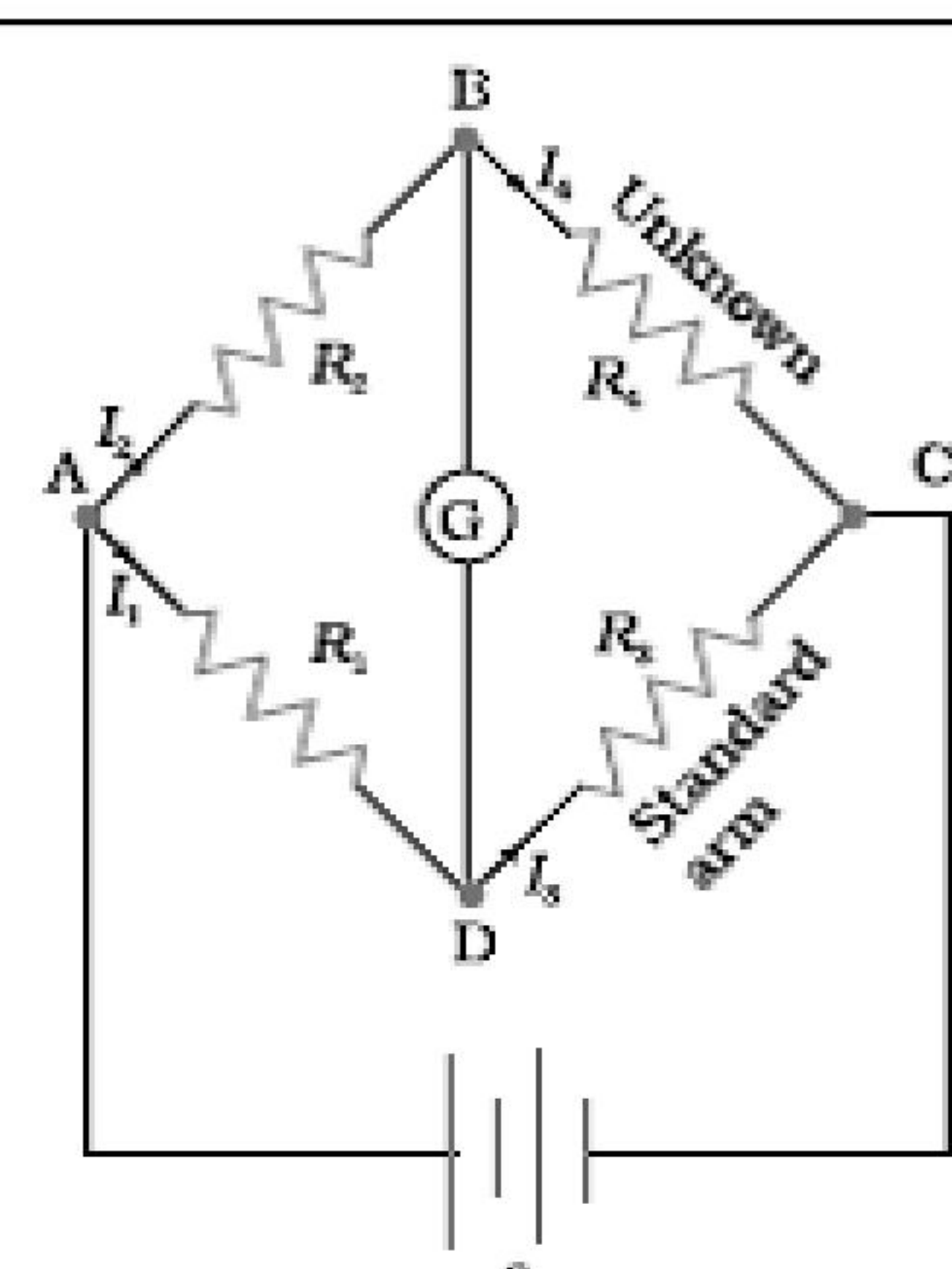
Q. No.	Expected Answer / Value Points	Marks	Total Marks				
Set1 Q1 Set2 Q5 Set3 Q4	It is defined as the opposition to the flow of current in ac circuits offered by a capacitor. Alternatively: $X_c = \frac{1}{\omega C}$ S.I Unit : ohm	1/2 1/2	1				
Set1 Q2 Set2 Q1 Set3 Q5	Zero	1	1				
Set1 Q3 Set2 Q2 Set3 Q1	Converging (Convex Lens),(Also accept if a student writes it as a diverging Lens or Concave lens (Since hindi translation does not match with English version))	1	1				
Set1 Q4 Set2 Q3 Set3 Q2	Side bands are produced due to the superposition of carrier waves of frequency ω_c over modulating / audio signal of frequency ω_m . Alternatively: (Credit may be given if a student mentions the side bands as $\omega_c \pm \omega_m$)	1	1				
Set1 Q5 Set2 Q4 Set3 Q3	DE : Negative resistance region AB : Where Ohm's law is obeyed.(Also accept BC)	1/2 1/2	1				
Set1 Q6 Set2 Q10 Set3 Q9	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Determination of ratio (i) accelerating potential</td> <td style="text-align: center; padding: 5px;">1</td> </tr> <tr> <td style="padding: 5px;">(ii) speed</td> <td style="text-align: center; padding: 5px;">1</td> </tr> </table> (i) $\lambda = \frac{h}{\sqrt{2mqV}} \Rightarrow V = \frac{h^2}{2mq\lambda^2}$ $m_\alpha = 4m_p, q_\alpha = 2q_p$ $\Rightarrow \frac{V_p}{V_\alpha} = \frac{m_\alpha q_\alpha}{m_p q_p}$ $= \frac{4m_p \times 2q_p}{m_p q_p}$ $= 8 : 1$	Determination of ratio (i) accelerating potential	1	(ii) speed	1	1/2 1/2	1
Determination of ratio (i) accelerating potential	1						
(ii) speed	1						



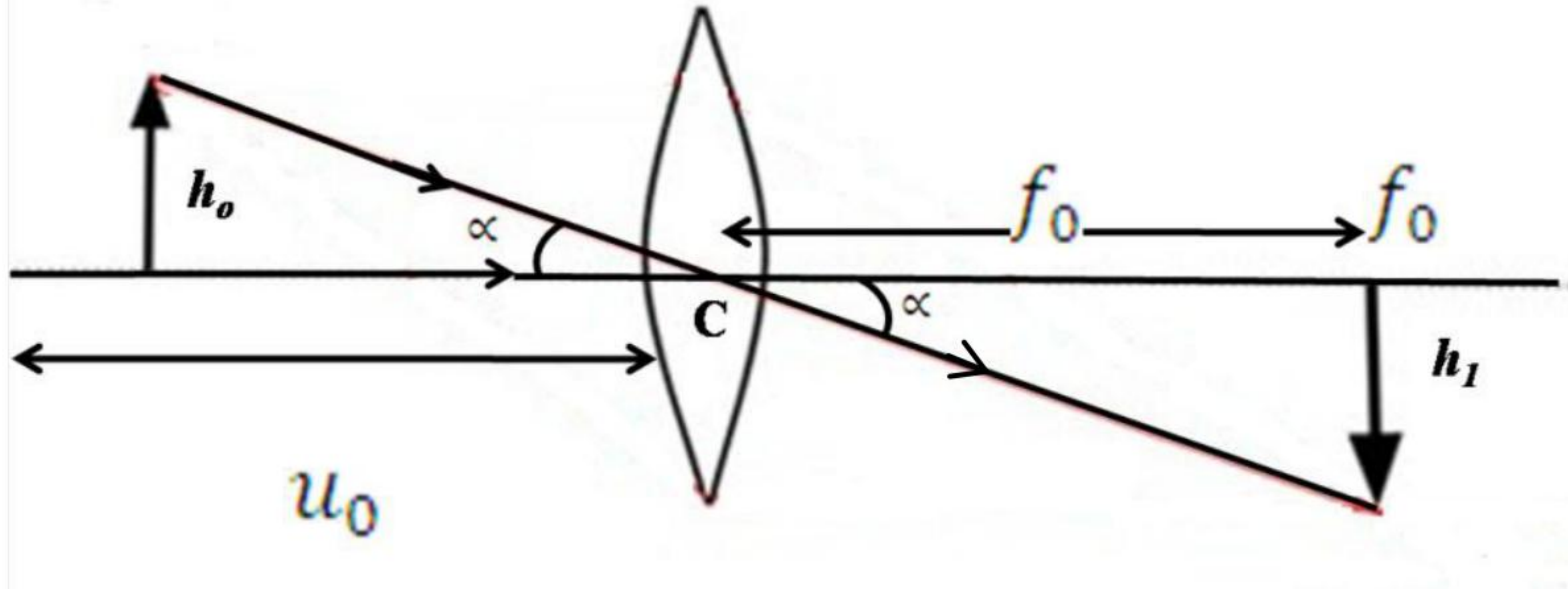
	$(ii) \quad \lambda = \frac{h}{mv} \Rightarrow v = \frac{h}{m\lambda}$ $\Rightarrow \frac{V_p}{V_\alpha} = \frac{m_\alpha}{m_p} = 4$	1/2							
		1/2	2						
Set1 Q7 Set2 Q6 Set3 Q10	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Showing that the radius of orbit varies as n^2 2 </div> $\frac{mv^2}{r} = \frac{1}{4\pi \epsilon_0} \frac{e^2}{r^2}$ <p>Or $mv^2r = \frac{1}{4\pi\epsilon_0} e^2 \dots\dots\dots(i)$</p> $mvr = \frac{nh}{2\pi}$ $m^2v^2r^2 = \frac{n^2h^2}{4\pi^2} \dots\dots\dots(ii)$ <p>Divide (ii) by (i)</p> $mr = \frac{n^2h^2}{4\pi^2} \times \frac{4\pi\epsilon_0}{e^2}$ $\therefore r = \frac{n^2h^2}{4\pi^2me^2} \cdot 4\pi \epsilon_0$ $\therefore r \propto n^2$ <p>(Give full credit to any other correct alternative method)</p>	1/2							
Set1 Q8 Set2 Q7 Set3 Q6	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Distinction between intrinsic & extrinsic semiconductor 2 </div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; padding: 5px;">Intrinsic Semiconductor</th> <th style="width: 50%; padding: 5px;">Extrinsic Semiconductor</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">(i) Without any impurity atoms.</td> <td style="padding: 5px;">(i) Doped with trivalent/ pentavalent impurity atoms.</td> </tr> <tr> <td style="padding: 5px;">(ii) $n_e = n_h$</td> <td style="padding: 5px;">(ii) $n_e \neq n_h$</td> </tr> </tbody> </table> <p>(Any other correct distinguishing features.)</p>	Intrinsic Semiconductor	Extrinsic Semiconductor	(i) Without any impurity atoms.	(i) Doped with trivalent/ pentavalent impurity atoms.	(ii) $n_e = n_h$	(ii) $n_e \neq n_h$	1	1
Intrinsic Semiconductor	Extrinsic Semiconductor								
(i) Without any impurity atoms.	(i) Doped with trivalent/ pentavalent impurity atoms.								
(ii) $n_e = n_h$	(ii) $n_e \neq n_h$								
Set1 Q9 Set2 Q8 Set3 Q7	<div style="border: 1px solid black; padding: 5px;"> Derivation of the required condition 2 </div>								
			2						

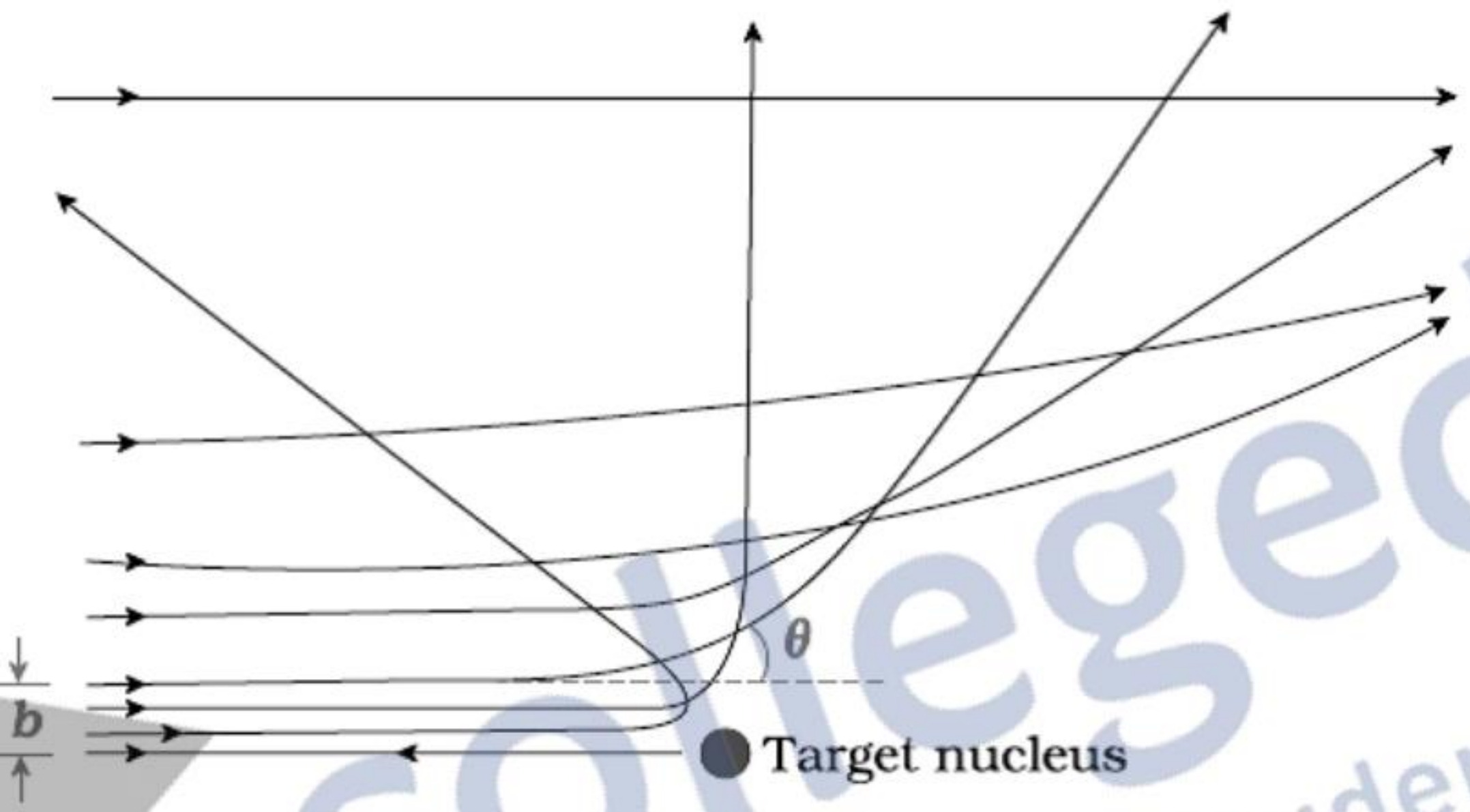
$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$	1/2	
<p>For concave mirror $f < 0$ and $u < 0$ As object lies between f and $2f$</p>		
<p>(i) At $u = -f$</p>		
$\frac{1}{v} = -\frac{1}{f} + \frac{1}{f}$		
<p>$\Rightarrow v = \infty$</p>		
<p>At $u = -2f$</p>	1/2	
$\Rightarrow \frac{1}{v} = -\frac{1}{f} + \frac{1}{2f} = -\frac{1}{2f}$		
<p>$\Rightarrow v = -2f$</p>	1/2	
<p>\Rightarrow Hence, image distance $v \geq -2f$</p>	1/2	2
<p>Since v is negative therefore the image is real.</p>		
<p>Alternative Method</p>	1/2	
$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$	1/2	
<p>For Concave mirror $f < 0, u < 0$</p>		
<p>$\therefore 2f < u < f$</p>		
$\Rightarrow \frac{1}{2f} > \frac{1}{u} > \frac{1}{f}$		
$\frac{1}{2f} - \frac{1}{f} > \frac{1}{u} - \frac{1}{f} > \frac{1}{f} - \frac{1}{f}$		
$\Rightarrow -\frac{1}{2f} - \frac{1}{v} > 0 \quad \therefore \frac{1}{u} - \frac{1}{f} = \frac{1}{-v}$		
$\Rightarrow \frac{1}{2f} < \frac{1}{v} < 0$	1/2	
<p>$\Rightarrow v < 0 \quad \therefore$ image is real</p>	1/2	
<p>Also $v > 2f$ image is formed beyond $2f$. (Any alternative correct method should be given full credit.)</p>		2



	<p style="text-align: center;">OR</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Finding the expression for intensity 1 ½ Position of polaroid sheet for maximum intensity ½</p> </div> <p>Let the rotating Polaroid sheet makes an angle θ with the first Polaroid \therefore angle with the other Polaroid will be $(90 - \theta)$</p> <div style="text-align: center;">  </div> <p>Applying Malus's law between P_1 and P_3 $I' = I_0 \cos^2 \theta$ Between P_3 and P_2 $I'' = (I_0 \cos^2 \theta) \cos^2 (90 - \theta)$ $I'' = \frac{I_0}{4} \sin^2 2\theta$ \therefore Transmitted intensity will be maximum when $\theta = \frac{\pi}{4}$</p>	<p>½</p> <p>½</p> <p>½</p> <p>2</p>	
<p>Set1 Q10 Set2 Q9 Set3 Q8</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Obtaining condition for the balance Wheatstone bridge 2</p> </div> <div style="text-align: center;">  </div> <p>Applying Kirchoff's loop rule to closed loop ADBA</p> <p>$-I_1 R_1 + 0 + I_2 R_2 = 0 \quad (I_g = 0) \quad \dots(i)$</p>	<p>½</p> <p>½</p>	

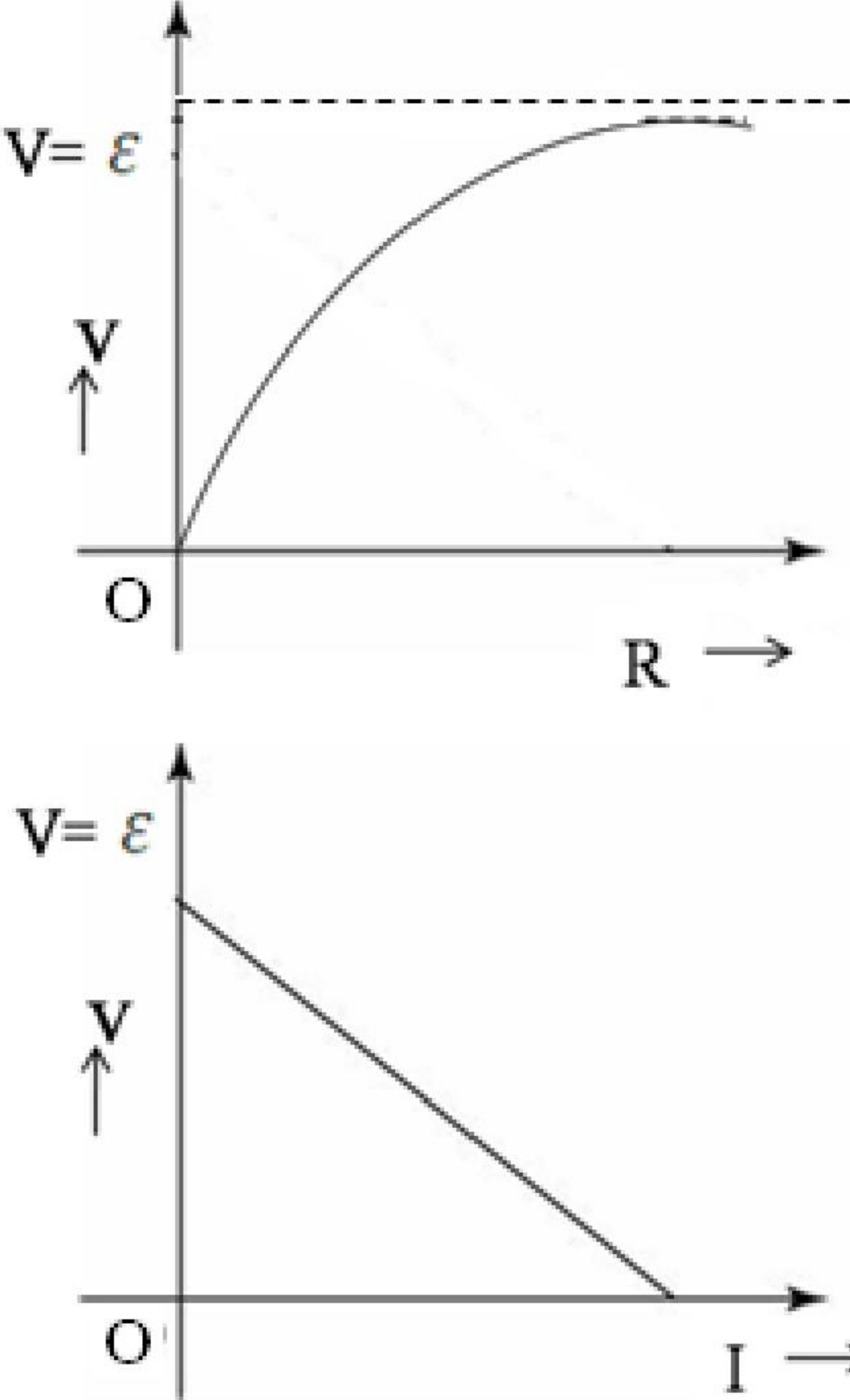
	<p>For loop CBDC $-I_2R_4 + 0 + I_1R_3 = 0$(ii)</p> <p>=> from equation (i)</p> $\frac{I_1}{I_2} = \frac{R_1}{R_2}$ <p>From equation (ii)</p> $\frac{I_1}{I_2} = \frac{R_4}{R_3}$ $\therefore \frac{R_1}{R_2} = \frac{R_4}{R_3}$	<p>1/2</p> <p>1/2</p>	<p>2</p>				
<p>Set1 Q11 Set2 Q19 Set3 Q16</p>	<table border="1" style="width: 100%;"> <tr> <td style="width: 60%;">Name of the parts of e.m. spectrum for a,b,c</td> <td style="width: 40%;">1/2+ 1/2 + 1/2</td> </tr> <tr> <td>Production</td> <td>1/2+ 1/2 + 1/2</td> </tr> </table> <p>(a) Microwave Production : Klystron/magnetron/Gunn diode (any one)</p> <p>(b) Infrared Radiation Production : Hot bodies / vibrations of atoms and molecules (any one)</p> <p>(c) X-Rays Production : Bombarding high energy electrons on metal target/ x-ray tube/inner shell electrons(any one).</p>	Name of the parts of e.m. spectrum for a,b,c	1/2+ 1/2 + 1/2	Production	1/2+ 1/2 + 1/2	<p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	<p>3</p>
Name of the parts of e.m. spectrum for a,b,c	1/2+ 1/2 + 1/2						
Production	1/2+ 1/2 + 1/2						
<p>Set1 Q12 Set2 Q20 Set3 Q17</p>	<table border="1" style="width: 100%;"> <tr> <td style="width: 60%;">(i) Calculation of angular magnification</td> <td style="width: 40%;">1 1/2</td> </tr> <tr> <td>(ii) Calculation of image of diameter of Moon</td> <td>1 1/2</td> </tr> </table> <p>Angular Magnification</p> $m = \frac{f_o}{f_e}$ $= \frac{15}{10^{-2}} = 1500$	(i) Calculation of angular magnification	1 1/2	(ii) Calculation of image of diameter of Moon	1 1/2	<p>1</p> <p>1/2</p>	
(i) Calculation of angular magnification	1 1/2						
(ii) Calculation of image of diameter of Moon	1 1/2						

	 <p>Angular size of the moon = $\left(\frac{3.48 \times 10^6}{3.8 \times 10^8}\right) = \frac{3.48}{3.8} \times 10^{-2}$ radian</p> <p>\therefore Angular size of the image = $\left(\frac{3.48}{3.8} \times 10^{-2} \times 1500\right) =$ radian</p> <p>Diameter of the image = $\frac{3.48}{3.8} \times 15 \times \text{focal length of eye piece}$ $= \frac{3.48}{3.8} \times 15 \times 1\text{cm}$ $= 13.7\text{cm}$</p> <p>(Also accept alternative correct method.)</p>	<p>1/2</p> <p>1/2</p> <p>1/2</p> <p>3</p>							
<p>Set1 Q13 Set2 Q21 Set3 Q18</p>	<table border="1" data-bbox="346 1299 1617 1469"> <tr> <td>(i) Einstein's Photoelectric equation</td> <td>1/2</td> </tr> <tr> <td>(ii) Important features</td> <td>1/2 + 1/2</td> </tr> <tr> <td>(iii) Derivation of expressions for λ_0 and work function</td> <td>1 1/2</td> </tr> </table> <p>$h\nu = \phi_0 + k_{max}$ or $h\nu = h\nu_0 + \frac{1}{2}mv_{max}^2$</p> <p>Important features (i) k_{max} depends linearly on frequency ν. (ii) Existence of threshold frequency for the metal surface. (Any other two correct features.)</p> <p>$h\nu = \phi_0 + k_{max}$</p> <p>$\frac{hc}{\lambda_1} = \frac{hc}{\lambda_0} + k_{max}$ -----(i)</p> <p>$\frac{hc}{\lambda_2} = \frac{hc}{\lambda_0} + 2k_{max}$ -----(ii)</p> <p>From (i) and (ii)</p> <p>$\frac{2hc}{\lambda_1} - \frac{hc}{\lambda_2} = \frac{hc}{\lambda_0}$</p>	(i) Einstein's Photoelectric equation	1/2	(ii) Important features	1/2 + 1/2	(iii) Derivation of expressions for λ_0 and work function	1 1/2	<p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	
(i) Einstein's Photoelectric equation	1/2								
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	$\frac{1}{\lambda_0} = \left(\frac{2}{\lambda_1} - \frac{1}{\lambda_2} \right)$ $\lambda_0 = \frac{\lambda_1 \lambda_2}{2\lambda_2 - \lambda_1}$ <p>Work function $\phi_0 = \frac{hc}{\lambda_0} = \frac{hc(2\lambda_2 - \lambda_1)}{\lambda_1 \lambda_2}$</p>	<p>1/2</p> <p>1/2</p>	<p>3</p>									
<p>Set1 Q14 Set2 Q22 Set3 Q19</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;">(i)</td> <td style="width: 70%;">Drawing of trajectory</td> <td style="width: 25%; text-align: right;">1</td> </tr> <tr> <td>(ii)</td> <td>Explanation of information on the size of nucleus</td> <td style="text-align: right;">1/2</td> </tr> <tr> <td>(iii)</td> <td>Proving that nuclear density is independent of A</td> <td style="text-align: right;">1 1/2</td> </tr> </table> <div style="text-align: center; margin: 20px 0;">  </div> <p>Only a small fraction of the incident α – particles rebound. This shows that the mass of the atom is concentrated in a small volume in the form of nucleus and gives an idea of the size of nucleus.</p> <p>Radius of nucleus $R = R_0 A^{\frac{1}{3}}$</p> <p>Density = $\frac{\text{mass}}{\text{volume}}$</p> $= \frac{mA}{\frac{4}{3}\pi R^3}$ <p style="text-align: center;">where, m: mass of one nucleon A: Mass number</p> $= \frac{mA}{\frac{4}{3}\pi (R_0 A^{\frac{1}{3}})^3}$ $= \frac{3m}{4\pi R_0^3}$ <p>=> Nuclear matter density is independent of A</p>	(i)	Drawing of trajectory	1	(ii)	Explanation of information on the size of nucleus	1/2	(iii)	Proving that nuclear density is independent of A	1 1/2	<p>1</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	<p>3</p>
(i)	Drawing of trajectory	1										
(ii)	Explanation of information on the size of nucleus	1/2										
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	<p style="text-align: center;">OR</p> <table border="1" style="width: 100%;"> <tr> <td>Distinction between nuclear fission and nuclear fusion</td> <td style="text-align: right;">1/2 + 1/2</td> </tr> <tr> <td>Showing release of energy in both processes</td> <td style="text-align: right;">1/2</td> </tr> <tr> <td>Calculation of release of energy</td> <td style="text-align: right;">1 1/2</td> </tr> </table> <p>The breaking of heavy nucleus into smaller fragments is called nuclear fission; the joining of lighter nuclei to form a heavy nucleus is called nuclear fusion.</p> <p>Binding energy per nucleon, of the daughter nuclei, in both processes, is more than that of the parent nuclei. The difference in binding energy is released in the form of energy. In both processes some mass gets converted into energy.</p> <p>Alternativey: In both processes, some mass gets converted into energy.</p> <p>Energy Released</p> $Q = [m ({}^2_1H) + m ({}^3_1H) - m({}^4_2He) - m(n)] \times 931.5 \text{ MeV}$ $= [2.014102 + 3.016049 - 4.002603 - 1.008665] \times 931.5 \text{ MeV}$ $= 0.018883 \times 931.5 \text{ MeV}$ $= 17.59 \text{ MeV}$	Distinction between nuclear fission and nuclear fusion	1/2 + 1/2	Showing release of energy in both processes	1/2	Calculation of release of energy	1 1/2	<p style="text-align: right;">1/2 + 1/2</p> <p style="text-align: right;">1/2</p> <p style="text-align: right;">1/2</p> <p style="text-align: right;">1/2</p> <p style="text-align: right;">1/2</p>	<p style="text-align: right;">3</p>
Distinction between nuclear fission and nuclear fusion	1/2 + 1/2								
Showing release of energy in both processes	1/2								
Calculation of release of energy	1 1/2								
<p>Set1 Q15 Set2 Q11 Set3 Q20</p>	<table border="1" style="width: 100%;"> <tr> <td>Drawing Block diagram of detector</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Showing detection of Message signal from Input AM Wave</td> <td style="text-align: right;">2</td> </tr> </table> <div style="text-align: center;"> <p style="text-align: center;">AM input wave Rectified wave Output (without RF component)</p> </div> <p>[Note: Award these 3 marks irrespective of the way the student attempts the question.]</p>	Drawing Block diagram of detector	1	Showing detection of Message signal from Input AM Wave	2	<p style="text-align: right;">1</p> <p style="text-align: right;">1+1</p> <p style="text-align: right;">1</p>	<p style="text-align: right;">3</p>		
Drawing Block diagram of detector	1								
Showing detection of Message signal from Input AM Wave	2								
<p>Set1 Q16 Set2 Q12 Set3 Q21</p>	<table border="1" style="width: 100%;"> <tr> <td>Drawing of Plots of Part (i) & (ii)</td> <td style="text-align: right;">1/2 + 1/2</td> </tr> <tr> <td>Finding the values of emf and internal resistance</td> <td style="text-align: right;">1 + 1</td> </tr> </table>	Drawing of Plots of Part (i) & (ii)	1/2 + 1/2	Finding the values of emf and internal resistance	1 + 1				
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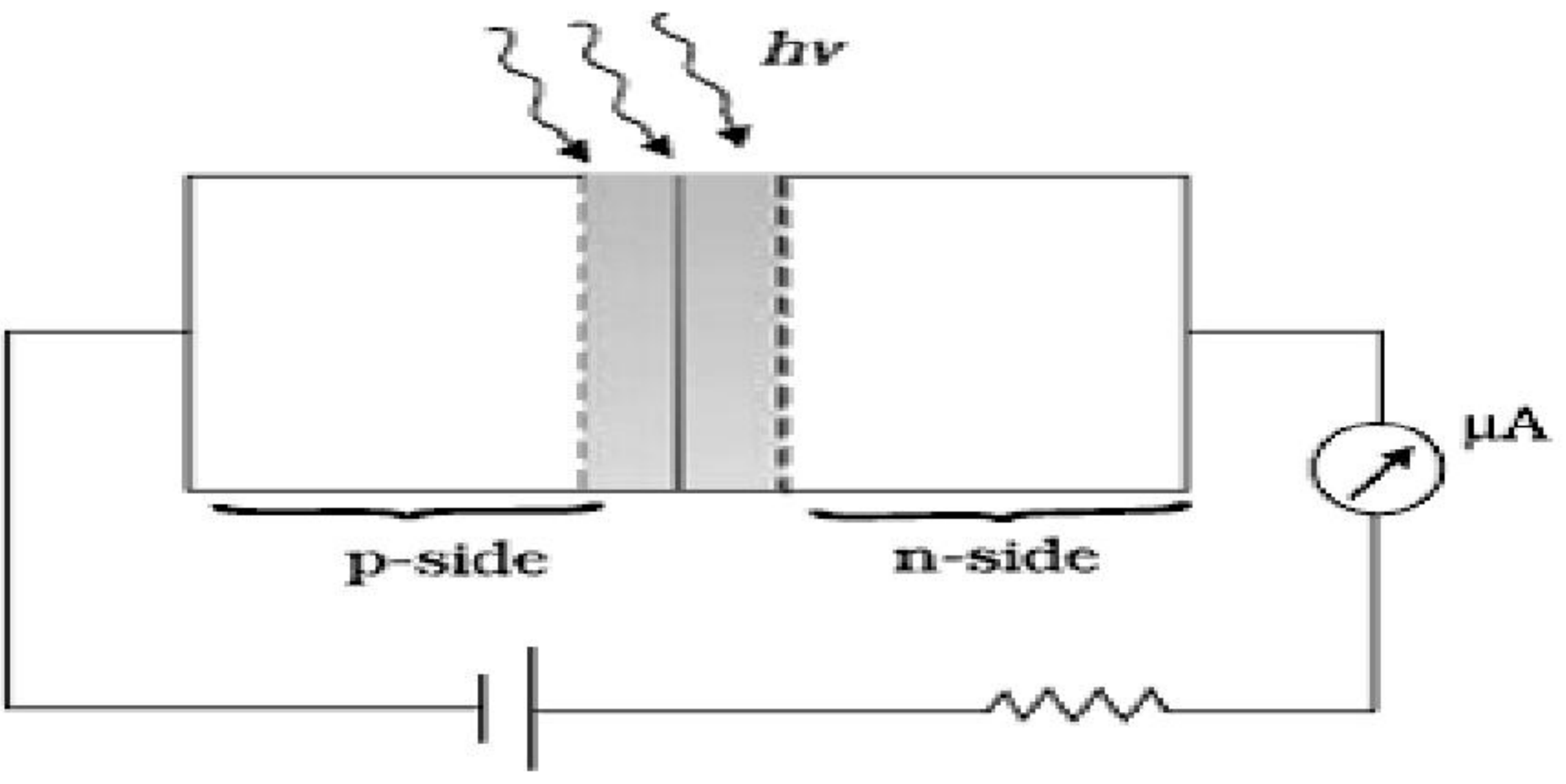
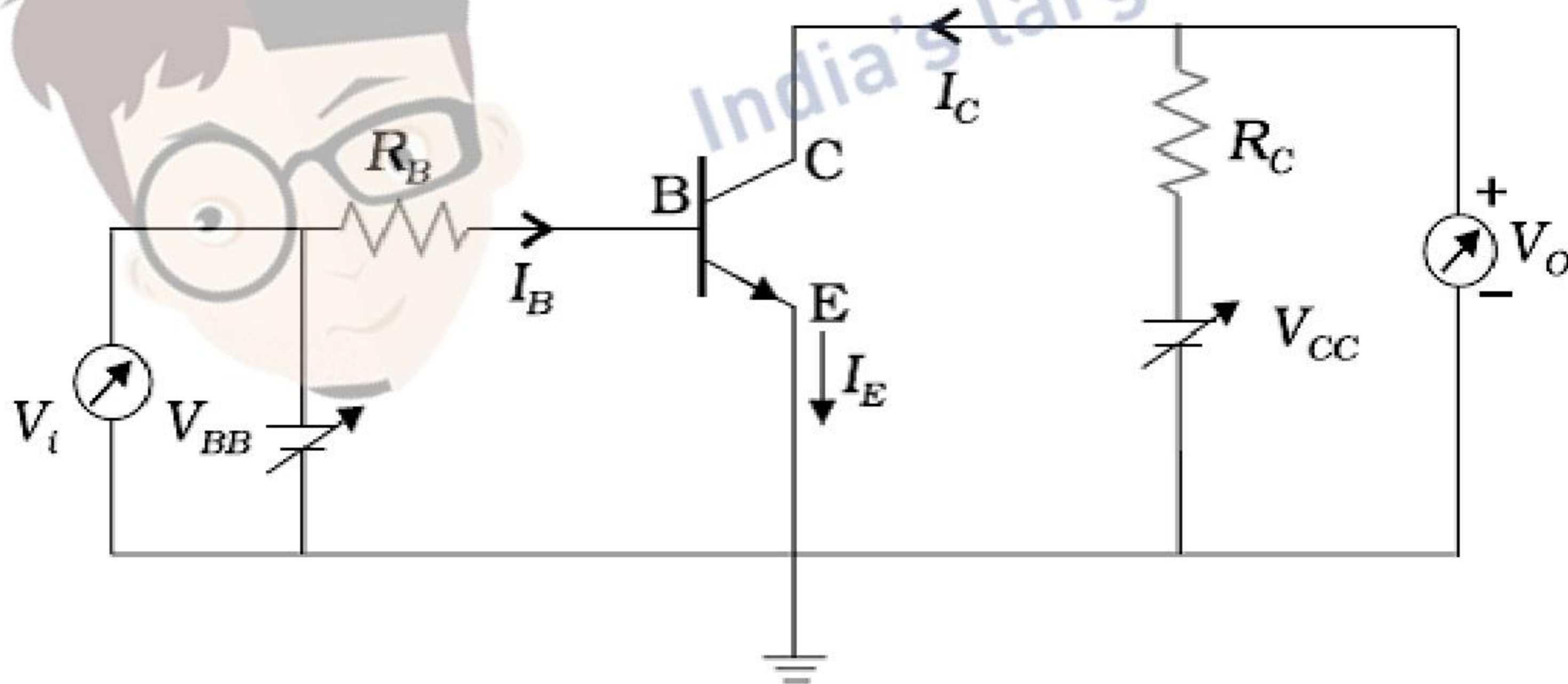
	 <p>(If the student just writes the relations $V = \epsilon - IR$ and $V = \frac{\epsilon R}{R+r}$ but does not draw the plots, award $\frac{1}{2}$ mark.)</p> <p>$I = \frac{E}{R+r}$</p> <p>$I = \frac{E}{4+r}$</p> <p>$\Rightarrow E = 4 + r \dots\dots(i)$</p> <p>Also</p> <p>$0.5 = \frac{E}{9+r}$</p> <p>$E = 4.5 + 0.5 r \dots\dots(ii)$</p> <p>From equation (i) & (ii)</p> <p>$4 + r = 4.5 + 0.5 r$</p> <p>$\therefore r = 1 \Omega$</p> <p>Using this value of r, we get</p> <p>$E = 5V$</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>3</p>	
<p>Set1 Q17 Set2 Q13 Set3 Q22</p>	<p>Determination of C_1 and C_2 2</p> <p>Determination of Charge on each capacitor in parallel combination $\frac{1}{2} + \frac{1}{2}$</p>		

	<p>Energy stored in a capacitor</p> $E = \frac{1}{2} CV^2$ <p>In series combination</p> $0.045 = \frac{1}{2} \frac{C_1 C_2}{C_1 + C_2} (100)^2$ $\Rightarrow \frac{C_1 C_2}{C_1 + C_2} = 0.09 \times 10^{-4} \quad \dots\dots(i)$ <p>In Parallel combination</p> $0.25 = \frac{1}{2} (C_1 + C_2) (100)^2$ $\Rightarrow C_1 + C_2 = 0.5 \times 10^{-4} \quad \dots\dots(ii)$ <p>On simplifying (i) & (ii)</p> $C_1 C_2 = 0.045 \times 10^{-8}$ $(C_1 - C_2)^2 = (C_1 + C_2)^2 - 4C_1 C_2$ $= (0.5 \times 10^{-4})^2 - 4 \times 0.045 \times 10^{-8}$ $= 0.25 \times 10^{-8} - 0.180 \times 10^{-8}$ $(C_1 - C_2)^2 = 0.07 \times 10^{-8}$ $(C_1 - C_2) = 2.6 \times 10^{-5} = 0.26 \times 10^{-4} \quad \dots\dots(iii)$ <p>From (ii) and (iii) we have</p> $\Rightarrow C_1 = 0.38 \times 10^{-4} \text{ F} \ \& \ C_2 = 0.12 \times 10^{-4} \text{ F}$ <p>Charges on capacitor C_1 and C_2 in Parallel combination</p> $Q_1 = C_1 V = (0.38 \times 10^{-4} \times 100) = 0.38 \times 10^{-2} \text{ C}$ $Q_2 = C_2 V = (0.12 \times 10^{-4} \times 100) = 0.12 \times 10^{-2} \text{ C}$ <p>[Note: If the student writes the relations/ equations $E = \frac{1}{2} CV^2$</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>1/2</p>	
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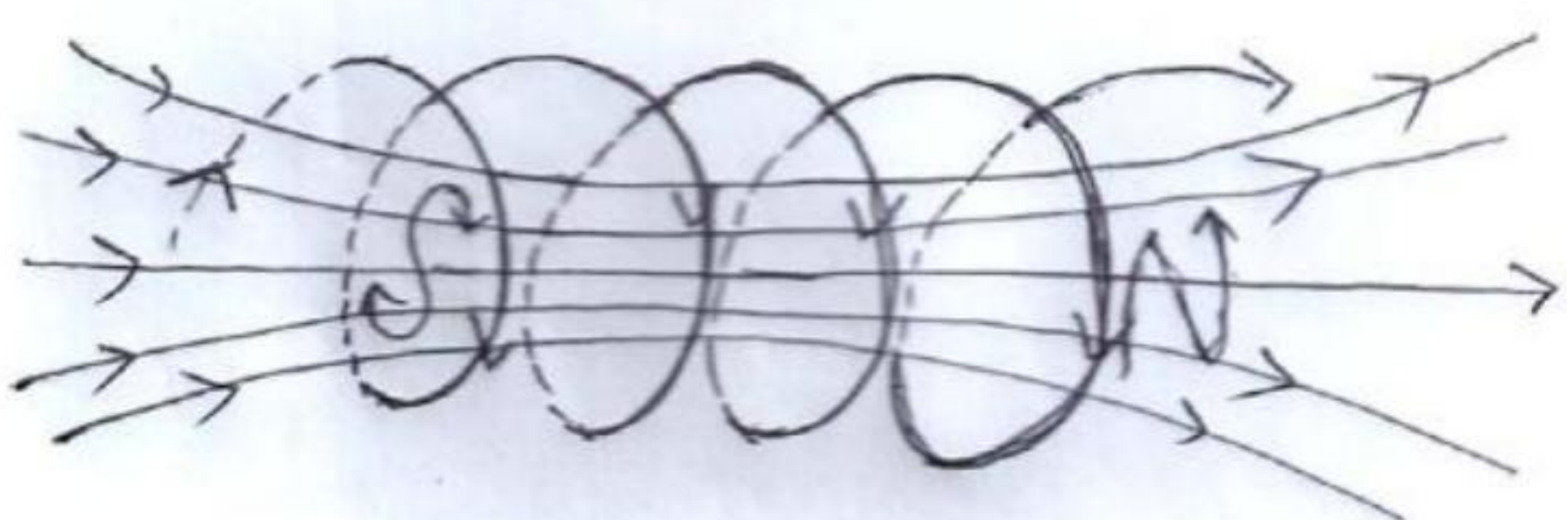
	<p>And $0.045 = \frac{1}{2} \left(\frac{C_1 C_2}{C_1 + C_2} \right) (100)^2$</p> <p>$0.25 = \frac{1}{2} (C_1 + C_2) (100)^2$</p> <p>But is unable to calculate C_1 and C_2, award him/her full 2 marks.</p> <p>Also if the student just writes $Q_1 = C_1 V = C_1 (100)$ and $Q_2 = C_2 V = C_2 (100)$ Award him/her one mark for this part of the question.]</p>		3						
Set1 Q18 Set2 Q14 Set3 Q11	<table border="1" data-bbox="346 736 1642 926"> <tr> <td>Working Principle</td> <td>1</td> </tr> <tr> <td>Finding the required resistance</td> <td>1</td> </tr> <tr> <td>Finding the resistance G of the Galvanometer</td> <td>1</td> </tr> </table> <p>Working Principle: A current carrying coil experiences a torque when placed in a magnetic field which tends to rotate the coil and produces an angular deflection.</p> <p>$V = I (G + R_1)$</p> <p>$\frac{V}{2} = I (G + R_2)$</p> <p>$\Rightarrow 2 = \frac{G + R_1}{G + R_2}$</p> <p>$\Rightarrow G = R_1 - 2R_2$</p> <p>Let R_3 be the resistance required for conversion into voltmeter of range 2V $\therefore 2V = I_g (G + R_3)$ Also $V = I_g (G + R_1)$ $\therefore 2 = \frac{G + R_3}{G + R_1}$</p> <p>$\therefore R_3 = G + 2R_1 = R_1 - 2R_2 + 2R_1 = 3R_1 - 2R_2$</p>	Working Principle	1	Finding the required resistance	1	Finding the resistance G of the Galvanometer	1	1 1/2 1/2 1/2 1/2	3
Working Principle	1								
Finding the required resistance	1								
Finding the resistance G of the Galvanometer	1								
Set1 Q19 Set2 Q15 Set3 Q12	<table border="1" data-bbox="346 1988 1633 2178"> <tr> <td>Fabrication of photodiode</td> <td>1/2</td> </tr> <tr> <td>Working with suitable diagram</td> <td>1 1/2</td> </tr> <tr> <td>Reason</td> <td>1</td> </tr> </table> <p>It is fabricated with a transparent window to allow light to fall on diode.</p> <p>When the photodiode is illuminated with photons of energy ($h\nu > E_g$) greater than the energy gap of the semiconductor, electron – holes pairs are generated. These gets separated due to the Junction electric field (before they recombine) which produces an emf.</p>	Fabrication of photodiode	1/2	Working with suitable diagram	1 1/2	Reason	1	1/2 1	
Fabrication of photodiode	1/2								
Working with suitable diagram	1 1/2								
Reason	1								

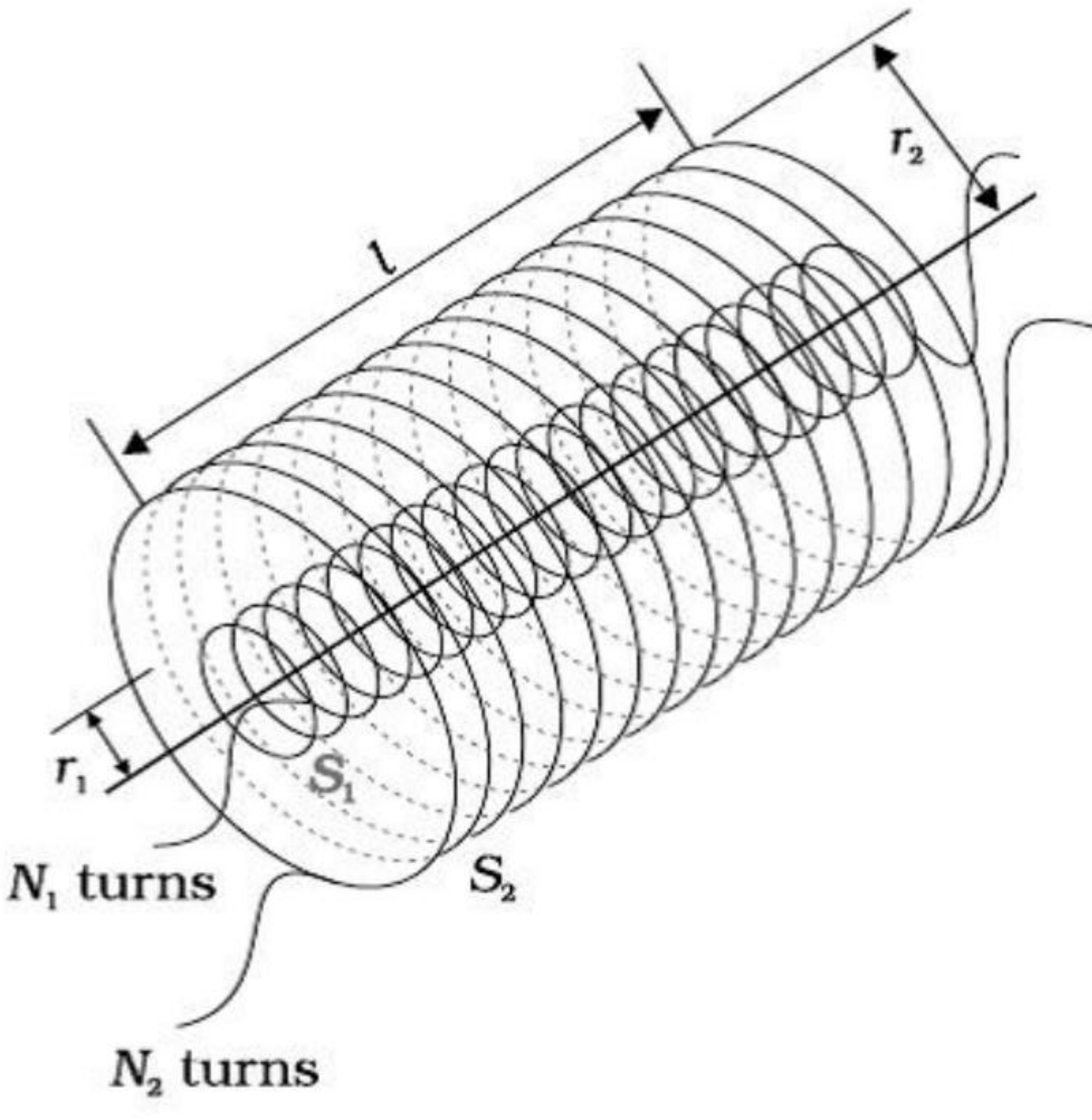


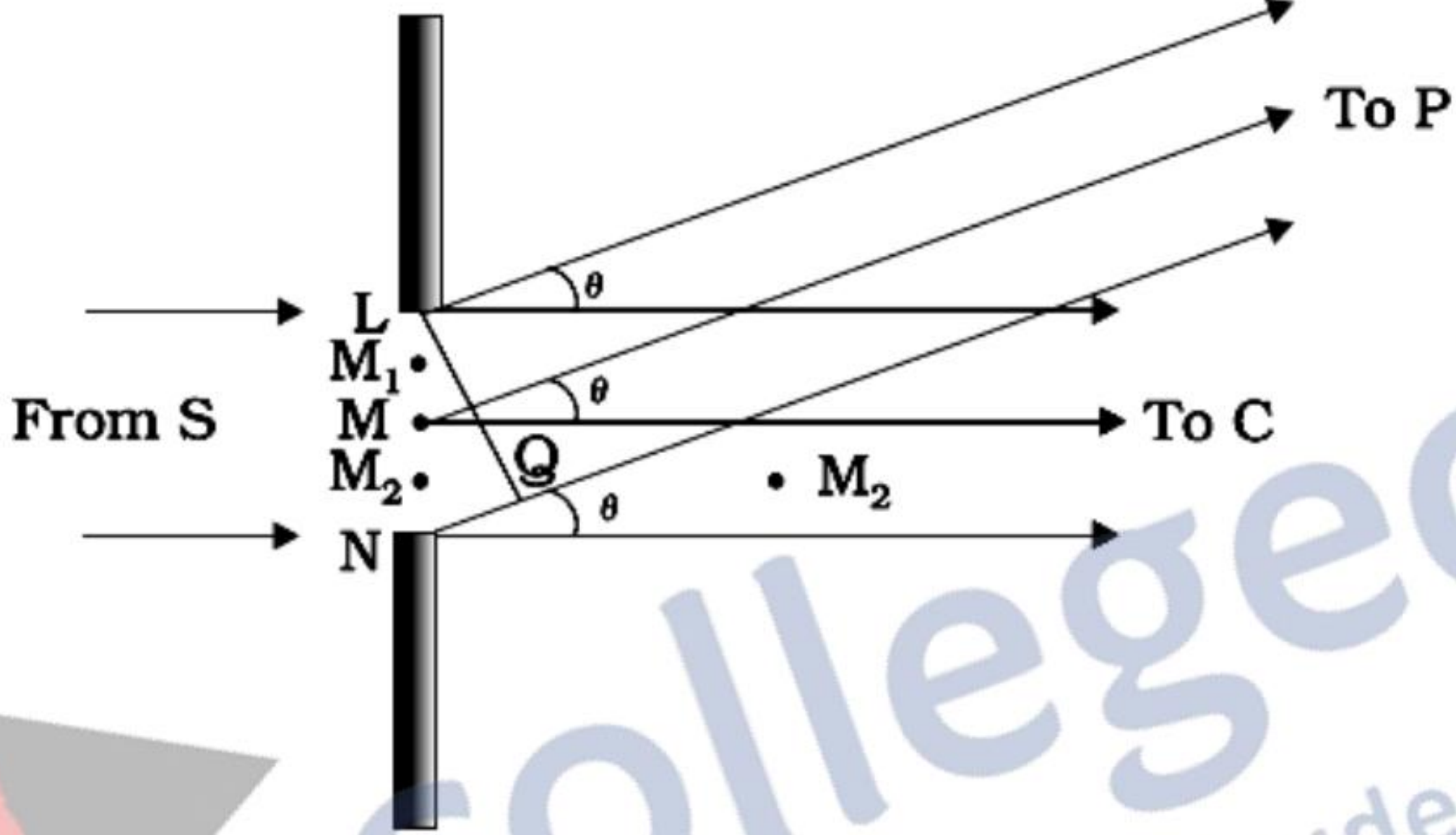
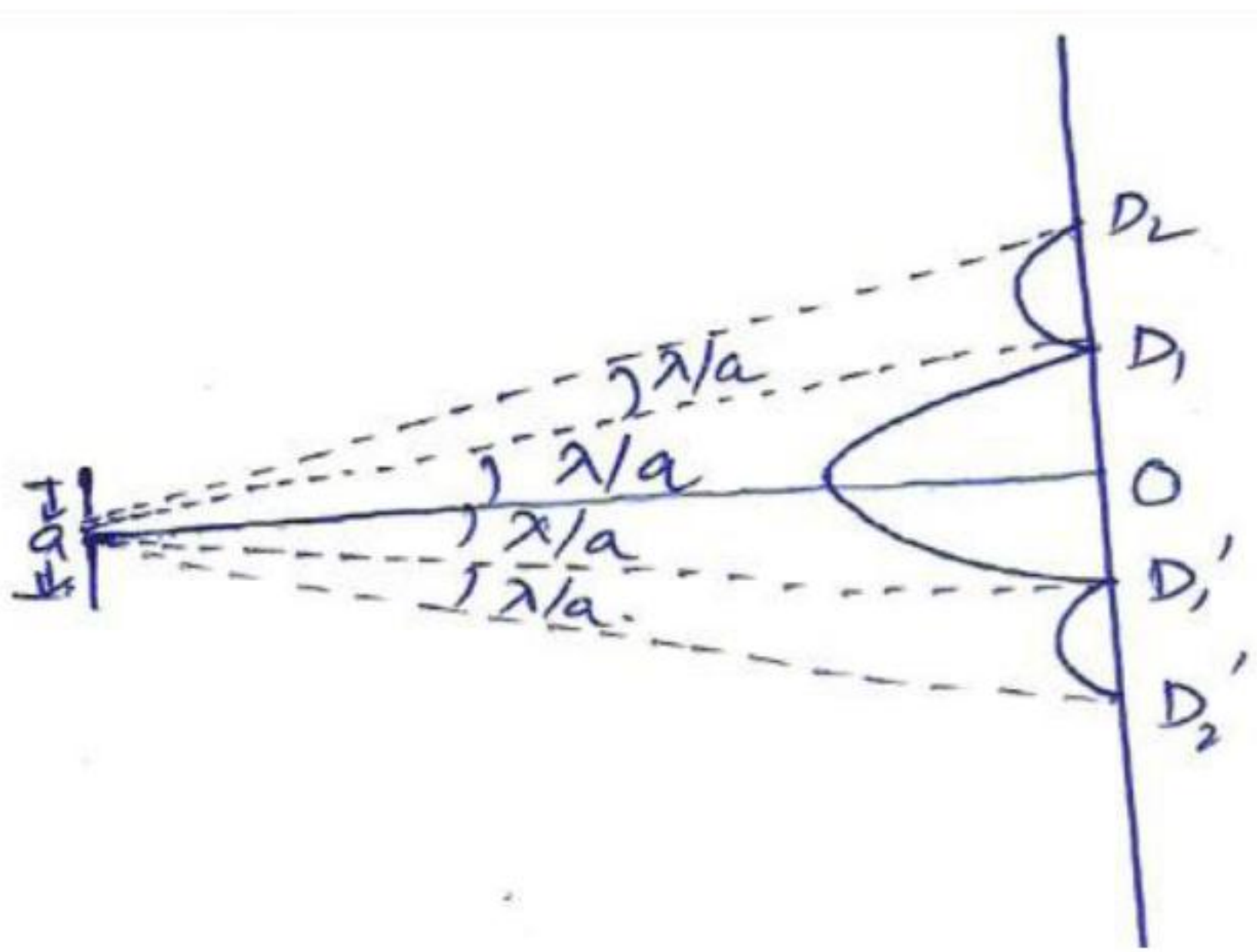
	 <p>Reason: It is easier to observe the change in the current, with change in light intensity, if a reverse bias is applied.</p> <p>Alternatively, The fractional change in the minority carrier current, obtained under reverse bias, is much more than the corresponding fractional change in majority carrier current obtained under forward bias.</p>	<p>1/2</p> <p>1</p>	<p>3</p>
<p>Set1 Q20 Set2 Q16 Set3 Q13</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Circuit diagram of Transistor amplifier in CE-configuration 1 1/2</p> <p>Definition and determination of</p> <p>(i) Input resistance 1 1/2</p> <p>(ii) Current amplification factor</p> </div>  <p>Input resistance</p> $R_i = \left(\frac{\Delta V_{BE}}{\Delta I_B} \right)_{V_{CE}}$ <p>Current amplification factor</p> $\beta_{ac} = \left(\frac{\Delta I_C}{\Delta I_B} \right)_{V_{CE}}$	<p>1 1/2</p> <p>1/2</p> <p>1/2</p>	

	<p>The value of input resistance is determined from the slope of I_B versus V_{BE} plot at constant V_{CE}.</p> <p>The value of current amplification factor is obtained from the slope of collector I_C versus V_{CE} plot using different values of I_B.</p> <p>(If a student uses typical characteristics to determine these values, full credit of one mark should be given)</p>	1/2	3						
Set1 Q21 Set2 Q17 Set3 Q14	<table border="1" style="width: 100%;"> <tr> <td style="width: 80%;">Finding the spacing between two slits</td> <td style="width: 20%; text-align: right;">1</td> </tr> <tr> <td>Effect on wavelength and frequency of reflected and refracted light</td> <td>2</td> </tr> </table> <p>(a) Angular width of fringes $\theta = \lambda/d$, where d = separation between two slits Here $\theta = 0.1^\circ = 0.1 \times \frac{\pi}{180}$ radian $\therefore d = \frac{600 \times 10^{-9} \times 180}{0.1 \times \pi} m$ $= 3.43 \times 10^{-4} m$ $= 0.34 m$</p> <p>(b) For Reflected light: Wavelength remains same Frequency remains same For Refracted light: Wavelength decreases Frequency remains same</p>	Finding the spacing between two slits	1	Effect on wavelength and frequency of reflected and refracted light	2	1/2 1/2 1/2 1/2	3		
Finding the spacing between two slits	1								
Effect on wavelength and frequency of reflected and refracted light	2								
Set1 Q22 Set2 Q18 Set3 Q15	<table border="1" style="width: 100%;"> <tr> <td style="width: 80%;">Change in the Brightness of the bulb in cases (i), (ii) & (iii)</td> <td style="width: 20%; text-align: right;">1/2 + 1/2 + 1/2</td> </tr> <tr> <td>Justification</td> <td>1/2 + 1/2 + 1/2</td> </tr> </table> <p>(i) Increases $X_L = \omega L$ As number of turns decreases, L decreases, hence current through bulb increases. / Voltage across bulb increases.</p> <p>(ii) Decreases Iron rod increases the inductance which increases X_L, hence current through the bulb decreases. / Voltage across bulb decreases.</p> <p>(iii) Increases Under this condition ($X_C = X_L$) the current through the bulb will become maximum / increase.</p>	Change in the Brightness of the bulb in cases (i), (ii) & (iii)	1/2 + 1/2 + 1/2	Justification	1/2 + 1/2 + 1/2	1/2 1/2 1/2 1/2 1/2 1/2	3		
Change in the Brightness of the bulb in cases (i), (ii) & (iii)	1/2 + 1/2 + 1/2								
Justification	1/2 + 1/2 + 1/2								
Set1 Q23 Set2 Q23 Set3 Q23	<table border="1" style="width: 100%;"> <tr> <td style="width: 80%;">(i) Name of device and Principle of working</td> <td style="width: 20%; text-align: right;">1/2 + 1</td> </tr> <tr> <td>(ii) Possibility and explanation</td> <td>1/2</td> </tr> <tr> <td>(iii) Values displayed by students and teachers</td> <td>1+1</td> </tr> </table>	(i) Name of device and Principle of working	1/2 + 1	(ii) Possibility and explanation	1/2	(iii) Values displayed by students and teachers	1+1		
(i) Name of device and Principle of working	1/2 + 1								
(ii) Possibility and explanation	1/2								
(iii) Values displayed by students and teachers	1+1								



$\oint \vec{B} \cdot d\vec{l} = \mu_0(n2\pi rI)$ $\oint Bdl\cos 0 = \mu_0 n 2\pi rI$ $\Rightarrow B \times 2\pi r = \mu_0 n 2\pi rI$ $B = \mu_0 nI$	<p>1/2</p> <p>1/2</p>							
<p>(b)</p>  <p>The solenoid contains N loops, each carrying a current I. Therefore, each loop acts as a magnetic dipole. The magnetic moment for a current I, flowing in loop of area (vector) A is given by m = IA</p> <p>The magnetic moments of all loops are aligned along the same direction. Hence, net magnetic moment equals NIA.</p> <p style="text-align: center;">OR</p>	<p>1/2 + 1/2</p> <p>1/2</p> <p>1/2</p>	<p>5</p>						
<table border="1"> <tr> <td>(a) Definition of mutual inductance and S.I. unit</td> <td>1 1/2</td> </tr> <tr> <td>(b) Derivation of expression for the mutual inductance of two long coaxial solenoids</td> <td>2 1/2</td> </tr> <tr> <td>(c) Finding out the expression for the induced emf</td> <td>1</td> </tr> </table>	(a) Definition of mutual inductance and S.I. unit	1 1/2	(b) Derivation of expression for the mutual inductance of two long coaxial solenoids	2 1/2	(c) Finding out the expression for the induced emf	1		
(a) Definition of mutual inductance and S.I. unit	1 1/2							
(b) Derivation of expression for the mutual inductance of two long coaxial solenoids	2 1/2							
(c) Finding out the expression for the induced emf	1							
<p>(a) $\phi = MI$</p> <p>Mutual inductance of two coils is equal to the magnetic flux linked with one coil when a unit current is passed in the other coil.</p> <p>Alternatively,</p> $e = -M \frac{dI}{dt}$ <p>Mutual inductance is equal to the induced emf set up in one coil when the rate of change of current flowing through the other coil is unity.</p> <p>SI unit : henry / (Weber ampere⁻¹) / (volt second ampere⁻¹)</p>	<p>1</p>							

	<p>(Any one)</p> <p>(b) .</p>  <p>Let a current I_2 flow through S_2. This sets up a magnetic flux ϕ_1 through each turn of the coil S_1.</p> <p>Total flux linked with S_1</p> $N_1 \phi_1 = M_{12} I_2 \quad \dots(i)$ <p>where M_{12} is the mutual inductance between the two solenoids</p> <p>Magnetic field due to the current I_2 in S_2 is $\mu_0 n_2 I_2$.</p> <p>Therefore, resulting flux linked with S_1.</p> $N_1 \phi_1 = [(n_1 \ell) \pi r_1^2] (\mu_0 n_2 I_2) \quad \dots(ii)$ <p>Comparing (i) & (ii), we get</p> $M_{12} I_2 = (n_1 \ell) \pi r_1^2 (\mu_0 n_2 I_2)$ $\therefore M_{12} = \mu_0 n_1 n_2 \pi r_1^2 \ell$ <p>(c) Let a magnetic flux be (ϕ_1) linked with coil C_1 due to current (I_2) in coil C_2;</p> <p>We have :</p> $\phi_1 \propto I_2$ $\Rightarrow \phi_1 = M I_2$	<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>	
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	$\therefore \frac{d\phi_1}{dt} = M \frac{dl_2}{dt}$ $\Rightarrow e = -M \frac{dl_2}{dt}$	<p>1/2</p> <p>1/2</p>	<p>5</p>
<p>Set1 Q25 Set2 Q24 Set3 Q26</p>	<div data-bbox="338 706 1633 937" style="border: 1px solid black; padding: 5px;"> <p>(a) Explanation of diffraction pattern using Huygen's construction 2</p> <p>(b) Showing the angular width of first diffraction fringe as half of the central fringe 2</p> <p>(c) Explanation of decrease in intensity with increasing n 1</p> </div> <p>(a).</p>  <p>We can regard the total contribution of the wavefront LN at some point P on the screen, as the resultant effect of the superposition of its wavelets like LM, MM₂, M₂N. These have to be superposed taking into account their proper phase differences. We, therefore, get maxima and minima, i.e a diffraction pattern, on the screen.</p> <p>(b)</p>  <p>Condition for first minimum on the screen</p> $a \sin \theta = \lambda$ $\Rightarrow \theta = \lambda/a$ <p>\therefore angular width of the central fringe on the screen (from figure)</p>	<p>1</p> <p>1/2</p> <p>1/2</p>	

$$= 2\theta = 2\lambda/a$$

Angular width of first diffraction fringe (From fig) = λ/a

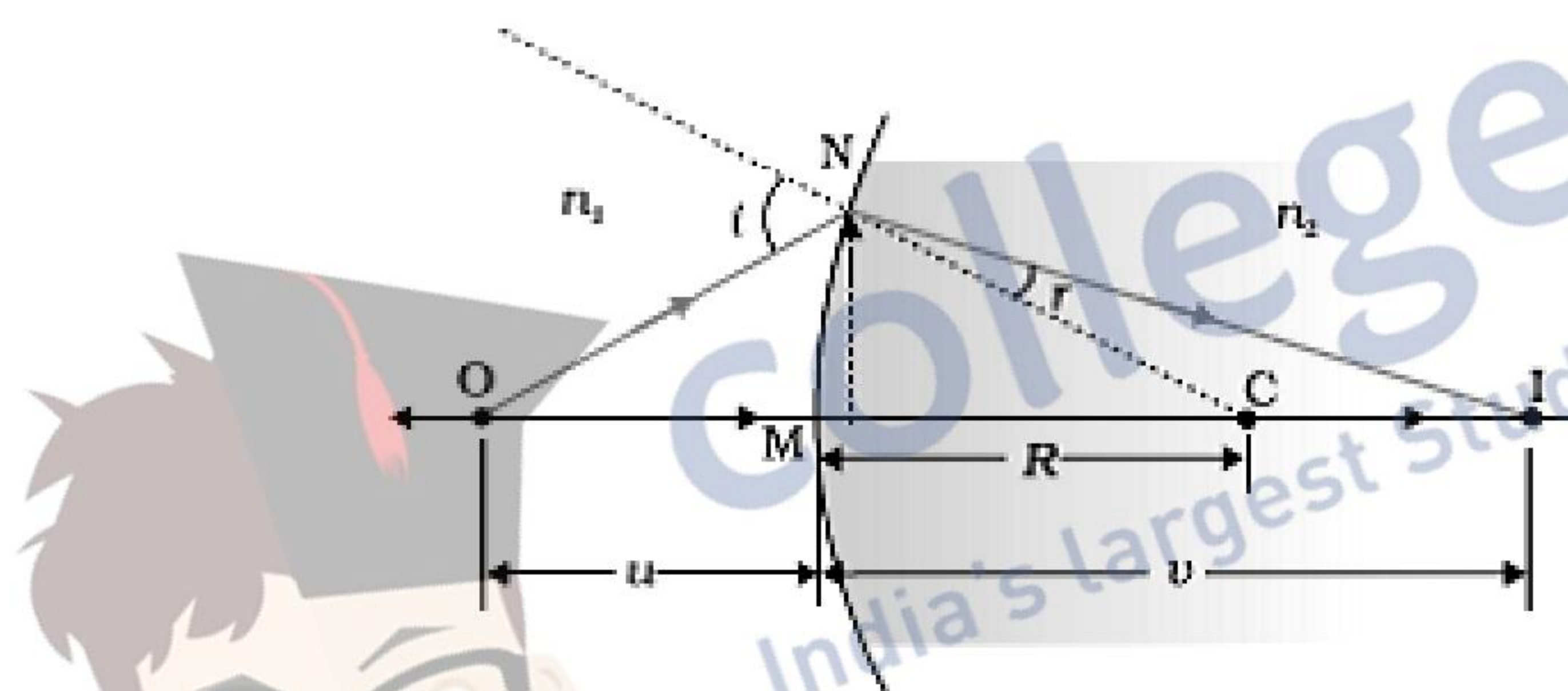
Hence angular width of central fringe is twice the angular width of first fringe.

Maxima become weaker and weaker with increasing n. This is because the effective part of the wavefront, contributing to the maxima, becomes smaller and smaller, with increasing n .

OR

a) Drawing the ray diagram showing the image formation	1
Derivation of relationship	2
b) Ray diagram	1/2
Similar relation	1/2
Derivation of lens maker's formula	1

(a)



(Deduct 1/2 mark for not showing direction of propagation of ray)

For small angles

$$\angle NOM \simeq \tan \angle NOM = \frac{MN}{OM}$$

$$\angle NCM \simeq \tan \angle NCM = \frac{MN}{MC}$$

$$\angle NIM \simeq \tan \angle NIM = \frac{MN}{MI}$$

In $\triangle NOC$, $\angle i = \angle NOM + \angle NCM$

$$\therefore \angle i = \frac{MN}{OM} + \frac{MN}{MC} \dots(i)$$

Similarly

1/2

1/2

1

5

1

1/2

1/2



$$\begin{aligned} \angle r &= \angle NCM - \angle NIM \\ &= \frac{MN}{MC} - \frac{MN}{MI} \quad \dots(ii) \end{aligned}$$

Using Snell's Law

$$n_1 \sin i = n_2 \sin r$$

For small angles

$$n_1 i^\theta = n_2 r$$

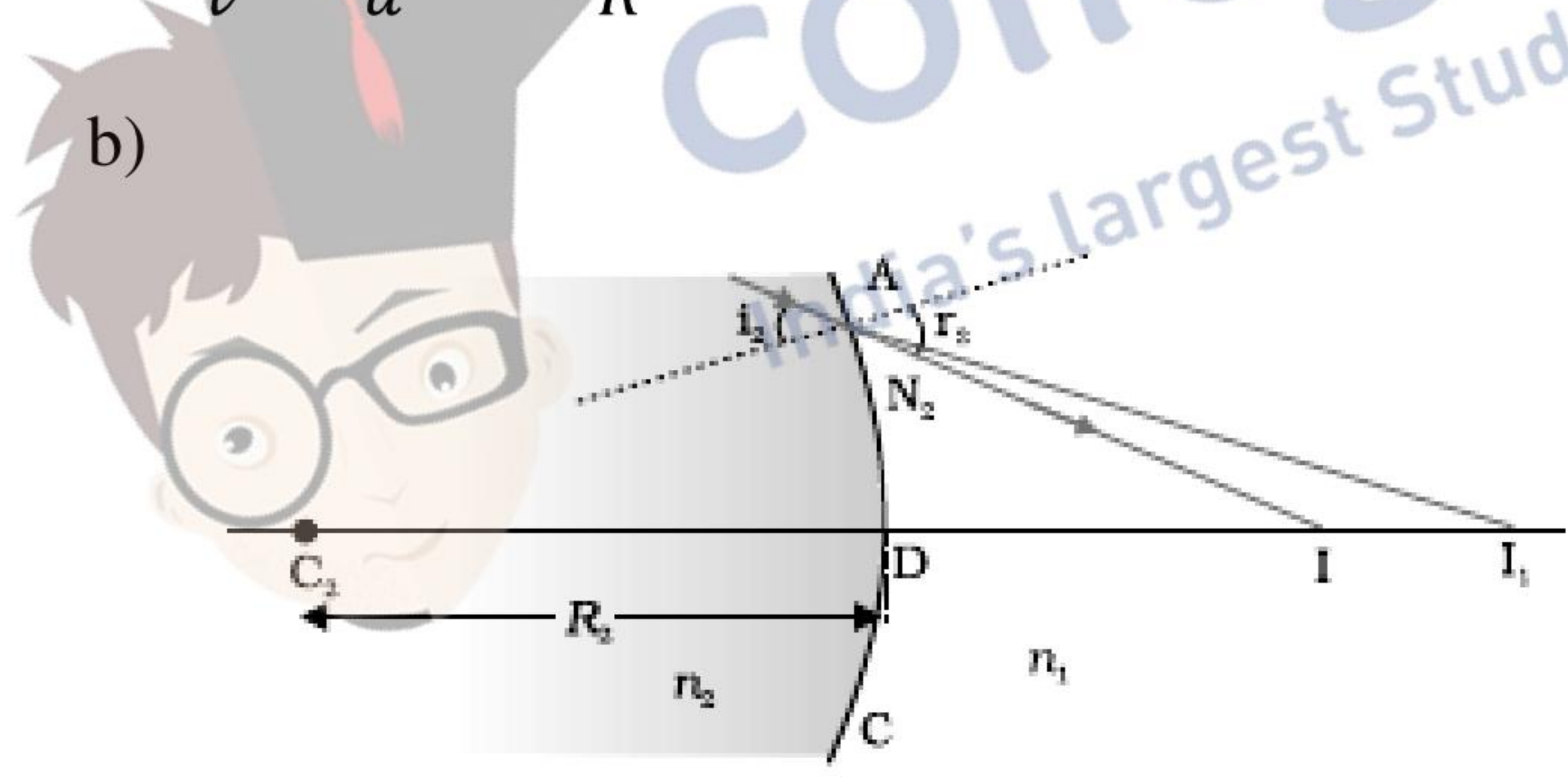
Substituting for i and r, we get

$$\frac{n_1}{OM} + \frac{n_2}{MI} = \frac{n_2 - n_1}{MC}$$

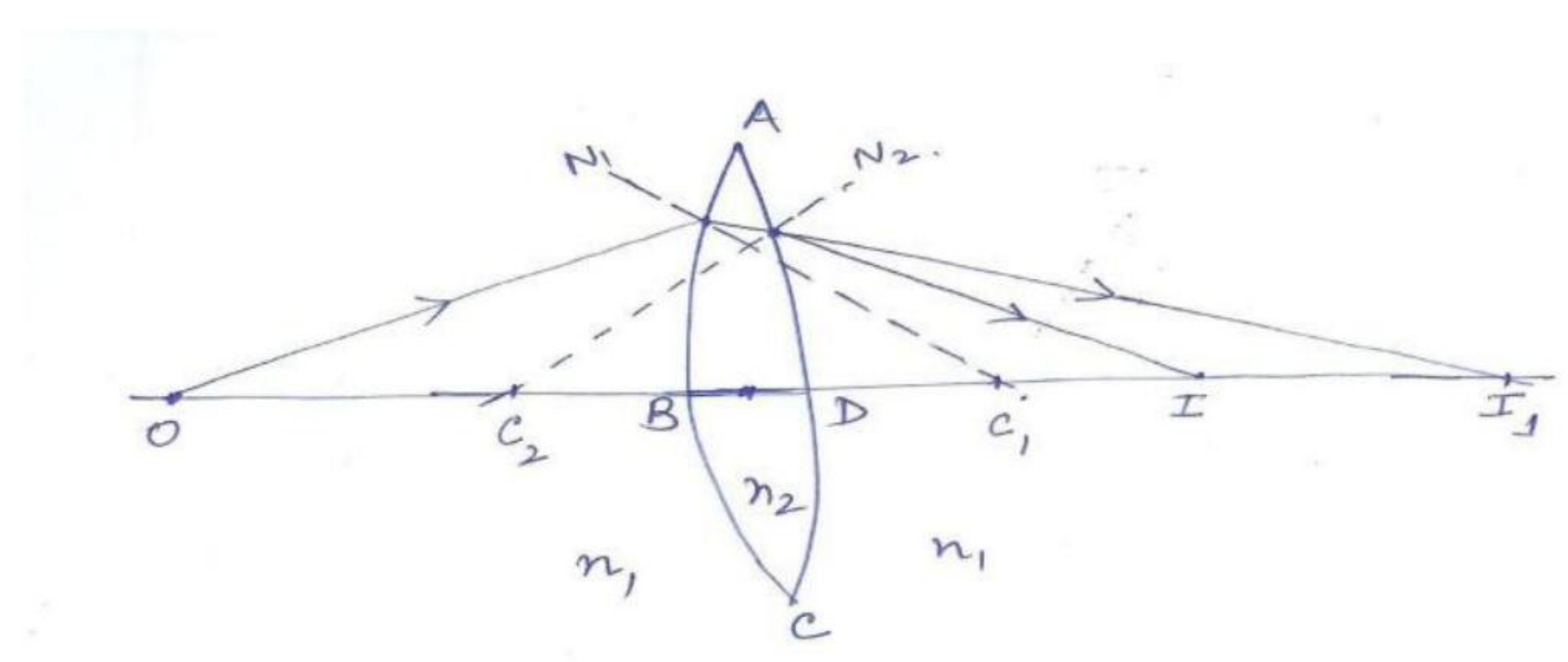
Here, $OM = -u$, $MI = +v$, $MC = +R$

Substituting these, we get

$$\Rightarrow \frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$$



(Alternatively accept this Ray diagram)

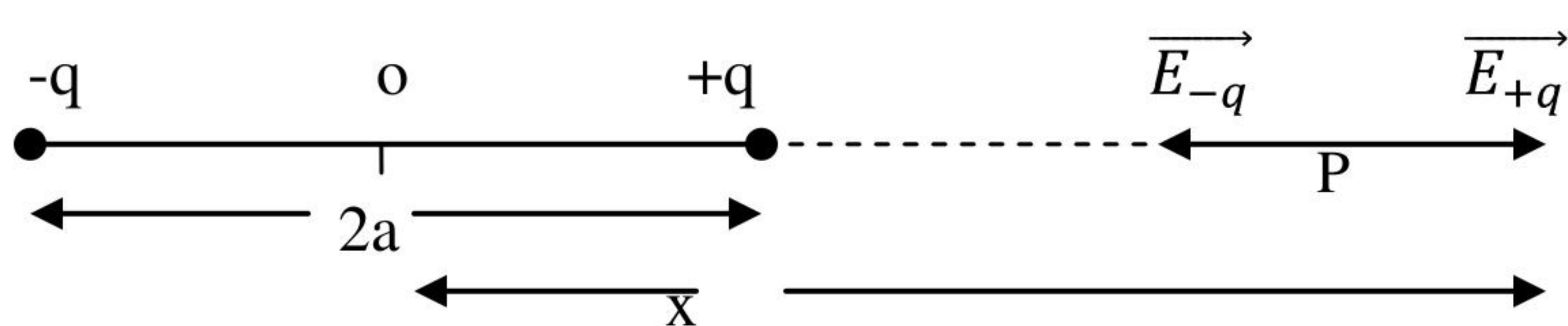


Similarly relation for the surface ADC.

1/2

1/2

1/2

	$\frac{-n_2}{DI_1} + \frac{n_1}{DI} = \frac{n_2 - n_1}{DC_2} \quad \dots(i)$ <p>Refraction at the first surface ABC of the lens.</p> $\frac{n_1}{OB} + \frac{n_2}{BI_1} = \frac{n_2 - n_1}{BC_1} \quad \dots(ii)$ <p>Adding (i) and (ii), and taking $BI_1 \simeq DI_1$, we get</p> $\frac{n_1}{OB} + \frac{n_1}{DI} = (n_2 - n_1) \left(\frac{1}{BC_1} + \frac{1}{DC_2} \right)$ <p>Here, $OB = -u$</p> $DI = +v$ $BC_1 = +R_1$ $DC_2 = -R_2$ $\Rightarrow \frac{n_1}{-u} + \frac{n_1}{v} = (n_2 - n_1) \left(\frac{1}{R_1} + \frac{1}{R_2} \right)$ $\Rightarrow n_1 \left(\frac{1}{v} + \frac{1}{u} \right) = (n_2 - n_1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$ $\Rightarrow \frac{1}{f} = \left(\frac{n_2}{n_1} - 1 \right) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$	<p>1/2</p> <p>1/2</p> <p>1/2</p>	<p>5</p>
<p>Set1 Q26 Set2 Q25 Set3 Q24</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>a) Derivation of the expression for the Electric field E and its limiting value 3</p> <p>b) Finding the net electric flux 2</p> </div> <p>a)</p>  <p>Electric field intensity at point p due to charge -q</p>	<p>1/2</p>	



$$\vec{E}_{-q} = \frac{1}{4\pi\epsilon_0} \cdot \frac{q}{(x+a)^2} (\hat{x})$$

Due to charge +q

$$\vec{E}_{+q} = \frac{1}{4\pi\epsilon_0} \cdot \frac{q}{(x-a)^2} (\hat{x})$$

Net Electric field at point p

$$\vec{E} = \vec{E}_{-q} + \vec{E}_{+q}$$

$$= \frac{q}{4\pi\epsilon_0} \times \left[\frac{1}{(x-a)^2} - \frac{1}{(x+a)^2} \right] (\hat{x})$$

$$= \frac{q}{4\pi\epsilon_0} \left[\frac{4ax}{(x^2-a^2)^2} \right] (\hat{x})$$

$$= \frac{1}{4\pi\epsilon_0} \frac{(q \times 2a) 2x}{(x^2-a^2)^2} (\hat{x})$$

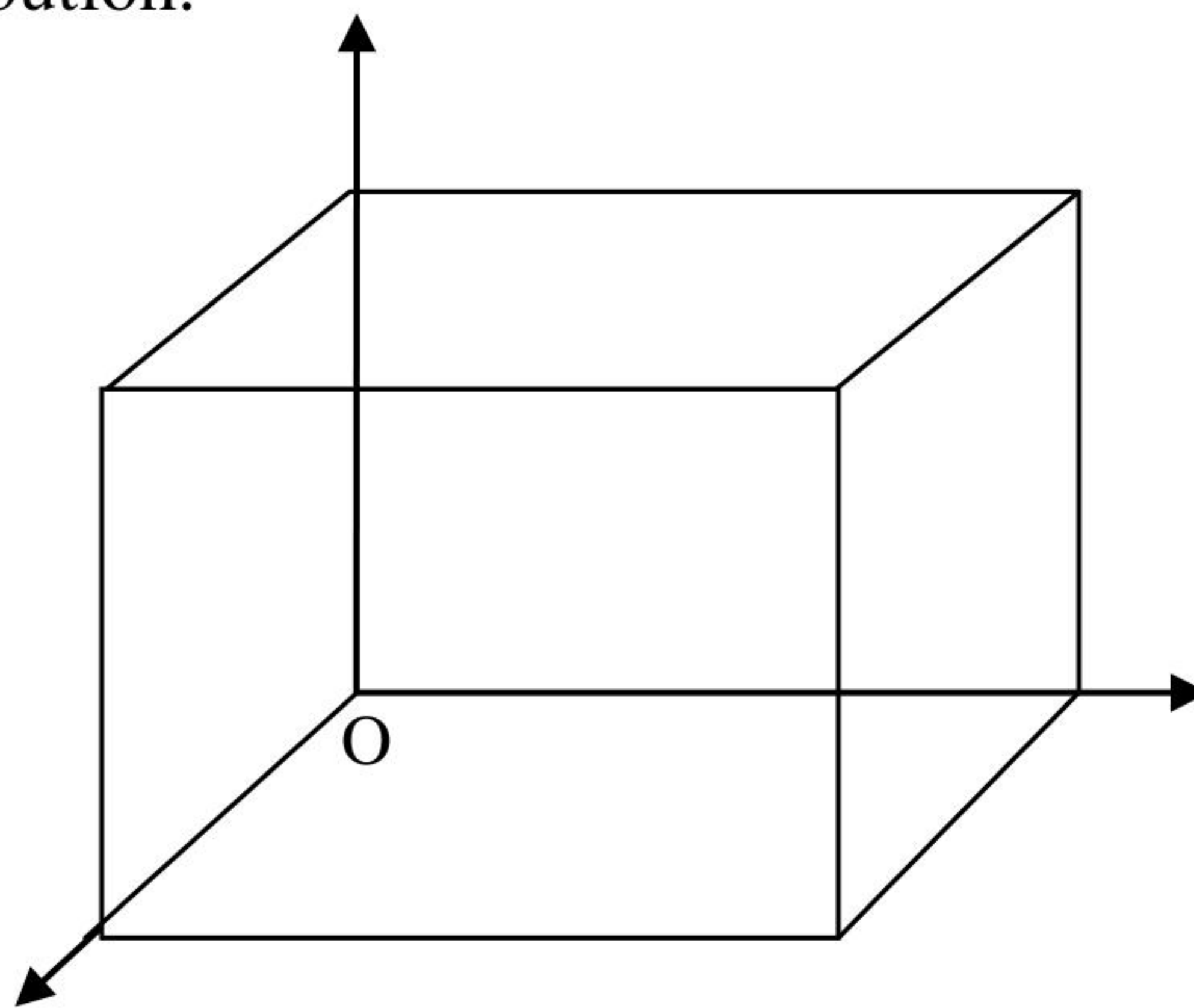
$$\vec{E} = \frac{1}{4\pi\epsilon_0} \cdot \frac{2px}{(x^2-a^2)^2} \hat{x}$$

For $x \gg a$

$$(x^2 - a^2)^2 \approx x^4$$

$$\vec{E} = \frac{1}{4\pi\epsilon_0} \cdot \frac{2p}{x^3} \hat{x}$$

- b) Only the faces perpendicular to the direction of x-axis, contribute to the Electric flux. The remaining faces of the cube give zero contribution.



$$\text{Total flux } \phi = \phi_I + \phi_{II}$$

$$= \oint_I \vec{E} \cdot \vec{ds} + \oint_{II} \vec{E} \cdot \vec{ds}$$

1/2

1/2

1/2

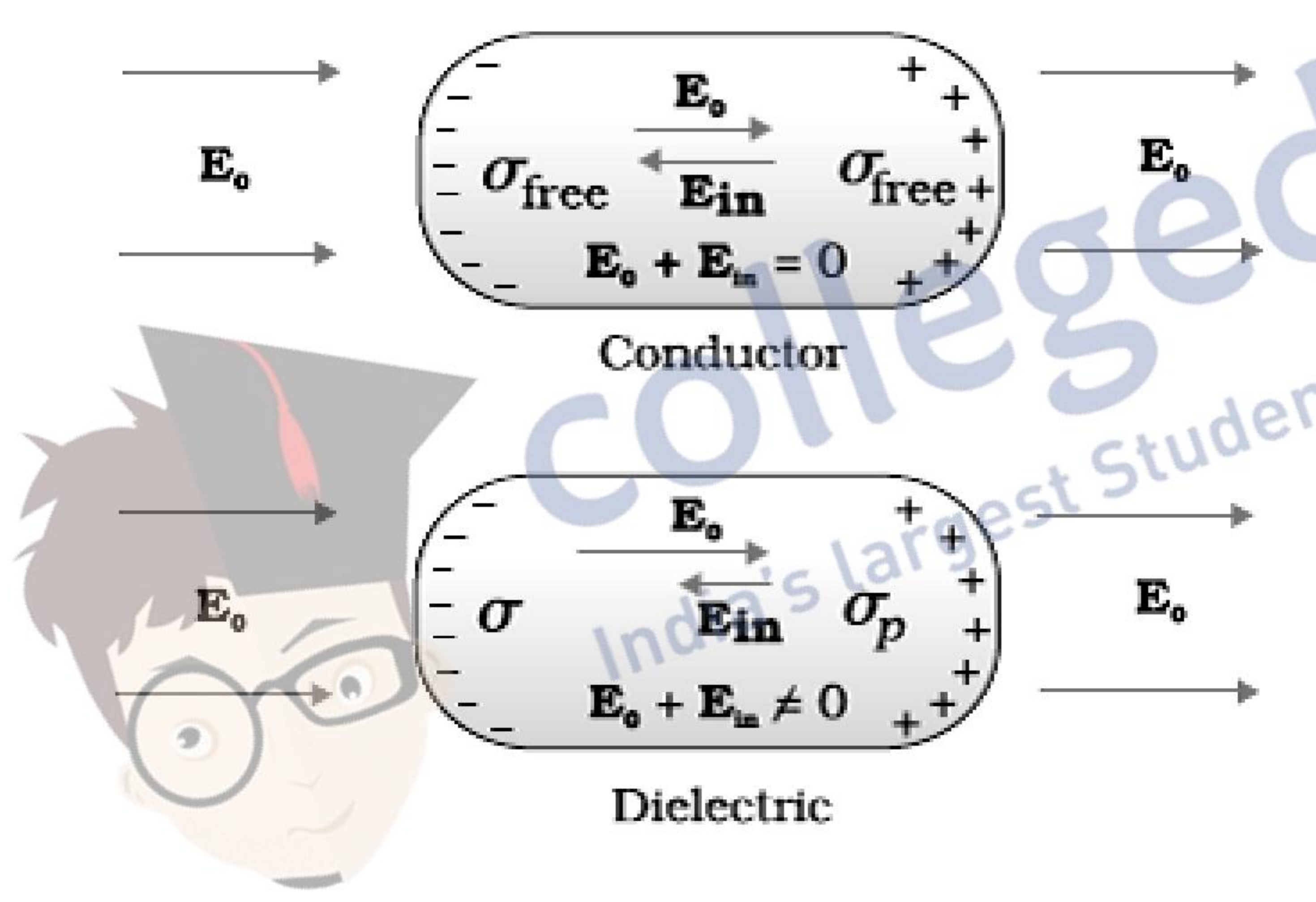
1/2

1/2

1/2

1/2



	<p>$= 0 + 2(a) \cdot a^2$</p> <p>$\therefore \phi = 2a^3$</p> <p style="text-align: center;">OR</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">a) Explanation of difference in behavior of (i) conductor (ii) dielectric</td> <td style="text-align: right; padding: 5px;">1+1</td> </tr> <tr> <td style="padding: 5px;">Definition of polarization and its relation with susceptibility</td> <td style="text-align: right; padding: 5px;">$\frac{1}{2} + \frac{1}{2}$</td> </tr> <tr> <td style="padding: 5px;">b) (i) Finding the force on the charge at centre and the charge at point A</td> <td style="text-align: right; padding: 5px;">$\frac{1}{2} + \frac{1}{2}$</td> </tr> <tr> <td style="padding: 5px;">(ii) Finding Electric flux through the shell</td> <td style="text-align: right; padding: 5px;">1</td> </tr> </table> <div style="text-align: center; margin: 20px 0;">  </div> <p>In the presence of Electric field, the free charge carriers, in a conductor, move the charge distribution in the conductor readjusts itself so that the net Electric field within the conductor becomes zero.</p> <p>In a dielectric, the external Electric field induces a net dipole moment, by stretching /reorienting the molecules. The Electric field, due to this induced dipole moment, opposes ,but does not exactly cancel, the external Electric field.</p> <p>Polarisation: Induced Dipole moment, per unit volume, is called the polarization. For Linear isotropic dielectrics having a susceptibility χ_c, we have</p>	a) Explanation of difference in behavior of (i) conductor (ii) dielectric	1+1	Definition of polarization and its relation with susceptibility	$\frac{1}{2} + \frac{1}{2}$	b) (i) Finding the force on the charge at centre and the charge at point A	$\frac{1}{2} + \frac{1}{2}$	(ii) Finding Electric flux through the shell	1	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	<p>5</p>
a) Explanation of difference in behavior of (i) conductor (ii) dielectric	1+1										
Definition of polarization and its relation with susceptibility	$\frac{1}{2} + \frac{1}{2}$										
b) (i) Finding the force on the charge at centre and the charge at point A	$\frac{1}{2} + \frac{1}{2}$										
(ii) Finding Electric flux through the shell	1										

	<p>$P = X_e E$</p> <p>B (i) Net Force on the charge $\frac{Q}{2}$, placed at the centre of the shell, Is zero.</p> <p>Force on charge '2Q' kept at point A</p> <p>$F = E \times 2Q = \frac{1\left(\frac{3Q}{2}\right)2Q}{4\pi\epsilon_0 r^2} = \frac{(K)3Q^2}{r^2}$</p> <p>Electric flux through the shell</p> <p>$\phi = \frac{Q}{2\epsilon_0}$</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>1</p>	<p></p> <p>5</p>
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