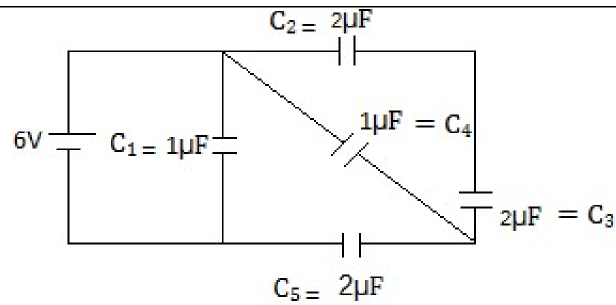
Class -XII

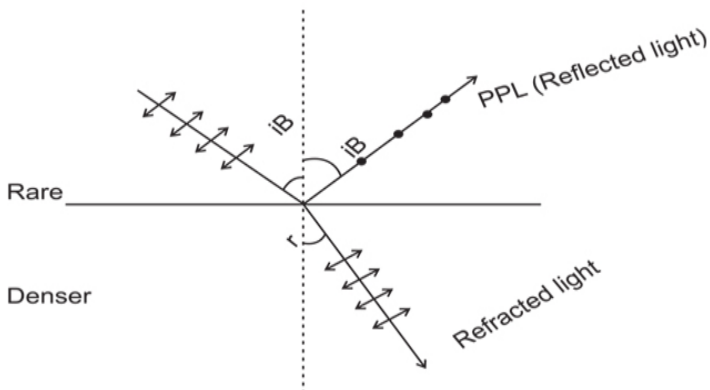
PHYSICS

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, 60^0	1
9.	b, work function	1
10.	b, third orbit	1
11.	45^0 or vertical	1
12.	2 H	1
13.	double	1
14.	1.227 A^o	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.	$N_o/8$	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 $\parallel$ $C'' = 1 + 1 = 2\mu f$ C'' & c_5 are in series $\frac{1}{c'''} = \frac{1}{2} + \frac{1}{2} \Longrightarrow c''' = 1\mu f$ c''' & c_1 are in $\parallel$ $C_{eq} = 1 + 1 = 2\mu f$ 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 $\frac{1}{2}m_p v_p^2 = K_P = q_p V_p$ ----------(i) $V_p = V_\alpha = V$ $\frac{1}{2}m_\alpha v_\alpha^2 = K_\alpha = q_\alpha V_\alpha$ -----------(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 1 to refracted beam $\therefore i_B + r = 90 \Longrightarrow r = 90 - i_B$ Using snell's law $\frac{Sin\ i}{Sin\ r} = \mu$ $\frac{Sin\ i_B}{Sin\ (90 - i_B)} = \mu \Longrightarrow \frac{Sin\ i_B}{Cos\ i_B} = \mu$ $\mu = \tan i_B$	1 1
25.	wave function $\omega = 2.14eV$ (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

$= 5.17 \times 10^{14} H_z$

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

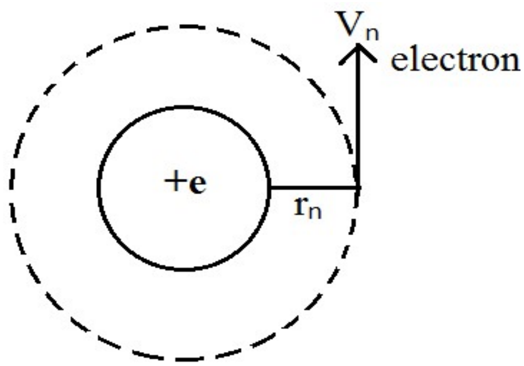
Energy of photon $E = k_{max} + \omega = 0.6eV + 2.14eV$

$= 2.74eV$

Wave length of photon $\lambda = \frac{hc}{E} = \frac{6.62\times10^{-34}\times3\times10^{-8}}{2.74\times1.6\times10^{-19}}$ 1

$= 4530Å$

26.



centripetal force = electrostatic attraction 1

$$\frac{mv_n^2}{r_n} = \frac{1}{4\pi\epsilon 0}\frac{e^2}{r_n^2}$$

$$mv_n^2 = \frac{1}{4\pi\epsilon 0}\frac{e^2}{r_n} \text{ --------(i)}$$

$$\text{as} mv_n r_n = n \cdot \frac{h}{2\pi}$$

$$v_n = \frac{nh}{2\pi m r_n} \text{ put in (i)}$$ 1

$$m \cdot \frac{n^2h^2}{4\pi^2m^2r_n^2} = \frac{1}{4\pi\epsilon 0}\frac{e^2}{r_n}$$

$$r_n = \frac{\epsilon 0 n^2h^2}{\pi m e^2}$$

<u>OR</u>

Energy of electron in n = 2 is -3.4eV

∴ energy in ground state = -13.6eV

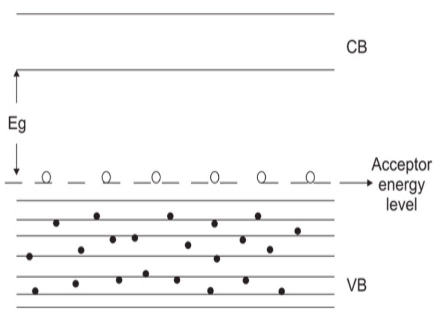
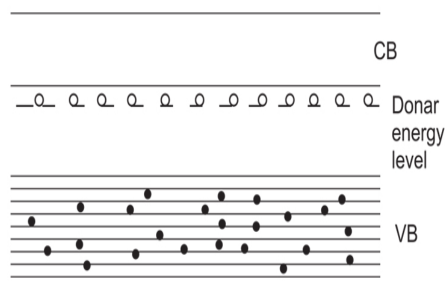
kE = -TE = +13.6eV

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

energy in ground state x = - 13.6eV. 1

PE = 2TE = -2×13.6eV = -27.2eV — 1

27. — Any 2x1 =1

P-type semiconductor	n-type semiconductor
1. Density of holes >> density of electron 2. Formed by doping trivalent impurity	1. density of electron>>density of holes 2. formed by doping pentavalent impurity
Energy band diagram for p-type 	Energy band diagram of n-type semiconductor 

OR

Energy of photon $E = \frac{hc}{\lambda} = \frac{6.62\times10^{-34}\times3\times10^{8}}{6000\times10^{-9}\times1.6\times10^{-19}}$ eV =2.06eV — 1

As $E<E_g$ (2.8eV), so photodiode cannot detect this photon. — 1

Section – C

28.

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.

Let resistance of wire AB be R_1 and its length be 'l' then current drawn from driving cell –

$I = \frac{V}{R+R1}$ and hence — 1

P.D. across the wire AB will be

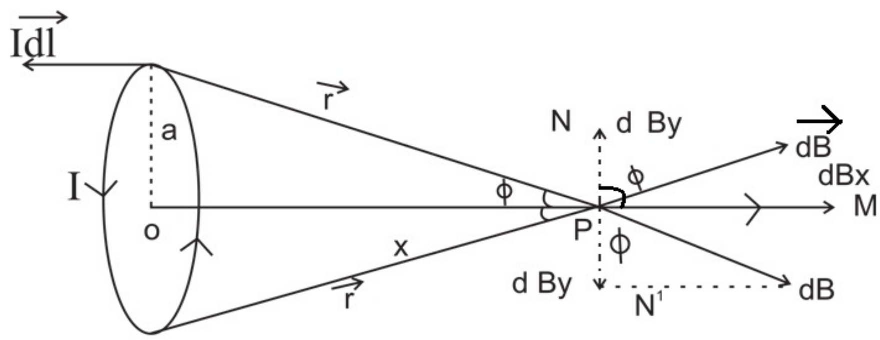
$V_{AB} = IR_1 = \frac{V}{R+R1} \times \frac{\rho l}{a}$

Where 'a' is area of cross-section of wire AB — 1

$\therefore \frac{V_{AB}}{l} = \frac{V\rho}{(R+R1).a}$ = constant = k

Where R increases, current and potential difference across wire AB will be — 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.



1

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

$$\vec{dB} = \frac{\mu 0}{4\pi}\frac{I\vec{dl}\times\hat{r}}{r^2} \quad \text{where } r = \sqrt{x^2 + a^2}$$

$$\therefore dB = \frac{\mu 0}{4\pi}\frac{Idl\,\sin 90^0}{x^2+a^2}$$ 1/2

And direction of $\vec{dB}$ is ⊥ to the plane containing I$\vec{dl}$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

$$B_x = \oint dB_x = \oint dB\sin\theta = \int \frac{\mu 0}{4\pi}\frac{Idl}{x^2+a^2}\frac{a}{\sqrt{x^2+a^2}}.$$

$$B_x = \frac{\mu 0}{4\pi}\frac{Ia}{(x^2+a^2)^{3/2}}\oint dl = \frac{\mu 0}{4\pi}\frac{Ia\times 2\pi a}{(x^2+a^2)^{3/2}}$$ 1/2

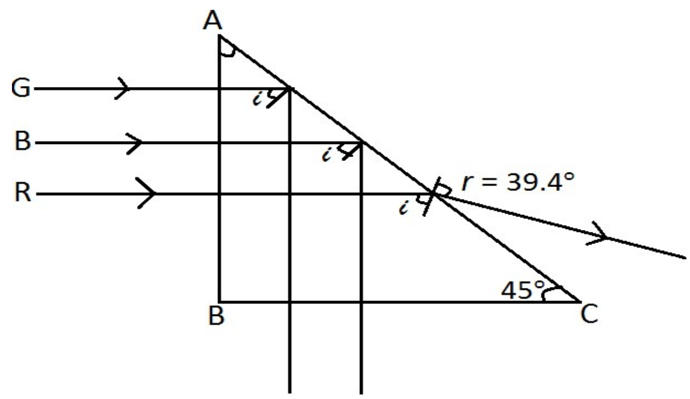
And $B_y = \oint dB_y = \oint dB\cos\theta = 0$

$$\therefore B_P = \sqrt{B_x{}^2 + B_y{}^2} = B_x = \frac{\mu 0}{4\pi}\frac{2IA}{(x^2+a^2)^{3/2}}$$

$$\therefore \vec{B_p} = \frac{\mu 0}{4\pi}\frac{2\vec{m}}{(x^2+a^2)^{3/2}} \left(\because \vec{m} = I\vec{A}\right)$$ 1

For centre x = 0

$$\therefore \left|\vec{B_o}\right| = \frac{\mu 0}{4\pi}\frac{2I\pi a^2}{a^3} = \mu_0\left(\frac{I}{2a}\right)$$ in the direction of $\vec{m}$

30.	∵ resonant frequency for LCR circuit is given by $v_0 = \frac{1}{2\pi\sqrt{LC}}$ $= \frac{1}{2\times3.14\sqrt{3\times27\times10^{-6}}}$ = 17.69Hz Or $\omega_0 = 2\pi v_0$= 111rad/s. ∵ quality factor of resonance $Q = \frac{\omega_0}{2\Delta w} = \frac{\omega_0 L}{R} = \frac{1}{R}\sqrt{\frac{L}{C}}$ $\therefore Q = \frac{1}{7.4}\sqrt{\frac{3}{27\times10^{-6}}} = 45.0$ To improve sharpness of resonance circuit by a factor 2, without reducing ω_0 ; reduce R to half of its value i.e. R = 3.7Ω	1 1 1
31.	 Two conditions for T IR – (a) Light must travel from denser to rarer medium (b) $i > i_c$ ∵ $\sin i_c = \frac{1}{\mu}$ $\therefore (i_c)_{Red} = \sin^{-1}\left(\frac{1}{1.39}\right) = 46°$ $(i_c)_{Green} = \sin^{-1}\left(\frac{1}{1.42}\right) = 44.8°$ $(i_c)_{Blue} = \sin^{-1}\left(\frac{1}{1.48}\right) = 43°$ ∵ 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.	1 1 1
32.	Resolving power (R.P) of an astronomical telescope is its ability to form separate images of two neighboring astronomical objects like stars etc. $R.P. = \frac{1}{d\theta} = \frac{D}{1.22\lambda}$ where D is diameter of objective lens and λ is wave length	1

of light used. 1

$D = 100\text{inch} = 2.54\times100\text{cm} = 254\text{cm}$

$= 2.54\text{m}$

$\lambda = 6000\text{Å}$

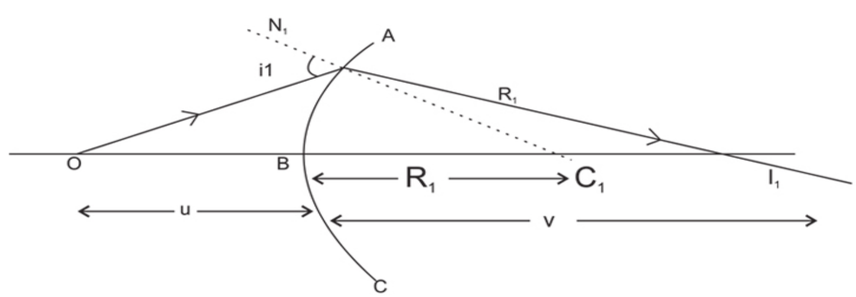
Limit of resolution $d\theta = \frac{1.22\lambda}{D}$ 1

$= \frac{1.22\times6000\times10^{-10}m}{254\times10^{-2}m}$

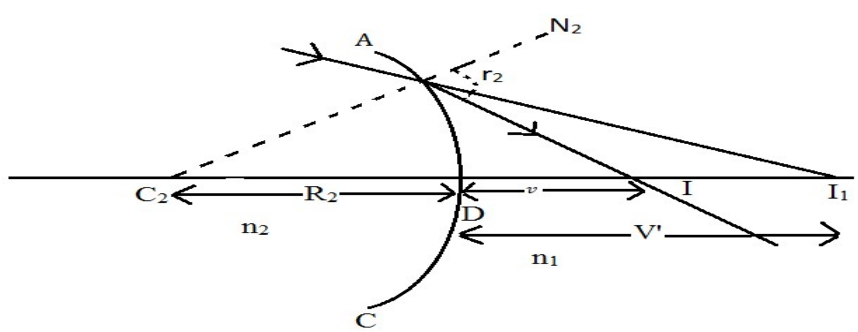
$= 2.9\times10^{-10}$

OR

Basic assumptions in derivation of Lens-maker's formula:
(i) Aperture of lens should be small
(ii) Lenses should be thin 1
(iii) Object should be point sized and placed on principal axis.



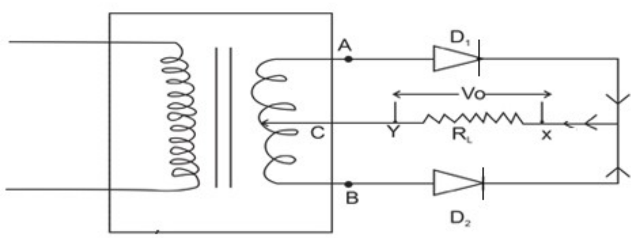
1

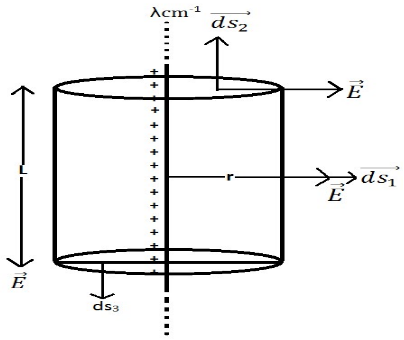
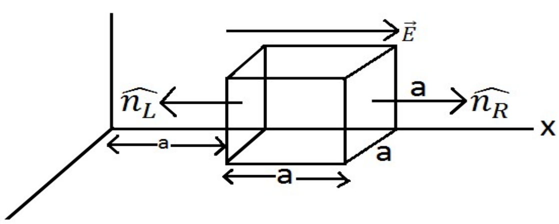


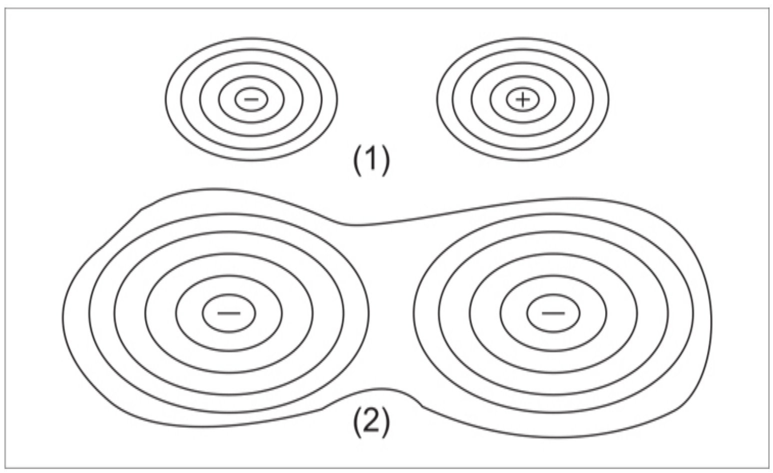
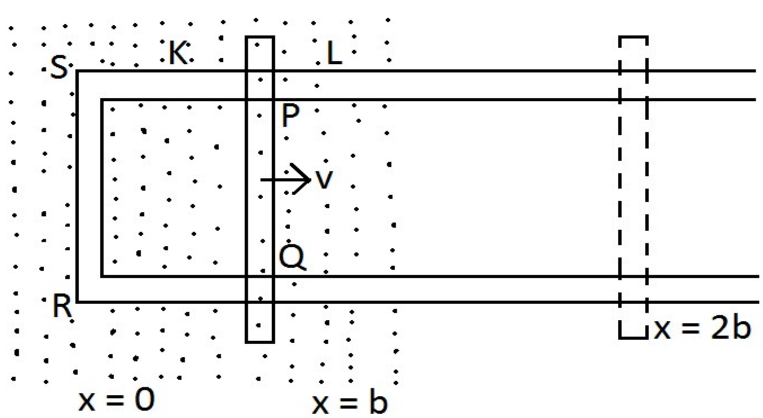
Suppose we have a thin lens of material of refractive index n_2, placed in a medium of refractive index n_1, let o be a point object placed on principle axis then for refraction at surface ABC we get image at I_1 ,

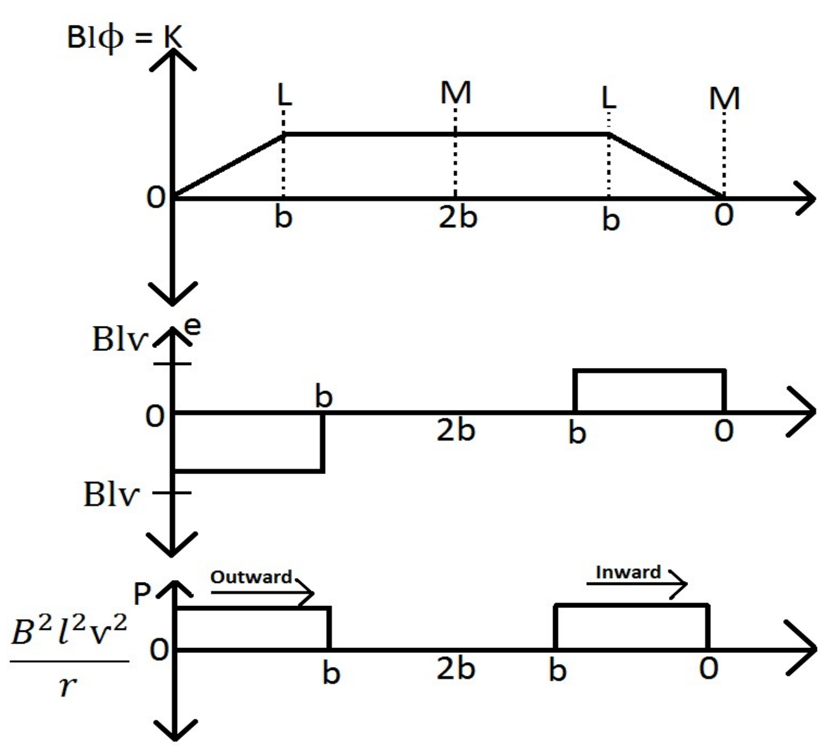
$\therefore \frac{n_2}{V'} - \frac{n_1}{u} = \frac{n_2-n_1}{R_1}$ ---------(1)

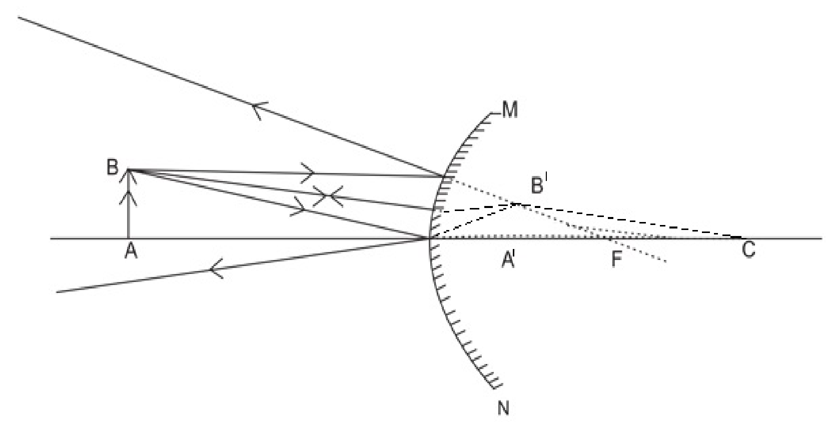
But the refracted ray before goes to meet at I_1 falls on surface ADC and refracts at I_2

	finally; hence I_1 works as a virtual object 2^{nd} refracting surface $\therefore \frac{n_1}{V} - \frac{n_2}{V^1} = \frac{n_1 - n_2}{R_2}$ --------- (2) Equation (1) + (2) $\frac{n_1}{V} - \frac{n_1}{u} = (n_2 - n_1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ $\therefore \frac{1}{V} - \frac{1}{u} = (n_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$--------(3) If u = ∞, v = f $\frac{1}{f} = (n_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$--------(4) Which is lens maker's formula.	1
33.	${}^{238}_{92}U \rightarrow {}^{237}_{91}Pa + {}^{1}_{1}H + Q$ $\because Q = [M_U - M_{Pa} - M_H]\ c^2$ $= [\ 238.05079 - 237.05121 - 1.00783]\ u \times c^2$ $= -\ 0.00825u \times 931.5\ \frac{MeV}{u}$ $= -\ 7.68MeV$ $\because Q < 0$; therefore it can't proceed spontaneously. We will have to supply energy of 7.68MeV to ${}^{238}_{92}U$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 the Gauss's law – $\oint N, d\vec{s} = \frac{1}{\epsilon 0}\{q\}$ $\int \vec{E}\,\overrightarrow{ds_1} + \int \vec{E}\,\overrightarrow{ds_2} + \int \vec{E}\,\overrightarrow{ds_3} = \frac{1}{\epsilon 0}(\lambda L)$ $\int Eds_1 Cos0 + \int Eds_2 Cos90^o + \int Eds_3 Cos90^o = \frac{\lambda L}{\epsilon 0}$ $E\int ds_1 = \frac{\lambda L}{\epsilon 0}$ $E \times 2\pi rL = \frac{\lambda L}{\epsilon 0}$ $E = \frac{\lambda}{2\pi\epsilon 0 r}$ $\vec{E} = \frac{\lambda}{2\pi\epsilon 0 r}\hat{r}$	1 1 1
35. (b)	 $\because E_x = \propto x = 400x$ $E_y = E_z = 0$ Hence flux will exist only on left and right faces of cube as $E_x \neq 0$ $\because \overrightarrow{E_L} . a^2(n_2) + \overrightarrow{E_R} . a^2\widehat{n_R} = \frac{1}{\epsilon 0}\{qin\} = \phi$ $- E_L . a^2(\bar{n_2}) + a^2 E_R = \phi_{Net}$ $\phi_{Net} = -(400a)a^2 + a^2 (400 \times 2a)$ $= -400a^3 + 800a^3$ $= 400a^3$ $= 400 \times (.1)^3$ $\phi_{Net} = 0.4\ Nm^2c^{-1}$	1

	$\because \phi_{Net} = \frac{1}{\epsilon 0}\{qin\}$ $\therefore$ qin = $\epsilon 0 \phi_{Net}$ = $8.85 \times 10^{-12} \times 0.4$ = 3.540×10^{-12}c	1
	OR	
(a)	Definition of electrostatic potential – SI unit J/c of Volt. Deduction of expression of electrostatic potential energy of given system of charges – $U = \frac{1}{4\pi\epsilon 0}\left[\frac{q1\,q2}{r12} + \frac{q1\,q3}{r13} + \frac{q2\,q3}{r23}\right]$	1 2
(b)		1 1
36.	For forward motion from x = 0 to x = 2b. The flux ϕ_B linked with circuit SPQR is 	

		$\phi_B = Blx$ $\quad 0 \le x < b$ Blb $\quad b \le x < 2b$ The induced emf is, $e = \frac{-d\phi B}{dt}$ $e = -Blv$ $\quad 0 \le x < b$ $= 0$ $\quad b \le x < 2b$ When induced emf is non-zero, the current İ 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 $F = IlB = \frac{B^2 l^2 v}{r}$; $\quad 0 \le x < b$ $= 0$; $\quad b \le x < 2b$ The Joule heating loss is $P_J = I^2 r$ $= \frac{B^2 l^2 v^2}{r}$ $\quad 0 \le x < b$ $= 0$ $\quad b \le x < 2b$ One obtains similar expressions for the inward motion from x = 2b to x = 0	1 1 1 1
			1

	OR Working principle of cyclotron Diagram Working of cyclotron with explanation Any two appliations	 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. ∴ f > c Object is always placed in front of mirror hence u < 0 (for real object) $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$ $\Rightarrow \quad \frac{1}{v}=\frac{1}{f}-\frac{1}{u}$ As u < 0 u –ve hence $\frac{1}{v}>0$ ⇒ v> 0 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

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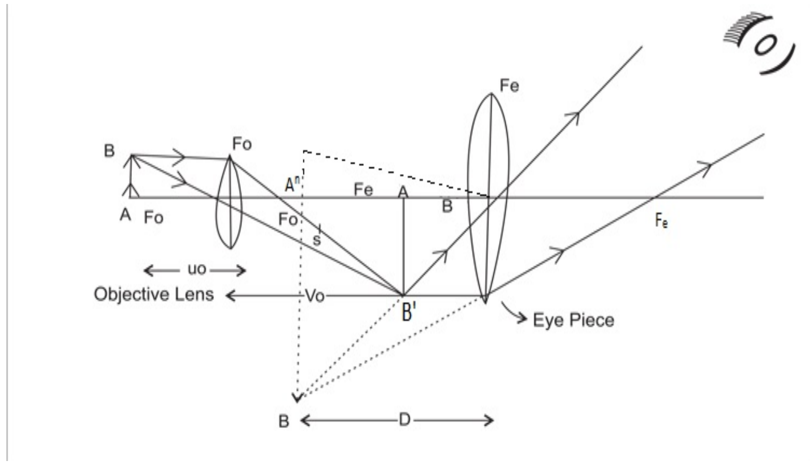

Magnifying power $m = \frac{V_o}{u_o}\left(1 + \frac{D}{f_e}\right)$

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

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<tr><td>37. (b)</td><td>

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

$\because f_o = 1.25cm$

$f_e = 5.0cm$

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

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

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

$\frac{1}{Ve} - \frac{1}{ue} = \frac{1}{fe}$

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

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

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

$\because m = m_o \times m_e$

$\therefore m_o = \frac{+Vo}{uo} = \frac{-30}{6} = -5$

$\therefore V = -5u_o$

$\frac{1}{Vo} - \frac{1}{uo} = \frac{1}{fo}$

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

</td><td>1

1</td></tr>
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	$\frac{-6}{5uo} = \frac{1}{1.25}$ uo = -1.5cm $\Rightarrow v_0$ = 7.5cm Tube length = $V_o + \lvert u_e \rvert$ = 7.5cm + 4.17cm L = 11.67cm Object should be placed at 1.5cm distance from the objective lens.	1