Senin, 25 Maret 2024

Hukum Gauss dan Appluid

$$\oint_s \vec{E}\cdot d\vec{a} = \int_v (\nabla\cdot\vec{E})\, d\tau$$

$\tau \Rightarrow V$

surface of Gaus

$$\oint \vec{E}\cdot da = \oint \frac{q}{4\pi\epsilon_0}\, a \sin\theta\, d\theta\, d\phi$$

$$= \frac{q}{4\pi\epsilon_0}\int_0^{\pi}\int_0^{2\pi} \sin\theta\, d\theta\, d\phi$$

$$= \frac{\cancel{4\pi}\, q}{\cancel{4\pi}\,\epsilon_0}$$

$$\boxed{\oint_s \vec{E}\cdot da = \frac{q}{\epsilon_0}}$$ → Persamaan Gauss dalam bentuk differensial

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

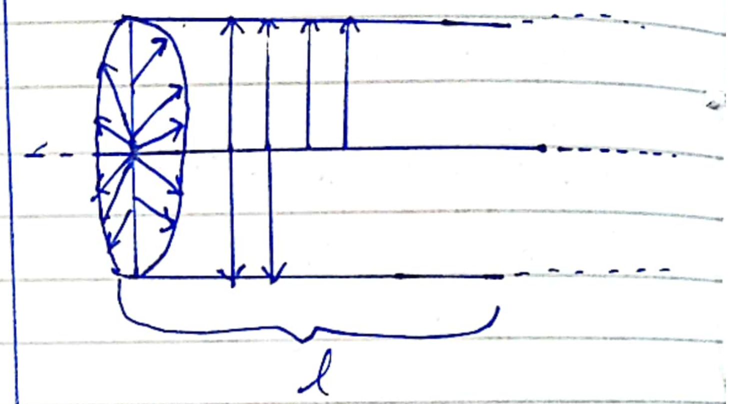
$$\to \oint_s \vec{E}\cdot da = \int_v (\nabla\cdot E)\, d\tau$$

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

$$\int_v (\nabla\cdot\vec{E})\, d\tau = \frac{Q}{\epsilon_0} \to \rho\, d\tau$$

$$= \frac{1}{\epsilon_0}\int_v \rho\, d\tau$$

$$\boxed{\nabla\cdot\vec{E} = \frac{\rho}{\epsilon_0}}$$ → Hukum Gaus dalam bentuk differensial

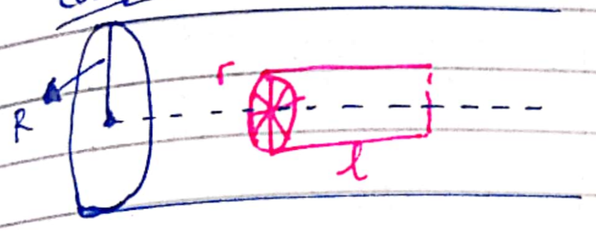


$$\oint \vec{E}\cdot da = \frac{q}{\epsilon_0}$$

$$\vec{E}\cdot(2\pi z\cancel{\ell}) = \frac{\lambda\cdot\cancel{\ell}}{\epsilon_0}$$

$$\vec{E} = \frac{\lambda}{2\pi\epsilon_0 z}\hat{z}$$

Contoh: soal



$$\oint \vec{E} \cdot da = \frac{Q}{\epsilon_0}$$

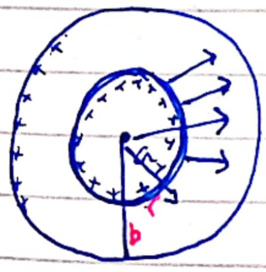
$$\vec{E}(2\pi r \cdot l) = \frac{Q}{\epsilon_0}$$

$$\vec{E} = \frac{Q}{2\pi\epsilon_0 r l} \hat{r}_0 \qquad r < R$$

$$\vec{E}(2\pi R l) = \frac{q}{\epsilon_0} \hat{r}_0$$

$$\vec{E} = \frac{q}{2\pi\epsilon_0 R l} \hat{r}_0$$

(1.)



① Calculatie $\vec{E}$

1.) $r < a$

2.) $a < r < b$ $\qquad \vec{E} = 0$

3.) $r > b$

② $\oint \vec{E} \cdot da = \frac{Q}{\epsilon_0}$

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

$$\vec{E} \cdot (4\pi r^2) = \frac{1}{\epsilon_0} \iiint \rho \, d\tau$$

$$= \frac{1}{\epsilon_0} \int_0^a \int_0^{2\pi} \int_0^{\pi} r^2 \sin\theta \, d\theta \, d\phi \, dr$$

$$= \frac{4\pi\rho}{\epsilon_0} \int_0^a r^2 \, dr$$

$$= \frac{4\pi\rho}{\epsilon_0} \left(\frac{1}{3} r^3 \Big|_0^a \right)$$

③ $r > b$

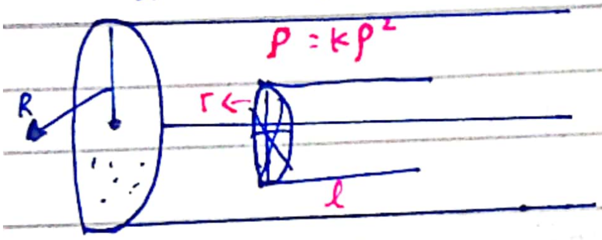
$$\oint \vec{E} \cdot da = \frac{1}{\epsilon_0} \iiint \rho \, d\tau$$

$$= \frac{1}{\epsilon_0} \iiint \rho r^2 \sin\theta \, d\theta \, d\phi \, dr$$

$$= \frac{4\pi\rho}{\epsilon_0} \int_a^b r^2 \, dr$$

$$= \frac{4\pi\rho}{\epsilon_0} \left(\frac{1}{3} r^3 \Big|_a^b \right)$$

silinder dengan kerapatan



1. $r < R$
2. $r > R$

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

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

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

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

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

POTENSIAL LISTRIK

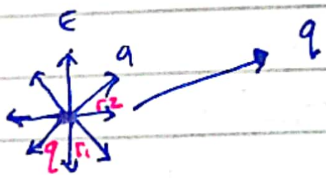
$W = F \cdot s$ $\quad s = r$

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

$\boxed{V = k \frac{q}{r_1}}$

$\Downarrow$

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



$= \int_r \cdot r\pi$

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

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

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

$\Delta V \neq dV$

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

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

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

potensial
- beda potensial oleh arus
- usaha memindahkan muatan dari jauh ke titik tertentu