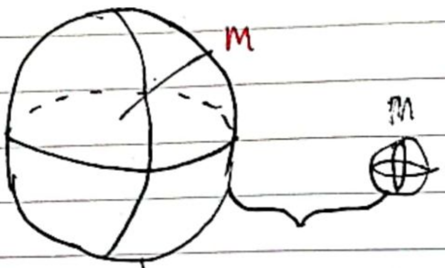
# Potensial ~~Elektrik~~ Listrik

Usaha / energi yg terkandung
Usaha tiap muatan



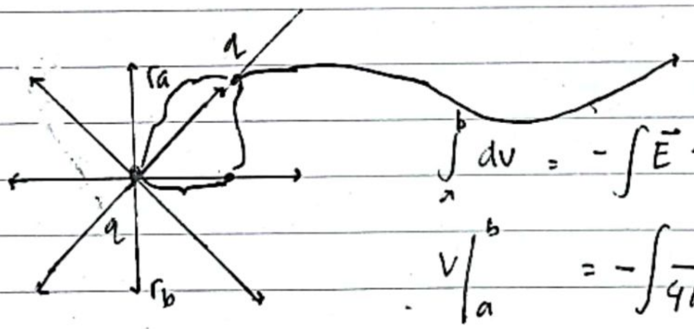

$$W = G\frac{Mm}{r}$$

$$V = G\frac{M}{r}$$

$$V = \frac{W}{m}$$

$$V = \frac{W}{M} = G\frac{M}{r}$$

$$V = \frac{W}{q} = \frac{F \cdot r}{q}$$




b

$$\int_a^b dv = -\int \vec{E} \cdot dr$$

$$V\Big|_a^b = -\int \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\,dr$$

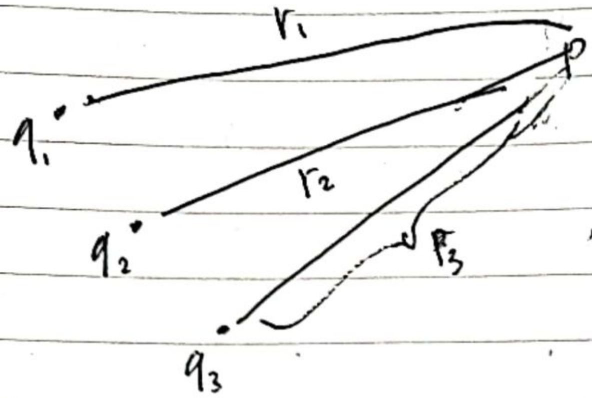
$$= -\frac{q}{4\pi\varepsilon_0}\int_{r_a}^{r_b}\frac{1}{r^2}\,dr = -\frac{q}{4\pi\varepsilon_0}\left(-\frac{1}{r}\Big|_{r_a}^{r_b}\right)$$

$$= \boxed{V_b - V_a = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r_b} - \frac{1}{r_a}\right)}$$

$\int \Delta v$

$$\boxed{V = k\frac{q}{r}} \qquad V = \frac{W}{q} \qquad W \to k\frac{q}{}$$

$q$ • $P = k\frac{q}{r}$

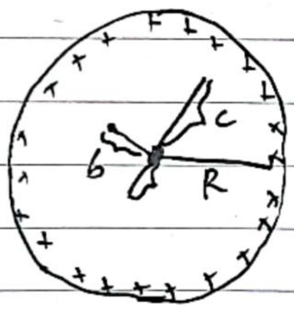



$$V = \frac{W}{q} = \frac{\vec{P}\cdot\vec{s}}{q} = K\frac{q}{r}$$

$$V_p = K\left[\frac{q_1}{r_1} + \frac{q_2}{r_2} + \frac{q_3}{r_3}\right]$$

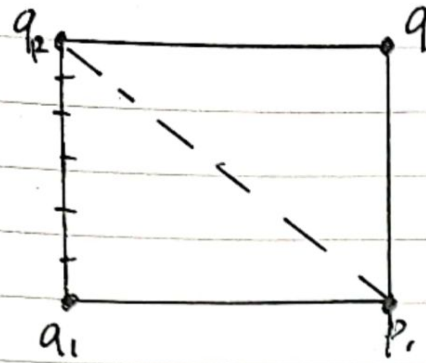
$$= K\sum_{i=1}^{n}\frac{q_i}{r_i}$$

→ Pada bola Konduktor berongga




$$V = K\frac{Q}{r}, \quad r > R$$

Soal :




$q_{12} = 5 \mu c$

jawab : $V = K\frac{q_1}{r_1} + K\frac{q_2}{r_2} + K\frac{(-q_3)}{r_3}$

$= K\left(\frac{5}{8} + \frac{5}{8} + \frac{(-4)}{\sqrt{8^2+8^2}}\right)$

$= K\left(\frac{5}{8} + \frac{5}{8} + \frac{(-4)}{\sqrt{28}}\right)$

# Persamaan Poisson & Laplace

$$E = -\nabla V$$

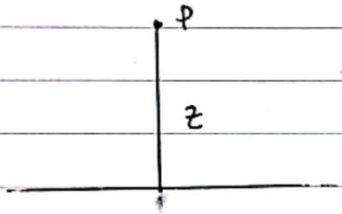
$$\nabla \cdot E = -\nabla^2 V$$

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

$$\nabla^2 V = -\frac{\rho}{\varepsilon_0}$$ → Poisson → ada sumber daya pada medan listrik

$$\nabla^2 V = 0$$ → Laplace

## Potensial Muatan terdistribusi lokal




$$\vec{E} = \frac{\lambda}{2\pi \varepsilon_0 r}$$

$$\oint \vec{E} \cdot da = \frac{\lambda \cdot \ell}{\varepsilon_0}$$

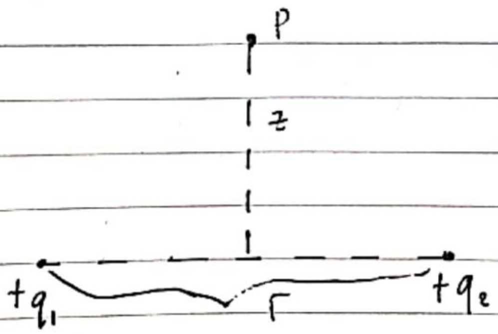
$$\vec{E}\,(2\pi r \ell) = \frac{\lambda \cdot \ell}{\varepsilon_0}$$

$$\vec{E} = \frac{\lambda}{2\pi \varepsilon_0 r}$$

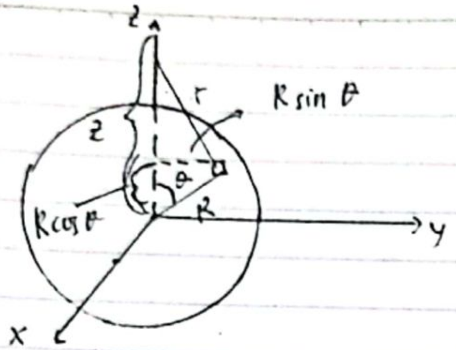
$$V = -\int \vec{E} \cdot dr$$

$$= -\int \frac{\lambda}{2\pi \varepsilon_0} \frac{1}{r}\, dr$$

$$= \frac{\lambda}{2\pi \varepsilon_0} \int \frac{1}{r}\, dr$$




$$V_p = K \left[ \frac{q_1}{\sqrt{(\frac{1}{2} r)^2 + z^2}} + \frac{q_2}{\sqrt{(\frac{1}{2} r)^2 + z^2}} \right]$$




$$V(p) = \frac{1}{4\pi\varepsilon_0} \int \frac{\sigma}{r}\, da$$

$$r^2 = R^2 + z^2 - 2Rz\cos\theta$$

$$r = \sqrt{(R\sin\theta)^2 + (z - R\cos\theta)^2}$$

$$= \sqrt{R^2 \sin\theta^2 + z^2 + R^2\cos\theta^2 - 2zR\cos\theta}$$

$$= \sqrt{R^2(\sin^2\theta + \cos^2\theta) + z^2 - 2zR\cos\theta}$$

$$= \sqrt{R^2 + z^2 - 2zR\cos\theta}$$

$$\xrightarrow{\quad} R^2 \sin\theta\, d\theta\, d\phi$$

$$V = \frac{1}{4\pi\varepsilon_0} \int \frac{\sigma\, da}{r}$$

$$= \frac{1}{4\pi\varepsilon_0} \iint \frac{\sigma\, da}{(R^2 + z^2 - 2Rz\cos\theta)^{1/2}}$$

$$= \frac{\sigma}{4\pi\varepsilon_0} \int_0^{\pi}\int_0^{2\pi} \frac{R^2 \sin\theta\, d\theta\, d\phi}{(R^2 + z^2 - 2Rz\cos\theta)^{1/2}}$$

$$= \frac{\sigma R 2\pi}{4\pi\varepsilon_0} \int_0^{\pi} \frac{\sin\theta\, d\theta}{(R^2 + z^2 - 2Rz\cos\theta)^{1/2}}$$

$$V_p = \frac{\sigma R 2\pi}{4\pi\varepsilon_0} \int_0^{\pi} \frac{d(\cos\theta)}{(R^2 + z^2 - 2Rz\cos\theta)^{1/2}}$$

$$= \int_0^{\pi} (R^2 + z^2 - 2Rz\cos\theta)^{1/2}\, d(\cos\theta)$$

$$= 2\,(R^2 + z^2 - 2Rz\cos\theta)^{1/2}\Big|_0^{\pi}$$