① **Ans:-** $RHS = \frac{V}{m} = \frac{J}{Cm}$

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

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

$$= LHS$$

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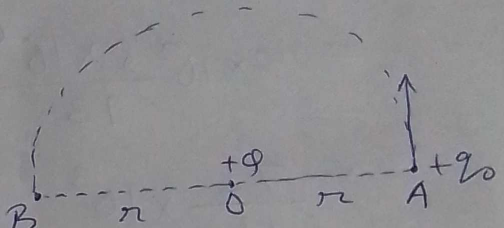
② **Ans:-** $V_A = \frac{1}{4\pi\epsilon_0}\frac{Q}{r}$

$$V_B = \frac{1}{4\pi\epsilon_0}\frac{Q}{r}$$



$$W_{A\to B} = +q_0\left(V_B - V_A\right)$$

$$= +q_0\left(\frac{1}{4\pi\epsilon_0}\frac{Q}{r} - \frac{1}{4\pi\epsilon_0}\frac{Q}{r}\right)$$

$$= +q_0 \cdot 0$$

$$= 0$$

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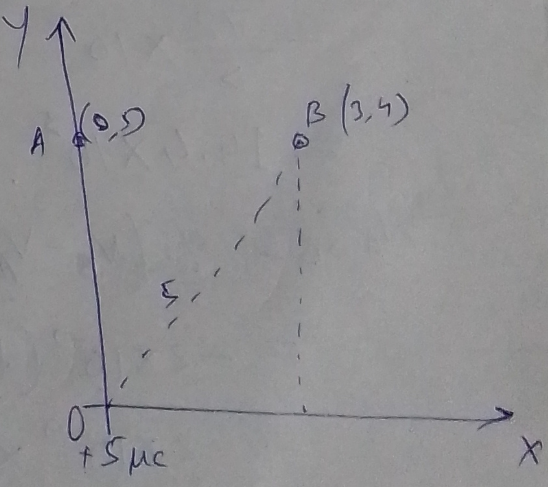
③ **Ans:-** Given, $Q = +5\,\mu C$

$$= 5\times10^{-6}\,C$$

$$q_e = -1.6\times10^{-9}\,C$$



$$V_A = \frac{1}{4\pi\epsilon_0}\frac{\cancel{5}\times10^{-6}}{\cancel{5}} = 9\times10^{9}\times10^{-6}$$

$$= 9\times10^{3}$$

$$V_B = \frac{1}{4\pi\epsilon_0}\frac{\cancel{5}\times10^{-6}}{\cancel{5}} = 9\times10^{3}$$

$$W_{A\to B} = q_e\left(V_B - V_A\right) = q_e \cdot 0$$

$$= 0$$

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(4) Ans - Given, $Q = +8\,\mu C$ $= 8 \times 10^{-6}\,C$

$q = -2\,nC$ $= -2 \times 10^{-9}\,C$.

A (12, 5)
B (3, 4)
C (5, 5)

$W_{A \to C \to B} = W_{A \to B}$

$V_A = \frac{1}{4\pi\epsilon_0} \frac{Q}{r_A}$

$= 9 \times 10^9 \frac{8 \times 10^{-6}}{13}$

$= \frac{72}{13} \times 10^3$

$= 5.53 \times 10^3\,V$

$V_B = \frac{1}{4\pi\epsilon_0} \frac{Q}{r_B}$

$= 9 \times 10^9 \frac{8 \times 10^{-6}}{5}$

$= \frac{72}{5} \times 10^3$

$= 14.4 \times 10^3$.

$W_{A \to B} = q(V_B - V_A)$

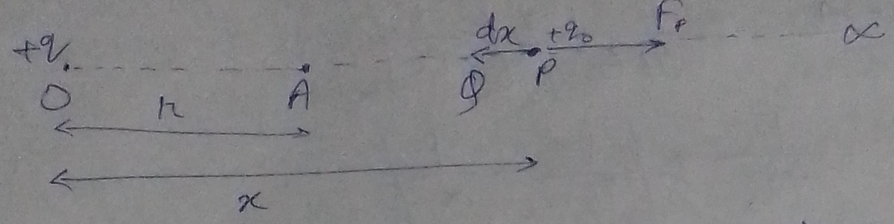
$= -2 \times 10^{-9}(14.4 \times 10^3 - 5.5 \times 10^3)\,J$.

$= -2 \times 10^{-9} \times 8.9 \times 10^3$

$= -17.8 \times 10^{-6}$

$= -1.78 \times 10^{-5}\,J$.

(5) Ans:→



Let a point charge $+Q$ at O due to which electric potential at A is →

$$V_A = \frac{W_{\alpha \to A}}{q_0} \longrightarrow (i)$$

Let a point 'P', $OP = x$,
Let the test charge '$+q_0$' be placed, moved from α towards A.

When '$+q_0$' is at P, repulsive force on '$+q_0$' due to $+q$ is,

$$F_P = \frac{1}{4\pi\epsilon_0}\frac{qq_0}{x^2} \longrightarrow (ii)$$

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

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

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

$$= F_P\, dx \cos 180^\circ \quad \left[\because \vec{F_P} \text{ \& } \vec{dx} \text{ are in the opposite direction}\right]$$

$$= -\frac{1}{4\pi\epsilon_0}\frac{qq_0}{x}dx \longrightarrow (iii)$$

$$\therefore W_{\alpha\to A} = \int dW_{P\to Q} = \int_{\alpha}^{r} -\frac{1}{4\pi\epsilon_0}\frac{qq_0}{x^2}dx$$

$$= -\frac{1}{4\pi\epsilon_0}qq_0\int\frac{dx}{x^2}$$

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

$$\Rightarrow V_A = \frac{1}{4\pi\epsilon_0} q \left[\frac{1}{r} - \frac{1}{\infty}\right]$$

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

———————— X ————————