Electrostatics: $\mathcal{E}_{pe}$, V, ΔV

can't see, touch, smell, hear or taste....

Believe you me!

① $\mathcal{E}_{pe} = \frac{kQq}{r} = \frac{9\times10^9\frac{Nm^2}{C^2}(2.00\times10^{-9}C)(3.00\times10^{-9}C)}{1.20\times10^{-5}m} = 4.50\times10^{-3}J$

② $\mathcal{E}_{pe} = \frac{kQq}{r} = \frac{9\times10^9\frac{Nm^2}{C^2}(-2.00\times10^{-9}C)(3.00\times10^{-9}C)}{1.20\times10^{-5}m} = -4.50\times10^{-3}J$

③ $\mathcal{E}_{pe} = \frac{kQq}{r} = \frac{9\times10^9N\frac{m^2}{C^2}(-2.00\times10^{-9}C)(-3.00\times10^{-9}C)}{1.20\times10^{-5}m} = 4.50\times10^{-3}J$

④ $\mathcal{E}_{pe} = \frac{kQq}{r} = \frac{9\times10^9N m^2/C^2(2.00\times10^{-9}C)(-3.00\times10^{-9}C)}{1.20\times10^{-5}m} = -4.50\times10^{-3}J$

Electrostatics: $\mathcal{E}_{pe}$, V, ΔV

⑤ $-18\,000\text{ V}$
$(-1.8\times10^{4}\text{ V})$

⑥ $1.80\times10^{5}\text{ V}$

⑦a $\Delta V = V_B - V_A = +7.20\times10^{-7}\text{ V}$

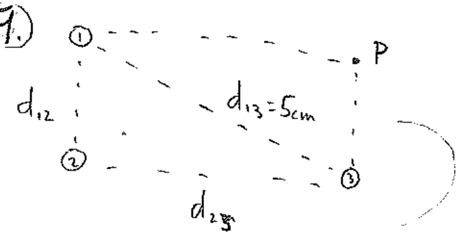
⑦b Point B

⑧a $\Delta V = V_y - V_x = -25.0\text{V} - 15.0\text{V} = -40.0\text{V}$

⑧b toward Y

⑧c toward X

⑨



→ 3 pairs of Charges 1,2 ; 1,3 ; 2,3

$\mathcal{E}_{pe_{12}} = \dfrac{kQ_1Q_2}{d_{12}} = +2.25\text{ J}$

$\mathcal{E}_{pe_{13}} = \dfrac{kQ_1Q_3}{d_{13}} = -0.900\text{ J}$

$\mathcal{E}_{pe_{23}} = \dfrac{kQ_2Q_3}{d_{23}} = -1.35\text{ J}$

a. $\mathcal{E}_{pe} = \mathcal{E}_{pe_{12}} + \mathcal{E}_{pe_{13}} + \mathcal{E}_{pe_{23}} = 0\text{ J!}$

b. $V_p = V_1 + V_2 + V_3 = \dfrac{kQ_1}{d_1} + \dfrac{kQ_2}{d_2} + \dfrac{kQ_3}{d_3} = 5.03\times10^{5}\text{ V}$

c. $\mathcal{E}_{pe} = qV = -8.04\times10^{-14}\text{ J}$

⑩ a. $\Delta V_{BA} = V_A - V_B = 50\text{ V} = 5.0\times10\text{V}$

b. $\Delta V_{AB} = V_B - V_A = -50\text{V} = -5.0\times10\text{V}$

c. A to B

d. B to A

e. $W_{nc} = 0\text{ J}$

$\Delta \mathcal{E}_k = -\Delta\mathcal{E}_p$

$\mathcal{E}_k - \cancel{\mathcal{E}_{k0}}^{0} = -q\,\Delta V$

$\frac{1}{2}mv^2 = -q\,\Delta V$

$v = \sqrt{\dfrac{-2(2.0\times10^{-6}\text{C})(-50\text{V})}{0.01\text{ kg}}} = 0.14\text{ m/s}$

f. $W_{nc} = \Delta\mathcal{E}_k + \Delta\mathcal{E}_p$

$0 = \mathcal{E}_k - \cancel{\mathcal{E}_{k0}}^{0} + \mathcal{E}_p - \mathcal{E}_{p0}$

$0 = \frac{1}{2}mv^2 + qV_A - qV_B$

$v = 0.12\text{ m/s}$

(11) $W_{nc} = 0\,J$

$\Delta E_k = -\Delta E_p$

$\frac{1}{2}mv^2 - \frac{1}{2}mv_0^2 = -kQq\left(\frac{1}{r} - \frac{1}{r_0}\right)$ → $\frac{1}{2}mv^2 = -k(2.0\times10^{-9}C)(-5.0\times10^{-6}C)\left(\frac{1}{0.4m} - \frac{1}{2}\right) = 1.8\times10^{-4}J$

$v = 3.0\,m/s$

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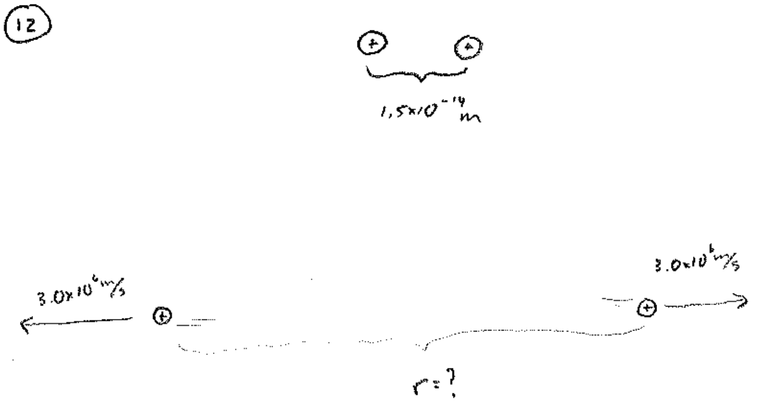
(12)



* From cons. of momentum we know:

$\sum\vec{p} = \sum\vec{p}_0 = 0$

$m_1\vec{v}_1 + m_2\vec{v}_2 = 0$

$m_1\vec{v}_1 = -m_2\vec{v}_2$

$v_1 = v_2$

$W_{nc} = 0\,J \Rightarrow \Delta E_k = -\Delta E_p \Rightarrow E_k - E_{k0} = -\left(\frac{kQq}{r} - \frac{kQq}{r_0}\right)$

$\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 = -kQq\left(\frac{1}{r} - \frac{1}{r_0}\right)$

$mv^2 = -kQq\left(\frac{1}{r} - \frac{1}{r_0}\right)$

$r = 6.98\times10^{-13}\,m$

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(13) Same as above except for m. $r = 1.50\times10^{-14}\,m$

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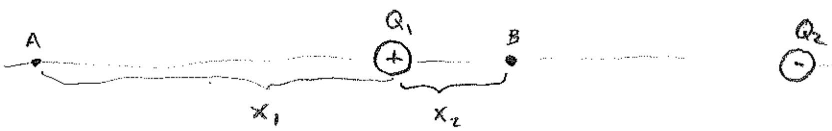
(14) * Potential is SCALAR so $V_T = V_1 + V_2$ can only be zero if one Q is positive, one Q is negative. TRUE.

* Potential will be zero if we are closer to the smaller charge ⇒ 2 spots.



A: $0 = V_1 + V_2$

$0 = \frac{kQ_1}{x_1} + \frac{kQ_2}{x_1+2}$

$0 = \frac{4}{x_1} + \frac{-6}{x_1+2}$ → $\frac{4}{x_1} = \frac{6}{x_1+2}$

$4x_1 + 8 = 6x_1$

$8 = 2x_1$

$4 = x_1$

$x_1 = 4.00\,mm$

B. $0 = V_1 + V_2$

$0 = \frac{kQ_1}{x_2} + \frac{kQ_2}{2-x_2}$

$0 = \frac{4}{x_2} + \frac{-6}{2-x_2}$ → $\frac{4}{x_2} = \frac{6}{2-x_2}$

$8 - 4x_2 = 6x_2$

$8 = 10x_2$

$x_2 = 0.80\,mm$

$\vec{x}_1 = -4.00\,mm$

$\vec{x}_2 = 0.80\,mm$

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(15) Both Charges are negative so $\frac{kQ_1}{d_1} + \frac{kQ_2}{d_2} \neq 0$

NO POINTS