Class - 12 Complete Physics

Electrostatics

(i) $Q = ne$; $n \in Z$ $e = 1.6 \times 10^{-19}$ C
Quantization

(ii) σR = Const for Conductor
Radius of Curvature

(iii) Mo charging :- Friction, Conduction, Induction

Repulsion is sure
Test of Charged bodeies*

(iv) Gold leaf Ex. :- magnetitide of charge ∝ DIVERGANCE

(v) Coulomb's Law :-

$$F = \frac{K q_1 q_2}{r^2}$$

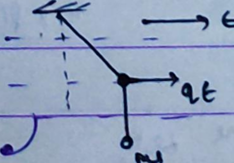
$F \to \ominus$ Attraction
$F \to (+)$ Repulsion

$K = 9 \times 10^9 \, Nm^2 C^{-2}$ $K = \frac{1}{4\pi\epsilon_0}$

$\epsilon_0 = 8.854 \times 10^{-12} \, N^{-1} C^2 m^{-2}$
Permitivity of free space.

(vi) $$\vec{E} = \lim_{q_0 \to 0} \frac{\vec{F}}{q_0} = \frac{Kq}{r^2}$$

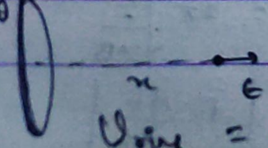
(vii)



$$\tan\theta = \frac{qE}{mg_{eff}}$$

$$g_{eff} = g\left(1 - \frac{\rho_L}{\rho_S}\right)$$

viii) $$E_{ring} = \frac{KQx}{(R^2+x^2)^{3/2}}$$

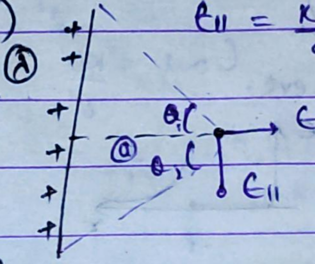


$E_{ring\,max} \Rightarrow R = \frac{x}{\sqrt{2}}$

$$V_{ring} = \frac{KQ}{\sqrt{R^2+x^2}}$$

ix)

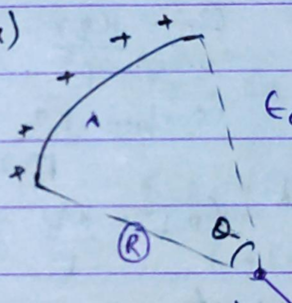
$$E_\perp = \frac{K\lambda}{a}(\sin\theta_1 + \sin\theta_2)$$
$$E_\parallel = \frac{K\lambda}{a}(\cos\theta_1 - \cos\theta_2)$$



$E^{\infty}_{\perp} = \frac{2K\lambda}{R}$
$E^{\infty}_{\parallel} = 0$

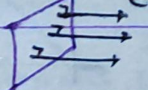
$E_{semi\infty\,\perp} = \frac{K\lambda}{R}$
$E_{semi\infty\,\parallel} = \frac{K\lambda}{R}$ $\Big\}$ $45°$ $\frac{\sqrt{2}K\lambda}{R}$

(x)



$$E_{arc} = \frac{2K\lambda}{R}\sin\frac{\theta}{2}$$

xi) Electric Field Line and Equipoten Surface.

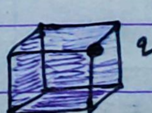


V Const.
$\boxed{W_q = 0}$

xii) $\phi = \oint \vec{E} \cdot d\vec{s} = \vec{E} \cdot \vec{A}$

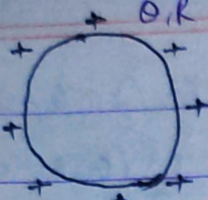
xiii) Gauss Law :-

$$\text{Total flux} = \frac{q_{in}}{\epsilon_0}$$



$q_{cube} = \frac{q}{8\epsilon_0}$

$q_{on\,face} = \frac{q}{24\epsilon_0}$



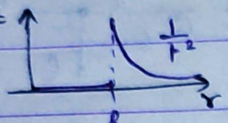
$E_{in} = 0$

$E_{surface} = \frac{kQ}{R^2}$

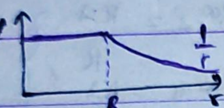
$E_{out} = \frac{kQ}{r^2}$

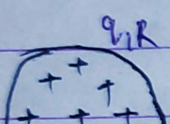
xiv) Holow sphere.

$V_{in} = \frac{kQ}{R}$



$V_{out} = \frac{kQ}{r}$





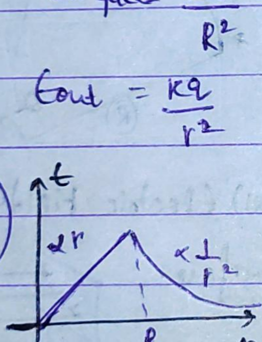
$E_{in} = \frac{kqr}{R^3}$

$E_{surface} = \frac{kq}{R^2}$

$E_{out} = \frac{kq}{r^2}$

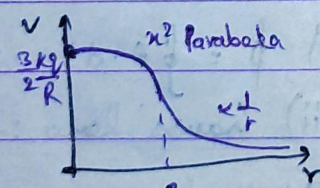
xv) uniformly charged sphere.

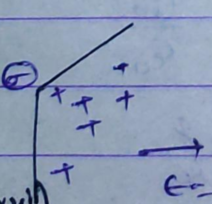
$V_{in} = \frac{kq}{R}\left(\frac{3}{2} - \frac{x^2}{2R^2}\right)$



$V_{surf} = \frac{kq}{R}$

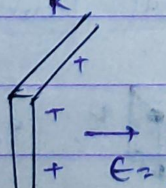
$V_{out} = \frac{kq}{r}$





$E = \frac{\sigma}{2\epsilon_0}$

xvi) Non Conducting



$E = \frac{\sigma}{\epsilon_0}$

Conducting

$E = \frac{\rho x}{\epsilon_0}$

NonConducting.

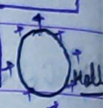
xvii) Electric potential

$V = -\frac{W_{EF}}{q_{test}} = \frac{W_{ext}}{q_{test}}$ (slowly)

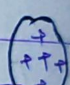
let $V_\infty = 0$ $\quad V_P = \frac{kq}{r}$ $\quad = \frac{\sigma}{2\epsilon_0}$ pressure

$\boxed{V = -\int \bar{E} \cdot ds}$ $\quad \boxed{E = -\frac{\partial V}{\partial x} - \frac{\partial V}{\partial y} - \frac{\partial V}{\partial z}}$

xviii) Potential Energy :- $\boxed{\text{Self } E_n = \frac{kQ^2}{2R}}$ hollow



$U_\infty = 0 \qquad U = \frac{kq_1q_2}{r}$



xix) Dipole

$\boxed{\text{Self } E_n = \frac{2kQ}{5R}}$ sphere

$\bar{P} = q \times d \qquad \ominus \longrightarrow \oplus$

$E_{axial} = \frac{2k\bar{P}}{r^3} \qquad V_{axial} = \frac{kP}{r^2}$

$E_{equitorial} = \frac{-k\bar{P}}{r^3} \qquad V_{equi} = 0$

$E_{general} = \frac{k\bar{P}}{r^3}\sqrt{1+3\cos^2\theta} \qquad V_{general} = \frac{kP\cos\theta}{r^2}$

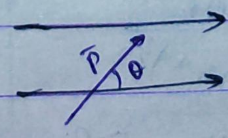
$\tan\alpha = \frac{\tan\theta}{2}$

$\alpha \rightarrow$ with axial line

$\alpha \rightarrow$ with dipole θ angle

let $PE_{\frac{\pi}{2}} = 0$

$PE = -\bar{P}\cdot\bar{E}$



$\tau = \bar{P} \times \bar{E}$

$T = 2\pi\sqrt{\frac{I}{PE}}$

$|\vec{F}_{dipole}| = \left|\bar{P}\frac{d\bar{E}}{d\bar{r}}\right|$

Current Electricity

(i) $I = \frac{dq}{dt}$ Ampere

(ii) $J = \frac{I}{A} \Rightarrow \boxed{I = \bar{J}\cdot\bar{A}}$ (+) charge flow

(iii) Drift velocity

$V_d = \left(\frac{eE\tau}{m}\right)$ $\tau \rightarrow$ Relaxation Time

(iv) रटो (i) $\sigma = \frac{ne^2\tau}{m}$

(ii) $\rho = \frac{m}{ne^2\tau}$ (iii) $R = \frac{\rho l}{A} = \frac{ml}{ne^2\tau A}$

(iv) $V = IR \Rightarrow V = \frac{mlI}{ne^2\tau A}$

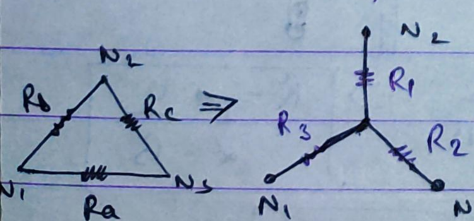
$\frac{I}{A} = \left(\frac{V}{l}\right)\left(\frac{ne^2\tau}{m}\right)$

$\boxed{\bar{J} = \sigma\bar{E}}$ microscopic form of ohm law.

$\boxed{I = neAV_d}$

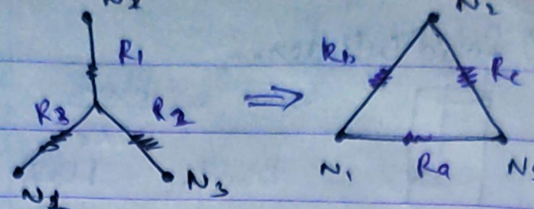
(v) $R_s = R_1 + R_2 \cdots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \cdots$

(vi) Star Delta Transformation :-



$R_1 = \frac{R_bR_c}{R_a+R_b+R_c}$ $R_3 = \frac{R_aR_b}{R_a+R_b+R_c}$

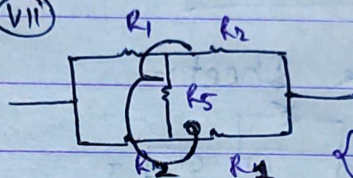
$R_2 = \frac{R_aR_c}{R_a+R_b+R_c}$



$R_a = \frac{R_1R_2+R_2R_3+R_3R_1}{R_1}$ $R_c = \frac{R_1R_2+R_2R_3+R_3R_1}{R_3}$

$R_b = \frac{R_1R_2+R_2R_3+R_3R_1}{R_2}$

(vii)



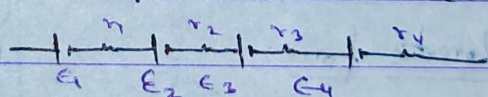
{ unbalanced wst.

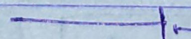
$R_{eq} = \frac{R_2R_1 + R_1R_5 + R_5R_2 + R_3R_1}{R_1+R_2+R_3+R_4+2R_5}$

or

Star ⇒ Delta

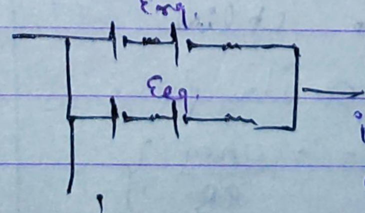
(viii) Equivalent Resistance :- EMF with Inter.





$r_{eq} = r_1 + r_2 + r_3 + \cdots$

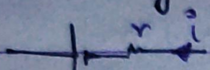
$E_{eq} = E_1 + E_2 + E_3 + E_4 \cdots$



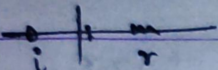
is same $E_{eq}' = E_{eq}$.

$E_{eq}' = \frac{\frac{E_{eq}}{r_{eq}} + \frac{E_{eq}}{r_{eq}} \cdots}{\frac{1}{r_{eq}} + \frac{1}{r_{eq}} + \cdots}$

ix) Voltage acc. battery



$V = \mathcal{E} - ir$ Discharging



$V = \mathcal{E} + ir$ Charging

(x) Maximum Power Transfer Theo

for maximum power trasfered

$\boxed{R_{ext} = R_{in}}$

If $R_{in} \to$ variable Maximum Power Trasfer $\boxed{R_{in} = 0}$

xi) Bulb Resistence $\Rightarrow$ Constant

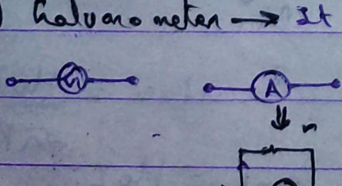
$P = VI = \frac{V^2}{R} = I^2 R$

xii) Temp dependence of Resist.

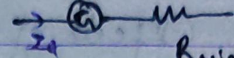
$R = R_0 (1 + \alpha \Delta T)$

Initial Temp Coefi change in Temp

xiii) Galvanometer $\to$ It detects cur



$I_{FSD} \cdot R_G = (I_a - I_{FSD})\, r$

xiv) 

$\Delta V = I (R_G + R_{high})$

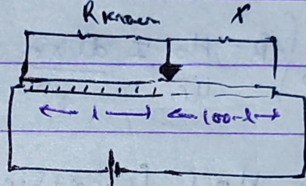
xv) Sensitivity

Current Voltage

$\frac{\Delta\theta}{\Delta I}$ rad A^{-1}

$\frac{\Delta\theta}{\Delta I R}$ rad V^{-1} Angle Rotate

xvi) Meter bridge



Balance condition

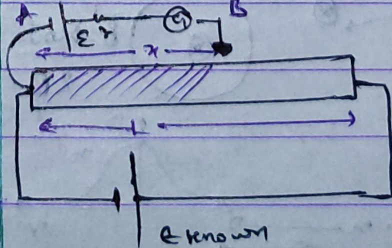
$\frac{R}{\frac{\rho l}{A}} = \frac{X}{\frac{\rho(100-l)}{A}}$

$\rightarrow \boxed{\frac{R}{l} = \frac{X}{(100-l)}}$ It is used to measure unknown Res.

$\to$ for minium Error $l \to 50$ cm

xvii) Potentiometer :-

$\to$ It donot draw current unlike Voltmeter.



$\frac{\Delta V}{\Delta L}$ = Potential Gradient

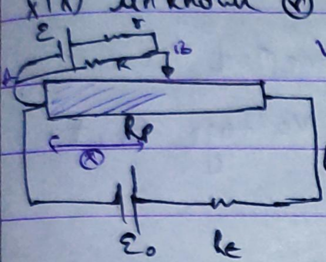
$\boxed{\Delta V_x = (\text{Poten. Grad})\, x}$ = Pt across AB

xviii) Cond^n for no null point.

① Unknown EMF > known EMF

② Polarity of both EMF diff.

xix) Unknown (r) :-



$V_{AB} = V_n$

$$\frac{\varepsilon R}{(r+R)} = \frac{\varepsilon_0 R_n}{(R_E+R_P)}$$

xx) Sensitivity of potentiometer

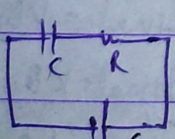
→ Smallest Reading that can be taken

Sensitivity = (k) (Least Count)

→ Potential Gradient.

xxi) RC Circuits :-

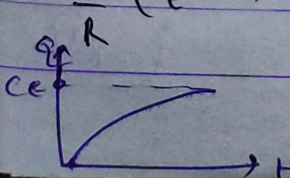
Charging



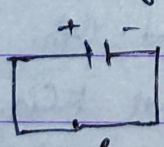
$Q = Q_0(1 - e^{-t/\tau})$

$Q = C\varepsilon(1 - e^{-t/\tau})$

$i = \frac{\varepsilon}{R}(e^{-t/\tau})$

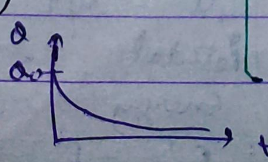


Dishaging.



$Q = Q_0 e^{-t/\tau}$

$i = \frac{Q_0}{t} e^{-t/\tau}$



xxii) Complex RC:-

① Short Battery

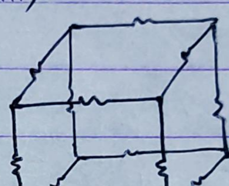
② find R across Capacitance

③ $\tau_{eq} = R C_{eq}$

④ Find V across Capacitance

⑤ $q_{final} = C\Delta V$

xxiii)



	Edge	Face Diaga	Edge Dia
R	$\frac{7}{12}R$	$\frac{9}{12}R$	$\frac{10}{12}R$
C	$\frac{12}{7}C$	$\frac{12}{9}C$	$\frac{12}{10}C$

xxiv) Capacitor:-

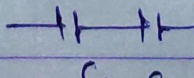
$\boxed{Q = C\Delta V}$ C → Farad

$\left\{ C = \frac{A\varepsilon_0}{d} \right\}$

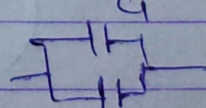
Energy ⇒ $\frac{1}{2}CV^2$

$\frac{1}{2}QV$

$\frac{Q^2}{2C}$



$C_{eq.} = \frac{C_1C_2}{C_1+C_2}$

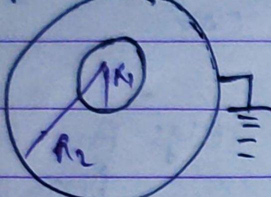


$C_{eq} = C_1 + C_2$.

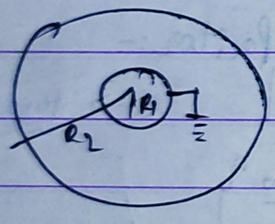
xxv)
Energy density

$$\boxed{\frac{1}{2}\epsilon_0 E^2}$$

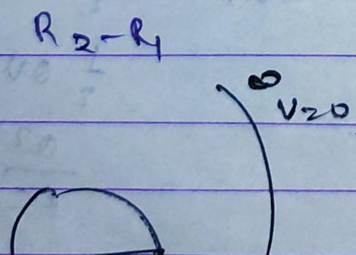
* xxvi)
Spherical Capacitors :-



$$C = \frac{4\pi\epsilon_0 R_1 R_2}{R_2 - R_1}$$



$$C = \frac{4\pi\epsilon_0 R_2^2}{R_2 - R_1}$$

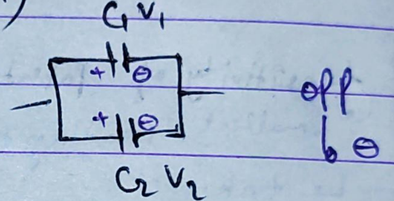


$$C_1 = 4\pi\epsilon_0 R$$

xxvii) • when
Battery disconnected
→ charge constat

when
Battery Connected
→ voltage Const.

xxviii)



$$V_{eq} = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$

Dielectric → { $C_1 = K\, C_{initial}$

Battery Dis. — Battery conected

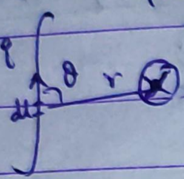
$Q_{final} = Q_{in}$	$V_{final} = V_{in}$
$C_{final} = K C_{in}$	$Q_{final} = KQ$
$V_{final} = V_{in}/K$	$C_{final} = KC$
$Ef_{final} = Ef/K$	$Ef_f = Ef_{in}$
$Ed = Ed/K$	$Ed_{final} = K\,Ed$
$U' = U/2$	$U' = K\,U_{in}$
Potential Energy	$F = K^2 F_{in}$

Force = F

Magnetic Effects of Current

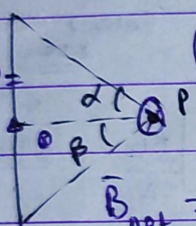
① Biot Savart's Law:-

$$d\bar{B} = \frac{\mu_0}{4\pi} I \frac{d\bar{l} \times \bar{r}}{|r|^3}$$



$$\frac{\mu_0}{4\pi} \rightarrow 10^{-7}\ SI$$

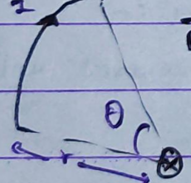
②

(i) 

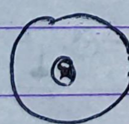
$$\int d\bar{B} = \frac{\mu_0}{4\pi} I \frac{d\bar{l} \times \bar{r}}{r^3}$$

$$\bar{B}_{net} = \frac{\mu_0 I}{4\pi r}(\sin\alpha + \sin\beta)$$

$$B_\infty = \frac{\mu_0 I}{2\pi r} \qquad B_{semi\infty} = \frac{\mu_0 I}{4\pi r}$$

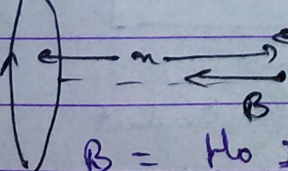
③ 

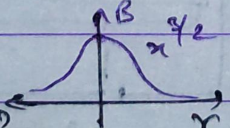
$$\bar{B} = \frac{\mu_0 I}{2R}\left(\frac{\theta}{2\pi}\right)$$



$$\bar{B} = \frac{\mu_0 I}{2R}$$

④ R





$$B = \frac{\mu_0 I}{4\pi} \frac{2\pi R^2}{(R^2+x^2)^{3/2}}$$

{easy to Rember

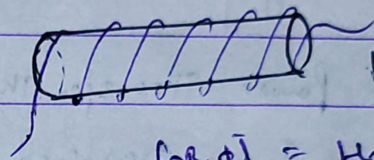
$$B = \frac{\mu_0 I R^2}{2(R^2+x^2)^{3/2}}$$

⑤ Ampere Circuital Law:-

$$\oint_{\text{line}} \bar{B}\cdot d\bar{l} = \mu_0 I_{in}.$$

⑥ Solenoid:-

$l >> r$



$$B_{end} = \frac{\mu_0 n I}{2}$$

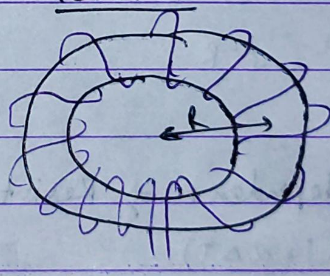
$$\oint \bar{B}\cdot d\bar{l} = \mu_0 I_{in}$$

$$Bl = \mu_0 n i l$$

$$n \Rightarrow \frac{\text{no. of Turns}}{\text{Length}} \qquad \boxed{B = \mu_0 n i}$$

$$B_{generall} = \frac{\mu_0 n I}{2}(\cos\theta_1 - \cos\theta_2)$$

⑦ Toroid:-

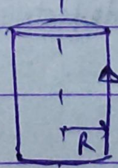


N → Total no of Turns

$$B = \frac{\mu_0 N I}{2\pi R}$$

Not Constant ~~Not Continuous~~

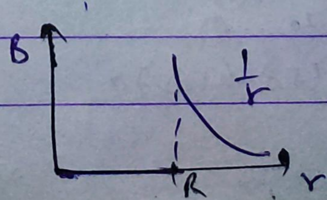
⑧ Hollow Cylinder:-



$B_{in} = 0$

$$B_{surface} = \frac{\mu_0 I}{2\pi R}$$

$$B_{out} = \frac{\mu_0 I}{2\pi r}$$

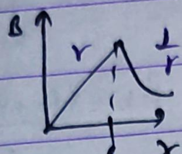


(9) Solid cylinder:-

$$B_{out} = \frac{\mu_0 I}{2\pi r}$$

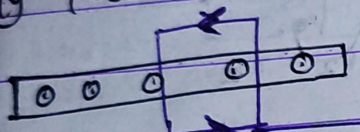
$$B_{surface} = \frac{\mu_0 I}{2\pi R}$$

$$B_{in} = \frac{\mu_0 I r^2}{2\pi r R^2}$$



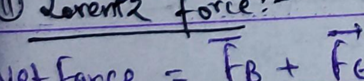
$$\boxed{B_{in} = \frac{\mu_0 I r}{2\pi R}}$$

(10) Thick sheet:-



$\lambda = \frac{I}{\text{length}}$ (cosθ)

$$\boxed{B = \frac{\mu_0 \lambda}{2}}$$



$$B = \frac{\mu_0 \lambda x}{2a}$$

(11) Lorentz force:-

Net Force $= \vec{F}_B + \vec{F}_E$

$$\boxed{F = q\,\bar{v} \times \bar{B} + q\bar{E}}$$

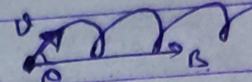
$\theta = 0, 180$ st line

$\theta = 90$ circular path

$r = \frac{mv}{qB}$ } $T = \frac{2\pi m}{qB}$ }

$\omega = \frac{qB}{m}$ }

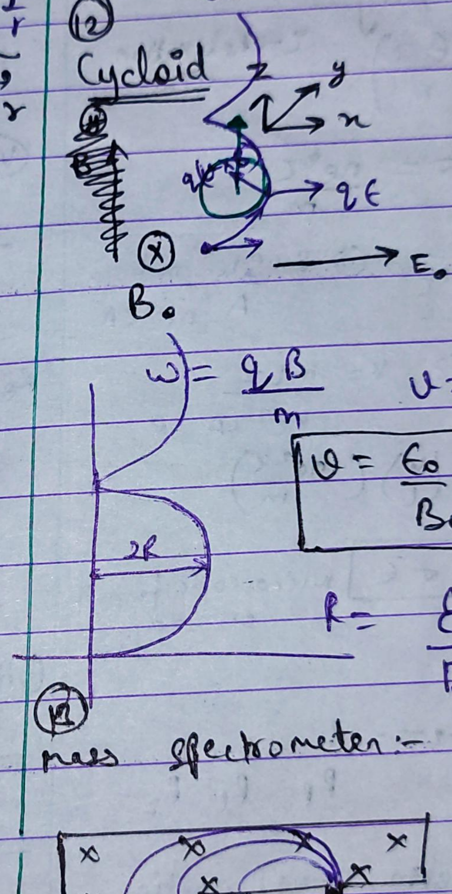
$\theta \neq 90, 0, 180$; Helix



$R = \frac{mv\sin\theta}{qB}$ pitch $= v\cos\theta \cdot t$

$= v\cos\theta \frac{2\pi m}{qB}$

(12) Cycloid

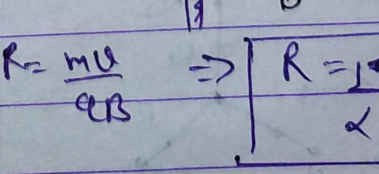


$\omega = \frac{qB}{m}$ $v = R\omega$

$$\boxed{v = \frac{E_0}{B_0}}$$

$$R = \frac{E_0}{B_0}\frac{m}{qB_0}$$

(13) mass spectrometer:-

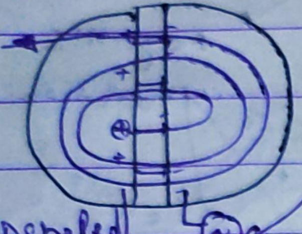


$R = \frac{mv}{qB} \Rightarrow \boxed{R = \frac{1}{\alpha}\frac{v}{B}}$

$$\boxed{\alpha = q/m}$$

(14)

Cyclotron:-



D shaped Conduct

$T = \frac{2\pi m}{qB}$

$\omega = \frac{qB}{m}$

$R = \frac{mv}{qB}$

Define

Req.

Ef do work

GF inc. speed. Behaves dine.

(15)

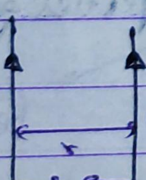
magnetic force on a current carrying Cond:-

$$\boxed{d\bar{F} = i\, d\bar{l} \times \bar{B}}$$

Force in a loop in Const B is zero.

→ l_{eff} → join Initial & final Pt.

(16)



i_1 i_2

$B = \frac{\mu_0 I_1}{2\pi r}$

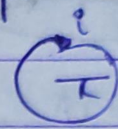
$F_{att} = \frac{\mu_0 I_1}{2\pi r} i_2 (l)$

$$\frac{f}{l} = \frac{\mu_0 I_1 I_2}{2\pi r}$$

(17) magnetic Dipole:-

Current Carrying loop

$$\boxed{|\bar{\mu}| = iA}$$



$\bar{M} = i\pi r^2$

(18) Torque on MD in Ext B:-

$\bar{\tau} = \bar{M} \times \bar{B}$

$\bar{PE} = -\bar{M} \cdot \bar{B}$

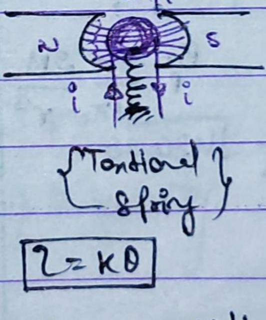
$\theta = \pi/2$

$\boxed{PE = 0}$

(19) Time period

$$T = 2\pi \sqrt{\frac{I}{MB}}$$

(20) Galvanometer:-



Soft Iron

N S

i i

{Torsional Spring}

$\boxed{\tau = K\theta}$

At Eq.

$K\theta = M \times B$

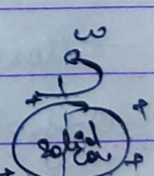
$K\theta = INAB$

$\boxed{I \propto \theta}$

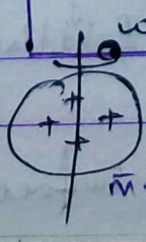
(21) Gyromagnetic Ratio:-

$$\frac{q}{2m} = \left|\frac{\bar{M}}{\bar{L}}\right|$$

$$\boxed{\bar{M} = \frac{q}{2m}\bar{L}}$$

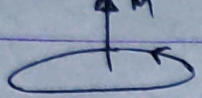


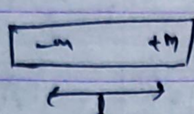
$m = \frac{q}{2m}\left(\frac{2}{3} mR^2\right)\omega$



$\bar{M} = \frac{q}{2m}\left(\frac{2}{5} mR^2\right)\omega = \frac{qR^2\omega}{5}$

magnetism & matter.

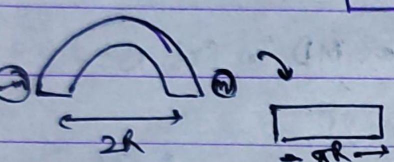




$|\vec{M}| = iA$

$\boxed{\vec{M} = m l}$

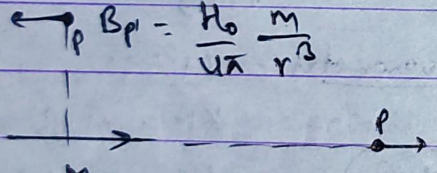
pole strenght



$\bar{m} = m\,2R \qquad \bar{m} = m\pi R$

{ $\bar{m} \propto$ Volume ↑, Dipole ↑ }

$B_p = \frac{\mu_0}{4\pi}\frac{m}{r^3}$



$B_p = \frac{\mu_0}{4\pi}\frac{2M}{r^3}$

$B_{general} = \frac{\mu_0}{4\pi}\frac{m}{r^3}\sqrt{1+3\cos^2\theta}$

$\tan\alpha = \frac{\tan\theta}{2}$

★ Magnatic field line & flux.

→ Close loop ✓

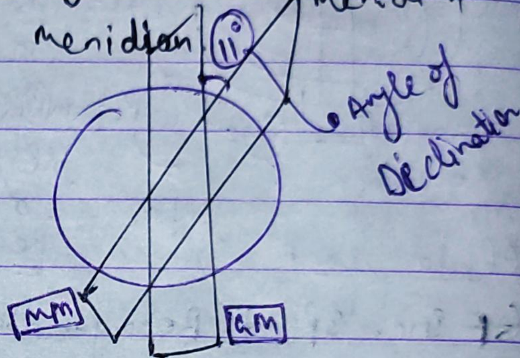
magnetic flux ∝ No. of m. field lines

$\oint B\cdot ds = 0$

for closed surface.

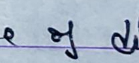
★ Earth magnetism :-

geographic meridian — magnetic meridian



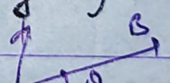
★ Angle of inclination and Angle of dip.

$\boxed{NH}$ Angle of dip.



$B_H = B\cos\delta$
$B_V = B\sin\delta$

$\boxed{SH}$ Angle of inclination



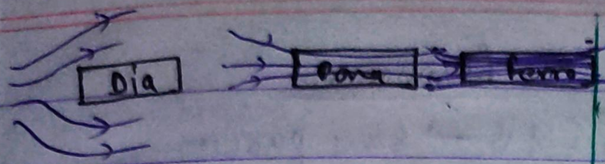
$B_H = B\cos\theta$
$B_V = B\sin\theta$

magnetic Properties of matter:

- Diamagnetic — paired e^-
- Paramagnetic — unpaired e^-
- Ferromagnetic — Domain Theory

Diamagnetic is universal applicable

Para, ferro all show Dia. also



★ (★)

Magnetic Intensity $\boxed{\bar{H}}$ independent of medium

$d\bar{H} = \frac{1}{4\pi} \frac{I\, \bar{dl} \times \bar{r}}{r^3}$

Intensity of magnetisation

$$\boxed{\vec{I} = \frac{\bar{M}}{Vol}}$$

Relative Permiability

$$\boxed{\mu_r = \frac{\mu_m}{\mu_0}}$$

Susceptibility

$\bar{I} = \chi \bar{H}$

$$\boxed{\chi = \frac{\bar{I}}{\bar{H}}}$$

$\chi >>> 1$	ferro
$\chi > 0$	Para
$\chi < 0$	Dia

Relation btw Sus. (χ) & μ_r:-

$$\boxed{\mu_r = 1 + \chi}$$

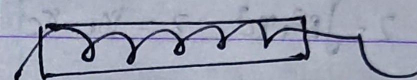
$\mu_r >>> 1$	ferro
$\mu_r > 1$	Para
$\mu_r < 1$	Dia.

★ Curie's Law:-

$$\boxed{\chi \propto \frac{1}{T}} \text{ for Paramagnetic}$$

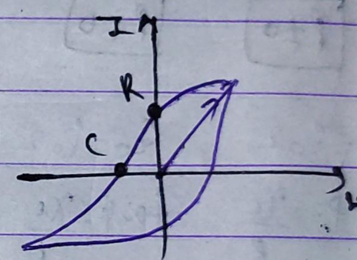
Curie's Temp:- ferro $\xrightarrow{\text{becomes}}$ Para

(★) for Solenoid



$H = ni$

$\boxed{B = \mu H}$ soft



R → Retentivity C → Coercitivity

Permanent Magnets	Electro magnets
High Retentivity	Low Retentivity
Huge Hystresis	low Coercitivity
W = Area of Hystr	slim fit Histrisis
	W = Area of Hystr

EMI

(i) magnetic flux
→ ∝ to No. of B field lines through a surface.

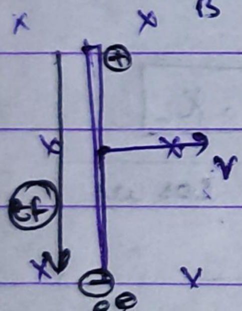
$d\phi = \bar{B}\cdot d\bar{s}$

(ii) Faraday's Law:-

$\varepsilon_{induced} = \ominus\frac{d\phi}{dt}$

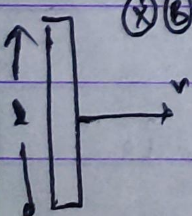
$\boxed{\text{Lenz}}$ Energy Conservation

(iii) motional EMF:-



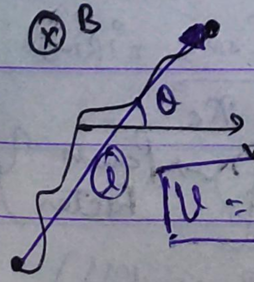
Under Eq. ⇒
$f_{net} = 0$
$q\bar{E} + q\,\bar{v}\times\bar{B} = 0$
$\boxed{\bar{E} = -\bar{v}\times\bar{B}}$

$\{dv = \bar{v}\times\bar{B}\cdot d\bar{l}\}$



$\boxed{V = BlV}$

{ $\bar{v}\times\bar{B}$ → +ve end

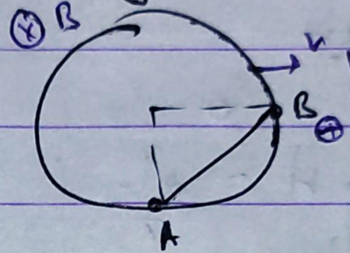


$\boxed{V = BlV\sin\theta}$

(iv) Induced Emf in rotating rod:-

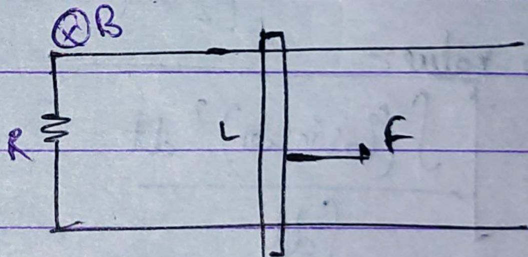
$\boxed{\text{Emf} = \frac{1}{2}B\omega l^2}$

v) Conducting ring rolling over ground:



$V_B - V_A = \frac{1}{2}B\omega(\sqrt{2}R)^2$
$= B\omega R^2$

vi) Conductor connected with Resistance:-



$I = \frac{BLV}{R}$

$F - BIL = ma$

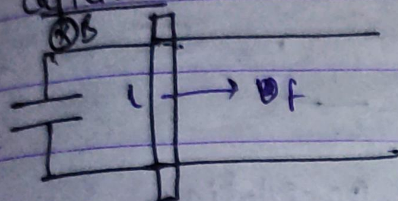
$\frac{F}{m} - \frac{B^2L^2V}{mR} = \frac{dv}{dt}$

→ exponential decay of velo

$\boxed{V_T}$ $\boxed{F = BIL}$

or Power $\boxed{I_T^2R = FV_T}$

vii) Conductor connected with Capacitor:-



$$\boxed{\text{Charge} = C\,(Blv)}$$

$$\frac{dQ}{dt} = CBla$$

$$\boxed{I = CBla}$$

$$f - ilb = ma$$

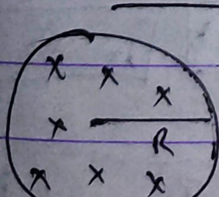
$$a = \frac{f}{m} - \frac{B^2l^2Ca}{m}$$

$$\boxed{a = \frac{f}{m + B^2l^2C}}$$ Const

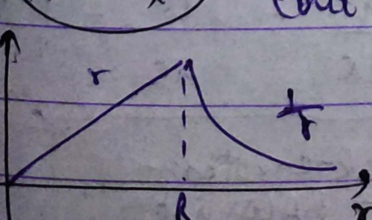
Newtons eq.

viii) E field:-

$$E_{in} = \frac{r}{2}\frac{dB}{dt}$$

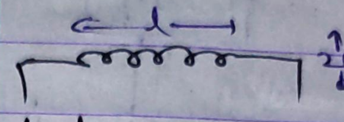


$$E_{out} = \frac{R^2}{2r}\frac{dB}{dt}$$



(x) Inductor:-

$$\boxed{\phi = Li}$$ self inductance Henry



$n = \frac{N}{L}$

L of solenoid

$$\phi = N(\mu_0 n I)\pi r^2$$

$$\phi = (\mu_0 n^2 \pi r^2 L) I$$

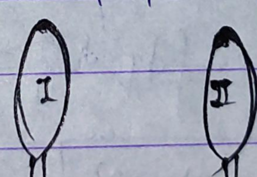
$$\boxed{L = \mu_0 n^2 \pi R^2 L}$$

↳ depends upon Dimensions R & "n".

⊗ Mutual Induction:-

flux in I ∝ Current in II

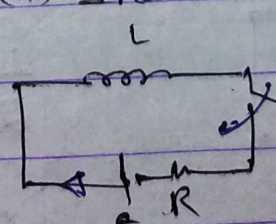
$$\phi_{I/II} = M i_{II}$$



↳ property of system

$$\phi_{II/I} = M i_I$$

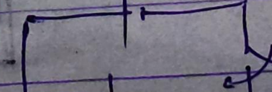
(xi) Inductor in Circuit:-



$$\phi = Li$$

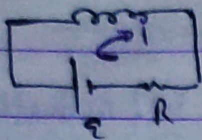
$$\frac{d\phi}{dt} = L\frac{di}{dt}$$

$L\,di/dt$ $\left\{ \text{Emf} = L\frac{di}{dt} \right\}$



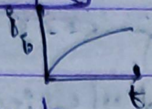
Growth

(xii)



$i = \frac{\varepsilon}{R}\left(1 - e^{-t/\tau}\right)$

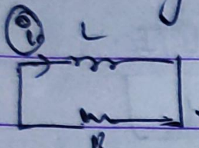
$\boxed{\tau = L/R}$



t ⇒ 0 L → open

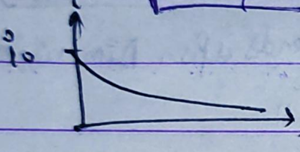
t ⇒ ∞ L → conductor

xiii) Decay:-

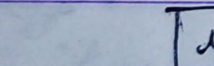


$i = i_0 e^{-t/\tau}$

$\boxed{\tau = L/R}$



xiv) Energy in inductor:-



{Charge}

Energy in form of $\boxed{B}$

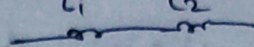
$i \quad L\frac{di}{dt} \quad \int dw = \int dq\, L\frac{di}{dt}$

$$\boxed{U = \frac{1}{2}Li^2}$$

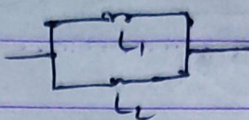
xv) Energy density:-

$$\boxed{U_d = \frac{B^2}{2\mu_0}}$$

xvi)

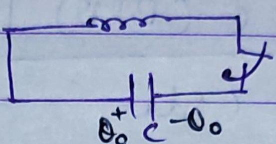


$L_{eq} = L_1 + L_2 + \dots$



$\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2} \dots$

xvii) LC Oscillations:-



$\boxed{q = Q_0 \sin(\omega t + \phi)}$

{initial phase}

$$\boxed{\omega = \frac{1}{\sqrt{LC}}}$$

$t = 0$

$q = Q_0$

$Q_0 = Q_0 \sin(\phi)$

$\boxed{\phi = \pi/2}$

$\boxed{q = Q_0 \cos \omega t}$

$i = -\frac{dq}{dt} = -Q_0\omega \cos(\omega t + \phi)$

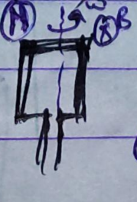
$i = i_0 \cos(\omega t + \pi/2)$

$\boxed{i = i_0 \sin \omega t}$ $\boxed{i_0 = Q_0\omega}$

★

$$\frac{1}{2}Li^2 + \frac{q^2}{2C} = \frac{q_0^2}{2C} = \frac{1}{2}Li_{max}^2$$

xviii) AC generator:-



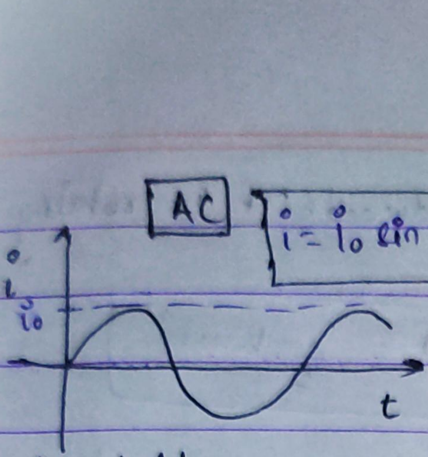
$\phi = BA\cos \omega t$

$\phi_{total} = BNA \cos \omega t$

$\boxed{emf = --BAN\omega \sin \omega t}$

$I = \frac{BAN\omega \sin(\omega t)}{R}$

AC $\boxed{i = i_0 \sin(\omega t + \phi)}$



Household:- $V_{rms} = 220\,V$

$f = 50\,Hz$

★ Average value:-

One cycle $\bar{H} = 0$

(+) Half cycle $\bar{H} = \frac{2 i_0}{\pi}$

$$\langle i \rangle = \frac{\int_0^{T/2} (i_0 \sin \omega t)\, dt}{T/2} = \frac{2 i_0}{\pi}$$

★ Rms value:-

$$I_{rms} = \sqrt{\frac{\int (i_0 \sin \omega t)^2\, dt}{\int dt}}$$

$$\boxed{I_{rms\,(sine)} = \frac{i_0}{\sqrt{2}}}$$

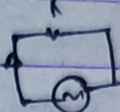
★ Hot wire instruments:-
will measure Rms value only.

★ Phasors :-

① Show current phasor on x-axis

② ACW is taken as +ve phase.

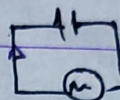
★ (I) R-AC



$i = \frac{\varepsilon}{R} \Rightarrow \frac{\varepsilon_0 \sin \omega t}{R}$

(ε & i → same phase) $\boxed{i = i_0 \sin \omega t}$

(II) C-AC



$q = C\varepsilon_0 \sin \omega t$

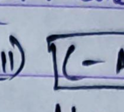
$i = C\varepsilon_0 \omega \cos \omega t$

$$\boxed{i = \frac{\varepsilon_0}{\frac{1}{\omega C}} \cos \omega t}$$

$X_C = \frac{1}{\omega C}\ (\Omega)$

(Capacitive Reactance) (Current voltage से $\pi/2$ phase आगे है)

(III) L-AC



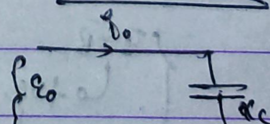
$\boxed{\varepsilon_0 = i_0 X_L}$

$$\boxed{i = \frac{\varepsilon_0}{\omega L} \cos \omega t}$$

$X_L = \omega L$

(Inductive Reactance) (Current voltage से $\pi/2$ phase पीछे है)

(IV) Power in AC:-



$\frac{\varepsilon_0}{X_C} = i_0$

$\frac{\varepsilon_{rms}}{X_C} = i_{Rms}$

Power Average $= \varepsilon_0 i_0 \cos \phi$ → Power Factor

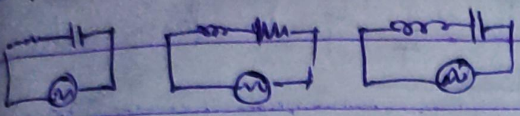
ϕ (phase diff)

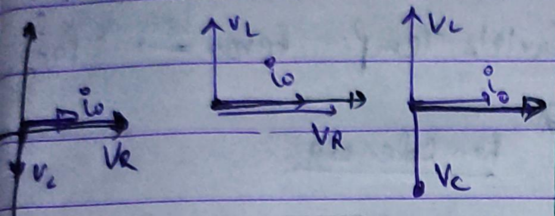
Capacity → 0

Inductive → 0

Res → $\varepsilon_0 i_0$

RC	LR	LC





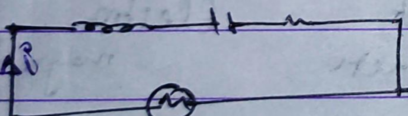
$Z = \sqrt{R^2 + X_c^2}$ $\quad Z = \sqrt{R^2 + X_L^2}$ $\quad Z = |X_L - X_c|$

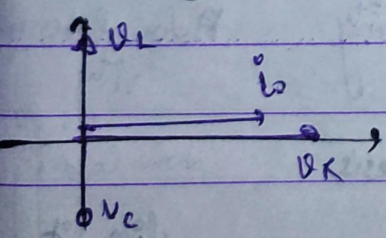
$\boxed{P \neq 0}$ $\quad \boxed{P \neq 0}$ $\quad \boxed{P = 0}$

$\mathcal{E}_0 = i_0 Z$ $\quad \mathcal{E}_0 = i_0 Z$ $\quad \mathcal{E}_0 = i_0 Z$

$\tan\phi = \frac{X_c}{R}$ $\quad \tan\phi = \frac{X_L}{R}$ $\quad \tan\phi = ND$

* Series $\boxed{LCR - AC}$





$Z = \sqrt{R^2 + (X_L - X_c)^2}$

$\mathcal{E}_0 = i_0 Z$

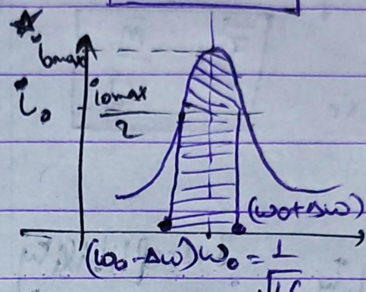
$\tan\phi = \frac{|X_L - X_c|}{R}$

* **Resonance:-**

i & V → same phase.

if $X_L = X_c$

$$\boxed{\omega = \frac{1}{\sqrt{LC}}}$$



$i_0 = \frac{\mathcal{E}_0}{2}$

$i_0 = \frac{\mathcal{E}_0}{\sqrt{R^2 + (X_L - X_c)^2}}$

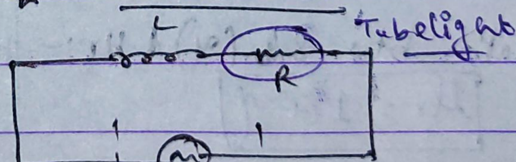
Q factor:- Bandwidth at Reso.

$Q = \frac{\omega_0}{2\Delta\omega}$ $\quad \boxed{2\Delta\omega}$ $\quad i_0 = \frac{\mathcal{E}_0}{R}$

$$\boxed{Q\text{ factor} = \frac{\omega_0 L}{R}}$$

$Z = \text{min}$

* Choke Coil:-



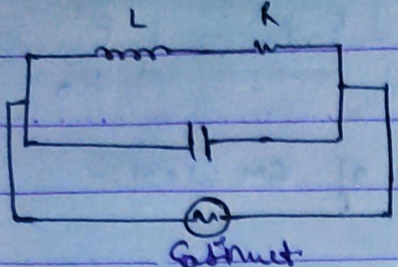
voltage Peak $= \left(\frac{\mathcal{E}_0}{\text{Impedance}}\right) R$
(across R) $\quad (Z)$

voltage peak $= \frac{\mathcal{E}_0}{\sqrt{R^2 + X_L^2}} R$

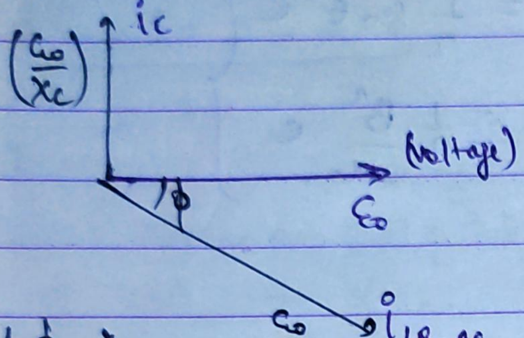
$\boxed{< \mathcal{E}_0}$

★

Parallel LCR Circuits:-



LR → voltage
||
C → voltage



$\tan\phi = \frac{X_L}{R}$

for zero

$\frac{\cancel{E_0}}{\sqrt{R^2+X_L^2}}$ $\quad \sin\phi = \frac{\cancel{E_0}}{X_L}$

Resonance

$$\begin{cases} \omega = \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}} \\ Z = \frac{X_L^2 + R^2}{R} \end{cases}$$

★ **Admittance:-**

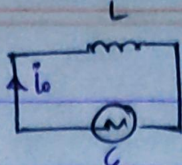
Reciprocal of impedance.

★ Complex no :- (optional)

$z = Ae^{i\theta}$

$z = A\cos\theta + A\sin\theta\, \hat{i}$

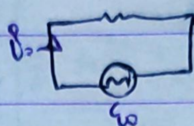
$\hat{i} \rightarrow$ (iota)



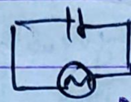
$\boxed{X_L = \omega L\, \hat{j}}$ — iota

$\boxed{E_0 = i_0 X_L}$

$E = i X_L$ ✓



$E_0 = I_0 R$ (Peak) $\quad E = iR$ (inst)



$E_0 = I_0 X_C$ (Peak)

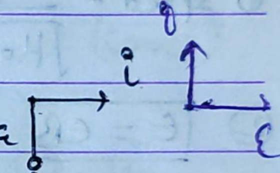
$X_C = -\frac{1}{\omega C}\hat{j}$ → iota

$E = i\left(-\frac{1}{\omega C}\hat{j}\right)$

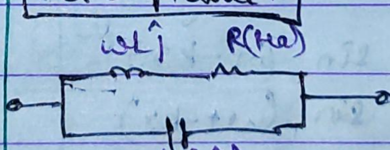
(×) real

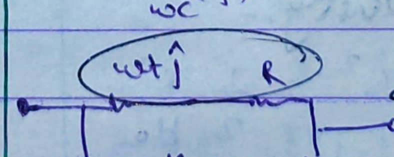
(imagn) (imaginary)

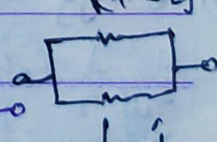
⊕ Real



$\boxed{\text{Net impedance:-}}$







$$X_{eq} = \frac{(R+\omega L\hat{j})\cdot\left(-\frac{1}{\omega C}\hat{j}\right)}{R + \left(\omega L - \frac{1}{\omega C}\right)\hat{i}}$$

EM Waves:-

Maxwell's Eq:-

① $\oint \bar{E}\cdot d\bar{s} = q_{in}/\varepsilon_0$

② $\oint \bar{B}\cdot d\bar{s} = 0$

③ $\oint \bar{B}\cdot d\bar{l} = \mu_0\left[I_{in} + \varepsilon_0 \frac{d\phi_E}{dt}\right]$

④ $\oint \bar{E}\cdot d\bar{l} = -\frac{d\phi_B}{dt}$

Displacement Current:-

$i_D = \varepsilon_0 \frac{d\phi_E}{dt}$ when Ef is changing with Time

⊕ **EM wave**

① speed $= \frac{1}{\sqrt{\mu_0\varepsilon_0}} = c$

② $\boxed{E = CB}$

③ Ef is ⊥ to Bf.

④ $\bar{E}\times\bar{B} \rightarrow$ Direction of flow of Energy

⑤ $E = E_0 \sin(\omega t - kx)$

$B = B \sin(\omega t - kx)$

⊛ Energy density:-

$\underset{\text{Total}}{u} = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\frac{B^2}{\mu_0}$

$\boxed{u_{Ef} = u_{Bf}}$

$u_{Ef} = \frac{1}{4}\varepsilon_0 E_0^2 = \frac{1}{4}\frac{B_0^2}{\mu_0}$

Intensity of EM wave:-

$$\left.\begin{aligned} I &= \frac{1}{2}\varepsilon_0 E^2 C \\ I &= \frac{1}{2}\frac{B^2}{\mu_0} C \end{aligned}\right\}$$

Ray Optics

① Laws of Reflection :-

(I) $\angle i = \angle r$

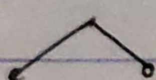
(II) IR, RR & N lie in same Plane.

$$\boxed{\hat{r} = \hat{i} - 2(\hat{i}\cdot\hat{n})\cdot\hat{n}}$$

$[\hat{i}\ \hat{r}\ \hat{n}] = 0$

② Object — Image

Point of Intersection of IR's — Point of Intersection of RR's



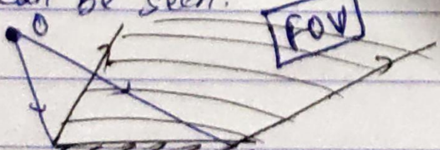
Real — Virtual

Real Intersection — Imaginary Inter.

→ — - - → - - -

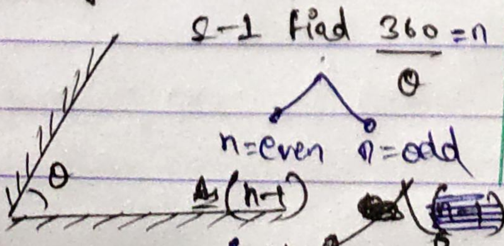
③ Field of view

Space where image of the object Can be seen.



④ No of Images :-

S-1 Find $\frac{360}{\theta} = n$

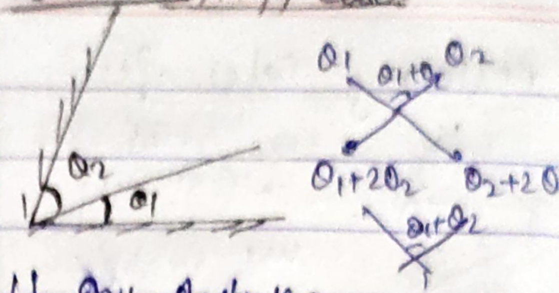


n = even — n = odd

As (n-1)

(n-1) bisector — (n) Not at bisector

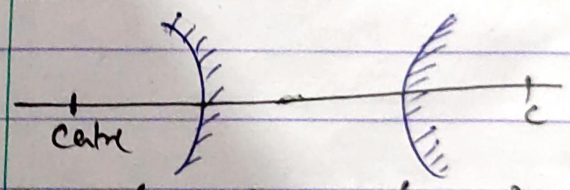
For All θ Anallysis :-
odd Cases / Diff cases



If any Angle > 180 $\boxed{\text{Stop}}$ — Cont

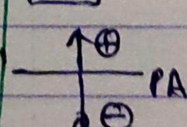
If all 3 (θ Angle) = 360
Consider 1 Imag

Spherical Mirror :-



Sign Convection

$\boxed{IR} \rightarrow$ Direction (+) ☆



☆

focal length :-

$$f = R - \frac{R}{2}\sec\theta$$

θ is very small Paraxially Rays

$$f = R - R/2 = \boxed{R/2}$$

☆ Mirror formula :-

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

Put the value with sign, get the value with sign

Magnifications:-

$$m_{lateral} = \frac{h_I}{h_O} = \frac{-v}{u}$$

$$m_{longitudinal} = \frac{x_I}{x_O} = \left(\frac{v}{u}\right)^2$$

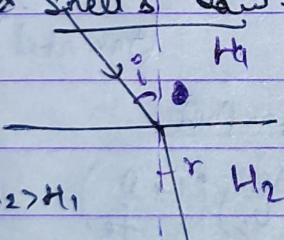
(very small)

Speed of Image:-

$$v_{I(\perp)} = m_{lateral}\, v_{O\perp}$$

$$v_{I(\parallel)} = m_{long.}\, v_{O\parallel}$$

Snell's law:-



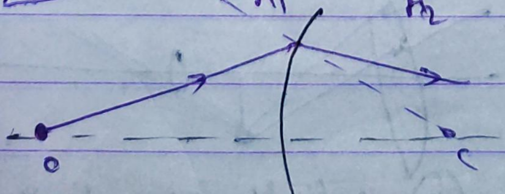
$$\boxed{\mu = \frac{c}{v}}$$

$$\boxed{\mu_1 \sin i = \mu_2 \sin r}$$

$\mu_2 > \mu_1$

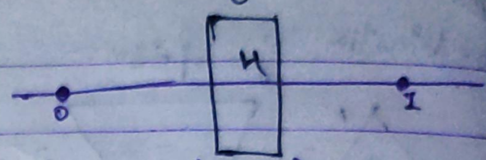
Refraction through Curved Su

$\boxed{\mu_2 > \mu_1}$



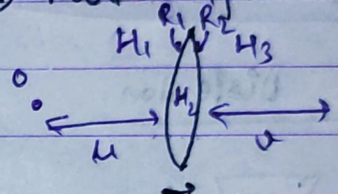
$$\boxed{\frac{\mu_r}{v} - \frac{\mu_i}{u} = \frac{\mu_r - \mu_i}{R}}$$

For Plain Surface $\boxed{R \to \infty}$



$$\text{shift} = t\left(1 - \frac{1}{\mu}\right)$$

Mother formula:-



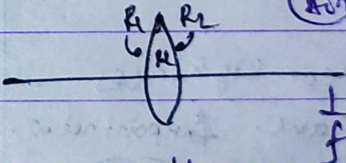
gap<<1

$$\frac{\mu_3}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R_1} + \frac{\mu_3 - \mu_2}{R_2}$$

(maker)

Lens formula:-

(Air)



$$\frac{1}{f} = (\mu_{rel} - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$\mu_{rel} = \frac{\mu_{lens}}{\mu_{surrounding}}$$

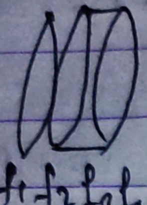
Power of Lens $= \dfrac{1}{f(m)}$

Power of mirror $= \dfrac{-1}{f(m)}$

Lens Formula:-

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

② Combination of lens:-

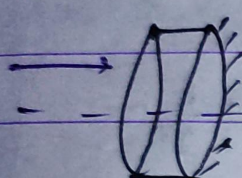


$P_{eq} = P_1 + P_2 + P_3 + P_4$

$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + \frac{1}{f_4}$

$f_1 f_2 f_3 f_4$

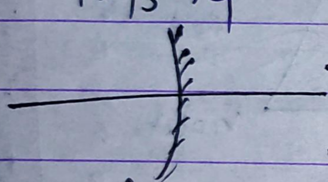
③ Combination of lens with mirror



$P_{eq} = 2P_1 + 2P_2 + 2P_3 + P_m$

$\frac{1}{f_{eq}} = \frac{2}{f_1} + \frac{2}{f_2} + \frac{2}{f_3} - \frac{1}{f_m}$

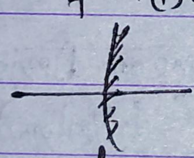
$f_1\ f_2\ f_3$



$f \rightarrow \ominus ve$

$f_{eq.}$

$f \rightarrow (+) ve$



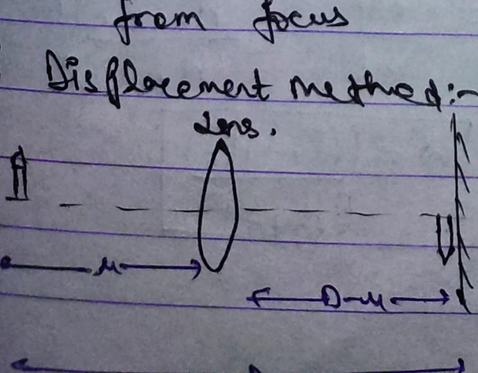
$f_{eq.}$

④ Newton's formula:-

$\boxed{x_1 x_2 = f^2}$

Distance of Image & Object from focus

⑤ Displacement method:-



$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\frac{1}{D-u} + \frac{1}{u} = \frac{1}{f}$

$\frac{\cancel{x} + D - \cancel{x}}{(D-u)u} = \frac{1}{f}$

$Df = Du - u^2$

$\boxed{u^2 - Du + Df = 0}$

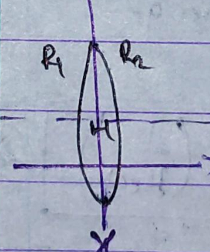
$D \geq 0$

$D^2 - 4Df \geq 0$

$\boxed{D \geq 4f}$

⑥ Cutting of lens:-

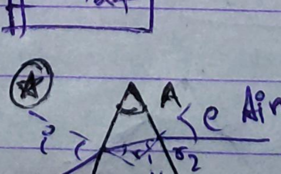
$\frac{1}{f} = (\mu_{rel} - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$



In this case f Dont Change {Intensity Dec.

$\boxed{f \rightarrow 2f}$

⑦

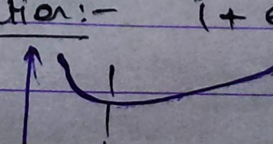


$\boxed{r_1 + r_2 = A}$

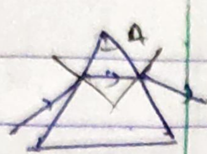
Deviation:- $i + e - A$

δ

$\delta_{min} \rightarrow \boxed{i = e}$



Minimum deviation :-



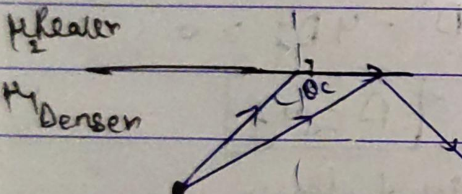
$\delta_{min} = 2i - A$

$i = \frac{\delta_{min} + A}{2}$

$r_1 = r_2 = \frac{A}{2}$

$$\frac{\sin\left(\frac{\delta_{min}+A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \mu$$

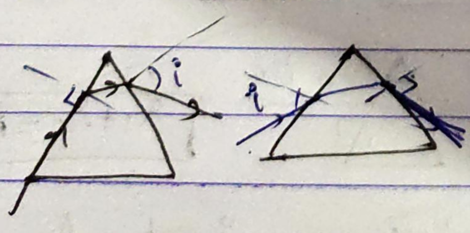
TIR :-



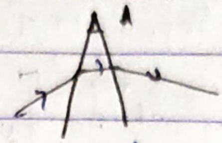
$\sin\theta_c = \frac{\mu_2}{\mu_1} \sin 90°$

$$\boxed{\theta_c = \sin^{-1}\left(\frac{1}{\mu_{rel}}\right)}$$

Maximum Deviation :-



Thin Prism :-



A and i are small

$\delta = i + e - A$

$\sin i = \mu \sin r_1$

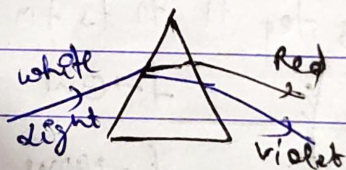
$\boxed{\delta = (\mu - 1)A}$

$\boxed{i = \mu r_1}$

$\boxed{\mu r_2 = e}$

Cauchy's Law :-

$\mu = \mu_0 + \frac{A}{\lambda^2} + \frac{B}{\lambda^4} + \cdots$



V
I
B
G
Y
O
R

$f \downarrow$
$\lambda \uparrow$
$\mu \downarrow$

Mean Deviation :-

(Yellow)

$\delta = (\mu_y - 1)A$

Angular Dispersion :-

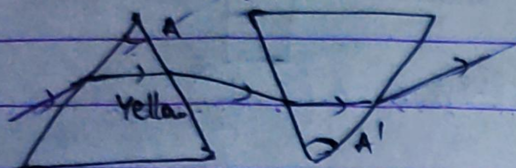
$\delta_V - \delta_R = (\mu_V - \mu_R)A$

Dispersive Power :-

$\omega = \frac{AD}{MD} = \frac{(\mu_V - \mu_R)\cancel{A}}{(\mu_y - 1)\cancel{A}}$

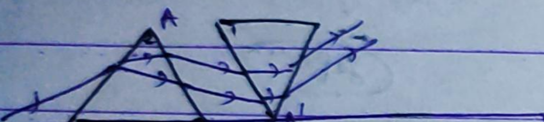
$$\boxed{\omega = \frac{(\mu_V - \mu_R)}{(\mu_y - 1)}}$$

Combination of prisms:-



$$\boxed{(\mu_y - 1)A = (\mu_y' - 1)A'}$$

There can be Displersion.

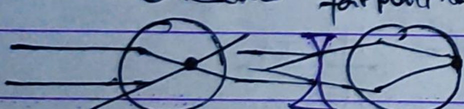


$$\boxed{(\mu_v - \mu_R)A = (\mu_v' - \mu_R')A'}$$

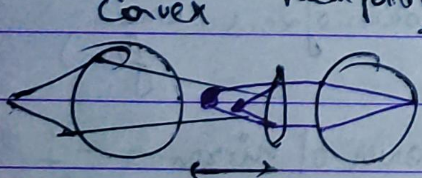
There may be some deviation

Eye Defects:-

myopia — Near sightness
Concave — far point not ∞.



Hyper metropia — Far sightness
Convex — Near point is not 25cm



Far point ∞
Near point 25cm

Optical Devices:-

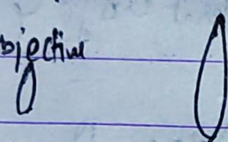
① Simple microscope:-

M magnifying power $= \dfrac{\beta}{\alpha}$ → Image का Angle eye par
α → Object का Angle lub

$$\boxed{M = \frac{D}{u_e}}$$

→ Normal $\boxed{\frac{D}{f}}$ $\boxed{D}$
→ Near point $\boxed{1 + \frac{D}{f}}$

② Compound microscope:-



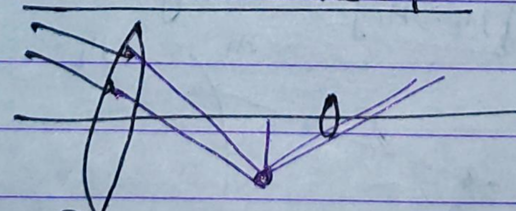
$$M = \frac{v_0}{u_0} \frac{D}{u_e}$$

(Inverted)

Normal: $\left(\dfrac{v_0}{u_0}\right)\dfrac{D}{f_e}$

Near point: $\left(\dfrac{v_0}{u_0}\right)\left(1 + \dfrac{D}{f_e}\right)$

③ Astronomical Telescope:-



$M = \dfrac{\beta}{\alpha}$
β → final image angle at eye
α → Angle at the eye when object is viewed directly.

$$\boxed{M = \frac{f_0}{u_e}}$$

→ Normal $m = f_0/f_e$
→ Near $m = f_0/f_e(1 + f_e/D)$

Reflecting Telescope:-

① spherical abretion नहीं दे पाता।
use Parabolic (mirror)

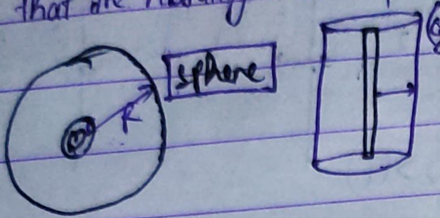
② Acromatic abretion नहीं देता

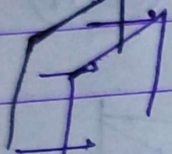
③ Easy to Handle.

④ Intensity is decreased due to Convex mirror.

Wave Optics

① Wavefront :- locus of all those points that are vibrating in same phase.

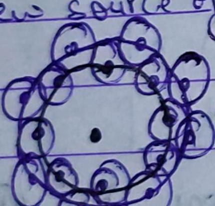




Plane

② Huygen's principle :- wavelets

Every point on wavefront act as a new source of light.



Huygen's Construction

③ Equation of a wave :- $\frac{2\pi}{\lambda}$

$$y = A \sin(\omega t - kx + \phi)$$

A → Electric field, ω → Angular freq., ϕ → Phase

④ Coherent Sources :-

Same frequency, Regular Phase difference

$$\boxed{\Delta\phi = \frac{2\pi}{\lambda}\Delta x}$$

Δx → Path Diff.

maxima

$\Delta x = N\lambda$

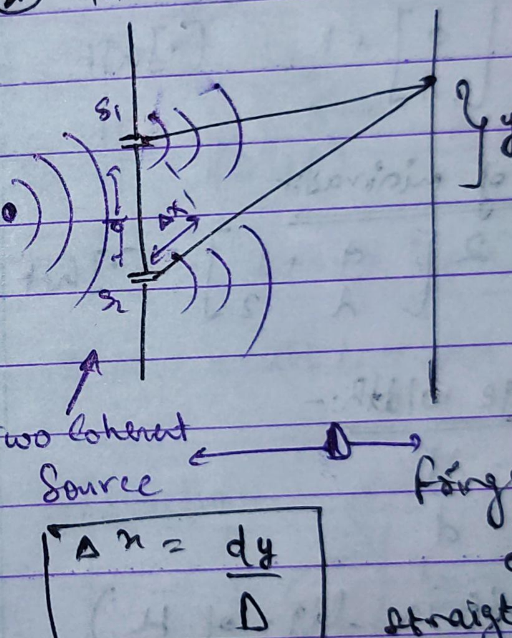
$\Delta\phi = 2N\pi$

minimum

$\Delta x = (2N+1)\lambda/2$

$\Delta\phi = (2N+1)\pi$

YDSE :- $\boxed{D >> d}$



Two Coherent Source

D

fringe Pattern → straight strips

$$\boxed{\Delta x = \frac{dy}{D}}$$

maxima Position

$$\Delta x = N\lambda = \frac{dy}{D}$$

$$\boxed{y = \frac{N\lambda D}{d}}$$

minima position

$$\Delta x = \frac{(2N+1)\lambda}{2} = \frac{dy}{D}$$

$$\boxed{y = \frac{(2N+1)}{2}\frac{\lambda D}{d}}$$

$$\boxed{I_{res}(\phi) = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi}$$

Intensity:- $I_{max} = (\sqrt{I_1}+\sqrt{I_2})^2$, $I_{min} = (\sqrt{I_1}-\sqrt{I_2})^2$

$I_1 = I_2 = I_0$

$$I_R = 4I_0\cos^2\frac{\phi}{2}$$

$$\phi = \frac{2\pi}{\lambda}\cdot\left(\frac{dy}{D}\right)$$

$$I_R = 4I_0\cos^2\left(\frac{dy\pi}{\lambda D}\right)$$

No. of maximas:-

$$2\left[\frac{d}{\lambda}\right]+1 \quad [\cdot]\text{ GIF}$$

No. of minimas:-

$$2\left[\frac{d}{\lambda}+\frac{1}{2}\right] \quad [\cdot]\text{ GIF}$$

Fringe width:-

$$\beta = \frac{\lambda D}{d}$$

* (YDSE in liq. of μ)

$$\beta_{new} = \frac{\beta}{\mu} \quad \text{(shrinking)}$$

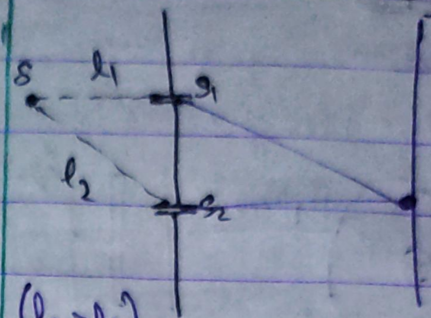
* (YDSE with glass slab) -

$$\Delta x = t(\mu-1)$$

whole fringe pattern shift toward by:- $\Delta x = \frac{dy}{D}$

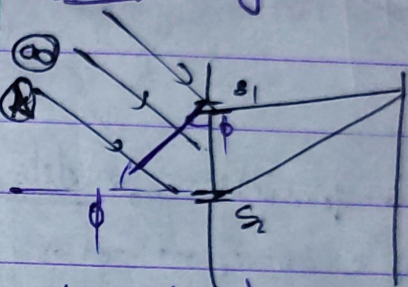
$$y = \frac{D(t(\mu-1))}{d}$$

* If S is not symmetric:



$(l_2 > l_1)$

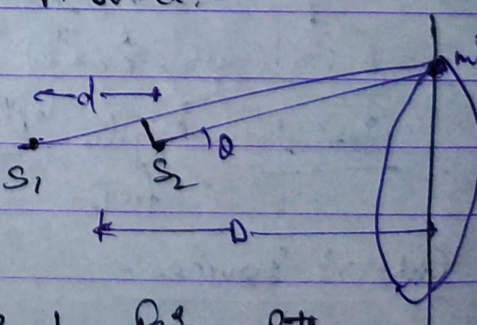
Shift $\Delta y = (l_2-l_1)\frac{D}{d}$



$\Delta x = d\sin\phi$

$$\boxed{\Delta y = \frac{(d\sin\phi)D}{d}}$$

* S_1 & S_2 are Horizontal & Pt source:- $D >> d$



* Circular Fringe Pattern

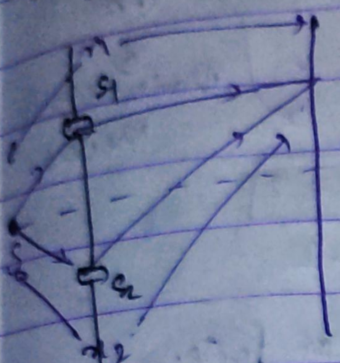
$\Delta x = d\cos\theta$

$= n\lambda$ (Const)

$= (2n-1)\frac{\lambda}{2}$ (Dest)

If S_1 and S_2 are pt sources. (holes)

$x << R$?



$|x_1 - x_2| = \lambda$

2λ

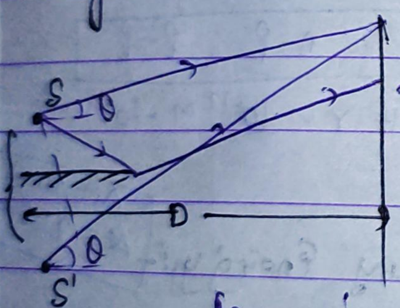
3λ

[Hyperbola]

Lloyd mirror:-

$D >> d$

FOV



for maxima.

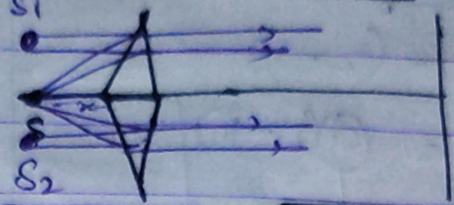
$d\sin\theta = (2N+1)\frac{\lambda}{2}$

for minima.

$d\sin\theta = N\lambda$

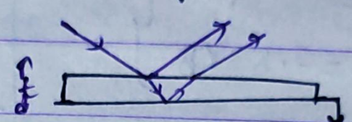
Due to π phase diff. of mirror.

Fresnel biprism



$\boxed{\delta = (\mu - 1)A}$ $\boxed{d = 2x\delta}$

Thin film Interference:-

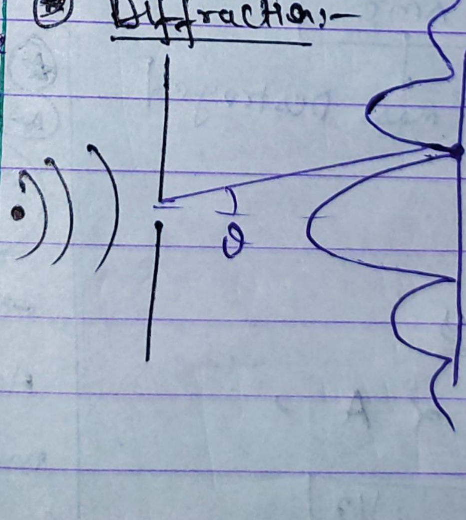


Path diff $= (2\mu t)$

for maxima $= 2\mu t = (2n+1)\frac{\lambda}{2}$

for minima $= 2\mu t = N\lambda$

Diffraction:-

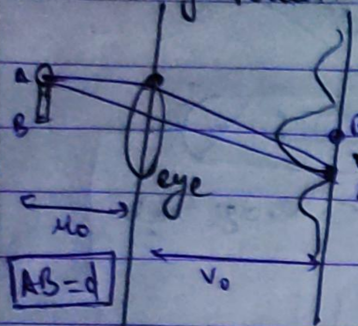


for minima

$\boxed{\theta = \frac{n\lambda}{d}}$

$n = 1, 2, 3 \ldots$

Resolving Power:-



$\left.\right\} \frac{v_o 1.22\lambda}{d}$

$\boxed{AB = d}$

$m = \frac{v_o}{u_o} = \frac{A'B'}{AB} \Rightarrow \boxed{A'B' = \left(\frac{v_o}{u_o}\right) d_{min}}$

$\boxed{\text{1.22 factor}}$

Circular Aperture
(Just Resolve)

In order to Resolve

$A'B' > \frac{v_o 1.22\lambda}{d}$

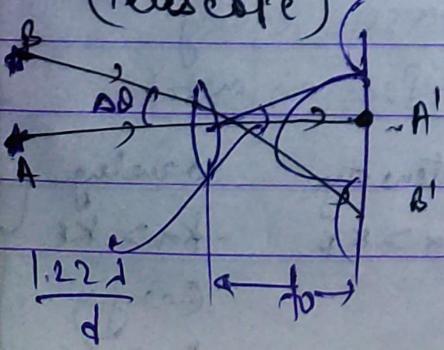
$\left(\frac{v_o}{u_o}\right) d_{min} = \frac{v_o 1.22\lambda}{d}$

$\boxed{\frac{1}{d_{min}}} = \frac{d}{u_o 1.22\lambda}$

Resolving Power

it is Resiprocal of min. dist. that can be resolved

→(Telescope)



$f_o \cdot \frac{1.22\lambda}{d} < A'B'$

$f_o \frac{1.22\lambda}{d} < f_o(\Delta\theta)$

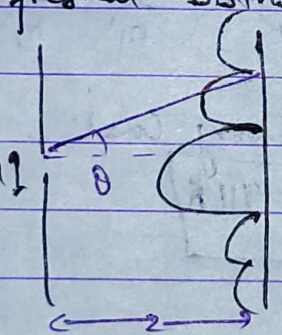
$\Delta\theta > \frac{1.22\lambda}{d}$

Limit of Resolution

min angle btw 2 stars that are just Resolved.

$$\boxed{\Delta\theta = \frac{1.22\lambda}{d}}$$

Fresnal Distase:-



$\boxed{Z\theta = d}$

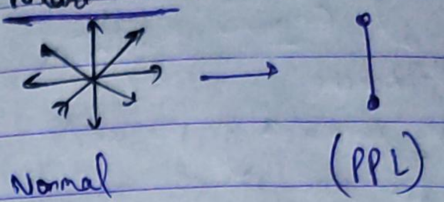
$Z\left(\frac{\lambda}{d}\right) = d$

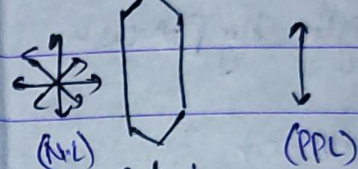
$\boxed{Z = \frac{d^2}{\lambda}}$

If Distace > Z then Wave op.

If Distace < Z then Ray op.

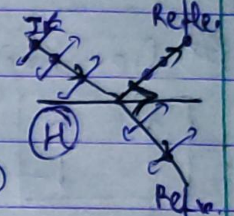
Polarization:





Polarizer
Nicole Prism

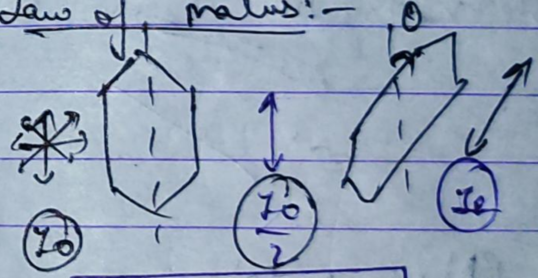
$\boxed{I_o}$ $\boxed{\frac{I_o}{2}}$



Brewster's Law

$\boxed{\tan(\theta) = \mu}$

Law of malus:-



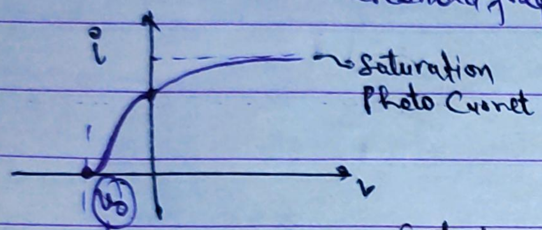
$$\boxed{I_\theta = \frac{I_o}{2}\cos^2\theta}$$

★ Modern Physics.

★ **Photo Electric effect:-**

ϕ work fn :- min Energy of Photon req. to knock out "Loosely held surface e^-".

$= h\boxed{\nu_0}$ → Threshold freq.



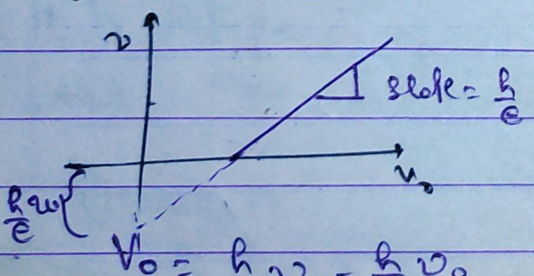
stopping Potential :- fastest moving e^- is just enable to reach.

($I \propto n$ of Photos)

($V_0 \propto$ freq. of Photons)

Einstein PEE's eq:-

$$\boxed{h\nu = h\nu_0 + (KE)_{max}}$$



$$V_0 = \frac{h}{e}\nu - \frac{h}{e}\nu_0$$

$E = h\nu = \frac{hc}{\lambda}$ $\quad \boxed{E = PC}$

Rad. Pres

Momentum $= h/\lambda \Rightarrow (1+r)\frac{I}{c}$

(r = reflection coeff)

★ $I = n h\nu$

n → No. of Photons striking normally per unit Area per unit time

$h\nu$ → Energy of 1 Photon

★ **De-broglie Hypothesis:-**

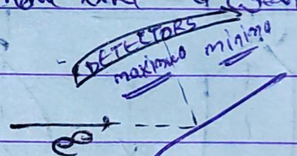
$$\boxed{\lambda = \frac{h}{p}}$$

λ → matter wave

p → linear momentum

★ **Davison & Germen Exp:-**

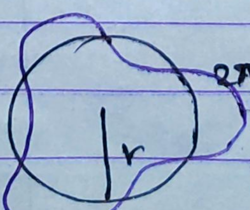
Electron behave like a wave.



★ **Bohr's model:-**

i) $\frac{mv^2}{r} = \frac{kZe^2}{r^2}$

ii) $mvr = \frac{nh}{2\pi}$



$2\pi r = N\lambda$

$2\pi r = \frac{Nh}{mv}$

Broglie → $\lambda = \frac{h}{mv}$ $\quad \boxed{mvr = \frac{nh}{2\pi}}$

HP

(*) $r = r_0 \frac{n^2}{z^2}$

$r_0 = 0.529$ Å

(*) $v = v_0 \frac{z^2}{n}$

$v_0 = 2.16 \times 10^6$ m/s

(*) $E = -13.6 \frac{z^2}{n^2}$

(*) ~~$TE = |KE|$~~

$|TE| = KE = \left|+\frac{PE}{2}\right|$

(*) $\frac{1}{\lambda} = R z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

Rydberg Const.

$\boxed{\frac{1}{R} = 911 \text{ Å}}$

(*)

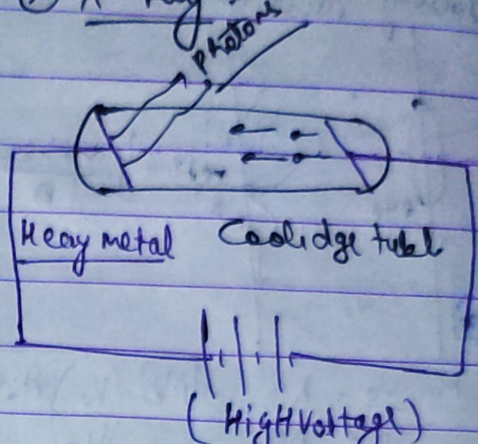
n_2

n_1

no. of Transition = ~~$\frac{(n_1+n_2)(n_1+n_2+1)}{2}$~~

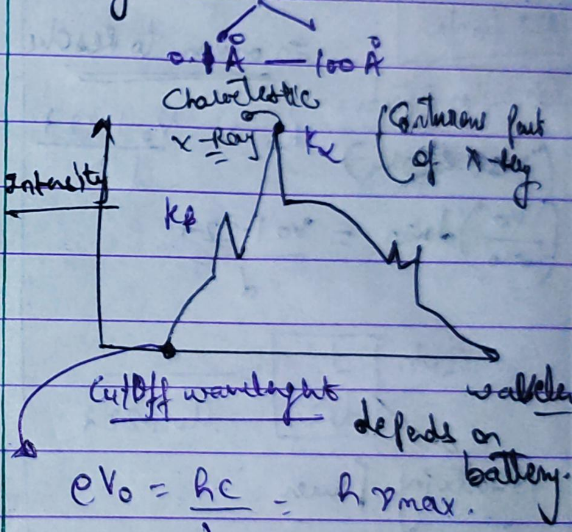
$= \frac{(n_2-n_1)(n_2-n_1+1)}{2}$

(*) X-Ray :-



X-Ray → Radiation

0.1 Å — 100 Å



$eV_0 = \frac{hc}{\lambda_{min}} = h\nu_{max}$

$\boxed{\lambda_{min} = \frac{hc}{eV_0}}$ Cut off wavelength

(*) (*)

Characteristic X-Ray

↳ depends on metal.

Intensity

Kα > Kβ

wavelength

Kα > Kβ

Energy

Kβ > Kα

Moseley's Law:-

$\sqrt{\nu} \propto (Z-1)$

$$\boxed{\sqrt{\nu} = a(Z-1)}$$

K_α ; $a \to$ const

$\sqrt{\nu} = a(Z-b)$ for general

$\to$ $b=1$ K_α
$b=7.8$ K_β

$$\boxed{\frac{1}{\lambda} = R(Z-b)^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)}$$

Einstein mass-Energy equivalence:-

$$\boxed{\Delta E = \Delta m c^2}$$

ΔE → Energy librated.
Δm → mass Destroyed

Nucleus

$\frac{4}{3}\pi r^3 \propto A$

$$\boxed{r \propto A^{1/3}}$$

$d = \frac{M}{V} \propto \frac{A}{A}$ d const

$\sim 10^{15}$ kg/m^3

$\boxed{Z \le 20}$

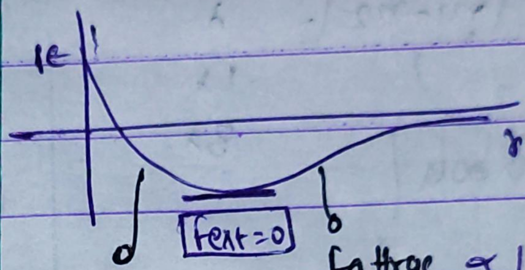
$\frac{n}{p} = 1$

$\boxed{Z = 82}$ (Pb) → Heaviest stable Nucleus

$\boxed{20 \le Z < 82}$

$\frac{n}{p} > 1$

Nuclear force:-



$F_{repulsion} \propto \frac{1}{r^9}$

$F_{attrac} \propto \frac{1}{r^7}$

$\boxed{n-n,\ n-p,\ p-p}$

{if $r \sim 10^{-12}$ m $- 10^{-15}$ m}

Binding Energy:-

$\Delta m = 1$ amu
$\Delta E = 931.5$ MeV

(A, Z)

Z → Protons
(A−Z) → neutrons

expected mass $= Zm_p + (A-Z)m_n$

Actual mass $= M_{actual}$

$M_{expected} > M_{Actual}$

$\Delta m_{defect} = (M_{actual} - M_{expected})$

$\Delta E = \Delta m c^2$

Released → Binding Energy

Binding Energy per Nucleon :-

$$\left(\frac{BE}{A}\right) = \left(\frac{\Delta m_{defect}\, c^2}{A}\right)$$

More $\left(\frac{BE}{A}\right)$ More stable Nucleus.

* (nucleus) Fe is most stable.

Radioactivity :-

Nucleus Process

Atom का कोई लेना देना नहीं।

$$\frac{dN_A}{dt} \propto N_A$$

Rate of Disintegration $\propto$ Na

$$N_t = N_0\, e^{-\lambda t}$$

time

decay const

No. of Nucleus at time (t)

Initial no. of Nu.

$$\boxed{t_{1/2} = \frac{\ln 2}{\lambda}}$$

50% decay half life

$$\boxed{t_{av} = \frac{1}{\lambda}}$$

63% decay avg. life.

α decay

$${}^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}X' + {}^{4}_{2}He$$

β decay

$\beta^{\oplus}$ (Z dec)

$p \to n + e^{\oplus} + \nu$

Positron Neutr.

$\beta^{\ominus}$ (A - same) (Z inc)

$n \to p + e^{\ominus} + \bar{\nu}$

electron Anti neu

K Capture

$p + e^{\ominus} \longrightarrow n + \nu$

Neutrino

γ Rays

Part of Radiation

Always

$X \longrightarrow X^{*} + \gamma$ Rays

Fusion

Sun

$H + H \to He$ (P)

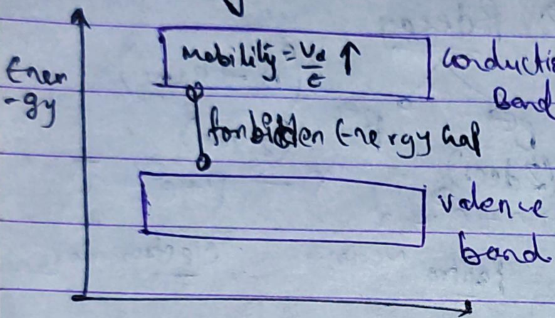
mass defect

Fission

Semi Conductors :-

Conductivity higher than Insulators but lower than Conductor.

→ **Band theory** :-



Band gap

Large — Small — No

Insulator — Semi Conductor — Conductor

} Temp can overcome this gap

(E > lattice Energy req.)

Covalent bond टूटी → electron | hole gene.

Natural semiconductor :-

Intrinsic $\boxed{n_e = n_h}$ No Doping

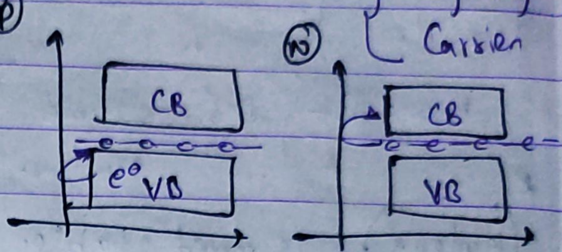
Extrinsic :- **Doping** ([illegible])

P — N

$n_h > n_e$ $n_e > n_h$

N → 15th group Doped (e^-) (majority Carrier)

P → 13th group Doped (Holes) { Majority Carrier

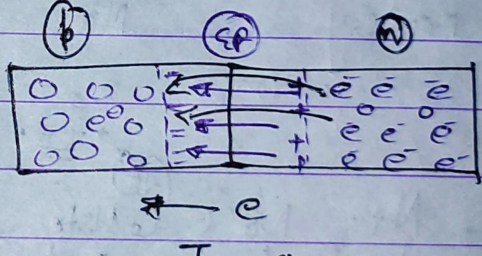


Thermodinamic Eq. law.

$n_h \cdot n_e = \text{const.}$

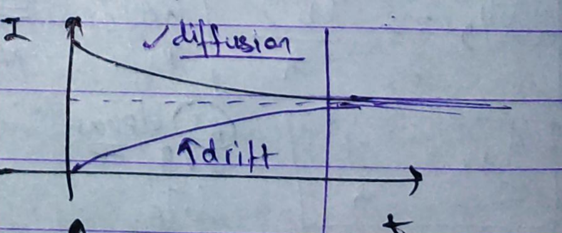
Dep. on Temp

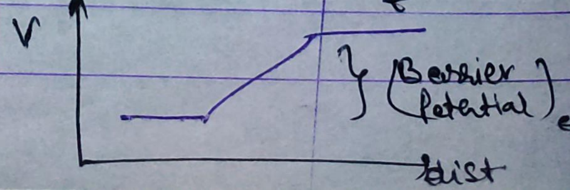
★ **P-N Diode :-**



I → diffusion Current.

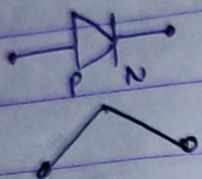
I drift → Due to EF





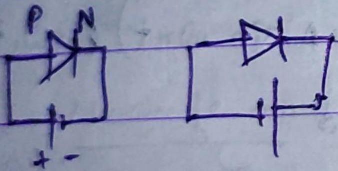
~~De~~pletion layer.
majority carriers की कमी
Resistance of pn junction ∝ Resistance of depletion Region.

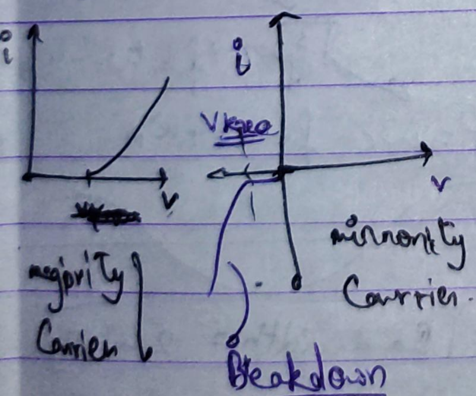
(A) **Biasing**

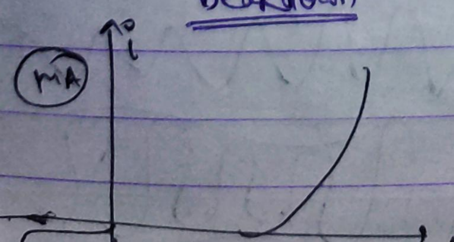


Forward
P → (+)
N → (−)

Reverse
P → (−)
N → (+)



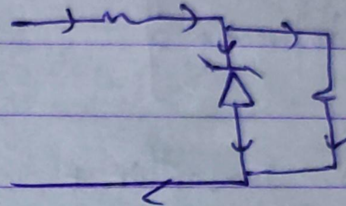




Zener Diode...

i) Highly doped
ii) Highly durable
iii) Reverse breakdown voltage
iv) Voltage Regulator

Concept:- voltage across load → const V

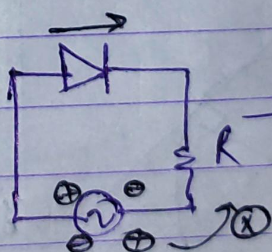


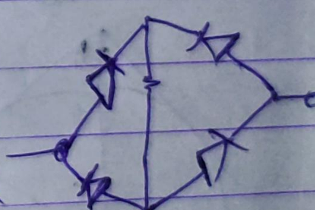
Rectifier:-

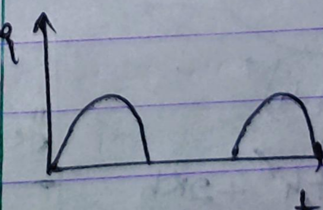
AC → DC

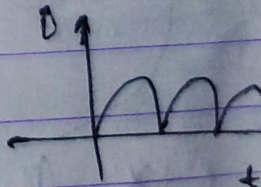
Half Wave

Full wave

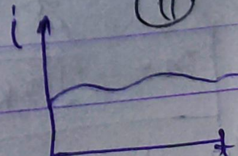








Capacitor ||



LED Light Emmiting Diode

i) FB

ii) Light is emerging.

iii) Highly Doped.

→ (fast on / OFF)

→ (Highly Durable)

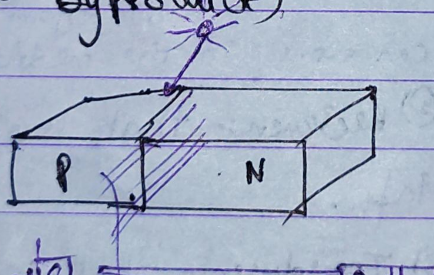
→ (Highly Portable)

→ (Monocromatic Light)

Solar cell:-

→ Sun rays are converted to electricity.

→ (No ByProduct)



→ I-V characteristic

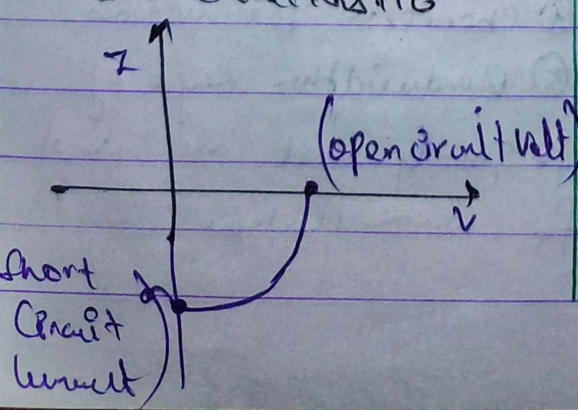
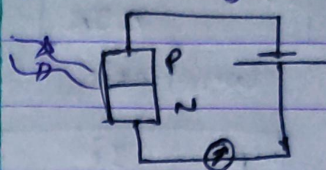
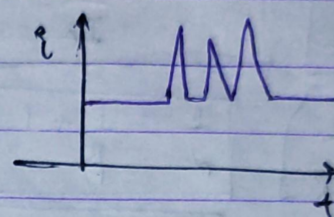


Photo diode:-

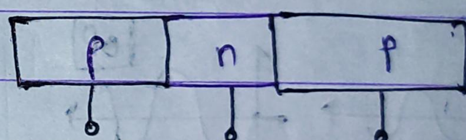
(It detects light) → **Reverse**

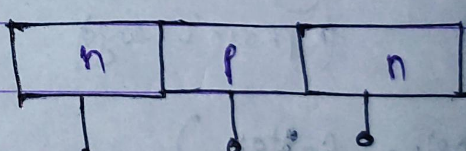




Transistors:-

(Triod)



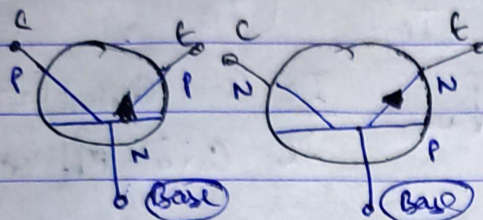


Emitter Base → FB

Collector Base → RB

Emitter	Base	Collector	
Moderate	smallest (least)	Largest	Size
Highest	least	Moderate	Doping

Biasing



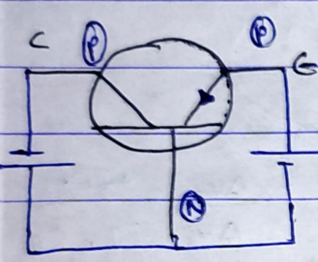
Case

npn → Syllabus

CB CC CE

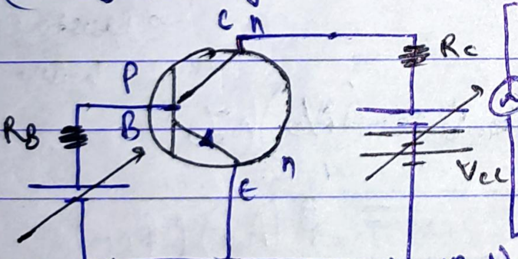
pnp

CB CC CE



(Common Base
PNP transistor)

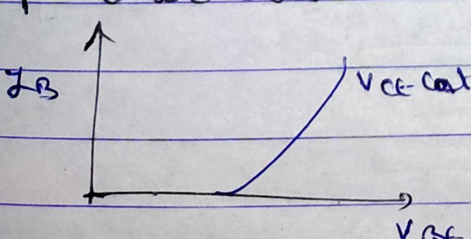
(Battery + Biasing)



V_{BB}
(Input)

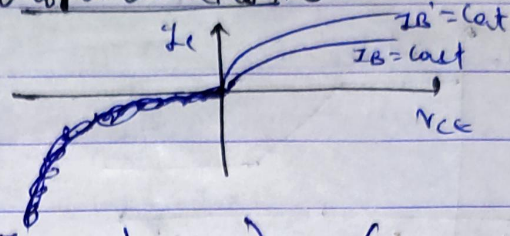
(Output)

Input characteristics



i_B and V_{BE} (V_{CE} = Const)

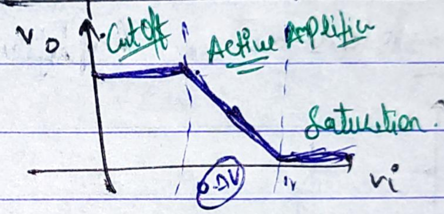
Output characteristics :-

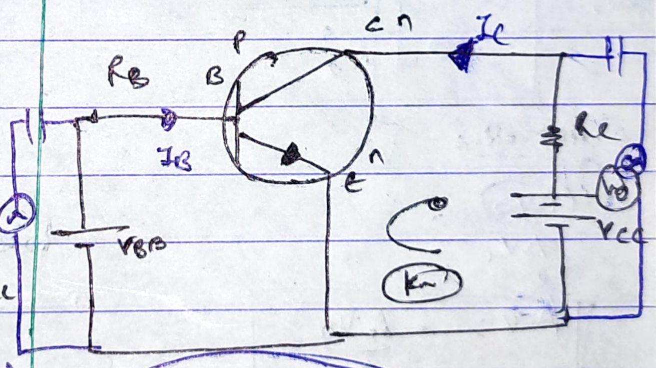


(I_C and V_{CE}) (I_{input} = Const)

$I_B' > I_B$

Transfer Characteristics





① $I_E = I_B + I_C$

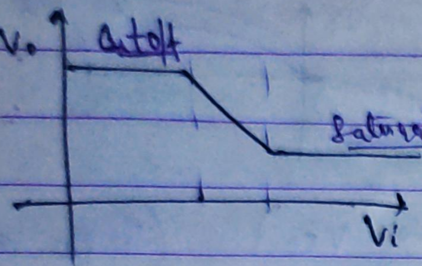
$V_{CC} - I_C R_C - V_{CE} = 0$

NCERT

$V_{CE} = V_O$

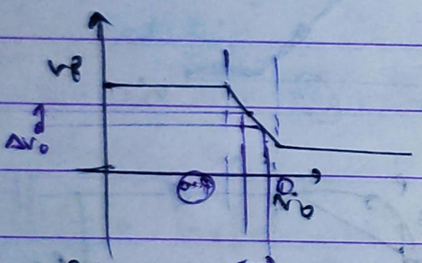
★ $V_O = V_{CC} - I_C R_C$

Transistor as a Switch:-



Input is low → Output High (Switch ON)

Transistors as an Amplifier:-



Output voltage

$\frac{\Delta V_o}{\Delta V_i}$

$$\boxed{A_v = -\frac{\Delta V_o}{\Delta V_i}}$$

(voltage Gain) = negative of slope of Transfer ch

$I_E = I_B + I_C$

$\frac{I_E}{I_C} = \frac{I_B}{I_C} + 1$

$\frac{1}{\left(\frac{I_C}{I_E}\right)} = \frac{1}{\left(\frac{I_C}{I_B}\right)} + 1$

$\beta_{DC} = \frac{I_C}{I_B}$ Current Gain | Current Application

$\alpha_{DC} = \frac{I_C}{I_E}$

$\frac{1}{\beta} = \frac{1}{\alpha} + 1$

voltage Gain $= -\frac{\Delta V_o}{\Delta V_i} = \frac{+I_C R_C}{I_B R_B}$

$\Delta V_o = +\Delta I_C R_C$

$$\boxed{A_v = \beta_{DC} \boxed{\frac{R_C}{R_B}}}$$

→ Resistance Gain

Power Gain $= (\Delta V_o)(\Delta I_o)$

$= \beta (A_v)(\beta_{AC})$

$$\boxed{P = (\beta_{AC})^2 \frac{R_C}{R_B}}$$

सभी के formulae (Transistor)

$\boxed{A_V = -\frac{\Delta V_0}{V_i}}$ $\boxed{\beta_{AC} = \frac{\Delta I_C}{\Delta I_B}}$

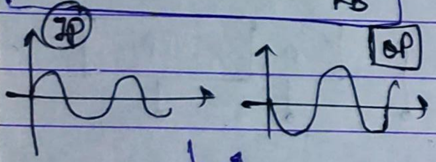
voltage gain Current gain

$\boxed{\alpha_{AC} = \frac{\Delta I_C}{\Delta I_E}}$ $\boxed{\alpha_{DC} = \frac{I_C}{I_E}}$

$\boxed{\beta_{DC} = \frac{I_C}{I_B}}$ $\boxed{\frac{1}{\alpha} = \frac{1}{\beta} + 1}$

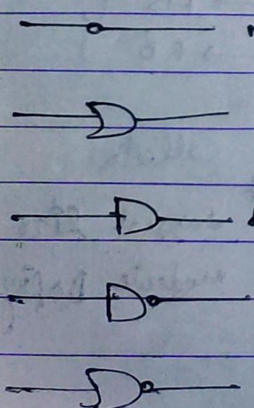
$\boxed{I_E = I_C + I_B}$

$\boxed{\text{Power gain} = \beta_{AC}^2 \frac{R_C}{R_B}}$



(π phase change)

(Logic Gates)



NOT

0 →	1
1 →	0

OR

1	1 →	1
0	0 →	0
1	0 →	1

AND

1	1 →	1
0	0 →	0
1	0 →	0

NAND (And)

NOR (OR)

~~XNOR~~

XOR

exclusive OR

0	0	0
1	0	1
0	1	1
1	1	0

Demorgan's law

$\overline{AB} = \overline{A} + \overline{B}$ ① OR

$\overline{A+B} = \overline{A}\cdot\overline{B}$ ② And

Comunication system:-

① Transmitter:- send message in such a form that can move in the medium.

② Reciever:- that receives the infor.

③ Transducer:- that converts one form of energy to other.

④ Chennel:- the medium.

⑤ Bandwidth:- Range of frequency that are used for communication.

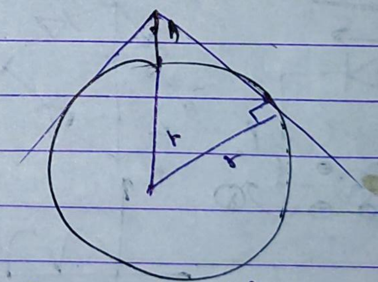
⑥ modulation:- low Energetic message wave is added to Highly Energetic wave.

⑦ Demodulation:- It is reverse of modulation.

⑧ Attenuation:- loss of energy due to propagation of message.

⑨ Reapeters:- Transmitter + Reciever + Amplifier.

⑩ Range:- max distace upto which we are able to recovered.



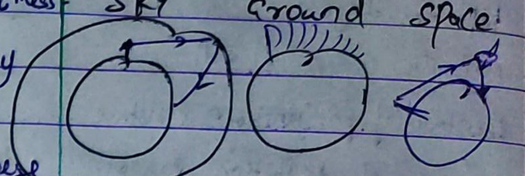
$R^2 + x^2 = (R+h)^2$

$\cancel{R^2} + x^2 = \cancel{R^2} + \cancel{h^2} + 2Rh$

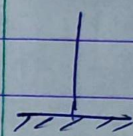
$\boxed{x = \sqrt{2Rh}}$

(Lign of sight)

(waves)



minimum height of Tower:-



$\boxed{R = \frac{\lambda}{4}}$

Amplitude modulation:-

$y_m = A_m \sin(\omega_m t)$

$y_c = A_c \sin(\omega_c t)$ (AM)

$y_{net} = (A_c + A_m \sin \omega_m t) \sin \omega_c t$

no of waves

3

$f = \omega_c - \omega_m$

$f = \omega_c$ $f = \omega_c + \omega_m$

$\boxed{\text{Bandwidth} = 2\omega_M}$