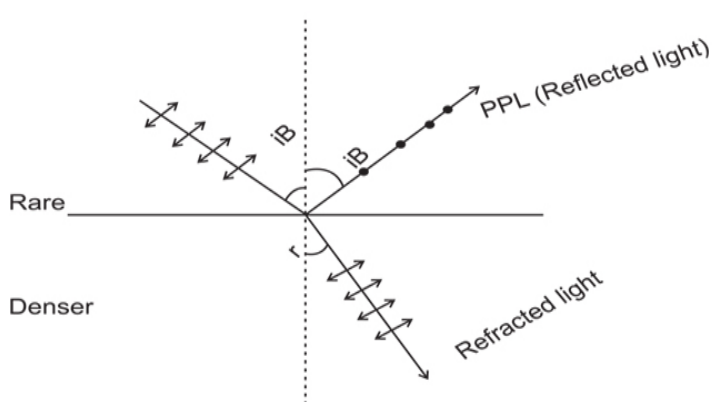


Class -XII
PHYSICS
SQP Marking Scheme
2019-20

Section - A		
1.	a, $\phi = \frac{q}{6\epsilon_0}$ (for one face)	1
2.	b, Conductor	1
3.	a, 1Ω .	1
4.	c, 12.0kJ	1
5.	a, speed	1
6.	d, virtual and inverted	1
7.	a, straight line	1
8.	d, 60°	1
9.	b, work function	1
10.	b, third orbit	1
11.	45° or vertical	1
12.	2 H	1
13.	double	1
14.	1.227 \AA	1
15.	60°	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

	OR	
	Any one use	
Section - B		
21.	<p>When electric field E is applied on conductor force acting on free electrons</p> $\vec{F} = -e \vec{E}$ $m\vec{a} = -e\vec{E}$ $\vec{a} = \frac{-e\vec{E}}{m}$ <p>Average thermal velocity of electron in conductor is zero $(u_t)_{av} = 0$</p> <p>Average velocity of electron in conductors in τ (relaxation time) = v_d (drift velocity)</p> $v_d = (u_t)_{av} + a \tau$ $v_d = 0 + \frac{-eE\tau}{m}$ $\vec{v}_d = \frac{-eE\tau}{m}$	 1 1
22.	<div style="text-align: center;"> <p>The circuit consists of a 6V battery on the left. A capacitor $C_1 = 1\mu F$ is connected in parallel across the battery. The main circuit then splits into three parallel branches. The top branch contains capacitor $C_2 = 2\mu F$. The middle branch contains capacitor $C_4 = 1\mu F$ in series with capacitor $C_3 = 2\mu F$. The bottom branch contains capacitor $C_5 = 2\mu F$.</p> </div> <p>C_2 and C_3 are in series</p> $\frac{1}{c'} = \frac{1}{2} + \frac{1}{2} = 1$ <p>$c' = 1\mu f$</p> <p>c' & C_4 are in </p> $C'' = 1 + 1 = 2\mu f$ <p>C'' & c_5 are in series</p> $\frac{1}{c'''} = \frac{1}{2} + \frac{1}{2} \Rightarrow c''' = 1\mu f$ <p>c''' & c_1 are in </p> $C_{eq} = 1 + 1 = 2\mu f$ <p>Energy stored</p> $U = \frac{1}{2} cv^2 = \frac{1}{2} \times 2 \times 10^{-6} \times 6^2$ $= 36 \times 10^{-6} J$	 1 1

23.	<p>Gain in KE of particle = Qv</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 (i_B)</p>  <p>At $i = i_B$, reflected beam is perpendicular to refracted beam $\therefore i_B + r = 90 \Rightarrow r = 90 - i_B$</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 $\omega = h\nu_0$</p> $\nu_0 = \frac{\omega}{h} = \frac{2.14 \times 1.6 \times 10^{-19}}{6.62 \times 10^{-34}}$	1

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

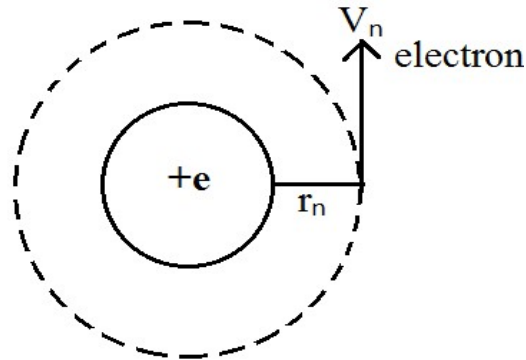
(b) As $k_{\text{max}} = eV_0 = 0.6 \text{ eV}$

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

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

1

26.



centripetal force = electrostatic attraction

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

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

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

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

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

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

OR

Energy of electron in $n = 2$ is -3.4 eV

\therefore energy in ground state = -13.6 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

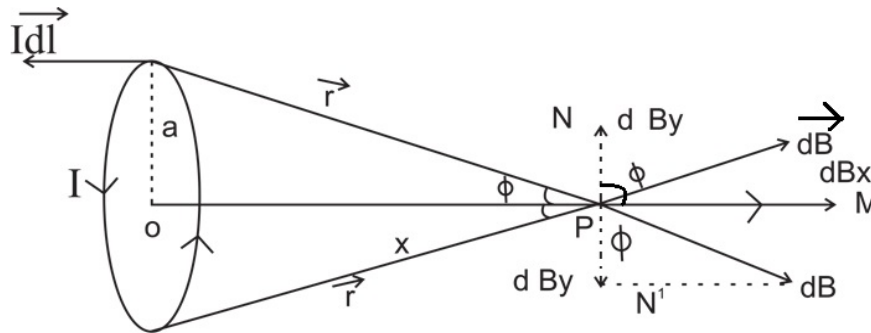
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1

	$PE = 2TE = -2 \times 13.6 \text{ eV} = -27.2 \text{ eV}$	1								
27.	<table border="1"> <thead> <tr> <th>P-type semiconductor</th> <th>n-type semiconductor</th> </tr> </thead> <tbody> <tr> <td>1. Density of holes \gg density of electron</td> <td>1. density of electron \gg 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;">OR</p> <p>Energy of photon $E = \frac{hc}{\lambda} = \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{6000 \times 10^{-3} \times 1.6 \times 10^{-19}} \text{ eV} = 2.06 \text{ eV}$</p> <p>As $E < E_g$ (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 									
Section - C										
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 R_1 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

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

$$\therefore dB = \frac{\mu_0 I dl \sin 90^\circ}{4\pi (x^2 + a^2)}$$

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 $x = 0$

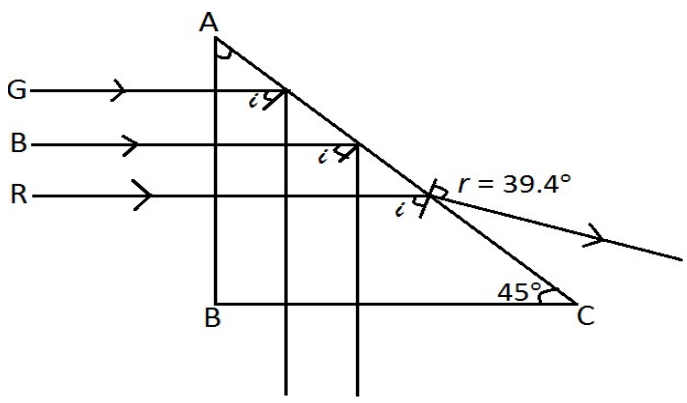
$$\therefore |\vec{B}_O| = \frac{\mu_0 2I\pi a^2}{4\pi a^3} = \mu_0 \left(\frac{I}{2a}\right) \text{ in the direction of } \vec{m}$$

1

1/2

1/2

1

30.	<p>∴ resonant frequency for LCR circuit is given by $\nu_0 = \frac{1}{2\pi\sqrt{LC}}$</p> $= \frac{1}{2 \times 3.14 \times \sqrt{3 \times 27 \times 10^{-8}}}$ $= 17.69 \text{ Hz}$ <p>Or $\omega_0 = 2\pi\nu_0 = 111 \text{ rad/s}$.</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 ω_0; reduce R to half of its value i.e. $R = 3.7\Omega$</p>	1 1 1
31.	 <p>Two conditions for TIR –</p> <p>(a) Light must travel from denser to rarer medium</p> <p>(b) $i > i_c$</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 45° 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 λ is wave length</p>	1

of light used.

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

$$= 2.54\text{m}$$

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

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

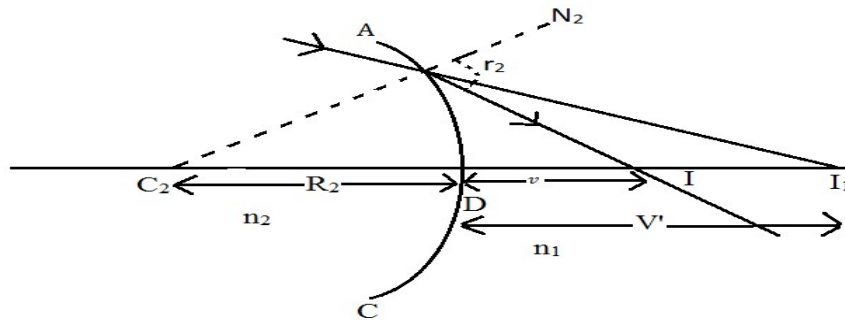
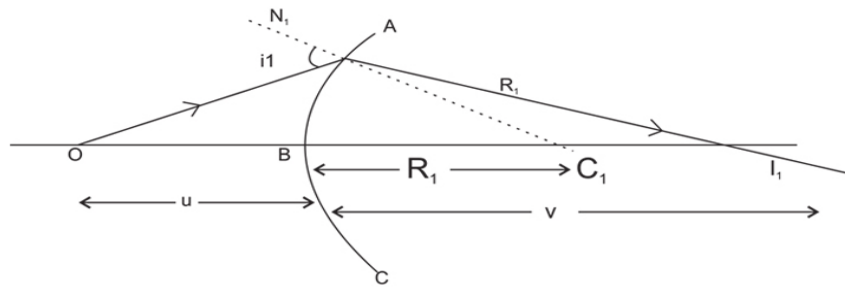
$$= \frac{1.22 \times 6000 \times 10^{-10}\text{m}}{254 \times 10^{-2}\text{m}}$$

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

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 ,

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

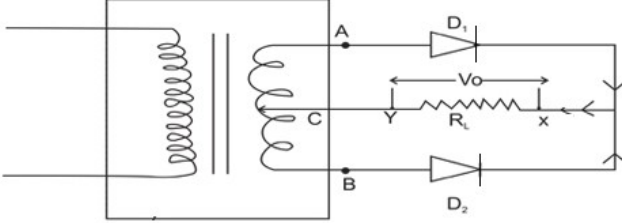
But the refracted ray before goes to meet at I_1 falls on surface ADC and refracts at I_2

1

1

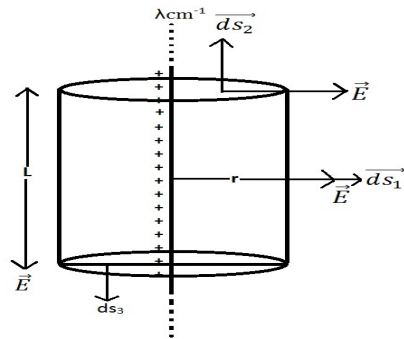
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	<p>finally; hence I_1 works as a virtual object 2nd refracting surface</p> $\therefore \frac{n_1}{v} - \frac{n_2}{v'} = \frac{n_2 - n_1}{R_2} \dots\dots\dots (2)$ <p>Equation (1) + (2)</p> $\frac{n_1}{v} - \frac{n_1}{u} = (n_2 - n_1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$ $\therefore \frac{1}{v} - \frac{1}{u} = (n_{21} - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) \dots\dots\dots (3)$ <p>If $u = \infty, v = f$</p> $\frac{1}{f} = (n_{21} - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) \dots\dots\dots (4)$ <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>$\therefore Q < 0$; therefore it can't proceed spontaneously. We will have to supply energy of 7.68MeV to ${}_{92}^{238}\text{U}$ 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 D_2 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 -

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

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

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

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

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

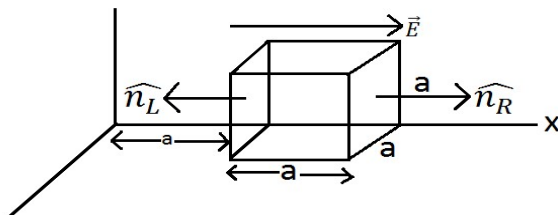
$$E = \frac{\lambda}{2\pi \epsilon_0 r}$$

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

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 $E_x \neq 0$

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

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

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

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

$$= 400a^3$$

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

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

1

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

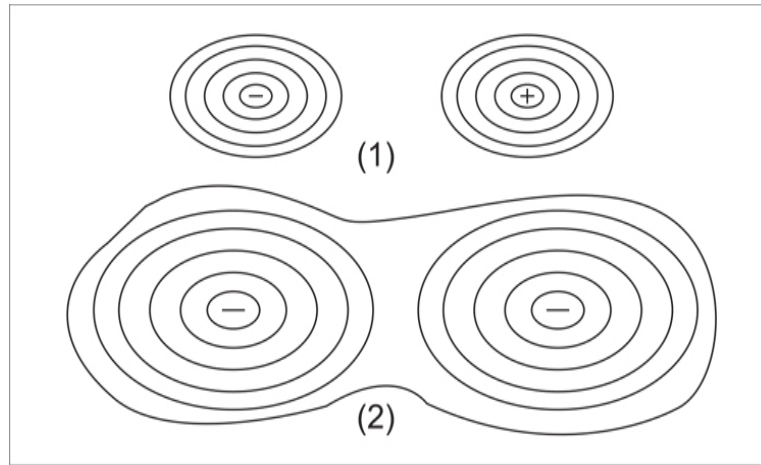
$$\begin{aligned} \therefore q_{in} &= \epsilon_0 \phi_{Net} \\ &= 8.85 \times 10^{-12} \times 0.4 \\ &= 3.540 \times 10^{-12} \text{C} \end{aligned}$$

OR

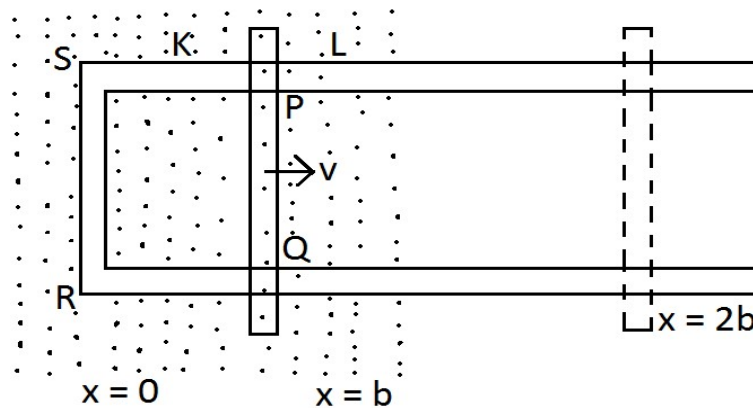
- (a) Definition of electrostatic potential – SI unit J/c of Volt.
Deduction of expression of electrostatic potential energy of given system of charges –

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

(b)



36. For forward motion from $x = 0$ to $x = 2b$.
The flux ϕ_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;

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

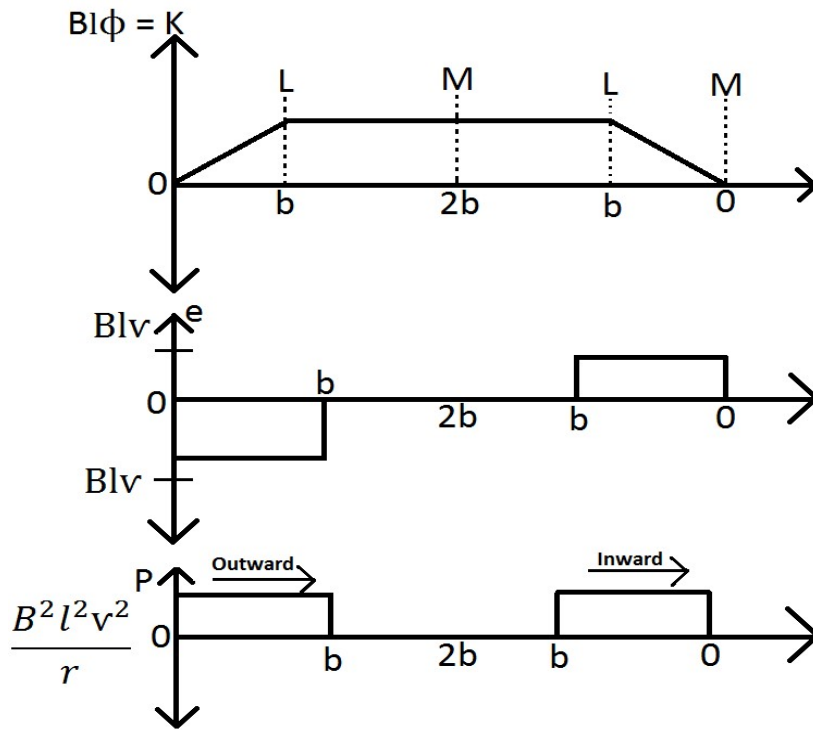
The force required to keep arm PQ in constant motion is $F = IlB$. Its direction is to the left. In magnitude

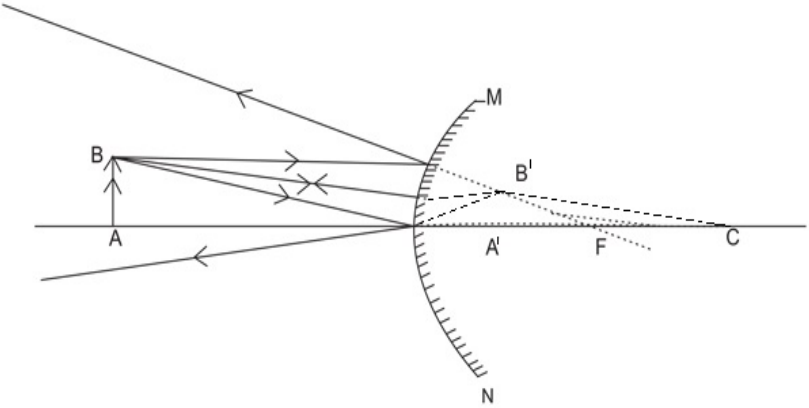
$$\begin{aligned} F &= I/B = \frac{B^2 l^2 v}{r} ; & 0 \leq x < b \\ &= 0 ; & b \leq x < 2b \end{aligned}$$

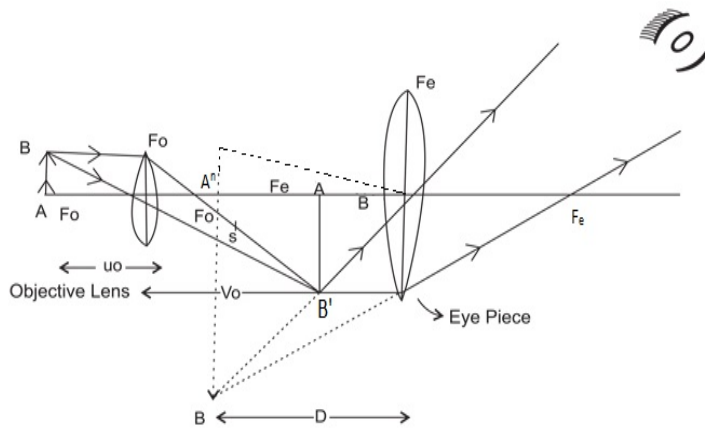
The Joule heating loss is

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

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



	OR	
	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 $u < 0$ (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 $u < 0$ u -ve hence</p> $\frac{1}{v} > 0$ <p>$\Rightarrow v > 0$ i.e. +ve for all values of u.</p> <p>Image will be formed behind the mirror and it will be virtual for all values of u.</p>	1 2 1 1
37. (a)	OR	
	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

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