No

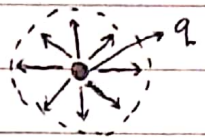
Date 25 Maret 2024

Hukum Gauss

$\Delta v \neq dv$

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

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



$$\int \vec{E}\, d\vec{a} = \oint \frac{q}{4\pi\varepsilon_0} \int_0^{\pi}\int_0^{2\pi} \sin\theta \, d\theta \, d\phi$$

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

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

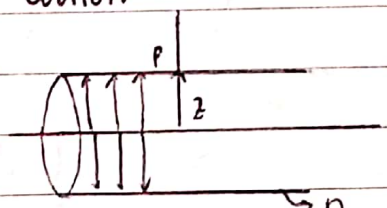
$$\int_v (\nabla \cdot \vec{E})\, d\tau$$

$$Q_{inc} = \rho\, d\tau$$
$$= \sigma\, da$$
$$= \lambda\, dl$$

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

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

Contoh :



Permukaan Gauss

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

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

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

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

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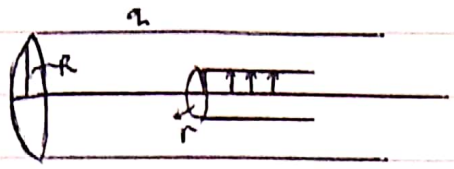
$$\oint \vec{E}\, d\vec{a} = \frac{q_{in}}{\varepsilon_0}$$

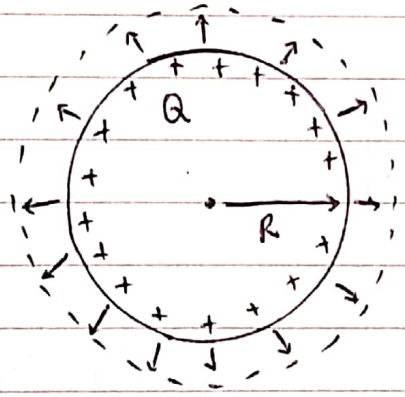


$$\vec{E}\,(2\pi r l) = \frac{q}{\varepsilon_0}$$

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

Pada $r = R$, maka $\vec{E}(2\pi R l) = \frac{q}{\varepsilon_0}\hat{r}_0$, sehingga

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



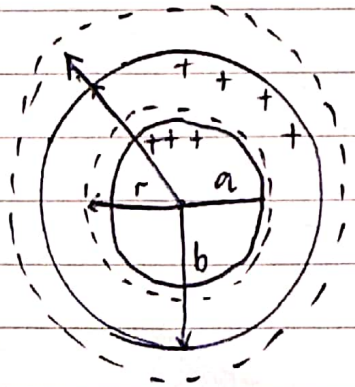
Hitung $\vec{E}$ pada :

a). $r < R$

b.) $r > R$

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

$$\vec{E}\,(4\pi r^2) = \frac{Q_{inc}}{\varepsilon_0} = \frac{Q}{4\pi\varepsilon_0 r^2}\,\hat{r}_0$$



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

$a < r < b$

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

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

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

$$\vec{E}(4\pi r^2) = \frac{4\pi}{\varepsilon_0}\int_0^a r^2 \, dr$$

$$\vec{E}(4\pi r^2) = \frac{4\pi}{\varepsilon_0}\left(\frac{1}{3}r^3\Big|_a^0\right)$$

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

$$E = \frac{\rho a^3}{3\varepsilon_0 r^2}\hat{r}_0$$

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

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

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

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

$$\vec{E}(4\pi r^2) = \frac{\rho 4\pi}{\varepsilon_0}\left(\frac{1}{3}r^3\Big|_a^b\right)$$

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

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