22/6/21

Test - Physics

Q No 1 Prove that, $N/C = V/m$ (1)

Sol $\Rightarrow$

$$\frac{[N]}{[C]} = \frac{[M^1L^1T^{-2}]}{[A^1T^1]} = [M^1L^1T^{-3}A^{-1}] \quad -(i)$$

and

$$\frac{[V]}{[m]} = \frac{[M^1L^1T^{-2}][L^1]}{[L^1][A^1T^1]} = [M^1L^1T^{-3}A^{-1}] \quad -(ii)$$

$\therefore (i) = (ii)$

$N/C = V/m$; so both is the same physical quantity.

Q No 2 Calculate the work done in moving a ~~Aft~~ test charge $+q_0$ along a semi circular ~~at~~ arc, with a source charge $+q$ at the centre of the arc.

Sol $\Rightarrow$ We know, $W = F.S\cos\theta$ - (i)

where θ is $90°$ [displacement and force is perpendicular]

(i) $\Rightarrow W = F.S.\cos 90° = 0$

so, no work done.

Q No 3

A point charge of $+5\mu C$ is placed at the origin of co ordinate system. An electron is to be moved from $(0, 5m)$ to $(3m, 4m)$. Find the work done.

Sol

Let $+5\mu C$ placed at the origin O

let, A(0, 5) and B(3, 4)

$$\therefore V_A = \frac{1}{4\pi\varepsilon_0} \times \frac{q}{r_1}$$

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

$$= 9 \times 10^3 \text{ V}$$

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

$$= 9 \times 10^3 \text{ V}$$

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

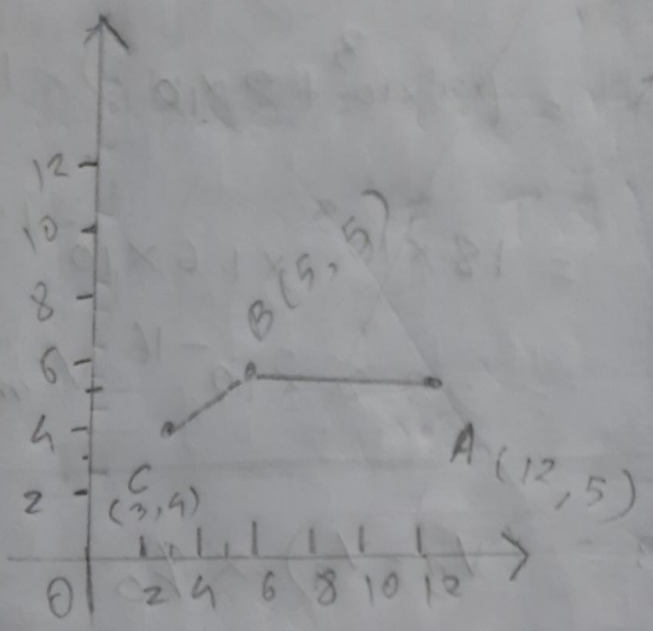
$= 0$

So no work done.

So no work done

Q.No.4) A point charge of $+8\,\mu C$ is placed at the origin of co-ordinate system. An electron Another charge of $-2\,nC$ is ~~m~~ to ve moved from $(12\,m, 5\,m)$ to $(3\,m, 4\,m)$ via $(5m, 5m)$ Find the work done.

Sol



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

$$= 5.54\times10^3$$

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

$$= 14.5\times10^3$$

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

$$\therefore W_{A\to C} = (V_C - V_A)\times q_0$$

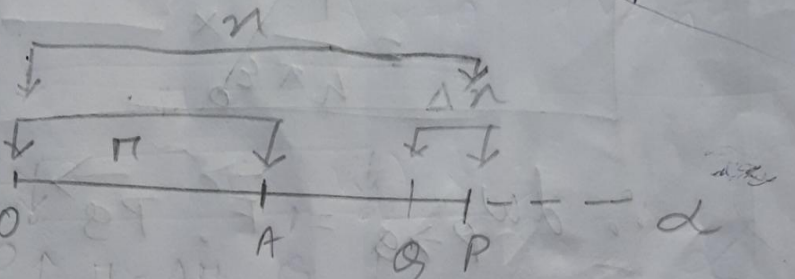
$$= (14.5\times10^3 - 5.54\times10^3)\times 2\times10^{-9}$$

$= 8.96 \times 10^3 \times (-2 \times 10^{-9})$

$= -17.92 \times 10^{-6}$ V/m

5) Find an expression for the electric potential due to a point charge

Sol



Let us consider a source charge Q at O, a test charge consider 'q_0' at A from ∞

By definition

$$V_A = \frac{W_{\infty \to A}}{q_0} \quad - (1)$$

let us consider test charge at P position with a distance r from O

$$\therefore F = \frac{1}{4\pi\varepsilon_0} \times \frac{Q q_0}{r^2}$$

$\therefore PQ = \Delta x \quad \therefore \overrightarrow{PQ} = dx$

$\therefore W_{P \to Q} = (V_Q - V_P)$

$= F . PQ$

$= \frac{1}{4\pi\varepsilon_0} \times$ ——

$\therefore dW_{P \to Q} = \overrightarrow{F} . \overrightarrow{PQ}$

$= \overrightarrow{F} . dx \cos 180^\circ$

[Force and displacement in opposite direction]

$= -\overrightarrow{F} . dx$

$= -\frac{1}{4\pi\varepsilon_0} \times \frac{Q q_0}{x^2} . dx$

$$\therefore \int dW_{P\to Q} = \int_{\alpha}^{r} \left(-\frac{1}{4\pi\varepsilon_0}\frac{q_0 Q}{r^2}\right) dr$$

$$= -\frac{1}{4\pi\varepsilon_0} Q q_0 \int_{\alpha}^{r} \frac{dr}{r^2}$$

$$= -\frac{1}{4\pi\varepsilon_0} Q q_0 \left[-\frac{1}{r}\right]_{\alpha}^{r}$$

$$\Rightarrow W_{\alpha\to A} = \frac{1}{4\pi\varepsilon_0} Q q_0 \left[\frac{1}{r} - \frac{1}{\alpha}\right]$$

$$\Rightarrow \frac{W_{\alpha\to A}}{q_0} = \frac{1}{4\pi\varepsilon_0} Q \frac{1}{r}$$

$$\boxed{\Rightarrow V_A = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}} \quad - (ii)$$