

**MARKING SCHEME  
SET 55/1/C**

Q. No.	Expected Answer / Value Points	Marks	Total Marks																		
<b>Section - A</b>																					
Set-1, Q1 Set-2, Q5 Set-3, Q2	Power factor = 1	1	1																		
Set-1, Q2 Set-2, Q4 Set-3, Q5	i) Width of depletion layer will decrease ii) potential barrier will decrease iii) junction will conduct (Any one point)	1	1																		
Set-1, Q3 Set-2, Q2 Set-3, Q4	$\vec{P} = \epsilon_0 X_e \vec{E}$ (Also accept if the student writes $\vec{P} \propto \vec{E}$ or $\vec{P} = X_e \vec{E}$ )	1	1																		
Set-1, Q4 Set-2, Q3 Set-3, Q1	Mobility is defined as drift velocity per unit electric field or $\mu = \frac{v_d}{E}$ S.I. Unit - $m^2/Vs$ or $Cm/Ns$	1/2 1/2	1																		
Set-1, Q5 Set-2, Q1 Set-3, Q3	$\frac{1}{f} = (\mu - 1) \left( \frac{1}{R_1} - \frac{1}{R_2} \right)$ $\therefore \mu = 1.5$ (Award 1 mark even if direct answer is written)	1/2 1/2	1																		
<b>Section - B</b>																					
Set-1, Q6 Set-2, Q7 Set-3, Q10	<table border="1" style="width: 100%;"> <tr> <td colspan="2">Two differences between Interference and Diffraction pattern</td> <td style="text-align: right;">2</td> </tr> <tr> <td></td> <td style="text-align: center;">Interference</td> <td style="text-align: center;">Diffraction</td> </tr> <tr> <td>1</td> <td>All the bright bands are of same intensity.</td> <td>Intensity of bright bands goes on decreasing with increasing order.</td> </tr> <tr> <td>2</td> <td>All the bright bands are of same width.</td> <td>Not of same width.</td> </tr> <tr> <td>3</td> <td>Dark bands may be completely dark.</td> <td>Not completely dark.</td> </tr> <tr> <td>4</td> <td>Number of fringes are more.</td> <td>Less in number.</td> </tr> </table> <p>(Any two) [ Award only 1 mark if student draws intensity distribution curves for both without writing points]</p> <p style="text-align: center;"><b>Or</b></p>	Two differences between Interference and Diffraction pattern		2		Interference	Diffraction	1	All the bright bands are of same intensity.	Intensity of bright bands goes on decreasing with increasing order.	2	All the bright bands are of same width.	Not of same width.	3	Dark bands may be completely dark.	Not completely dark.	4	Number of fringes are more.	Less in number.	1×2	2
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	<div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;">           Difference in Construction - 1            Difference in Working - 1         </div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;"></th> <th style="width: 35%;">Microscope</th> <th style="width: 35%;">Telescope</th> </tr> </thead> <tbody> <tr> <td>Construction</td> <td>Objective is of very short focal length and short aperture and eye piece of short focal length and large aperture. [<math>f_e &gt; f_o</math>]</td> <td>Objective is of large focal length and large aperture but eye piece of short focal length and short aperture.</td> </tr> <tr> <td>Working</td> <td>It will form magnified image of a small nearby object. (Object is placed close to focus of objective which forms real and magnified image.)</td> <td>It will form magnified image of distant object. (Objective will form the image of distant object at its focus and image is diminished.)</td> </tr> </tbody> </table>		Microscope	Telescope	Construction	Objective is of very short focal length and short aperture and eye piece of short focal length and large aperture. [ $f_e > f_o$ ]	Objective is of large focal length and large aperture but eye piece of short focal length and short aperture.	Working	It will form magnified image of a small nearby object. (Object is placed close to focus of objective which forms real and magnified image.)	It will form magnified image of distant object. (Objective will form the image of distant object at its focus and image is diminished.)	   1/2+ 1/2  1/2+ 1/2  2
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Set-1, Q7 Set-2, Q10 Set-3, Q8	<div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;">           Postulate - 1            Formula for <math>H'_\alpha</math> line - 1/2            Substitution and calculation - 1/2         </div> <p>Postulate- Energy is radiated when an electron jumps from a (permitted) higher to lower orbit and it equal to the difference in energy in the two orbits.</p> $hv = E_i - E_f$ $\frac{1}{\lambda_\alpha} = R_H \left[ \frac{1}{2^2} - \frac{1}{3^2} \right]$ $= 1.03 \times 10^7 \times \frac{5}{36} \quad \therefore \lambda_\alpha = 6.99 \times 10^{-7} \text{ m} = 699 \text{ nm}$ <p>[ Award 1/2 mark if student only writes <math>\frac{1}{\lambda} = R_H \left[ \frac{1}{n_f^2} - \frac{1}{n_i^2} \right]</math></p>	   1   1/2  1/2  2									

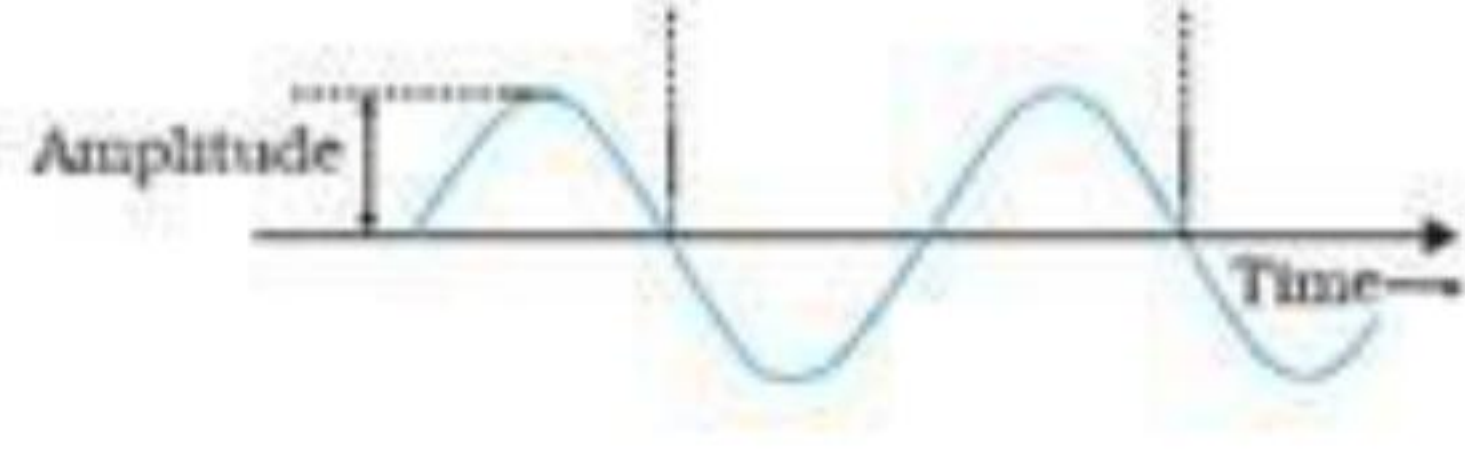
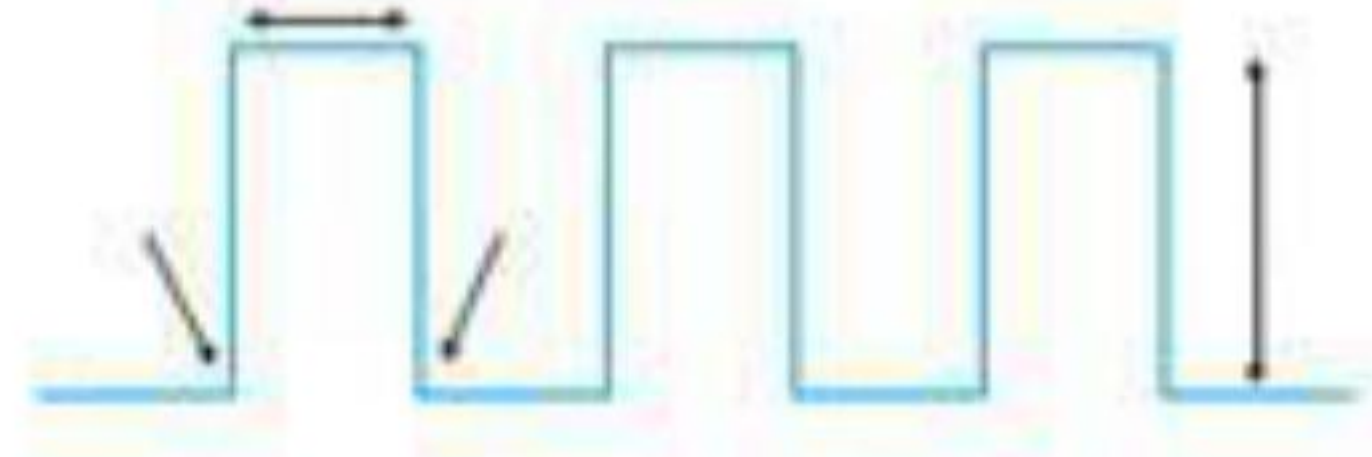
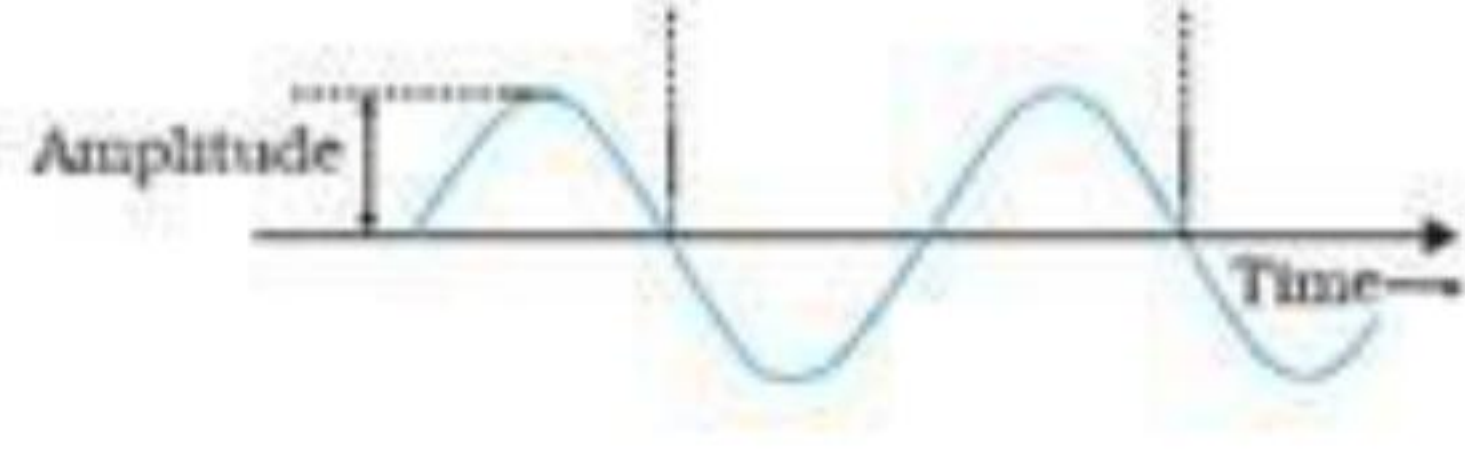
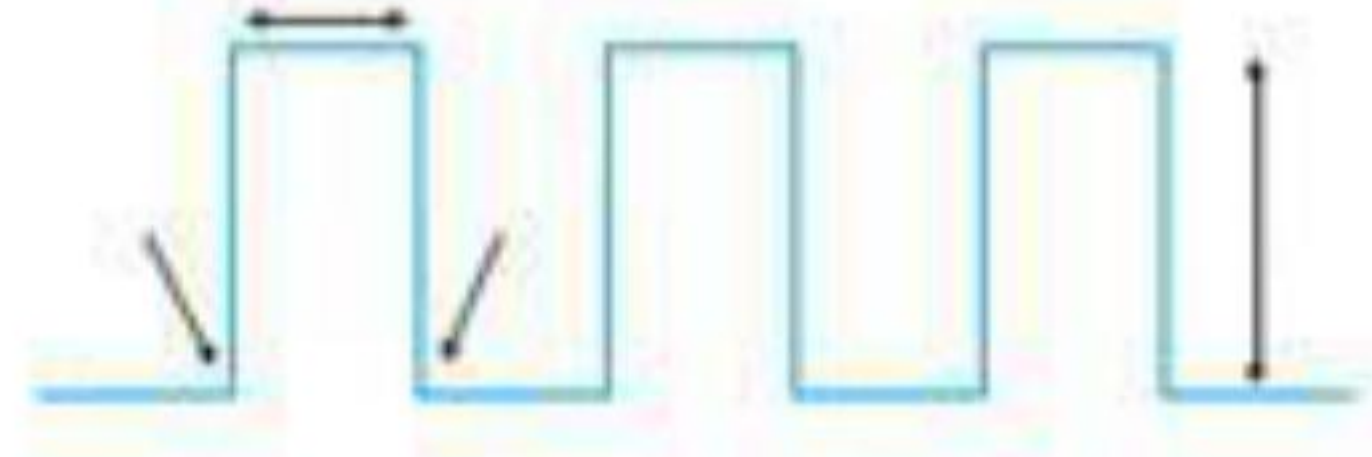
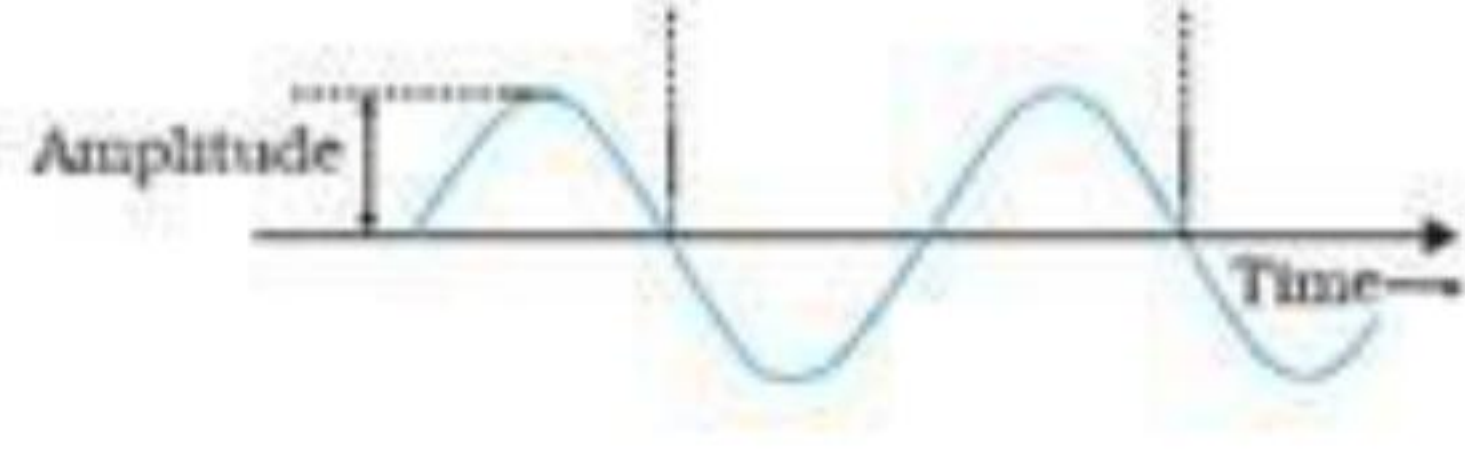
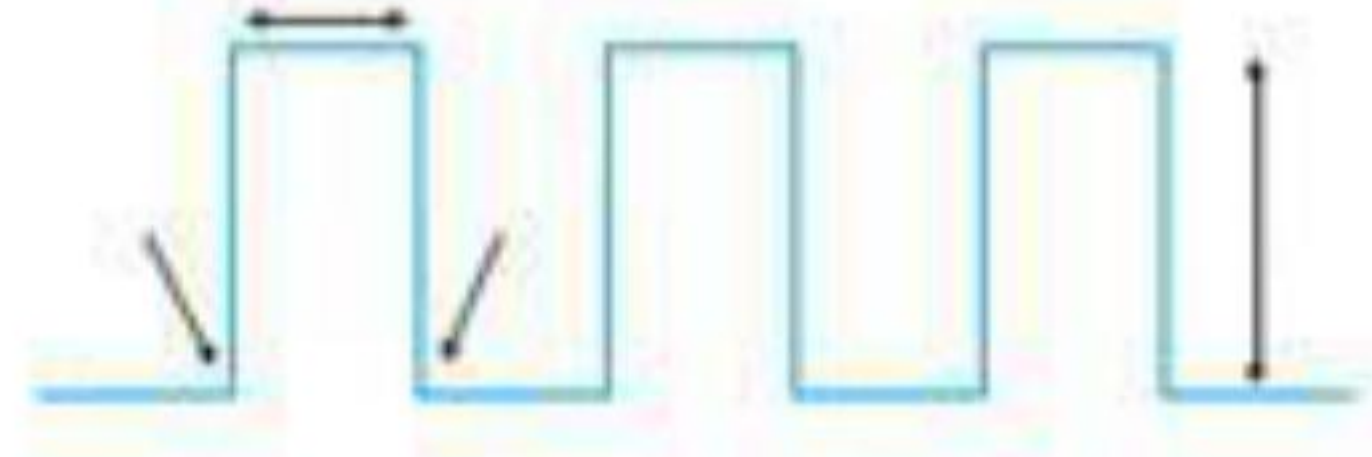




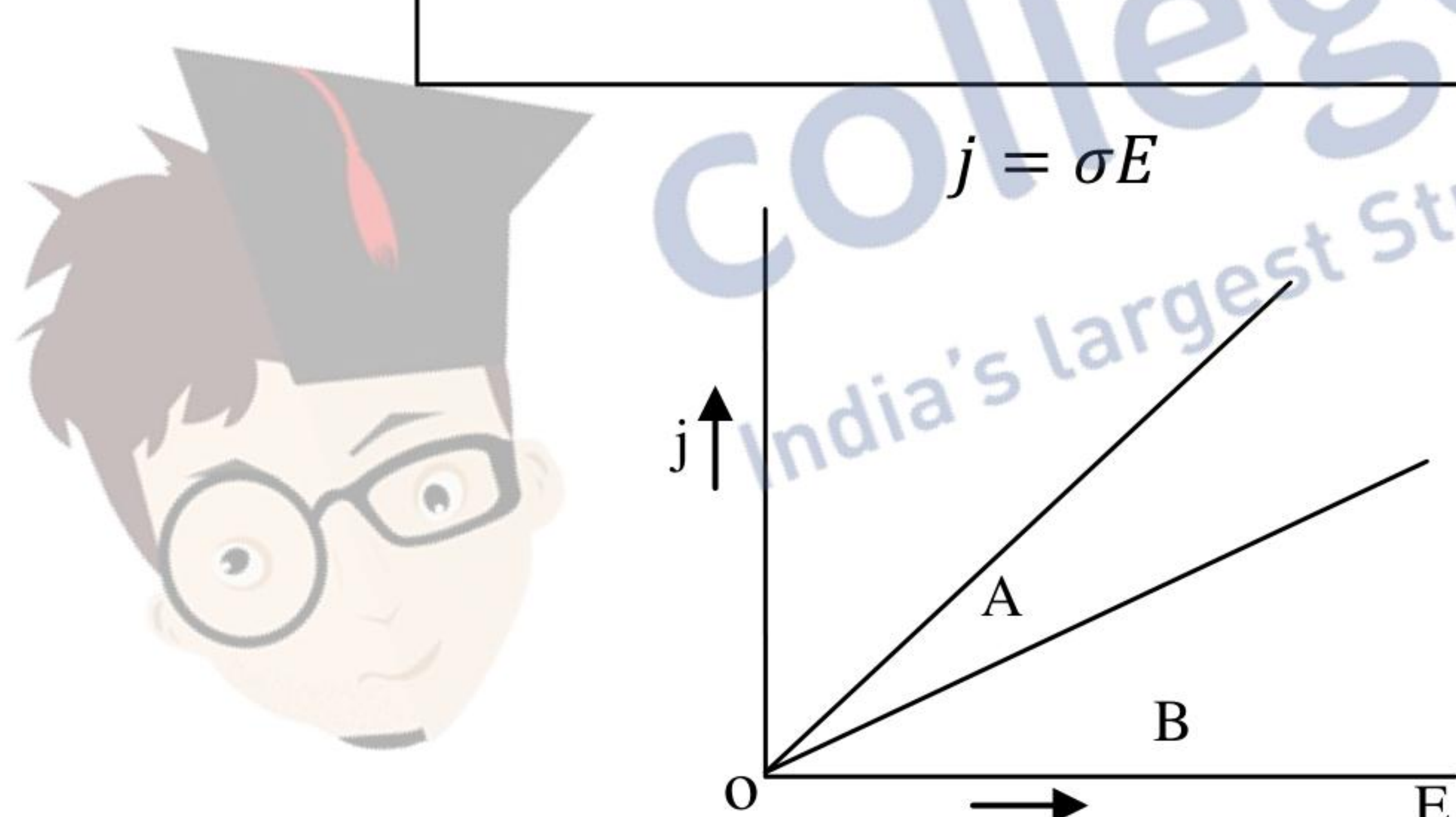
Set-1, Q8 Set-2, Q6 Set-3, Q9	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">             Kirchhoff's laws <span style="float: right;">1/2+1/2</span>              To justify them <span style="float: right;">1/2+1/2</span> </div> <p>Kirchhoff's I Law: (JUNCTION LAW)            Sum of the incoming currents at a junction = Sum of outgoing currents</p> <p><b>[Alternatively]</b>            Algebraic sum of all the currents meeting at a junction in the electrical circuit is zero] <span style="float: right;">1/2</span></p> <p>2<sup>nd</sup> Law : ( LOOP LAW)            The algebraic sum of the changes in potential around any closed loop involving resistors and cells in the loop is zero <span style="float: right;">1/2</span></p> <p><b>[Alternatively]</b>            In any closed electrical part of circuit, sum of the e.m.f s is equal to sum of products of various currents and resistances through which currents pass.]</p> <p>To justify <span style="float: right;">1/2</span>            First law is based on the law of conservation of charge.</p> <p>Second Law is based on the law of conservation of energy. <span style="float: right;">1/2</span></p>		2
Set-1, Q9 Set-2, Q8 Set-3, Q7	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">             Formula for de Broglie wavelength – 1              Calculation and result – 1           </div> <p>Formula used <math>\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mE}}</math></p> $\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{E_2}{E_1}}$ <p>since <math>E_n \propto \frac{1}{n^2}</math></p> <p>For <math>n = 2</math> <math>E_2 = \frac{E_1}{4}</math></p> $\therefore \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{1}{4}} = \frac{1}{2}$ <p>[ Award 1/2 mark if the student only writes <math>\lambda = \frac{h}{mv}</math>]</p> <p>Also accept any other correct alternative answer.</p>	1  1/2  1/2	2
Set-1, Q10 Set-2, Q9 Set-3, Q6	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">             (a) Difference between Analog and Digital signal <span style="float: right;">1</span>              (b) Any two uses of internet <span style="float: right;">1</span> </div>		





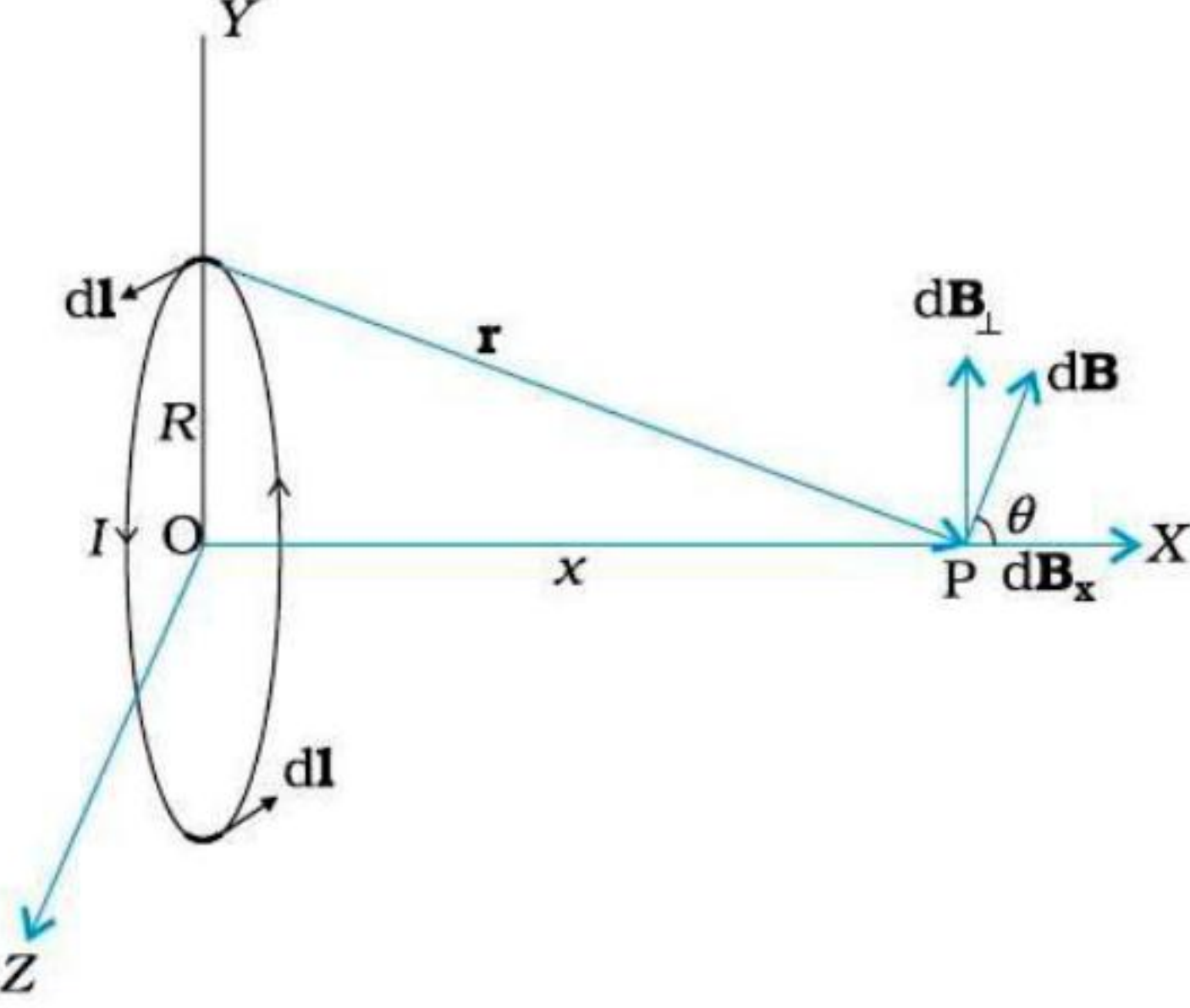
(a)	<table border="1"> <tr> <th>Analog signal (Any one of the two)</th> <th>Digital Signal (Any one of the two)</th> </tr> <tr> <td>It is single valued function of time or varies continuously with time</td> <td>These signals take only discrete set of values i.e. 0 or 1</td> </tr> <tr> <td>alternatively</td> <td>alternatively</td> </tr> <tr> <td></td> <td></td> </tr> </table>	Analog signal (Any one of the two)	Digital Signal (Any one of the two)	It is single valued function of time or varies continuously with time	These signals take only discrete set of values i.e. 0 or 1	alternatively	alternatively			1	2
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It is single valued function of time or varies continuously with time	These signals take only discrete set of values i.e. 0 or 1										
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(b) Uses of Internet : Any two ( E mail, E- banking, chatting, file transfer, e-shopping, e-ticketing, surfing etc)	$\frac{1}{2} + \frac{1}{2}$										

### Section - C

Set-1, Q11 Set-2, Q20 Set-3, Q15	<table border="1"> <tr> <td>Formula</td> <td><math>\frac{1}{2}</math></td> </tr> <tr> <td>Graph</td> <td>1</td> </tr> <tr> <td>Information from the graph</td> <td></td> </tr> <tr> <td>Selecting the materials</td> <td>1</td> </tr> <tr> <td>Explanation for large current</td> <td><math>\frac{1}{2}</math></td> </tr> </table>	Formula	$\frac{1}{2}$	Graph	1	Information from the graph		Selecting the materials	1	Explanation for large current	$\frac{1}{2}$		
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Explanation for large current	$\frac{1}{2}$												
		$\frac{1}{2}$											
	<p>Slope of the graph= conductivity (<math>\sigma</math>)</p> <p>Material with less slope (smaller conductivity) is used for making standard resistances and material with greater slope (higher conductivity) for making connecting wires</p> <p>We have <math>I = nAev_d</math></p> <p>Although <math>v_d</math> is small but n (electron number density) is very large. Hence the current can be large.</p>	$\frac{1}{2}$											
		$\frac{1}{2}$	3										
Set-1, Q12 Set-2, Q21 Set-3, Q16	<table border="1"> <tr> <td>Statement</td> <td><math>\frac{1}{2}</math> mark</td> </tr> <tr> <td>Derivation of magnetic field on axis</td> <td>2 marks</td> </tr> <tr> <td>Magnetic field at centre</td> <td><math>\frac{1}{2}</math> mark</td> </tr> </table>	Statement	$\frac{1}{2}$ mark	Derivation of magnetic field on axis	2 marks	Magnetic field at centre	$\frac{1}{2}$ mark						
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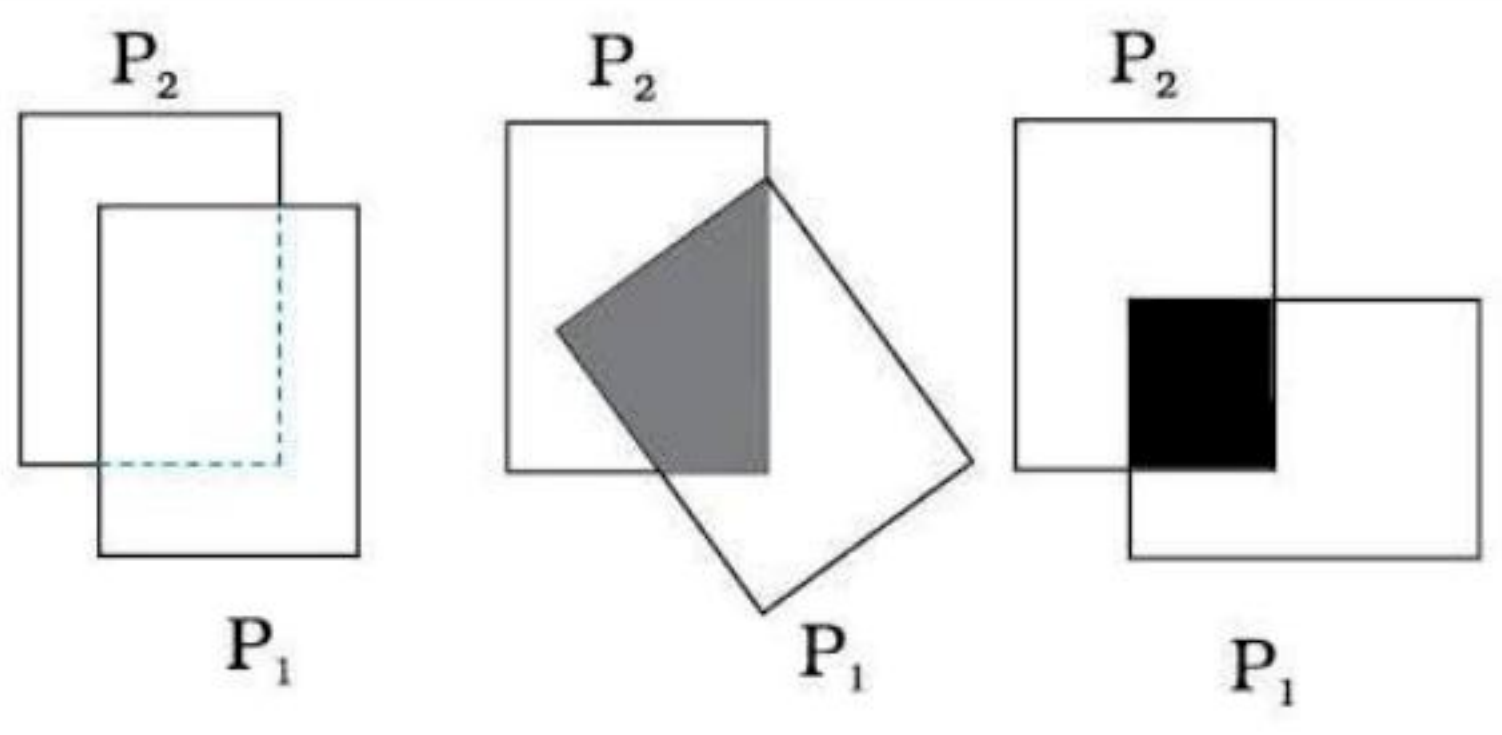
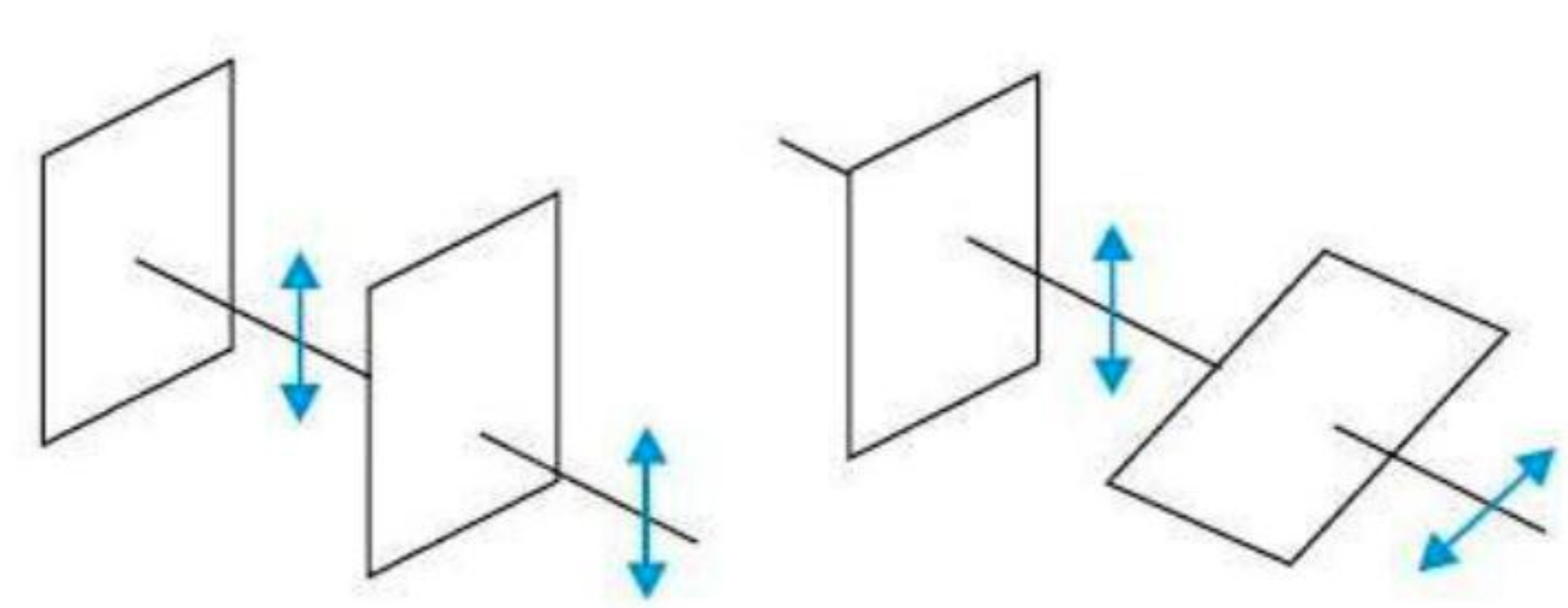
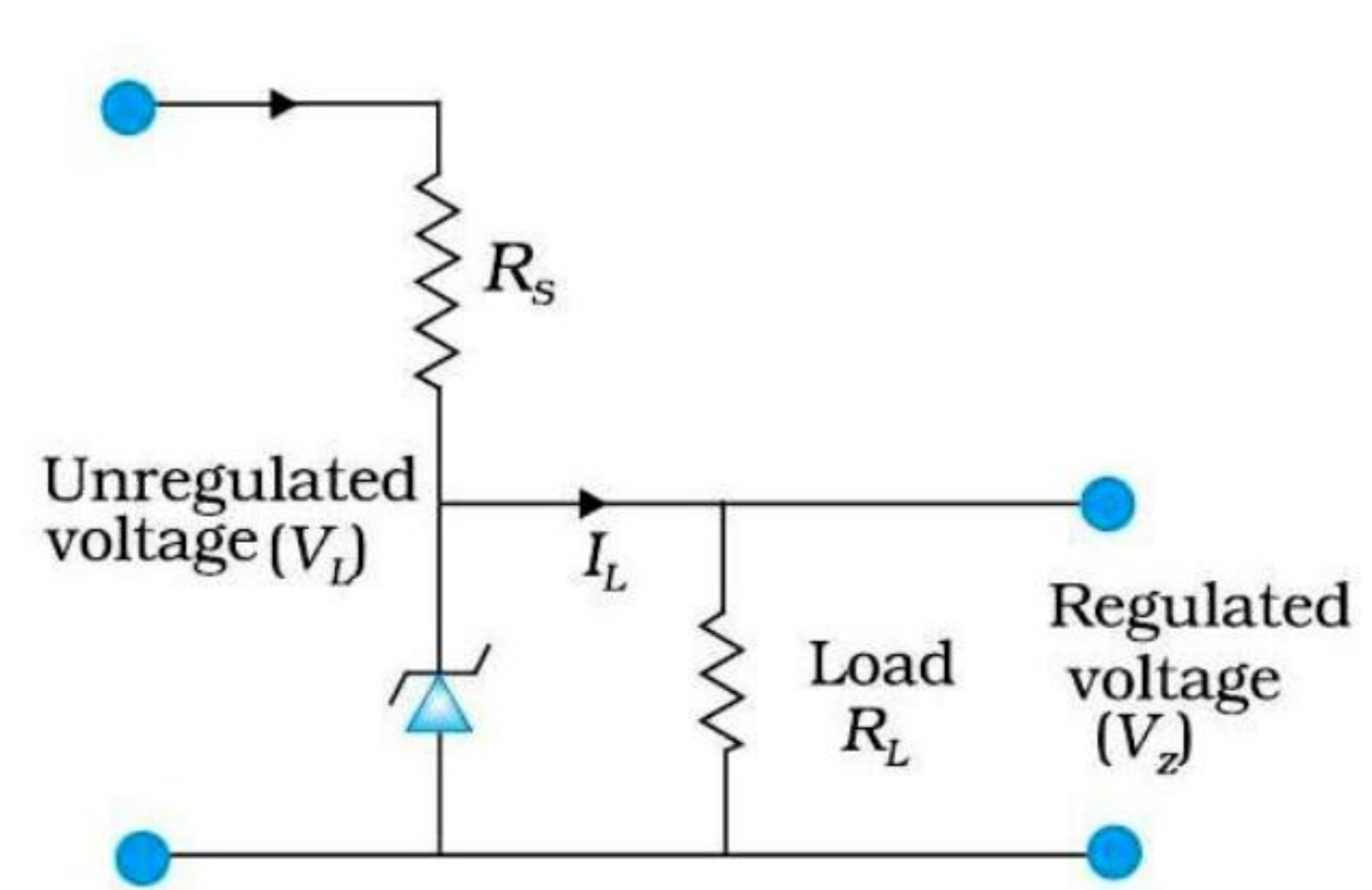




	<p>Biot Savart's law</p> $\vec{dB} \propto I \frac{d\vec{l} \times \vec{r}}{r^3}$ $\text{Or } \vec{dB} = \frac{\mu_0}{4\pi} I \frac{d\vec{l} \times \vec{r}}{r^2}$ <p>[Also accept if the student writes <math>dB \propto I, dB \propto dl</math> and <math>dB \propto \frac{1}{r^2}</math>]</p>  <p>Derivation The resultant magnetic field will be along the axis as the perpendicular (to the axis) components cancel out in pairs.</p> $B = \int_0^{2\pi R} dB \cos \theta$ $= \int_0^{2\pi R} \frac{\mu_0}{4\pi} \frac{I dl}{(R^2+x^2)^{3/2}} \frac{R}{(R^2+x^2)^{1/2}}$ $= \frac{\mu_0 I}{4\pi} \frac{2\pi R^2}{(R^2+x^2)^{3/2}} = \frac{\mu_0 I R^2}{2(R^2+x^2)^{3/2}}$ <p>At centre, <math>x=0</math>  <math>\therefore B_0 = \frac{\mu_0 I}{2R}</math></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>3</p>						
<p>Set-1, Q13 Set-2, Q22 Set-3, Q17</p>	<table border="1" data-bbox="369 2125 1497 2300"> <tr> <td>Polaroid</td> <td>1</td> </tr> <tr> <td>Transverse nature of light</td> <td>1</td> </tr> <tr> <td>Required Explanation</td> <td>1</td> </tr> </table> <p>Polaroid consists of long chain molecules aligned in a particular direction Transverse nature of light.</p>	Polaroid	1	Transverse nature of light	1	Required Explanation	1	<p>1</p>	
Polaroid	1								
Transverse nature of light	1								
Required Explanation	1								





	 <p><b>Alternatively</b></p>  <p><b>Explanation:</b> Unpolarised light incident on a polaroid, gets linearly polarized with electric vector oscillating along the pass axis of Polaroid. It will pass out with same intensity from P<sub>2</sub>, if pass axis of P<sub>2</sub> is parallel to that of P<sub>1</sub>. On rotating P<sub>2</sub> intensity of light reduces to zero when their pass axes are perpendicular to each other showing transverse nature of light.</p> <p><b>Explanation for intensity of light</b> Unpolarised light incident on a Polaroid, gets polarized and its intensity is reduced to half and it does not depend on the orientation of the Polaroid.</p>	1/2									
Set-1, Q14 Set-2, Q16 Set-3, Q18	<table border="1" data-bbox="378 1469 1501 1706"> <tr> <td>Fabrication of Zener Diode</td> <td>1/2</td> </tr> <tr> <td>Cause of high Electric field</td> <td>1/2</td> </tr> <tr> <td>Diagram for Zener Diode as Voltage Regulator</td> <td>1</td> </tr> <tr> <td>Working</td> <td>1</td> </tr> </table> <p>Zener diode is fabricated by heavy doping of its p and n sections. Since doping is high, depletion layer becomes very thin. Hence, electric field (<math>= \frac{V}{d}</math>) becomes high even for a small reverse bias.</p>  <p><b>Working :</b> If input voltage increases/ decreases, current through Zener diode will also increase/ decreases. It increases/ decreases voltage drop across R<sub>s</sub> without any change in voltage across R<sub>L</sub> as potential across Zener diode does not change in</p>	Fabrication of Zener Diode	1/2	Cause of high Electric field	1/2	Diagram for Zener Diode as Voltage Regulator	1	Working	1	1/2 1/2 1 1	3 3
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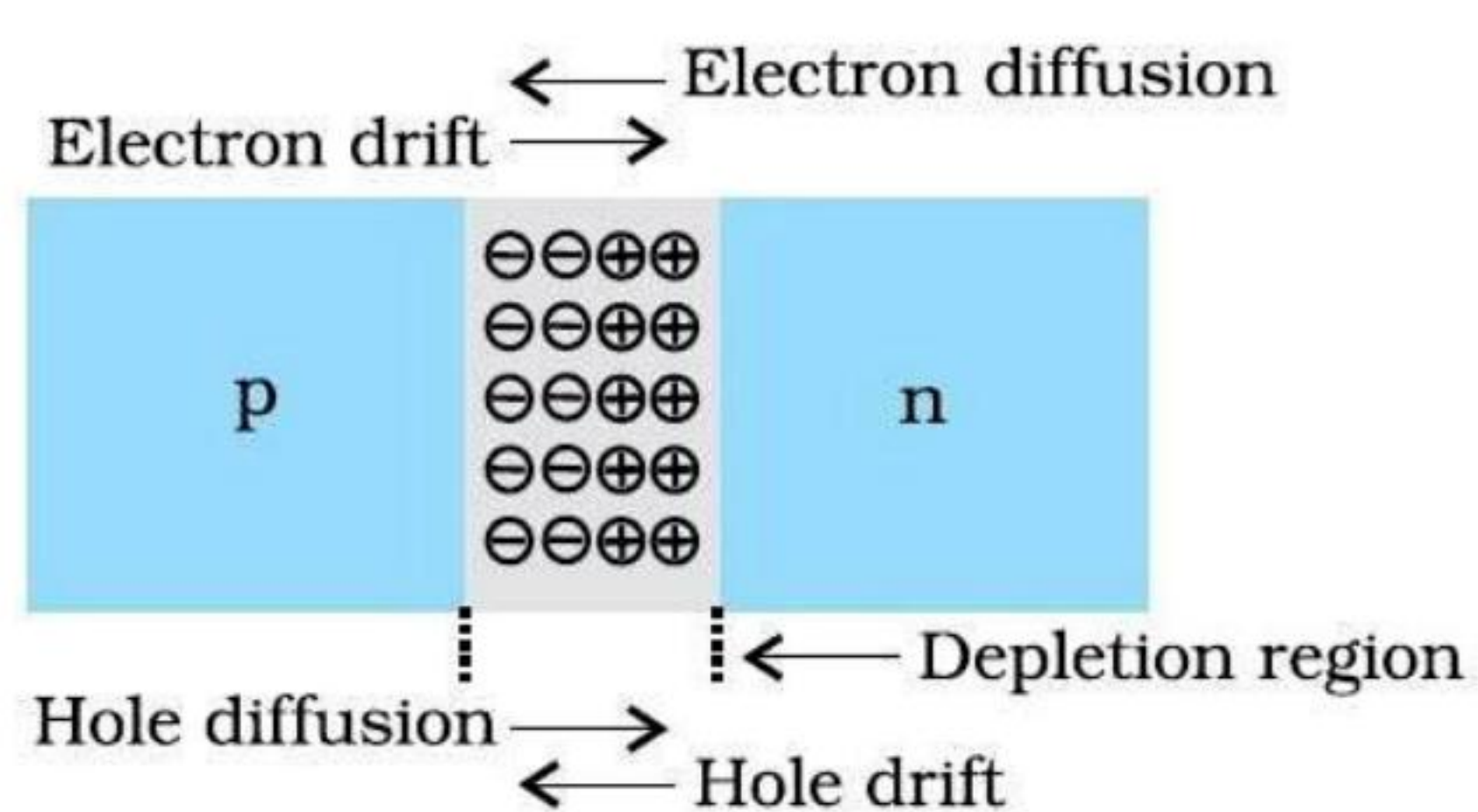


breakdown region giving the regulated output voltage.

**OR**

(a) Diagram	1/2
Formation of depletion region	1
Potential barrier	1/2
b) Effect on barrier potential	1

a)



Explanation

Due to concentration gradient across p and n sides, holes from p diffuse into n section and leave behind ionized acceptor (negatively) ions which are immobile. As holes continue to diffuse from p to n, a layer of negative charge on p-side of junction is formed. Similarly, the diffusion of electrons from n to p will form a positive charge space region on the n side.

The space charge region on either side of the junction which gets devoid of mobile charge carrier is known as the **depletion layer**.

The loss of electrons from n side and holes from p side cause a potential difference across the junction. This is known as the called barrier potential .

b) Barrier potential decreases in forward bias .

Barrier potential increases in reverse bias.

Set-1, Q15  
Set-2, Q17  
Set-3, Q11

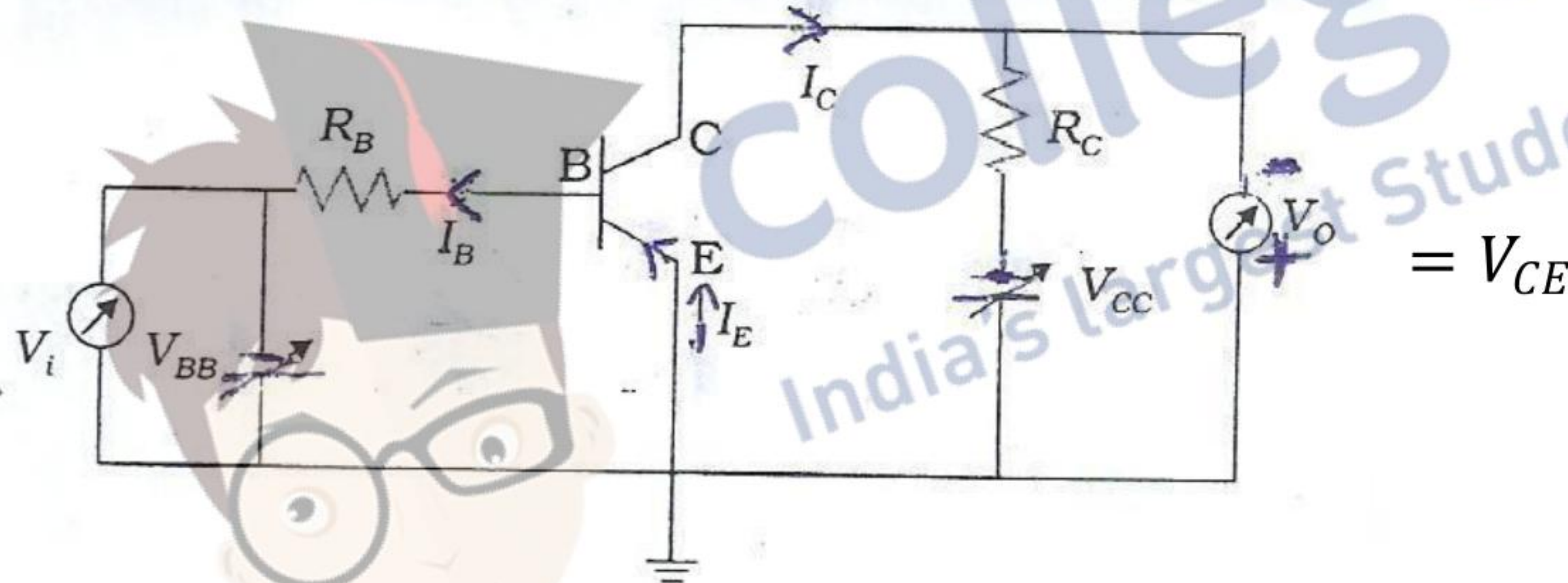
Effect in each case	1 1/2
Justification in each case	1 1/2

i) Anode current will increase with increase of intensity  
More is intensity of light, more is the number of photons and hence more number of electrons are emitted

ii) No effect

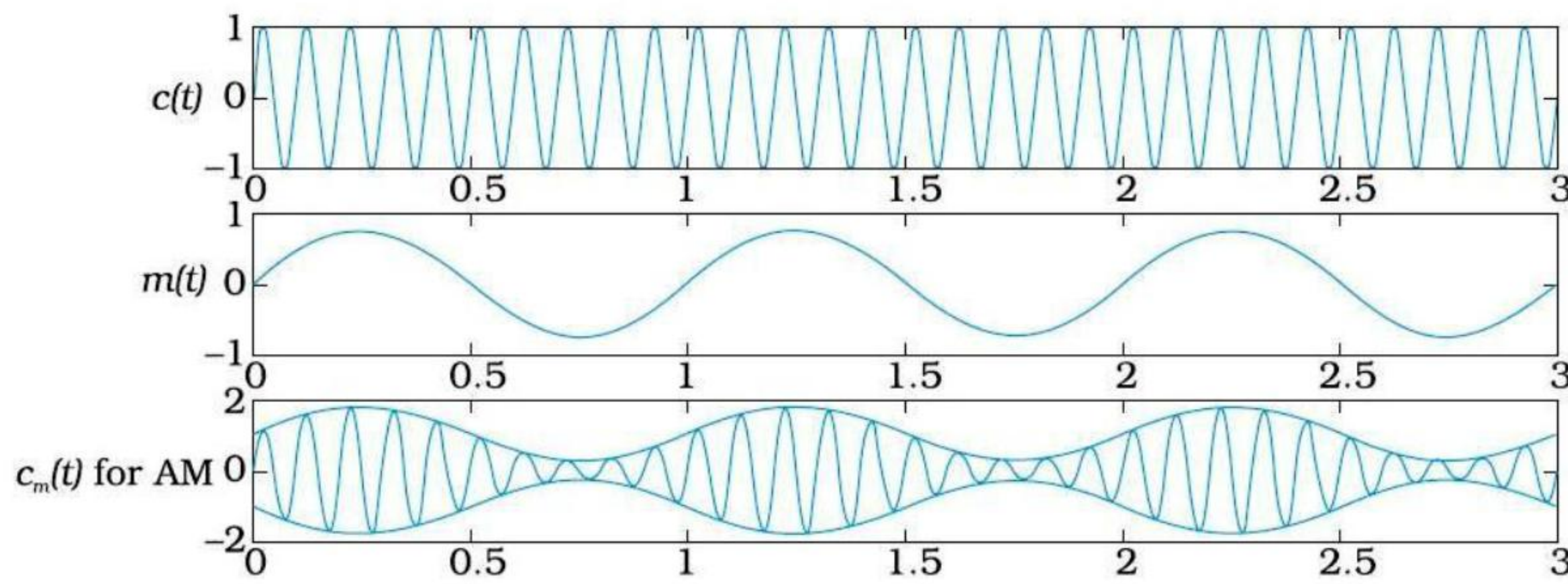
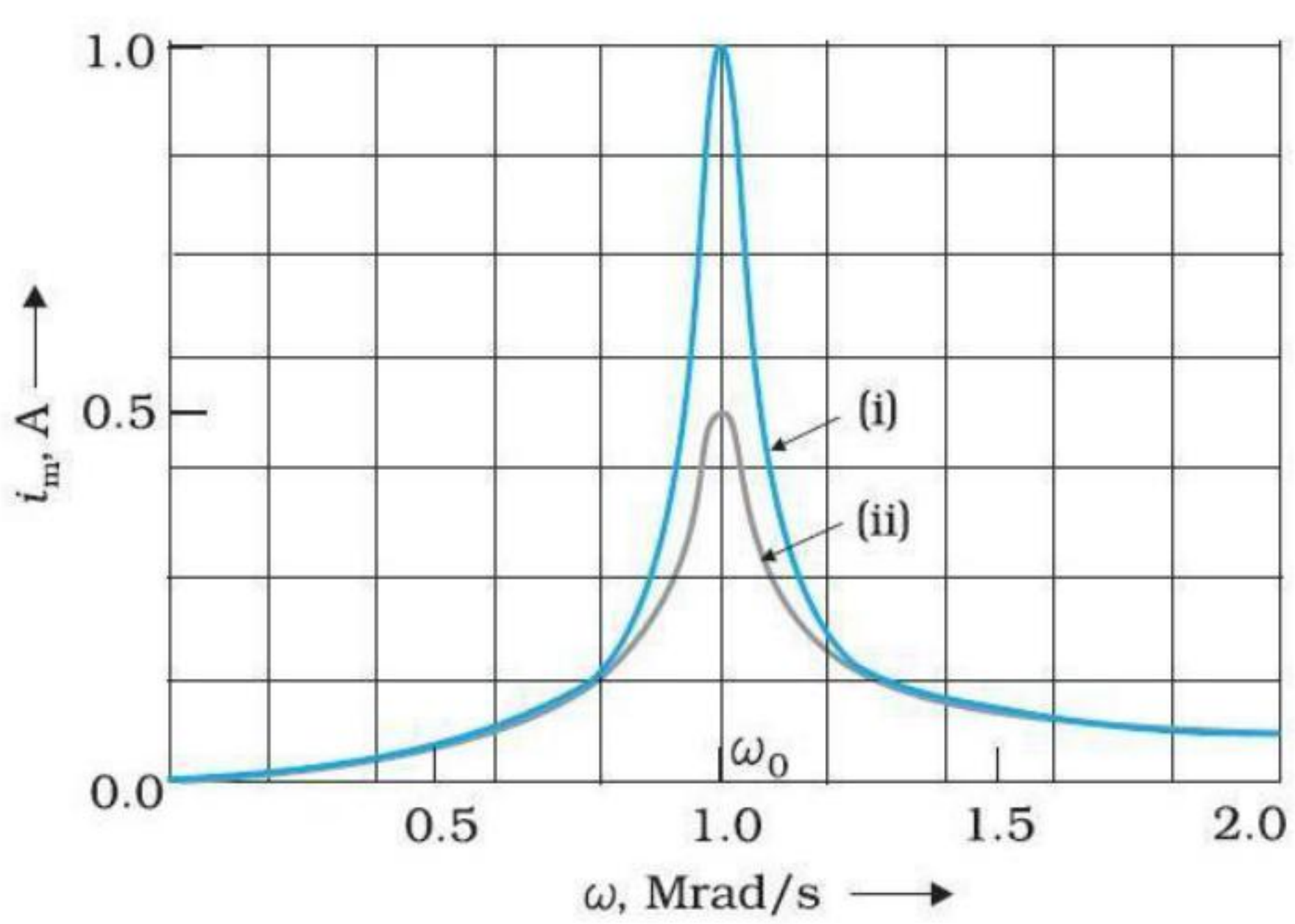




	<p>Frequency of light affects the maximum K.E. of the emitted photoelectrons.</p> <p>iii) Anode current will increase with anode potential More anode potential will accelerate the electrons more till it attains a saturation value and get them collected at the anode at a faster rate.</p>	<p>1/2</p> <p>1/2</p> <p>1/2</p>	3								
<p>Set-1, Q16 Set-2, Q18 Set-3, Q12</p>	<table border="1"> <tr> <td>Active state</td> <td>1/2</td> </tr> <tr> <td>Circuit diagram</td> <td>1</td> </tr> <tr> <td>Working</td> <td>1/2</td> </tr> <tr> <td>Reasons in each case</td> <td>1</td> </tr> </table> <p><u>Active State :</u></p> <p>When the emitter base junction is forward biased and the base collector junction is reverse biased with <math>V_i &gt; 0.6V</math> or <math>V_i &gt; 0.3V</math>. (Also accept any other correct answer)</p> <p><u>Diagram :</u></p>  <p><u>Explanation :</u></p> <p>If <math>V_i</math> is +ve or -ve, changes in <math>V_{BE}</math> will produce changes in <math>I_c</math> and hence changes in <math>V_{CE}</math> which will appear in amplified form</p> <p><u>Base</u> is thin so that there are few majority carriers in it.</p> <p><u>Emitter</u> is heavily doped so that it supplies more number of majority charge carriers. (Note: Award 1 mark if the student writes the reason for any one case)</p>	Active state	1/2	Circuit diagram	1	Working	1/2	Reasons in each case	1	<p>1/2</p> <p>1</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	3
Active state	1/2										
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<p>Set-1, Q17 Set-2, Q19 Set-3, Q13</p>	<table border="1"> <tr> <td>Factors for need of modulation</td> <td>1 1/2</td> </tr> <tr> <td>Sketch of carrier wave, modulating wave and AM wave</td> <td>1 1/2</td> </tr> </table> <p><u>Need of Modulation:</u></p> <p>1. To have smaller height of antenna <math>[h \sim \frac{\lambda}{4}]</math></p>	Factors for need of modulation	1 1/2	Sketch of carrier wave, modulating wave and AM wave	1 1/2	<p>1/2</p>					
Factors for need of modulation	1 1/2										
Sketch of carrier wave, modulating wave and AM wave	1 1/2										





	<p>2. So that more power is radiated by the antenna, <math>P \propto \frac{1}{\lambda^2}</math></p> <p>3. To avoid mixing up of signals from different transmissions.</p> 	<p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>3</p>	
<p>Set-1, Q18 Set-2, Q11 Set-3, Q14</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Identification of circuit elements                      1 1/2</p> <p>Impedance value    1/2</p> <p>Plot of circuit vs frequency                              1/2</p> <p>Significance of plot                                        1/2</p> </div> <p>Identification of elements</p> <p>X- Resistor    1/2</p> <p>Y- Inductor    1/2</p> <p>Z- Capacitor    1/2</p> <p>Impedence <math>Z=R</math> Since <math>X_L = X_C</math></p> <p>(Also accept if the student writes <math>Z = \sqrt{R^2 + (X_L - X_C)^2} = R</math>)    1/2</p> <p>Plot of current vs frequency</p>  <p>(Only one curve is expected)</p> <p>Significance, at <math>w = \omega_o</math> (resonance frequency) current is maximum</p> <p>(Alternatively: Gives information about sharpness of resonance or quality factor of the circuit)    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>3</p>	





Set-1, Q19 Set-2, Q12 Set-3, Q21	<table border="1"> <tbody> <tr> <td>Equation of <math>\beta^+</math> decay</td> <td>1</td> </tr> <tr> <td>Identification</td> <td><math>\frac{1}{2}</math></td> </tr> <tr> <td>Calculation of mass defect</td> <td><math>\frac{1}{2}</math></td> </tr> <tr> <td>Calculation of Q value</td> <td>1</td> </tr> </tbody> </table>	Equation of $\beta^+$ decay	1	Identification	$\frac{1}{2}$	Calculation of mass defect	$\frac{1}{2}$	Calculation of Q value	1	1	3
Equation of $\beta^+$ decay	1										
Identification	$\frac{1}{2}$										
Calculation of mass defect	$\frac{1}{2}$										
Calculation of Q value	1										
	Equation ${}^{11}_6C \rightarrow {}^{11}_5X + e^+ + \nu + Q$										
	(Also accept if the student does not write $\nu$ or $Q$ on the R.H.S.)										
	X is an isobar	$\frac{1}{2}$									
	Mass defect ( $\Delta m$ ) = $m({}^{11}_6C) - m({}^{11}_5X)$	$\frac{1}{2}$									
	= (11.011434 – 11.009305)u										
	= 0.002129 u	$\frac{1}{2}$									
	Q= $\Delta m \times 931.5$ MeV										
	= 0.002129 $\times$ 931.5 MeV	$\frac{1}{2}$									
	= 1.98 MeV										
Set-1, Q20 Set-2, Q13 Set-3, Q22	<table border="1"> <tbody> <tr> <td>Calculation to find image formed by lens</td> <td><math>1\frac{1}{2}</math></td> </tr> <tr> <td>Nature of image</td> <td><math>\frac{1}{2}</math></td> </tr> <tr> <td>Distance of mirror from lens</td> <td>1</td> </tr> </tbody> </table>	Calculation to find image formed by lens	$1\frac{1}{2}$	Nature of image	$\frac{1}{2}$	Distance of mirror from lens	1	$\frac{1}{2}$	3		
Calculation to find image formed by lens	$1\frac{1}{2}$										
Nature of image	$\frac{1}{2}$										
Distance of mirror from lens	1										
	For lens $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$										
	$\frac{1}{v} - \frac{1}{-15} = \frac{1}{+10}$	$\frac{1}{2}$									
	$\frac{1}{v} + \frac{1}{15} = \frac{1}{10}$	$\frac{1}{2}$									
	$\therefore v = 30$ cm	$\frac{1}{2}$									
	Nature of image- real, magnified	$\frac{1}{2}$									
	Final image formed will be at the object itself only if image formed by lens is at the position of centre of curvature of mirror	$\frac{1}{2}$									
	$\therefore D = (30 + R)cm = (30 + 20)cm = 50$ cm	$\frac{1}{2}$									
	(Distance of mirror from lens)										





Set-1, Q21 Set-2, Q14 Set-3, Q19	<table border="1"> <tr> <td>Arranging in order</td> <td>1½</td> </tr> <tr> <td>Production of infrared waves</td> <td>½</td> </tr> <tr> <td>Role of infrared waves in Earth's warmth and physical therapy</td> <td>1</td> </tr> </table>	Arranging in order	1½	Production of infrared waves	½	Role of infrared waves in Earth's warmth and physical therapy	1				
Arranging in order	1½										
Production of infrared waves	½										
Role of infrared waves in Earth's warmth and physical therapy	1										
	Gamma( $\gamma$ ) rays, X-rays, Microwaves, Radiowaves	1½									
	Infrared rays are produced by hot bodies / vibration of atoms and molecules	½									
	Infrared rays: (i) Maintain Earth's warmth through green house effect	½									
	(ii) Produce heat	½	3								
Set-1, Q22 Set-2, Q15 Set-3, Q20	<table border="1"> <tr> <td>Process of charging capacitor</td> <td>1</td> </tr> <tr> <td>Effect of dielectric on</td> <td></td> </tr> <tr> <td>(i) Electric field and justification</td> <td>½+½</td> </tr> <tr> <td>(ii) Energy stored and justification</td> <td>½+½</td> </tr> </table>	Process of charging capacitor	1	Effect of dielectric on		(i) Electric field and justification	½+½	(ii) Energy stored and justification	½+½		
Process of charging capacitor	1										
Effect of dielectric on											
(i) Electric field and justification	½+½										
(ii) Energy stored and justification	½+½										
	<u>Process of charging</u>										
	The electrons, from the plate of the capacitor, which is connected to the positive terminal of the battery, move towards the battery. The reverse happens at the other plate. Hence, the plates get positively and negatively charged respectively.	½ ½									
	<u>Effect of dielectric</u>										
	(a) Electric fields decreases Justification	½									
	Because initially $E_1 = \frac{\sigma}{\epsilon_0}$ and finally $E_2 = \frac{1}{K} \cdot \frac{\sigma}{\epsilon_0}$ , $E = \frac{E_1}{K}$	½									
	(b) Energy stored increases	½									
	New capacitance $C = \left(\frac{\epsilon_0 A}{2d}\right) k$ $= \frac{K}{2} C_o, \quad \therefore C < C_o$	½	3								
	Initially Energy = $\frac{Q^2}{2C}$ and Energy = $\frac{Q^2}{C} \cdot \frac{2}{K}$ as $1 < K < 2$										
<b>Section – D</b>											
Set-1, Q23 Set-2, Q23 Set-3, Q23	<table border="1"> <tr> <td>Necessity</td> <td>1</td> </tr> <tr> <td>Explanation; low power factor implies large power loss?</td> <td>1</td> </tr> <tr> <td>Two values each displayed by Ajit and his uncle</td> <td>1+1</td> </tr> </table>	Necessity	1	Explanation; low power factor implies large power loss?	1	Two values each displayed by Ajit and his uncle	1+1				
Necessity	1										
Explanation; low power factor implies large power loss?	1										
Two values each displayed by Ajit and his uncle	1+1										





	<p>a) For the same power at high voltage, current in the transmission wires becomes smaller.  <math>\therefore</math> power loss is less</p> <p>[Award <math>\frac{1}{2}</math> mark if the student just writes <math>P = I^2R</math>]</p> <p>b) If power factor is less, current in the cables is more so power loss is more  [Alternately <math>P_{av} = E_v I_v \cos \theta</math></p> <p>If <math>\cos \theta</math> is less, <math>I_v</math> is more so power loss is more]  (Award <math>\frac{1}{2}</math> mark if the student just writes <math>P = E_E I_v \cos \theta</math>)</p> <p>c) Values displayed  By Ajit (Any two) – Social Awareness, understanding nature, concern for society  By Uncle- Knowledgeable, professional honesty, concern for society.  (Also accept other suitable values)</p>	<p><math>\frac{1}{2}</math> <math>\frac{1}{2}</math></p> <p>1</p> <p><math>\frac{1}{2} + \frac{1}{2}</math> <math>\frac{1}{2} + \frac{1}{2}</math></p>	4
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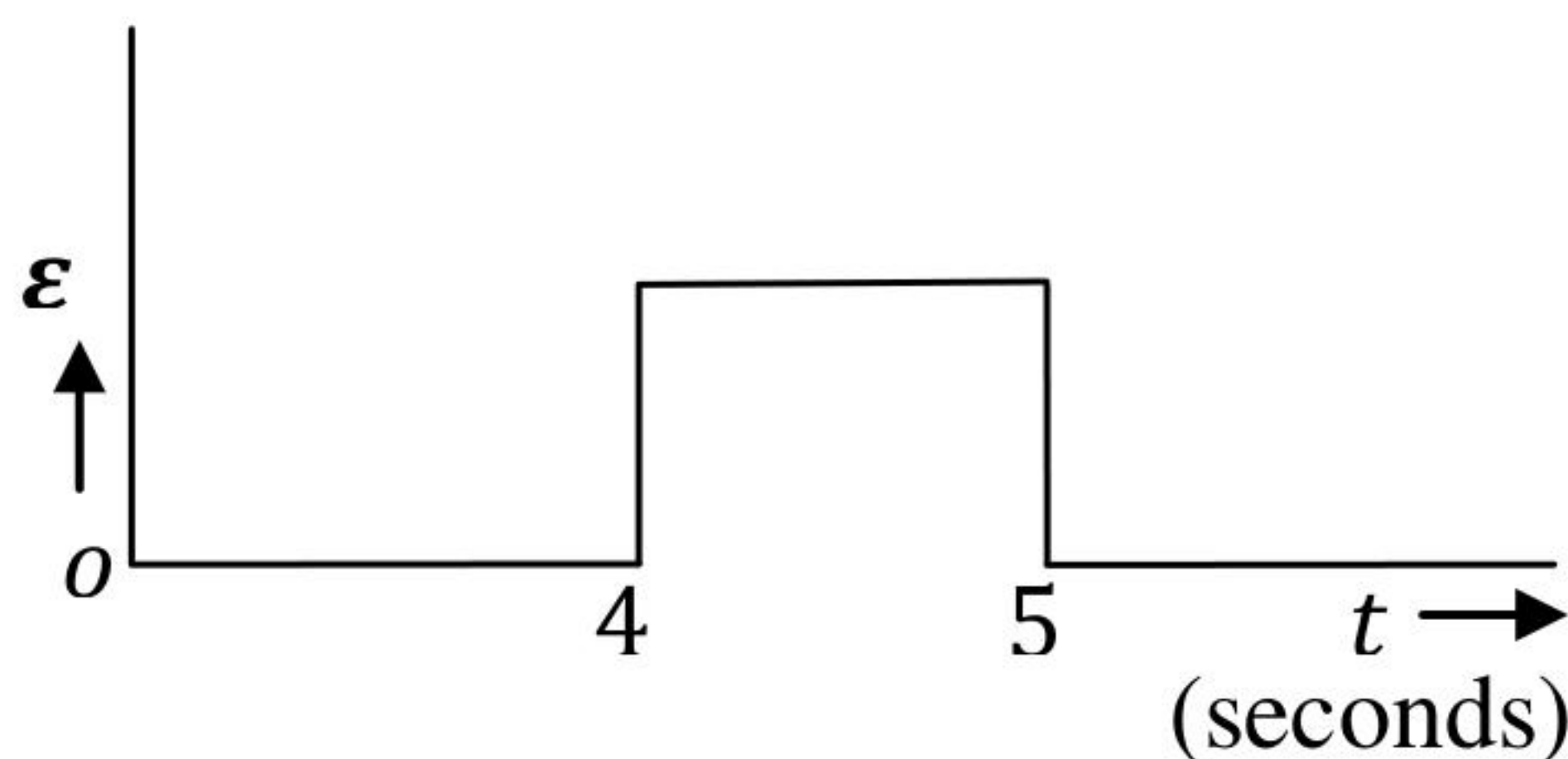
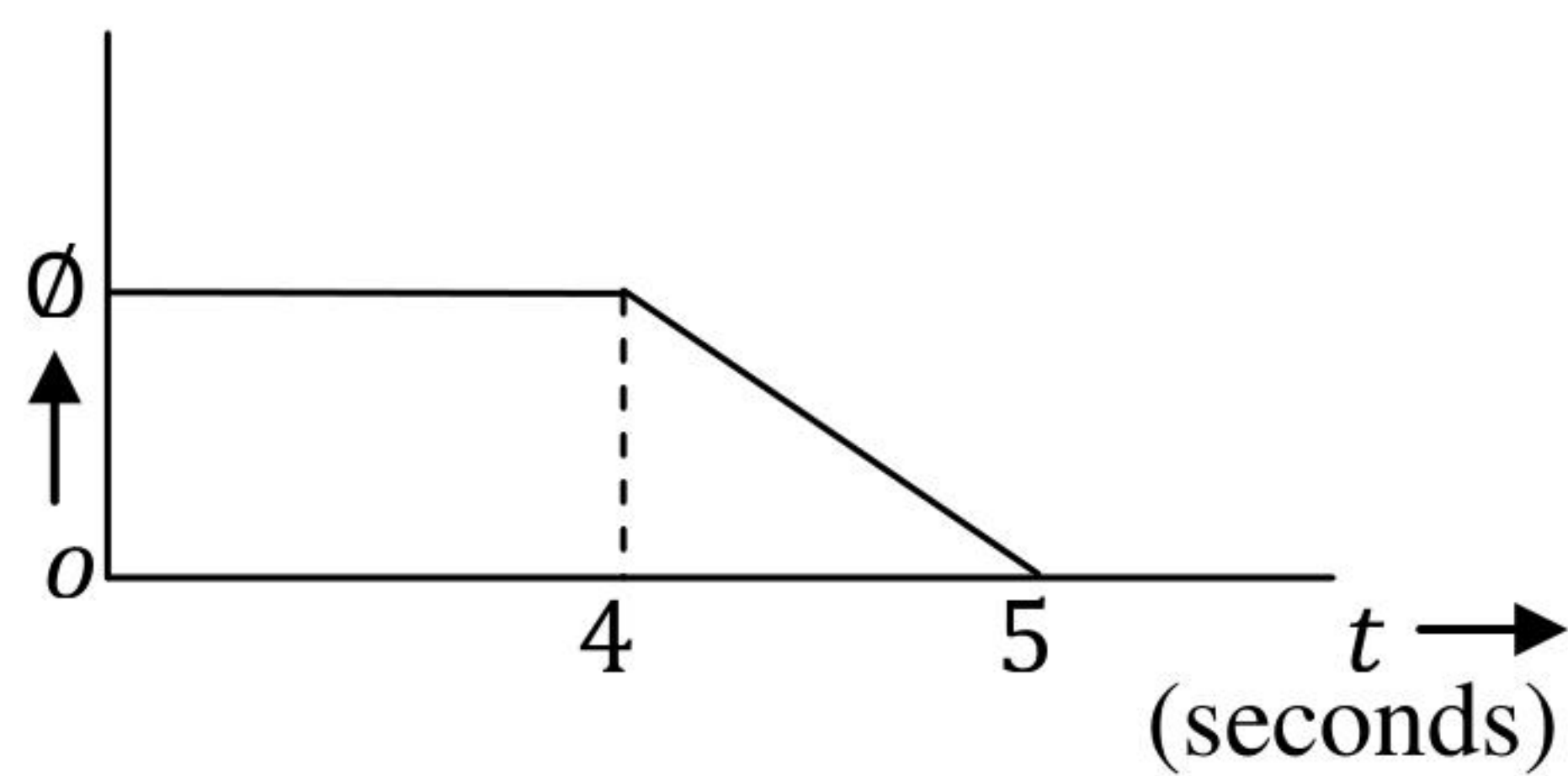
**Section - E**

<p>Set-1, Q24  Set-2, Q26  Set-3, Q25</p>	<table border="1"> <tr> <td>Definition of self-inductance</td> <td>1</td> </tr> <tr> <td>Expression for energy stored</td> <td>2</td> </tr> <tr> <td>Direction of induced current</td> <td><math>\frac{1}{2}</math></td> </tr> <tr> <td>Duration of induced current</td> <td><math>\frac{1}{2}</math></td> </tr> <tr> <td>Graphs of magnetic flux and induced e.m.f</td> <td>1</td> </tr> </table> <p>a) Self inductance of a coil is numerically equal to magnetic flux linked with the coil when unit current passes through it. <math>L = \frac{\phi}{I}</math></p> <p>Alternately  Self inductance of a coil is numerically equal to induced e.m.f. produced in it when rate of change of current is unity in it.</p> <p>Expression for energy  Induced e.m.f. produced in coil, <math>\varepsilon = -L \frac{dI}{dt}</math></p> <p><math>\therefore</math> work done by the source, <math>dw = +\varepsilon I dt = LI dI</math></p> $W = \int_0^I LI dI = \frac{1}{2} LI^2$ <p>b) Direction of induced current – clockwise (MNOP)  [A student can also show the direction in the diagram itself]</p> <p>Duration of induced current - 1s</p>	Definition of self-inductance	1	Expression for energy stored	2	Direction of induced current	$\frac{1}{2}$	Duration of induced current	$\frac{1}{2}$	Graphs of magnetic flux and induced e.m.f	1	<p>1 <math>\frac{1}{2}</math> <math>\frac{1}{2}</math> <math>\frac{1}{2} + \frac{1}{2}</math> <math>\frac{1}{2}</math> <math>\frac{1}{2}</math></p>	
Definition of self-inductance	1												
Expression for energy stored	2												
Direction of induced current	$\frac{1}{2}$												
Duration of induced current	$\frac{1}{2}$												
Graphs of magnetic flux and induced e.m.f	1												





Plot of graph



(Award this 1 mark even if the student draw the two graphs correctly without mentioning the values on the time axis)

OR

Plot of magnetic field lines

To show,  $\vec{m} = I\vec{A}$

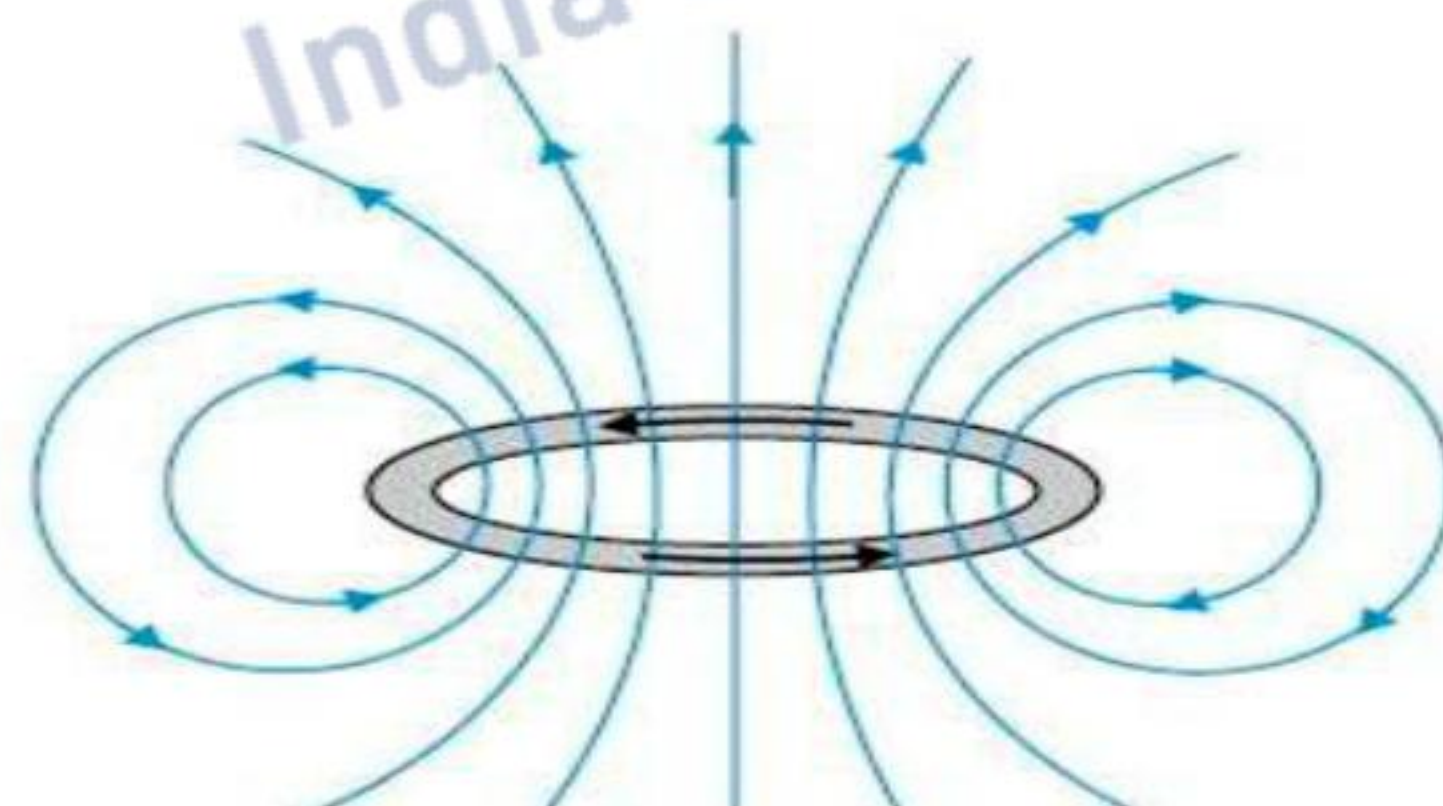
Expression for magnetic field due to finite solenoid and comparison with bar magnet

1

1

3

(a)



Magnetic field due to circular loop on its axis for far off points

$$B = \frac{\mu_0}{4\pi} \frac{2IA}{x^3}$$

Magnetic field due to bar magnet at an axial point

$$B = \frac{\mu_0}{4\pi} \frac{2m}{x^3}$$

By comparison  $m = IA$

[**Alternatively:** Students can also get this equality by comparing the torque values in the two cases]

1/2

1/2

5

1

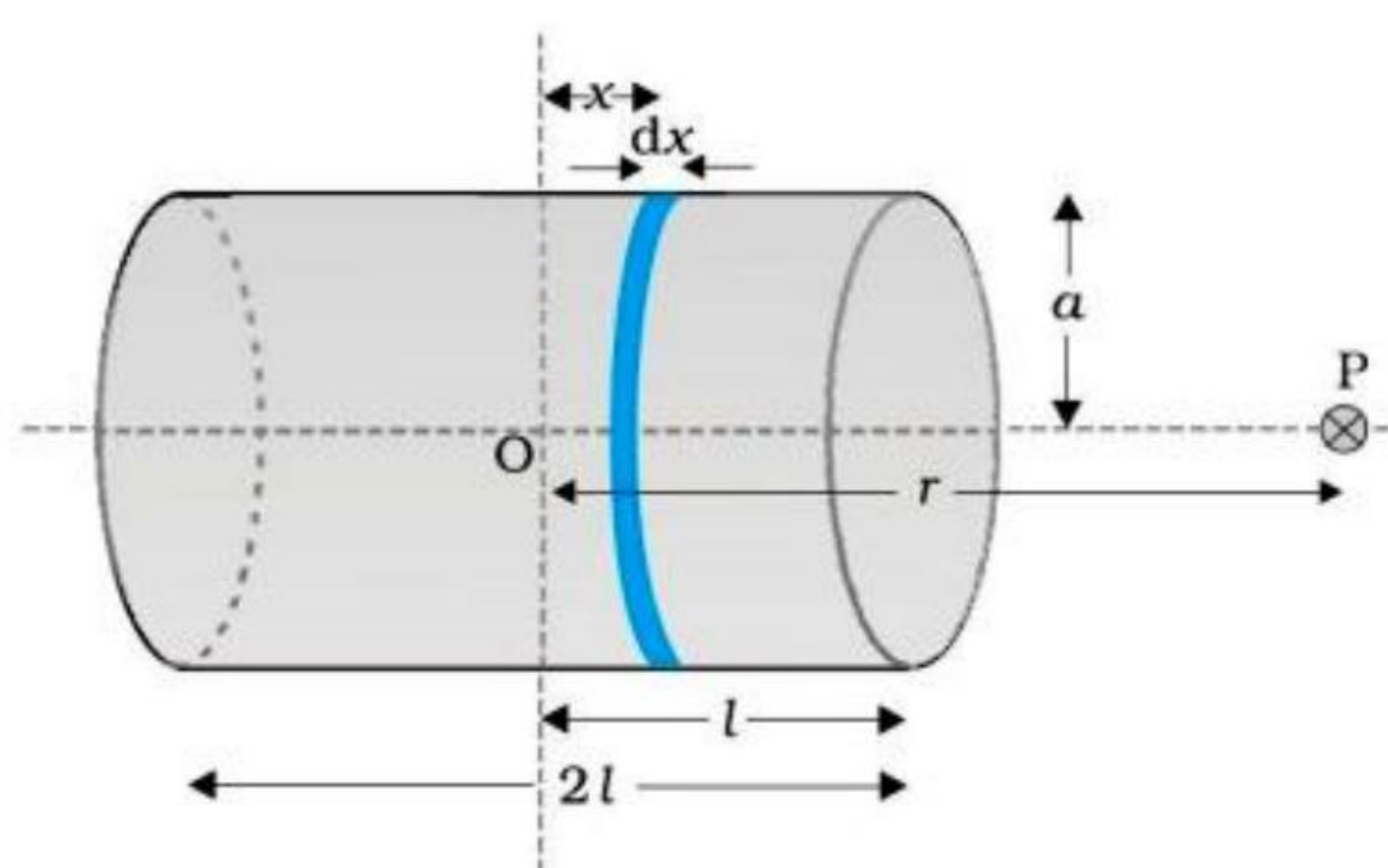
1/2

1/2





a) Magnetic field on the axis of a finite solenoid



Magnetic field due to element  $dx$  at point P

$$dB = \frac{\mu_0 n dx l a^2}{2[(r-x)^2 + a^2]^{3/2}}$$

$$\therefore B = \int dB = \frac{\mu_0 I a^2 \times n}{2} \int_{-l}^{+l} \frac{dx}{[(r-x)^2 + a^2]^{3/2}}$$

For  $r \gg a, (r \gg l)$

$$\therefore B = \frac{\mu_0 I a^2 n}{2 \times r^3} \int_{-l}^{+l} dx = \frac{\mu_0 n I}{2} \frac{2la^2}{r^3}$$

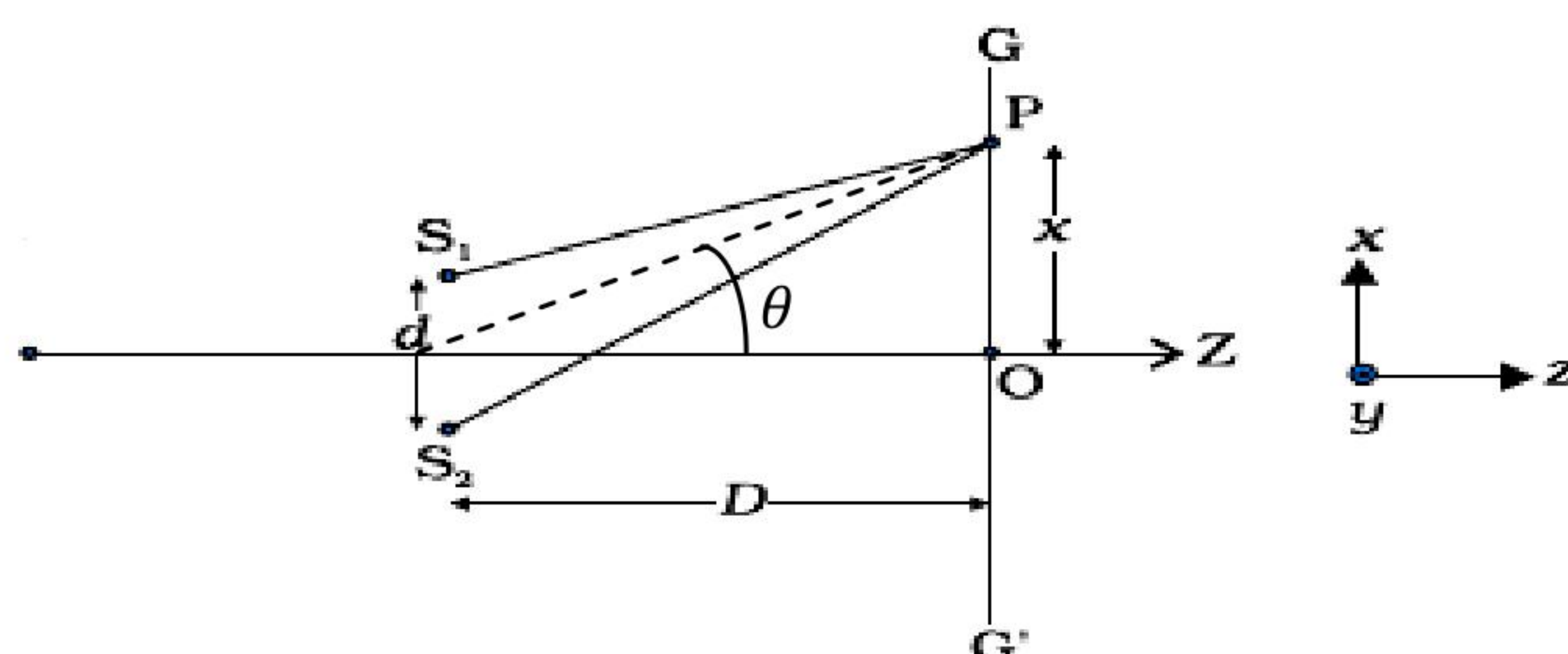
Magnetic moment of solenoid,  $m = (n \times 2l)I(\pi a^2)$

$\therefore B = \frac{\mu_0}{4\pi} \frac{2m}{r^3}$  same as that of a bar magnet

Set-1, Q25  
Set-2, Q24  
Set-3, Q26

Conditions for constructive and destructive interference	1½
Expression for fringe width	2
Fringe pattern in double slit related to diffraction pattern	½
Numerical	1

Diagram





(a) Path difference ( $\Delta$ ) =  $S_2P - S_1P = d \sin \theta = \frac{dx}{D}$   
 For constructive interference,  $\Delta = n\lambda$  [ $n = 0, 1, 2, \dots$ ]

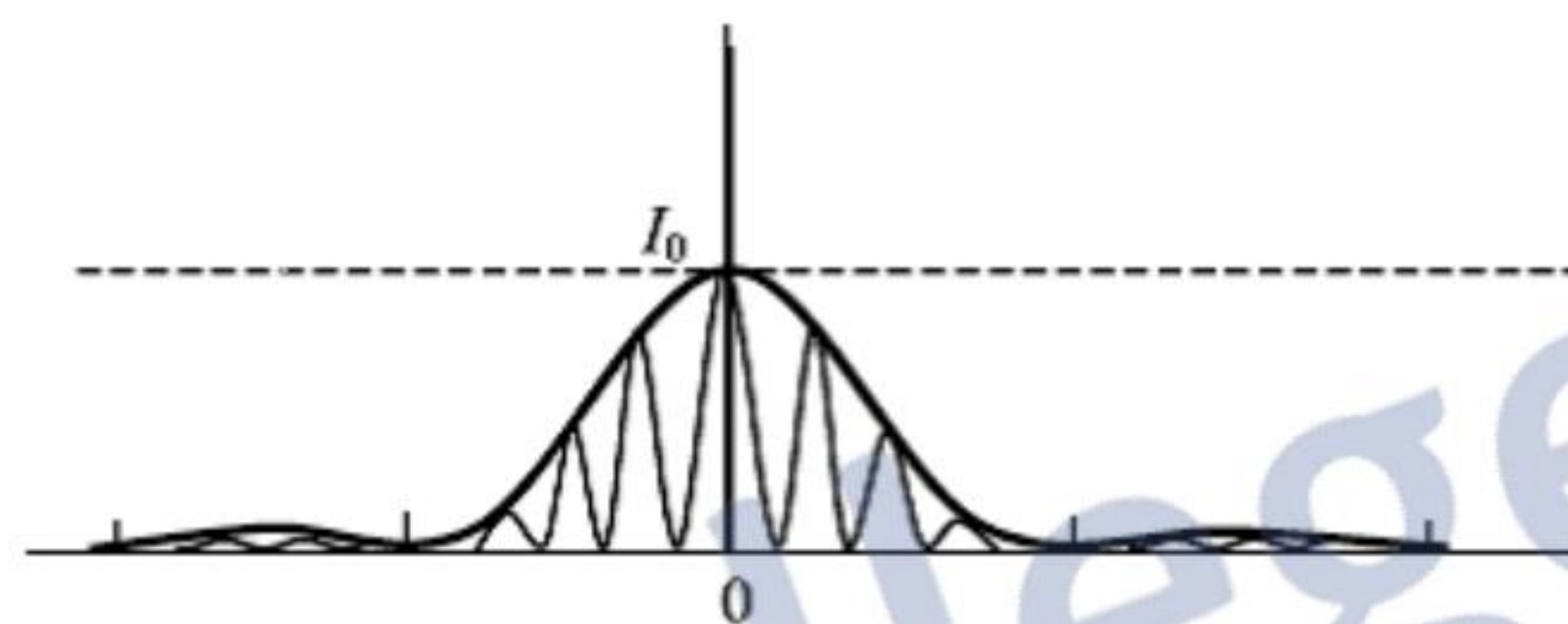
Destructive interference,  $\Delta = (2n - 1) \frac{\lambda}{2}$  [ $n = 1, 2, \dots$ ]

For bright bands,  $\Delta = n\lambda = \frac{x_n d}{D}$  or  $x_n = \frac{n\lambda D}{d}$

For dark bands,  $\Delta = (2n - 1) \frac{\lambda}{2} = \frac{x_n d}{D}$  or  $x_n = (2n - 1) \frac{\lambda D}{2d}$

Fringe width  $\beta = X_n - X_{n-1} = \frac{\lambda D}{d}$

b)



[Alternately

It is a broader diffraction peak in which there appears several fringes of smaller width due to double slit interference pattern]

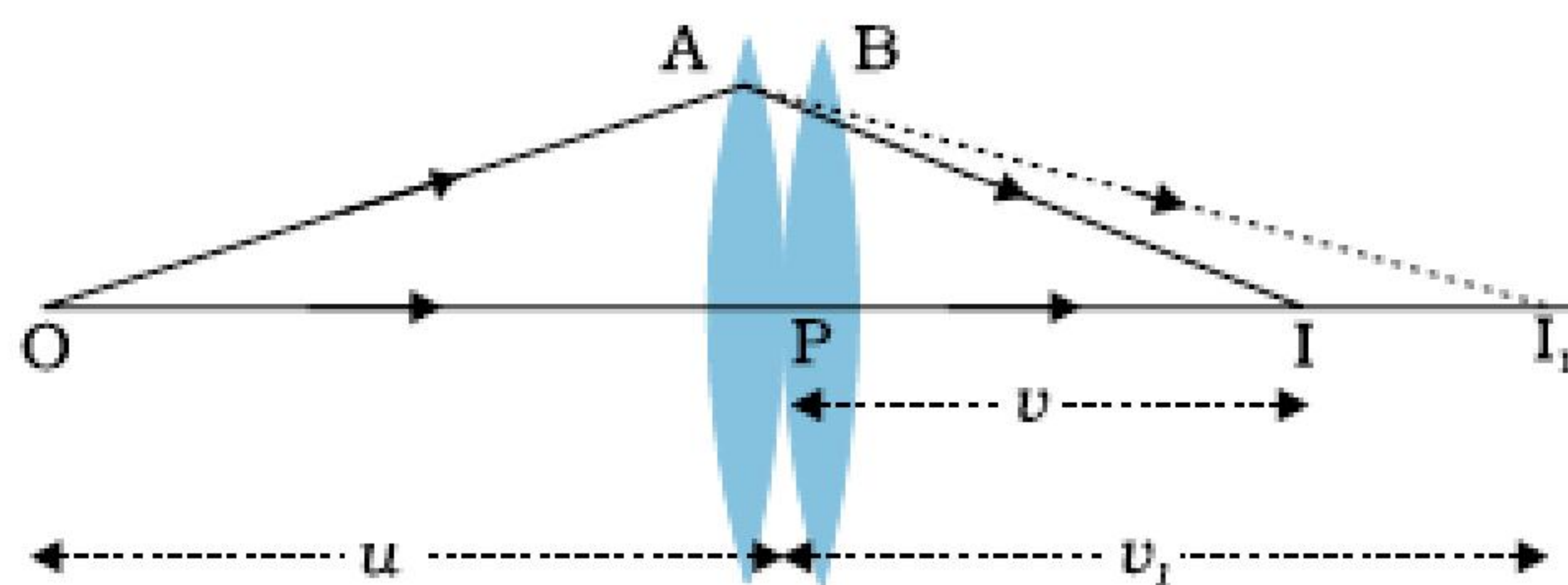
(c)  $10\beta =$  width of central maxima

$$10 \frac{D\lambda}{d} = 2 \frac{D\lambda}{a}$$

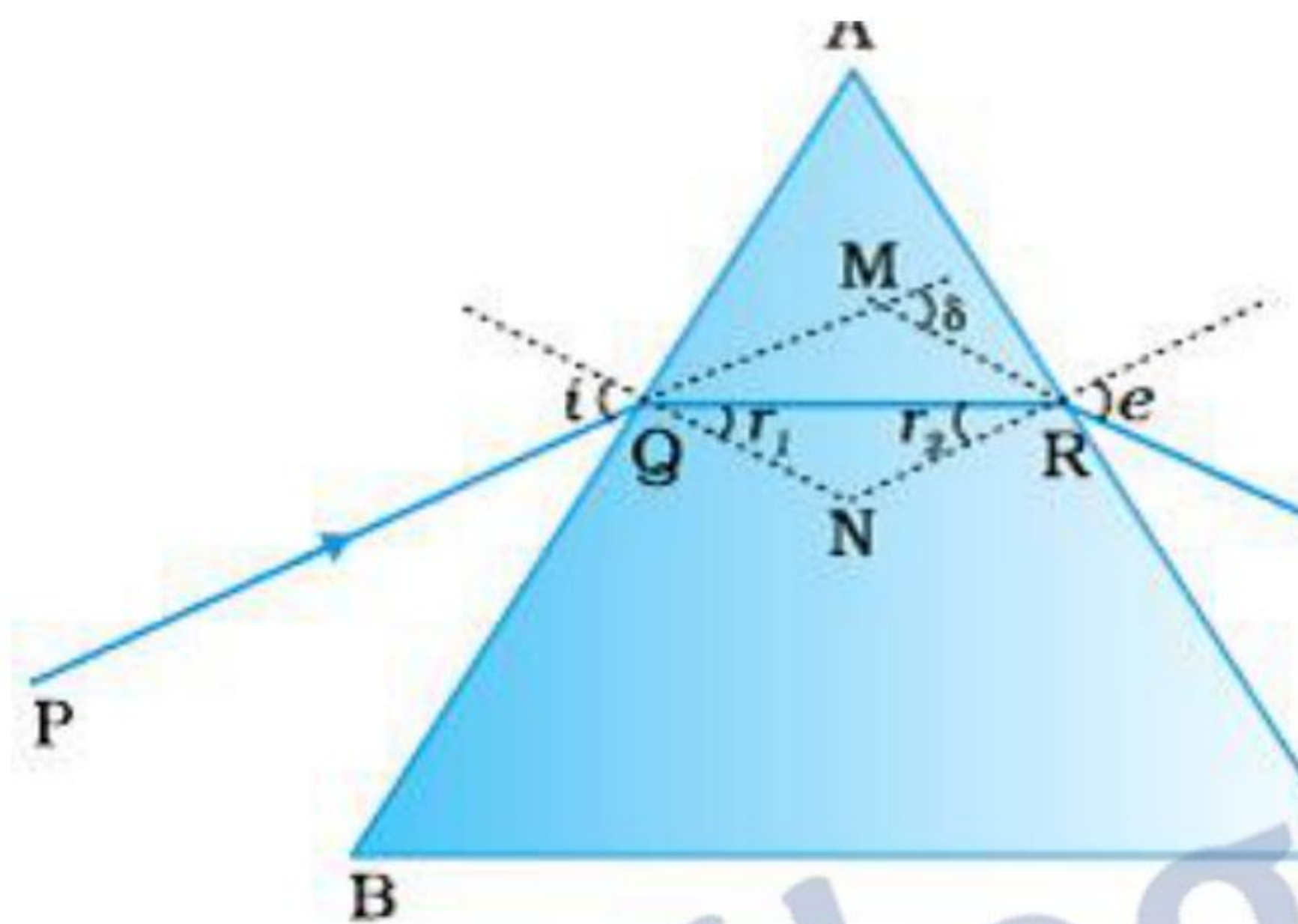
$$a = \frac{d}{5} = \frac{1}{5} \text{ mm} = 0.2 \text{ mm}$$

OR

Diagram for image formation	1/2
Derivation for combines focal length	1 1/2
Ray diagram through prism	1
Calculation of angle of incidence and angle of deviation	2





	<p>For First lens <math>\frac{1}{v_1} - \frac{1}{u} = \frac{1}{f_1}</math> (i)</p> <p>For Second lens <math>\frac{1}{v} - \frac{1}{v_1} = \frac{1}{f_2}</math> (ii)</p> <p>By adding i) and ii) <math>\frac{1}{v} - \frac{1}{u} = \frac{1}{f_1} + \frac{1}{f_2}</math></p> <p>Or <math>\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}</math></p> <p>b) Ray Diagram</p>  <p>Given <math>A=60^\circ</math>, <math>\mu = \sqrt{3}</math>  It is minimum deviation position of prism,  <math>\therefore r = \frac{A}{2} = 30^\circ</math></p> <p><math>\mu = \frac{\sin i}{\sin r}</math>  <math>\therefore \sqrt{3} \times \sin 30 = \sin i</math>  <math>\Rightarrow i = 60^\circ</math></p> <p><math>\therefore e = 60^\circ</math></p> <p><math>i + e = A + D</math>  <math>60 + 60 = 60 + D \therefore D = 60^\circ</math></p> <p>Alternately</p> <p><math>[i = \frac{A+D_m}{2} \therefore D_m = 60^\circ]</math></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>1/2</p>	<p>5</p>				
<p>Set-1, Q26  Set-2, Q25  Set-3, Q24</p>	<table border="1"> <tr> <td>Expression for potential energy</td> <td>2</td> </tr> <tr> <td>Numerical</td> <td>3</td> </tr> </table> <p>a) Expression for potential energy  i) To bring charge <math>q_1</math> from <math>\infty</math> to point(<math>\vec{r}_1</math>)  Work done = <math>W_1 = q_1V(r_1)</math></p>	Expression for potential energy	2	Numerical	3	<p>1/2</p>	
Expression for potential energy	2						
Numerical	3						



ii) To bring charge  $q_2$  from  $\infty$  to point  $(\vec{r}_2)$

$$\text{Work done} = W_2 = q_2 V(r_2) + \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r_{12}}$$

$$\therefore \text{Potential energy } U = W_1 + W_2 = q_1 V(r_1) + q_2 V(r_2) + \frac{Kq_1 q_2}{r_{12}}$$

$$\text{b) } U_i = \frac{1}{4\pi\epsilon_0} \left[ \frac{Q \times 2Q}{l} + \frac{Q(-3)Q}{l} + \frac{2Q \times (-3)Q}{l} \right]$$

$$= -\frac{1}{4\pi\epsilon_0} \frac{7Q^2}{l}$$

$$U_f = \frac{1}{4\pi\epsilon_0} \left[ \frac{Q \times 2Q}{\frac{l}{2}} + \frac{Q(-3)Q}{\frac{l}{2}} + \frac{2Q \times (-3)Q}{\frac{l}{2}} \right]$$

$$= -\frac{1}{4\pi\epsilon_0} \frac{14Q^2}{l}$$

$$W = U_f - U_i = -\frac{1}{4\pi\epsilon_0} \frac{7Q^2}{l}$$

(If a student writes  $U_i = \frac{1}{4\pi\epsilon_0} \left[ \sum \sum \frac{q_i q_j}{r_{ij}} \right]$ , award 1/2 mark)

Or

Definition of electric flux	1
S.I. unit	1/2
State and explain Gauss's law	1 1/2
Outward flux	1
Flux is independent of shape and size	1

Electric flux through a given area is defined as the number of electric field lines crossing normally through that area

[Alternately,

Electric flux is the surface integral of electric field over the surface

$$\Phi = \oint \vec{E} \cdot \vec{ds}]$$

S.I. unit -  $Nm^2 C^{-1}$  or  $Vm$

Gauss Law: Electric flux through a given closed surface is  $\frac{1}{\epsilon_0}$  times the charge enclosed by the closed surface

$$[\text{Alternatively: } \phi = \frac{q}{\epsilon_0}]$$

Flux of a point charge placed at the centre of cube =  $\frac{q}{\epsilon_0}$





	As the Electric field is radial and inversely proportional to the square of distance. Therefore, it is independent of shape and size. The number of electric field lines, crossing normally through a closed surface depends only on the charge enclosed by it.	1	5
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