Electric Potential : Paper - 01

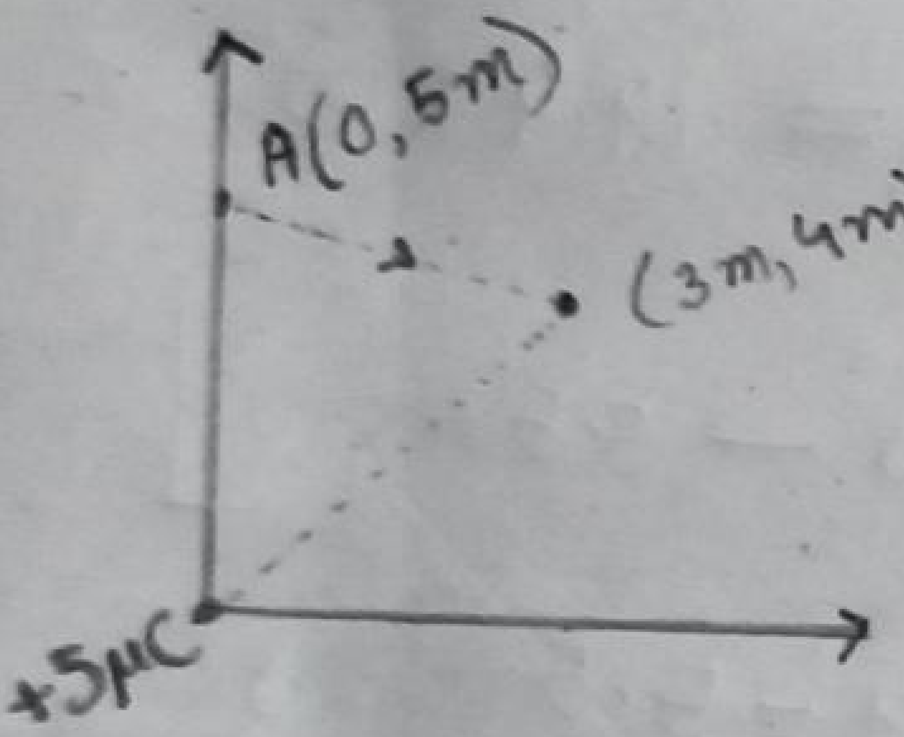
Ans to Q. No - 2

As the displacement and centripital force are perpendicular to each other therefore work done,

$$W = Fd\cos 90^\circ$$

$$\Rightarrow \boxed{W = 0} //$$

Ans to Q. No - 3



$$\therefore W_{A\,to\,B} = q_0 (V_B - V_A) \quad \text{— (i)}$$

Where, $q_0 = 5\,\mu C = 5\times10^{-6}\,C$

Charge of an electron, $q_0 = 1.6\times10^{-19}\,C$

$$V_A = 9\times10^9 \times \frac{q}{r_A}$$

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

$$= 9\times10^3\ V$$

$$V_B = 9\times10^9\ \frac{q}{r_B}$$

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

$$= 9\times10^3\ V$$

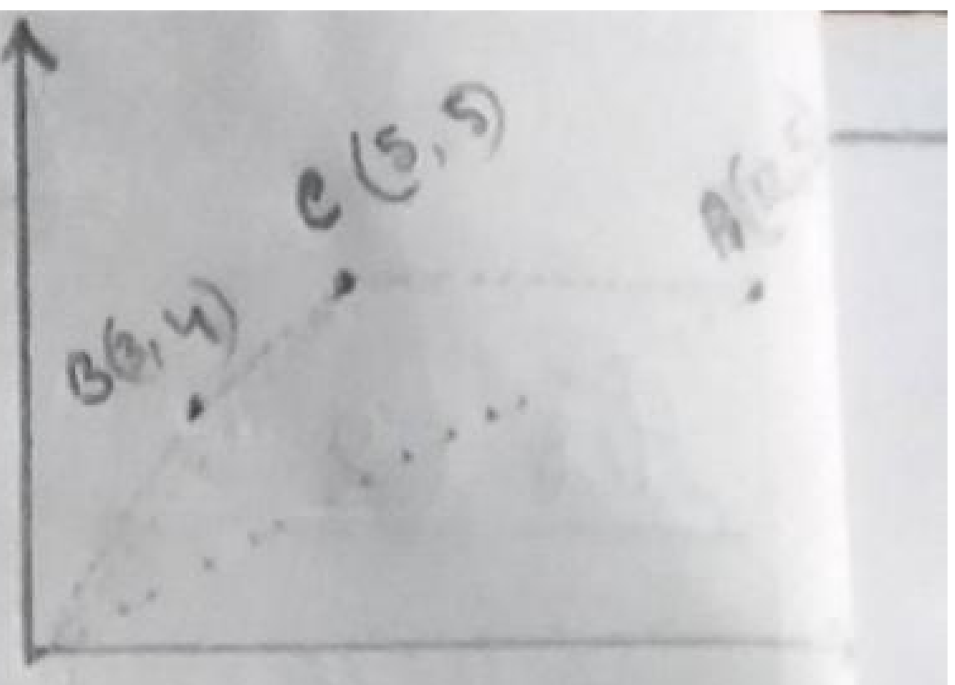
$$\therefore W_{A\to B} = q_0 (V_B - V_A)$$

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

$$= 0$$

$\therefore$ The work done is 0.

Ans to Q No. 4



Here, $q = 8\mu C = 8\times10^{-6} C$

$q_0 = -2nC = -2\times10^{-9} C$

$A \rightarrow (12m, 5m)$; $B \rightarrow (3m, 4m)$; $C \rightarrow (5m, 5m)$

$\therefore W_{A\rightarrow B} = q_0 [V_B - V_A]$ —— (i)

$V_A = 9\times10^9 \frac{q}{r_A}$

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

$= 5.53\times10^3$

$V_B = 9\times10^9 \frac{q}{r_B}$

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

$= 14.4\times10^3$

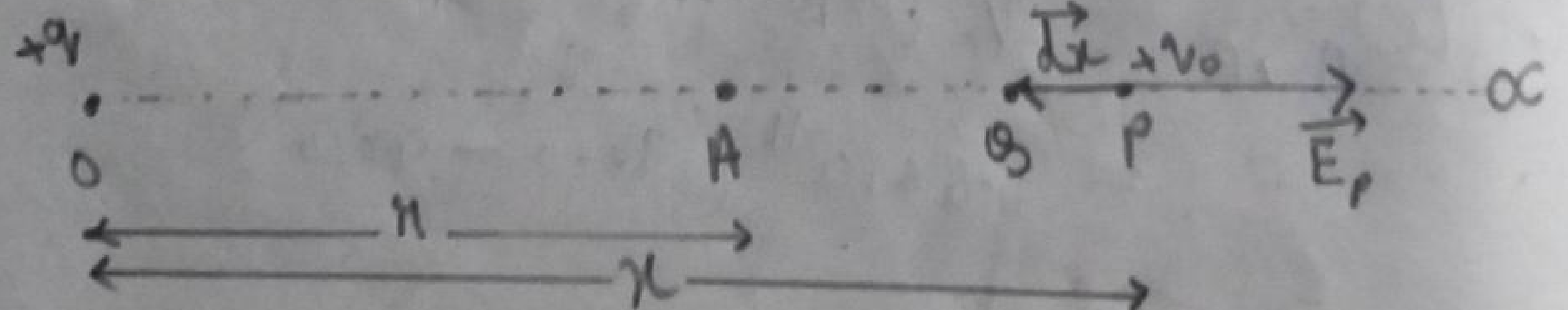
(i) $\rightarrow W_{A\rightarrow B} = -2\times10^{-9} [14.4\times10^3 - 5.53\times10^3]$

$= -2\times10^{-9} [14.4 - 5.53] 10^3$

$= -17.74\times10^{-7}$

$= -1.77\times10^{-6} J$ //

Ans to Q No-5



Let a point charge +q be at O due to which we have to find out electric potintial at A.

By defn of electric potential at A:—

$V_A = \frac{W_{\alpha \to A}}{q_0}$ [where $W_{\alpha\to A}$ is the amt. of work done in bringing a test charge $+q_0$ from α to A]

Let $OP = x$ $(r < x < \alpha)$

$\therefore E_p = \frac{1}{4\pi\epsilon_0}\frac{q}{x^2}$

Let $\vec{PQ} = \vec{dx}$ ($\because$ P and Q are very much close to each other)

Small amount of work is done in bringing a test charge $+q_0$ from P to Q

$dW_{P\to Q} = \vec{F}.\vec{PQ} = \vec{F}.\vec{dx}$ ~~$= q_0\vec{E_p}.\vec{dx}$~~ $= q_0 \vec{E_p}\vec{dx}$

~~$\Rightarrow dW_{P\to Q} = q_0 \times \frac{1}{4\pi\epsilon_0}\frac{q}{x^2} dx$~~

$\Rightarrow dW_{P\to Q} = q_0 E_p dx \cos 180°$ ($\because \vec{E_p}$ and $\vec{dx}$ are in opp. dirn)

$\Rightarrow dW_{P\to Q} = -q_0 E_p dx$

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

$\therefore W_{\alpha\to A} = \int dW_{P\to Q} = \int_{\alpha}^{r} \frac{-1}{4\pi\epsilon_0}\frac{q q_0\, dx}{x^2} = \frac{-q q_0}{4\pi\epsilon_0}\int_{\alpha}^{r}\frac{dx}{x^2}$

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

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

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

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