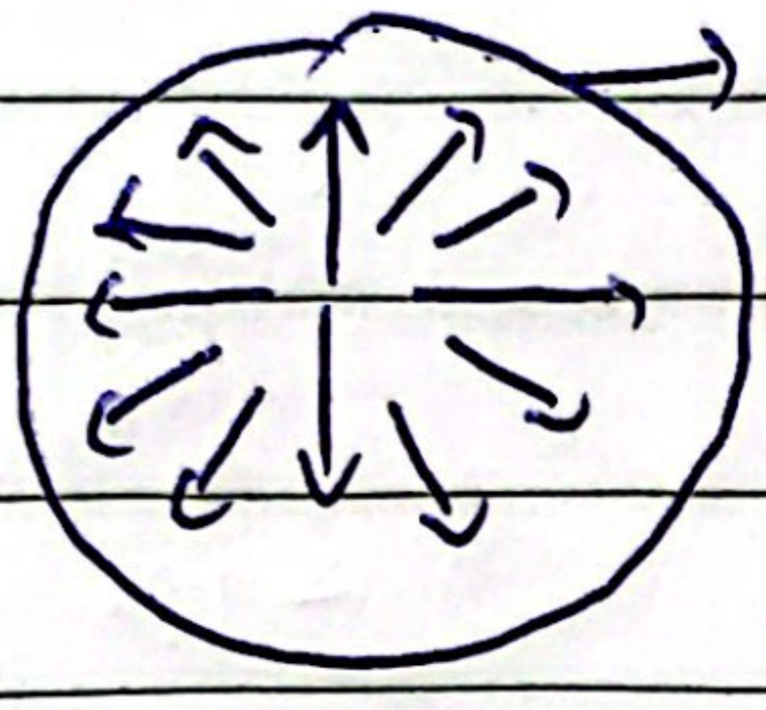
Date :

HUKUM GAUSS & Aplikasinya

$$\oint_S \vec{E}\cdot d\vec{a} = \int_V (\nabla\cdot\vec{E})\, d\tau$$

$\tau \rightarrow V$



surface of Gauss

$$\oint \vec{E}\cdot da = \oint \frac{q}{4\pi\varepsilon_0 r^2} r^2 \sin\theta \, d\theta \, d\phi$$

$$= \frac{q}{4\pi\varepsilon_0}\int_0^{\pi}\int_0^{2\pi} \sin\theta \, d\theta \, d\phi$$

$$= \frac{\cancel{4\pi}\, q}{\cancel{4\pi}\, \varepsilon_0}$$

$$\oint_S \vec{E}\, da = \frac{q}{\varepsilon_0}$$ → persamaan Gauss dalam bentuk differensial

$$\int_V (\nabla\cdot\vec{E})\, d\tau$$

$$Q = \rho\, d\tau$$

$$\int (\nabla\cdot\vec{E})\, d\tau = \frac{Q}{\varepsilon_0}$$ →

$$\oint \vec{E}\cdot d\vec{a} = \int_V (\nabla\cdot E)\cdot d\tau$$

$$\rho\, d\tau$$

$$\frac{1}{\varepsilon_0}\int_V \rho\, d\tau$$

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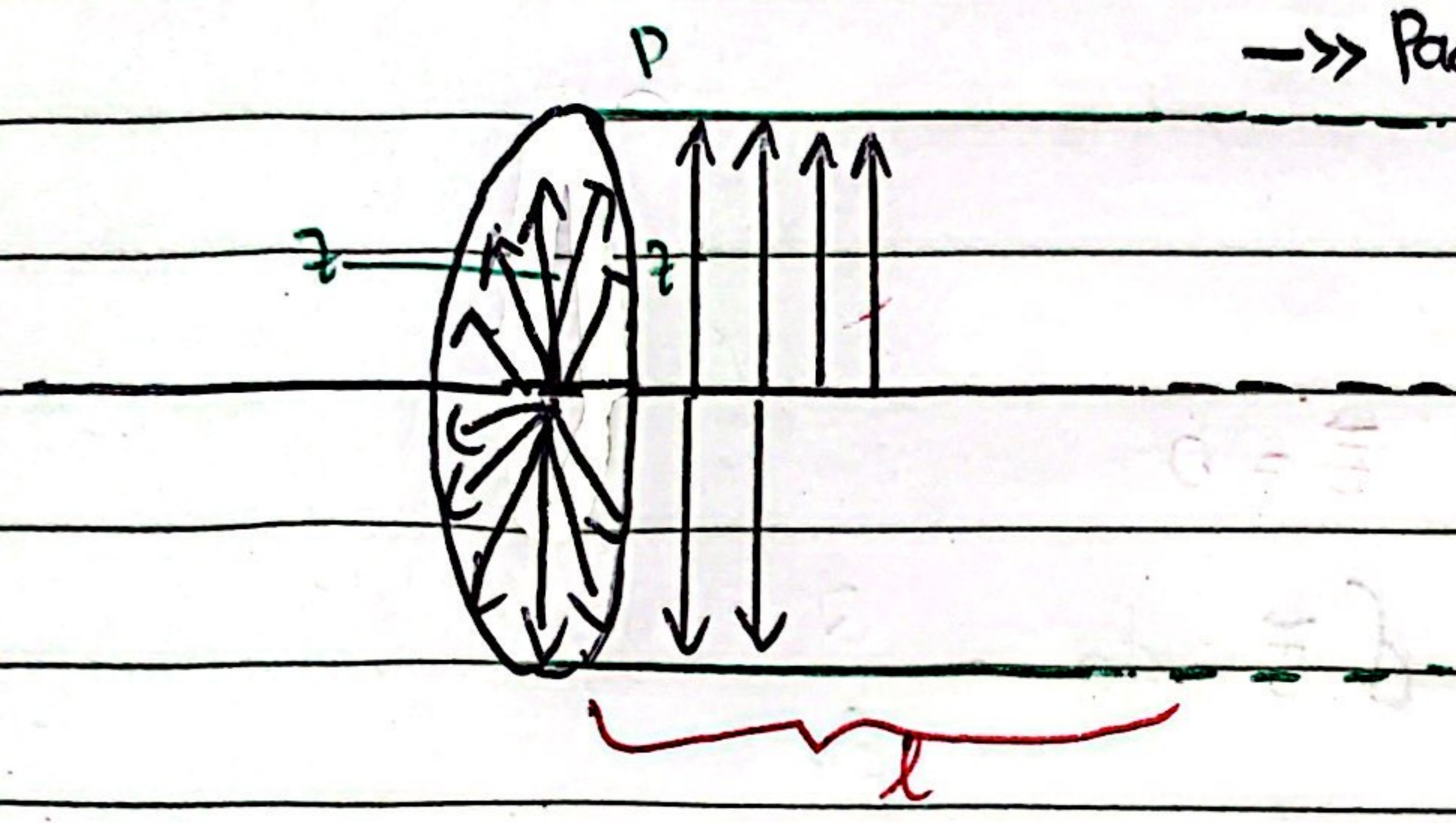
$$\boxed{\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}} \longrightarrow \text{Hk. Gauss}$$

dalam bentuk differensial

→> Pada Kawat Lurus Panjang

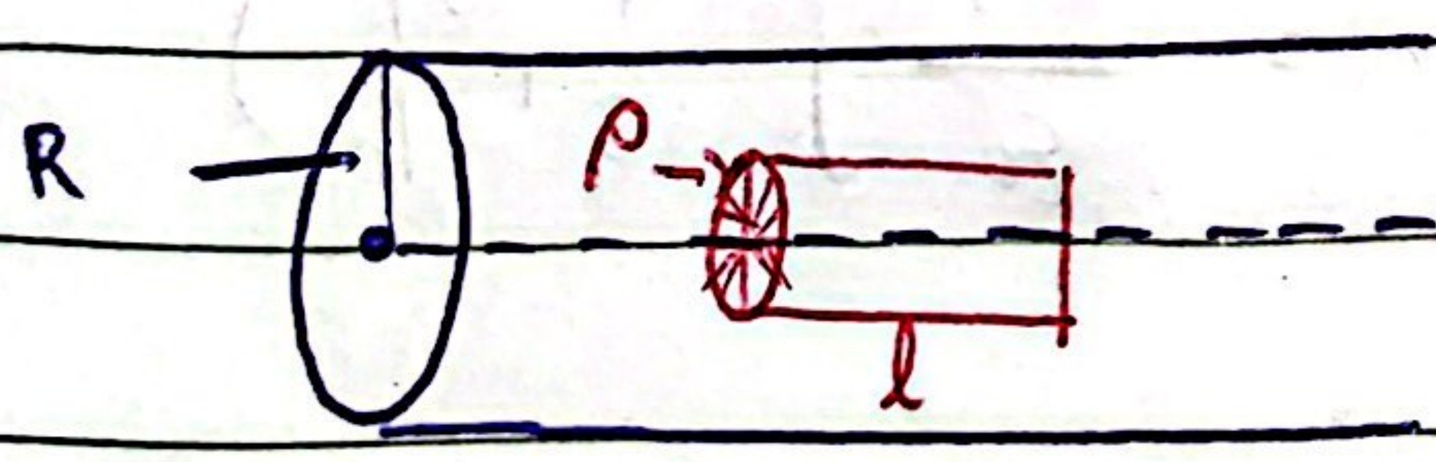


$$\oint \vec{E} \cdot da = \frac{q}{\varepsilon_0}$$

$$\vec{E} \cdot (2\pi z \cdot d) = \frac{\lambda \cdot l}{\varepsilon_0}$$

$$E = \frac{\lambda}{2\pi \varepsilon_0 z} \hat{z_0}$$

→ Pada silinder, dg jari² R



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

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

$$\vec{E} = \frac{Q}{2\pi \varepsilon_0 \rho l} \hat{r_0}$$

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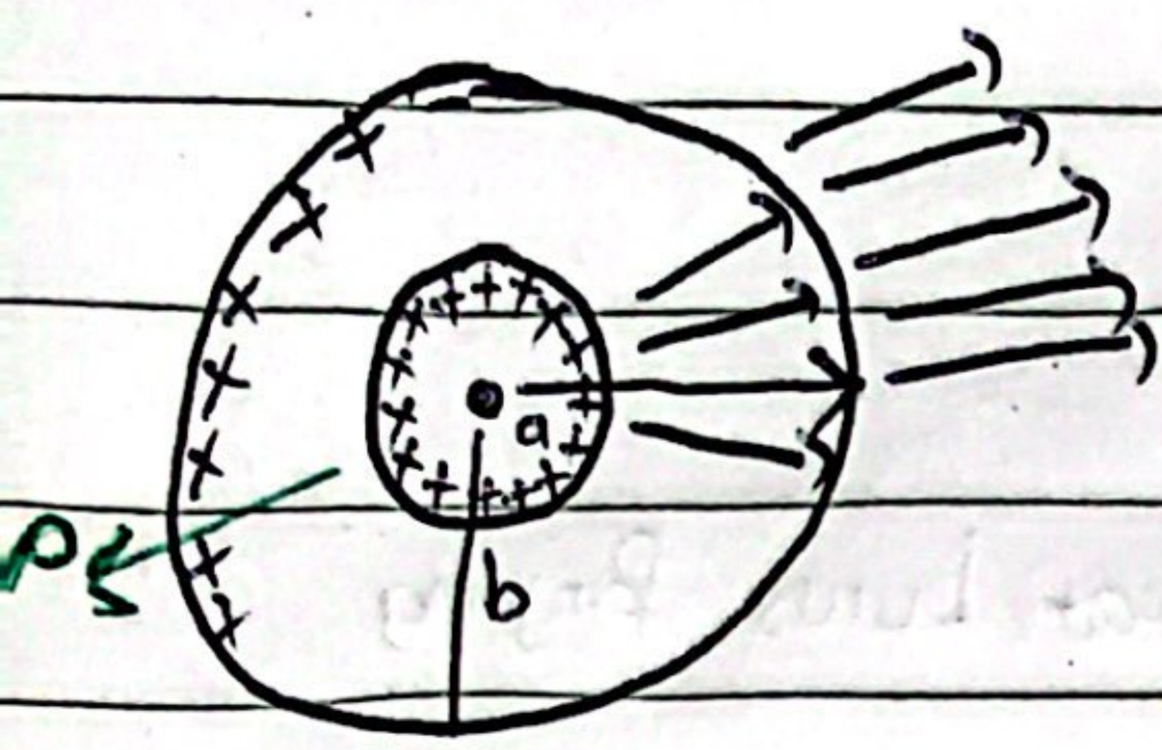

Hitunglah $\vec{E}$:

1.) $r < a$ ⟶ $\vec{E} = 0$

2.) $a < r < b$ ⟶ $\oint \vec{E} \cdot da = \frac{Q}{\varepsilon_0}$

3.) $r > b$

$\oint \vec{E} \cdot da$

$\vec{E}(4\pi r^2) = \frac{1}{\varepsilon_0} \iiint \rho \, d\tau$

$= \frac{1}{\varepsilon_0} \int_0^a \int_0^{2\pi} \int_0^{\pi} \rho r^2 \sin\theta \, d\theta \, d\phi \, dr$

$\cancel{\rho r^2 \sin\theta \, d\theta \, d\phi \, dr}$

$= \frac{4\pi \rho}{\varepsilon_0} \int_0^a r^2 dr$

$\int_0^{\pi} \int_0^{2\pi} \sin\theta \, d\theta \, d\phi = 4\pi$

$= \frac{4\pi \rho}{\varepsilon_0} \left(\frac{1}{3} r^3 \Big|_0^a \right)$

$\int dx$

$= \int x^0 dx$

$= x \Big|_{\dots}^{\dots}$

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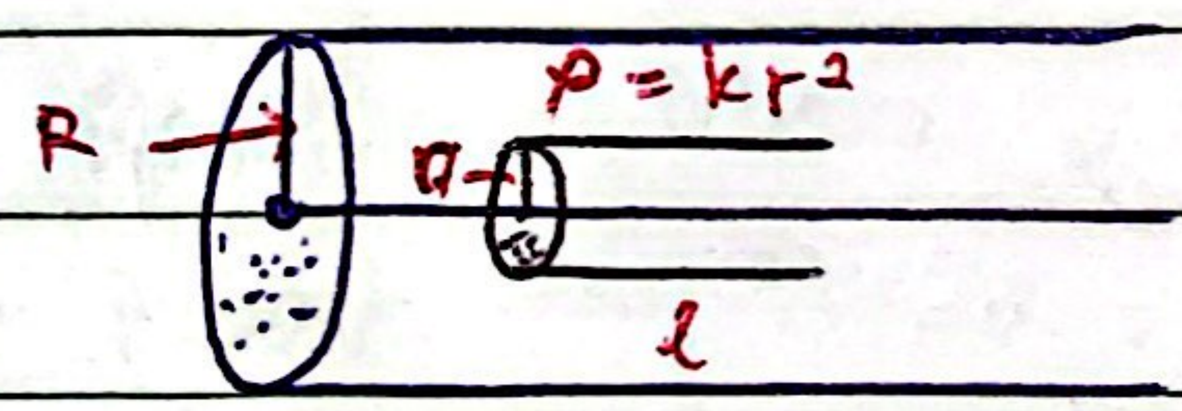
$r > b$

$$\oint \vec{E} \cdot da = \frac{1}{\varepsilon_0} \iiint \rho \, d\tau$$

$$= \frac{1}{\varepsilon_0} \iiint \rho r^2 \sin\theta \, d\theta \, d\phi \, dr$$

$$= \frac{4\pi\rho}{\varepsilon_0} \int_a^b r^2 \, dr$$

$$= \frac{4\pi\rho}{\varepsilon_0} \left(\frac{1}{3} r^3 \Big|_a^b \right)$$



1.) $r < R$

$$\oint \vec{E} \, da = \frac{1}{\varepsilon_0} \iiint \rho \, d\tau$$

$$\vec{E} \, (2\pi r \cdot l) = \frac{1}{\varepsilon_0} \int_0^{2\pi} \int_0^{l} \int_0^{R} (kr^2) \, r \, d\phi \, dz \, dr$$

$$= \frac{2\pi k}{\varepsilon_0} \int_0^{l} dz \int_0^{R} r^3 \, dr$$

2.) $r > R$

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

$$\vec{E} \cdot (2\pi r \cdot l) = \frac{1}{\varepsilon_0} \int_0^{R} \int_0^{\pi}$$

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Kalisma Pak Wadis

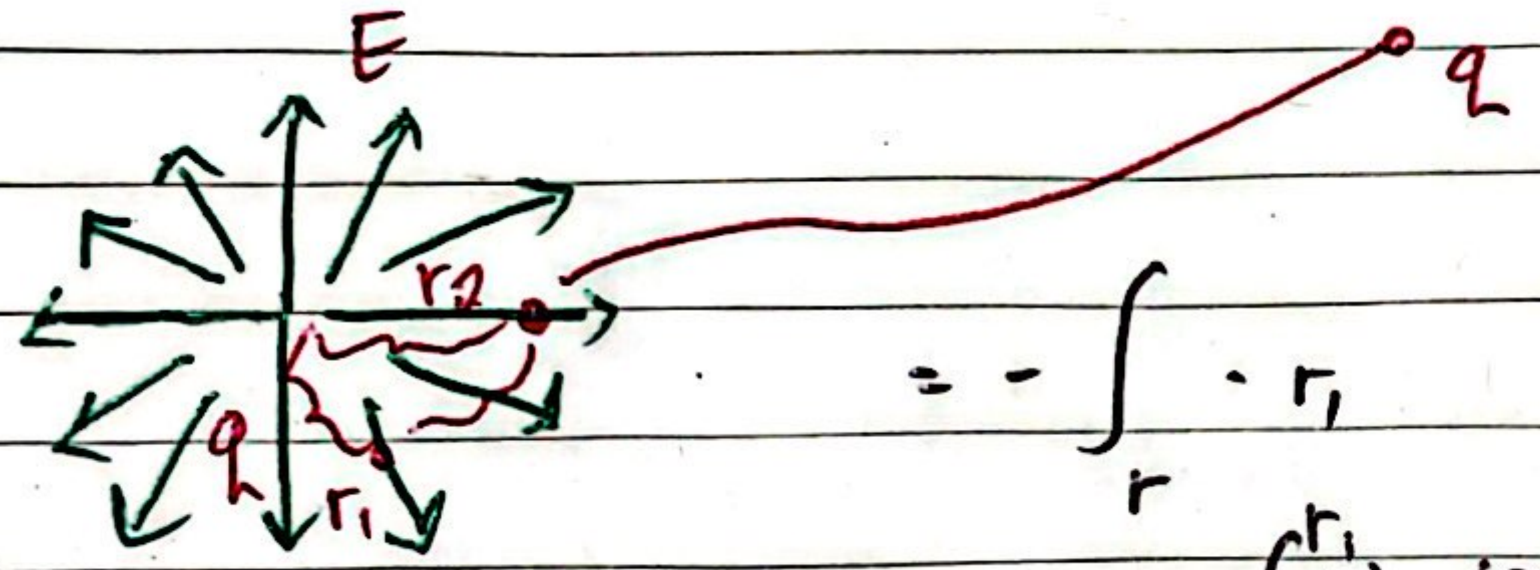
POTENSIAL LISTRIK

$W = F . S$

$V = \frac{W}{q} = \frac{F.S}{q} = \frac{k \frac{q.q}{r} S}{q}$

$$\boxed{V = k \frac{q}{r}}$$

$$dV = -\int_{r_1}^{r_2} \tilde{E} \, dr$$



$$= -\int_{r} \cdot r_1$$

$$V_1 - V_2 = -\int^{r_1} \vec{E} \, d\vec{r}$$

$$\Delta V = -\int_{r_1}^{r_2} \frac{q}{4\pi \varepsilon_0 r^2} dr$$

$$= \frac{q}{4\pi \varepsilon_0} \int_{r_1}^{r_2} r^{-2} dr$$

$\Delta V \neq dV$

$$= - \square \int_{r_1}^{r_2} r^{-2} dr$$

$$= - \square \left(-\frac{1}{r} \Big|_{r_1}^{r_2} \right) = \square \left(\frac{1}{r_2} - \frac{1}{r_1} \right)$$

$$\boxed{V = \frac{1}{4\pi \varepsilon_0} \frac{q}{r} = k \frac{q}{r}}$$