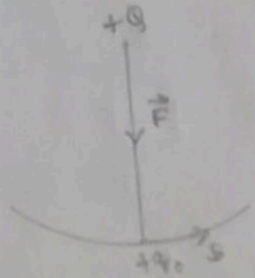
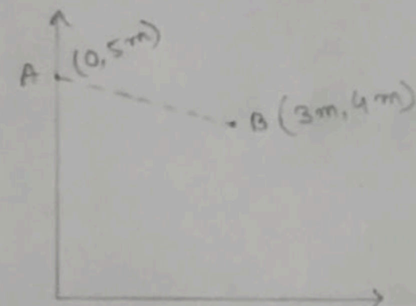
ELECTRIC POTENTIAL : PAPER-01

② no. Ans:-



As the force on the test charge and displacement are perpendi-cular to each other. So, the workdone in moving the test charge is 0.

③ no. Ans:



$\therefore W_{A\to B} = q_0 (V_B - V_A)$ — ①

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

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

$$\therefore V_A = 9\times10^9 \frac{q}{r_A} = 9\times10^9 \times \frac{\cancel{5}\times10^{-6}\text{ C}}{\cancel{5}}$$

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

$$V_B = 9\times10^9 \frac{q}{r_B} = 9\times10^9 \times \frac{\cancel{5}\times10^{-6}\text{ C}}{\cancel{5}}$$

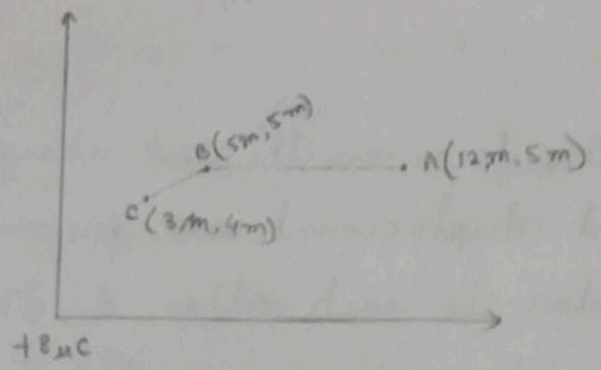
$$= 9\times10^3 \text{ C}$$

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

$$= 1.6\times10^{-19}(9\times10^3 c - 9\times10^3 c)$$

$$= 0$$

(4) no. Ans:



Given,

$q = 8 \times 10^{-6}\ C$

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

$A \rightarrow (12\ m, 5\ m)$

$B \rightarrow (5\ m, 5\ m)$

$C \rightarrow (3\ m, 4\ m)$

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

$$= q_0 [V_C - V_A] \quad \text{—— (1)}$$

$$V_A = 9 \times 10^9 \times \frac{q}{r_A} = 9 \times 10^9 \times \frac{8 \times 10^{-6}\ C}{13}$$

$$= 5.54 \times 10^3\ C$$

$$V_C = 9 \times 10^9 \times \frac{q}{r_C} = 9 \times 10^9 \times \frac{8 \times 10^{-6}\ C}{5}$$

$$= 14.4 \times 10^3\ C$$

$$W_{A \rightarrow C} = q_0 [V_C - V_A]$$

$$= -2 \times 10^{-9}\ C \left[14.4 \times 10^3\ C - 5.54 \times 10^3\ C \right]$$

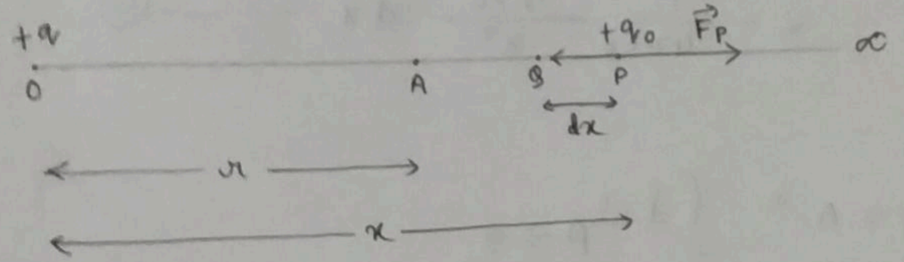
$= -2 \times 10^{-9}\, C \left[(14.4 - 5.54) \times 10^{3}\, C \right]$

$= -2 \times 10^{-9}\, C \left[\times 8.86 \times 10^{3}\, C \right.$

$= -17.72 \times 10^{-6}\, C$

$= -1.772 \times 10^{-5}\, C$

(5) no Ans:



Let the point charge $+q$ be at O.

Let $OA = r$

By defⁿ of electric potential,

at A,

$$V_A = \frac{W_{\infty \to A}}{q_0} \quad \text{——} ①$$

[where $W_{\infty \to A}$ is the amt of workdone in moving $+q$ from ∞ to A]

Let, $OP = x$ $(r < x < \infty)$

Let the test charge $+q_0$ at P

∴ Repulsion force betⁿ $+q$ and $+q_0$ is

$$F_P = \frac{1}{4\pi\epsilon_0} \frac{q \cdot q_0}{x^2} \text{ (towards right) —— } ⑪$$

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

The work done in bringing $+q_0$ from P to Q

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

$$= \vec{F_P} \cdot dx \cos 180 \quad \left[\because \vec{F_P} \text{ \& } \vec{dx} \text{ are in opposite dir}^n\right]$$

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

$$W_{\infty\to A} = \int dW_{P\to Q}$$

$$= \int_{\infty}^{r} -\frac{1}{4\pi\epsilon_0} \frac{q q_0}{x^2} \cdot dx$$

$$= -\frac{1}{4\pi\epsilon_0} q q_0 \int_{\infty}^{r} \frac{dx}{x^2}$$

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

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

$$\Rightarrow V_A = \frac{1}{4\pi\epsilon} \frac{q}{r} \quad \text{——— (iv)}$$

This is the required exp^n for electric potential due to a point charge.