CLASS: 12th
Subject: Physics
PM SHRI STUDY MATERIAL
(Session 2025-26)

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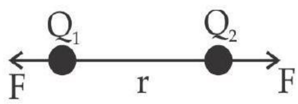
Ch 1 Electric Charges and Fields

1. **Quantization of charge:**
Net charge on anybody is given by $Q = \pm ne$ where, n: number of electrons supplied to the body or removed from the body.

2. **Electrostatic force between two charges**
Coulomb's Law



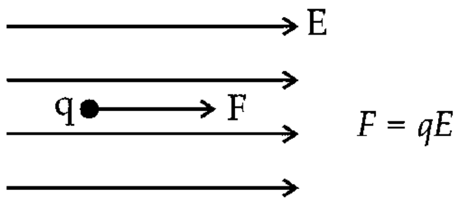
$F = K.\frac{q_1 q_2}{r^2} = \frac{1}{4\pi\epsilon_0\epsilon_r}.\frac{q_1 q_2}{r^2}$

For air, $\epsilon_r = 1$

Fair = $\frac{1}{4\pi\epsilon_0}.\frac{q_1 q_2}{r^2} = 9 \times 10^9\ \frac{q_1 q_2}{r^2}$

3. **Electric field intensity** due to a point charge,

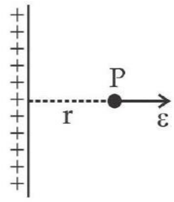
$$\vec{E} = \lim_{q_0 \to 0} \frac{\vec{F}}{q_o}$$



4. **Force on a charge particle placed in electric field**.

$\vec{F} = q\vec{E}$ (in vector form)

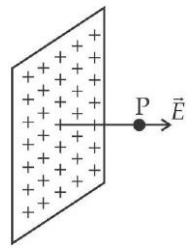
Direction of $\vec{F}$ and $\vec{E}$ is same if q is +ve and opposite if q is -ve



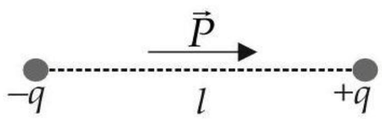
5. Electric field intensity due to infinite linear charge density (λ)
$E = \frac{1}{4\pi\epsilon_0}.\frac{2\lambda}{r}$

6. Electric field intensity near an infinite thin sheet of surface charge density σ
$E = \frac{\sigma}{2\epsilon_0}$

For thick sheet $= \frac{\sigma}{\epsilon_0}$.



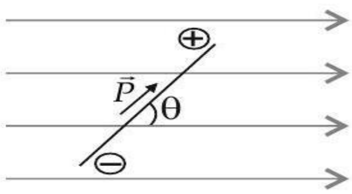
7. **Dipole moment**, $\vec{P} = q.2\vec{l}$



8. **Torque on a dipole** in uniform electric field, $\vec{\tau} = \vec{p} \times \vec{E}$

$\tau_{\max} = PE$ at $\theta = 90°$

$\tau_{\min} = 0$ at $\theta = 0°/180°$

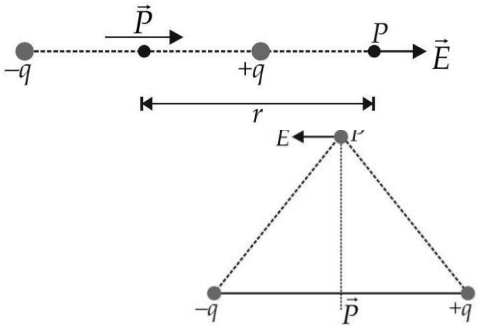


Note: $F_{\text{net}} = 0$ at any value of θ.

9. Electric field due to a short dipole

(i) at axial point, $E_{axis} = \frac{1}{4\pi\epsilon_0} \cdot \frac{2p}{r^3}$

(ii) at equatorial point, $E_1 = \frac{1}{4\pi\epsilon_0} \cdot \frac{p}{r^3}$



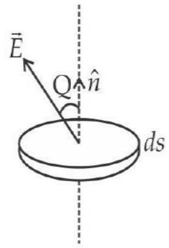
10. **Dielectric constant**, $K = \frac{\epsilon}{\epsilon_0} = \frac{C_{med}}{C_{air}}$

11. Electric flux:

For a closed surface

$$\phi = \int (E) ds \cos\theta = \int \vec{E} \cdot d\vec{s}$$

$$d\vec{s} = ds \cdot \hat{n}$$



12. **Electric flux for uniform field is**

$$\phi = ES\cos\theta = \vec{E} \cdot \vec{S}$$

$\phi_{\max} = \pm ES$ when lines are perpendicular to surface.

$\phi_{\min} = 0$ when lines are parallel to surface.

$\phi = +$ ve for leaving flux.

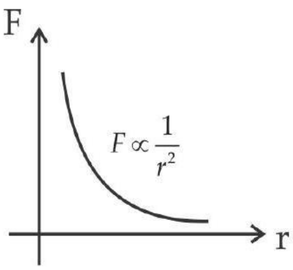
$\phi = -$ ve for entering flux.

13. Gauss's Theorem

Total electric flux, $\Phi = \oint \vec{E} . \overrightarrow{ds} = \frac{1}{\epsilon_0} \times net\ charge\ enclosed\ by\ the\ surface$

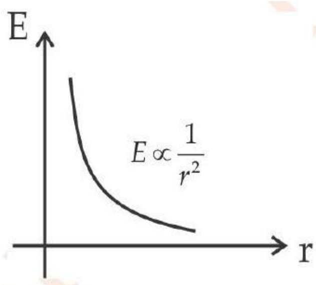
GRAPH:

1. Force between two charges (vs) distance between them



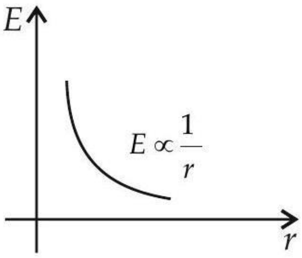
$$F = \frac{1}{4\pi\varepsilon_0} \frac{Q_1 Q_2}{r^2}$$

2. $\vec{E}$ due to point charge w.r.t. distance



$$E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{r^2}$$

3. $\vec{E}$ due to charged wire w.r.t. distance



$$E = \frac{\lambda}{2\pi\varepsilon_0 r}$$

Ch 2 Electric Potential and Capacitance

1. Potential energy stored between two-point charges:

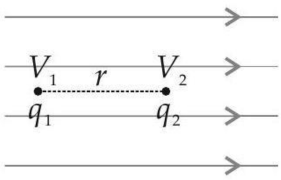
$$U = \frac{1}{4\pi\varepsilon_0}\frac{Q_1 Q_2}{r}$$

2. Potential energy of a charge placed in electric field:

$U = qV$

V - Potential at point where charge is placed

3. Potential energy of two charge system placed in external field:



$$U = q_1 v_1 + q_2 v_2 + \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r}$$

4. Work to be done by external agent to change the distribution of charges in a system:

$W = U_f - U_i$

U_f : Final potential energy of system

U_i : Initial potential energy of system

5. Work done in moving a charge particle between two points in a field:

$$\begin{aligned} W_{A\to B} &= q(V_B - V_A) \Rightarrow \text{ By external agent} \\ &= -q(V_B - V_A) \Rightarrow \text{ By electric field} \end{aligned}$$

where, $W_{A\to B}$: Work done in moving charge q from A to B.

6. **Electric potential**, $V = \lim\limits_{q_0\to 0}\frac{w}{q_0}$

Electric potential due to a point charge, $V = \frac{1}{4\pi\epsilon_0}.\frac{q}{r}$

7. Relation between electric field and potential, $E = -\frac{dV}{dr} = \frac{V}{r}$ (numerically)

8. n small drops of V volt each are combine to form big drop, then potential of big drop is

$V_{\text{Big}} = n^{2/3}V_{\text{small}}$

9. Potential energy of dipole

$U = -PE\cos\theta = -\vec{P}\cdot\vec{E}$

$U_{\max} = PE$ at $\theta = 180^\circ$

$\Rightarrow$ Unstable equilibrium position

$U_{\min} = -PE$ at $\theta = 0^\circ$

⇒ Stable equilibrium position

10. Electric potential due to a short dipole

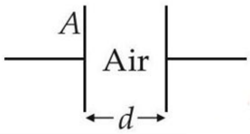
(i) At axial point, $V_{axis} = \frac{1}{4\pi\epsilon_0} \cdot \frac{p}{r^2}$

(ii) At equatorial point, $V_{equator} = 0$.

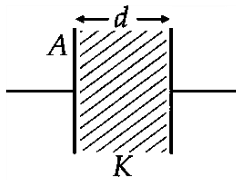
11. Relation between voltage on a capacitor and charge stored in it: $Q = C.V$

12. Capacitance of parallel plate capacitor

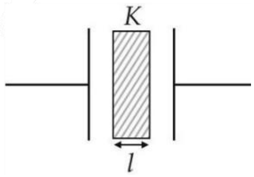
(i) In air $C = \frac{A\epsilon_0}{d}$



(ii) $C = \frac{A\epsilon_0 K}{d}$,
in medium of dielectric constant K



(iii) $C = \frac{A\epsilon_0}{d - t(1-\frac{1}{K})}$; if space between plate partially filled with dielectric of thickness t.

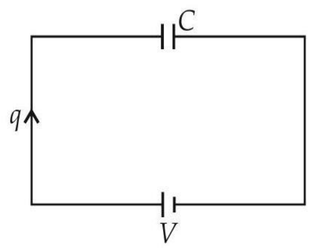


13. Combination of capacitors:

(i) In series, $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$, $q_1 = q_2 = q_3$, $V = V_1 + V_2 + V_3$

(ii) In parallel, C= $C_1 + C_2 + C_3$, $q = q_1 + q_2 + q_3$, $V_1 = V_2 = V_3 = V$

14. Charging of a capacitor



Total work done by battery $= CV^2$

Energy stored in capacitor $= \frac{1}{2}CV^2$

Heat loss in process $= \frac{1}{2}CV^2$

15. Energy stored by capacitor (other forms)

U$= \frac{1}{2}CV^2 = \frac{Q^2}{2C} = \frac{1}{2}QV$

16. Electrostatic energy density

$u_e = \frac{1}{2}\epsilon_0 E^2$, in air

$u_e = \frac{1}{2}\epsilon E^2$, in medium

17. Effect of dielectric on capacitor:

Physical Quantity	**Before Dielectric Placed**	**After Dielectric Placed With cell**	**Without cell**
Capacitance	$C_0 = \varepsilon_0 A/d$	KC_0	KC_0
Voltage	V_0	V_0	V_0/K
Charge stored	$Q_0 = C_0 V_0$	KQ_0	Q_0

Electric field between plates	$E_0 = V_0/d$	E_0	E_0/K
Energy stored	$U_0 = \frac{1}{2} C_0 V_0^2$	KU_0	U_0/K
Force between the plates	$F_0 = \frac{Q_0^2}{2A\varepsilon_0}$	KF_0	F_0/K

18. n identical small drops are combined to form a big drop, then

$C_{\text{Big}} = n^{1/3} C_{\text{Small}}$

$V_{\text{Big}} = n^{2/3} V_{\text{Small}}$

$U_{\text{Big}} = n^{5/3} U_{\text{Small}}$

Ch 3 Current Electricity

1. **Electric current**: $i = \frac{dq}{dt}$ or $i = \frac{Q}{t}$

2. In case of an electron revolving in a circle of radius r with speed v,

Time period of revolution is, $T = \frac{2\pi r}{v}$

Frequency of revolution, $v = \frac{1}{T} = \frac{v}{2\pi r}$

Current, $I = e/T = \frac{ev}{2\pi r}$

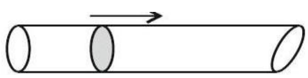
3. **Ohm's law**

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

V - Voltage (potential difference) across body

4. **Current in terms of drift velocity (V_d):**

$I = neAv_d$, where, n is the density of free electrons

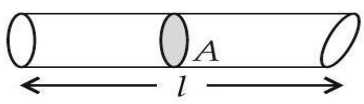


5. Resistance of a uniform conductor, $R = \frac{I}{A} = \frac{ml}{ne^2\tau A}$

6. Resistivity or specific resistance, $\rho = \frac{RA}{I} = \frac{m}{ne^2\tau}$

7. **Resistance of a conductor:**

$$R = \frac{\rho l}{A}$$



8. **Conductance**, $G = \frac{1}{R}$

9. Conductivity $= \frac{1}{\text{Resistivity}} \Rightarrow \sigma = \frac{1}{\rho} = \frac{l}{RA}$

10. Relation between current density and electric field: $J = \sigma . E$ (Another form of Ohm's law)

11. **Mobility**, $\mu = \frac{V_d}{E}$

12. Temperature coefficient of resistance, $\alpha = \frac{R_2 - R_1}{R_1(t_2 - t_1)}$

13. The equivalent resistance R_s of a number of resistances connected in series is given by

$$R_s = R_1 + R_2 + R_3 + \ldots..$$

14. The equivalent resistance R_p of a number of resistances connected in parallel is given by

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots.$$

15. **EMF of a cell**, $E = \frac{W}{q}$

16. **Terminal voltage (V) of a cell:**

$\boldsymbol{V = E - \mathrm{ir}}$ ⇒ While discharging of cell

$\boldsymbol{V = E + \mathrm{ir}}$ ⇒ While charging of cell

$\boldsymbol{V = E}$ ⇒ When cell is open branch

$\boldsymbol{V = 0}$ ⇒ When cell is short circuited

Terminal p.d of a cell, $V = IR = \frac{E\,R}{R+r}$

17. **Internal resistance of a cell**, $r = R\,[\frac{E-V}{V}]$

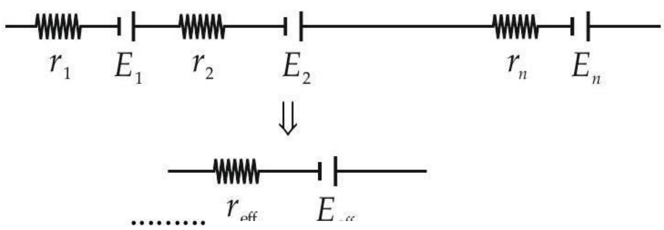
18. **For n cell in series**, $I = \frac{nE}{R+nr}$

19. **For n cells in parallel**, $I = \frac{nE}{nR+r}$

20. Cells in series:

$r_{\text{eff.}} = r_1 + r_2 + \_\_\_\_\_\_ + r_n$

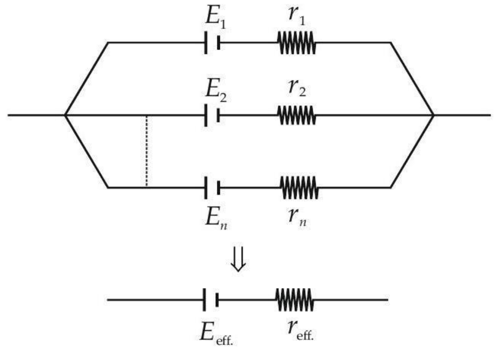
$E_{\text{eff.}} = E_1 + E_2 + \_\_\_\_\_\_ + E_n$



* Follow sign convention for $E_{\text{eff.}}$

21. Cells in parallel:

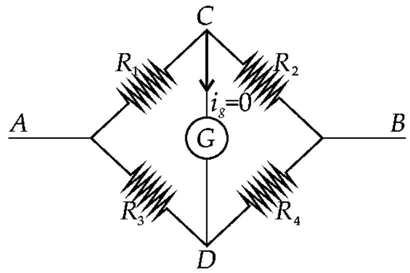
$$\frac{1}{r_{\text{eff.}}} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_n}$$



$$E_{\text{eff.}} = \frac{\frac{E_1}{r_1} + \frac{E_2}{r_2} + \cdots \ldots + \frac{E_n}{r_n}}{\frac{1}{r_1} + \frac{1}{r_2} + \cdots \ldots + \frac{1}{r_n}}$$

*Follow sign convention while taking values of emf.

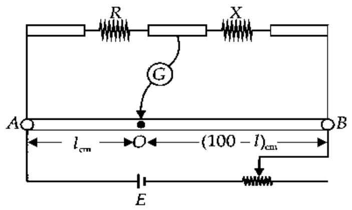
22. In a balanced Wheatstone bridge:



- $i_g = 0$
- $V_C = V_D \Rightarrow V_C - V_D = 0$

$\frac{R_1}{R_2} = \frac{R_3}{R_4}$ (Or) $R_1 R_4 = R_2 R_3$

23. In a balanced meter bridge:



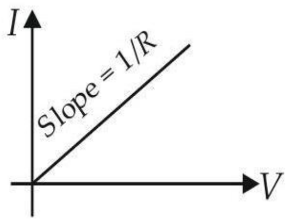
$\frac{R}{X} = \frac{l}{100 - l}$

24. Potential gradient of potentiometer wire AB is $K = \frac{V_{AB}}{L_{AB}}$

V_{AB}: Voltage on wire AB

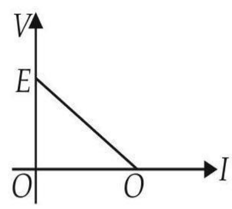
L_{AB}: Length of wire AB

GRAPHS



1. Current (I) vs voltage (V) for an ohmic conductor:
2. The terminal voltage (V) of a cell vs. current drawn from cell:

$V = E - Ir$
$V = -Ir + E$
$\Downarrow$
$y = -mx + C$



Ch 4 Moving Charges and Magnetism

1. **Biot-Savart law** (Magnetic field due to current element) $dB = \frac{\mu_0}{4\pi}\frac{Idl\sin\theta}{r^2}$

2. Magnetic field due to long straight conductor $B = \frac{\mu_0}{4\pi}\frac{I}{a}[\sin\theta_1 + \sin\theta_2]$

3. Magnetic field due to an infinitely long straight current carrying wire $B = \frac{\mu_0 I}{2\pi r}$

4. Magnetic field at the centre of a current carrying circular loop

$$B = \frac{\mu_0 I}{2r} \quad \text{(for 1 turn)}, \; B = \frac{\mu_0 NI}{2r} \quad \text{(for N turns)}$$

5. Magnetic field on the axis of a circular current loop of 'N' turns $B = \frac{\mu_0 N I a^2}{2(r^2+a^2)^{3/2}}$

6. **Ampere's Circuital Law:**

It states that the line integral of the magnetic field $\vec{B}$ around any closed circuit is equal to μ_o times the total current threading or passing through this closed circuit.

7. Magnetic field due to a solenoid:

Solenoid interior: $B = \mu_o nI$, Solenoid end: $B = \frac{1}{2}\mu_o nI$

8. Force on moving charge in magnetic field

$F = Bqv\sin\theta$, $\vec{F} = q(\vec{v} \times \vec{B})$

9. **Motion of a charged particle in a uniform magnetic field**

Case-1: (If v is perpendicular to B)

(i) $r = \frac{mv}{Bq} \Rightarrow v = \frac{Bqr}{m} \therefore T = \frac{2\pi m}{Bq}$

(ii) K.E. $= \frac{B^2q^2r^2}{2m}$

Case-2: (If v makes an angle θ with B)

(i) $r = \frac{mv\ sin\theta}{Bq} \Rightarrow vsin\theta = \frac{Bqr}{m} \therefore T = \frac{2\pi m}{Bq}$

(ii) K.E. $= \frac{B^2q^2r^2}{2m}$

(iii) Pitch $= v_{||}T = \frac{2\pi mv\cos\theta}{Bq}$

10. Time period or frequency of revolution is independent of K.E or velocity of charged particle.

11. Force current carrying wire $\vec{F} = I(\vec{l} \times \vec{B}) \therefore F = BIl\sin\theta$

12. Force per unit length, $f = \frac{\mu_0 I_1 I_2}{2\pi r}$

13. Force on wire of length ' L ', $f = \frac{\mu_0 I_1 I_2 L}{2\pi r}$

14. **Torque on a rectangular coil in a uniform magnetic field**

$\tau = NIBA\sin\theta$, $\tau = MB\sin\theta$, $\vec{\tau} = \vec{M} \times \vec{B}$

15. **In M.C.G.**

$I = \frac{k}{NBA}\phi$, Figure of merit $(G) = \frac{k}{NBA}$, Current sensitivity $(I_s) = \frac{\phi}{I} = \frac{NBA}{k}$

Voltage sensitivity $(V_s) = \frac{\phi}{V} = \frac{\phi}{IR} = \frac{I_s}{R}$

16. **Conversion to ammeter**

Shunt resistance $S = \frac{I_g G}{I - I_g}$

Ammeter resistance $A = \frac{GS}{G+S}$

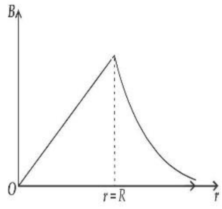
Galvanometer current $I_g = \frac{IS}{G+S}$

17. **Conversion to voltmeter**

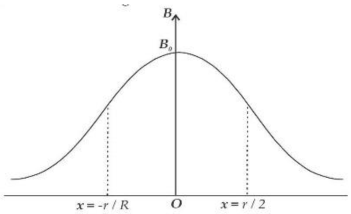
$R = \frac{V}{I_g} - G,\ I_g = \frac{V}{R+G},\ V_R = G + R$

GRAPHS

1. **Variation of magnetic field from centre of wire**



2. **Variation of magnetic field at axis of circular coil.**



Ch 5 Magnetism and Matter

1. Magnetic dipole moment: $M = q_m \times 2l$
2. Magnetic force between two magnetic poles of strengths $q_{m_1}\, and\, q_{m_2}$ is $F = \frac{\mu_0}{4\pi}\frac{q_{m_1} q_{m_2}}{r^2}$
3. Magnetic field on the axial line of a bar magnet is $B_{\text{axis}} = \frac{\mu_0}{4\pi}\frac{2Mr}{(r^2-l^2)^{3/2}}$
4. Magnetic field on the equatorial line of a bar magnet is $B_{\text{eq.}} = \frac{\mu_0}{4\pi}\frac{M}{(r^2+l^2)^{3/2}}$ when $l << r$
5. Magnetic field on the axial line of a short dipole is $B_{\text{axis}} = \frac{\mu_0}{4\pi}\frac{2M}{r^3}$
6. Magnetic field on the equatorial line of a bar magnet is $B_{\text{eq.}} = \frac{\mu_0}{4\pi}\frac{M}{r^3}$
7. Torque acting on a dipole of magnetic moment M is $\tau = MB \sin\theta$
8. Work done by external force in rotating a bar magnet form initial angle θ_1 to θ_2 is

$W = \Delta U = -MB(\cos\theta_2 - \cos\theta_1)$

9. Magnetic dipole moment of a coil having N turns, area A and carrying current I is $M = NIA$
10. Magnetic moment of an atom is $\mu_l = \frac{neh}{4\pi m_e}$
11. Gauss law in magnetism: The magnetic flux through any closed surface is always 0.

$\therefore \phi_B = \oint \vec{B} \cdot \vec{ds} = 0$

12. Ratio of vertical and horizontal components of total intensity of earth's magnetic field at a place

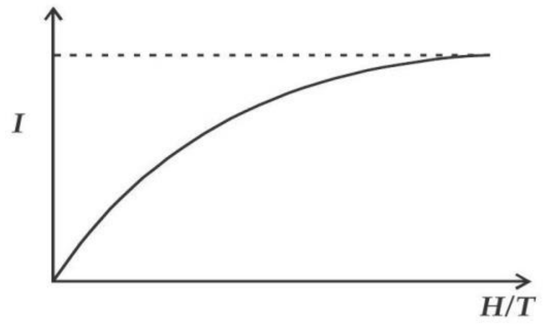
is $\frac{B_v}{B_H} = \tan\delta$, $\therefore B = \sqrt{B_H^2 + B_v^2}$, $B_H = \frac{\mu_0}{4\pi}\frac{2Mr}{(r^2-l^2)} = \frac{\mu_0}{4\pi}\frac{2M}{r^3}$

13. Magnetic permeability of a substance is $\mu = \frac{B}{H} = \mu_0(1+\chi_m)$, $\therefore \mu_r = \frac{\mu}{\mu_0} = 1 + \chi_m$
14. Magnetic susceptibility of a sample is $\chi_m = \frac{I}{H}$, $\therefore \chi_m = \frac{C}{T}$ (Curie's Law)

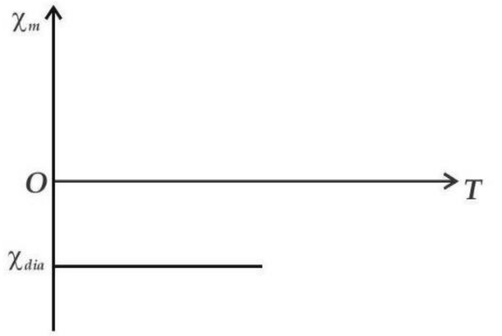
15. Magnetic field inside a sample is $B = \mu_0(H + I)$

GRAPHS

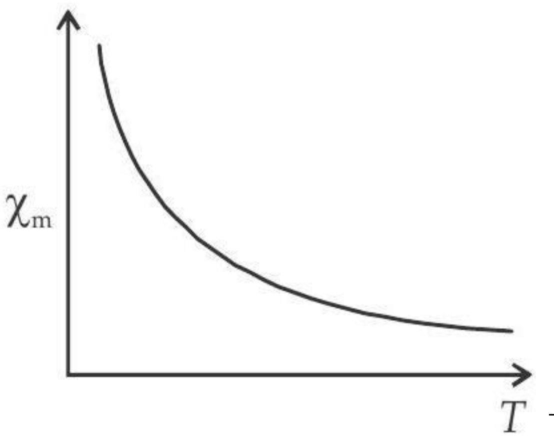
1. Intensity of magnetisation as a function of H/T



2. $\chi_m - T$ graph for diamagnetic material



3. $\chi_m - T$ graph for paramagnetic material



Physi		**SI unit**	**Dimension**
Magnetic flux (ϕ)	$\vec{B} \bullet \vec{A} = BA\cos\theta = \int \vec{B} \bullet d\vec{A}$	Wb = Tm^2	$[ML^2T^{-2}A^{-1}]$
Induced emf (e)	$\varepsilon = -\frac{d\phi}{dt}$ Induced current $i = \frac{\varepsilon}{R} = -\frac{N}{R}\frac{d\phi}{dt}$ Induced charge $q = i\Delta t = -\frac{N}{R}\Delta\phi$ <u>Motional emf induced in a straight conductor</u> (i) Linear motion = Blv (ii) Rotation about one end = $Bl^2\omega/2$	Volt	$[ML^2T^{-1}A^{-1}]$

Self-inductance	$L = \phi / I$ and $L = \frac{\lvert\varepsilon\rvert}{dI/dt}$ Self-inductance of a long solenoid $L = \mu_r \mu_0 n^2 A\, l$	Henry	$[ML^2T^{-2}A^{-2}]$
Mutual inductance	$M_{12} = \phi_2 / I_1$ and $M_{12} = \frac{\lvert\varepsilon_2\rvert}{dI_1/dt}$ Mutual-inductance of two long co-axial solenoids $M_{12} = \mu_0 n_1 n_2 \pi r^2 l$, $M_{12} = \sqrt{L_1 L_2}$	Henry	$[ML^2T^{-2}A^{-2}]$
Magnetostatic energy stored	$U = \frac{1}{2} LI^2$	Joule	$[ML^2T^{-2}]$

Ch 6 EMI

1. Magnetic flux through some area is $\phi = \vec{B} \cdot \vec{A} = BA\cos\theta$
2. Emf induced in a coil is $e = -\frac{Nd\phi}{dt}$
3. According to Faraday's second law, emf induced in a coil is $e = -\left[\frac{\phi_2 - \phi_1}{t}\right]$
Negative sign indicates that induced emf opposes the change in magnetic flux.
4. Motional emf in a conductor is $e = Blv$
5. Current induced in a closed circuit is $I = \frac{e}{R} = \frac{Blv}{R}$
6. According to Faraday's second law, current induced in a coil is $I = -\frac{[\phi_2 - \phi_1]}{tR} = -\frac{N}{R}\frac{d\phi}{dt}$
7. $e = \frac{1}{2} B l^2 \omega$ [e.m.f is induced across the rod of length ' l ']
8. Alternating emf is given by $E = E_0 \sin \omega t$ $\omega = 2\pi v$ or $\omega = 2\pi f$
9. Amplitude of alternating emf induced in a coil is $E_o = NBA\omega$
10. Amplitude of alternating current induced in a coil is $I_o = \frac{E_o}{R} = \frac{NBA\omega}{R}$
11. Magnetic flux through a coil is $\phi = LI$, where L is self-inductance of the coil.
12. Emf induced in a coil is $e = -\frac{LdI}{dt}$
13. $L_1 + L_2 + L_3 + \cdots \ldots \ldots . . L_n = L$ when inductors are in series
14. $L = \frac{L_1 L_2}{L_1 + L_2}$ when when inductors are in parellel
15. Self-inductance of a long solenoid of number of turns N, area A and length $\boldsymbol{l}$ is $L = \frac{\mu_o N^2 A}{l}$
16. Magnetic energy stored in an inductor of self-inductance L is $U = \frac{1}{2} L I^2$
17. Emf induced in second coil when rate change of current in the first coil is $\frac{dI}{dt}$ is $e = -\frac{MdI}{dt}$

18. Mutual inductance of two long solenoids is $M = \frac{\mu_o N_1 N_2 A}{l} = \mu_o n_1 n_2 A l$

19. Coefficient of coupling of two coils of inductances L_1 and L_2 is $K = \frac{M}{\sqrt{L_1 L_2}}$

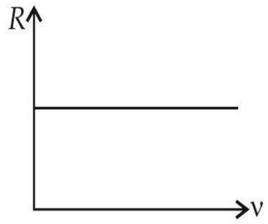
Ch 7 AC

Physical Quantity	**Formula**	**SI unit**	**Dimension**
Alternating current and voltage	$E = E_0 \sin(\omega t+\phi)$ or $E = E_0 \cos(\omega t+\phi)$ $I = I_0 \sin(\omega t+\phi)$ or $I = I_0 \cos(\omega t+\phi)$ $I_{rms} = I_o/\sqrt{2} = 0.707\, I_0$ and $E_{rms} = E_o/\sqrt{2} = 0.707\, E_0$		
Phase relationship	**For R**: No phase difference b/w V and I **For L**: Voltage leads the current by π/2 **For C**: Current leads the voltage by π/2 **For LCR circuit: if f > f_r** $\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$ or $\phi = \tan^{-1}\left(\frac{V_L - V_C}{V_R}\right)$ **If f < f_r** $\phi = \tan^{-1}\left(\frac{X_C - X_L}{R}\right)$ or $\phi = \tan^{-1}\left(\frac{V_C - V_L}{V_R}\right)$	Unit less	Dimensionless
Reactance and impedance	Inductive reactance, $X_L = \omega L$ Capacitive reactance, $X_C = 1/\omega C$ Impedance of LR circuit $Z = \sqrt{(X_L^2 + R^2)}$ Impedance of RC circuit $Z = \sqrt{(X_C^2 + R^2)}$ Impedance of LCR circuit $Z = \sqrt{[(X_L - X_C)^2 + R^2]}$	Ohm	$[ML^2T^{-1}A^{-2}]$
Resonance frequency	$f_r = \frac{1}{2\pi\sqrt{LC}}$, angular frequency $\omega_r = \frac{1}{\sqrt{LC}}$	Hertz, rad/s	$[T^{-1}]$
Quality factor	$Q = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{\omega_r}{2\Delta\omega} = \frac{\omega_r L}{R} = \frac{1}{\omega_r CR}$	Unit less	Dimensionless
Power dissipated in ac circuit	In pure inductor and capacitor: Zero In pure resistive circuit: $I^2R/2$ In a combination of L, C and R: $V_{rms}I_{rms}\cos\phi$	Watt	$[ML^2T^{-3}]$

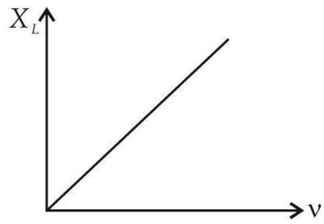
Power factor	$\cos\phi = R/Z$	Unit less	Dimensionless
Wattles current	$I_{rms}\cos\phi$	Ampere	[A]
Transformation ratio and efficiency of transformer	$\frac{v_S}{v_P} = \frac{N_S}{N_P}$ Efficiency: $\eta = \frac{v_s I_s}{v_p I_p} = \frac{P_0}{P_i}$	Unit less	Dimensionless

GRAPHS

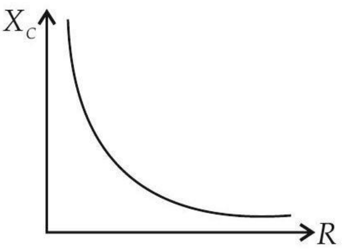
1. Variation of resistance v/s frequency:



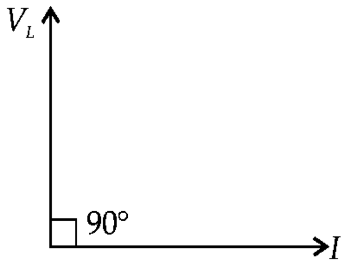
3. . Inductive reactance v/s frequency:



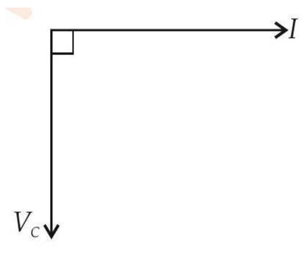
2. Capacitive reactance v/s frequency



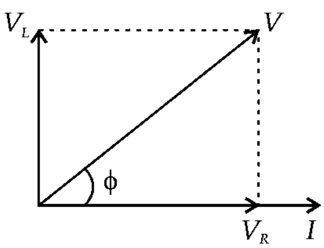
4. Purely inductive circuit. Voltage leads by 90°.



5. In purely capacitive circuit, voltage lags by current by 90°.

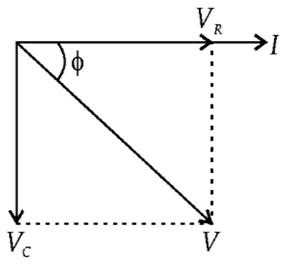


6. In purely resistive circuit, voltage and current are in same phase.

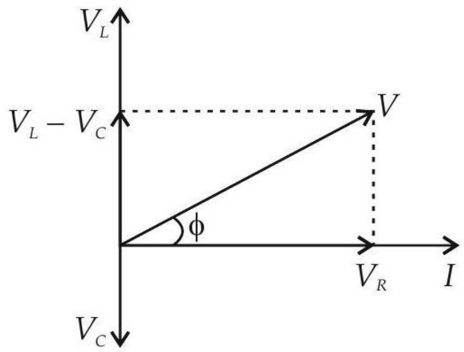


7. In $R-L$ circuit, voltage leads by some angle ϕ.

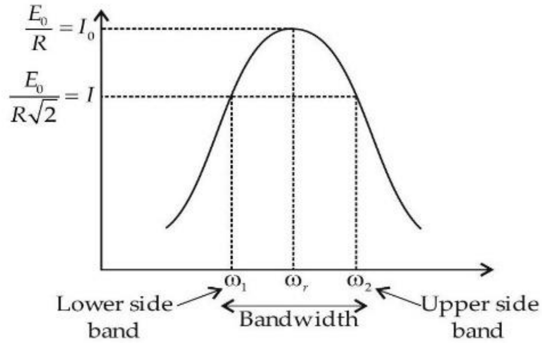
8. In purely capacitive resistance circuit, voltage lags by current.



9. $L - C - R$ circuit voltage and current



10. Band width of a seri



Ch 8

Electromagnetic Waves

1. Displacement current is given by $I_D = \varepsilon_0 \frac{d\phi_E}{dt}$

2. Displacement current can also be written as $I_D = \varepsilon_0 \frac{d}{dt}(EA) = \varepsilon_0 A \frac{dE}{dt}$

3. Displacement current is also given by $I_D = C \frac{dV}{dt}$

4. The modified Ampere Circuital law can be written as $\oint \vec{B} \cdot d\vec{l} = \mu_0 (I_C + I_D)$

Where I_C is conduction current in wires and I_D is displacement current ib between plates of capacitor.

5. Wave propagation constant of an electromagnetic wave is $K = \frac{2\pi}{\lambda}$

6. Velocity of light $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ in vacuum

7. Velocity of light $c = \frac{1}{\sqrt{\mu_r \mu_0 \varepsilon_r \varepsilon_0}}$ in material medium

$E_y = E_0 \sin(kx - wt), B_z = B_0 \sin(kx - wt)$

(For a wave propagating along x-axis)

8. Average electric energy density in an electromagnetic wave is $U_E = \frac{1}{4}\varepsilon_0 E_0^2 = \frac{1}{2}\varepsilon_0 E_{\text{r.m.s.}}^2$

9. Average magnetic energy density in an electromagnetic wave is $U_B = \frac{1}{4\mu_0}B_0^2 = \frac{1}{2\mu_0}B_{\text{rms}}^2$

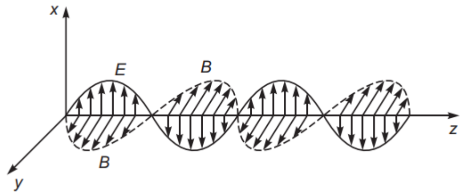
10. Total average energy density in an electromagnetic wave is $U_{av.} = \frac{1}{2}\varepsilon_0 E_{\text{rms}}^2 + \frac{1}{2\mu_0}B_{\text{rms}}^2 = \frac{B_{\text{rms}}^2}{\mu_0}$

11. Momentum of a part of electromagnetic waves of energy U is $p = \frac{U}{c}$

12. Intensity of wave $(I) = \frac{p}{A}$

13. For a plane progressive electromagnetic wave propagating along + Z direction, the electric and magnetic fields can be written as

$$E = E_0 \sin(kz - \omega t)$$
$$B = B_0 \sin(kz - \omega t)$$



14. The amplitudes of electric and magnetic fields in free space, in electromagnetic waves are related by

$$E_0 = cB_0 \text{ or } B_0 = \frac{E_0}{c}$$

15. Electromagnetic spectrum

- **Radio waves:** $\lambda > 10^8$ nm

Application: radio, TV signal

- **Micro waves**: $10^8 > \lambda > 10^5$ nm

Application: micro wave oven, radar

- **Infrared**: $10^5 > \lambda > 700$ nm

Application: night vision

- **Visible light:** $700 > \lambda > 400$ nm

Application: to observe world

- **UV rays**: $400 > \lambda > 10$ nm

Application: destroying bacteria

- **X-rays**: $10 > \lambda > 0.01$ nm

Application: detect bone break

- **γ rays**: $0.01 \text{ nm} > \lambda$

Application: to treat cancer

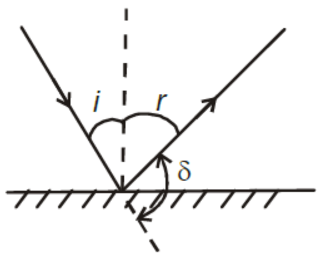
Ray Optics and Optical Instrument

Reflection

I) Plane Mirror:

(i) Object distance = Image distance

(ii) **Deviation:** $\delta = 180^0 - 2i$



(iii) Law of reflection, $\angle i = \angle r$

II) Spherical Mirror:

i) General equation

$f = \frac{R}{2}, \qquad \frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

ii) Magnification

i) Transverse magnification $m = \frac{h'}{h} = \frac{-v}{u} = \frac{f}{f-u} = \frac{f-v}{f}$, ii) Longitudinal magnification $m' = \frac{(v_2 - v_1)}{(u_2 - u_1)}$

Refraction

I) **Shell's Law and Law of Refraction**

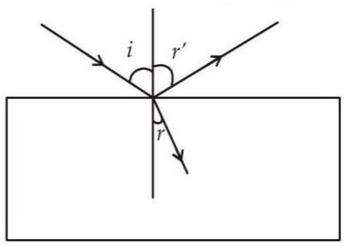
i) Absolute refractive index If comparison with vaccum

Ex: $\mu_w = \frac{4}{3}, \ \mu_g = \frac{3}{2}$

ii) Relative refractive index

$_1\mu_2 = \frac{\mu_2}{\mu_1}$

iii) Snell's Law $_1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{\sin i}{\sin r} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$



iv) $\delta = i - r$, Light travels from rarer to denser $\delta = r - i$, Light travels from denser to rarer

v) Apparent Depth:

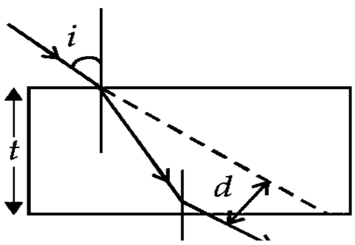
➢ Observer in rarer medium $\mu = \frac{h}{h'}$,

$h =$ Actual height
$h' =$ Apparent height

Shift $= h\left(1 - \frac{1}{\mu}\right)$

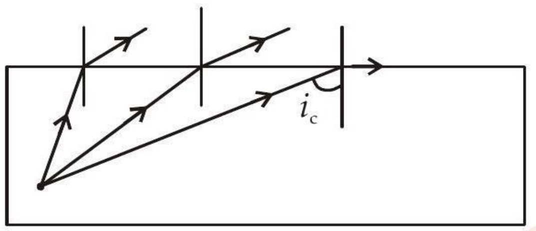
➢ Observer in denser medium

$\mu = \frac{h'}{h}$, Shift $= h(\mu - 1)$



vi) **Lateral shift:**

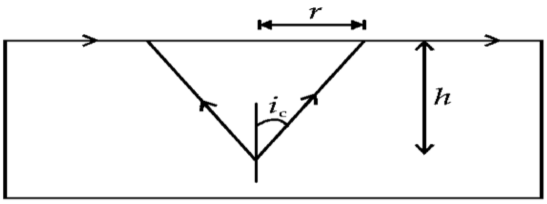
$$d = \frac{t\sin(i - r)}{\cos r}$$



Total internal reflection

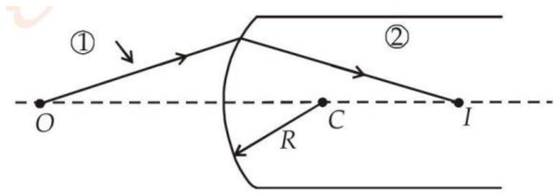
$$\sin ic = \frac{1}{\mu}$$

$\text{Height}(h) = r\sqrt{\mu^2 - 1}$



III) **Refraction through spherical surface**

$$\frac{\mu_2}{v} - \frac{\mu_1}{v} = \frac{\mu_2 - \mu_1}{R}$$



IV) Lens

i) **Lens formula** $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

ii) **Magnification:** $m = \frac{h'}{h} = \frac{f}{f+u} = \frac{f-v}{f}$

iii) **Lens maker's formula** $\frac{1}{f} = \left(\frac{\mu_2}{\mu_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

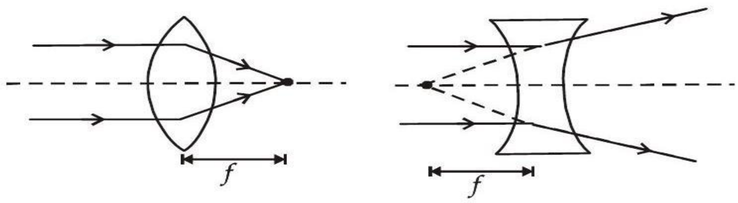
Refractive index of lens $= \mu_2$

Refractive index of surrounding medium $= \mu_1$

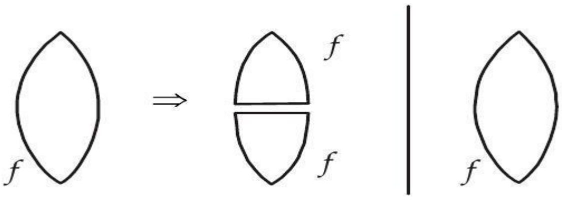
If $\mu_2 = \mu$ and $\mu_1 = 1$ (air)

then $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

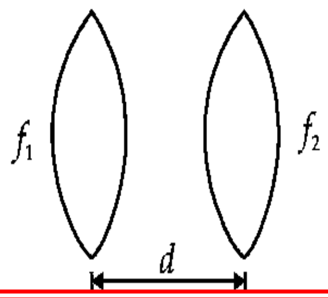
iv) **Focus**



v) **Cutting of lens**



vi) **Combination of Lens**



$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} + \ldots..$

$P_{eq} = P_1 + P_2 +$

When lens are at distance ' d '

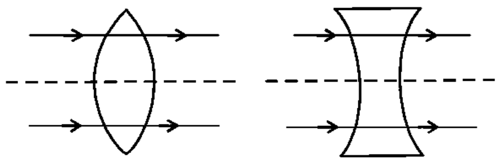
$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$$

$$P_{eq} = P_1 + P_2 - dP_1P_2$$

vii) **Power of lens** $P = \frac{1}{f(m)}$

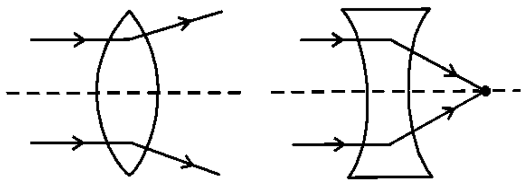
viii) Refractive index of medium is same as that of surrounding

$f = \infty$



ix) Refractive index of surrounding greater than lens $f = -$ ve

x) Focal length depends on medium $f \propto \frac{1}{\lambda}$



V) Prism

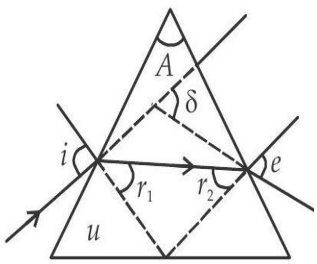
i) General

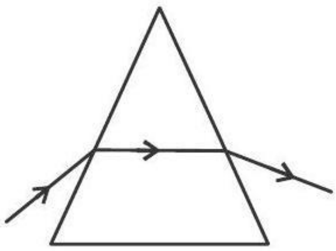
Equation

$A = r_1 + r_2$

$i + e = A + \delta$

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



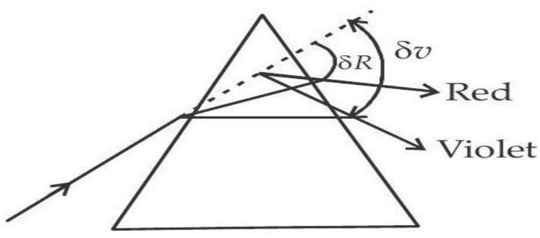


ii) Minimum Deviation

$$i = e, \delta = \delta_m, r_1 = r_2 = r$$
$$\therefore r = A/2$$
$$\delta_m = 2i - A$$
$$\mu = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

iv) Angular Dispersion

$$\theta = \delta_r - \delta_R = A(\mu_v - \mu_R)$$



v) Dispersive power (ω) $\quad \omega = \frac{\theta}{\delta_{\text{mean}}}$

a) If $\delta_{\text{mean}} = \delta_{\text{y}}$

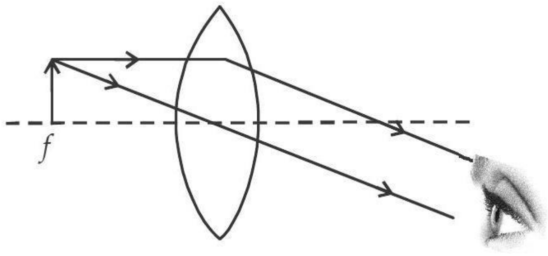
$$\omega = \frac{\theta}{\delta_y} = \frac{A(\mu_v - \mu_R)}{A(\mu+1)} = \frac{\mu_v - \mu_R}{\mu_y - 1}$$

b) If $\delta_{\text{mean}} = \frac{\delta_v + \delta_R}{2}$

VI) Optical Instrument

i) Microscope

- **Simple microscope**

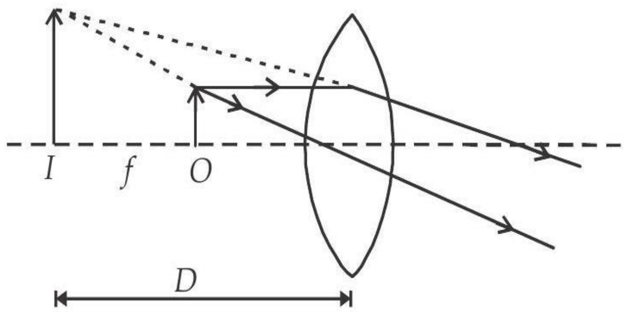


a) Image is formed at infinity

$V = f$

$v = \infty$

$$m = \frac{D}{f}$$



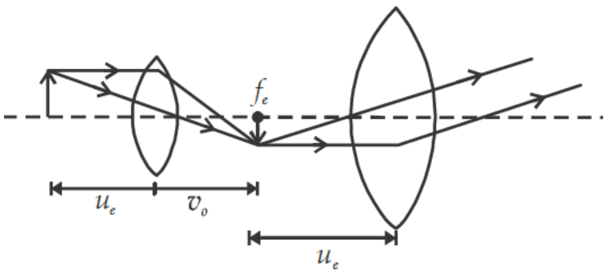
b) Image is formed at DDV (D)

$V < f$

$v = D$

$m = 1 + \frac{D}{f}$

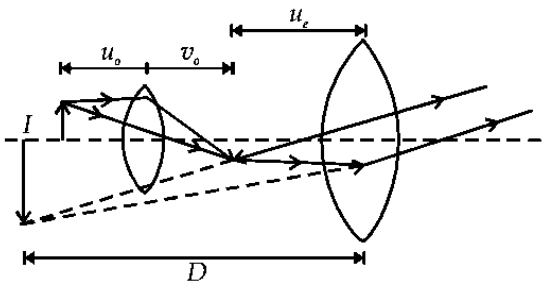
Compound microscope



a) Image is formed at infinity

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

b) Image is formed at DDV (D)

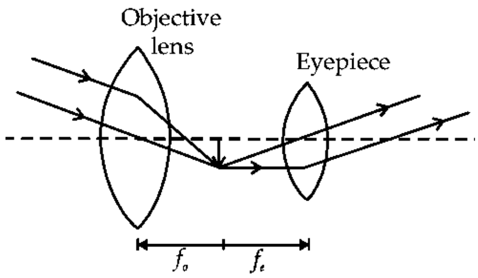


$$\frac{v_o}{u_o}\left(1 + \frac{D}{f_e}\right)$$
$$L = v_o + V_e$$
$$m = -\frac{L}{f_o}\left(1 + \frac{D}{f_e}\right)$$

VII) Telescope

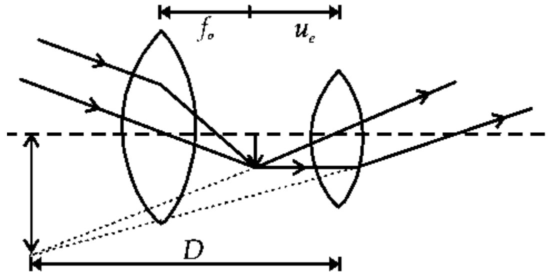
a) Image is formed at infinity

$$m = \frac{f_o}{f_e}$$



b) Image is formed at DDV (D)

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



Ch 10 Wave Optics

1. Superposition of wave

$Y_1 = a_1 \sin \omega t$

$Y_2 = a_2 \sin(\omega t + \phi)$

$Y = Y_1 + Y_2$

$Y = R \sin(\omega t + \phi)$

2. Resultant Amplitude

$$R = \sqrt{a_1^2 + a_2^2 + 2a_1 a_2 \cos\phi}$$

$$I_1 = K a_1^2, I_2 = K a_2^2, I_R = KR^2, I_R = a_1^2 + a_2^2 + 2a_1 a_2 \cos\phi$$

3. Conditions for Constructive and Destructive Interference

For constructive interference $[\phi = 0, 2\pi, 4\pi, \dots]$
For destructive interference $[\phi = \pi, 3\pi, 5\pi, \dots]$

$I_{\max} = (a_1 + a_2)^2$

$$\frac{I_{\max}}{I_{\min}} = \frac{(a_1 + a_2)^2}{(a_1 - a_2)^2} = \frac{(r+1)^2}{(r-1)^2}$$

$$r = \frac{a_1}{a_2}$$

4. Resultant Intensity

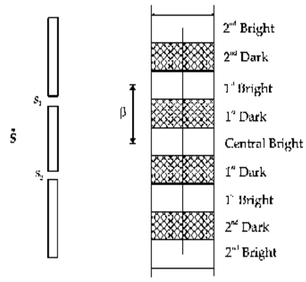
$I_R = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$

If $= I_1 = I_2 = I$

$I_R = 4I\cos^2\left(\frac{\phi}{2}\right)$

$I_{\max} = 4I$

$I_{\min} = 0$

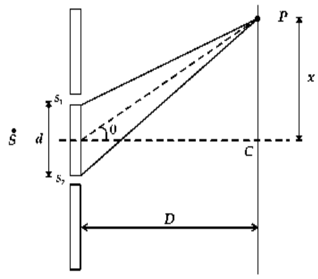


5. Young double slit experiment
Constructive pattern

Path difference $= \mathrm{n}\lambda, \mathrm{n} = 0,1,2,3 \ldots \ldots$

Destructive pattern

Path difference $= (2n-1)\frac{\lambda}{2}, \mathrm{n} = 1,2, \ldots\ldots$

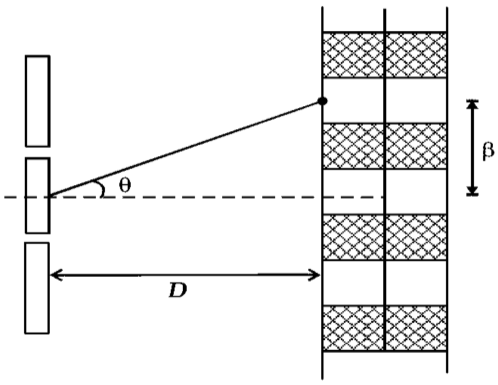


a) n^{th} bright fringe from central maxima $x_n = \frac{n\lambda D}{d}$, n $= 0,1,2 \ldots \ldots \ldots$

b) n^{th} fringe from central maxima $x_n = (2n-1)\frac{\lambda D}{2d}$, n $= 1,2,3, \ldots\ldots$

c) **Fringe width** $\beta = \frac{\lambda D}{d}$,

d) Angular width $\theta = \frac{\lambda}{d} = \frac{\beta}{D}$

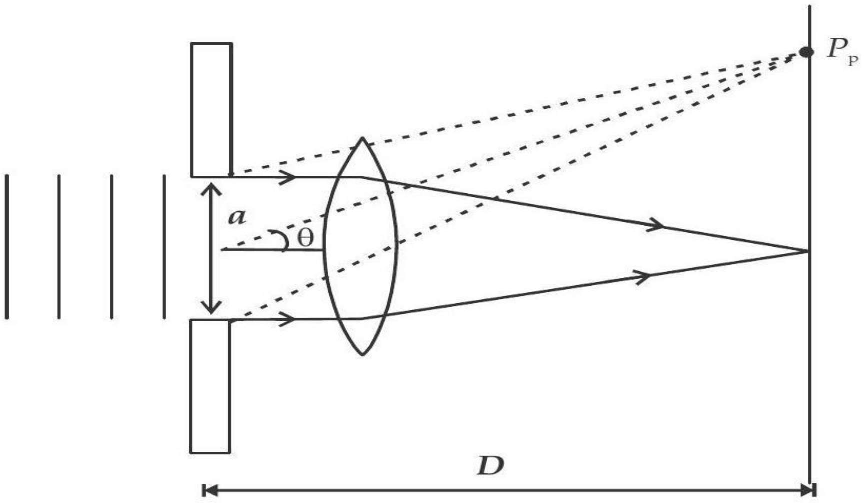


d) In $YDSE$ if n_1 fringes are visible in a field of view with light of wavelength λ_1, while n_2 with light of wavelength λ_2 in the same field then $n_1\lambda_1 = n_2\lambda_2$

e) If whole YDSE set up taken is taken in another medium then λ changes so fringe with (β) changes

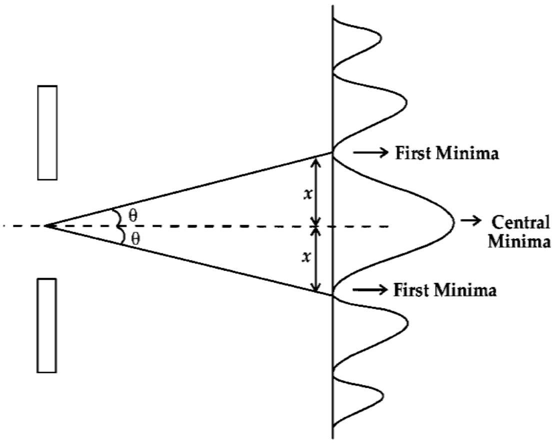
$$\frac{\mu_b}{\mu_1} = \frac{\lambda_2}{\lambda_1} \quad \therefore \mu \propto \frac{1}{\lambda}$$

Fraunhoffer diffraction [Single slit]



a) **Secondary minima**, $a\ \sin\theta_n = n\lambda, n = 1,2,3$
If θ_n is small then a $\cdot\ \theta_n = n\lambda$

b) **Secondary minima**, $a\sin\theta_n = (2n+1)\frac{\lambda}{2}, n =$ 1,2,3 … …

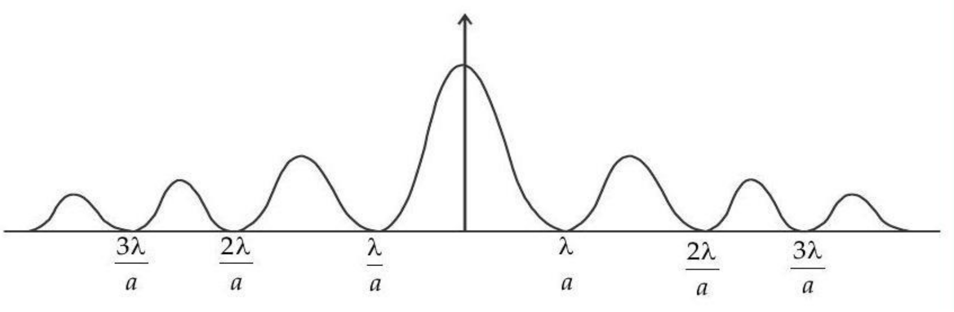


c) **Width of central maximum**

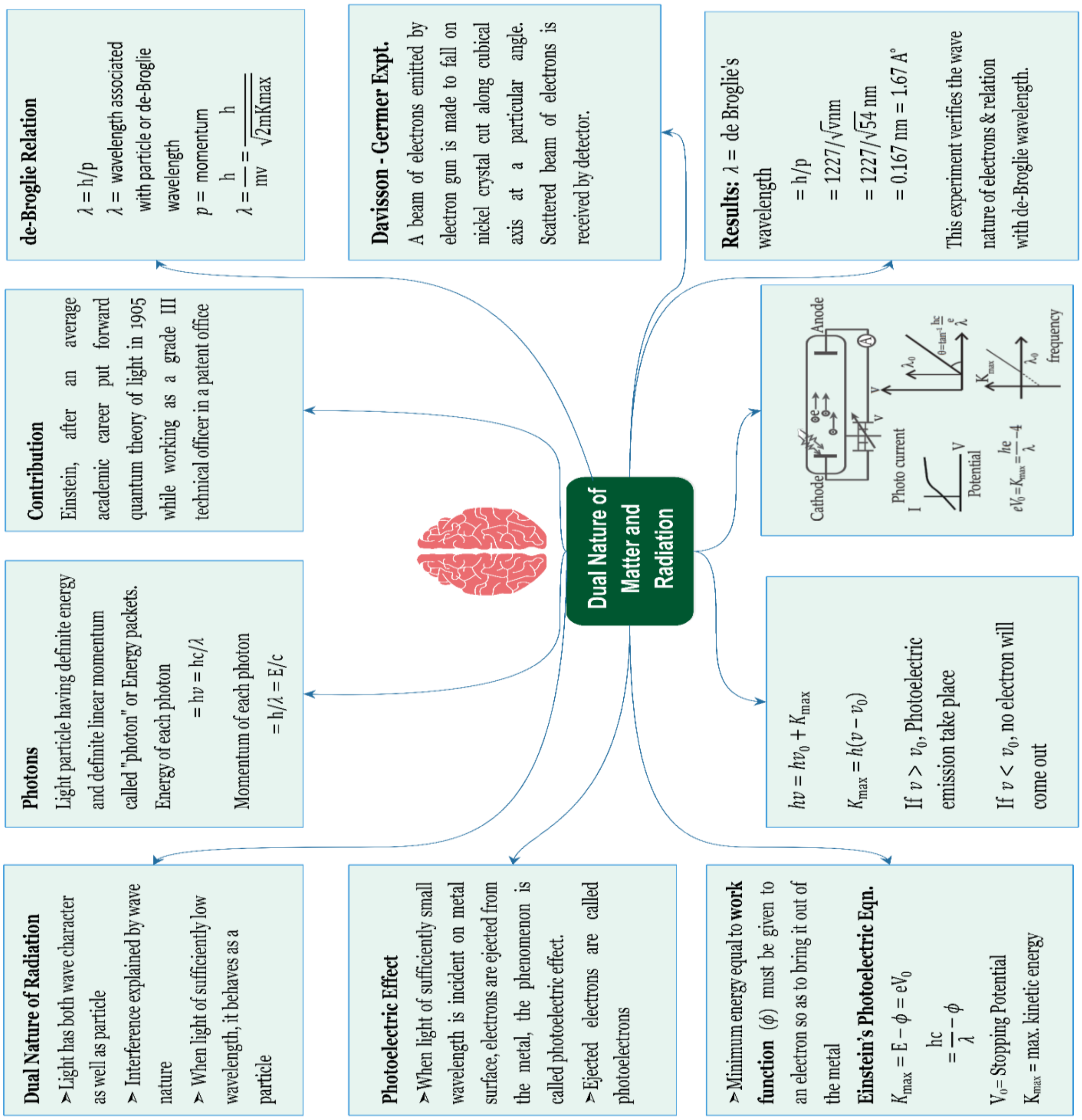
Width of central maxima $=$ w $= 2x = \frac{2\lambda D}{a}$

Angular width $= 2\theta = \frac{2\lambda}{a}$

d) **Intensity graph**



Ch 11 Dual Nature of Matter and Radiation



(1) Energy of a photon: $E = h\upsilon = \frac{hc}{\lambda}$

(2) Number of photons emitted per second: $n = \frac{P}{E} = \frac{P}{h\nu}$

(3) Momentum of photon: $P = mc = \frac{h\upsilon}{c} = \frac{h}{\lambda} = \frac{E}{c}$

(4) Intensity: $I = \frac{E}{At} = \frac{P}{A}$

(5) Equivalent mass of photon: $m = \frac{h\upsilon}{c^2} = \frac{E}{c^2} = \frac{h}{c\lambda}$

(6) Work function: $W_0 = h\upsilon_0 = \frac{hc}{\lambda 0}$

(7) Kinetic energy of photoelectron is given by Einstein's photoelectric equation:
$K_{max} = \frac{1}{2}mV^2 = h\upsilon - W_0 = h(\upsilon - \upsilon_0) = h\left(\frac{c}{\lambda} - \frac{c}{\lambda 0}\right)$

(8) If V_0 is the stopping potential, the maximum kinetic energy of the ejected photoelectron,
$K = \frac{1}{2}mv_{max}^2 = eV_0$

(9) Kinetic energy of De-Broglie Waves: $K = \frac{1}{2}mv^2 = P^2/2m$

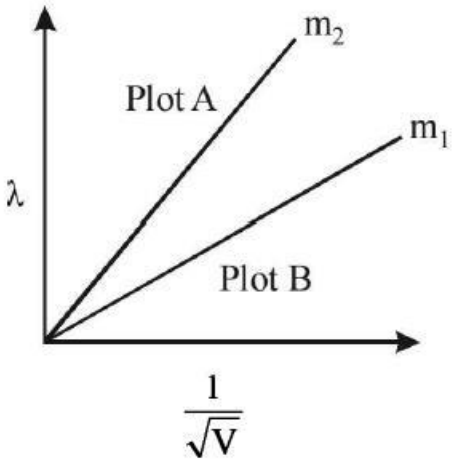
(10) Momentum of de-Broglie Waves: $P = \sqrt{2mK}$

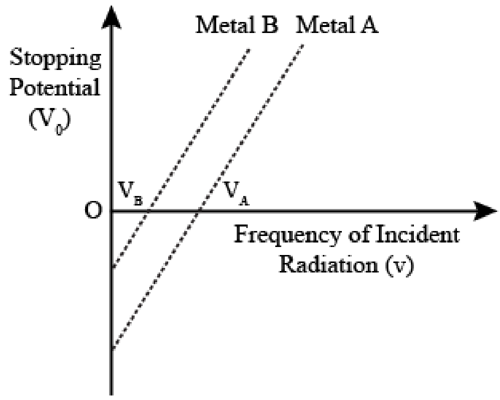
(11) Wavelength of de-Broglie Waves: $\lambda = \frac{h}{p} = \frac{h}{mv} = \frac{h}{\sqrt{(2mK)}}$

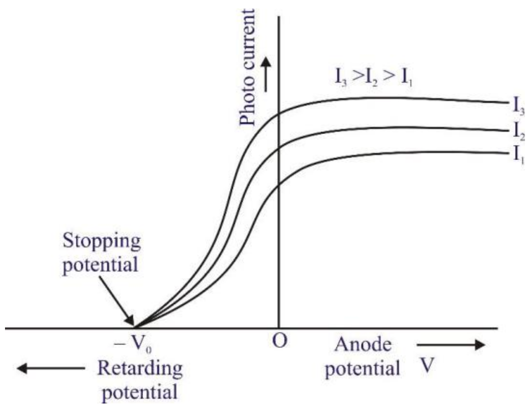
(12) de –Broglie Wavelength of an electron beam accelerated through a potential difference 'V' volt is:

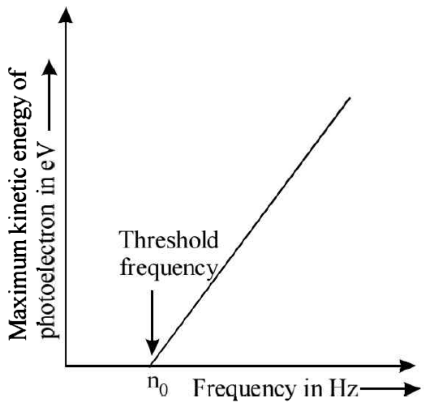
$$\lambda = \frac{h}{\sqrt{(2meV)}} = \frac{1.23}{\sqrt{V}} \text{ nm} = \frac{12.27}{\sqrt{V}} A^0$$

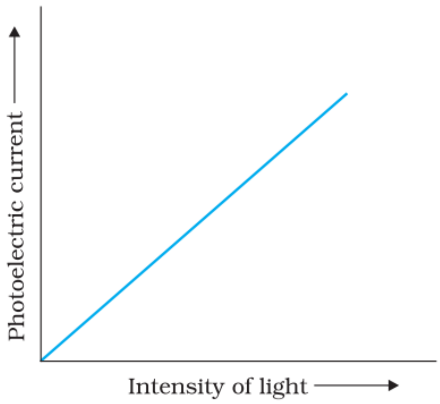
GRAPHS:





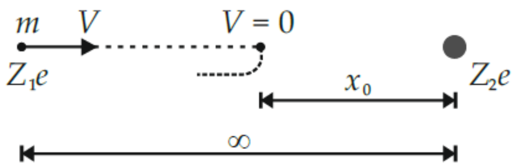






Ch 12 Atoms

1. Distance of closest approach (Estimation of size of nucleus)



$x_0 = \frac{Z_1 Z_2 e^2}{2\pi\varepsilon_0 m V^2}$, $x_0 \propto \frac{1}{m}$

2. Impact Parameter (b)

b = $\frac{Ze^2 \cot\theta/2}{4\pi\varepsilon_0 \left(\frac{1}{2} m\, u^2\right)}$

b is less, θ is more

$b = 0$, $\theta = 180°$ Head on collision

3. Radius of nth orbit of an atom is $r_n = \frac{\varepsilon_0 h^2 n^2}{\pi m e^2 Z}$ ……….$r_n \propto \frac{n^2}{Z}$

$$r_n = 0.53Å\left(\frac{n^2}{Z}\right)$$

h is Planck's constant.

4. Speed of electron in nth orbiot of an atom is $V_n = \frac{Ze^2}{2\varepsilon_0 hn}$ …..$V_n \propto \frac{Z}{n}$

$$V_n = 2.2 \times 10^6 \left(\frac{Z}{n}\right) \text{m/s}$$

5. Energy of radiation emitted when an electron jumps from level n_2 to n_1 is $E_2 - E_1 = \text{h}\nu = \frac{hc}{\lambda}$

6. Angular momentum of an electron in nth orbit is $L = mV_n r_n = \frac{nh}{2\pi}$

7. Time period, $T = \frac{2\pi r_n}{V_n}$

$$T \propto \frac{n^3}{Z^2}$$

8. K.E. $= \frac{1}{2} m_e V_n^2 = \frac{m_e Z^2 e^4}{8\varepsilon_0^2 h^2 n^2}$

9. P.E. $= -\frac{1}{4\pi\varepsilon_0}\frac{Ze\times e}{r} = -\frac{m_e Z^2 e^4}{4\varepsilon_0^2 h^2 n^2}$

10. T.E. = K.E. + P.E. $= \frac{-m_e Z^2 e^4}{8\varepsilon_0^2 h^2 n^2}$

11. **Relation:** T.E. = − K.E. = $\frac{\text{P.E.}}{2}$

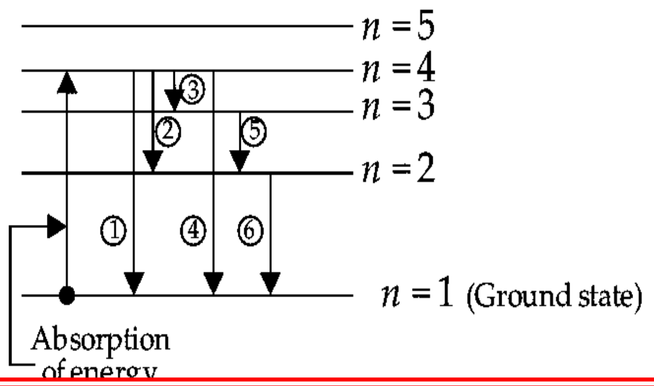
12. T.E. $= -13.6\text{eV}\left(\frac{Z^2}{n^2}\right)$

For hydrogen atom, $E_1 = -13.6\text{eV}$

$E_2 = -3.4\text{eV}$

$E_3 = -1.51\text{eV}$

$E_4 = -0.85\text{eV}$



$E_5 = -0.54\text{eV}$

13. $\frac{1}{\lambda} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

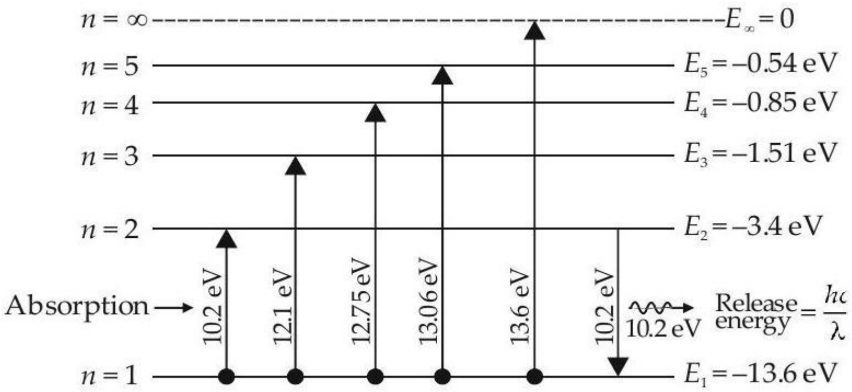
14. Number of spectral lines $(N) = \frac{n(n-1)}{2}$

Ex.: $n = 4, N = 6$

15. Series:

Name Of Series	n_1	n_2	**Region**
1) Lyman series	1	$2,3,4, \dots \infty$	Ultra violet
2) Balmer series	2	$3,4,5, \dots \infty$	Visible
3) Paschen series	3	$4,5,6, \dots \infty$	Infrared
4) Brackett series	4	$5,6,7, \dots \infty$	Infrared
5) P-Fund series	5	$6,7,8, \dots \infty$	Infrared

16. **For hydrogen atom:** $Z = 1$

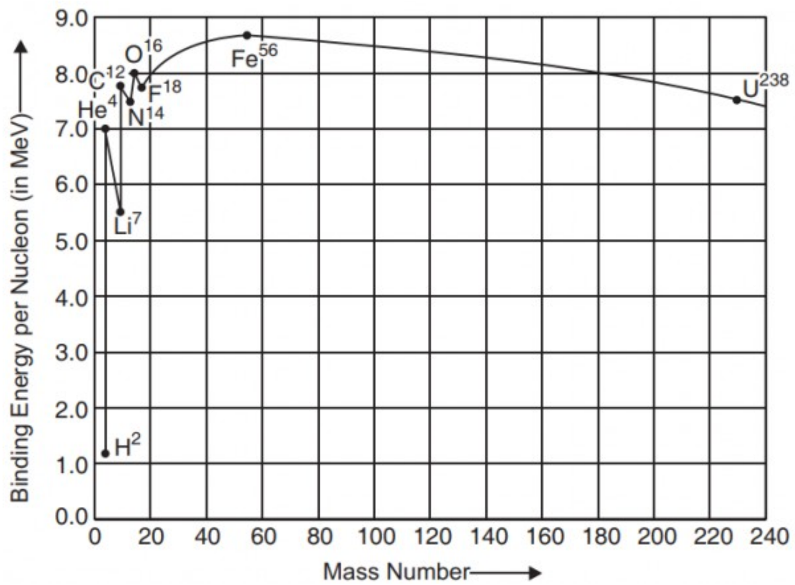


Ch 13 Nuceli

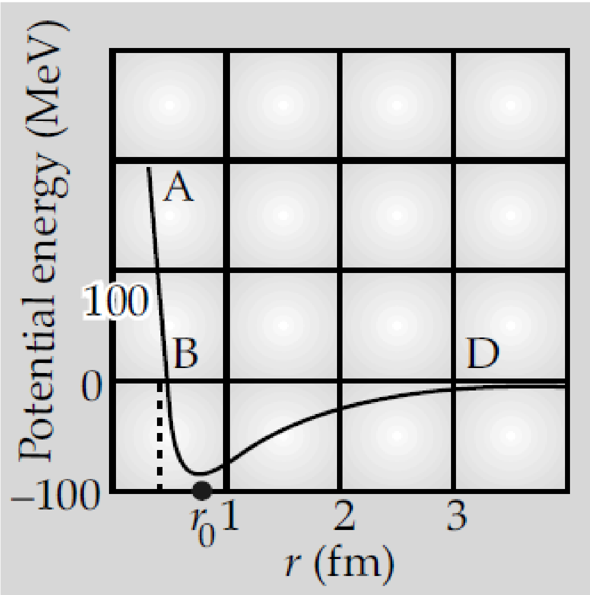
1. Radius of nucleus: $R = R_0 A^{1/3}$
2. Nuclear density: $\rho = \frac{\text{Mass of nucleus}}{\text{Volume of nucleus}} = 2.97 \times 10^{17}\ \text{kg/m}^3$
3. $E = mc^2$
4. Mass defect (Δm) : $\Delta m = \left[Zm_p + (A-Z)m_n - M_N\right]$
5. Binding energy $= \Delta m \times 931.5$ (in Mev) $= \left[Zm_p + (A-Z)m_n - M_N\right] \times 931.5$
6. Binding energy per nucleon $= \frac{\text{Binding energy}}{A}$

GRAPH

(1)



(2)



Marking the regions: $r < r_0$

❼ repulsive force $r > r_0$

❼ attractive force

IMPORTANT DEFINITIONS

1. Isotopes:

The atoms of an element, which have the same atomic number but different mass numbers, are called isotopes.

Ex.: (i) $_8O^{16}$, $_8O^{17}$, $_8O^{18}$ (ii) $_{17}O^{35}$, $_{17}Cl^{37}$

2. Isotones:

The atoms whose nuclei have same number of neutrons are called isotones.

3. Isobars:

The atoms which have same mass number but different atomic numbers, are called isobars.

Ex.: (i) $_1H^3$, $_2He^3$

(ii) $_3Li^7$, $_4Be^7$

4. Atomic mass unit (a.m.u.):

It is defined as $(1/12)^{\text{th}}$ of mass of one $_6C^{12}$ atom. 1 a.m.u. $= 1.660565 \times 10^{-27}$ kg

5. Energy equivalent of atomic mass unit:

According to Einstein's mass-energy equivalence reaction, the energy equivalent of mass m is given by

$E = mc^2$

1 a.m.u. $= 931.5\text{MeV}$

6. Mass defect ($\boldsymbol{\Delta m}$) :

The difference between the sum of masses of nucleons constituting a nucleus and the rest mass of nucleus is known as mass defect.

7. Binding energy:

The energy equivalent to the mass defect of the nucleus.

8. Binding energy per nucleon:

It is the average energy required to extract one nucleon from the nucleus.

9. Properties of nuclear Forces

(i) Nuclear forces are very short-range attractive forces.
(ii) Nuclear forces are charge independent.
(iii) Nuclear forces are non-central forces.
(iv) Nuclear forces do not obey inverse square law.

Ch 14 Semiconductor Electronics

1. For intrinsic semiconductor, $n_e = n_h = n_i$
2. For extrinsic semiconductor, $n_e \cdot n_h \simeq n_i^2$
3. In p-type semiconductor, $n_h \gg n_e$

Holes: Majority carriers, **Electrons:** Minority carriers

4. In n-type semiconductor, $n_e \gg n_h$

Electrons: Majority carriers , **Holes:** Minority carriers

5. In semiconductors, $I = I_e + I_h$

Conductivity, $\sigma = e(n_e\mu_e + n_h\mu_h)$

6. In $\boldsymbol{p - n}$ junction diode

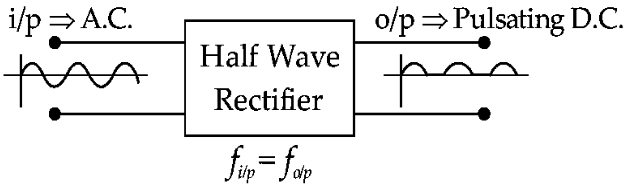
- Forward current ⇒ Diffusion current
- Reverse current ⇒ Drift current

- Reverse resistance $\neq \infty$

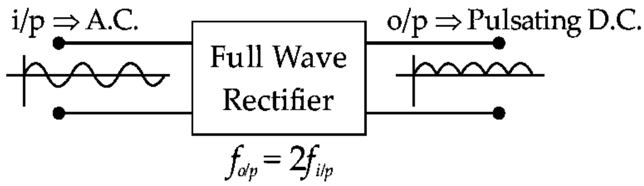
7. In $p - n$ junction diode

- In forward bias acts as closed switch
- In reverse bias acts as open switch

8. Half wave rectifier

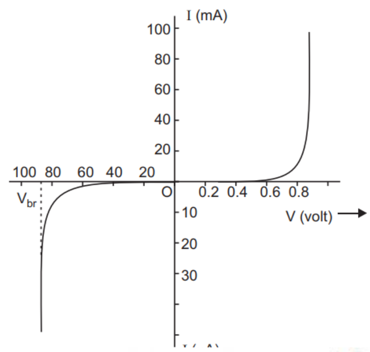


9. Full wave rectifier



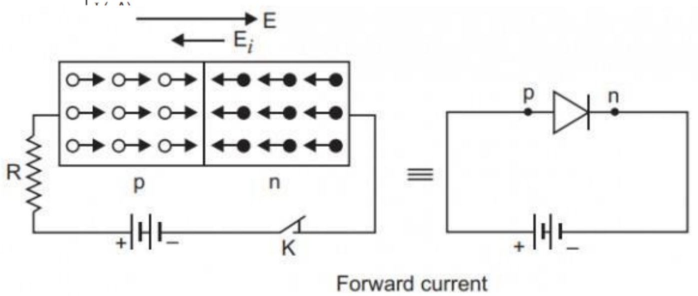
GRAPH & DIAGRAMS

(1) V-I Characteristic Curve

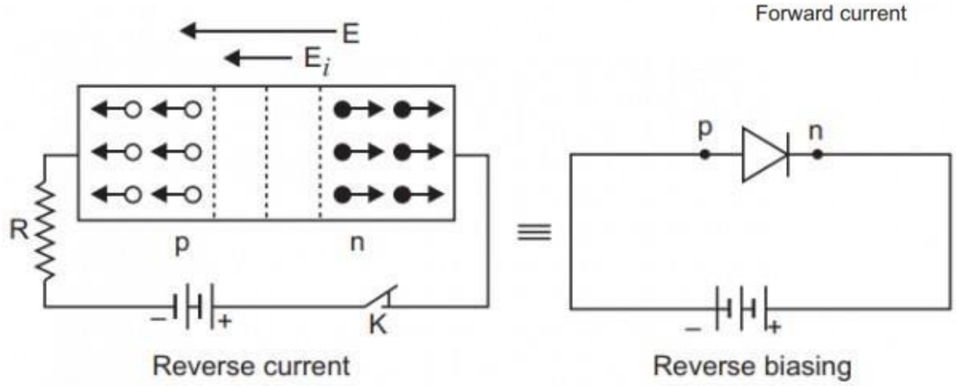


V-I char

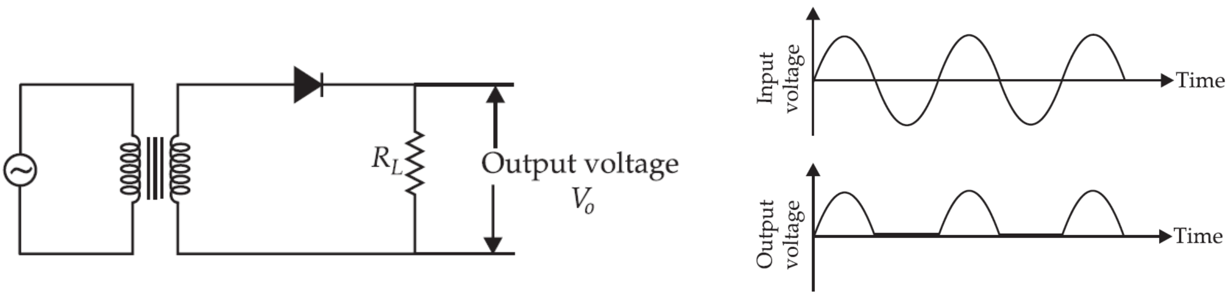
(2) Forward Biased



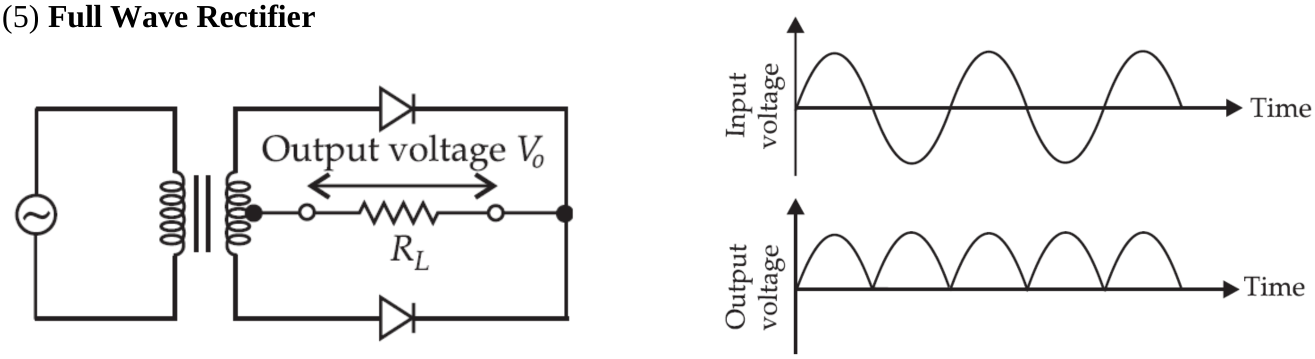
(3) **Reverse Biased**



(4) **Half Wave Rectifier**



(5) **Full Wave Rectifier**



Sample Paper 1

Class 12th

Subject: - Physics (Theory)

TIME 3 Hrs. **M.M. 70**

<u>Instructions</u>

The question paper consists of 18 questions. All questions are compulsory.

Section A contains question no. 1 which carries 20 objective type questions of one mark each.

Section B contains question numbers 2 to 8 which carry 2 marks each.

Section C contains question numbers 9 to 15 which carry 3 marks each.

Section D contains question numbers 16 to 18 which carry 5 marks each.

<u>Section- A (1 Mark Questions)</u>

<u>Q1. Objective Type Questions</u>

<u>MCQs</u>

(i) eV is the unit of (a) charge (b) potential difference (c) energy (d) momentum

(ii) On what factors does the capacitance of a capacitor depend? (a) dielectric (b) distance between the plates (c) area of plates (d) all of these

(iii) Which of the following is used to make standard resistance? (a) Silicon (b) Copper (c) Constantan (d) Carbon

(iv) Two parallel wires carry current in the same direction. They will (a) attract each other (b) repel each other (c) neither repel nor attract each other (d) none of these

(v) The equivalent quantity of mass in electricity is (a) current (b) self-inductance (c) potential (d) charge

(vi) In Lenz's law there is a conservation of (a) charge (b) energy (c) momentum

(d) electric current

(vii) The waves used in telecommunication are (a) ultra violet waves (b) micro waves (c) infrared rays (d) visible rays

(viii) A short pulse of white light is incident from air to glass slab at normal incidence. After travelling through the glass slab, the first colour to emerge is (a) green (b) red (c) blue (d) violet

(ix) The wave front due to a source situated at infinity is (a) spherical (b) cylindrical (c) planar (d) none of these

(x) When a light wave goes from air to water, which of the following remains unchanged (a) frequency (b) amplitude (c) speed (d) wavelength

(xi) The least energy to eject an electron from the surface of metal is called (a) kinetic energy (b) work function (c) electrical energy (d) fermi energy

(xii) If the intensity of incident radiation falling on a photo cell is increased three times, the number of photoelectrons emitted and the energy of photoelectrons emitted becomes (a) doubled, remains unchanged (b) three times, remains unchanged (c) remains unchanged, three times (d) three times each

(xiii) Hydrogen bomb is based upon (a) fusion (b) fission (c) transmutation (d) chemical reaction

(xiv) The energy band gap is maximum in (a) metals (b) super conductors (c) semi-conductors (d) insulators

(xv) When a semi-conductor is heated its resistance (a) decreases (b) increases (c) remains unchanged (d) all of these

(TRUE/FALSE)

(xvi) Density of nucleus increases with increase in mass number A. (T/F)

(xvii) The critical angle of light passing from glass to air is minimum for red colour. (T/F)

(xviii) The power of thick lens is more than a thin lens. (T/F)

(xix) If a metallic wire is stretched, its resistance increases. (T/F)

(xx) Diamagnetic substances do not obey Curie's law. (T/F)

<u>Section- B (2 Marks Questions)</u>

Q2. Write physical significance of electric potential.

(OR)

Calculate the Coulomb's force between two protons separated by distance of 1.6×10^{-19} m.

Q3. Derive relation between electric current and drift velocity.

(OR)

A current of 5.0 A flows through an electric press of resistance 11Ω. Calculate the energy consumed by electric press in 10 minutes.

Q4. Write two properties of ferromagnetic substances. (1,1)

Q5. State and explain Gauss's law in magnetism. Write its significance. (1,1)

Q6. What is the principle of production of electromagnetic waves?

Q7. What is photon? Write its two properties. (1,1)

(OR)

Calculate the momentum of photon with frequency 5×10^{13} Hz. ($h = 6.62 \times 10^{-34}$ Js)

Q8. What are isotopes, give example. (1,1)

<u>Section- C (3 Marks Questions)</u>

Q9. Define law of conservation of charge and give its example.

Q10. Derive an expression for electrical energy stored inside a capacitor.

Q11. Using Ampere's circuital law, derive an expression for magnetic field due to infinitely long current carrying wire at a point at a distance 'r' from it.

(OR)

An ion carrying a charge 6.4×10^{-19} C is revolving in a circular path in a magnetic field of intensity 4×10^{-4} T. Calculate the frequency of revolution if the mass of ion is 2.8×10^{-26} Kg.

Q12. Describe principle, construction and working of a generator. (1,1,1)

(OR)

A magnetic flux of 5 µWb is linked with a coil, when a current of 1mA flows through it. What is the self-inductance of the coil?

Q13. Define polarisation of light and write any two uses of plane polarised light. (1,1,1)

(OR)

A lens placed at a distance of 20 cm from an object produces a virtual image 2/3 the size of object. Find the position of the image, kind of a lens and its focal length.

Q14. Tabulate the difference between nuclear fission and fusion (any three). (1 each)

Q15. Draw the I-V characteristics of p-n junction diode and hence discuss the resistance of the junction in both forward bias and reverse bias conditions. (2,1)

<u>Section- D (Comprehension Type Questions)</u>

Q16 Read the following paragraph and answer the questions given below.

Iron and steel are not the only substances which are attracted by a magnet or which can be magnetized. In fact, all the substances process magnetic properties. On the basis of their magnetic behaviour, Faraday divided the magnetic materials into three classes-diamagnetic, paramagnetic and ferromagnetic materials. Dia magnetic substance is feebly repelled by a magnet. The behaviour of diamagnetic substance is independent of temperature. eg copper, zinc, gold etc. Paramagnetic substance is feebly attracted by a magnet. In contrast to diamagnetic, the behaviour of a paramagnetic is temperature dependent. Aluminum, sodium, manganese are paramagnetic substances. Ferromagnetic substances are strongly attracted by a magnet. Further the ferromagnetic behaviour of a substance becomes temperature dependent above the certain temperature which is characteristic of that substance. It is called curie temperature. The diamagnetic substances do not obey Curie's law but paramagnetic substances obey Curie's law. At a certain temperature, the ferromagnetic substance starts behaving as a paramagnetic substance. Iron, nickel, cobalt are the examples of ferromagnetic substances.

Questions-

(i) What happens when a diamagnetic substance is placed in a varying magnetic field? (1)

(ii) Is the behaviour of paramagnetic substances being independent of temperature like diamagnetic substances? (1)

(iii) What is curie point or curie temperature? (1)

(iv) Write any two properties of ferromagnetic substance. (1)

(v) When does a ferromagnetic substance start behaving as a paramagnetic substance? (1)

<u>Section- E (5 Marks Questions)</u>

Q17. With the help of a labeled diagram write down the principle and magnifying power of astronomical telescope when final image is formed at the least distance of distinct vision. (1,1,3)

(OR)

Describe Young's double slit experiment for interference of light and find expression for fringe width. (2,3)

Q18. Establish an expression for electric field intensity at a point on the axial line of an electric dipole. Also discuss the case when the observation point is far away. (3,2)

(OR)

Derive an expression for capacitance of parallel plate capacitor. State on which factors capacitance of parallel plate capacitor depends? Also discuss the case when the whole space in between the plates is filled with the dielectric. (3,1,1)

Physics 12 Sample Paper 1 Answer Key

1. C, energy
2. D, all of thes
3. C, constantan
4. A, attract each other
5. B, self inductance
6. B, energy
7. B, microwaves
8. B, red
9. C, planar
10. A, frequency
11. B, work function
12. b, three times, remains unchanged
13. a, fusion
14. d, insulators
15. a, decreases
16. False
17. False
18. True
19. True
20. True

Q2 OR: Use F = $\frac{1}{4\pi\varepsilon_o}\frac{q_1 q_2}{r^2} = 9 \times 10^9 \times \frac{1.6\times10^{-19}\times1.6\times10^{-19}}{1.6\times10^{-19}\times1.6\times10^{-19}} = 9 \times 10^9\ N$

Q3 OR: Use E = $I^2Rt = 5 \times 5 \times 11 \times 10 \times 60 = 165000\ J = 165\ KJ$

Q7 OR: Use P = $\frac{h}{\lambda} = \frac{h\nu}{c} = \frac{6.62\times10^{-34}\times5\times10^{13}}{3\times10^8} = 11 \times 10^{-29}\ Kgms^{-1}$

Q11 OR: Use $\nu = \frac{Bq}{2\pi m}$ = 1456 Hz

Q 12 OR: $\phi = LI \Rightarrow L = \frac{\phi}{I} = \frac{5\times10^{-6}}{1\times10^{-3}} = 5 \times 10^{-3}$ H

Q 13. m = $\frac{h_2}{h_1} = \frac{2}{3} = \frac{v}{u}$

u = -20 cm

v = 2u/3 = 2 × -20/3 = -40/3 = -13.33 cm

virtual erect and diminished image is formed. Thus, the lens is concave.

Focal length is given by $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = -\frac{3}{40} + \frac{1}{20} = -\frac{1}{40}$

f = - 40 cm