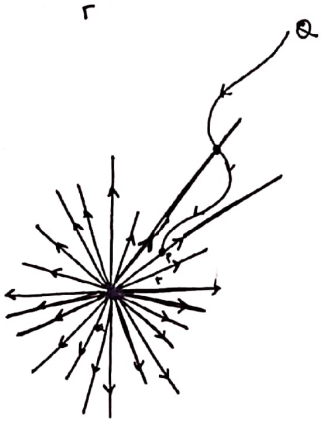
22/ April 2024

Usaha dan Energi

1. Usaha oleh muatan titik Q.

$$W = \int F \, dp \longrightarrow \vec{dp}$$



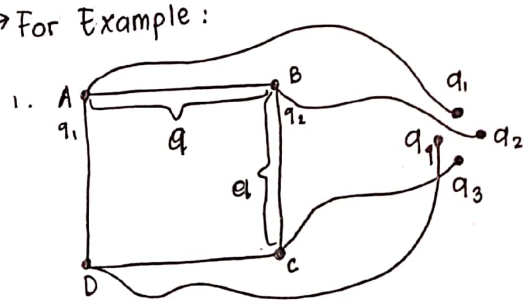
$$W = \int F \, dr$$

$$= -q \cdot \int E dp$$

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

$$W = qV$$

→ For Example :



- $W_1 = q_1(V_1)^{=0}$

$= 0$

$W_2 = q_2 V_2$

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

- $W_2 = Kq_2\frac{q_1}{a} = K\frac{q_1q_2}{a}$

- $W_3 = q_3V_3$

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

$W_3 = K\left[\frac{q_1q_2}{\sqrt{2}a} + \frac{q_2q_3}{a}\right]$

- $W_4 = q_4V_4 \rightarrow V_4 = K\left[\frac{q_1}{a} + \frac{q_2}{\sqrt{2}a} + \frac{q_3}{a}\right]$

$W_4 = K\left[\frac{q_1q_4}{a} + \frac{q_2q_4}{\sqrt{2}a} + \frac{q_3q_4}{a}\right]$

- $W_{total} = W_1 + W_2 + W_3 + W_4$

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

$$= \frac{1}{8\pi\varepsilon_0}\sum_{i=1}^{n} q_i \sum_{J\neq 1}^{m}\frac{q_J}{r_{ij}}$$

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

$$W = \frac{1}{2}\sum_{i=1}^{n} q_1 \sum_{JF_1}^{n} V_9$$

$a^2 = \sqrt{a^2+a^2}$

$a = a\sqrt{2}$

$$W = \frac{1}{2}\sum_{1=1}^{n} q_1 \sum_{J\neq 1}^{m} V_J$$

→ Integral lipat !

$W = \frac{1}{2}\int a v d\vec{l}$ → potensial oleh muatan pada garis

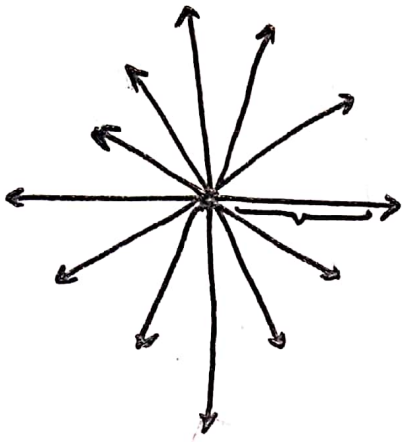
→ Integral lipat 2

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

→ Integral lipat 3

$W = \frac{1}{2}\int \rho V dE$ → Volume

$$\rho = \sigma \nabla \cdot \vec{E} \longrightarrow \nabla \cdot \vec{E} = \frac{\rho}{E_\rho}$$



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

Hukum Gauss

sehingga :

$$W = \frac{1}{2} \int P \, V \, dE \longrightarrow \text{Volume}$$

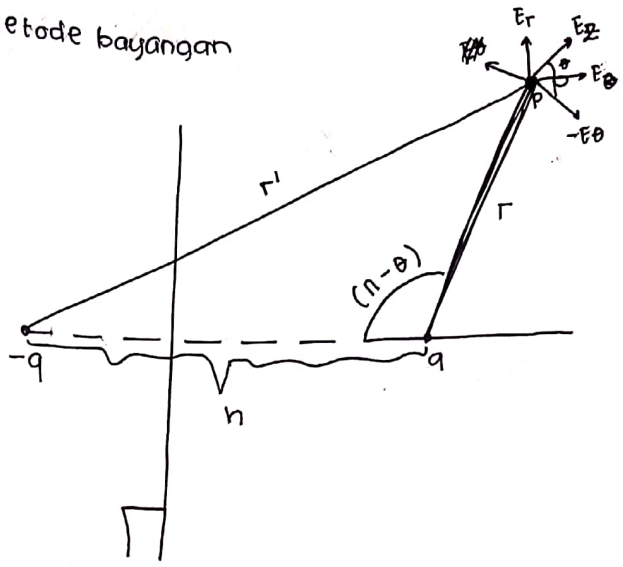
$$W = \frac{\sigma}{2} \int (\nabla \cdot E) \, V \, d\sigma$$

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

Bab 3

Metoda Penentuan Potensial

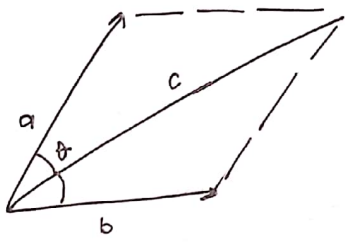
→ Metode bayangan



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

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

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



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

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

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

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

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