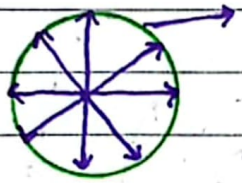
Hukum Gauss dan Applied

$\tau \Rightarrow V$

$$\oint_S \vec{E} \cdot d\vec{a} = \int_V (\nabla \cdot \vec{E})\, d\tau$$



$$\oint \vec{E} \cdot da = \oint \frac{q}{4\pi\epsilon_0 r^2} r^2 \sin\theta \; dt\, d\phi$$

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

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

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

Persamaan Gauss dalam bentuk deferensial

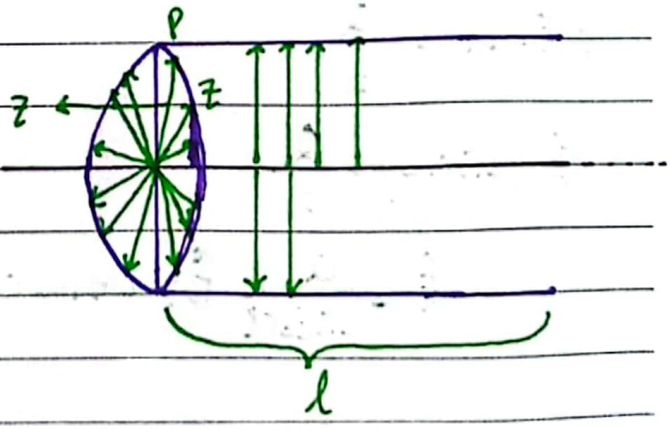
$$\int_V (\nabla \cdot \vec{E})\, d\tau$$

$$Q = \rho\, d\tau \qquad \oint_S \vec{E} \cdot d\vec{a} = \int_V (\nabla \cdot E)\, \theta\tau$$

$$\int_V (\nabla \cdot \vec{E})\, d\tau = \boxed{\frac{Q}{\epsilon_0}} \rightarrow \rho\, d\tau$$

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

$$\boxed{\nabla \cdot \vec{E} = \frac{\rho}{\epsilon_0}} \rightarrow \text{Hukum Gauss dalam bentuk diferensial}$$



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

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

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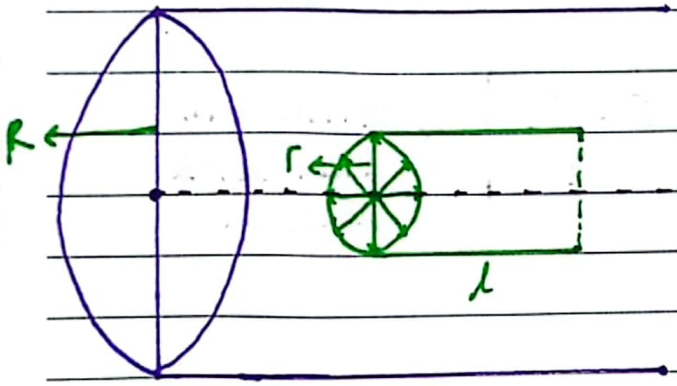
$$E = \frac{\lambda}{2\pi\epsilon_0 z}\hat{z}_0$$

Soal no 2, Hal. 61

2. Sebuah silinder pejal panjang sekali, dengan jari-jari silinder R, rapat muatannya q, hitung medan listrik di dalam silinder!

Jawab:



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

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

$$\vec{E} = \frac{Q}{2\pi\epsilon_0 rl}\hat{r}_0, \text{ dimana } r<R$$

Soal Hal. 62

1. Di daerah $a \le r \le b$

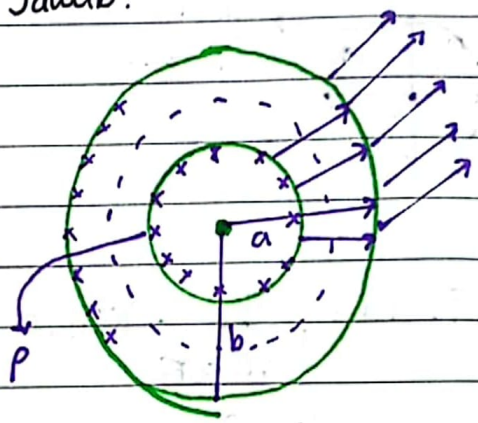
Cari medan listrik di tiga wilayah:

1) $r < a$

2) $a < r < b$

3) $r > b$

Jawab:



1) $\vec{E} = 0$

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

$\oint \vec{E}.da$

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

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

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

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

3) $r > b$

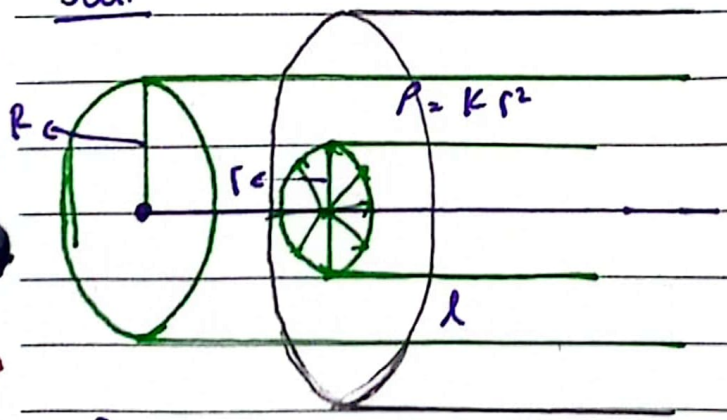
$$\oint \vec{E}\cdot da = \frac{1}{\epsilon_0}\iiint \rho\, d\tau$$

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

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

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

Soal



1) $r < R$

2) $r > R$

Jawab:

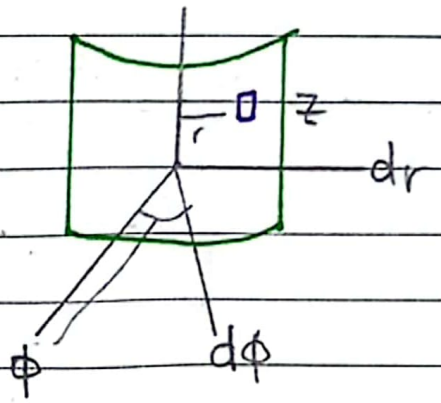
1.

1) $r < R$

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

$$\vec{E}\cdot(2\pi r\cdot l) = \frac{1}{\epsilon_0}\int_0^{2\pi}\int_0^{l}\int_0^{R}(kr^2)\, r\, dr\, d\phi\, dz$$

$$= \frac{k(4\pi)}{\epsilon_0}\int_0^{d} dz \int_0^{r} r^2 dr$$



2) $r > R$

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

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Potensial Listrik

- Potensial → oleh muatan listrik
- Bedapotensial → oleh arus listrik

$$W = F \cdot S$$

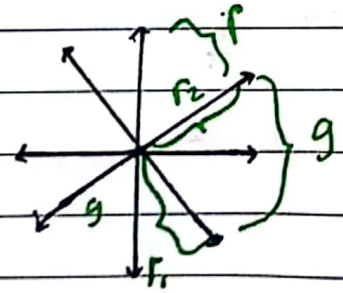
$$V = \frac{W}{q} = \frac{F \cdot S}{q} = \frac{k\frac{q \cdot q}{r}}{q} \cdot s$$

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

Note:
$S = r$

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

$$= -\int_{r} r_1$$



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

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

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

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

$$\Delta V \neq dV$$

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

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

$$= \square\left(\frac{1}{r_2} - \frac{1}{r_1}\right)$$