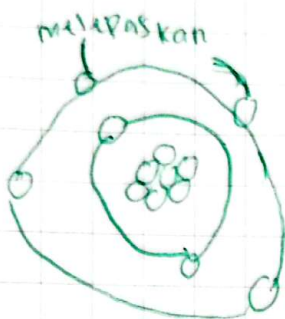


12 September 2025

Medan Elektromagnetik

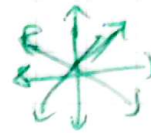
- $\vec{E}$ oleh muatan diskrit



↳ kata sifat dari kata atom

$$+q = ze$$

Muatannya rapat



$$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{ze\hat{r}}{r^2}$$

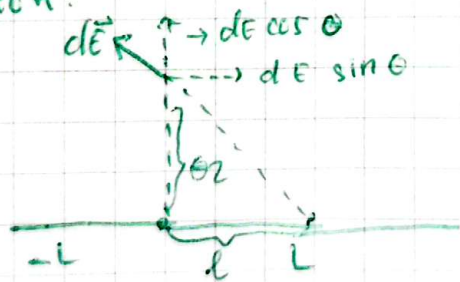
- Medan distribusi

$\vec{E} \rightarrow$ terdistribusi dalam bahan

distribusi: $\vec{E} = \frac{q}{4\pi\epsilon_0 r^2} \hat{r}_0$

(1.) $\vec{E} = \frac{1}{4\pi\epsilon_0} \int \frac{q}{r^2} d\vec{l}$ (berbentuk garis)

Contoh:



$$d\vec{E} = dE_y + dE_x$$
$$= dE_y$$

$$dE = dE \cos \theta$$

$$\vec{E} = \frac{1}{4\pi\epsilon_0} \int \frac{dq}{r^2}$$

$$= \frac{1}{\square} \int_{-L}^L \frac{\lambda dl \cos \theta}{r^2}$$

$$= \frac{1}{\square} \int_0^{2L} \frac{\lambda d\ell \cos \theta}{r^2} \frac{1}{\square}$$

$$= \frac{1}{\square} \int_0^{2L} \frac{\lambda z dp}{r^3}$$

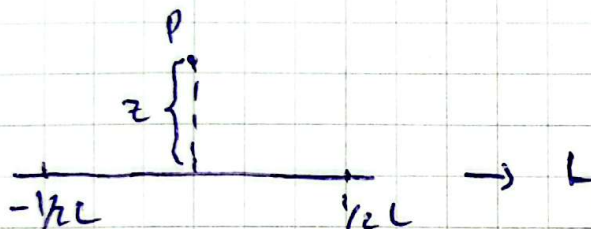
$$\vec{E} = \frac{1}{\square} \int_0^{2L} \frac{\lambda z dl}{(z^2 + l^2)^{3/2}}$$

$$= \frac{2\lambda}{\square} \int \frac{dl}{(z^2 + l^2)^{3/2}}$$

$$= \frac{2\lambda}{\square} \left[\frac{l}{z^2 (z^2 + l^2)^{1/2}} \right]_0^{2L}$$

$$\vec{E} = \frac{2\lambda}{4\pi\epsilon_0} \left[\frac{2L}{z^2 (z^2 + (2L)^2)^{1/2}} \right]$$

Soal:



$$dE = \frac{1}{4\pi\epsilon_0} \frac{dq}{r^2} = \frac{1}{4\pi\epsilon_0} \frac{\lambda dx}{(x^2 + z^2)}$$

$$dE_z = dE \cos \theta = \frac{1}{4\pi\epsilon_0} \frac{\lambda dx}{x^2 + z^2} \frac{z}{\sqrt{x^2 + z^2}}$$

$$= \frac{\lambda z}{4\pi\epsilon_0} \frac{dx}{(x^2 + z^2)^{3/2}}$$

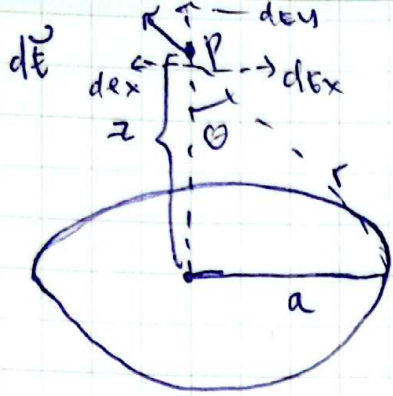
$$dE_z = \frac{\lambda z}{4\pi\epsilon_0} \int_{-L/2}^{L/2} \frac{dx}{(x^2 + z^2)^{3/2}}$$

$$\int \frac{dx}{(x^2 + a^2)^{3/2}} = \frac{x}{a^2 \sqrt{x^2 + a^2}} + C$$

$$\int_{-L/2}^{L/2} \frac{dx}{(x^2 + z^2)^{3/2}} = \left[\frac{x}{z^2 \sqrt{x^2 + z^2}} \right]_{-L/2}^{L/2}$$

$$E_z = \frac{\lambda z}{4\pi\epsilon_0} \cdot \frac{L}{z^2 \sqrt{(L/2)^2 + z^2}} = \frac{\lambda L}{4\pi\epsilon_0} \cdot \frac{1}{z \sqrt{z^2 + (L/2)^2}}$$

$$E_z(P) = \frac{\lambda L}{4\pi\epsilon_0 z \sqrt{z^2 + (L/2)^2}}$$



Berapa medan yang ditimbulkan?

$\Rightarrow$ saling meniadakan

$$d\vec{E} = dE_x + dE_y$$

$$= dE_y$$

$$= dE \cos \theta$$

$$\vec{E} = dE \cos \theta$$

$$\vec{E} = \frac{1}{4\pi\epsilon_0} \int_0^{2\pi a} \frac{\lambda dl \cos \theta}{r^2} = \frac{1}{4\pi\epsilon_0} \int_0^{2\pi a} \frac{\lambda z}{r^3} dl$$

$$= \frac{1}{4\pi\epsilon_0} \int_0^{2\pi a} \frac{\lambda z}{(z^2 + l^2)^{3/2}} dl$$

$$= \frac{\lambda z}{4\pi\epsilon_0 (z^2 + a^2)^{3/2}} \Big|_0^{2\pi a}$$

$$\vec{E} = \frac{\lambda z 2\pi a}{4\pi\epsilon_0 (z^2 + a^2)^{3/2}}$$

$$= \frac{\lambda z a}{2\epsilon_0 (z^2 + a^2)^{3/2}}$$