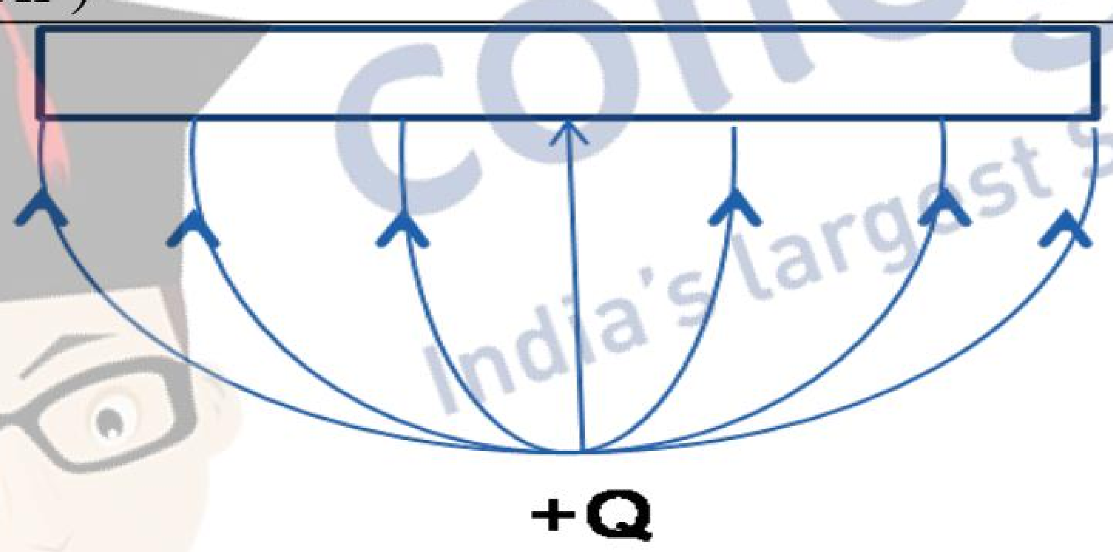
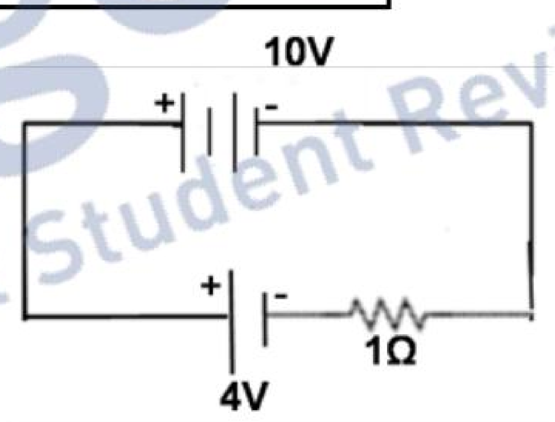
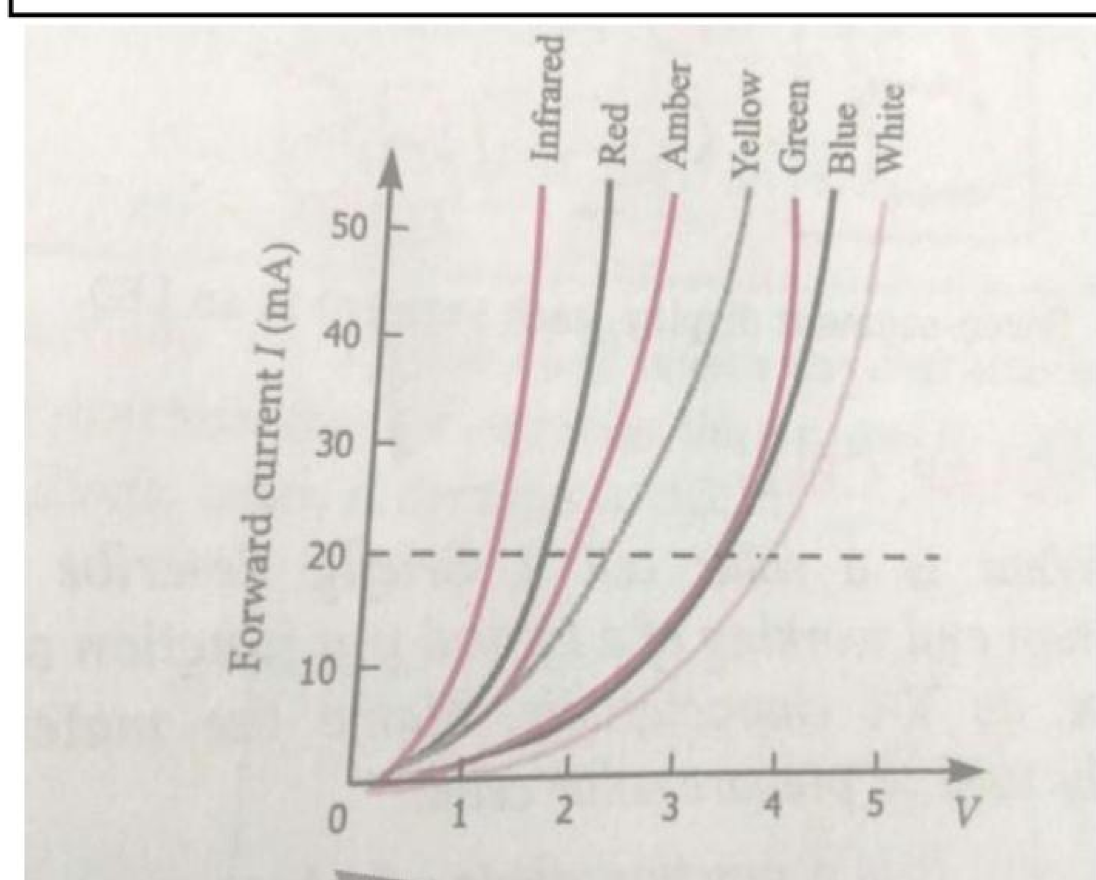
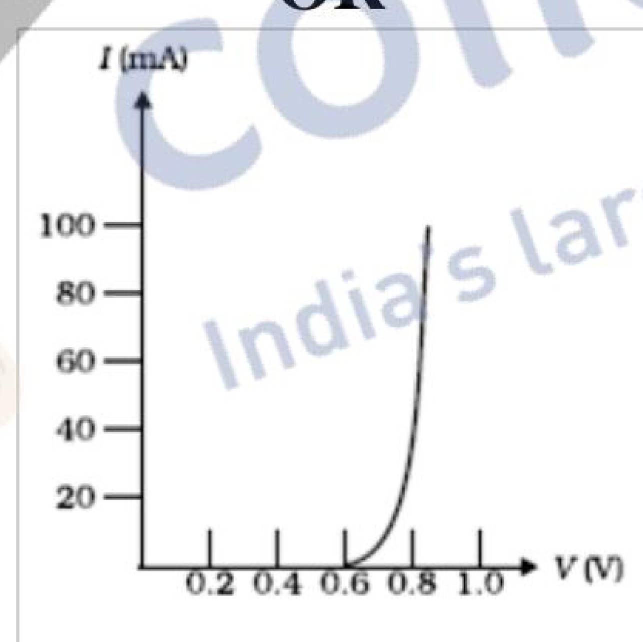
SET : 55/3

MARKING SCHEME

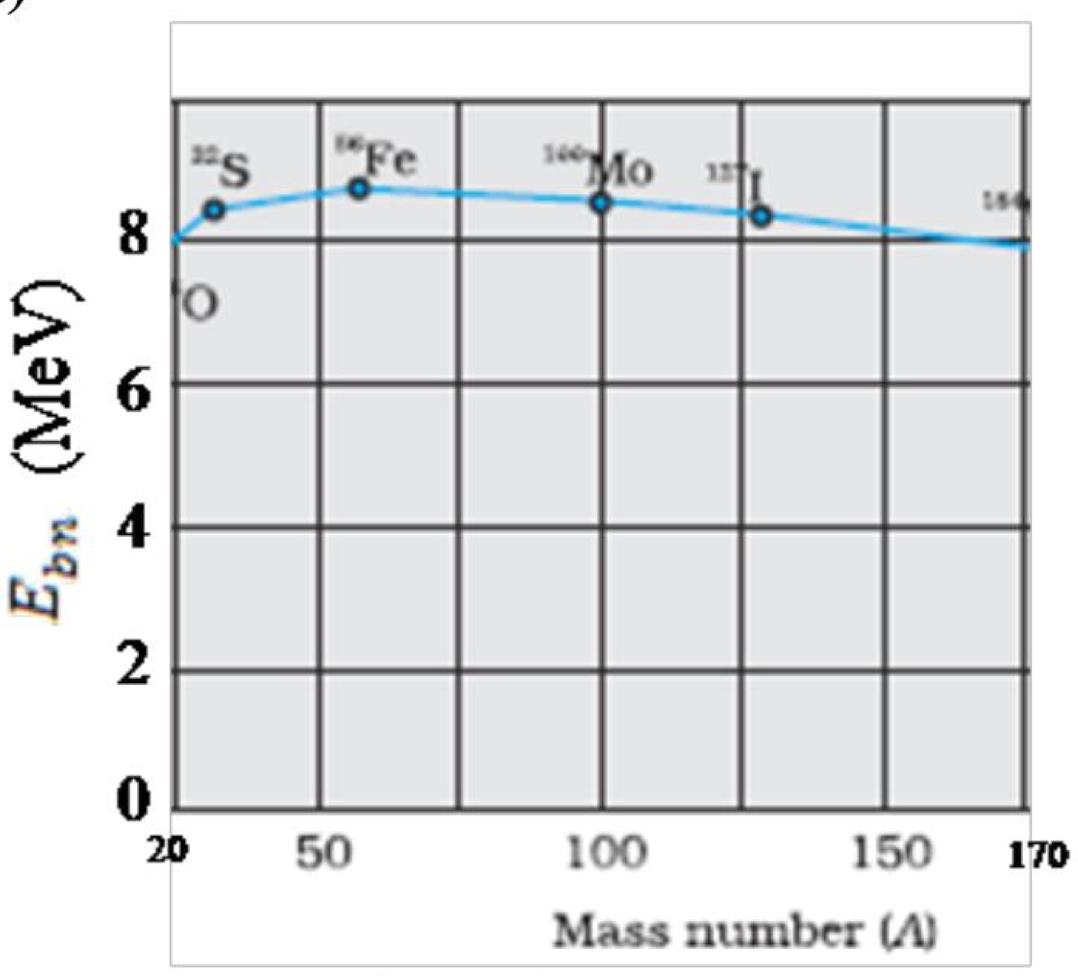
Q. No.	Expected Answer/ Value Points **SECTION A**	Marks	Total Marks
Q1	For higher magnification both objective and eyepiece must have short focal length (Alternatively : $\because m \propto \frac{1}{f_o f_e}$)	1	1
Q2	Accept both the answers : A : +ve ; B: -ve or A : -ve ; B: +ve	1	1
Q3	Any two of the following i. Length of transmitting antenna is short. ii. Power radiated is more. iii. Mixing of signals can be avoided.	½ + ½	1
Q4	Definition ½ SI Unit ½ Conductivity is reciprocal of resistivity $\sigma = \frac{1}{\rho}$ SI unit : S(siemen)	 ½ ½	1
Q5		1	1
	SECTION B		
Q6	Two properties of photon ½ + ½ Reason for different energies of photoelectrons 1 i. Photon is electrically neutral ii. Photon has an energy $h\nu$ [Or any other property] **Reason:** In addition to the work done to free them from the surface, different (emitted) photoelectrons need different amounts of work to be done on them to reach the surface. OR Energy of photon ½ KE of proton 1 Comparison ½	 ½ ½ 1	

	Energy of photon, $K_1 = \frac{hc}{\lambda}$ For proton: $\lambda = \frac{h}{\sqrt{2mK_2}}$ $\therefore K_2 = \frac{h^2}{2m\lambda^2}$ $\therefore \frac{K_1}{K_2} = 2mc\lambda/h$	½ ½ ½ ½	2
Q7	Distinction between nuclear fission and fusion 1 Cause of release of energy 1 In nuclear fission a heavy nucleus breaks up into smaller nuclei accompanied by release of energy where as in nuclear fusion two light nuclei combine to form a heavier nucleus accompanied by release of energy. In both the cases, some mass(= mass defect) gets converted into energy as per the relation. E = Δmc^2	½ + ½ 1	2
Q8	Calculation of Current 1 Calculation of Terminal Voltage 1 10-4 = I(1+5) ∴I = 1A ∴ terminal voltage across cell = (4 + 1 x 1)V = 5V 	½ ½ ½ ½	2
Q9	Distinction between 'point to point' and broadcast modes 1 One example for each ½ + ½ Point to point communication takes place between a single transmitter and a receiver. In broadcast mode, a large number of receivers can receive signal from a single transmitter. Example of point to point mode : telephony Example of Broadcast mode: Radio/TV	½ ½ ½ ½	2
Q10	Definition 1 Calculation of Speed 1 i. Refractive index of a medium is the ratio of speed of light (c) in free space to the speed of light (v) in that medium. $\mu = \frac{c}{v}$	1	

	ii. $$\mu = \frac{c}{v} = \frac{1}{sin\, i_c}$$ $$= \frac{3 \times 10^8}{v} = \frac{1}{30/_{50}}$$ $$v = \frac{30}{50} \times 3 \times 10^8 = 1.8 \times 10^8\, m/s$$	½ ½	 2
SECTION C			
Q11	VI characteristics 1 Two advantages ½ + ½ Factors ½ + ½  **OR**  <u>Advantages (any two)</u> i. Low operational voltage. ii. less power consumption. iii. Long life iv. ruggedness [or any other] a. Energyband gap controls the wavelength of light emitted. **b.** Forward current controls the intensity of emitted light.	**1** ½ ½ ½ ½	 3
Q12	Formula for magnetic field of toroid 1 Calculation of magnetic field 1 ½ Effect of change of core ½ $B = \mu_r \mu_o n\, I$ $= (800 \times 4\pi \times 10^{-7}) \times \left(\frac{4000}{2\pi \times 20 \times 10^{-2}}\right) \times 3$ =9.6T	**1** ½ **1**	

	Since Bismith is diamagnetic, its $\mu_r < 1$ ∴ The magnetic field in the core will get very much reduced.	½	**3**
Q13	Name of em wave 1 Method of generation 1 Two uses 1 Em waves : ultra violet Sun is an important source of UV rays. Some special lamps and very hot bodies also produce UV rays. Uses i. In lasik eye surgery ii. UV lamps are used to kill germs in water purifiers.	**1** **1** ½ ½	**3**
Q14	Formula for de Broglie's wavelength 1 Calculation of de Broglie's wavelength ½ Formula for RP 1 Comparison of RP ½ $\lambda = \frac{1.227}{\sqrt{V}} nm$ $= \frac{1.227}{\sqrt{5000}} \approx 0.02$nm R.P $= \frac{2n sin\beta}{1.22\lambda}$ $\frac{\text{R. P. of electron microscope}}{\text{R. P. of optical microscope}} = \frac{\lambda_o}{\lambda_e}$ $= \frac{550}{0.02} = 27500$	**1** ½ **1** ½	**3**
Q15	Explanation / reason 1 Finding intensities 1+1 a) Interference pattern will not be observed as two independent lamps are not coherent sources. b) $I_1 = 4I_0^2 cos^2\left(\frac{\phi_1}{2}\right) = 4I_0^2 \quad \phi_1 = 0$ $I_2 = 4I_0^2 cos^2\left(\frac{\pi}{2}\right) = 0 \quad \phi_1 = \pi$ [Note: Give full two marks if the student just writes : Ratio →∞ $(as\ I_2 = 0)$]	**1** **1** **1**	**3**

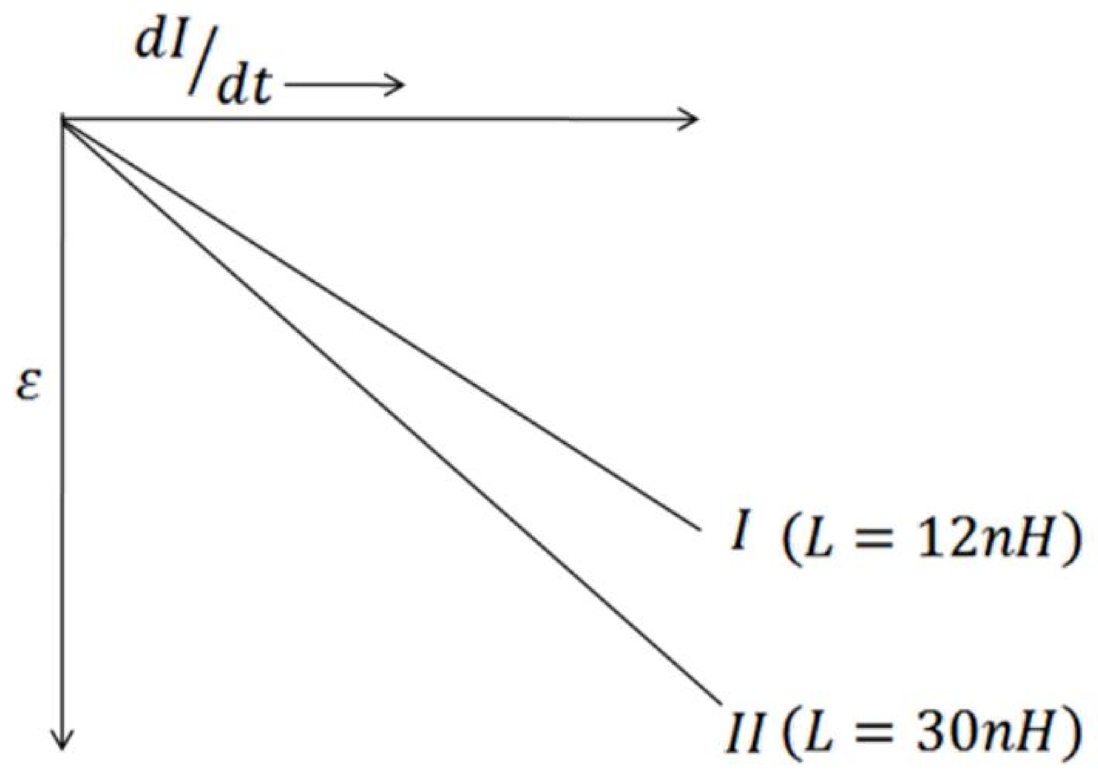
Q16	Definition of current sensitivity 1 Ratio ${R_1}/{R_2}$ 2 Current sensitivity of a galvanometer is deflection per unit current $\left[\text{Alternatively}: I_s = \frac{\phi}{I} = \frac{NAB}{K}\right]$ In circuit (i) $\frac{4}{6} = \frac{R_1}{4} => R_1 = \frac{8}{3}\ \Omega$ In circuit (ii) $\frac{6}{R_2} = \frac{12}{8} => R_2 = 4\ \Omega$ $\therefore \frac{R_1}{R_2} = \frac{2}{3}$	1 ½ ½ 1	3
Q17	Effect on capacitance 1 Effect on charge 1 Effect on energy 1 i. $C = \frac{\in_o A}{d}$ $C' = \frac{K \in_o A}{d'} = \frac{10}{3} \frac{\in_o A}{d} = \frac{10}{3} C$ ii. V remains same since battery is not disconnected $\therefore Q' = C'V$ $= \frac{10}{3} CV = \frac{10}{3} Q$ iii. Energy density, $u_d = \frac{1}{2} \in_o E^2$ $E = \frac{V}{d}$ $u'_d = \frac{1}{2} K \in_o E'^2$ $= \frac{10}{2} \in_o \left(\frac{V}{d'}\right)^2$ $= \frac{10}{9}\left(\frac{1}{2} \in_o E^2\right)$ $= \frac{10}{9} u_d$	½ ½ ½ ½ ½ ½	3

Q18	Graph of BE 1 Calculation of energy released 2 **a)**  b) Energy released = [(110+130) x 8.5 – 240 x 7.6] MeV = 240(8.5 – 7.6) MeV = 216 MeV	1 1 1	3
Q19	Variation of intensity 1 Separation between maxima 2 a) Intensity of diffraction pattern drops rapidly with order n because every higher order maxima gets intensity only from $\frac{1}{2n+1}$ part of the slit. The central maxima gets intensity from the whole slit (n=0) 1st secondary maxima gets its intensity only from 1/3 of slit 2nd secondary maxima gets its intensity only from 1/5 of slit and so on. b) Position of 1st maxima on the screen: $x_1 = \frac{3}{2}\frac{\lambda_1}{a}D$; $\lambda_1 = 590nm$ $x_2 = \frac{3}{2}\frac{\lambda_2}{a}D$; $\lambda_2 = 596nm$ Separation $\Delta x = x_2 - x_1$ $= \frac{3}{2}\frac{D}{a}(\lambda_2 - \lambda_1)$ $= \frac{3}{2}\left(\frac{2}{4\times10^{-3}}\right) \times 6 \times 10^{-9}$m $= 4.5 \text{ x } 10^{-6}$m	1 ½ ½ ½ ½	3

Q20

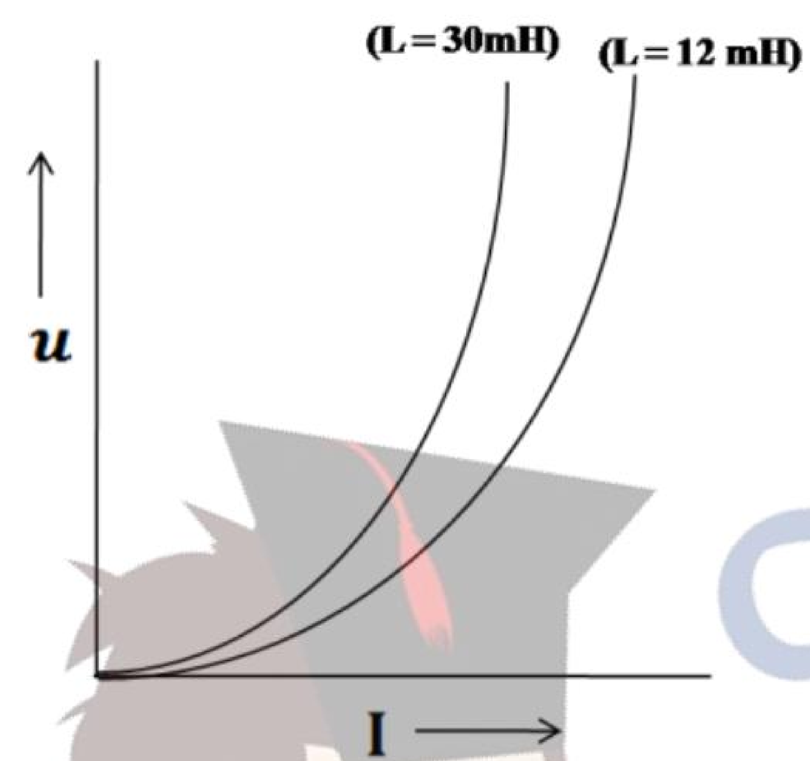
Graph of emf	½
Graph of energy stored	½
Ratio of energy stored	2

a)



½

b)



½

$$\frac{u_1}{u_2} = \frac{\frac{1}{2}L_1 i_1^2}{\frac{1}{2}L_2 i_2^2}$$ ½

But $\varepsilon_1 i_1 = \varepsilon_2 i_2$ (∵power dissipated is same) ½

$\therefore \frac{i_1}{i_2} = \frac{\varepsilon_2}{\varepsilon_1} = \frac{L_2}{L_1}$ $\left(\because \frac{dI}{dt} \text{ is same and } \varepsilon = -L\frac{dI}{dt}\right)$ ½

$$\therefore \frac{u_1}{u_2} = \frac{L_1}{L_2}\left(\frac{L_2}{L_1}\right)^2$$ ½

$$= \frac{L_2}{L_1} = \frac{30}{12} = 2.5$$

3

Q21

Function of each of the three devices	1+1+1

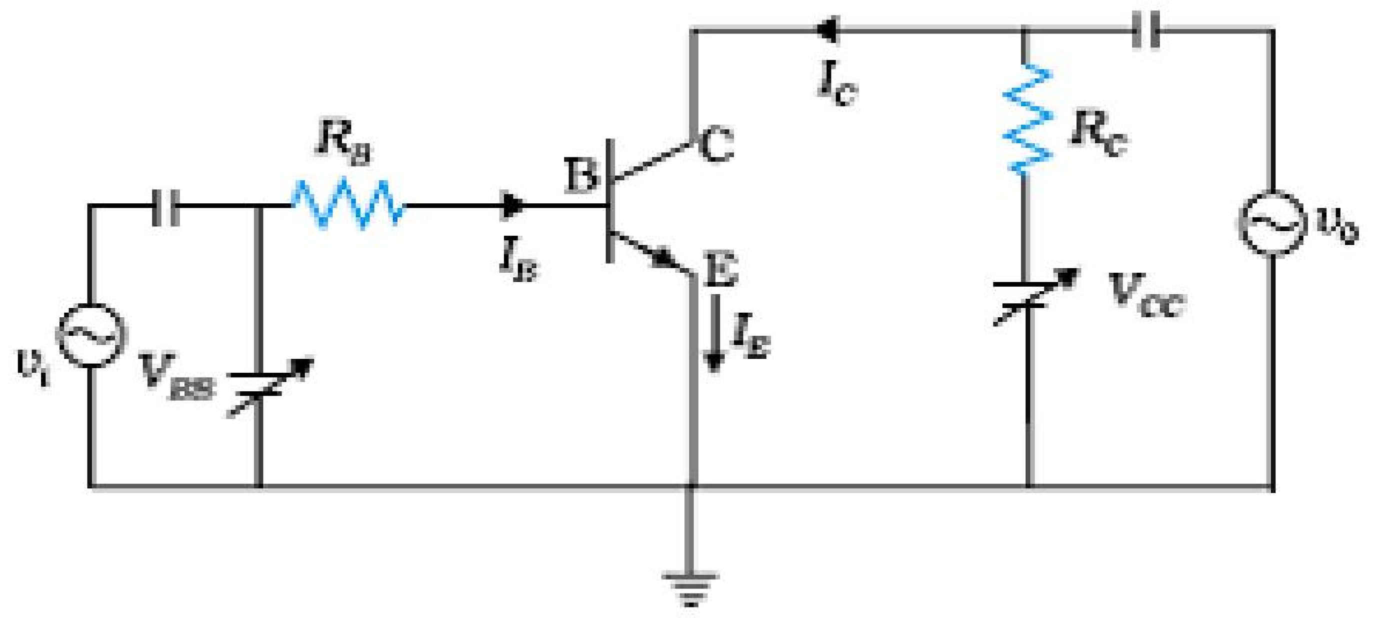
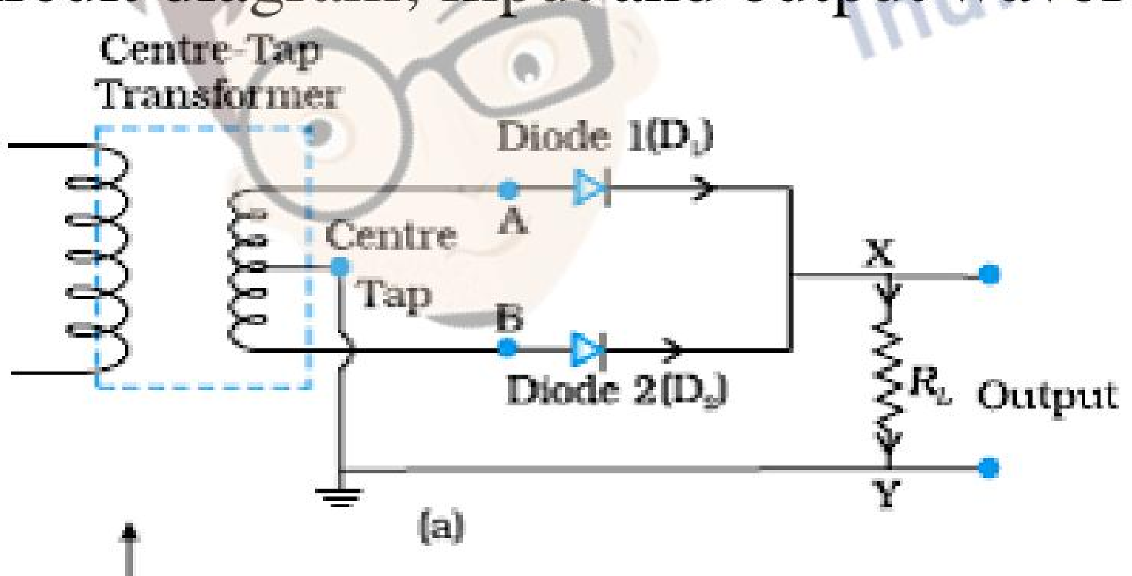
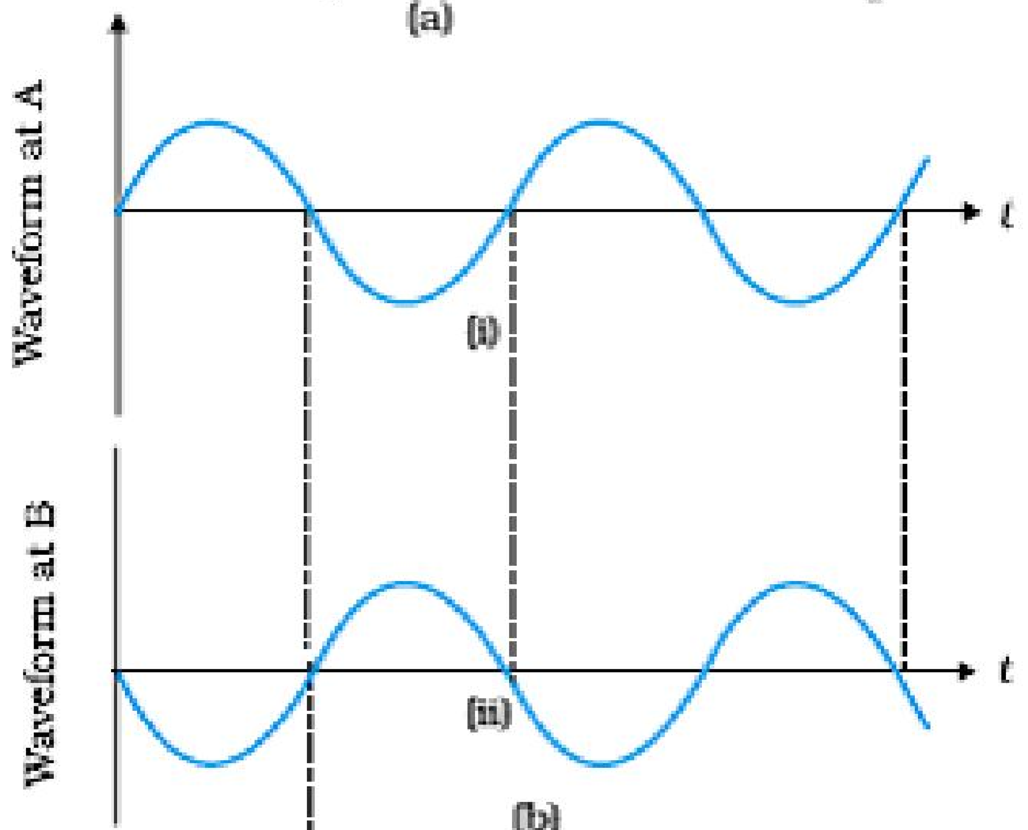
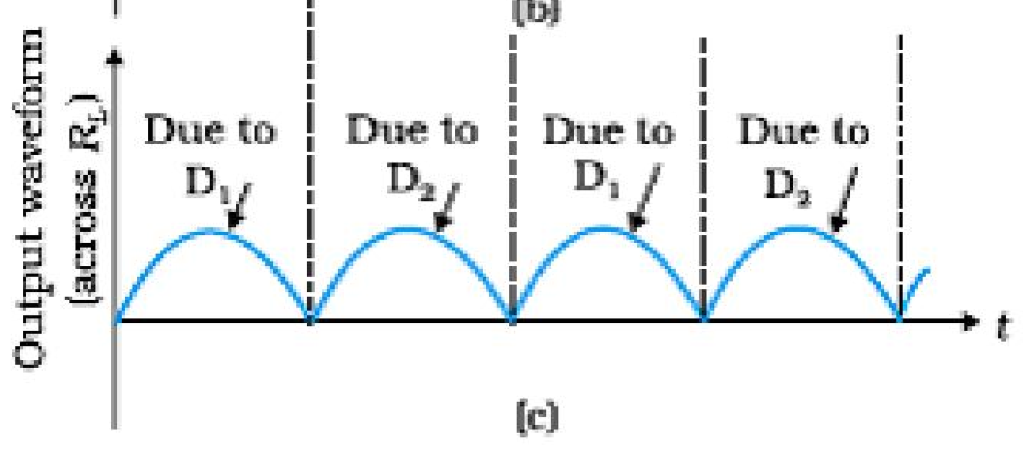
Transducer :It converts one form of energy into another **1**

Transmitter :It processes the incoming message so as to make it suitable for transmission through a channel. **1**

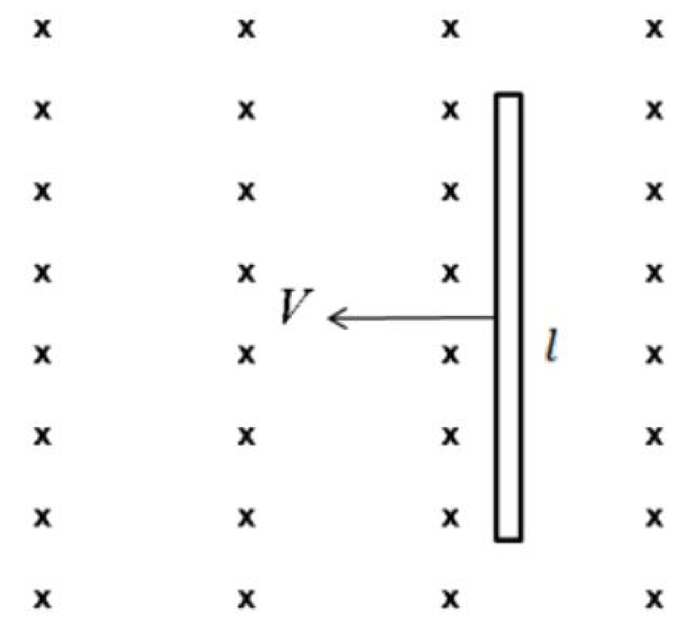
Repeater :It picks up signal from the transmitter, amplifies and retransmits it to the receiver sometimes with a change in carrier frequency. **1**

[Alternatively : Repeaters are used to extend the range of communication.]

3

Q22	Circuit diagram 1 Expression for voltage gain 1 Explanation for 180^o phase difference 1		
		1	
	$A_V = \frac{V_o}{V_i} = \frac{\Delta V_{CE}}{r \Delta I_B} = - \beta_{ac} \frac{R_L}{r}$	1	
	$V_{CC} = V_{CE} + I_C R_L$	½	
	$\therefore \Delta V_{CC} = \Delta V_{CE} + R_L \Delta I_C = 0$ $\therefore \Delta V_{CE} = -R_L \Delta I_C$ Hence, change in output is negative when the input signal is +ve. This shows 180^0 phase difference between input and output signal.	½	
	OR		
	Circuit of full wave rectifier 1 Working Principle 1 Input and output waveforms 1		
	Circuit diagram; input and output waveforms;		
		1	
		½	
		½	

	<u>Working Principle:</u> When A is +ve, B is negative Only D_1 conducts because it is forward biased Current in R_L flows from X to Y When B is positive and A is negative, only D_2 conducts and Current in R_L is once again from X to Y.	½ ½	3
	SECTION D		
Q23	Two values of Mr. Hiorki 1 Two values of Mr. Kamath 1 Meissner effect 1 Value of μ_r 1 a) Eager to share ideas and knowledge; Professionalism; Environment friendly nature. (any two) b) Eager to learn (open minded); observant; appreciating good ideas.(any two) c) Phenomenon of perfect diamagnetism in super conductors $\mu_r = 0$	½ + ½ ½ + ½ 1 1	4
	SECTION E		
Q24	a) Average Power dissipation is zero 2 b) Numerical 3 a) Instantaneous Power = $vi = V_o sinwt\ I_o coswt$ Average power, P = $\frac{1}{T}\int_o^T vidt$ $= \frac{V_o I_o}{2T}\int_o^T 2\ sinwt\ coswt\ dt$ $= \frac{V_o I_o}{2T}\int_o^T sin2wt\ dt$ $= 0$ b) i. $\omega_o = \frac{1}{\sqrt{LC}}$ $= \frac{1}{(200 \times 10^{-3} \times 400 \times 10^{-6})^{\frac{1}{2}}}$ $= \frac{1}{\sqrt{8 \times 10^{-5}}} s^{-1} = \frac{10^3}{\sqrt{80}} s^{-1} \simeq 111 s^{-1}$ $I = \frac{V}{R} = \frac{50}{10} = 5\ A$ ii. $Q = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{10}\sqrt{\frac{200 \times 10^{-3}}{400 \times 10^{-6}}} = \sqrt{5}$ OR a) Derivation of induced emf 2 ½ b) Numerical 2 ½ a)	½ ½ ½ ½ ½ ½ 1 1	5



½

$\phi_B = Blx$ ½

$\varepsilon = \dfrac{-d\phi_B}{dt}$ ½

$= -Bl\,\dfrac{dx}{dt}$ ½

$= Blv$ ½

b) $\omega = 360 \times \frac{2\pi}{60} = 12\,\pi$ ½

$\varepsilon = \dfrac{1}{2} B_H l^2 \omega$ ½

$\therefore 400 \text{ x } 10^{-3} = \frac{1}{2}.B_H \times (60 \times 10^{-2})^2 \times 12\pi$ ½

$\therefore B_H = \frac{5}{27\pi} = 0.06\text{T}$ ½

No change in emf if no. of spokes is increased. ½

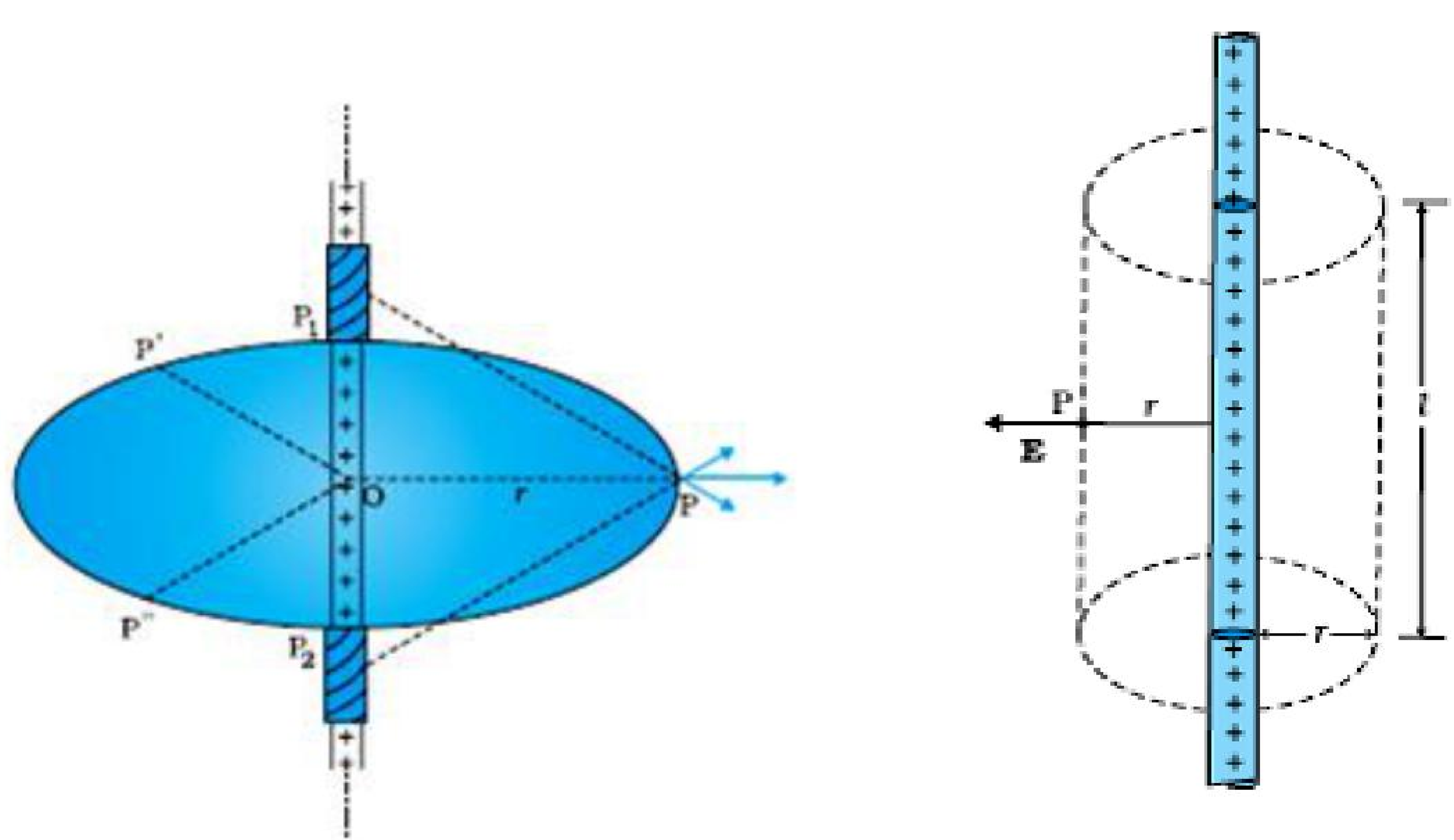
5

Q25

a)	Statement of Guass's law	1
	Derivation	2
b)	Electric flux Expression	2

a) Electric flux through a closed surface is $\frac{1}{\epsilon_o}$ times charge enclosed by the closed surface. **1**

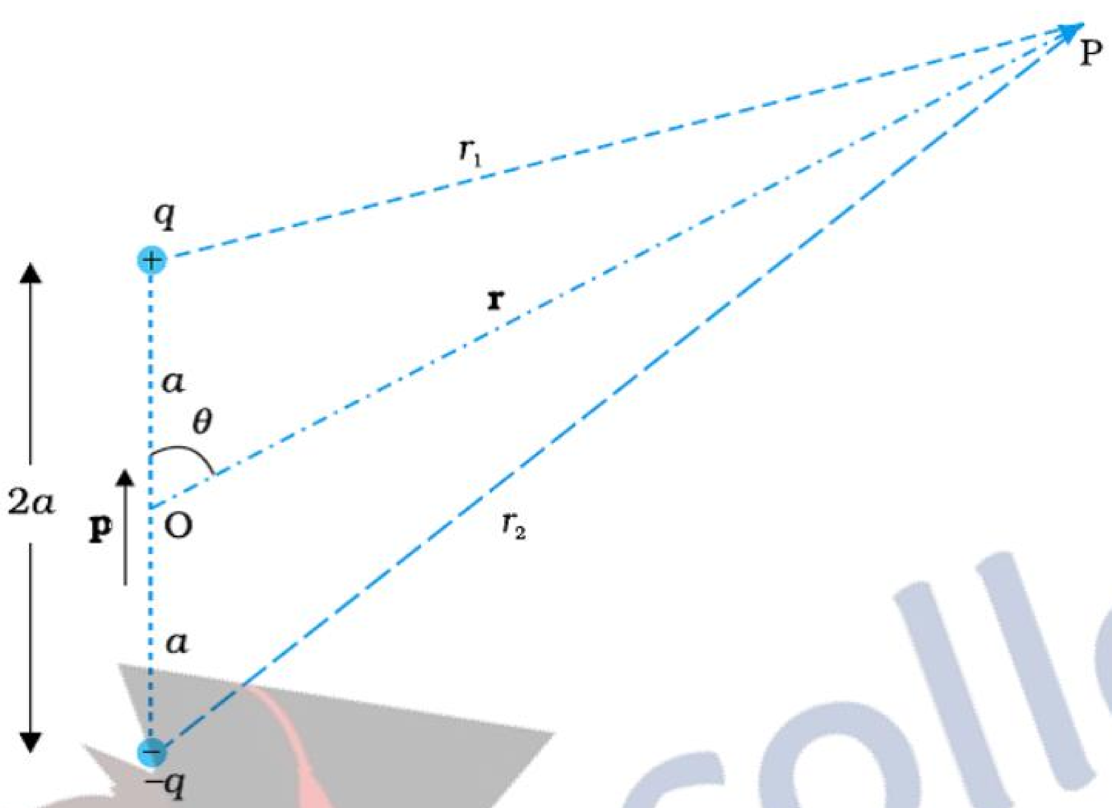
$\phi = \dfrac{Q_{enclosed}}{\epsilon_o}$



½

$\phi = \oint \vec{E}.\vec{ds} = \dfrac{Q_{enclosed}}{\epsilon_o}$

$\therefore \text{E}.2\pi r l = \dfrac{\lambda l}{\epsilon_o}$ ½

	$\therefore E = \frac{\lambda}{2\pi \in_o r}$	1	
	b) $dq = \lambda dx = kxdx$	½	
	$Q = \int_o^l dq = \int_o^l kxdx = \frac{1}{2}kl^2$	½	
	$\therefore \phi = \frac{Q}{\in_o} = \frac{kl^2}{2 \in_o}$	1	
	OR		
	a) Derivation of expression for electric potential 3 b) Numerical Problem 2		
	a) 	½	
	$V = \frac{1}{4\pi \in_o}\left[\frac{q}{r_1} - \frac{q}{r_2}\right]$	½	
	$r_1^2 = r^2 + a^2 - 2ar\cos\theta \approx r^2\left(1 - \frac{2a\cos\theta}{r}\right)$	½	
	$r_2^2 = r^2 + a^2 + 2ar\cos\theta \approx r^2\left(1 + \frac{2a\cos\theta}{r}\right)$	½	
	If r > > a $\frac{1}{r_1} = \frac{1}{r}\left[1 - \frac{2a\cos\theta}{r}\right]^{-\frac{1}{2}} \simeq \frac{1}{r}\left[1 + \frac{a}{r}\cos\theta\right]$	½	
	and $\frac{1}{r_2} \simeq \frac{1}{r}\left[1 - \frac{a}{r}\cos\theta\right]$	½	
	$\therefore V = \frac{q}{4\pi \in_o}.\frac{2a\cos\theta}{r^2}$ $= \frac{1}{4\pi\in_o}\frac{p\cos\theta}{r^2}$	½	
	b) $\frac{1}{4\pi\in_o}\frac{4\mu C}{x^2} = \frac{1}{4\pi\in_o}\frac{1\mu C}{(2-x)^2}$	1	
	$\therefore \frac{x}{2} = 2 - x$ $\therefore 3x = 4 => x = \frac{4}{3}m$	½	5

Q26

a) Explanation with reason	2 ½
b) Calculation of separations	2 ½

a) $P = \frac{1}{f} = \left(\frac{n_2 - n_1}{n_2}\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ ½

$= \left(\frac{n_2 - n_1}{n_2}\right)\left(-\frac{2}{R}\right)$ for diverging lens

= negative ½

i. If $n_1 > n_2$

$\frac{n_2 - n_1}{n_1}$ becomes negative ½

$\therefore P = \frac{1}{f}$ becomes positive ½

or lens become converging

ii. $(n_2)_{violet} > (n_2)_{red}$ ½

$\therefore$Power increases on changing to violet light

b) Rays on L_3 be incident parallel to the principal axis ½

image from L_1 is formed at focus of L_2 ½

and focus of L_2 is $2f_1$ from 'O' of L_1 ½

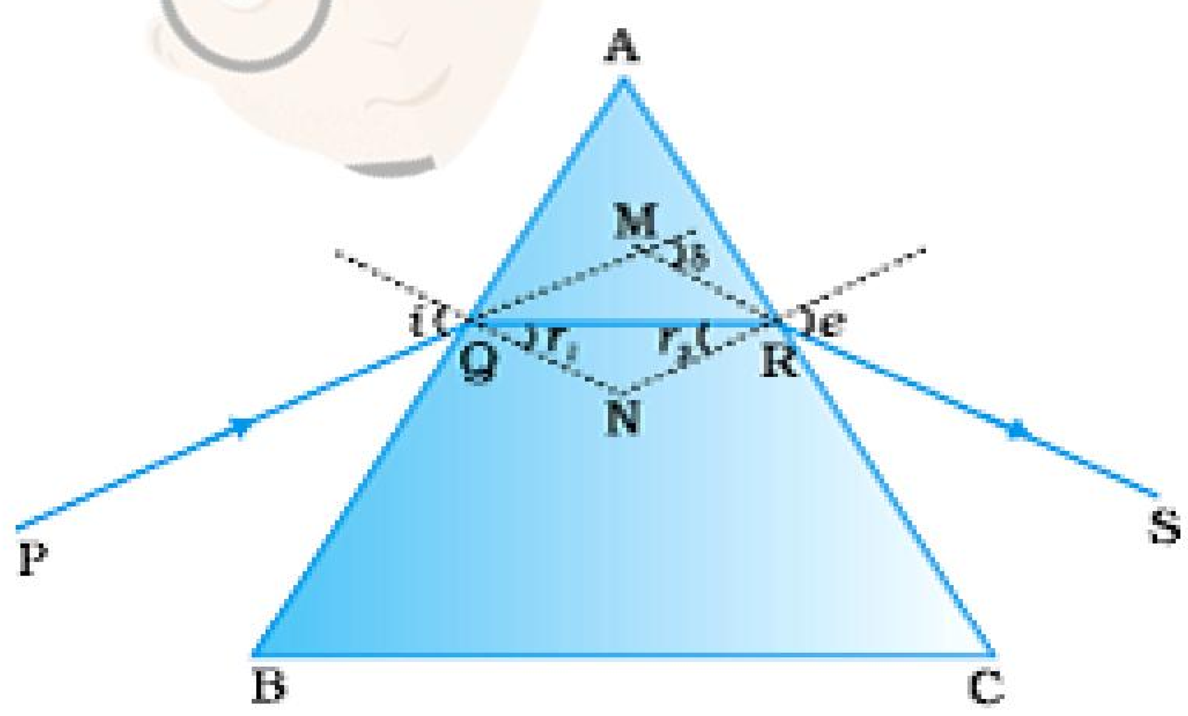
$\therefore L_1L_2 = 2f_1 + f_2$ = (3 x 30)cm = 90cm ½

L_2L_3 can be any distance ½ **5**

OR

a) Derivation of expression for refractive index	2
Graph	1
b) Numerical	2

a)



½

$\angle A + \angle QNR = 180^o$

$r_1 + r_2 + \angle QNR = 180^o$ ½

$\therefore r_1 + r_2 = \angle A$

$\delta = (i - r_1) + (e - r_2)$

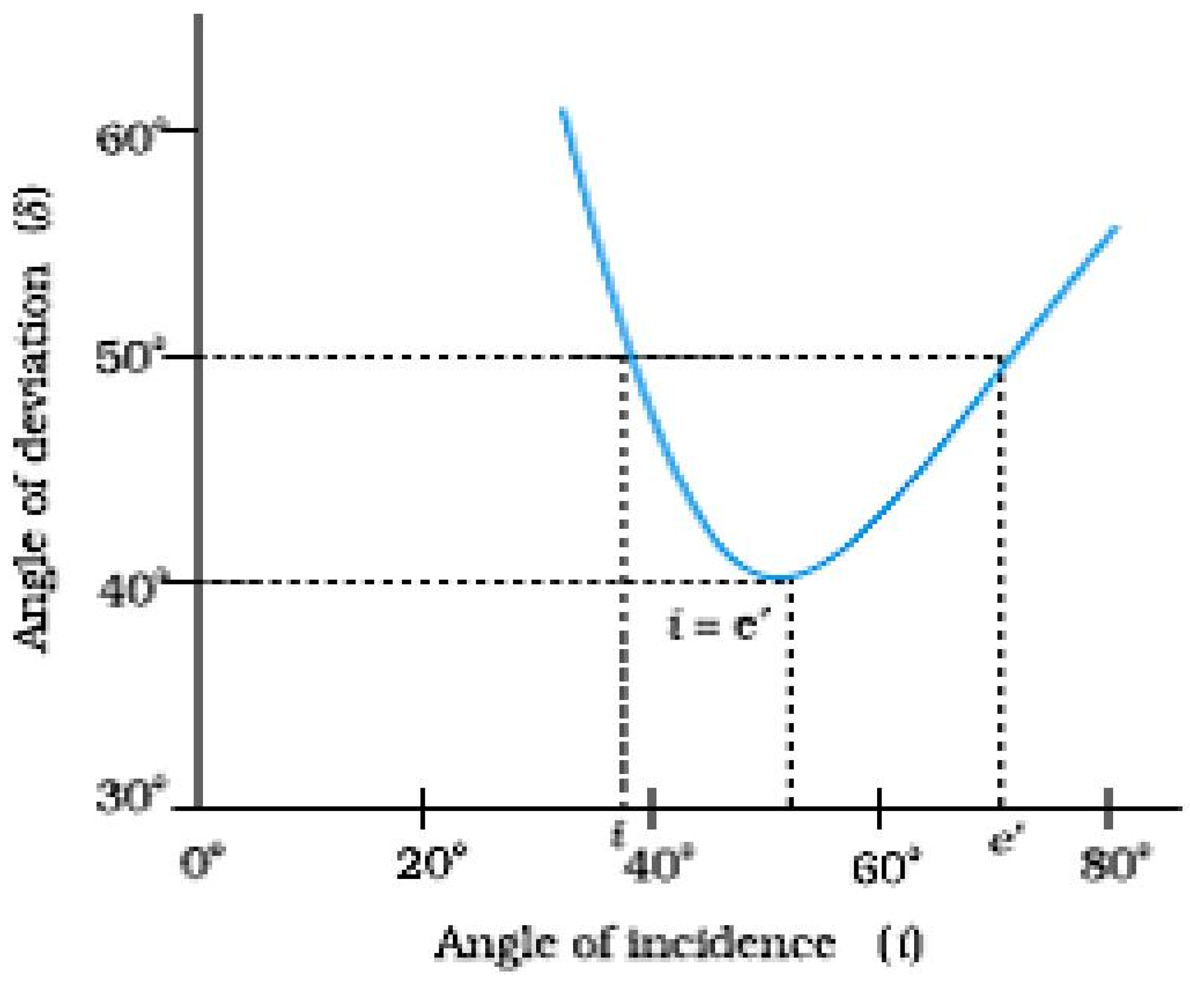
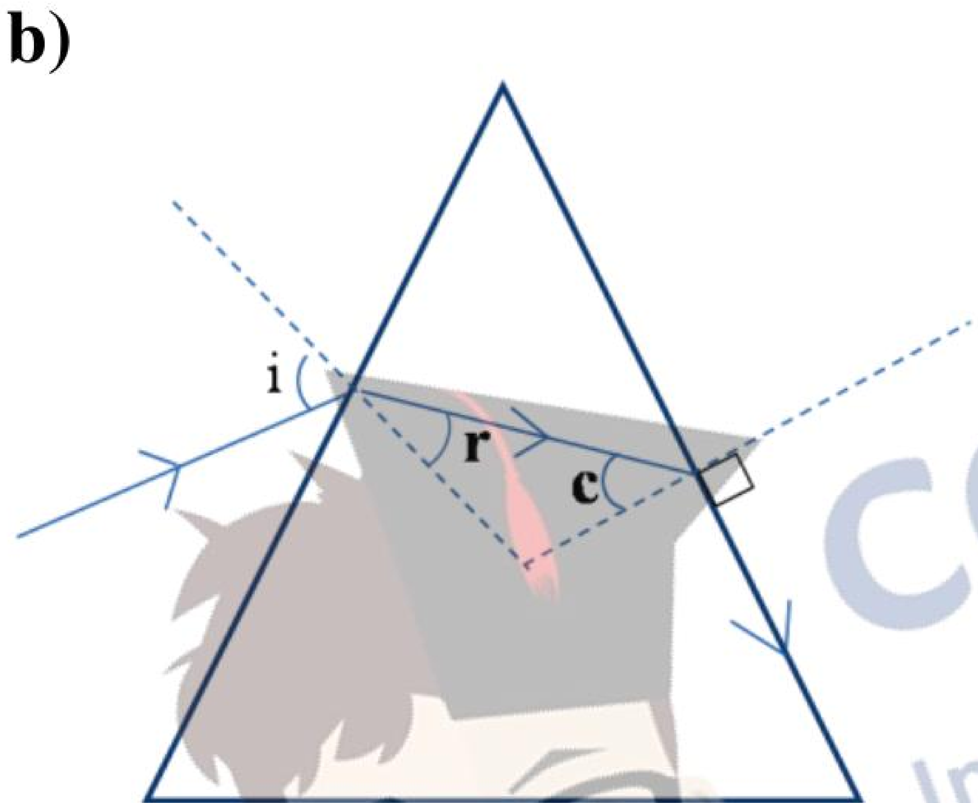
$\delta = i + e - A$

For minimum derivation,

$\delta = D_m,\ i = e$ and $r_1 = r_2$

$\therefore 2r = A => r = \frac{A}{2}$ ½

$D_m = 2i - A => i = \frac{A + D_m}{2}$

	$\therefore n = \frac{n_2}{n_1} = \frac{\sin i}{\sin r}$ $= \frac{sin\left(\frac{A+D_m}{2}\right)}{\sin\frac{A}{2}}$	½	
		1	
	b)  Sin c $= \frac{1}{n} = \frac{1}{\sqrt{2}}$	½	
	$\Rightarrow c = 45^0$ $r + c = 60^0 \quad => r = 15^0$	½	
	$n = \frac{\sin i}{\sin r}$ $\Rightarrow \sqrt{2} = \frac{\sin i}{\sin 15^0}$	½	
	$\Rightarrow i = sin^{-1}[\sqrt{2}\sin 15^0]$	½	**5**