<Q.> Determine the Potential at a Point 0.50 m (i) from a +20 μC point charge and (ii) from a -20 μC point charge.

Solⁿ :- Electrostatic potential due to a point charge

$$V = \frac{Kq}{r}$$

(i) Potential due to a $+20\mu C$ charge

$$V = \frac{Kq}{r}$$

$$V = \frac{9 \times 10^{9} \times \overset{4}{\cancel{20}} \times 10^{-6} \times 1\cancel{0}}{0.\cancel{5}\cancel{0}}$$

$$V = \underline{36 \times 10^{3}\ V} \quad \underline{\text{Ans}}$$

(ii) Potential due to a $-20\mu C$ charge

$$V = \frac{Kq}{r}$$

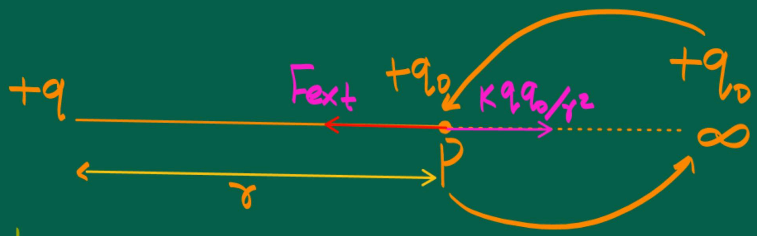
$$V = \frac{9\times10^{9} \times (-\cancel{20}^{\,4}\times10^{-6}) \times 1\cancel{0}}{0.\cancel{5}\cancel{0}}$$

$$V = -36\times10^{3}\ V$$ Ans

* Electrostatic Potential due to a point charge :-

The Electrostatic force acting on charge q_0.

$$F = \frac{Kqq_0}{r^2}$$



Small Work done

$dW = F\,dr\cos\theta$

$(W_{\infty \to P})$

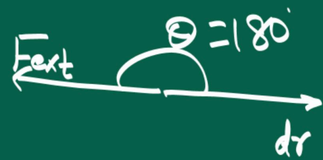
$= -(W_{P \to \infty})$

$$\int dW = \int_r^\infty F\,dr\cos\theta$$

$$W = \int_r^\infty F\,dr\cos\theta$$

$$W = \int_r^\infty \frac{Kqq_0}{r^2}\,dr\cos\theta$$

$$\theta = 180^\circ$$



$$W = \int_r^\infty \frac{Kqq_0}{r^2}\,dr\cos(180^\circ)$$

$$W = \int_r^\infty \frac{Kqq_0}{r^2}\,dr(-1)$$

$$[\because \cos(180^\circ) = -1]$$

$$W = -\int_{r}^{\infty} \frac{Kqq_0}{r^2}\, dr$$

$$W = -Kqq_0 \int_{r}^{\infty} \frac{dr}{r^2}$$

$$W = -Kqq_0 \int_{r}^{\infty} r^{-2}\, dr$$

$$W = -Kqq_0 \left[\frac{r^{-2+1}}{-2+1} \right]_{r}^{\infty}$$

$$W = -Kqq_0 \left[\frac{r^{-1}}{-1} \right]_{r}^{\infty}$$

$$W = Kqq_0 \left[\frac{1}{r} \right]_{r}^{\infty}$$

$$W = Kqq_0 \left[\cancelto{0}{\frac{1}{\infty}} - \frac{1}{r} \right]$$

$$W = Kqq_0\left(-\frac{1}{r}\right)$$

$$W = \frac{-Kqq_0}{r}$$

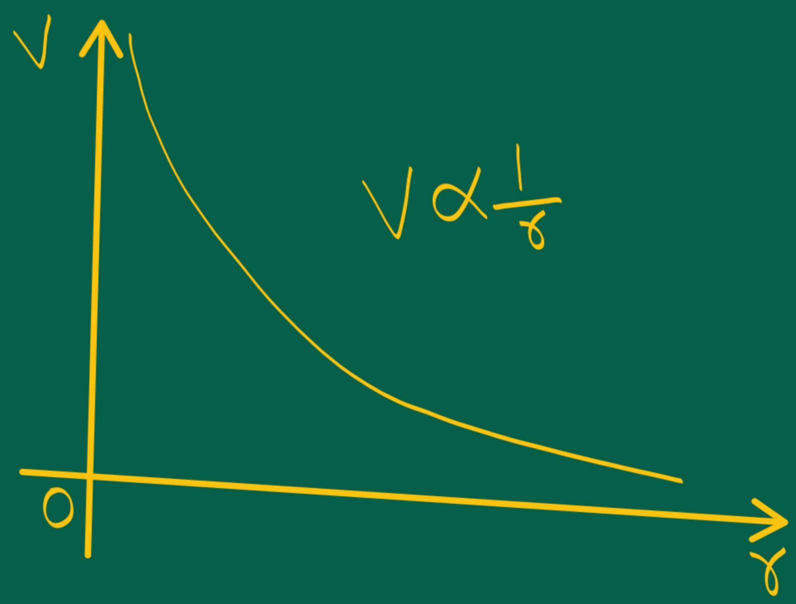
$$\left(W_{\infty \to p}\right) = -\left(W_{p \to \infty}\right)$$

$$\boxed{V = \frac{W}{q_0}} = -\left(\frac{-Kqq_0}{r}\right)$$

$$V_p - \cancelto{0}{V_\infty} = \frac{+Kq\cancel{q_0}}{r\cancel{q_0}}$$

$$\boxed{V_p = \frac{Kq}{r}}$$

$$\boxed{V = \frac{Kq}{r}}$$


V
$V \propto \frac{1}{r}$
O
r

* Dot Product

$$\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}|\cos\theta$$

$$\boxed{\vec{a} \cdot \vec{b} = ab\cos\theta}$$

$$W = \vec{F} \cdot \vec{x} = Fx\cos\theta$$

* Cross Product :-

$$\vec{a} \times \vec{b} = |\vec{a}||\vec{b}|\sin\theta\,\hat{n}$$

$$\boxed{\vec{a} \times \vec{b} = ab\sin\theta\,\hat{n}}$$

⟨Q.⟩ What is the electrostatic potential at the surface of a silver nucleus of diameter 12.4 fermi? [Atomic number (Z) for silver is 47]

Solⁿ:- radius$(r) = \frac{12.4}{2} = 6.2\,fm = 6.2 \times 10^{-15}\,m$

$Z = 47$

$\therefore$ charge $= Ze = 47 \times 1.6 \times 10^{-19}\,C$

$\therefore$ Electrostatic Potential

$$V = \frac{Kq}{r}$$

$$V = \frac{9\times10^{\cancel{9}\,5}\times47\times1.6\times10^{\cancel{-19}\,-4}}{6.2\times\cancel{10^{-15}}}$$

$$V = \frac{9\times47\times1.6\times10^{5}}{6.2}$$

$$V = \frac{9 \times 47 \times \cancel{16}^{\,8} \times 10^5}{\cancel{62}_{\,31}}$$

$$V = \frac{9 \times 47 \times 8 \times 10^5}{31}$$

$$V = \frac{3384}{31} \times 10^5$$

$$V = 109.161 \times 10^5 \ V$$

$$V = 1.09 \times 10^7 \ V \ \underline{\underline{\text{Ans}}}$$