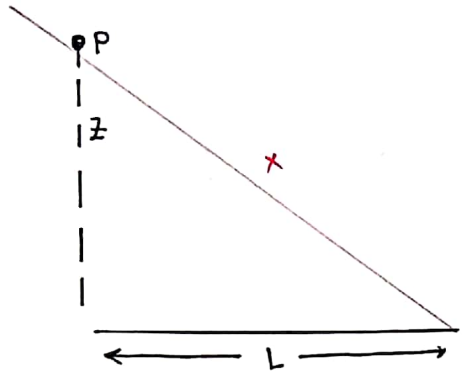
(1).



Besar E, jika $z >> L$ . . . ?

$\rightarrow$ $dq = \lambda \, dx$

$r = z$

$\longrightarrow dE = \dfrac{1}{4\pi\varepsilon_0} \dfrac{dq}{r^2} \longrightarrow dE = \dfrac{1}{4\pi\varepsilon_0} \dfrac{\lambda \, dx}{z^2}$

integrasikan medan listrik dE dari $x = 0$ hingga $x = L$

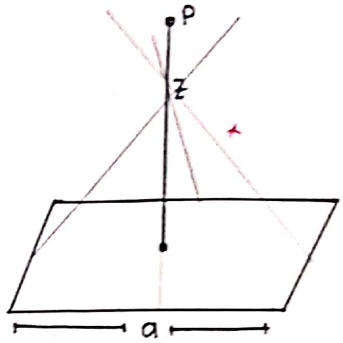
$$E = \int_0^L \frac{\lambda}{4\pi\varepsilon_0 z^2} \, dx$$

$$= \frac{\lambda}{4\pi\varepsilon_0 z^2} \int_0^L dx$$

$$= \frac{\lambda}{4\pi\varepsilon_0 z^2} \Big[x \Big]_0^L$$

$$= \frac{\lambda}{4\pi\varepsilon_0 z^2} \cdot L \longrightarrow E = \frac{\lambda L}{4\pi\varepsilon_0 z^2}$$

2.



ditanya E . . . ?

$$\longrightarrow \quad dE = \frac{1}{4\pi\varepsilon_0}\left(\frac{\lambda\, dx}{r^2}\right) \qquad r^2 = \sqrt{z^2 + x^2}$$

$$E = \int_0^{a/2} \frac{1}{4\pi\varepsilon_0} \frac{\lambda\, dx}{z^2 + x^2}$$

$$x = z \tan\theta$$

$$dx = z \sec^2\theta\, d\theta$$

$$\sqrt{z^2 + x^2} = z \sec\theta$$

$$E = \int_0^{\frac{\pi}{4}} \frac{1}{4\pi\varepsilon_0} \frac{\lambda \cdot z \sec^2\theta}{z^2 + z^2 \tan^2\theta}\, d\theta$$

$$E = \frac{\lambda}{4\pi\varepsilon_0} \int_0^{\frac{\pi}{4}} \frac{z \sec^2\theta}{z^2 + (1 + \tan^2\theta)}\, d\theta$$

$$= \frac{\lambda}{4\pi\varepsilon_0} \int_0^{\frac{\pi}{4}} \frac{\sec^2\theta}{z + (1 + \tan^2\theta)}\, d\theta$$

$$= \frac{\lambda}{4\pi\varepsilon_0} \int_0^{\frac{\pi}{4}} \frac{\sec^2\theta}{z}\, d\theta$$

$$E = \frac{\lambda}{4\pi\varepsilon_0 z} \int_0^{\pi/4} \sec^2\theta\, d\theta$$

$\longrightarrow$ integrasi dari $\sec^2\theta = \tan\theta$

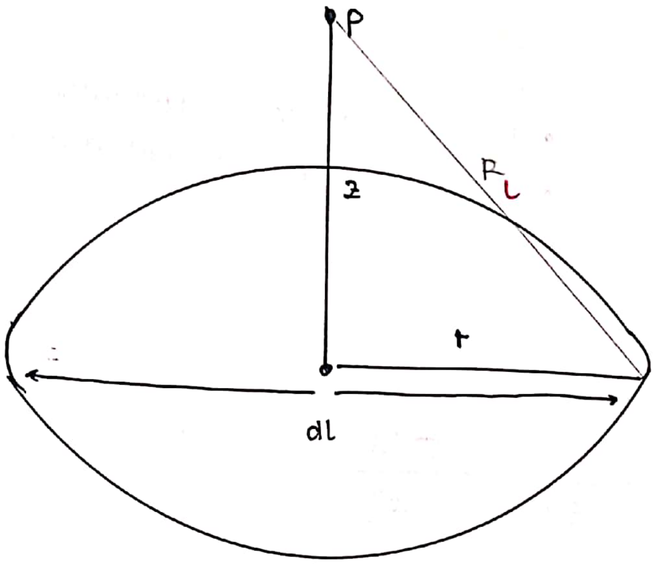
$$E = \frac{\lambda}{4\pi\varepsilon_0 z} \Big[\tan\theta\Big]_0^{\pi/4}$$

$$= \frac{\lambda}{4\pi\varepsilon_0 z} \Big[\tan(\pi/4) - \tan(0)\Big]$$

$$= \frac{\lambda}{4\pi\varepsilon_0 z} (1 - 0)$$

$$E = \frac{\lambda}{4\pi\varepsilon_0 z}$$

3) .



ditanya E . . . ?

$$\rightarrow dE = \frac{1}{4\pi\varepsilon_0}\frac{dq}{r^2} \rightarrow dq = \lambda dl$$

$$R = \sqrt{r^2 + z^2}$$

$$dE = \frac{1}{4\pi\varepsilon_0}\frac{\lambda dl}{r^2 + z^2}$$

$$E = \int_0^{2\pi r} \frac{\lambda}{4\pi\varepsilon_0 (r^2 + z^2)} dl$$

$$= \frac{\lambda}{4\pi\varepsilon_0 (r^2 + z^2)} \int_0^{2\pi r} dl$$

$$= \frac{\lambda}{4\pi\varepsilon_0 (r^2 + z^2)} \Big[dl \Big]_0^{2\pi r}$$

$$= \frac{\lambda}{4\pi\varepsilon_0 (r^2 + z^2)} \cdot 2\pi r$$

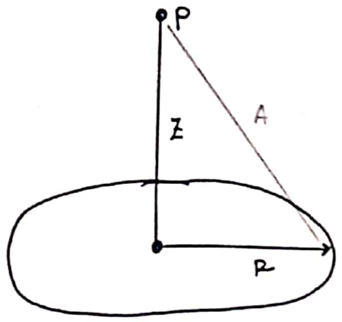
$$= \cancel{\frac{2\lambda r}{4\pi\varepsilon_0 (r^2 + z^2)}}\pi \quad \frac{2\lambda r}{4\pi\varepsilon_0 (r^2 + z^2)}\pi$$

$$= \frac{\lambda r}{2\varepsilon_0 (r^2 + z^2)}\pi$$

$$E = \frac{\lambda r \pi}{2\varepsilon_0 (r^2 + z^2)}$$

Dipindai dengan CamScanner

1).



- elemen kecil dA pada permukaan plat lingkaran
- $r = z$ karena jaraknya sejauh z

$\rightarrow dE = \frac{1}{4\pi\varepsilon_0} \frac{dQ}{r^2}$ $\quad \rightarrow dE = \frac{1}{4\pi\varepsilon_0} \cdot \frac{\sigma dA}{z^2}$

$$E = \int \frac{\sigma}{4\pi\varepsilon_0 z^2} dA$$ → karena permukaan bidang datar maka menggunakan koordinat polar

$dA = R\, d\theta\, dr$ → jarak dari pusat lingkaran ke permukaan.
sudut

$$E = \int_0^{2\pi} \int_0^R \frac{\sigma}{4\pi\varepsilon_0 z^2} R\, dr\, d\theta$$

$$= \frac{\sigma R}{4\pi\varepsilon_0 z^2} \int_0^{2\pi} \int_0^R dr\, d\theta$$

$$= \frac{\sigma R}{4\pi\varepsilon_0 z^2} \int_0^{2\pi} R\, d\theta$$

$$= \frac{\sigma R^2}{2\varepsilon_0 z^2} \int_0^{2\pi} d\theta$$

$$= \frac{\sigma R^2}{\cancel{2}\varepsilon_0 z^2} \cdot \cancel{2}\pi$$

$$E = \frac{\sigma R^2 \pi}{\varepsilon_0 z^2}$$ → medan listrik diatas plat lingkaran sejauh z yg membawa muatan seragam σ.

→ Besar E jika $(R \rightarrow \infty)$

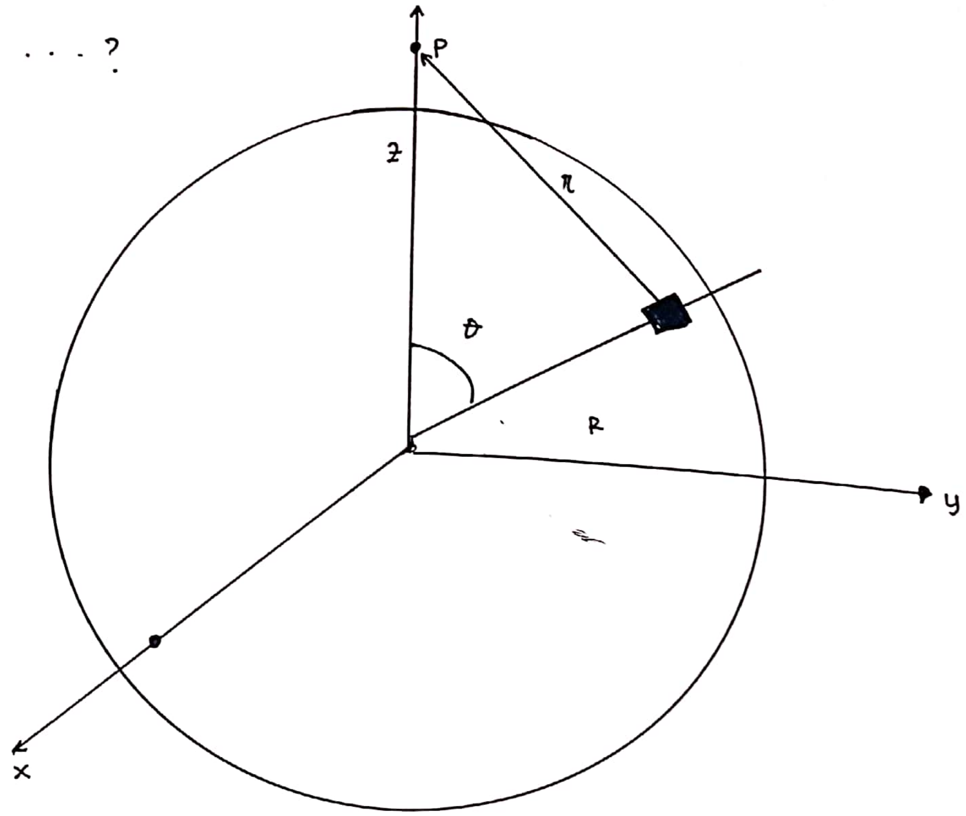
$$\lim_{R\to\infty} E = \lim_{R\to\infty} \frac{\sigma R^2 \pi}{\varepsilon_0 z^2} = 0$$ → jika R semakin besar maka banyak muatan yang tersebar di permukaan plat, dan medan listrik akan semakin mendekati nol.

→ $z \gg R$

menggunakan pendekatan $\lim_{R\to\infty}$
sehingga R^2 dalam penyebut akan menjadi besar dibandingkan dengan z^2
sehingga medan listrik akan menjadi nol

maka $E \approx 0$

5). ditanya E . . . ?



$$\rightarrow \Phi_E = \oint \vec{E} \cdot dA$$

$$= E \oint dA$$

diketahui bahwa fluks medan listrik melalui permukaan tertutup yaitu :

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

$$\Phi_E = \frac{Q_{in}}{\varepsilon_0}$$

$$Q = \sigma \cdot \frac{4}{3} \pi R^3$$

$$\rightarrow \Phi_E = E \cdot 4\pi R^2$$

$$E \cdot 4\pi R^2 = \sigma \cdot \frac{4}{3} \pi R^3 \cdot \frac{1}{\varepsilon_0}$$

$$E \cdot \cancel{4\pi R^2} = \frac{3\sigma \cancel{4\pi R^3}}{\varepsilon_0}$$

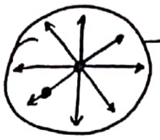
$$E = \frac{3\sigma R}{\varepsilon_0}$$

Jadi E diatas pusat bola dengan jejari ~~σ~~ R yang membawa muatan seragam desitas σ adalah

$$E = \frac{3\sigma R}{\varepsilon_0}$$

- **Hukum gauss and appluid**

$$\oint_s \vec{E}\, d\vec{A} \cdot \int (\nabla \cdot \vec{E})\, d\sigma \longrightarrow \sigma \cdot v$$



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

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

$$= \frac{\cancel{4\pi}\, q}{\cancel{4\pi}\, \varepsilon_0}$$

$$\boxed{\oint \vec{E} \cdot da = \frac{q}{\varepsilon_0}} \rightarrow \text{persamaan garis dalam bentuk diferensial}$$

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

$Q = \rho\, d\sigma \qquad \oint_s \vec{E} \cdot d\vec{a} \cdot \int (\nabla \cdot E)\, d\sigma$

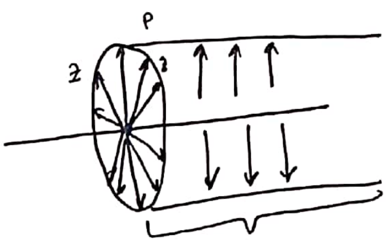
$\rightarrow \rho\, d\sigma$

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

$$\hookrightarrow \cdot \frac{1}{\varepsilon_0} \int_v \rho\, d\sigma$$

$$\boxed{\nabla \vec{E} = \frac{\rho}{\sigma}} \longrightarrow \text{Hukum gauss dalam bentuk differensial}$$

example :

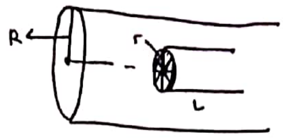


$$\oint \vec{E} . da \cdot \frac{q}{\varepsilon_0}$$

$$\dot{E}\, (2\pi z . \ell) \quad \frac{\lambda . l}{\varepsilon_0}$$

$$\varepsilon_0 \cdot \frac{\lambda}{2\pi\varepsilon_0 z} \, z^{\circ}$$

2).



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

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

$$\vec{E} \cdot \frac{Q}{2\pi r . l} \hat{\varepsilon}_0$$

soal

1).

calculate of $\vec{E}$

(1). $r < a$

(2) $a < r < b$

(3) $r > b$

$$\oint \vec{E} \cdot da \cdot \frac{Q}{\varepsilon_0}$$

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

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

$$= \frac{4\pi\rho}{\cancel{6}} \int_0^a r^2\, d\rho$$

$$= \frac{4\pi\rho}{\cancel{\rho}\varepsilon_0} r^2$$

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

$$\cdot \frac{\cancel{4\pi}\rho}{\varepsilon_0} \left(\frac{1}{3} r^3 \right]_0^a \checkmark$$

$$= \frac{4}{3} \frac{\pi a^3}{\varepsilon_{0_3}}$$

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

• $E \rightarrow r > b$

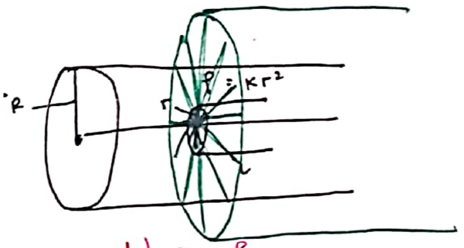
$$\oint \vec{E}\, d\vec{a} = \frac{1}{\varepsilon_0}\iiint \rho\, d\tau$$

$$= \frac{1}{\varepsilon_0}\iiint \rho \sin\theta\, d\theta\, d\phi\, dr$$

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

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

2)



1) $r < R$

2) $r > R$

•). $\oint \vec{E}\cdot da = \frac{1}{\varepsilon_0}\iiint \rho\, d\tau$

$$\vec{E}(2\pi r . l) = \frac{1}{\varepsilon_0}\iiint (kr^2)\, r\, dr\, d\phi\, dz \quad \cancel{r^2 \sin\theta\, d\theta\, d\phi\, dr}$$

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

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

$$\vec{E}(2\pi r . l) = \frac{1}{\varepsilon_0}\int_0^R\int_0^{\pi}$$

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potensial → muatan

Beda poten → arus listri

→ usaha memindahkan muatan dari jauh ke titik tertentu (atau kerja yang dilakukan persatuan muatan)

usaha ← $W = F . S$

$$V = \frac{W}{q} = \frac{F . S}{q} = \frac{k\frac{q . q}{r}\, r}{q}$$

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

$$V = -\int \vec{E}\, dr$$

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

$$V_1 - V_0 = -\int_{r_1}^{r_2} \vec{E}\, (dr)$$

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

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

$\Delta V \neq dV$

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

$$= -\left[-\frac{1}{r}\Big|_{r_1}^{r_2}\right]$$

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

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