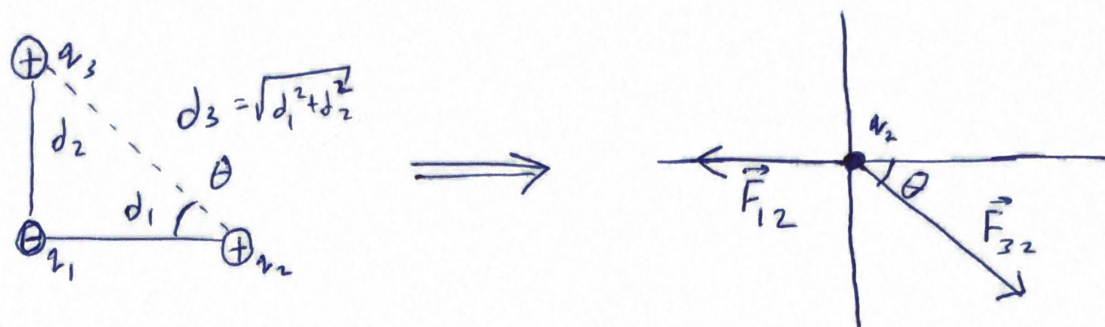


①



$$\vec{F}_2 = \vec{F}_{12} + \vec{F}_{32}$$

$$\vec{F}_{12} = k_e \frac{q_1 q_2}{d_1^2} \hat{i} = -k_e \frac{|q_1| |q_2|}{d_1^2} \hat{i}$$

$$\vec{F}_{32} = k_e \frac{|q_3| |q_2|}{d_3^2} [\cos \theta \hat{i} - \sin \theta \hat{j}]$$

$$\Rightarrow \vec{F}_2 = \left[-k_e \frac{|q_1| |q_2|}{d_1^2} + k_e \frac{|q_3| |q_2|}{d_3^2} \cos \theta \right] \hat{i} - \left[k_e \frac{|q_3| |q_2|}{d_3^2} \sin \theta \right] \hat{j}$$

$$\Rightarrow |\vec{F}_2| = \sqrt{ \left(-k_e \frac{|q_1| |q_2|}{d_1^2} + k_e \frac{|q_3| |q_2|}{d_3^2} \cos \theta \right)^2 + \left(k_e \frac{|q_3| |q_2|}{d_3^2} \sin \theta \right)^2 }$$

②

$$\theta = \tan^{-1} \left(\frac{\text{---}}{\text{---}} \right)$$

$$\begin{aligned}
 3) \quad & \left. \begin{aligned} \vec{a} &= \frac{q}{m} \vec{E} \\ a &= -\frac{q}{m} E \end{aligned} \right\} \begin{aligned} v_f &= v_i + 2ad \\ 0 &= v_i^2 - 2 \frac{q}{m} E d \\ 2 \frac{q}{m} E d &= v_i^2 \end{aligned}
 \end{aligned}$$

$$\Rightarrow d = \frac{m v_i^2}{2 q E}$$

4) C

$$5) \quad \Phi = E A \cos \phi, \quad \phi = 90^\circ - \theta$$

$$6) \quad \Phi = \frac{q_{in}}{\epsilon_0} \quad \& \quad \Phi = \sigma \times (2 \times 10^{-2})$$

$$\Rightarrow q_{in} = \Phi \epsilon_0$$

$$7) \quad E = \frac{k_e q}{R^3} r$$

$$8) \quad E = \frac{\sigma}{\epsilon_0} \quad \& \quad \sigma = \frac{Q}{A}$$

$$\Rightarrow \boxed{\sigma = E \epsilon_0}$$

9) $\Delta V = -E d$ or $V_f = V_i - E d$

10) $V = k_e \frac{q}{r}$

11) D

12) $V = \frac{V_0}{k}$

13) $C = \frac{\epsilon_0 A}{d}$, $C = \frac{Q}{\Delta V}$, $\sigma = \frac{Q}{A}$
 $\Rightarrow Q = \sigma A$

$$d = \frac{\epsilon_0 A}{C} = \frac{\epsilon_0 A}{\frac{\sigma A}{\Delta V}} = \frac{\epsilon_0 \Delta V}{\sigma}$$

14) $C_{23} = C_2 + C_3 = 2C$

$$C_{123} = \frac{C_1 C_{23}}{C_1 + C_{23}} = \frac{2C^2}{3C} = \frac{2}{3} C$$

15) $U = \frac{1}{2} Q \Delta V = \frac{1}{2} C \Delta V^2 = \boxed{\frac{1}{2} \frac{Q^2}{C}}$

$Q_1 > Q_2 = Q_3$ but $C_1 = C_2 = C_3$