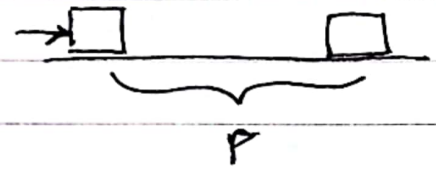
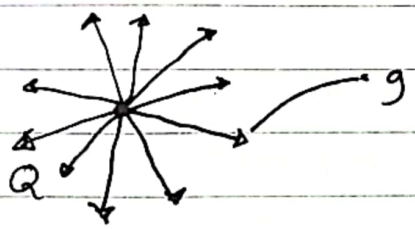
Usaha dan Energi

$W = \int F(dp) \rightarrow d\vec{p}$





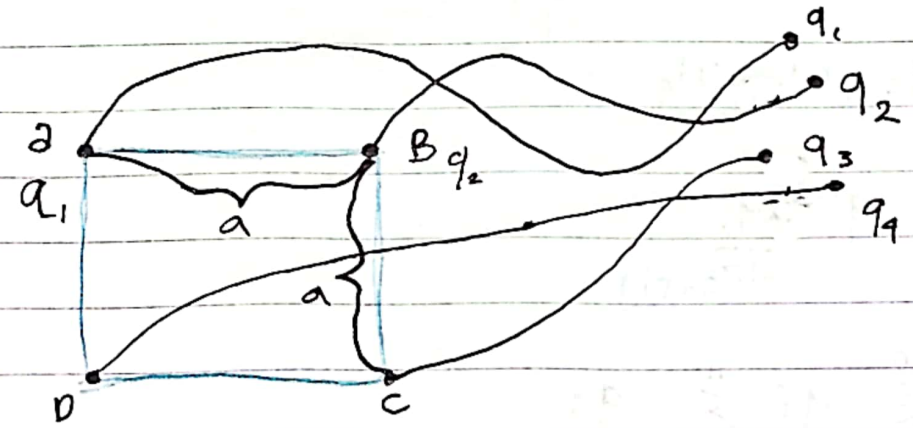
$$W = \int F\,dp$$

$$= -Q \int E\,dp$$

$$= -q\left[-k\frac{Q}{p}\right]$$

$$\boxed{W = qV}$$

Ex :



$W_1 = q_1 (V_1) \rightarrow = 0$

$= 0$

$W_2 = q_2 V_2$

$V_2 = k\frac{q_1}{a}$

$W_2 = k q_2 \frac{q_1}{a} = k\frac{q_1 q_2}{a}$

$W_3 = q_3 V_3$

$$V_3 = K\frac{q_1}{\sqrt{2}q} + K\frac{q_2}{q}$$

$$W_3 = K\left[\frac{q_1 q_3}{\sqrt{q}} + \frac{q_2 q_3}{q}\right]$$

$W_4 = q_4 V_4$

$$V_4 = K\left[\frac{q_1}{q} + \frac{q_2}{\sqrt{2}q} + \frac{q_3}{q}\right]$$

$$= K\left[\frac{q_1 q_4}{q} + \frac{q_2 q_4}{\sqrt{2}q} + \frac{q_3 q_4}{q}\right]$$

$W_{tot} = W_1 + W_2 + W_3 + W_4$

$$= \sum_{i=1}^{n} \sum_{j \neq i}^{m} q_i \frac{q_j}{4\pi\varepsilon_0 r_{ij}}$$

$$= \frac{1}{8\pi\varepsilon_0} \sum_{i=1}^{n} q_i \sum_{j \neq i}^{n} \frac{q_j}{r_{ij}}$$

$$= \frac{1}{2} \sum_{i=1}^{n} q_i \sum \frac{1}{4\pi\varepsilon_0 r_{ij}} q_j$$

$$W = \frac{1}{2} \sum_{i=1}^{n} q \sum_{j \neq i}^{n} V_j = \frac{1}{2} \sum_{i=1}^{n} q_i \sum_{j \neq i}^{n} V_j$$

$$W = \frac{1}{2}\int \rho V \, d\vec{f}$$

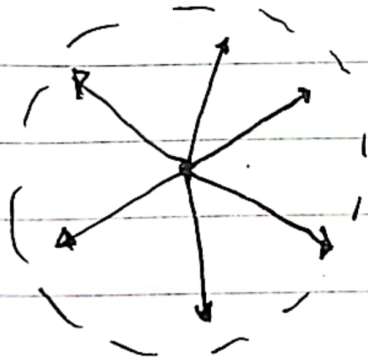
$$W = \frac{1}{2}\int \sigma V \, d\vec{s}$$

$$W = \frac{1}{2}\int \rho V \, d\sigma$$

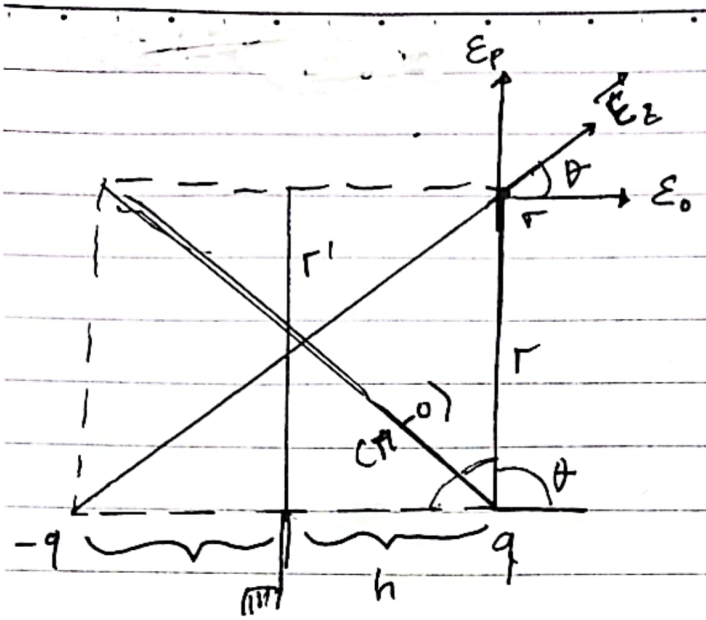
$$\rho = \varepsilon_0 \nabla \vec{E}$$

$$W = \frac{\varepsilon_0}{2}\int (\nabla E) V \, d\sigma$$

$$W = \frac{\varepsilon_0}{2}\int E^2 \, d\sigma$$



$$\oint E \, d\vec{a} = \frac{Q}{\varepsilon_0}$$

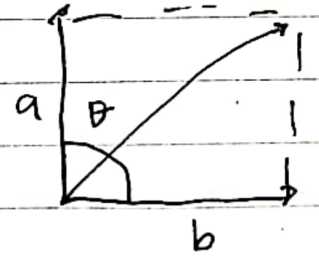


$$V_p = K\left[\frac{q}{r} + \frac{-q}{r'}\right]$$

$$= Kq\left[\frac{1}{r} - \frac{1}{(r^2+(2h)^2 4hr\cos(\pi-\theta)^{1/2}}\right.$$

$$V_p = Kq\left[\frac{1}{r} - \frac{1}{(r^2+4h^2+4hr\cos\theta)^{1/2}}\right.$$

$$\vec{E_p} = -\frac{\partial V}{\partial p} \longrightarrow Kq\left[-\frac{1}{r^2} + \frac{\frac{1}{2}(r^2+4h^2+4hr\cos\theta)^{1/2}}{(r^2+4h^2+4h)}\right.$$



$$\frac{(2r+4h\cos\theta)}{r\cos\theta}$$

$$E_p = Kq\left[\frac{1}{r^2} + \frac{(r+2h\cos\theta)}{(r^2+4h^2+4hr\cos\theta)^{1/2}}\right.$$

$$\vec{E_\theta} = \frac{\partial V}{2\theta}$$

$$= Kq\left[\frac{\frac{1}{2}(r^2+4h^2+4hr\cos\theta)^{1/2} 4hr\sin\theta}{(r^2+4h^2+4hr\cos\theta)^{1}}\right]$$

$$= Kq\left[\frac{2hr\sin\theta}{(r^2+4h^2+4hr\cos\theta)^{3/2}}\right]$$