CBSE March-2017

Key Notes

The Coulomb's law, $F = \frac{1}{4\pi\varepsilon_0}.\frac{q_1 q_2}{r^2}$

Electric field, E = $\frac{F}{q_0}$; $E = \frac{1}{4\pi\varepsilon_0}.\frac{q}{r^2}$

Electric dipole moment, $p = q \times 2a$, where 2a→length of dipole

'E' at the axial line of an electric dipole, $E = \frac{1}{4\pi\varepsilon_0}.\frac{2p}{d^3}$

'E' at the equatorial line of an electric dipole, $E = \frac{1}{4\pi\varepsilon_0}.\frac{p}{d^3}$

Torque on a dipole in a uniform electric field, $\tau = pE\sin\theta = \bar{p} \times \bar{E}$

Electric potential due to a point charge, $V = \frac{1}{4\pi\varepsilon_0}.\frac{q}{r_0}$, $V = \frac{W}{q}$

Potential due to an electric dipole, $V = \frac{1}{4\pi\varepsilon_0}\frac{p\cos\theta}{r^2 - a^2\cos^2\theta}$

∗Equipotential surface is that surface when potential at any point of the surface has the same value.

Application of Gauss' Theorem:-

Electric field due to a spherical shell, $E = \frac{1}{4\pi\varepsilon_0}.\frac{q}{r^2}$

Field due to an infinite line of charge, $E = \frac{\lambda}{2\pi\varepsilon_0 r}$

Field due to a plane sheet of charge (infinite), $E = \frac{\sigma}{2\varepsilon_0}$

Capacity of Capacitors, $C = \frac{q}{V}$

Parallel plate capacitor, $C = \frac{q}{V} = \frac{\varepsilon_0 A}{d}$

Capacitors in series, $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

Capacitors in parallel, $C = C_1 + C_2 + C_3$

Energy of a charged capacitor, $PE = \frac{q^2}{2C} = \frac{1}{2}CV^2 = \frac{1}{2}qV$

Gauss's theorem→Total flux $\phi = \frac{q}{\varepsilon_0}$

Electric current→ I in amperes $= \frac{q \text{ in coilombs}}{t \text{ in seconds}}$

Drift velocity $v_d = \frac{-eE}{m}\tau$; Mobility $\mu = \frac{v_d}{E} = \frac{e\tau}{m}$

I=nAev$_d$→relation b/w I and v_d

Ohm's law → $I \propto V$ or $V = IR$ or $= \frac{V}{I}$;Resistivity, $\rho = \frac{RA}{l}$

Effect of temperature on resistance

$\alpha = \frac{R - R_0}{R_0 \times t} = \frac{Increase\ in\ resistance}{Resistance\ at\ 0^0C \times rise\ in\ temperature}$

Resistance in series, $R = R_1 + R_2 + R_3$

Resistance in parallel $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Terminal potential→V=E-Ir

Internal resistance of cell→$r = \frac{(E-V)R}{V}$

Find unknown resistance using Meter Bridge

Wheatstone bridge balancing condition→$\frac{R_1}{R_2} = \frac{R_3}{R_4}$

Unknown resistance, $X = \frac{l.R}{100 - l}$

Comparison of e.m.f using potentiometer→$\frac{E_1}{E_2} = \frac{l_1}{l_2}$

Internal resistance of a cell using potentiometer→ $r = \frac{R(l_0 - l)}{l}$

Heating effect of electric current→$H = I^2Rt$

Electric power and electric energy

Electric power = $\frac{W}{t}$ = VI watts ; Electric energy $E = VIt$

Magnetic flux density→ $dB = \frac{\mu_0}{4\pi}\frac{Idl\sin\theta}{r^2}$

Flux density in a circular coil→ $B = \frac{\mu_0 nI}{2a}$

Flux density for infinity long semi conductor→$B = \frac{\mu_0 I}{2\pi a}$

Flux density in a straight conductor→ $\oint B.dl = \mu_0 I$

Lorentz force equation→ $F_m = q(v \times B)$

Torque on a magnetic dipole in magnetic field

Torque $= m \times B$; Magnetic susceptibility→ $\chi = \frac{M}{H}$

Electromagnetic induction and alternating current

Magnetic flux $= nAB\cos\theta$

Induced emf→ $\varepsilon = -\frac{d\emptyset}{dt}$;Induced e.m.f→ $\varepsilon = Blv$

Magnetic flux→ $\emptyset = LI$ or MI

Induced $e.m.f = L.\frac{dI}{dt}$ or $M.\frac{dI}{dt}$

L of solenoid $= \mu_0 n^2 lA$

Induced charge $= \frac{change\ of\ flux}{resistance}$

M for co-axial solenoids $= \mu_0 n_1 n_2 Al$

$E_{rms} = \frac{E_0}{\sqrt{2}}$, $I_{rms} = \frac{I_0}{\sqrt{2}}$; $X_L = \omega L = 2\pi f_\ell$; $X_C = \frac{1}{\omega L} = \frac{1}{2\pi f_c}$

Impedance of LCR circuits

$Z = \sqrt{R^2(X_L - X_C)^2}$ and phase angle, $\tan\Phi = \frac{L\omega - \frac{1}{C\omega}}{R}$

Series resonance frequency→ $f_r = \frac{1}{2\pi\sqrt{LC}}$

Q-factor $= \frac{\omega_r L}{R} = \frac{X_L at\ resonance}{R}$

Energy stored in an inductor $= \frac{1}{2}LI^2$

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

Power factor $\cos\phi = \frac{R}{Z}$

Frequency of LC oscillators→ $f = \frac{1}{2\pi\sqrt{LC}}$

For any waves $v = \nu\lambda$

Speed of e.m wave in a medium $= \frac{1}{\sqrt{\mu\varepsilon}}$

Speed in vaccum $= \frac{1}{\sqrt{\mu_0\varepsilon_0}}$

Refractive index $= \frac{C}{v} = \sqrt{\mu_r\varepsilon_r} \sim \sqrt{\varepsilon_r}$

Focal length, $f = \frac{R}{2}$; where R → Radius of curvature

Mirror Equation→$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$;Snell's law, $n_{21} = \frac{n_2}{n_1} = \frac{\sin i}{\sin r}$

Refractive index of medium, $n = \frac{speed\ of\ light\ in\ air}{speed\ of\ light\ in\ medium}$

$Sin\ i_c = \frac{1}{n}$ ie. $i_c = \sin^{-1}(\frac{1}{n})$

Equation of refraction in a spherical surface (When ray from n_1 to n_2) → $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ ie.

$\frac{\text{R.I of 2}^{nd}}{\text{Image distance}} - \frac{\text{R.I of 1}^{st}}{\text{Object distance}} = \frac{\text{R.I of 2}^{nd} - \text{R.I of 1}^{st}}{R}$

$Len's\ Makers\ Formula \to \frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

Thin Lens Formula→ $\frac{1}{f} = \frac{1}{V} - \frac{1}{u}$;Power of lens→ $P = \frac{1}{f}$

Combination of lens → $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$; $P = P_1 + P_2$; $m = m_1 \times m_2$

Refractive index of material of prism→$n_{glass} = \frac{\sin(\frac{A + D_m}{2})}{\sin(\frac{A}{2})}$

Simple microscope→ $m = 1 + \frac{D}{F}$(Near point);$m = \frac{D}{F}$(Infinity)

Compound microscope→ $m = m_0 x m_e$→$m \approx \frac{L}{f_o} \times (1 + \frac{D}{f_e})$

Interference⇒Condition for Bright fringe→path diff. =nλ

Condition for Dark fringe→path diff. = (2n+1)$\frac{\lambda}{2}$

Fringe with (Band width) → $\beta = \frac{\lambda D}{d}$

Resolving power of microscope $= \frac{1}{d} = \frac{2n\sin\theta}{\lambda}$ where d is the smallest distance between two points. n→refractive index of medium.

Brewsters's Law→$\tan\theta_p = n$; θ_p – Polarising angle

$R = R_0 A^{1/3}$;$N = N_0 e^{-\lambda t}$;$T_{1/2} = \frac{0.693}{\lambda}$;$T_{mean} = \frac{1}{\lambda}$

$\beta = \frac{\Delta i_c}{\Delta i_b}$; $\alpha = \frac{\Delta i_c}{\Delta i_e}$

Modulation index $\mu = \frac{A_m}{A_c} \ll 1$ in prctical condition

Range of transmission, $d_T = \sqrt{2Rh}$:h→hight of antenna