Risnawati Hutapea

2213022079

No. Senin

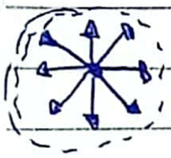
Date 25-03-2024

Catatan Pertemuan 6.

## Hukum Gauss

$\Delta v \neq dv$

$\oint \vec{E}\, d\vec{a} = \int (\nabla \vec{E})\, d\ell$ → menentukan lipat 2 atau 1



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

$$= \frac{q}{4\pi\varepsilon_0} \int_0^{\pi}\int_0^{2\pi} \sin\theta\, d\theta\, d\phi$$ → $-\cos\pi - (-\cos 0)$

$1 + 1 = 2$

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

$$= \frac{q(2\pi)}{4\pi\varepsilon_0} \cdot 2$$

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

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

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

$$\left.\begin{aligned} Q_{inc} &= \rho\, d\tau \\ &= \sigma\, da \\ &= \lambda\, d\ell \end{aligned}\right\} \rho$$

$\iiint \nabla E\, d\tau = \iiint \frac{\rho\, d\tau}{\varepsilon_0}$ → $\boxed{\nabla \vec{E} = \frac{\rho}{\varepsilon_0}}$ → persamaan Gauss dalam bentuk differensial.

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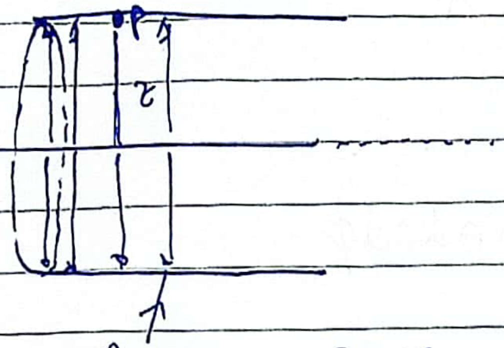
Contoh :



Permukaan Gauss

$$\oint \vec{E} \cdot d\vec{a} = \frac{q}{\varepsilon_0} \cdot \lambda \cdot L$$

$$\oint \vec{E} \left( d\vec{a} \right) = \frac{\lambda L}{\varepsilon_0}$$

$$\vec{E} \left( 2\pi r \cdot l \right) = \frac{\lambda l}{\varepsilon_0}$$

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

Fluks yang muncul pada luasan tertutup karena ada sumber muatan disebut hukum gauss.

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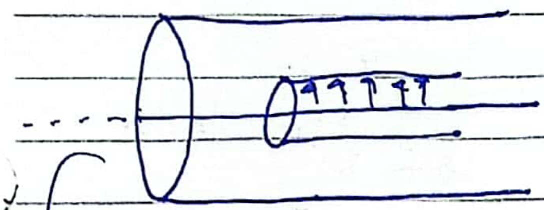
$$\oint \vec{E}\cdot d\vec{a} = \frac{q}{\varepsilon_0}$$

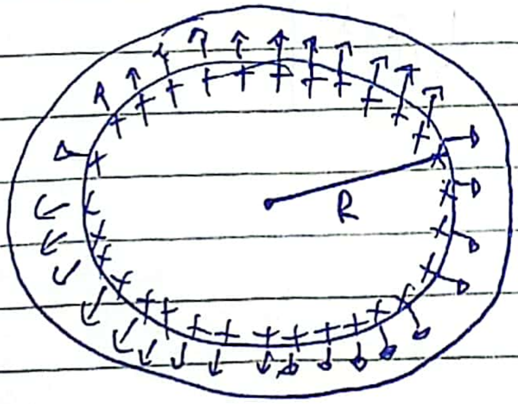


$$\vec{E} = \frac{Q}{4\pi\varepsilon_0 r^2}\hat{r}_0$$

$$\oiint \vec{E}\cdot dA = \frac{Q}{\varepsilon_0}$$

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

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




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

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

$$\vec{E} = \frac{q}{4\pi\varepsilon_0 r^2}\hat{r}_0$$ , dimana $r < R$

Hitung $E$ pada

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

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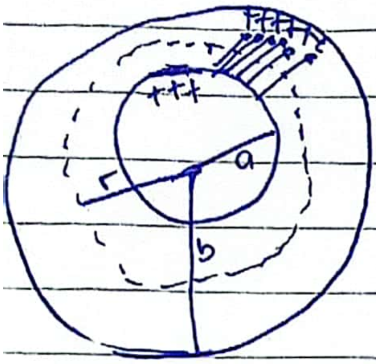


$r < a \rightarrow \vec{E} = 0$

$a < r < b$

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

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

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

$= \frac{\cancel{4\pi}\rho}{\varepsilon_0} \int_0^a \int_0^{\pi} \int_0^{2\pi} r^2 \sin\theta \, d\theta \, d\phi \, d\tau$

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

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

$= \frac{4\pi}{\varepsilon_0} \left[ \frac{1}{3}(a^3) - \frac{1}{3}(0)^3 \right]$

$= \frac{4\pi}{\varepsilon_0} \left[ \frac{a^3}{3} \right]$

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

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

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

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$\vec{E} \rightarrow r > b$

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

hasilnya $4\pi$

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

$$= \frac{\rho}{\varepsilon_0} \int_a^b \boxed{\int_0^{2\pi} \int_0^{\pi} \sin\theta \, d\theta \, d\phi} \, dr$$

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

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

$$\vec{E}(4\pi r^2) = \frac{4\pi\rho}{3\varepsilon_0} (b^3 - a^3)$$

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