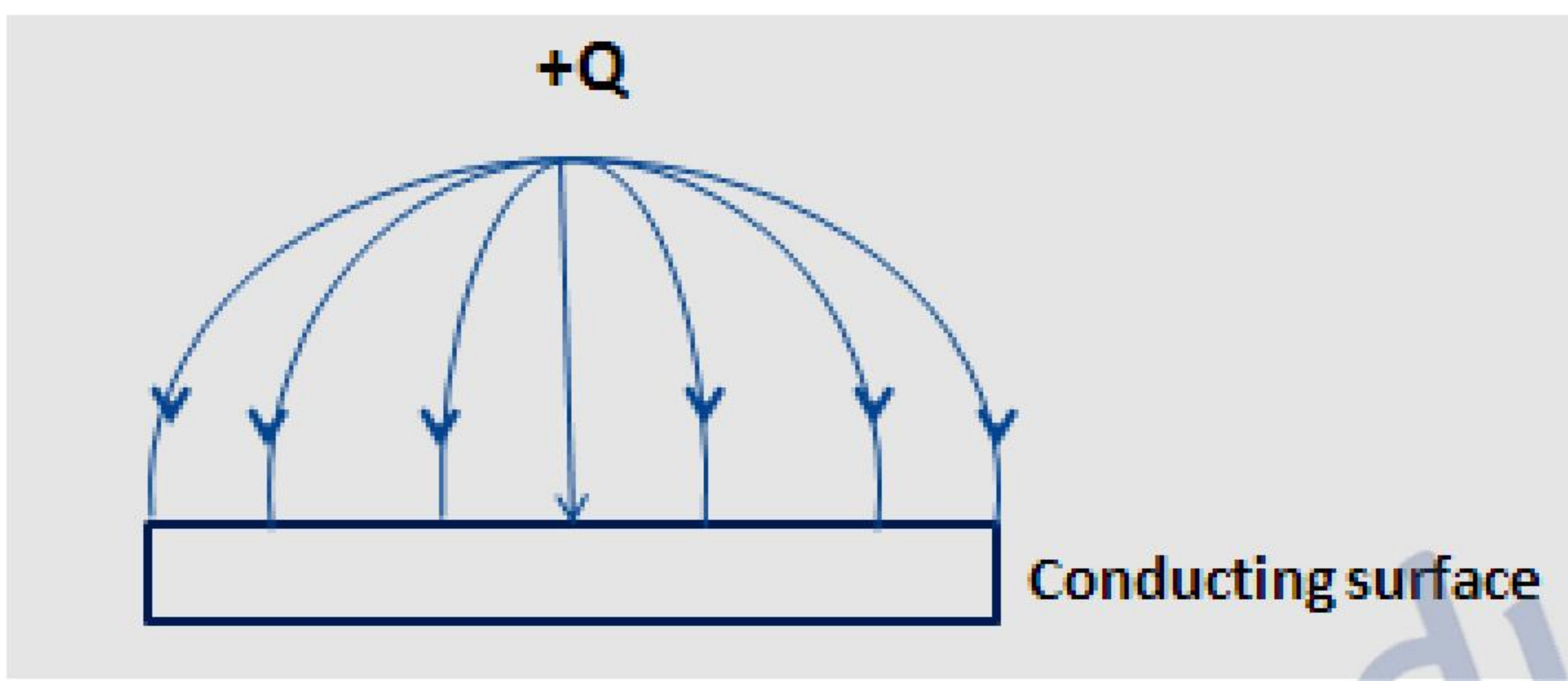


**MARKING SCHEME  
SET 55/1/B**

Q. No.	Expected Answer / Value Points	Marks	Total Marks
<b>Section A</b>			
Set1,Q1 Set2,Q5 Set3,Q2	It is a measure of the sharpness of resonance. <b>Alternatively</b> , $Q = \frac{1}{\omega_0 CR} / \frac{\omega_0 L}{R}$ No unit	1/2 1/2	1
Set1,Q2 Set2,Q4 Set3,Q5	To convert one form of energy into another. <b>(Alternatively</b> , To convert other forms of energy into electrical energy)	1	1
Set1,Q3 Set2,Q2 Set3,Q4		1	1
Set1,Q4 Set2,Q3 Set3,Q1	Medium A	1	1
Set1,Q5 Set2,Q1 Set3,Q3	Line A represents parallel combination, Its slope is more(or It corresponds to a lower value of resistance)	1/2 + 1/2	1
<b>Section B</b>			
Set1,Q6 Set2,Q7 Set3,Q10	<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     Finding the angle of incidence <span style="float: right;">2</span> </div> <p>It is the case of minimum deviation</p> $\mu = \frac{\sin i}{\sin r} = \frac{\sin i}{\sin \left(\frac{A}{2}\right)}$ $\Leftrightarrow \frac{\sqrt{3}}{2} = \sin i$ $\Leftrightarrow i = 60^\circ$ <p><b>Alternatively,</b> Deviation produced by prism here is minimum.</p> $\therefore \mu = \frac{\sin \left(\frac{A + \delta_m}{2}\right)}{\sin \frac{A}{2}}$ $\therefore \frac{\sqrt{3}}{2} = \sin \left(\frac{60 + \delta_m}{2}\right)$ $\Rightarrow 60^\circ \times 2 = 60^\circ + \delta_m$ $\delta_m = 60^\circ$	1/2 1/2 1/2 1/2 1/2	1

	$A + \delta_m = i + e = 2i$ $\Rightarrow i = 60^\circ$ <p style="text-align: center;"><b>OR</b></p> <table border="1" style="width: 100%;"> <tr> <td>Finding the focal length</td> <td style="text-align: right;">1 ½</td> </tr> <tr> <td>Value of refractive index</td> <td style="text-align: right;">½</td> </tr> </table> <p>Lens maker's formula</p> $\frac{1}{f} = (n-1) \left( \frac{1}{R_1} - \frac{1}{R_2} \right)$ $\therefore \frac{1}{20} = (1.5-1) \left( \frac{1}{R_1} - \frac{1}{R_2} \right)$ $\therefore \frac{1}{R_1} - \frac{1}{R_2} = \frac{1}{10}$ $\therefore \frac{1}{f'} = \left( \frac{1.5}{1.65} - 1 \right) \left( \frac{1}{10} \right)$ $f = -110 \text{ cm}$ <p>Refractive index of the medium should be 1.5 (i.e. same as that of material of lens)</p>	Finding the focal length	1 ½	Value of refractive index	½	½ ½	2		
Finding the focal length	1 ½								
Value of refractive index	½								
Set1,Q7 Set2,Q10 Set3,Q8	<table border="1" style="width: 100%;"> <tr> <td>Determination of K.E</td> <td style="text-align: right;">½</td> </tr> <tr> <td>Wave length for ground state</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Nature of change</td> <td style="text-align: right;">½</td> </tr> </table> <p>In Ground state</p> $\text{K.E} = E_1 = 13.6\text{eV} = 2.18 \times 10^{-18}\text{J}$ $\lambda_1 = \frac{h}{\sqrt{2mK}} = 0.33\text{nm}$ <p>[ Note: Award ½ marks if student evaluates <math>\lambda_1</math> directly without calculating <math>E_1</math>]</p> <p><b>Alternatively,</b></p> $2\pi r_n = n\lambda_n$ $\therefore \lambda_{\text{ground state}} = 2\pi r_1 = 2\pi \times 0.53\text{A}^\circ$ $\cong 3.33 \text{A}^\circ \cong 0.33 \text{ nm}$ <p>In first excited state, the de Broglie wavelength will increase.</p>	Determination of K.E	½	Wave length for ground state	1	Nature of change	½	½ 1 ½	2
Determination of K.E	½								
Wave length for ground state	1								
Nature of change	½								
Set1,Q8 Set2,Q6 Set3,Q9	<table border="1" style="width: 100%;"> <tr> <td>i) Finding the K.E &amp; P.E in Ground state</td> <td style="text-align: right;">½ +½</td> </tr> <tr> <td>ii) Finding the K.E &amp; P.E in Second excited state</td> <td style="text-align: right;">½ +½</td> </tr> </table>	i) Finding the K.E & P.E in Ground state	½ +½	ii) Finding the K.E & P.E in Second excited state	½ +½				
i) Finding the K.E & P.E in Ground state	½ +½								
ii) Finding the K.E & P.E in Second excited state	½ +½								



	<p>For Ground state,</p> <p>K.E = 13.6 eV                      (<math>\because</math> K.E = - T.E)</p> <p>P.E = - 27.2 eV                      (<math>\because</math> P.E = 2 T.E)</p> <p>For second Excited state (n=3)</p> <p>K.E = - <math>(-\frac{13.6}{9})</math> eV = 1.51 eV</p> <p>P.E = -3.02 eV</p> <p>[ Award <math>\frac{1}{2}</math> mark if the student does the calculations by taking n=2 ]</p>	$\frac{1}{2}$	$\frac{1}{2}$									
Set1,Q9 Set2,Q8 Set3,Q7	<table border="1"> <tr> <td>Distinguishing between sky wave and space wave mode</td> <td>1</td> </tr> <tr> <td>Reason</td> <td>1</td> </tr> </table> <table border="1"> <thead> <tr> <th>Space Wave</th> <th>Sky Wave</th> </tr> </thead> <tbody> <tr> <td>In space wave mode, the waves travel in straight line directly from transmitter to receiver</td> <td>Reflected by Ionosphere</td> </tr> </tbody> </table> <p>Because frequencies is greater than 40 MHz penetrate the ionosphere. (<b>Alternatively:</b> There frequencies (greater than 40 MHz) are not reflected by the ionosphere)</p>	Distinguishing between sky wave and space wave mode	1	Reason	1	Space Wave	Sky Wave	In space wave mode, the waves travel in straight line directly from transmitter to receiver	Reflected by Ionosphere	1	1	2
Distinguishing between sky wave and space wave mode	1											
Reason	1											
Space Wave	Sky Wave											
In space wave mode, the waves travel in straight line directly from transmitter to receiver	Reflected by Ionosphere											
Set1,Q10 Set2,Q9 Set3,Q6	<table border="1"> <tr> <td>Shift in balance point for part 'a' and 'b'</td> <td>1</td> </tr> <tr> <td>Reason</td> <td>1</td> </tr> </table> <p>a) Balance Point will be shifted towards B. The potential gradient will decrease and hence the balancing length will increase.</p> <p>b) No effect on balance point. At balance point no current flows through resistor S.</p>	Shift in balance point for part 'a' and 'b'	1	Reason	1	$\frac{1}{2}$	$\frac{1}{2}$	2				
Shift in balance point for part 'a' and 'b'	1											
Reason	1											
<b>Section C</b>												
Set1,Q11 Set2,Q20 Set3,Q15	<table border="1"> <tr> <td>Effect of dielectric on</td> <td></td> </tr> <tr> <td>a) Electric field energy</td> <td><math>\frac{1}{2} + \frac{1}{2}</math></td> </tr> <tr> <td>b) Charge</td> <td><math>\frac{1}{2} + \frac{1}{2}</math></td> </tr> <tr> <td>c) Potential difference</td> <td><math>\frac{1}{2} + \frac{1}{2}</math></td> </tr> </table> <p>The capacitance of both the capacitors increases by a factor K.</p> <p>a) New Electric field energy values are:</p> $= \frac{1}{2} K (C_1 V_1^2) \text{ and } \frac{1}{2} K (C_2 V_2^2)$ <p>b) New charges are:</p> $= \frac{1}{2} K C_1 V_1 \text{ and } \frac{1}{2} K C_2 V_2$	Effect of dielectric on		a) Electric field energy	$\frac{1}{2} + \frac{1}{2}$	b) Charge	$\frac{1}{2} + \frac{1}{2}$	c) Potential difference	$\frac{1}{2} + \frac{1}{2}$	$\frac{1}{2} + \frac{1}{2}$	$\frac{1}{2} + \frac{1}{2}$	
Effect of dielectric on												
a) Electric field energy	$\frac{1}{2} + \frac{1}{2}$											
b) Charge	$\frac{1}{2} + \frac{1}{2}$											
c) Potential difference	$\frac{1}{2} + \frac{1}{2}$											

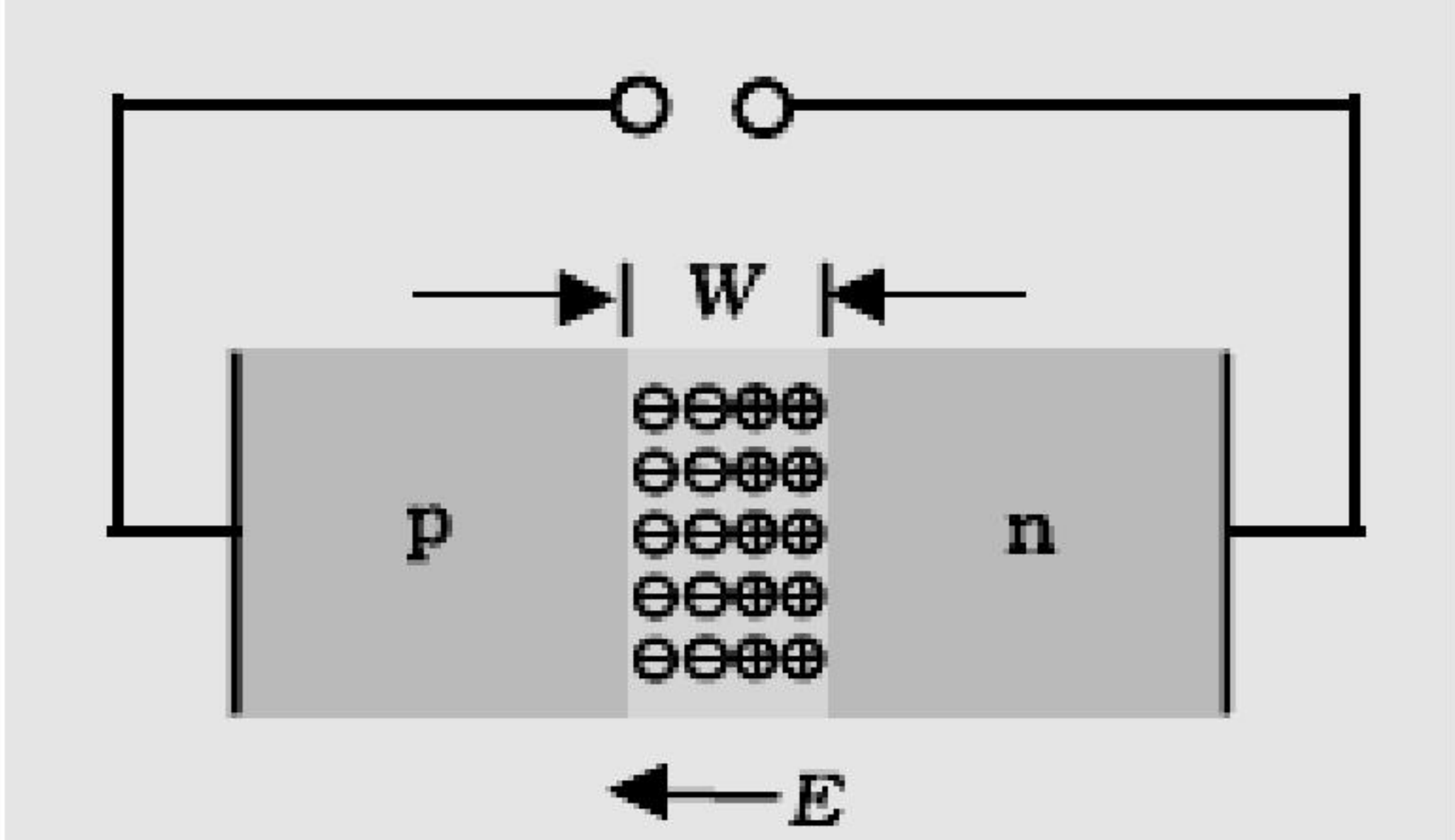
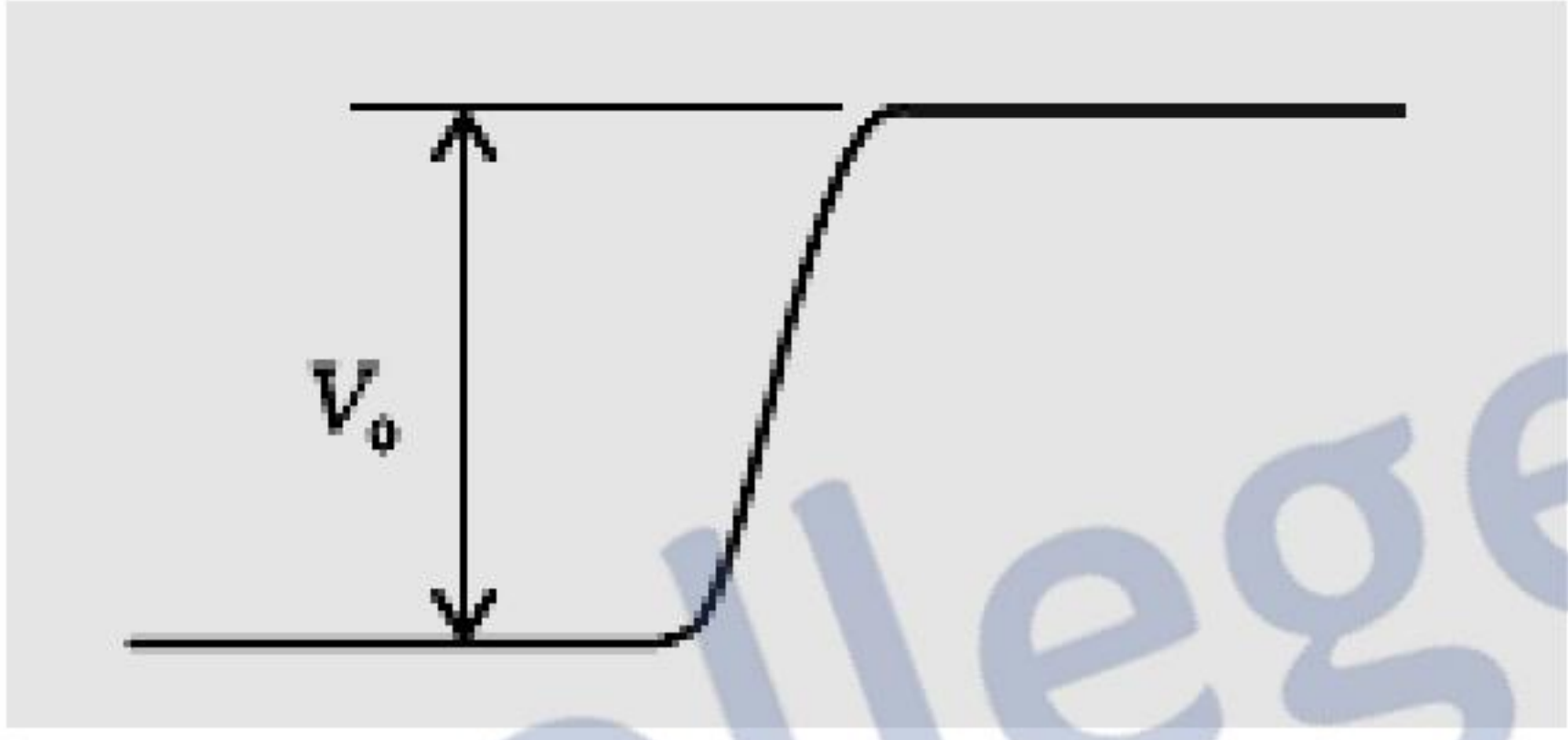


	<p>c) New P.D values are:  <math>V_1</math> and <math>V_2</math>  (The battery remains connected to the capacitors)  <b>Alternatively:</b> The student may assume that the battery has been removed.</p> <p>a) New Electric field energy values are:  <math>= \frac{1}{2} \frac{Q^2}{KC_1}</math> and <math>\frac{1}{2} \frac{Q^2}{KC_2}</math></p> <p>b) New charges are:  <math>Q</math> and <math>Q</math> as before</p> <p>c) New P.D values are:  <math>\frac{Q}{KC_1}</math> and <math>\frac{Q}{KC_2}</math></p>	<p><math>\frac{1}{2} + \frac{1}{2}</math></p> <p><math>\frac{1}{2} + \frac{1}{2}</math></p> <p><math>\frac{1}{2} + \frac{1}{2}</math></p> <p><math>\frac{1}{2} + \frac{1}{2}</math></p>	<p>3</p>				
<p>Set1,Q12  Set2,Q21  Set3,Q16</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Definition of activity and SI unit</td> <td style="text-align: center; padding: 5px;">1</td> </tr> <tr> <td style="padding: 5px;">Calculation of half life +Activity</td> <td style="text-align: center; padding: 5px;"><math>1\frac{1}{2} + \frac{1}{2}</math></td> </tr> </table> <p>The rate at which the nuclei of the radioactive sample disintegrate.</p> <p>[Alternatively, <math>R = \frac{-dN}{dt}</math>]</p> <p>SI Unit – becquerel (Bq)/ disintegration per second/</p> <p>Half Life = 10 hrs.  (Given : Activity becomes half after 10 hrs )</p> <p>Activity after 20 hrs  (= 2× half life )</p> <p><math>= \frac{1}{2^2} = \frac{1}{4}</math> of initial activity</p> <p>∴ Initial activity</p> <p>= 10000× 4 dps</p> <p>= 40000dps</p> <p>Alternatively :</p> <p><math>R = R_0 e^{-\lambda t}</math></p> <p>10,000 = <math>R_0 e^{-\lambda \times 20}</math></p> <p>5000 = <math>R_0 e^{-\lambda \times 30}</math></p> <p>By dividing</p> <p><math>2 = e^{\lambda \times 10}</math></p>	Definition of activity and SI unit	1	Calculation of half life +Activity	$1\frac{1}{2} + \frac{1}{2}$	<p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p>	
Definition of activity and SI unit	1						
Calculation of half life +Activity	$1\frac{1}{2} + \frac{1}{2}$						

	$\log 2 = 10\lambda$ $= \frac{\log 2}{T_{\frac{1}{2}}} \times 10$ $T_{\frac{1}{2}} = 10 \text{ hour}$ <p>Initial activity = <math>10000 \times (2)^2 = 40000 \text{ dps}</math></p>	1/2	3						
Set1,Q13 Set2,Q22 Set3,Q17	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Answers of part (a), (b), (c)</td> <td style="text-align: right; padding: 5px;">1+1+1</td> </tr> </table> <p>(a) The intensity of interference fringes in double slit arrangement is modulated by the diffraction pattern of each slit. <b>Alternatively,</b> In double slit experiment the interference pattern on the screen is actually superposition of single slit diffraction for each slit.</p> <p>(b) Waves diffracted from the edges of the circular obstacle interfere constructively at the centre of the shadow producing a bright spot.</p> <p>(c) Resolving power = <math>\frac{2\mu \sin \theta}{1.22\lambda}</math> ∴ Resolving power is inversely proportional to wavelength and directly proportional to the refractive index.</p> <p>Alternatively :</p> <p>(i) R.P ∝ <math>\frac{1}{\lambda}</math> (ii) R.P ∝ <math>\mu</math></p>	Answers of part (a), (b), (c)	1+1+1	1 1 1/2 1/2	3				
Answers of part (a), (b), (c)	1+1+1								
Set1,Q14 Set2,Q16 Set3,Q18	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Definition of Intensity of radiation</td> <td style="text-align: right; padding: 5px;">1</td> </tr> <tr> <td style="padding: 5px;">Calculation of work function</td> <td style="text-align: right; padding: 5px;">1 1/2</td> </tr> <tr> <td style="padding: 5px;">Response to red light</td> <td style="text-align: right; padding: 5px;">1/2</td> </tr> </table> <p>Definition : It is defined as the number of photons (of given frequency) incident per unit area per unit time.</p> <p>[Alternatively, <math>I = nh\nu</math>]</p> $\frac{hc}{\lambda} = \phi_0 + eV_0$ $\phi_0 = \left( \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{2270 \times 10^{-10} \times 1.6 \times 10^{-19}} - 1.3 \right) \text{eV}$ <p>= 4.2 eV (also accept the answer in joules)</p> <p>For red light incident photon energy will be less than the work function, hence no emission of electrons. (Also accept : There would be no photoemission)</p>	Definition of Intensity of radiation	1	Calculation of work function	1 1/2	Response to red light	1/2	1  1/2 1/2 1/2	3
Definition of Intensity of radiation	1								
Calculation of work function	1 1/2								
Response to red light	1/2								



	<b>OR</b>		
	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">           Photo electric equation <span style="float: right;">1</span>            Explanation of observations (any two) <span style="float: right;">1+1</span> </div> <p>Incident photon energy(<math>h\nu</math>) is used up in two ways:            (1) A part of this energy is used to remove the electrons. <span style="float: right;">1/2</span>            (2) Remaining part of the energy imparts KE to the emitted electrons</p> $h\nu = \phi_o + (K.E)$ $h\nu - \phi_o = \frac{1}{2}mv^2 = eV_o$ <p>Explanation :            (i)Maximum KE depends on frequency and not on intensity.            (ii) There exists a threshold frequency <math>\nu_o</math> (for which <math>h\nu_o = \phi_o</math>) below which no photoemission takes place.            (iii)Basic elementary process involved is absorption of photon by <math>e^-</math>. This process is instantaneous. <span style="float: right;">1+1</span>  <b>(Any Two)</b></p>		3
Set1,Q15 Set2,Q17 Set3,Q11	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">           Answers of parts (a), (b) &amp; (c) <span style="float: right;">1+1+1</span> </div> <p>a) Microwaves <span style="float: right;">1</span>            b) Electric charges can acquire energy and momentum from e.m. waves. <span style="float: right;">1</span>            c) <math>U = U_E + U_B = \frac{1}{2}\epsilon_0 E^2 + \frac{B^2}{2\mu_o}</math> <span style="float: right;">1/2 + 1/2</span></p>		3
Set1,Q16 Set2,Q18 Set3,Q12	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">           Drawing of magnetic field lines <span style="float: right;">1+1</span>            Explanation <span style="float: right;">1/2 + 1/2</span> </div> <div style="text-align: center; margin-bottom: 10px;"> </div> <p>Explanation : For diamagnetic material resultant magnetic moment in an atom is zero. In presence of external magnetic field, they acquire a net magnetic moment in a direction opposite to applied field. (<u>or</u> get repelled)            In paramagnetic material there is a permanent magnetic dipole moment of atoms. The external magnetic field tends to align these along its own direction. (<u>or</u> attracts them).</p>	1 + 1  1/2  1/2	3
Set1,Q17 Set2,Q19 Set3,Q13	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">           Explanation of two processes with diagram <span style="float: right;">1+1</span>            Definition of depletion region &amp; barrier potential <span style="float: right;">1/2 + 1/2</span> </div>		

	<p>Two important processes involved during the formation of p-n junction are</p> <p>(i) Diffusion (ii) Drift</p> <p><u>Diffusion</u> is the movement of the majority charge carriers across the junction. <b>Alternatively</b>, Diffusion results in the formation of negative and positive space charge regions around the junction</p> <p><u>Drift</u> is the movement of the minority charge carriers across the junction.</p>  <p><b>Alternatively,</b></p>  <p><b>Depletion Region:</b> The <u>depletion layer</u> is the negative and positive space charge region formed around the junction.</p> <p><b>Alternatively:</b> Depletion region : Space Charge region on either side of the junction together is known as depletion region.</p> <p><b>Barrier Potential :</b> The loss of electron from n region and gain of electron by p region causes a difference of potential across the junction. This is known as barrier potential.</p> <p><b>Alternatively:</b> The potential developed across the junction, that opposes the flow of (majority) charge carriers.</p>	<p><math>\frac{1}{2} + \frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p>	<p>3</p>									
<p>Set1,Q18 Set2,Q11 Set3,Q14</p>	<table border="1" data-bbox="364 1992 1528 2184"> <tr> <td>i)</td> <td>Fabrication</td> <td><math>\frac{1}{2}</math></td> </tr> <tr> <td>ii)</td> <td>Working</td> <td><math>1 \frac{1}{2}</math></td> </tr> <tr> <td>iii)</td> <td>Advantage</td> <td><math>\frac{1}{2} + \frac{1}{2}</math></td> </tr> </table> <p>LED is fabricated by:</p> <p>(i) Heavy doping of both th p and n regions. (ii) providing a transparent cover so that light can come out. <b>(Any one point)</b></p> <p><b>Working:</b> When the diode is forward biased electrons are sent from <math>n \rightarrow p</math> and holes from <math>p \rightarrow n</math>. At the junction boundary, the excess minority carriers on either side of junction recombine with majority carriers.</p>	i)	Fabrication	$\frac{1}{2}$	ii)	Working	$1 \frac{1}{2}$	iii)	Advantage	$\frac{1}{2} + \frac{1}{2}$	<p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p>+</p> <p><math>\frac{1}{2}</math></p> <p>+</p>	
i)	Fabrication	$\frac{1}{2}$										
ii)	Working	$1 \frac{1}{2}$										
iii)	Advantage	$\frac{1}{2} + \frac{1}{2}$										

	<p>This releases energy in the form of photon <math>h\nu = E_g</math>.</p> <p><b>Advantages (any two)</b>          Low operational voltage          Long life          Fast on /off switching capability          No warm up time required</p>	<p><math>\frac{1}{2}</math> <math>\frac{1}{2} + \frac{1}{2}</math></p>	<p>3</p>				
<p>Set1,Q19 Set2,Q12 Set3,Q21</p>	<table border="1" data-bbox="338 599 1497 724"> <tr> <td>Block diagram</td> <td>2</td> </tr> <tr> <td>Calculation of <math>A_m</math></td> <td>1</td> </tr> </table> <p>[Full credit for this part maybe given to the student. ]</p> <p><math>A_c = 12V</math></p> <p><math>\mu = \frac{A_m}{A_c} = \frac{75}{100} = 0.75</math></p> <p><math>A_m = 0.75 \times 12 = 9 V</math></p>	Block diagram	2	Calculation of $A_m$	1	<p>2 <math>\frac{1}{2}</math> <math>\frac{1}{2}</math></p>	<p>3</p>
Block diagram	2						
Calculation of $A_m$	1						
<p>Set1,Q20 Set2,Q13 Set3,Q22</p>	<table border="1" data-bbox="338 1165 1497 1345"> <tr> <td>a) Explanation of the phenomenon using diagram</td> <td><math>1\frac{1}{2}</math></td> </tr> <tr> <td>b) Explanation of polarisation of Reflected light. Derivation of Brewster's Law</td> <td><math>1\frac{1}{2}</math></td> </tr> </table> <div data-bbox="393 1383 1199 1787" style="text-align: center;"> </div> <p>The basic phenomenon / process which occurs is polarisation.</p> <p>The incident unpolarised sun light encounter the molecules of earth's atmosphere. Under the influence of electric field of incident wave the <math>e^-</math> in the molecule acquires component of motion in both these direction. If an observer is looking <math>90^\circ</math> to the direction of the Sun ,charge accelerating parallel to double arrow do not radiate energy towards the observer.[Their acceleration has no transverse component.] This explain polarisation of scattered light from sky.</p> <p>b)</p> <div data-bbox="685 2253 1219 2626" style="text-align: center;"> </div>	a) Explanation of the phenomenon using diagram	$1\frac{1}{2}$	b) Explanation of polarisation of Reflected light. Derivation of Brewster's Law	$1\frac{1}{2}$	<p><math>\frac{1}{2}</math> <math>\frac{1}{2}</math> <math>\frac{1}{2}</math></p>	
a) Explanation of the phenomenon using diagram	$1\frac{1}{2}$						
b) Explanation of polarisation of Reflected light. Derivation of Brewster's Law	$1\frac{1}{2}$						



	<p>When unpolarised light is incident at polarising angle, at the interface of a refracting medium, the reflected ray being perpendicular to the refracted ray is completely polarised.</p> <p>Now</p> $\mu = \frac{\sin i}{\sin r}$ $\therefore \mu = \frac{\sin i_p}{\sin (90 - i_p)} \quad (\because i_p + r = 90^\circ)$ $\therefore \mu = \tan i_p$ <p>This is Brewster's Law</p>	<p>1/2</p> <p>1/2</p>	<p>3</p>						
<p>Set1,Q21 Set2,Q14 Set3,Q19</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>i)</td> <td>Derivation of the Average power in inductor</td> <td>1 1/2</td> </tr> <tr> <td>ii)</td> <td>Ratio of Power factors <math>P_1</math> and <math>P_2</math></td> <td>1 1/2</td> </tr> </table> <p>For an ideal inductor connected to ac source</p> $V = V_o \sin \omega t \quad I = I_o \sin \left( \omega t - \frac{\pi}{2} \right)$ $P_{avg} = \frac{1}{T} \int_0^T V_o I_o \sin \omega t \cos \omega t dt$ $= \frac{1}{T} \frac{V_o I_o}{2} \int_0^T \sin 2\omega t dt$ $= \frac{1}{T} \frac{V_o I_o}{2} \left[ \frac{\cos 2\omega t}{2\omega} \right]_0^T = 0$ <p>(Also accept any other correct method)</p> <p>Power factor <math>\cos \phi = R/Z</math></p> <p>For LR circuit, at <math>X_L = R</math></p> $Z = \sqrt{R^2 + R^2}$ $Z = R\sqrt{2}$ $P_1 = \cos \phi = \frac{R}{R\sqrt{2}} = \frac{1}{\sqrt{2}}$ <p>For LCR circuit <math>X_L = X_C</math></p> $Z = \sqrt{R^2} = R$	i)	Derivation of the Average power in inductor	1 1/2	ii)	Ratio of Power factors $P_1$ and $P_2$	1 1/2	<p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>	
i)	Derivation of the Average power in inductor	1 1/2							
ii)	Ratio of Power factors $P_1$ and $P_2$	1 1/2							

	<p>Power factor <math>P_2 = \frac{R}{R} = 1</math></p> <p><math>\Rightarrow \frac{P_1}{P_2} = 1:\sqrt{2}</math></p> <p>[Award 1½mark if the student writes directly : <math>P_1 = \frac{1}{\sqrt{2}}</math> and <math>P_2 = 1</math></p> <p><math>\therefore \frac{P_1}{P_2} = \frac{1}{\sqrt{2}}</math> ]</p>	½	3						
<p>Set1,Q22 Set2,Q15 Set3,Q20</p>	<table border="1" data-bbox="352 621 1512 823"> <tr> <td>Definition of resistivity</td> <td>1</td> </tr> <tr> <td>Graphs</td> <td>½ +½</td> </tr> <tr> <td>Explanation</td> <td>½ +½</td> </tr> </table> <p>Resistivity of a conductor is defined as the resistance of a material (of a Conductor) of unit length and unit area of cross section. (<b>Alternatively</b>, <math>\rho = \frac{RA}{l}</math>)</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="352 1010 907 1569"> <p>Conductor</p> </div> <div data-bbox="937 1010 1481 1569"> <p>Semiconductor</p> </div> </div> <p>In conductor with increase in temperatures relaxation time decreases, but number density of charge carriers is not dependent on temperature. Hence, <math>\rho</math> increases.</p> <p>In semiconductors number density of charge carriers increases with temperature, it dominates the decrease in relaxation time. Hence, <math>\rho</math> decreases.</p>	Definition of resistivity	1	Graphs	½ +½	Explanation	½ +½	<p>1</p> <p>½ + ½</p> <p>½</p> <p>½</p>	3
Definition of resistivity	1								
Graphs	½ +½								
Explanation	½ +½								
<b>Section D</b>									
<p>Set1,Q23 Set2,Q23 Set3,Q23</p>	<table border="1" data-bbox="342 2144 1501 2315"> <tr> <td>Values displayed</td> <td>2</td> </tr> <tr> <td>Answer of part (b)</td> <td>½</td> </tr> <tr> <td>Maximum &amp; Minimum force</td> <td>1 +½</td> </tr> </table> <p>a) Asha and her family helpful, concern for others , caring nature (any two) Doctor was generous, helping nature, caring (any two) (Any other alternative correct value should be accepted )</p> <p>b) High magnetic field required. / (Expensive set up needed) Any other correct answer [Note: Full credit of ½ mark may be given [for this part to all students]</p>	Values displayed	2	Answer of part (b)	½	Maximum & Minimum force	1 +½	<p>1</p> <p>1</p> <p>½</p>	
Values displayed	2								
Answer of part (b)	½								
Maximum & Minimum force	1 +½								

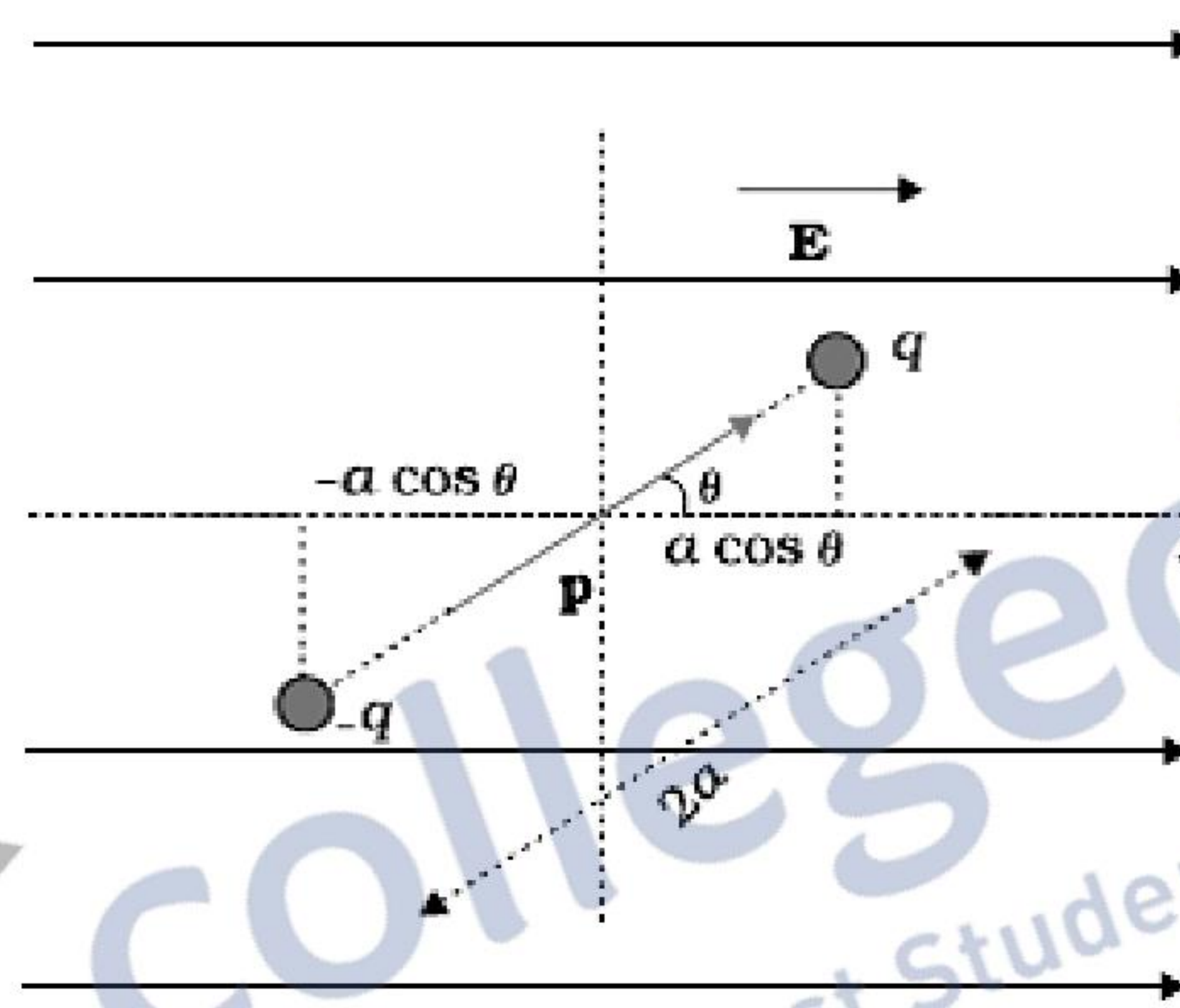
$\vec{F} = q \vec{v} \times \vec{B} $ $F_{max} = qvB = 1.6 \times 10^{-19} \times 10^4 \times 0.1 N$ $= 1.6 \times 10^{-16} N$ $F_{min} = 0$	1/2	1/2	1/2	4
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**Section E**

Set1,Q24  
Set2,Q26  
Set3,Q25

a) Derivation of potential energy of dipole	2
Angle for stable and unstable equilibrium	1/2 + 1/2
b) Dependence of potential on r	2

a)



Torque experienced by an electric dipole

$$\tau = pE \sin \theta$$

Work done by external torque

$$w = \int_{\theta_1}^{\theta_2} PE \sin \theta d\theta$$

$$= PE[-\cos \theta]_{\theta_1}^{\theta_2}$$

$$U = PE[\cos \theta_1 - \cos \theta_2]$$

When  $\theta_1 = 90^\circ$ , and  $\theta_2 = \theta$

$$\Rightarrow U = -\vec{P} \cdot \vec{E}$$

For stable equilibrium  $\theta = 0^\circ$

Unstable equilibrium  $\theta = 180^\circ$

1/2

1/2

1/2

1/2

1/2

1/2



(b)

$$V_p = V_q + V_q + V_{-2q}$$

$$= \frac{kq}{r-a} + \frac{kq}{r+a} - \frac{2kq}{r}$$

$$= kq \left( \frac{r+a+r-a}{r^2-a^2} \right) - \frac{2kq}{r}$$

$$= \frac{2kqr}{r^2-a^2} - \frac{2kq}{r}$$

$$= 2kq \left[ \frac{r}{r^2-a^2} - \frac{1}{r} \right]$$

$$= 2kq \left[ \frac{r^2-r^2+a^2}{r(r^2-a^2)} \right] = \frac{2kqa^2}{r(r^2-a^2)}$$

For  $r \gg a$

$$V_p = \frac{2kqa^2}{r^3}$$

$$V_p \propto \frac{1}{r^3}$$

OR

a) Electric flux and its SI unit	1+½
b) Calculation of Electric flux	1
c) Derivation of electric field due to infinite plane sheet	2 ½

a) Electric flux equals the surface integral of electric field over the given surface.

(Alternatively,  $\phi_E = \int \vec{E} \cdot \vec{ds}$ )

S.I Unit  $Nm^2/C$  (Alternatively: V-m)

b) By Gauss's Law

$$\oint \vec{E} \cdot \vec{ds} = \frac{q}{\epsilon_0} \quad (q = \text{charge enclosed})$$

Here the charge enclosed in the cube = q

$$\therefore \phi_E = \oint \vec{E} \cdot \vec{ds} = \frac{q}{\epsilon_0}$$

½

½

½

½

5

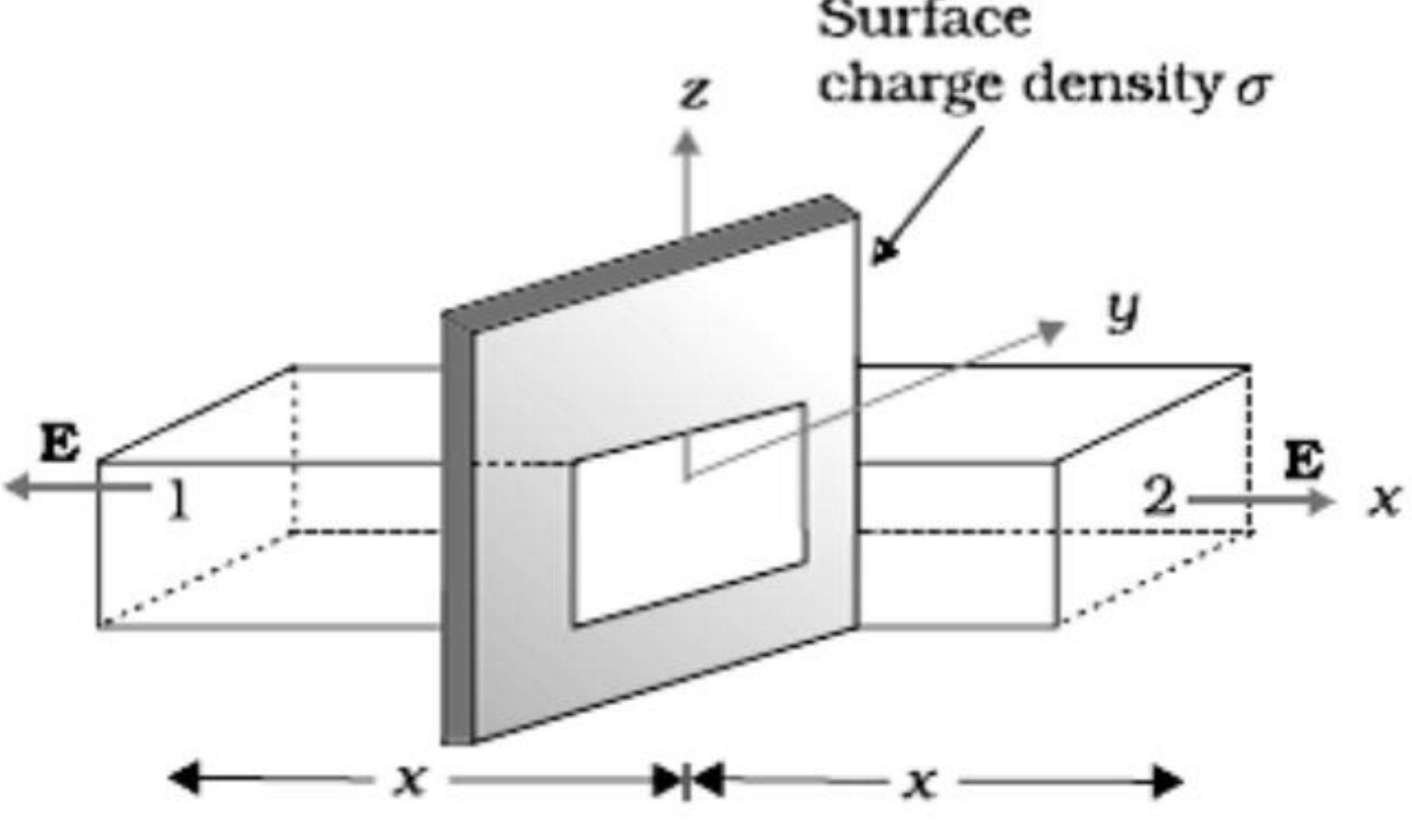
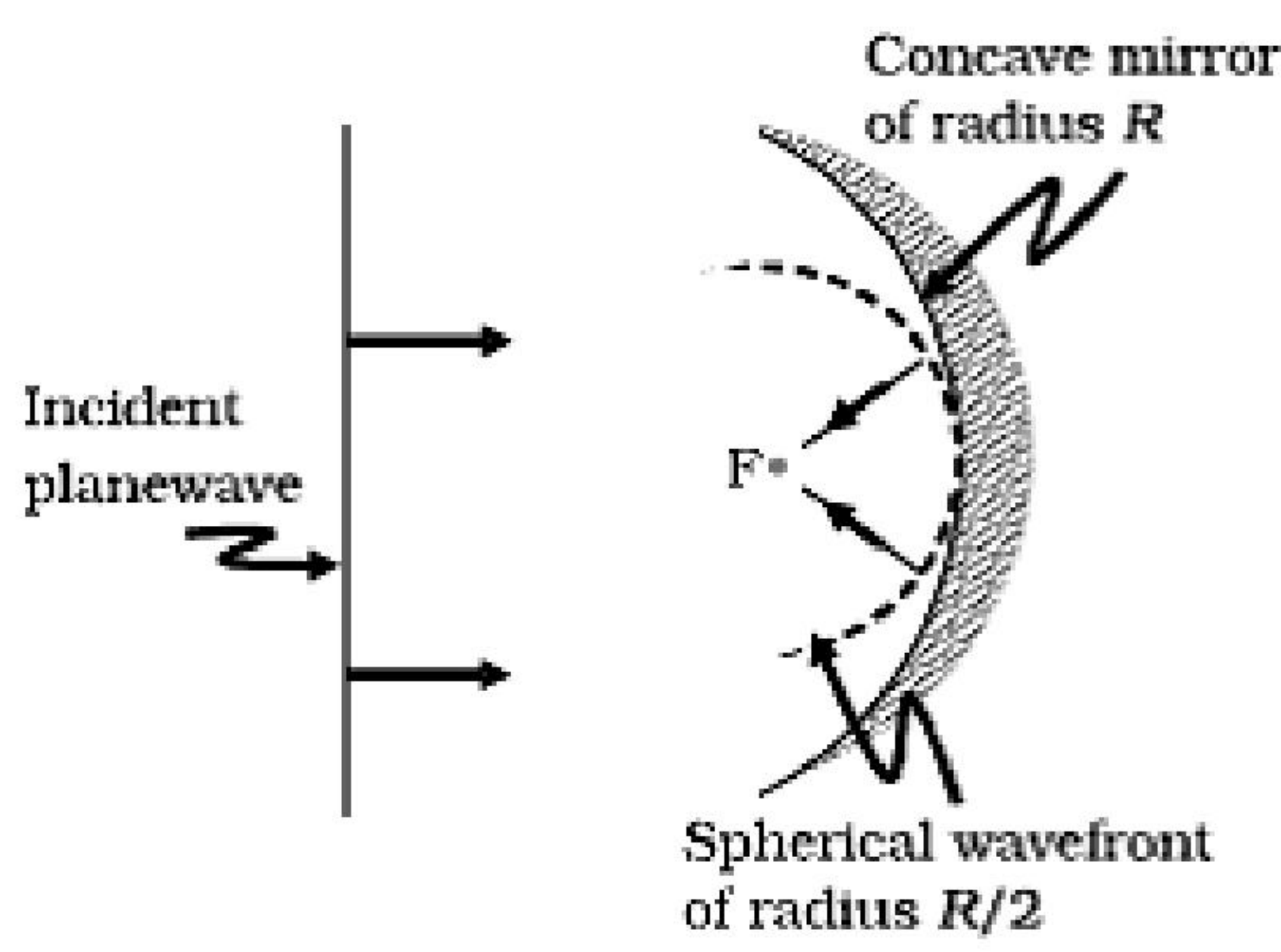
1

½

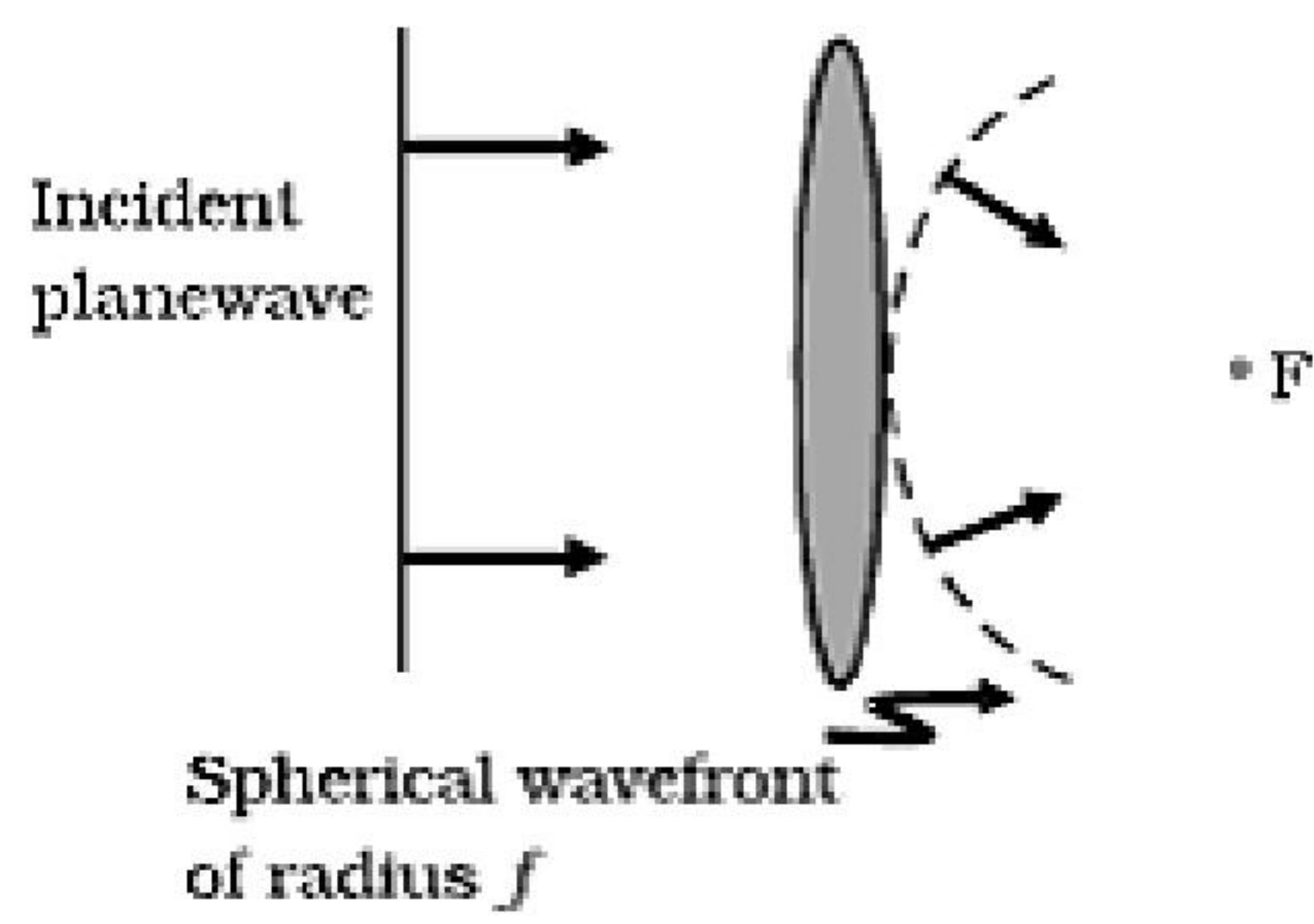
½

½



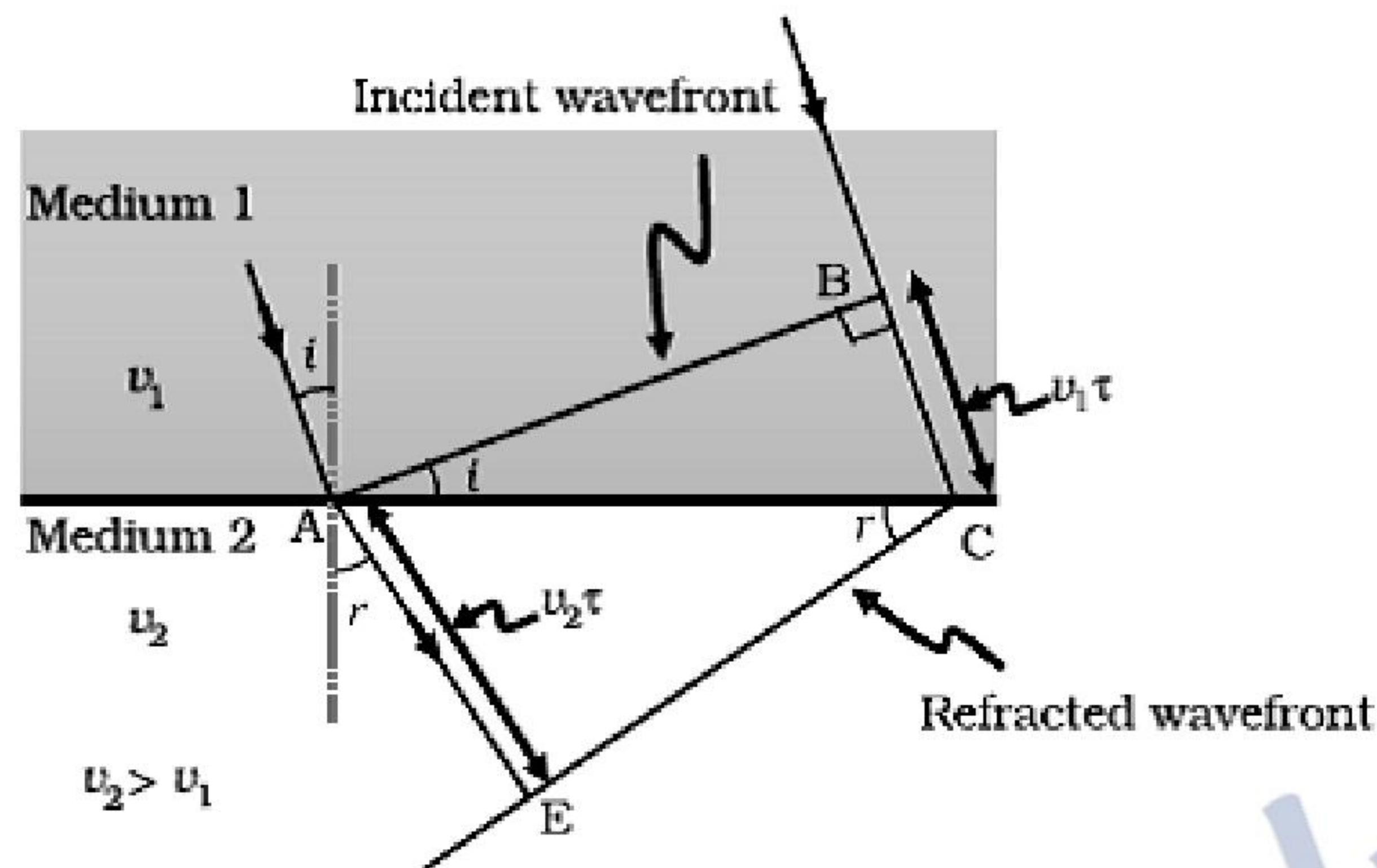
<p>c)</p>	 <p style="text-align: center;">Surface charge density <math>\sigma</math></p> $\phi = \oint \vec{E} \cdot d\vec{s} = \int_{s_1} \vec{E} \cdot d\vec{s} + \int_{s_2} \vec{E} \cdot d\vec{s} + \int_{s_3} \vec{E} \cdot d\vec{s}$ $= EA + EA + 0 = 2EA$ <p style="text-align: center;">By Gauss Law,</p> $2EA = \frac{q}{\epsilon_0}$ $\therefore E = \frac{q}{2\epsilon_0 A} = \frac{\sigma A}{2\epsilon_0 A} = \frac{\sigma}{2\epsilon_0}$ <p><math>\therefore E</math> is independent of <math>x</math></p>	<p style="text-align: center;">1/2</p> <p style="text-align: center;">1/2</p> <p style="text-align: center;">1</p> <p style="text-align: center;">1/2</p> <p style="text-align: center;">1/2</p>	<p style="text-align: center;">5</p>
<p>Set1,Q25 Set2,Q24 Set3,Q26</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>a) Definition of wave front <span style="float: right;">1</span></p> <p>b) Diagram of wave fronts for</p> <p style="padding-left: 20px;">(i) Reflection of plane wave by concave mirror <span style="float: right;">1</span></p> <p style="padding-left: 20px;">(ii) Refraction of plane wave by convex lens <span style="float: right;">1</span></p> <p>c) Verification of Snell's Law/ <span style="float: right;">2</span></p> </div> <p>a) Locus of all the points which are in same phase / surface of constant phase <span style="float: right;">1</span></p> <p>b) (i)</p>  <p style="text-align: center;">Incident plane wave</p> <p style="text-align: center;">Concave mirror of radius <math>R</math></p> <p style="text-align: center;">Focal point <math>F</math></p> <p style="text-align: center;">Spherical wavefront of radius <math>R/2</math></p>	<p style="text-align: center;">1</p> <p style="text-align: center;">1</p>	

(ii)



1

c)



1/2

$$\sin i = \frac{BC}{AC}$$

$$\sin r = \frac{AE}{AC}$$

$$\frac{\sin i}{\sin r} = \frac{BC}{AC} = \frac{v_1 t}{v_2 t} = \frac{v_1}{v_2} = \frac{n_2}{n_1}$$

$$\frac{\sin i}{\sin r} = \eta_{21} \text{ Snell's law}$$

1/2

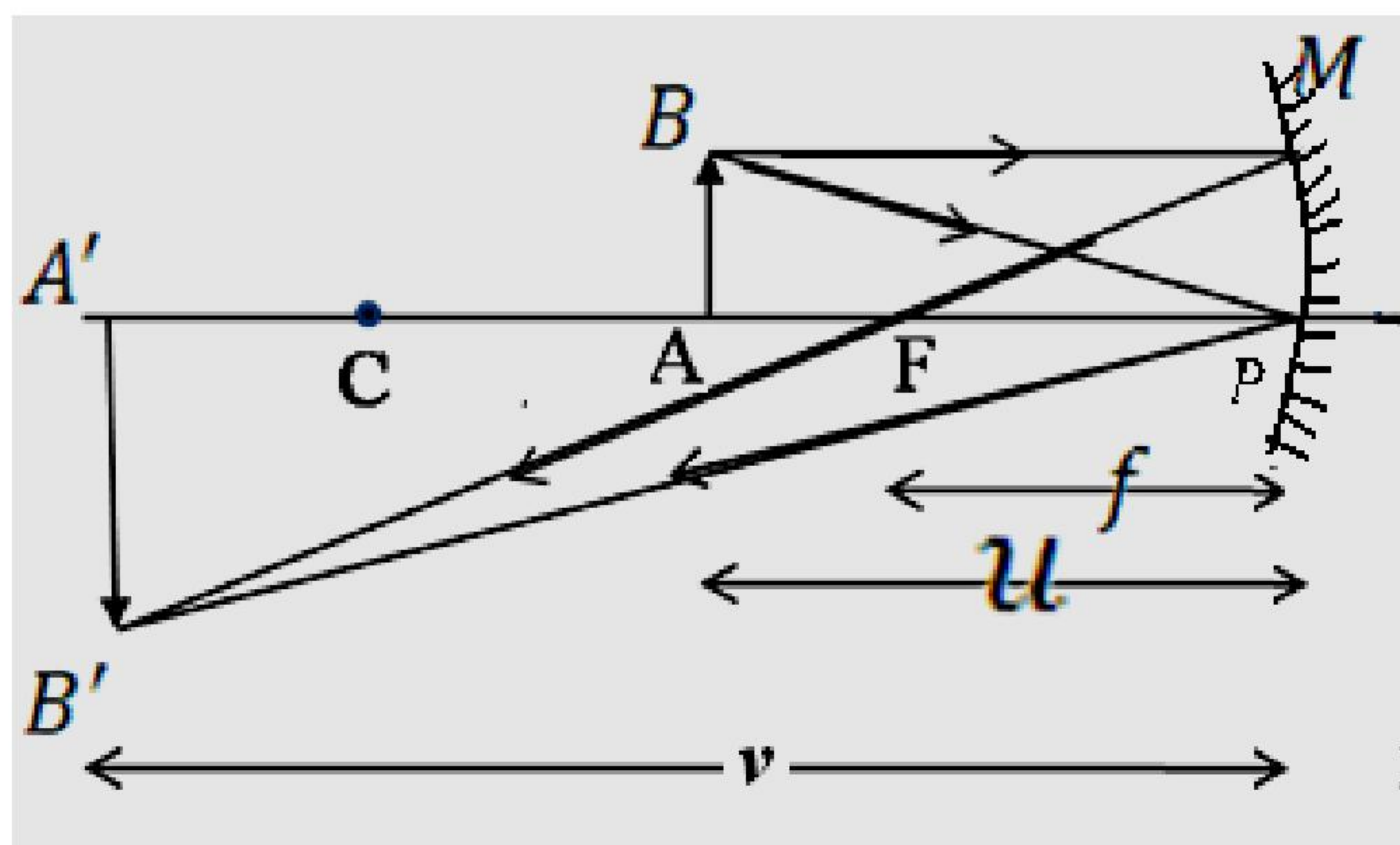
1/2

OR

1/2

a) Ray diagram	1
Derivation of mirror formula	2
b) Calculation	2

5



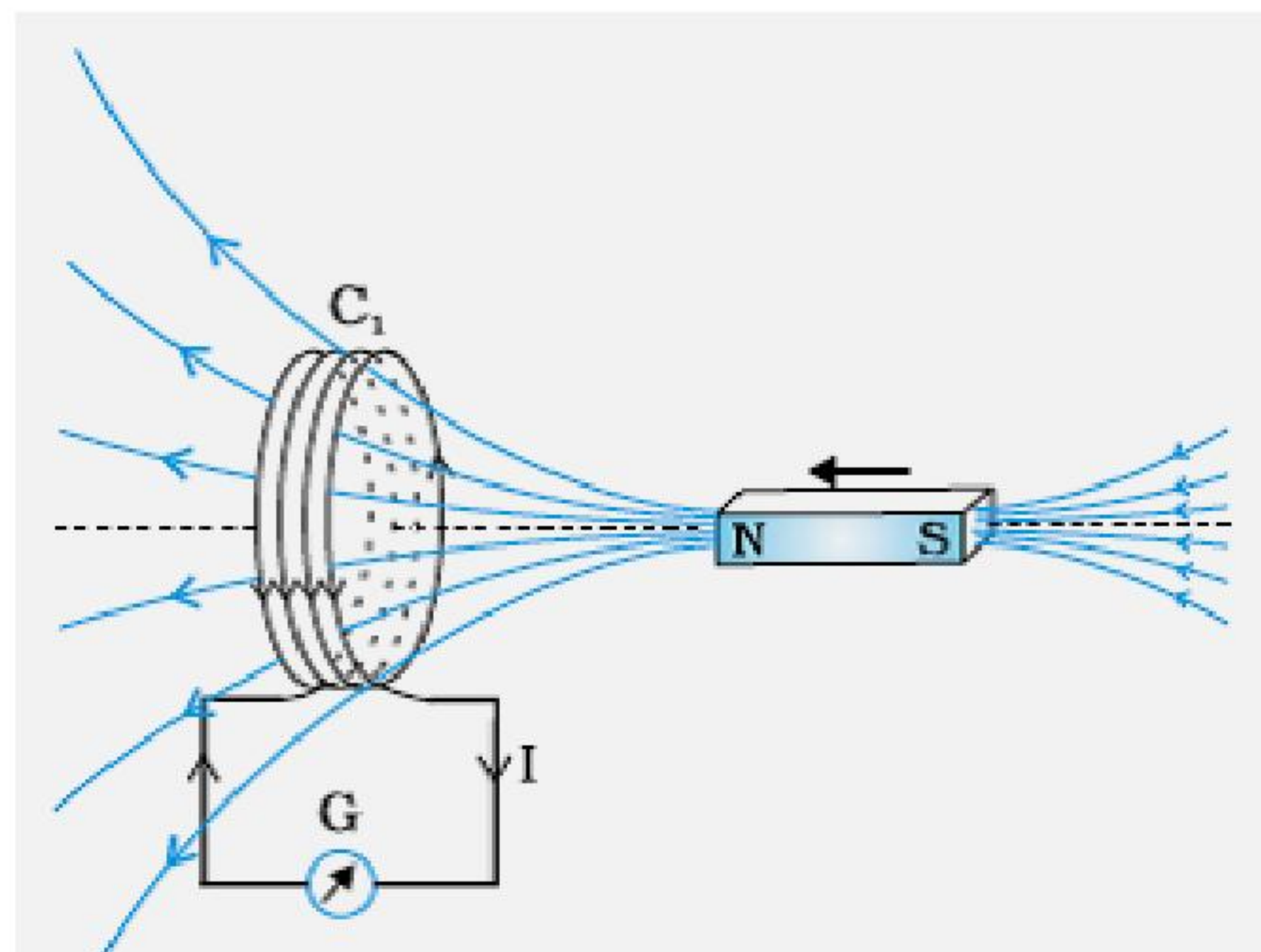
1

[Note: Deduct 1/2 mark if arrows are not indicated]



	<p>In <math>\Delta ABP</math> and <math>\Delta A'B'P</math></p> $\frac{AB}{A'B'} = \frac{AP}{A'P}$ <p>In <math>\Delta MPF</math> and <math>\Delta B'A'F</math></p> $\frac{MP}{A'B'} = \frac{FP}{A'F}$ <p>But <math>AB = MP</math></p> $\therefore \frac{AP}{A'P} = \frac{FP}{A'P} = \frac{FP}{A'P - FP}$ $\frac{-u}{-v} = \frac{-f}{-(v-f)}$ $uv - uf = vf$ <p>Dividing by <math>uvf</math></p> $\frac{1}{f} - \frac{1}{v} = \frac{1}{u}$ $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ <p>b) Here the object is virtual and image is real <math>u = +12\text{cm}</math></p> <p>(i)</p> $\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} - \frac{1}{12} = \frac{1}{20}$ $\Rightarrow v = 7.5 \text{ cm from the lens}$ <p>(ii)</p> $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ $\Rightarrow \frac{1}{v} - \frac{1}{12} = \frac{1}{-16}$ $\Rightarrow v = 48 \text{ cm from the lens}$	<p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p>	<p>5</p>						
<p>Set1,Q26 Set2,Q25 Set3,Q24</p>	<table border="1"> <tr> <td>a) Description with diagram</td> <td>1 +1</td> </tr> <tr> <td>Statement of Faraday's law</td> <td>1</td> </tr> <tr> <td>b) Answers and their justification parts (i) &amp; (ii)</td> <td>1+1</td> </tr> </table>	a) Description with diagram	1 +1	Statement of Faraday's law	1	b) Answers and their justification parts (i) & (ii)	1+1		
a) Description with diagram	1 +1								
Statement of Faraday's law	1								
b) Answers and their justification parts (i) & (ii)	1+1								

a)



(Also accept any other correct figure)

When the bar magnet moves towards the coil, connected to a Galvanometer. The Galvanometer shows a deflection. This is due to change in the magnetic field/flux, linked with the coil. This shows that an emf is induced.

The magnitude of emf induce is directly proportional to the rate of change of magnetic flux in the circuit .

$$e = - \frac{d\phi}{dt}$$

b) (i) the emf induced  $e = -B\ell v$

Emf will be more in case of square loop as the side perpendicular to the velocity is longer as compared to the rectangular loop.

(ii) Current will be less in rectangular loop, as it has more resistance and less induced emf.

[Note: also accept if the student says

(i) emf induced will be zero in both cases as long as the coils stay in the field.

(ii) current will be zero in both the cases as long as the coils stays in the field.

**OR**

a. Principle of a.c. generator	1
b. Explanation of working with labeled diagram and obtaining the expression of emf	3
c. Schematic diagram	1

a) Principle : Electromagnetic induction; effective area of the loop ( $= A \cos \theta$ ), exposed to the magnetic field, keeps on changing as the coil rotates.

[Alternatively: Whenever magnetic flux linked with a coil changes, an emf is setup in the coil]

1

1

1

1/2

1/2

1/2 + 1/2

1/2 + 1/2

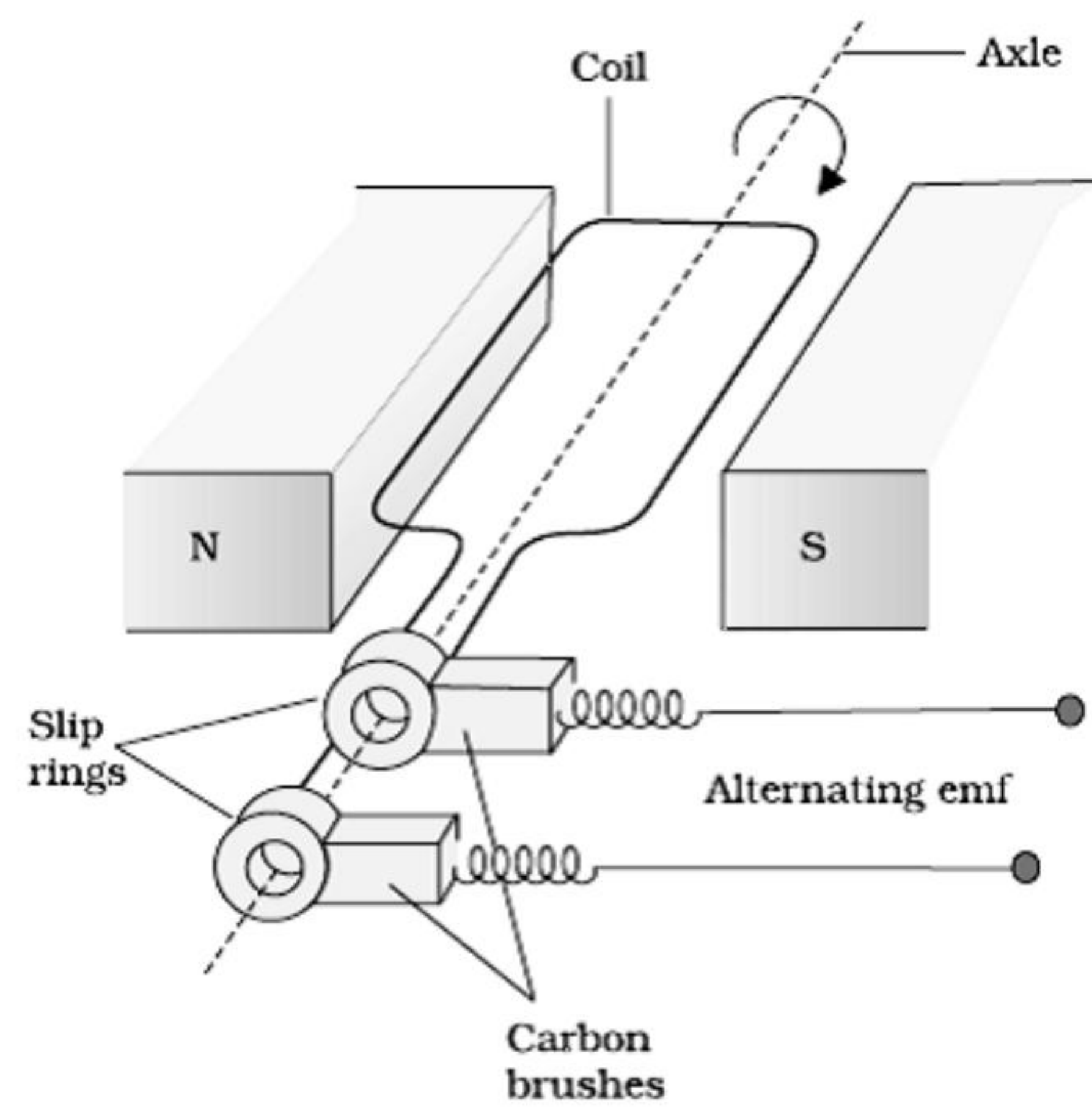
1/2 + 1/2

5





b)



1 1/2

**Working**

When the coil is rotated with constant angular speed  $\omega$ , the angle  $\theta$  between magnetic field vector  $B$  and area vector  $A$  of the coil changes at any instant  
 $\theta = \omega t$

1/2

Magnetic flux at any time 't'  $\phi = BA \cos \theta = BA \cos \omega t$

1/2

$\therefore$  induced emf

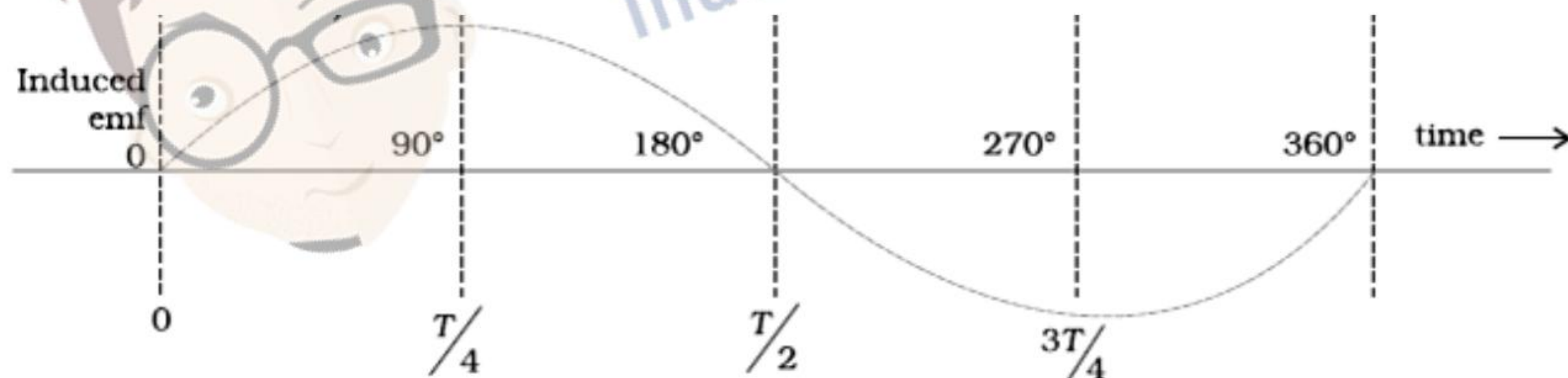
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$$e = -N \frac{d\phi}{dt} = -N \frac{d}{dt} (BA \cos \omega t)$$

$$e = NBA\omega \sin \omega t$$

1

c)



5

