Formula Sheet

Chapter - 1

Quantization → $\pm qe$

Coulomb's law → $\frac{Kq_1q_2}{r^2}$

Linear charge → $dq = \lambda\, dl$

Surface charge → $dq = \sigma\, ds$

Volume charge → $dq = \rho\, dV$

Electric field Intensity → $\vec{E} = \frac{F}{q}$

Electric field ~~Sintensity~~ Intensity due to point charge → $\vec{E} = \frac{Kq}{r^2}$

Superposition → $K \sum_{n}^{i=1} \frac{q_i}{r^2}\hat{r}$

$\vec{E}$ dipole along axis → $\vec{E} = \frac{K2\vec{P}}{r^3}$

$\vec{E}$ dipole along equitorial line → $\vec{E} = \frac{-K\vec{P}}{r^3}$

$\vec{E}$ dipole at any point along direction θ → $\frac{K\vec{P}}{r^3}\sqrt{1+3\cos^2\theta}$

Torque on dipole → $\tau = \vec{P}\times\vec{E} = PE\sin\theta$

Gauss law → $\phi = \oint B\,ds = \frac{q}{\varepsilon_0}$

Flux from cube

↳ If q is at the centre → $\frac{q}{\varepsilon_0}$

↳ from each face of cube → $\frac{q}{6\varepsilon_0}$

$\vec{E}$ field due to thin infinitely long straight wire of uniform linear charge → $\frac{\lambda}{2\pi\varepsilon_0 r}$

$\vec{E}$ field due to thin infinite non conducting infinite sheet of charge with uniform surface charge density → $\frac{\sigma}{2\varepsilon_0}$

$\vec{E}$ field betn 2 infinite thin plane parallel sheets of uniform surface charge density. → $\frac{\sigma}{\varepsilon_0}$

Chapter - 2

Electric potential → $V = \frac{W}{Q}$

Electric potential from a point distant r → $V = \frac{Kq}{r}$

Electric dipole at θ → $V = \frac{K\vec{P}\cos\theta}{r^2}$

Electric dipole at axial point → $\frac{K\vec{P}}{r^2}$

Electric ~~pt~~ dipole at equitorial point → 0

Electric potential due to a uniformly charged sphere

↳ point outside the shell $r > R$

↳ $\frac{Kq}{r}$

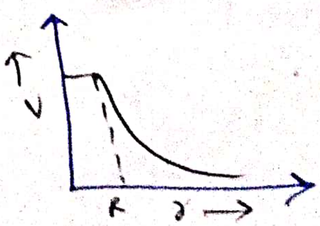
↳ point on the shell $r = R$

↳ $\frac{Kq}{R}$

↳ point inside the shell $r < R$

↳ $\frac{Kq}{R}$

$q = 4\pi R^2\sigma$



Electrostatic potential due to non conducting solid sphere of uniform (ρ) vol^m charge density

↳ At point outside the sphere $r > R$

↳ $\frac{Kq}{r}$

↳ At a point on the sphere $r = R$

↳ $\frac{Kq}{R}$

↳ At a point inside the sphere $r < R$

↳ ~~$\frac{4}{3}\pi R^3 \rho$~~ .

Here, $q = \frac{4}{3}\pi R^3 \rho$

Relation betn $\vec{E}$ and $\vec{V} \rightarrow \vec{E} = -\frac{\partial V}{\partial x}$

Electric Potential energy $\rightarrow \frac{Kq_1q_2}{r^2}$

capacitance $\rightarrow C = Q/V$

capacitance of a spherical conductor of Radius R $\rightarrow C = 4\pi\varepsilon_0 R$

capacitance of an air filled parallel plate capacitor $\rightarrow C = \frac{\varepsilon_0 A}{d}$

capacitance of air filled spherical capacitor $\rightarrow C = 4\pi\varepsilon_0 \frac{ab}{a-b}$

capacitance of parallel plate capacitor w/ dielectric slab completely filled in it $\rightarrow C = \frac{K\varepsilon_0 A}{d}$

when dielectric slab of thickness t is filled in it. $\rightarrow \frac{\varepsilon_0 A}{d-t\left(1-\frac{1}{K}\right)}$

When metallic conductor is filled betn the parallel plate capacitor. $\rightarrow C = \frac{\varepsilon_0 A}{d-t}$

capacitors in series

↳ $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

capacitors in parallel

↳ $C_p = C_1 + C_2 + C_3$

When 2 capacitors charged to diff potentials are connected by conducting wire

↳ $V = \frac{\text{Total charge}}{\text{Total capacity}} = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$

energy stored in capacitor

↳ $\frac{1}{2}CV^2 = \frac{1}{2}QV = \frac{1}{2}\frac{Q^2}{V}$

energy density

↳ $\frac{1}{2}\varepsilon_0 E^2$.

Chapter-3

current $\rightarrow I = q/t$

current density $\rightarrow J = \frac{I}{A}$

Drift velocity $\rightarrow V_d = \frac{-e\vec{E}}{m}\tau$

mobility $\rightarrow \mu = \frac{q\tau}{m}$

Ohm's law $\rightarrow V = RI$

Resistance, $R \rightarrow \rho\frac{l}{A}$

where, $\rho = \frac{m}{ne^2\tau}$

↳ resistivity

If conductor is in the form of wire, then resistence $= R = \frac{\rho l}{\pi r^2}$

If conductor has mass m, volume V & density d then Resistance

↳ $\frac{\rho l d}{m}$

- If length of metallic wire of Resistance R is stretched to n times, it's Resistance becomes $= n^2 R$
  - but resistivity remains unchanged
- If radius of metallic wire becomes n times $R_1 = (1/n^4) R$.
- If area of cross section of the wire becomes n times then Resistance $R = (1/n^2) R$
- Conductivity, $\sigma = \frac{1}{\rho} = \frac{ne^2\tau}{m} = ne\mu$
- Relation betn $\vec{J}$, σ and $\vec{E}$
  - $\vec{J} = \sigma \vec{E}$
- Resistance of a conductor at temp $t°C$
  - $R_T = R_0 (1 + \alpha t)$
- Resistivity at temp $t°C$.
  - $\rho_T = \rho_0 (1 + \alpha t)$
- Series grouping →

$E_{eq} = nE$, $r_{eq} = nr$

current in circuit $= I = \frac{E}{R + nr}$

~~Parallel grouping~~

$\frac{E_{eq}}{\cancel{r_{eq}}}$ If $R >> nr$ [max. current]

$\hookrightarrow I = \frac{nE}{R}$

Parallel grouping →

$\frac{E_{eq}}{r_{eq}} = \frac{E_1 + E_2}{r_1 + r_2}$

current, $I = \frac{E}{R + (\frac{r}{m})}$

If $R << \frac{r}{m}$

$I = \frac{mE}{r}$

Mixed grouping

$\hookrightarrow E_{eq} = nE$, $r_{eq} = \frac{nr}{m}$

$\therefore I = \frac{nE}{R + (\frac{nr}{m})}$

- In case of mixed grouping of cells current in the circuit will be max when $R = \frac{nr}{m}$

~~Heating of current~~

Heating effect of current

$\hookrightarrow H = I^2 RT$

Electric Power

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

Power in series combination

$\hookrightarrow \frac{1}{P_S} = \frac{1}{P_1} + \frac{1}{P_2} + \frac{1}{P_3}$

Power in parallel combination

$\hookrightarrow P_p = P_1 + P_2 + P_3$

Wheatstone Bridge

$\hookrightarrow \frac{R_1}{R_2} = \frac{R_3}{R_4}$.