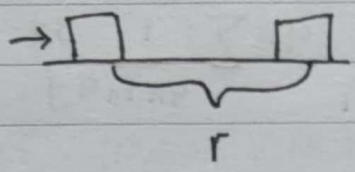
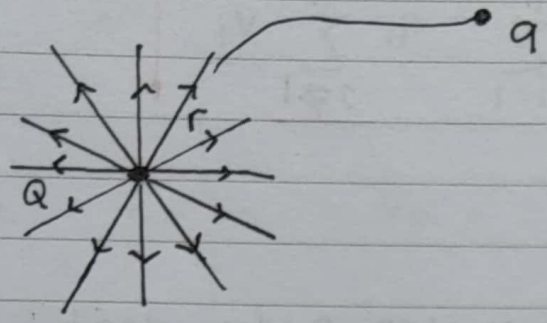
No 22.04.24
Date

# Usaha dan Energi

$W = \int F\,dr \rightarrow \bar{dr}$



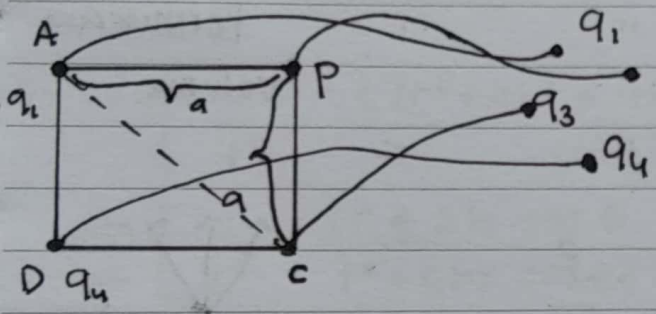

$W = \int F \cdot dr$

$= -q \int E\,dr$

$= -q\left[-K\,\frac{Q}{r}\right] = qV$

$\boxed{W = qV}$

for example :




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

$= 0$

$W_2 = q_2 V_2$

$V_2 = K\,\frac{q_1}{a}$

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

$* \quad V_3 = K\,\frac{q_4}{\sqrt{2}a} + K\,\frac{q_2}{a}$

$W_3 = q_3 V_3$

$* W_3 = K\left[\frac{q_1 q_3}{\sqrt{2}a} + \frac{q_2 q_3}{a}\right]$

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

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

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

$= \sum_{i=1}^{n} \sum_{j \neq i}^{m} q_i\,\frac{q_j}{4\pi\epsilon_0 r_i}$

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

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

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

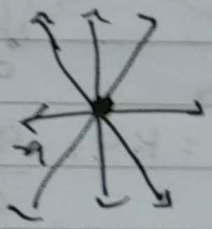
$$W = \frac{1}{2} \sum_{i=1}^{n} q_i \sum_{j \neq i}^{n} v_j$$

$W = \frac{1}{2} \int \lambda v \, d\bar{p}$ → Potensial oleh muatan pada garis

$W = \frac{1}{2} \int \sigma v \, d\vec{s}$ = " = Permukaan

$W = \frac{1}{2} \int \rho v \, dG$ = " = Volume

$(\rho) = \varepsilon_0 . \nabla . \bar{E} \longrightarrow \nabla . \bar{E} = \frac{\rho}{\varepsilon_0}$



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

$$W = \frac{\varepsilon_0}{2} \int (\nabla . E) \, v \, dG$$

$$W = \frac{\varepsilon_0}{2} \int E^2 \, dG .$$

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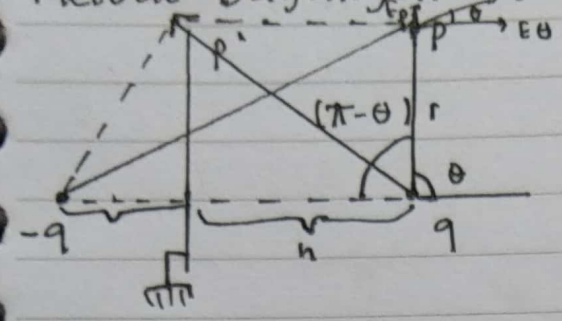
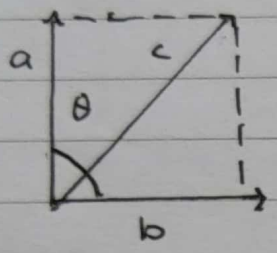
Metode bayangan




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

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

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




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

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

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

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

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

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

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