classmate
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Electric Potential

Paper - 1

1\. Ans:- R.H.S $= \frac{V}{m}$

$= \frac{J}{Cm}$

$= \frac{N \times m}{C \times m}$

$= \frac{N}{C}$

$=$ L.H.S

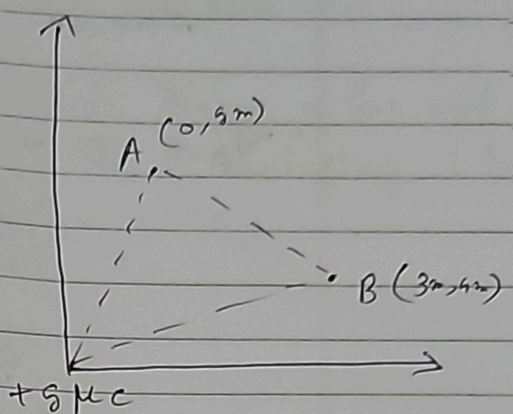
2\. Ans:- As the electrostatic attraction between the test charge & source charge are perpendicular to each other.

So; ~~Word~~ Work done is 0 .

3. Here,

$$Q = 5\mu C$$
$$= 5 \times 10^{-6} C$$

$$q_0 = -1.6 \times 10^{-19} C$$

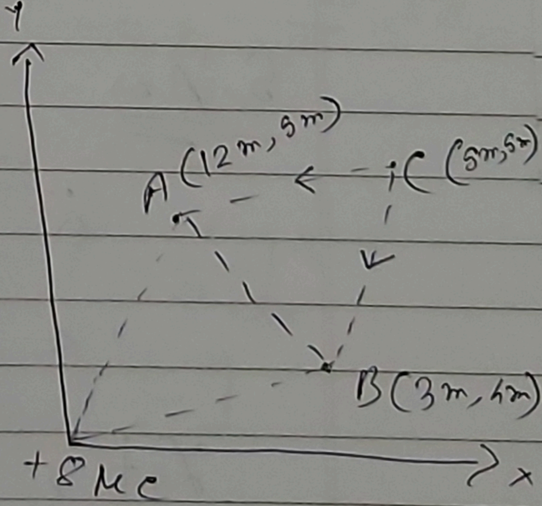


$$\therefore V_A = \frac{1}{4\pi\epsilon_0} \frac{5 \times 10^{-6}}{5}$$
$$= 9 \times 10^{9} \times 10^{-6}$$
$$= 9 \times 10^{3}$$

$$V_B = \frac{1}{4\pi\epsilon_0} \frac{5 \times 10^{-6}}{5}$$
$$= 9 \times 10^{9} \times 10^{-6}$$
$$= 9 \times 10^{3}$$

$$\therefore W_{A \to B} = q_0 [V_B - V_A]$$
$$= -1.6 \times 10^{-19} [9 \times 10^{3} - 9 \times 10^{3}]$$
$$= 0$$

4. Soln: $A \to (12m, 5m)$
$B \to (3m, 4m)$
$C \to (5m, 5m)$



$$Q = +8\mu C = 8 \times 10^{-6} C$$

$$q_0 = -2nC$$
$$= -2 \times 10^{-9} C$$

$W_{A\to C\to B} = W_{A\to B} = q_0[V_B - V_A]$

$\therefore V_A = 9\times10^9 \times \frac{8\times10^{-6}}{13}$

$= \frac{72\times10^3}{13}$

$= 5.53\times10^3$

$V_B = 9\times10^9 \times \frac{8\times10^{-6}}{5}$

$= \frac{72\times10^3}{5}$

$= 14.4\times10^3$

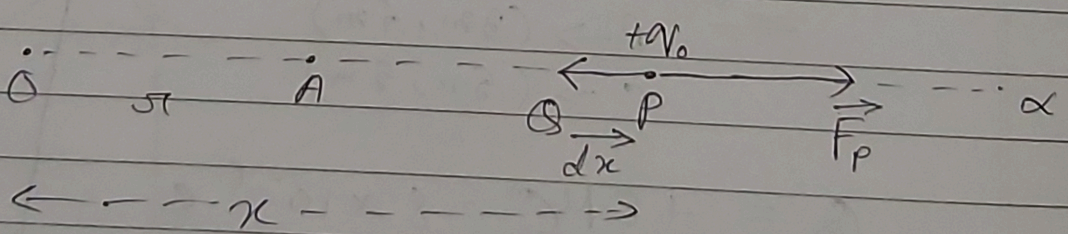
$\therefore W_{A\to B} = -2\times10^{-9}[14.4\times10^3 - 5.53\times10^3]$

$= -2\times10^{-9}\times 8.9\times10^3$

$= -17.8\times10^{-6}$

$= -1.78\times10^{-5}$ J

5. Ans:



Let, a point charge +q be at O.

Let, OA = r

By def^n, electric potential at A,

$$V_A = \frac{W_{\infty \to A}}{q_0} \quad \text{--- (i)}$$

[where, $W_{\infty \to A}$ is the amt. of WD in bringing $+q_0$ from $\infty \to A$]

Let, $OP = x$ $[r < x < \infty]$

The test charge $+q_0$ be at P
So, coulomb's force on $+q_0$ at P due to $+q$ at O.

$$F_P = \frac{1}{4\pi\epsilon_0} \frac{q q_0}{x^2} \quad \text{--- (ii)}$$

Let, $\vec{PQ} = \vec{dx}$

Amount of WD in bringing $+q_0$ from P to Q,

$$dW_{P \to Q} = \vec{F_P} \cdot \vec{PQ} = \vec{F_P} \cdot \vec{dx}$$

$$= F_P \, dx \cos 180^\circ$$

$$\Rightarrow dW_{P \to Q} = -\frac{1}{4\pi\epsilon_0} \frac{q q_0}{x^2} dx \quad \text{--- (iii)}$$

So, $$W_{\infty \to A} = \int dW = \int_{\infty}^{r} -\frac{1}{4\pi\epsilon_0} \frac{q q_0}{x^2} dx$$

$$= -\frac{q q_0}{4\pi\epsilon_0} \int_{\infty}^{r} \frac{dx}{x^2}$$

$$= -\frac{q q_0}{4\pi\epsilon_0} \left[-\frac{1}{x} \right]_{\infty}^{r}$$

$$\Rightarrow \frac{W_{\infty \to A}}{q_0} = \frac{q}{4\pi\epsilon_0} \left[\frac{1}{r} - \frac{1}{\infty} \right]$$

$$\Rightarrow \boxed{V_A = \frac{1}{4\pi\epsilon_0} \frac{q}{r}}$$