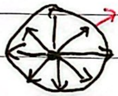
Hukum Gauss and Aplikasi

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



permukaan
Hukum
Gaus

$\tau \Rightarrow v$

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

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

$$= \frac{\cancel{4\pi} q}{\cancel{4\pi} \varepsilon}$$

$$\boxed{\oint \vec{E}\, da = \frac{q}{\varepsilon}}$$

Persamaan Gaus
Dalam bentuk deferensial

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

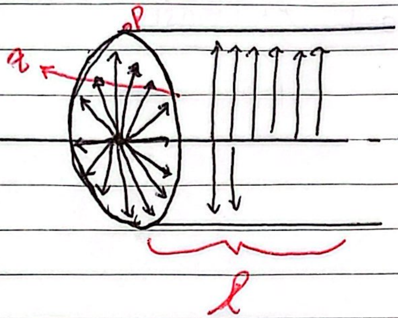
$$Q = \rho \, d\tau$$

$$\int_v (\nabla \cdot \vec{E})\, d\tau = \frac{Q}{\varepsilon_0} \rightarrow \rho \, d\tau$$

$$= \frac{1}{\varepsilon_0} \int_v \rho \, d\tau$$

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

HK Gauss
dalam bentuk deferensial



rapat kawat dlm muatan yaitu λ (lamda)

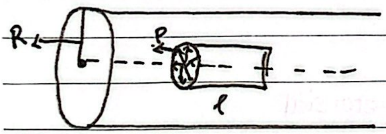
λ kerapatan dalam muatan

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

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

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

Example



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

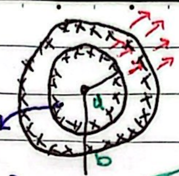
$$\vec{E}\,(2\pi r l) = \frac{Q}{\varepsilon_0}$$

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

No

Date

1.)



ρ
(kerapatan)
(rho)

Hitonglah $\vec{E}$:

1.) $\rho < a \rightarrow \vec{E} = 0$

2) $a < \rho < b$

3) $\rho > b$

2) $\oint \vec{E} \cdot da = \dfrac{Q}{\varepsilon_0}$

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

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

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

$$= \frac{4\pi\rho}{\varepsilon_0}\int_0 r^2\, dr = \frac{4\pi\rho}{\varepsilon_0}\left(\frac{1}{3} r^3 \Big|_0^a\right)$$

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

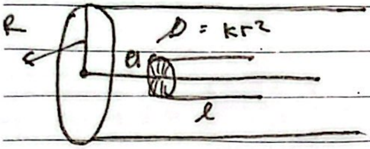
3) $\oint \vec{E}\, da = \dfrac{1}{\varepsilon_0}\iiint \rho\, d\varepsilon_0$

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

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

No
Date

Silinder dgn kerapatan



1) $\rho < R$

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

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

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

2) $\rho > R$

$$\oint \vec{E}\, da =$$

No

Date

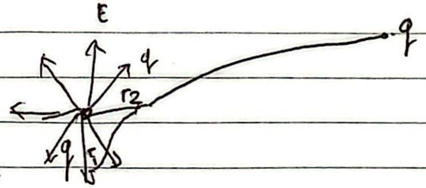
Pontensial Listrik

Secara matematis

$W = F \cdot S$

$$V = \frac{W}{q} = \frac{F \cdot S}{q} = \frac{\frac{k\, q_1 q_2}{q} S}{q}$$

$$V = k \frac{q}{r} \qquad dv = -\int_{r_1}^{r_2} \vec{E}\, dr$$



$$= \int_{r}^{r_{ir}}$$

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

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

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

$$\Delta v \neq dv$$

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

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

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