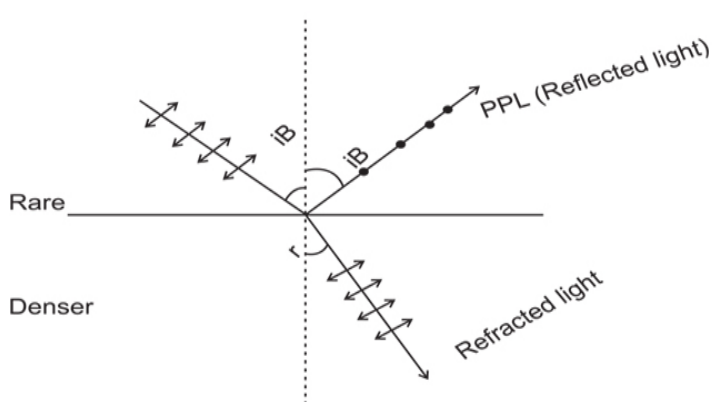


**Class -XII**  
**PHYSICS**  
**SQP Marking Scheme**  
**2019-20**

<b>Section - A</b>		
1.	a, $\phi = \frac{q}{6\epsilon_0}$ (for one face)	1
2.	b, Conductor	1
3.	a, $1\Omega$ .	1
4.	c, 12.0kJ	1
5.	a, speed	1
6.	d, virtual and inverted	1
7.	a, straight line	1
8.	d, $60^\circ$	1
9.	b, work function	1
10.	b, third orbit	1
11.	$45^\circ$ or vertical	1
12.	2 H	1
13.	double	1
14.	$1.227 \text{ \AA}$	1
15.	$60^\circ$	1
16.	Difference in initial mass energy and energy associated with mass of products Or Total Kinetic energy gained in the process	1
17.	Increases	1
18.	$N_0/8$	1
19.	0.79 eV	1
20.	Diodes with band gap energy in the visible spectrum range can function as LED	1



23.	<p>Gain in KE of particle = <math>Qv</math></p> $\frac{1}{2} m_p v_p^2 = K_p = q_p V_p \text{ -----(i) } V_p = V_\alpha = V$ $\frac{1}{2} m_\alpha v_\alpha^2 = K_\alpha = q_\alpha V_\alpha \text{ -----(ii)}$ <p>(ii)/(i)</p> $\frac{m_\alpha v_\alpha^2}{m_p v_p^2} = \frac{q_\alpha}{q_p} = \frac{2}{1}$ $\frac{v_\alpha^2}{v_p^2} = \frac{m_p \times 2}{m_\alpha \times 1} = \frac{2m_p}{4m_p \times 1} = \frac{1}{2}$ $V_\alpha : V_p = 1 : \sqrt{2}$	1  1
24.	<p>“The angle of incidence at which the reflected light is completely plane polarized, is called as Brewster’s angle (<math>i_B</math>)”</p>  <p>At <math>i = i_B</math>, reflected beam is perpendicular to refracted beam  <math>\therefore i_B + r = 90 \Rightarrow r = 90 - i_B</math></p> <p>Using Snell's law</p> $\frac{\sin i}{\sin r} = \mu$ $\frac{\sin i_B}{\sin (90 - i_B)} = \mu \Rightarrow \frac{\sin i_B}{\cos i_B} = \mu$ $\mu = \tan i_B$	1  1
25.	<p>wave function</p> $\omega = 2.14 \text{ eV}$ <p>(a) Threshold frequency <math>\omega = h\nu_0</math></p> $\nu_0 = \frac{\omega}{h} = \frac{2.14 \times 1.6 \times 10^{-19}}{6.62 \times 10^{-34}}$	1

$$= 5.17 \times 10^{14} \text{ Hz}$$

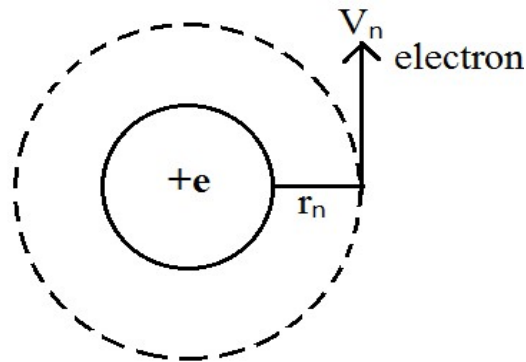
(b) As  $k_{\text{max}} = eV_0 = 0.6 \text{ eV}$

$$\begin{aligned} \text{Energy of photon } E &= k_{\text{max}} + \omega = 0.6 \text{ eV} + 2.14 \text{ eV} \\ &= 2.74 \text{ eV} \end{aligned}$$

$$\begin{aligned} \text{Wave length of photon } \lambda &= \frac{hc}{E} = \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{2.74 \times 1.6 \times 10^{-19}} \\ &= 4530 \text{ \AA} \end{aligned}$$

1

26.



centripetal force = electrostatic attraction

$$\frac{mv_n^2}{r_n} = \frac{1}{4\pi\epsilon_0} \frac{e^2}{r_n^2}$$

$$mv_n^2 = \frac{1}{4\pi\epsilon_0} \frac{e^2}{r_n} \text{-----(i)}$$

$$asmv_n r_n = n \cdot \frac{h}{2\pi}$$

$$v_n = \frac{nh}{2\pi m r_n} \text{ put in (i)}$$

$$m \cdot \frac{n^2 h^2}{4\pi^2 m^2 r_n^2} = \frac{1}{4\pi\epsilon_0} \frac{e^2}{r_n}$$

$$r_n = \frac{\epsilon_0 n^2 h^2}{\pi m e^2}$$

1

1

**OR**

Energy of electron in  $n = 2$  is  $-3.4 \text{ eV}$

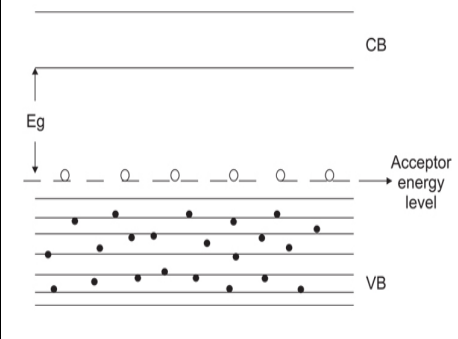
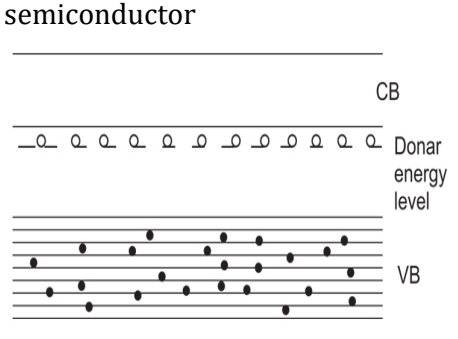
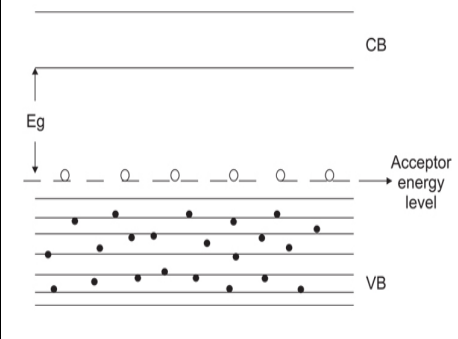
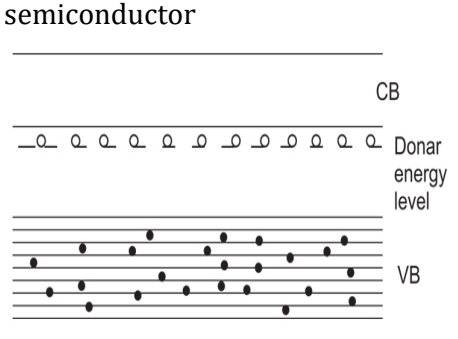
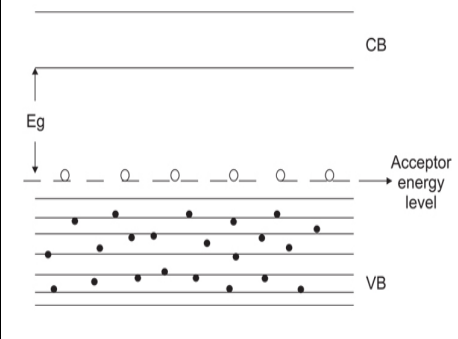
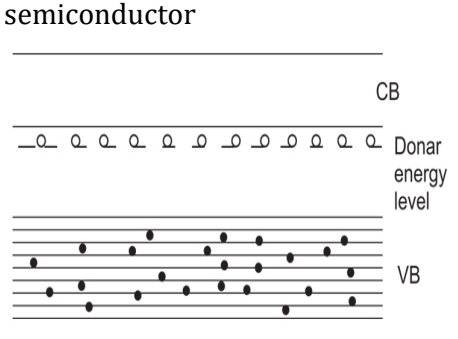
$\therefore$  energy in ground state =  $-13.6 \text{ eV}$

$kE = -TE = +13.6 \text{ eV}$

$$E_n = \frac{\infty}{n^2} \Rightarrow -3.4 \text{ eV} = \frac{\infty}{2^2} \Rightarrow$$

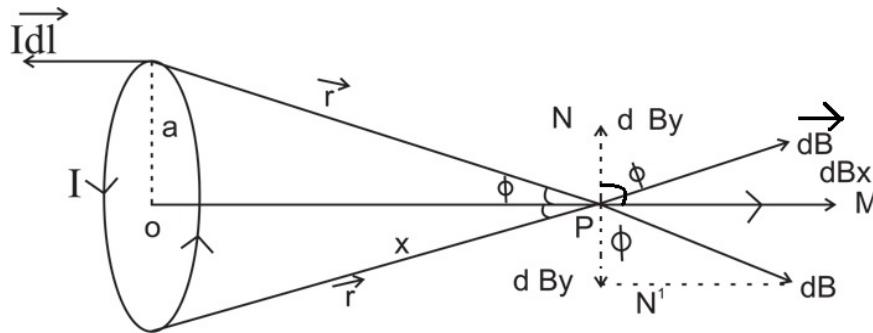
energy in ground state  $x = -13.6 \text{ eV}$ .

1

	$PE = 2TE = -2 \times 13.6 \text{ eV} = -27.2 \text{ eV}$	1								
27.	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">P-type semiconductor</th> <th style="width: 50%; text-align: center;">n-type semiconductor</th> </tr> </thead> <tbody> <tr> <td>1. Density of holes <math>\gg</math> density of electron</td> <td>1. density of electron <math>\gg</math> density of holes</td> </tr> <tr> <td>2. Formed by doping trivalent impurity</td> <td>2. formed by doping pentavalent impurity</td> </tr> <tr> <td>           Energy band diagram for p-type   </td> <td>           Energy band diagram of n-type semiconductor   </td> </tr> </tbody> </table> <p style="text-align: center;"><b>OR</b></p> <p>Energy of photon <math>E = \frac{hc}{\lambda} = \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{6000 \times 10^{-3} \times 1.6 \times 10^{-19}} \text{ eV} = 2.06 \text{ eV}</math></p> <p>As <math>E &lt; E_g</math> (2.8 eV), so photodiode cannot detect this photon.</p>	P-type semiconductor	n-type semiconductor	1. Density of holes $\gg$ density of electron	1. density of electron $\gg$ density of holes	2. Formed by doping trivalent impurity	2. formed by doping pentavalent impurity	Energy band diagram for p-type 	Energy band diagram of n-type semiconductor 	<p>Any 2x1 =1</p> <p>1</p> <p>1</p>
P-type semiconductor	n-type semiconductor									
1. Density of holes $\gg$ density of electron	1. density of electron $\gg$ density of holes									
2. Formed by doping trivalent impurity	2. formed by doping pentavalent impurity									
Energy band diagram for p-type 	Energy band diagram of n-type semiconductor 									
<b>Section - C</b>										
28.	<p>Principle of potentiometer, when a constant current flows through a wire of uniform area of cross-section, the potential drop across any length of the wire is directly proportional to the length.</p> <p>Let resistance of wire AB be <math>R_1</math> and its length be 'l' then current drawn from driving cell -</p> $I = \frac{V}{R+R_1} \text{ and hence}$ <p>P.D. across the wire AB will be</p> $V_{AB} = IR_1 = \frac{V}{R+R_1} \times \frac{\rho l}{a}$ <p>Where 'a' is area of cross-section of wire AB</p> $\therefore \frac{V_{AB}}{l} = \frac{V\rho}{(R+R_1).a} = \text{constant} = k$ <p>Where R increases, current and potential difference across wire AB will be</p>	<p>1</p> <p>1</p> <p>1</p>								

decreased and hence potential gradient 'k' will also be decreased. Thus the null point or balance point will shift to right (towards, B) side.

29.



According to Biot-Savart's law, magnetic field due to a current element is given by

$$d\vec{B} = \frac{\mu_0 I d\vec{l} \times \vec{r}}{4\pi r^3} \text{ where } r = \sqrt{x^2 + a^2}$$

$$\therefore dB = \frac{\mu_0 I dl \sin\theta}{4\pi (x^2 + a^2)^{3/2}}$$

And direction of  $d\vec{B}$  is  $\perp$  to the plane containing  $d\vec{l}$  and  $\vec{r}$ .

Resolving  $d\vec{B}$  along the x - axis and y - axis.

$$dB_x = dB \sin\theta$$

$$dB_y = dB \cos\theta$$

taking the contribution of whole current loop we get

$$B_x = \oint dB_x = \oint dB \sin\theta = \int \frac{\mu_0 I dl}{4\pi (x^2 + a^2)^{3/2}} \frac{a}{\sqrt{x^2 + a^2}}$$

$$B_x = \frac{\mu_0 I a}{4\pi (x^2 + a^2)^{3/2}} \oint dl = \frac{\mu_0 I a \times 2\pi a}{4\pi (x^2 + a^2)^{3/2}}$$

$$\text{And } B_y = \oint dB_y = \oint dB \cos\theta = 0$$

$$\therefore B_P = \sqrt{B_x^2 + B_y^2} = B_x = \frac{\mu_0 2IA}{4\pi (x^2 + a^2)^{3/2}}$$

$$\therefore \vec{B}_P = \frac{\mu_0 2m}{4\pi (x^2 + a^2)^{3/2}} (\because \vec{m} = I\vec{A})$$

For centre  $x = 0$

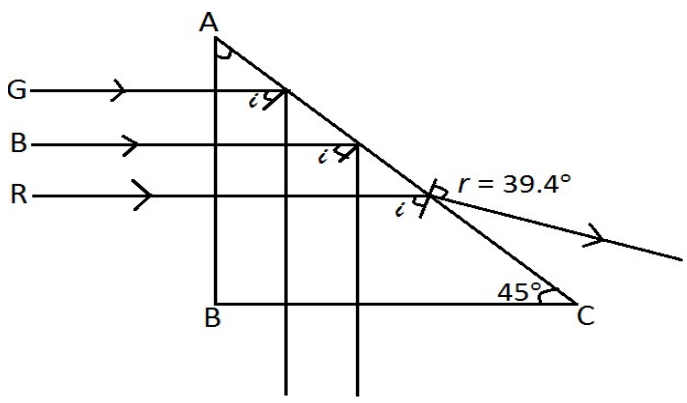
$$\therefore |\vec{B}_O| = \frac{\mu_0 2I\pi a^2}{4\pi a^3} = \mu_0 \left(\frac{I}{2a}\right) \text{ in the direction of } \vec{m}$$

1

1/2

1/2

1

30.	<p>∴ resonant frequency for LCR circuit is given by <math>\nu_0 = \frac{1}{2\pi\sqrt{LC}}</math></p> $= \frac{1}{2 \times 3.14 \times \sqrt{3 \times 27 \times 10^{-8}}}$ $= 17.69 \text{ Hz}$ <p>Or <math>\omega_0 = 2\pi\nu_0 = 111 \text{ rad/s}</math>.</p> <p>∴ quality factor of resonance</p> $Q = \frac{\omega_0}{2\Delta\omega} = \frac{\omega_0 L}{R} = \frac{1}{R} \sqrt{\frac{L}{C}}$ $\therefore Q = \frac{1}{7.4} \sqrt{\frac{3}{27 \times 10^{-8}}} = 45.0$ <p>To improve sharpness of resonance circuit by a factor 2, without reducing <math>\omega_0</math>; reduce R to half of its value i.e. <math>R = 3.7\Omega</math></p>	1  1  1
31.	 <p>Two conditions for TIR –</p> <p>(a) Light must travel from denser to rarer medium</p> <p>(b) <math>i &gt; i_c</math></p> $\therefore \sin i_c = \frac{1}{\mu}$ $\therefore (i_c)_{\text{Red}} = \sin^{-1}\left(\frac{1}{1.39}\right) = 46^\circ$ $(i_c)_{\text{Green}} = \sin^{-1}\left(\frac{1}{1.42}\right) = 44.8^\circ$ $(i_c)_{\text{Blue}} = \sin^{-1}\left(\frac{1}{1.48}\right) = 43^\circ$ <p>∴ Angle of incidence at face AC is <math>45^\circ</math> which is more than the critical angle for Blue and Green colours therefore they will show TIR but Red colour will refract to other medium.</p>	1          1  1
32.	<p>Resolving power (R.P) of an astronomical telescope is its ability to form separate images of two neighboring astronomical objects like stars etc.</p> $\text{R.P.} = \frac{1}{\theta} = \frac{D}{1.22\lambda}$ <p>where D is diameter of objective lens and <math>\lambda</math> is wave length</p>	1

of light used.

$$D = 100\text{inch} = 2.54 \times 100\text{cm} = 254\text{cm}$$

$$= 2.54\text{m}$$

$$\lambda = 6000\text{\AA}$$

$$\text{Limit of resolution } d\theta = \frac{1.22\lambda}{D}$$

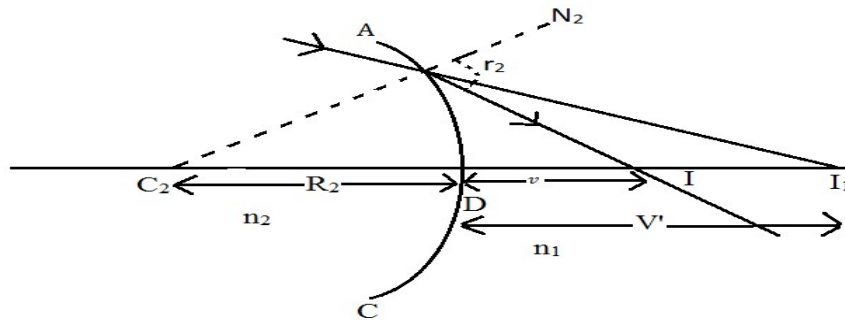
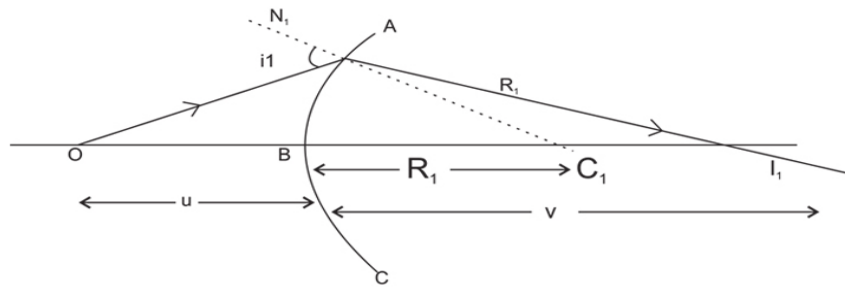
$$= \frac{1.22 \times 6000 \times 10^{-10}\text{m}}{254 \times 10^{-2}\text{m}}$$

$$= 2.9 \times 10^{-10}$$

**OR**

Basic assumptions in derivation of Lens-maker's formula:

- (i) Aperture of lens should be small
- (ii) Lenses should be thin
- (iii) Object should be point sized and placed on principal axis.



Suppose we have a thin lens of material of refractive index  $n_2$ , placed in a medium of refractive index  $n_1$ , let  $o$  be a point object placed on principle axis then for refraction at surface ABC we get image at  $I_1$ ,

$$\therefore \frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1} \text{ -----(1)}$$

But the refracted ray before goes to meet at  $I_1$  falls on surface ADC and refracts at  $I_2$

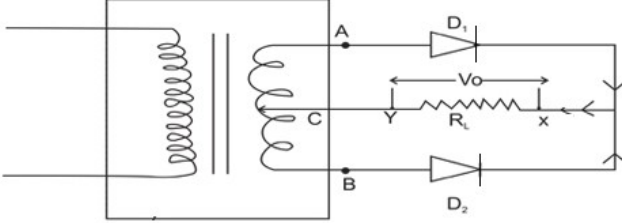
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1

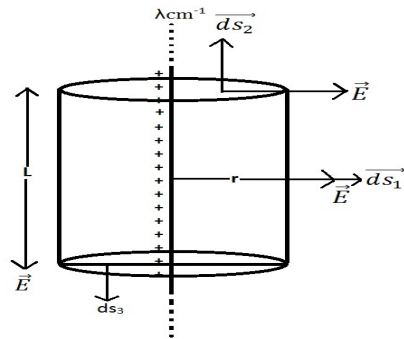
1



	<p>finally; hence <math>I_1</math> works as a virtual object 2<sup>nd</sup> refracting surface</p> $\therefore \frac{n_1}{v} - \frac{n_2}{v'} = \frac{n_2 - n_1}{R_2} \text{----- (2)}$ <p>Equation (1) + (2)</p> $\frac{n_1}{v} - \frac{n_1}{u} = (n_2 - n_1) \left( \frac{1}{R_1} - \frac{1}{R_2} \right)$ $\therefore \frac{1}{v} - \frac{1}{u} = (n_{21} - 1) \left( \frac{1}{R_1} - \frac{1}{R_2} \right) \text{-----(3)}$ <p>If <math>u = \infty, v = f</math></p> $\frac{1}{f} = (n_{21} - 1) \left( \frac{1}{R_1} - \frac{1}{R_2} \right) \text{-----(4)}$ <p>Which is lens maker's formula.</p>	1
33.	${}_{92}^{238}\text{U} \rightarrow {}_{91}^{237}\text{Pa} + {}_1^1\text{H} + Q$ $\therefore Q = [M_U - M_{Pa} - M_H] c^2$ $= [238.05079 - 237.05121 - 1.00783] \text{ u} \times c^2$ $= -0.00825 \text{ u} \times 931.5 \frac{\text{MeV}}{\text{u}}$ $= -7.68 \text{ MeV}$ <p><math>\therefore Q &lt; 0</math> ; therefore it can't proceed spontaneously. We will have to supply energy of 7.68MeV to <math>{}_{92}^{238}\text{U}</math> nucleus to make it emit proton.</p>	1 1 1
34.	<p>Circuit Diagram</p>  <p>One possible answer: Change the connection of R from point C to point B.</p> <p>Now No Current flowing through <math>D_2</math> in the second half.</p> <p>1 mark for any correct diagram 2 marks for correct explanation</p>	1  2

**Section - D**

35.  
(a)



1

According to Gauss's law -

$$\oint \vec{E} \cdot d\vec{s} = \frac{1}{\epsilon_0} \{q\}$$

$$\int \vec{E} \cdot d\vec{s}_1 + \int \vec{E} \cdot d\vec{s}_2 + \int \vec{E} \cdot d\vec{s}_3 = \frac{1}{\epsilon_0} (\lambda L)$$

$$\int E ds_1 \cos 0 + \int E ds_2 \cos 90^\circ + \int E ds_3 \cos 90^\circ = \frac{\lambda L}{\epsilon_0}$$

$$E \int ds_1 = \frac{\lambda L}{\epsilon_0}$$

$$E \times 2\pi r L = \frac{\lambda L}{\epsilon_0}$$

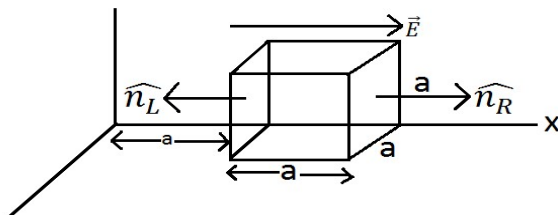
$$E = \frac{\lambda}{2\pi\epsilon_0 r}$$

$$\vec{E} = \frac{\lambda}{2\pi\epsilon_0 r} \hat{r}$$

1

1

35.  
(b)



$$\because E_x = \alpha x = 400x$$

$$E_y = E_z = 0$$

Hence flux will exist only on left and right faces of cube as  $E_x \neq 0$

$$\because \vec{E}_L \cdot a^2(\vec{n}_L) + \vec{E}_R \cdot a^2(\vec{n}_R) = \frac{1}{\epsilon_0} \{q_{in}\} = \phi$$

$$-E_L \cdot a^2(\vec{n}_L) + a^2 E_R = \phi_{Net}$$

$$\phi_{Net} = -(400a)a^2 + a^2(400 \times 2a)$$

$$= -400a^3 + 800a^3$$

$$= 400a^3$$

$$= 400 \times (.1)^3$$

$$\phi_{Net} = 0.4 \text{ Nm}^2\text{c}^{-1}$$

1

$$\therefore \phi_{Net} = \frac{1}{\epsilon_0} \{q_{in}\}$$

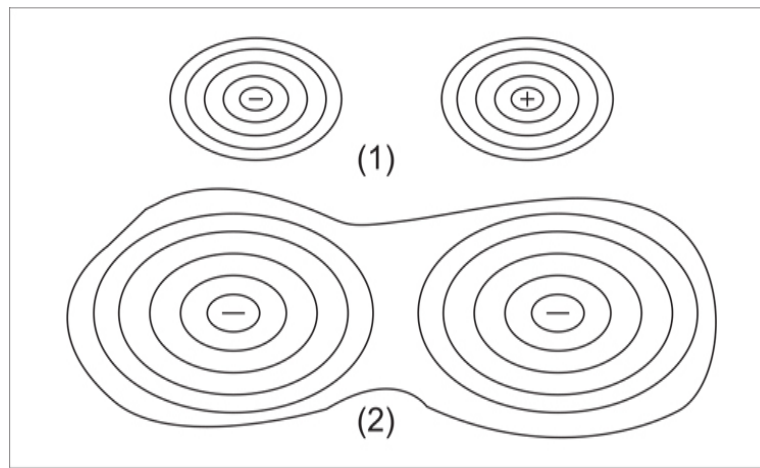
$$\begin{aligned} \therefore q_{in} &= \epsilon_0 \phi_{Net} \\ &= 8.85 \times 10^{-12} \times 0.4 \\ &= 3.540 \times 10^{-12} \text{C} \end{aligned}$$

**OR**

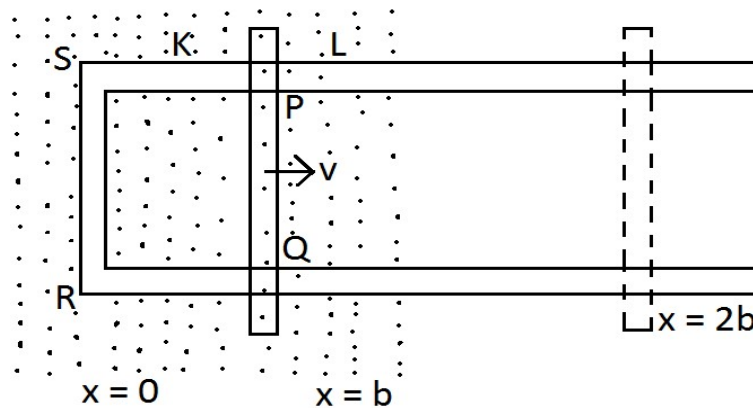
- (a) Definition of electrostatic potential – SI unit J/c of Volt.  
Deduction of expression of electrostatic potential energy of given system of charges –

$$U = \frac{1}{4\pi\epsilon_0} \left[ \frac{q_1 q_2}{r_{12}} + \frac{q_1 q_3}{r_{13}} + \frac{q_2 q_3}{r_{23}} \right]$$

(b)



36. For forward motion from  $x = 0$  to  $x = 2b$ .  
The flux  $\phi_B$  linked with circuit SPQR is



$$\begin{aligned} \phi_B &= Blx & 0 \leq x < b \\ &= Blb & b \leq x < 2b \end{aligned}$$

The induced emf is,

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

$$\begin{aligned} e &= -Blv & 0 \leq x < b \\ &= 0 & b \leq x < 2b \end{aligned}$$

When induced emf is non-zero, the current  $I$  in the magnitude;

$$I = \frac{e}{r} = \frac{Blv}{r}$$

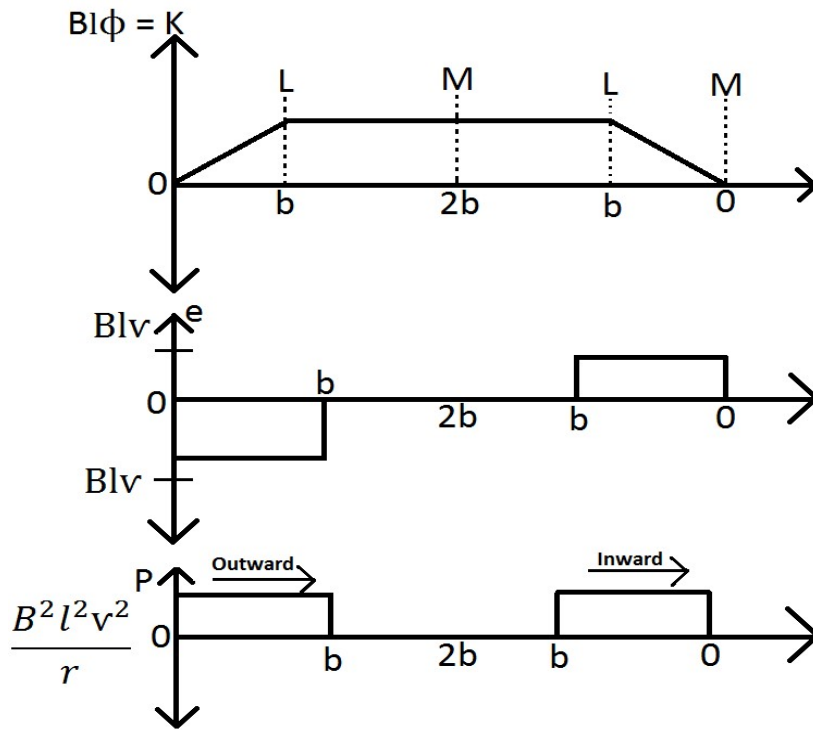
The force required to keep arm PQ in constant motion is  $F = IlB$ . Its direction is to the left. In magnitude

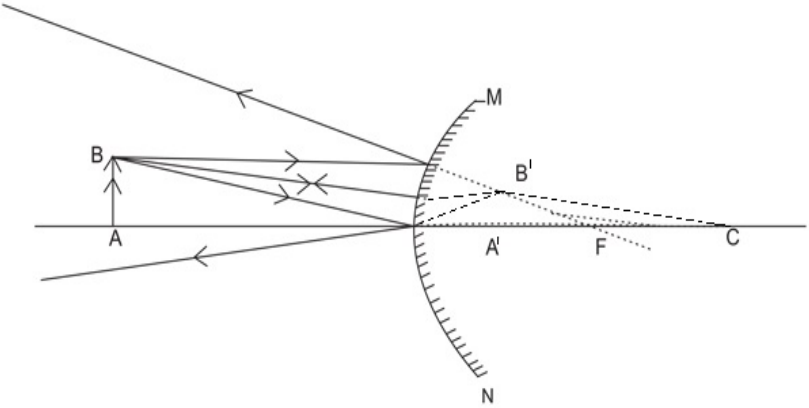
$$\begin{aligned} F &= I/B = \frac{B^2 l^2 v}{r} ; & 0 \leq x < b \\ &= 0 ; & b \leq x < 2b \end{aligned}$$

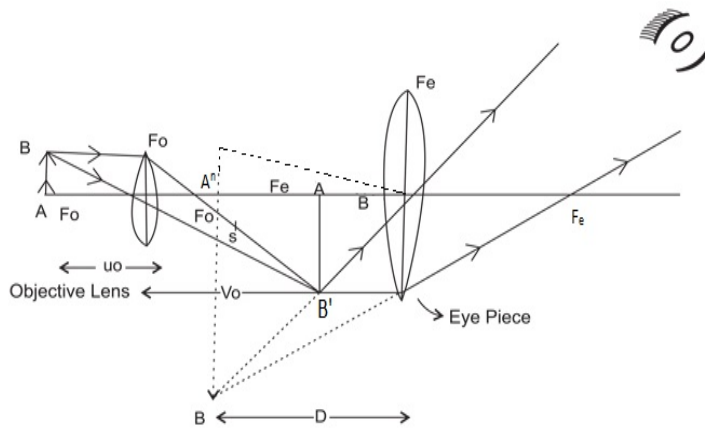
The Joule heating loss is

$$\begin{aligned} P_J &= I^2 r \\ &= \frac{B^2 l^2 v^2}{r} & 0 \leq x < b \\ &= 0 & b \leq x < 2b \end{aligned}$$

One obtains similar expressions for the inward motion from  $x = 2b$  to  $x = 0$



	<b>OR</b>	
	Working principle of cyclotron Diagram Working of cyclotron with explanation Any two applications	1 1 2 1
37.	<div style="text-align: center;">  </div> <p>Deduction of mirror formula</p> $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ <p>For a convex mirror f is always +ve.</p> $\therefore f > c$ <p>Object is always placed in front of mirror hence <math>u &lt; 0</math> (for real object)</p> $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$ <p>As <math>u &lt; 0</math> <math>u</math> -ve hence</p> $\frac{1}{v} > 0$ <p><math>\Rightarrow v &gt; 0</math> i.e. +ve for all values of <math>u</math>.</p> <p>Image will be formed behind the mirror and it will be virtual for all values of <math>u</math>.</p>	1  2  1  1
37. (a)	<b>OR</b>	
	Ray Diagram : (with proper labeling)	1



$$\text{Magnifying power } m = \frac{V_o}{u_o} \left( 1 + \frac{D}{f_e} \right)$$

$$m = \frac{L}{f_o} \left( 1 + \frac{D}{f_e} \right)$$

1

37.  
(b)

$\therefore m = m_o m_e = -30$  (virtual, inverted)

$$\therefore f_o = 1.25 \text{ cm}$$

$$f_e = 5.0 \text{ cm}$$

Let us setup a compound microscope such that the final image be formed at D, then

$$m_e = 1 + \frac{v}{f_e} = 1 + \frac{25}{5} = 6$$

and position of object for this image formation can be calculated -

$$\frac{1}{v_e} - \frac{1}{u_e} = \frac{1}{f_e}$$

$$\frac{1}{-25} - \frac{1}{u_e} = \frac{1}{5}$$

$$-\frac{1}{u_e} = \frac{1}{5} + \frac{1}{25} = \frac{6}{25}$$

$$u_e = \frac{-25}{6} = -4.17 \text{ cm.}$$

$$\therefore m = m_o \times m_e$$

$$\therefore m_o = \frac{+V_o}{u_o} = \frac{-30}{6} = -5$$

$$\therefore V = -5u_o$$

$$\frac{1}{v_o} - \frac{1}{u_o} = \frac{1}{f_o}$$

$$\frac{1}{-5u_o} - \frac{1}{u_o} = \frac{1}{1.25}$$

1

1

	$\frac{-f}{5u_o} = \frac{1}{125}$ $u_o = -1.5\text{cm} \Rightarrow v_o = 7.5\text{cm}$ <p>Tube length = <math>V_o +  u_e  = 7.5\text{cm} + 4.17\text{cm}</math></p> $L = 11.67\text{cm}$ <p>Object should be placed at 1.5cm distance from the objective lens.</p>	1
--	--	---