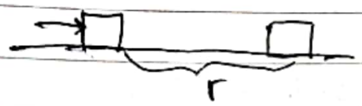
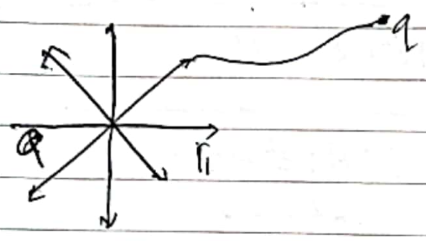
Usaha dan Energi

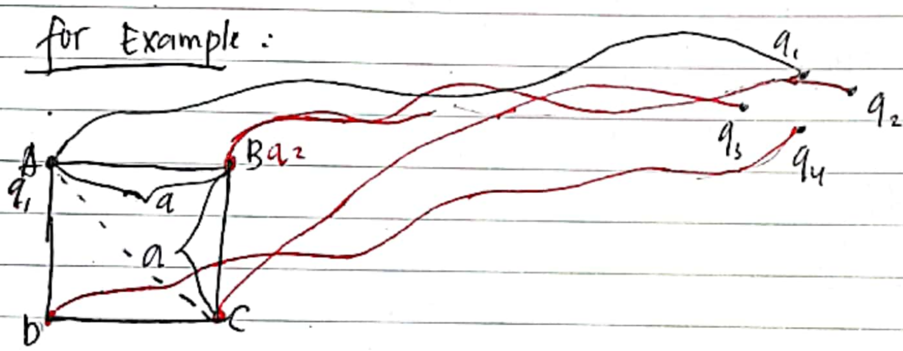
$$W = \int F \, dr$$





$$W = \int F \, dr$$
$$= -q \int E \, dr$$
$$= -q \left[-K \frac{Q}{r} \right]$$
$$= qV$$

for Example :



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

$$W_2 = q_2 V_2$$
$$V_2 = K \frac{q_1}{a}$$
$$W_2 = K q_2 \frac{q_1}{a} = K \frac{q_1 q_2}{a}$$

$$W_3 = q_3 V_3$$
$$V_3 = K \frac{q_1}{\sqrt{2}a} + K \frac{q_2}{a}$$

didapat dari teorema phytagoras

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

$$W_4 = q_4 V_4 \rightarrow V_4 = K \left[\frac{q_1}{a} + \frac{q_2}{\sqrt{2}a} + \frac{q_3}{a} \right]$$
$$= K \left[\frac{q_1 q_4}{a} + \frac{q_2 q_4}{\sqrt{2}a} + \frac{q_3 q_4}{a} \right]$$

$$W_{total} = W_1 + W_2 + W_3 + W_4$$
$$= \sum_{i=1}^{n} \sum_{j \neq 1}^{m} q_i \frac{q_j}{4\pi\varepsilon_0 r_{ij}}$$
$$= \frac{1}{8\pi\varepsilon_0} \sum_{i=1}^{n} q_i \sum_{j \neq 1}^{n} \frac{q_j}{r_{ij}}$$

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

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

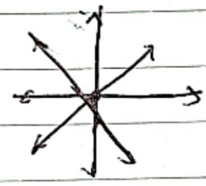
$$W = \frac{1}{2} \sum_{i=1}^{n} q_i \sum_{j \neq 1}^{n} V_j$$

$W = \frac{1}{2} \int \alpha V \, d\vec{l}$ → potensial oleh muatan pada garis

$W = \frac{1}{2} \int \sigma V \, d\vec{s}$ → potensial oleh muatan pda permukaan

$W = \frac{1}{2} \int \rho V \, d\tau$ → volume

$\rho = \varepsilon_0 \nabla \cdot \vec{E} \longrightarrow \nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$ → persamaan Hk. Gauss



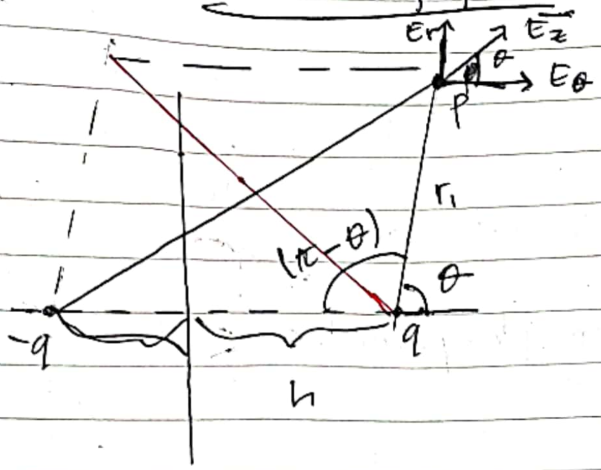
$\oint E \, d\vec{a} = \frac{Q}{\varepsilon_0}$

sehingga

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

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

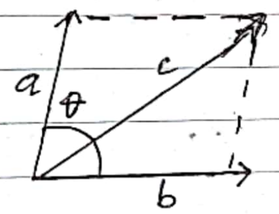
Metode Bayangan



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

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

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



$$\vec{E}_r = -\frac{\partial V}{\partial r}$$

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

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

$$= Kq\left[\frac{1}{r^2} - \frac{(r + 2h\cos\theta)}{\left(r^2 + 4h^2 + 4hr\cos\theta\right)^{3/2}}\right.$$

Date

$$\vec{E}_\theta = \frac{\partial v}{\partial \theta}$$

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

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