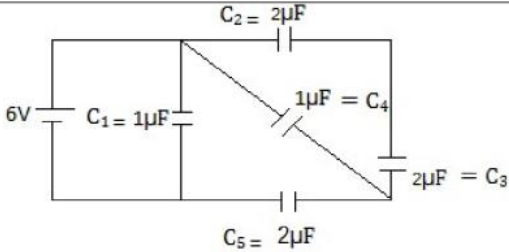
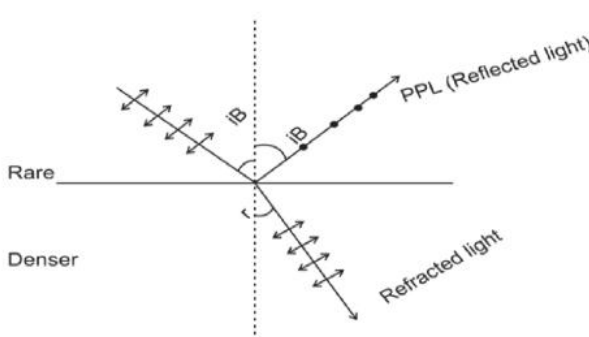
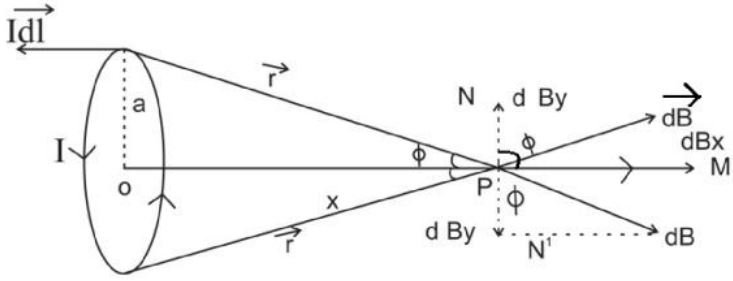


Class -XII
PHYSICS
SQP Marking Scheme
2019-20

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.	$1.227 \text{ \AA}$	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.	When electric field E is applied on conductor force acting on free electrons $\vec{F} = -e \vec{E}$ $m\vec{a} = -e\vec{E}$ $\vec{a} = \frac{-e\vec{E}}{m}$ Average thermal velocity of electron in conductor is zero $(u_t)_{av} = 0$ Average velocity of electron in conductors in τ (relaxation time) = v_d (drift velocity) $v_d = (u_t)_{av} + a \tau$ $v_d = 0 + \frac{-eE\tau}{m}$ $\vec{v}_d = \frac{-e\vec{E}\tau}{m}$	1 1
22.	 C_2 and C_3 are in series $\frac{1}{c'} = \frac{1}{2} + \frac{1}{2} = 1$ $c' = 1\mu f$ c' & C_4 are in $C'' = 1 + 1 = 2\mu f$ C'' & C_5 are in series $\frac{1}{c'''} = \frac{1}{2} + \frac{1}{2} \Rightarrow c''' = 1\mu f$ c''' & C_1 are in $C_{eq} = 1 + 1 = 2\mu f$ Energy stored $U = \frac{1}{2} cv^2 = \frac{1}{2} \times 2 \times 10^{-6} \times 6^2$ $= 36 \times 10^{-6} J$	1 1

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

	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 $\vec{dB} = \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \vec{r}}{r^2} \text{ where } r = \sqrt{x^2 + a^2}$ $\therefore dB = \frac{\mu_0 I dl \sin 90^\circ}{4\pi (x^2 + a^2)^{3/2}}$ And direction of $\vec{dB}$ is $\perp$ to the plane containing $I d\vec{l}$ and $\vec{r}$. Resolving $\vec{dB}$ 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 $B_x = \oint dB_x = \oint dB \sin \theta = \int \frac{\mu_0}{4\pi} \frac{I dl}{x^2 + a^2} \frac{a}{\sqrt{x^2 + a^2}}$ $B_x = \frac{\mu_0}{4\pi} \frac{I_a}{(x^2 + a^2)^{3/2}} \oint dl = \frac{\mu_0}{4\pi} \frac{I_a \times 2\pi a}{(x^2 + a^2)^{3/2}}$ And $B_y = \oint dB_y = \oint dB \cos \theta = 0$ $\therefore B_p = \sqrt{B_x^2 + B_y^2} = B_x = \frac{\mu_0}{4\pi} \frac{2IA}{(x^2 + a^2)^{3/2}}$ $\therefore \vec{B}_p = \frac{\mu_0}{4\pi} \frac{2m'}{(x^2 + a^2)^{3/2}} (\because \vec{m}' = I\vec{A})$ For centre $x = 0$ $\therefore \vec{B}_o = \frac{\mu_0}{4\pi} \frac{2I\pi a^2}{a^3} = \mu_0 \left(\frac{I}{2a} \right) \text{ in the direction of } \vec{m}$	1 1/2 1/2 1

of light used.

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

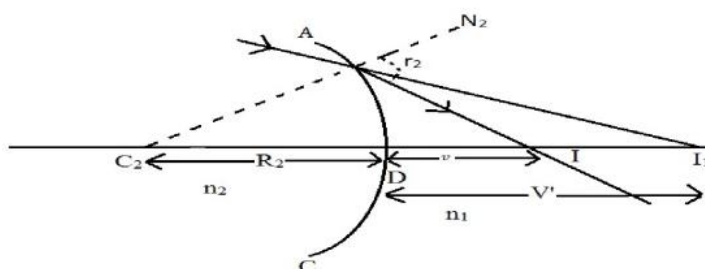
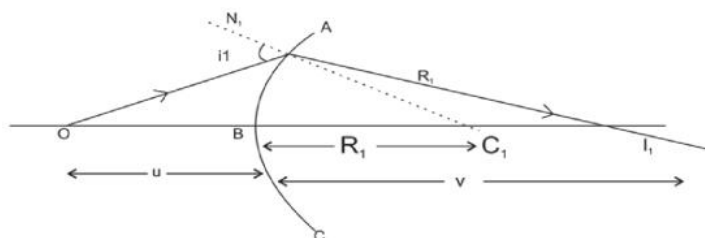
$$\lambda = 6000\text{\AA}$$

$$\text{Limit of resolution } d\theta = \frac{1.22\lambda}{D} \\ = \frac{1.22 \times 6000 \times 10^{-10}\text{m}}{254 \times 10^{-2}\text{m}} \\ = 2.9 \times 10^{-10}$$

OR

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

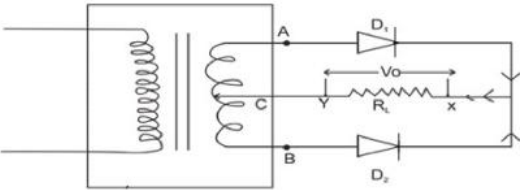
- (i) Aperture of lens should be small
- (ii) Lenses should be thin
- (iii) Object should be point sized and placed on principal axis.



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 ,

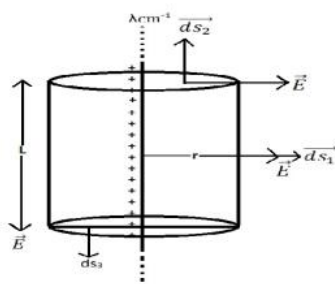
$$\therefore \frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1} \text{ -----(1)}$$

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

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

Section – D

35.
(a)



According to Gauss's law –

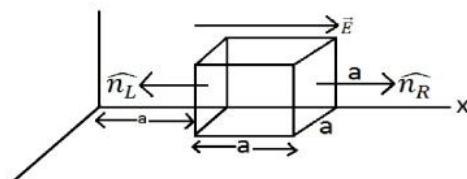
$$\begin{aligned}\oint \vec{E} \cdot d\vec{s} &= \frac{1}{\epsilon_0} \{q\} \\ \int \vec{E} \cdot d\vec{s}_1 + \int \vec{E} \cdot d\vec{s}_2 + \int \vec{E} \cdot d\vec{s}_3 &= \frac{1}{\epsilon_0} (\lambda L) \\ \int E ds_1 \cos 0 + \int E ds_2 \cos 90^\circ + \int E ds_3 \cos 90^\circ &= \frac{\lambda L}{\epsilon_0} \\ E \int ds_1 &= \frac{\lambda L}{\epsilon_0} \\ E \times 2\pi r L &= \frac{\lambda L}{\epsilon_0} \\ E &= \frac{\lambda}{2\pi \epsilon_0 r} \\ \vec{E} &= \frac{\lambda}{2\pi \epsilon_0 r} \hat{r}\end{aligned}$$

1

1

1

35.
(b)

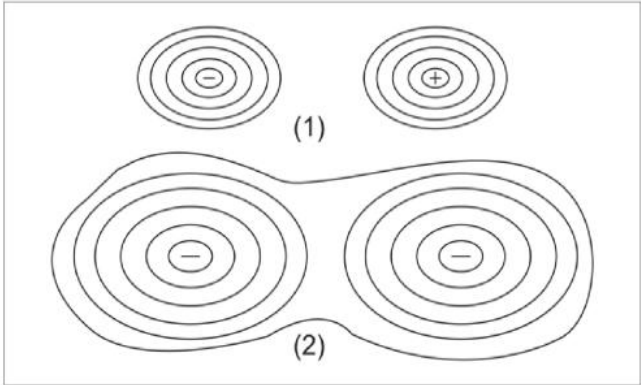
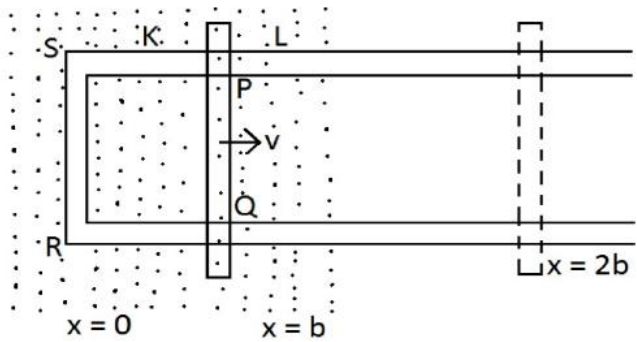


$$\begin{aligned}\because E_x &= \propto x = 400x \\ E_y &= E_z = 0\end{aligned}$$

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

$$\begin{aligned}\because \vec{E}_L \cdot a^2(\hat{n}_L) + \vec{E}_R \cdot a^2(\hat{n}_R) &= \frac{1}{\epsilon_0} \{q_{in}\} = \phi \\ -E_L \cdot a^2(\hat{n}_L) + a^2 E_R &= \phi_{Net} \\ \phi_{Net} &= -(400a)a^2 + a^2(400 \times 2a) \\ &= -400a^3 + 800a^3 \\ &= 400a^3 \\ &= 400 \times (.1)^3 \\ \phi_{Net} &= 0.4 \text{ Nm}^2\text{C}^{-1}\end{aligned}$$

1

	$\therefore \phi_{Net} = \frac{1}{\epsilon_0} \{q_{in}\}$ $\therefore q_{in} = \epsilon_0 \phi_{Net}$ $= 8.85 \times 10^{-12} \times 0.4$ $= 3.540 \times 10^{-12} C$ 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) 	1 1 2 1 1
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,

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

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

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

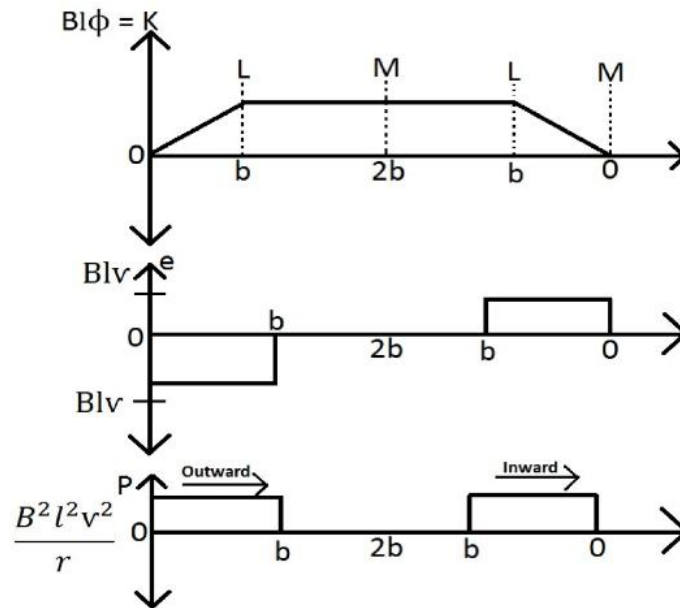
The force required to keep arm PQ in constant motion is $F = IlB$. Its direction is to the left. In magnitude

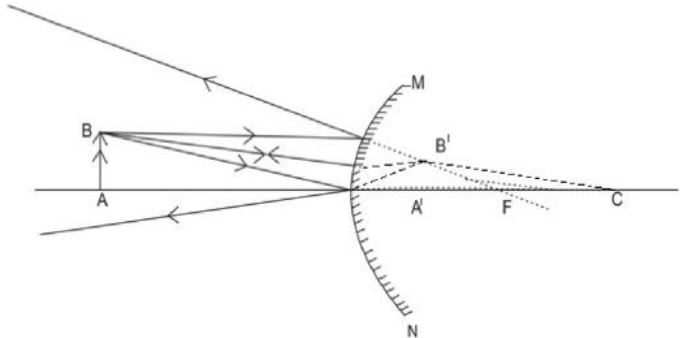
$$\begin{aligned}F &= IlB = \frac{B^2 l^2 v}{r} ; & 0 \leq x < b \\ &= 0 ; & b \leq x < 2b\end{aligned}$$

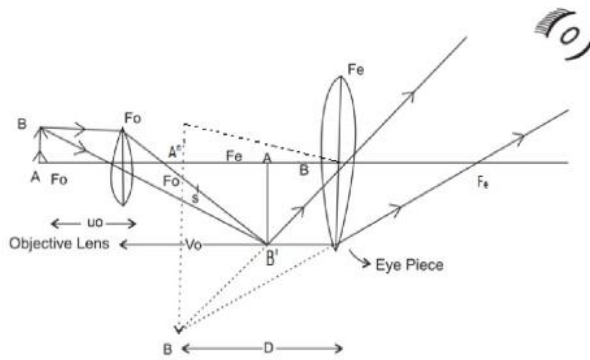
The Joule heating loss is

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

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.	 Deduction of mirror formula $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ For a convex mirror f is always +ve. $\therefore f > 0$ Object is always placed in front of mirror hence $u < 0$ (for real object) $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$ As $u < 0$ u -ve hence $\frac{1}{v} > 0$ $\Rightarrow v > 0 \text{ i.e. +ve for all values of } u.$ Image will be formed behind the mirror and it will be virtual for all values of u.	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. $\therefore m = m_o m_e = -30$ (virtual, inverted)

(b)

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

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

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

	$\frac{-6}{5u_o} = \frac{1}{125}$ $u_o = -1.5\text{cm} \Rightarrow v_o = 7.5\text{cm}$ Tube length = $V_o + u_e = 7.5\text{cm} + 4.17\text{cm}$ $L = 11.67\text{cm}$ Object should be placed at 1.5cm distance from the objective lens.	1
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