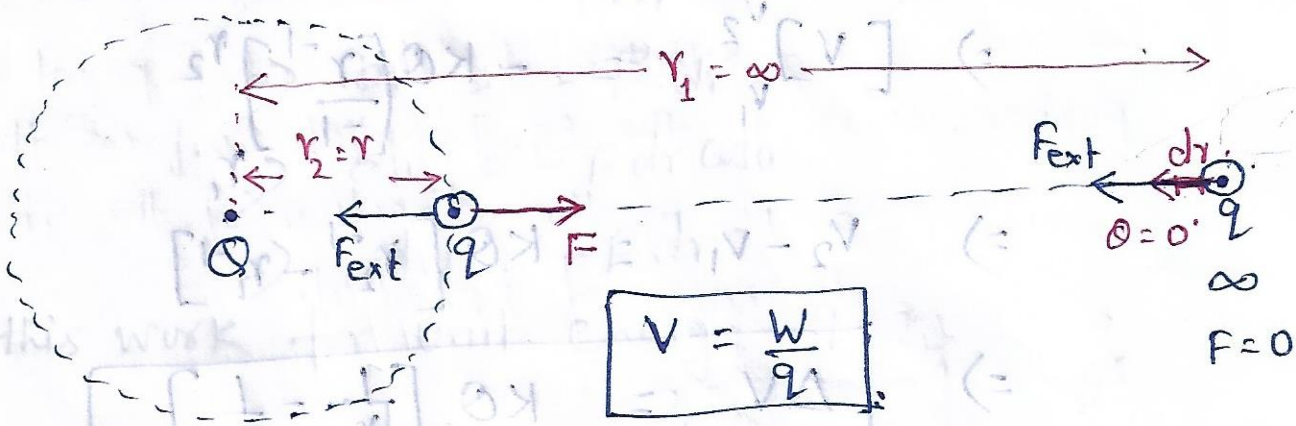
* Electrostatic Potential :→ Work done carry for unit positive charge particle infinite to a point define as potential.



$$V = \frac{W}{q}$$

S.I Unit = J/c = Volt

Calculation for Potential :-

Work = Force × displacement

$\Rightarrow dw = \vec{F}_{ext} \cdot \vec{dr}$

$\Rightarrow dw = F_{ext} \cdot dr \cos 0°$

$\Rightarrow dw = -F\, dr$ $\{-F = F_{ext}\}$

$\Rightarrow dw = -K\frac{Q \cdot q}{r^2} dr$ $\left\{F = K\frac{Q \cdot q}{r^2}\right\}$

$\Rightarrow \frac{dw}{q} = -KQ\, r^{-2}\, dr$

$$\Rightarrow \int_0^V dV = -KQ\int_\infty^r r^{-2}\,dr$$ {Integrating we get

$$\Rightarrow [V]_0^V = -KQ\left[\frac{r^{-2+1}}{-2+1}\right]_\infty^r$$

$$\Rightarrow V - 0 = -KQ\left[\frac{r^{-1} - \infty^{-1}}{-1}\right]$$

$$\Rightarrow V = KQ\left[\frac{1}{r} - \frac{1}{\infty}\right]$$

Potential Due to point charge

$$\boxed{V = K\frac{Q}{r} = \frac{1}{4\pi\epsilon_0}\cdot\frac{Q}{r}}$$

Potential due to point charge in any shifting:—

$$\int_{V_1}^{V_2} dV = -KQ\int_{r_1}^{r_2} r^{-2}\,dr$$

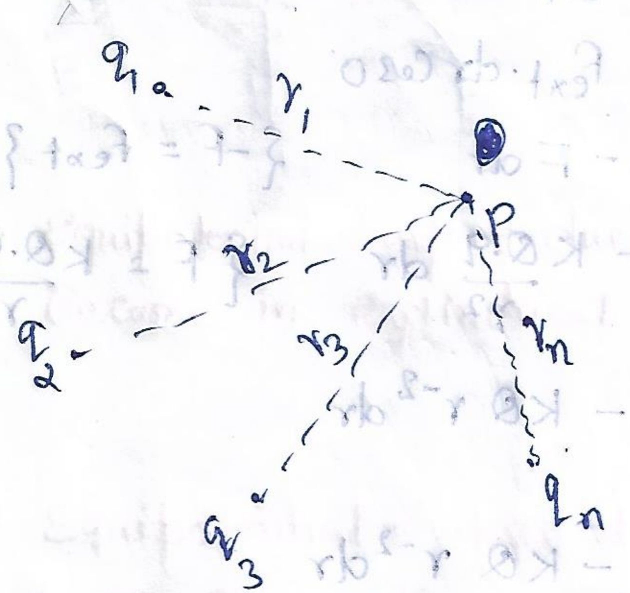
$$\Rightarrow [V]_{V_1}^{V_2} = -KQ\left[\frac{r^{-1}}{-1}\right]_{r_1}^{r_2}$$

$$\Rightarrow V_2 - V_1 = KQ\left[r_2^{-1} - r_1^{-1}\right]$$

$$\Rightarrow \boxed{\Delta V = KQ\left[\frac{1}{r_2} - \frac{1}{r_1}\right]}$$

ΔV → Potential diffrence:

* Potential Due to System of Charge:-



Potential due to a system of Charge is equal to the Sum of potential due to each an every Charge Particle.

$$V = V_1 + V_2 + V_3 \text{ ---- } V_n$$

$$V = K\frac{q_1}{r_1} + K\frac{q_2}{r_2} + K\frac{q_3}{r_3} \text{ ---- } K\frac{q_n}{r_n}.$$

$$\boxed{V = K\sum_{i=1}^{n}\frac{q_i}{r_i}}$$

* Relation b/w Field and Potential :→

According to diffn of Potential :-

$\Rightarrow dw = \vec{F}_{ext} \cdot \vec{dr}$

$\Rightarrow dw = -\vec{F} \cdot \vec{dr}$

$\Rightarrow dw = -F\,dr\cos 0$

$\Rightarrow dw = -F\,dr$

this work for unit charge q :

$$\Rightarrow \frac{dw}{q} = -\frac{F}{q}\,dr$$

$\left\{ \text{We know } \frac{dw}{q} = dv \quad \text{and } \frac{F}{q} = E \right\}$

$$\Rightarrow dv = -E\,dr \qquad \text{—— (1)}$$

$$\Rightarrow \boxed{E = -\frac{dv}{dr}}$$

Integrating we get

$$\Rightarrow \quad \int dV = -\int E\,dr$$

$$\Rightarrow \quad \boxed{V = -\int E\,dr}$$

Here two Conclusions Carry on :-

→ Electric Field is in the direction in which the Potential decreases steepest.

→ Its magnitude is given by the charge in magnitude of potential per unit displacement normal to equipotential surface at the point.