بسم الله الرحمن الرحيم

No. Senin (6)

Date 25 . 03 . 24

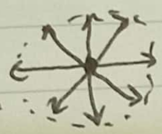
Kelistrikan dan kemagnetan

Hukum Gauss.

→ Integral lipat 3 bisa dihitung dengan integral lipat 2
Simetri tinggi

$\Delta V \neq dV$

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



Penentu lipat²

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

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

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

$$\oint \vec{E}\, da = \frac{4\pi q}{4\pi\varepsilon_0}$$

$$\therefore \; = \frac{q}{\varepsilon_0}$$

Gaya listrik distrik → penangkal listrik, FC, kriuker, cerobong asap

Potensial : b. kerja ?
↓
• muatan

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

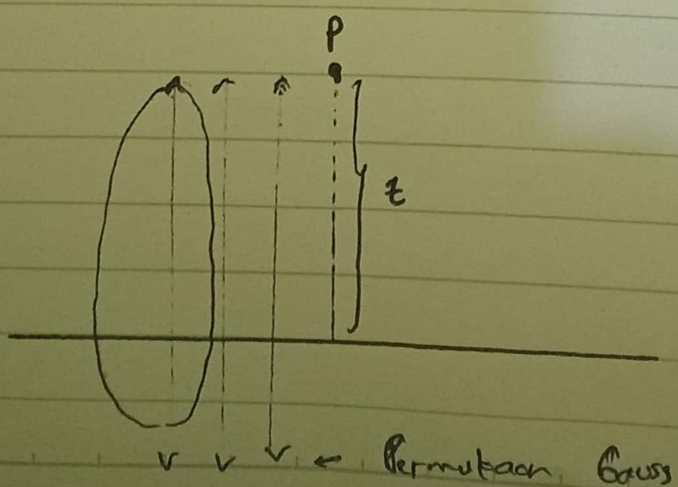
Q_{enc} : $\rho\, d\tau$ ruang volume
: $\sigma\, da$ luas
: $\lambda\, dl$ Garis

$$\iiint \nabla \cdot E\, d\tau : \iiint \frac{\rho\, d\tau}{\varepsilon_0}$$

$$\nabla \cdot \vec{E} : \frac{\rho}{\varepsilon_0}$$
divergensi

Jarak → kecepatan ⟶ percepatan : GLBB (differensial)
fluks → terjadi perubahan dari ~~atas~~ bawah ke atas.

Contoh



$$\oint \vec{E}\, da = \frac{q}{\varepsilon_0} \quad \lambda L$$

$$\oint \vec{E}\, d\vec{a} = \frac{\lambda L}{\varepsilon_0} \rightarrow \vec{E}\,(2\pi r \cdot L) = \frac{\lambda L}{\varepsilon_0}$$

$$\vec{E} = \frac{\lambda}{2\pi \varepsilon_0 r} \cdot \hat{r}_0$$

H.G

Hds y muncul pd luasn d. tertentu karena ada muatan

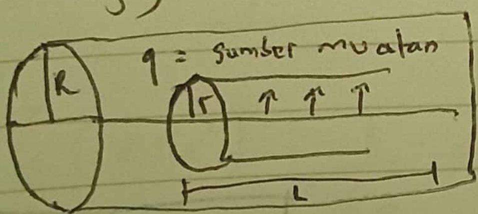
θ : sumber

Hal. 61 nomor 2.

Sebuah silinder pejal panjang sekali, dengan jari-jari silinder R, Rapat muatan q, hitung medan listrik di dalam silinder!

Jawab:

- Panjang sekali => Hukum Gauss



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

$r < R$

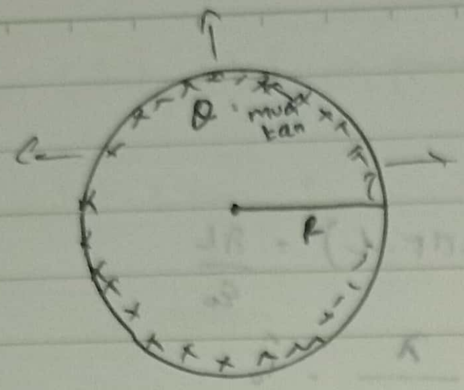
$$\oint \vec{E} \cdot dA = \frac{q}{\varepsilon_0}$$

$$\vec{E}\,(2\pi r L) = \frac{q}{\varepsilon_0}$$

$$\vec{E} = \frac{q}{2\pi \varepsilon_0 r l}\, \hat{r}_0 \quad \text{dimana } r < R$$

Pada $R = r$, maka $\vec{E}\,(2\pi R l) = \frac{q}{\varepsilon_0}\, r_0$

$$\vec{E} = \frac{q}{2\pi \varepsilon_0 R l}\, \hat{r}_0$$



Hitung $\bar{E}$ Pada

a. $r < R$ $= 0$

b. $r > R$

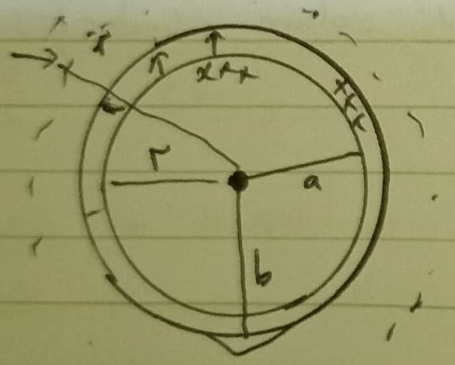
Jawab:

1. $r < R$

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

$$\vec{E}\,(4\pi r^2) = \frac{Q_{in}}{\varepsilon_0}$$

$$\vec{E} = \frac{Q}{4\pi\varepsilon_0 r^2} \cdot \hat{r}_0$$



1. $r < a$

$\vec{E} = 0$

2. $a < r < b$

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

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

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

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

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

$$\bar{E}\,(4\pi r^2) = \frac{4\pi}{\varepsilon_0}\int_0^a r^2\, d\rho$$

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

$$\bar{E}\,(\cancel{4\pi} r^2) = \frac{4}{3}\frac{\cancel{\pi}\, a^3}{\varepsilon_0}$$

$$E = \frac{\rho a^3}{3\varepsilon_0} r^2$$

- $\bar{E}$: $r > b$

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

$$\vec{E}\,(4\pi r^2) = \frac{1}{\varepsilon_0}\int_a^b\int_0^{2\pi}\int_0^{\pi} \rho \sin\theta \; d\theta\, d\phi\, d\rho$$

Kanan = muatan
Kiri = medan

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

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

$$= \frac{\rho 4\pi}{3\varepsilon_0}(b^3 - a^3)$$

$$= \frac{\rho}{3\varepsilon_0 r^2}(b^3 - a^3)$$