بسم الله الرحمن الرحيم

No. Senin (5)

Date 18 . 03 . 24

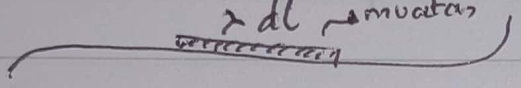
Kelistrikan dan Kemagnetan

1. $\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{q}{r^2} \hat{r}$

   $= k \frac{q}{r^2} \cdot \hat{r}_0$ → Oleh muatan diskrit (terpisah)

2. $\vec{E} = \frac{1}{4\pi\varepsilon_0} \int \frac{\lambda \, dL}{r^2}$

   $= q = \lambda L$ → muatan terdistribusi pada penggaris



3. $\vec{E} = \frac{1}{4\pi\varepsilon_0} \iint \frac{\sigma \, da}{r^2} \cdot \hat{r}_0$

   Luas permukaan

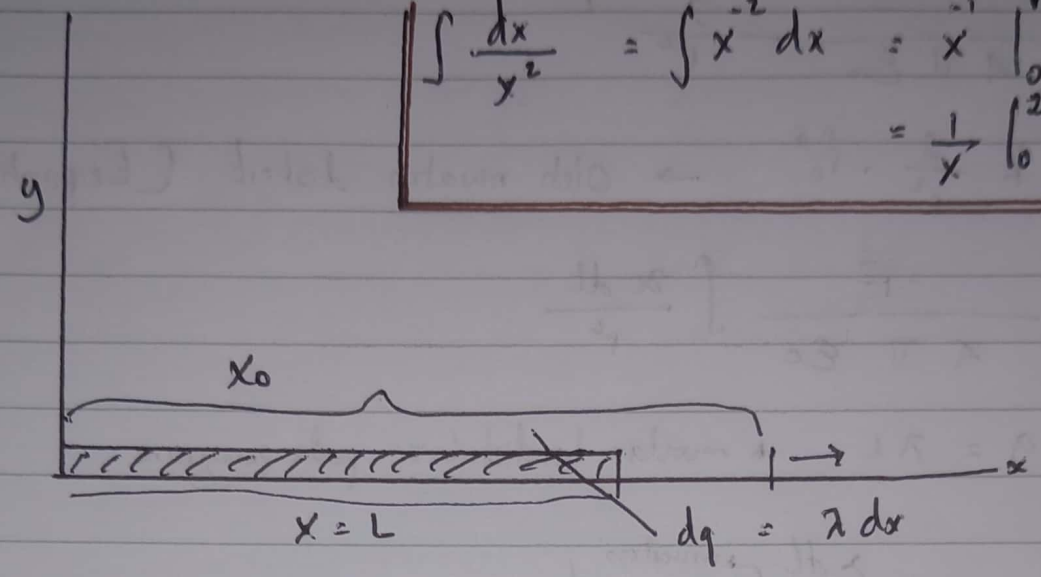
4. $\vec{E} = \frac{1}{4\pi\varepsilon_0} \iiint \frac{\rho \, d\tau}{r^2} \hat{r}_0$ Pada ruang

   muatan tersebar pada volume

Contoh soal. Hal 50.

1. Muatan terdistribusi dengan panjang tertentu (L), muatan seragam Q terletak pada garis ȳ panjangnya L. di sepanjang sumbu x. x = 0 sampai x = L. densitas muatan Q = λL. Hitung medan listrik pada titik P, ȳ terletak pada $x_0 > L$!

$$\int \frac{dx}{x^2} = \int x^{-2}\,dx = x^{-1}\Big|_0^{+2} = \frac{1}{x}\Big|_0^2$$



$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\int_0^2 \frac{\lambda\,dx}{(x_0 - x)^2}$$

$$= \frac{1}{4\pi\varepsilon_0}\lambda\int_0^2 (x_0 - x)^{-2}\,dx$$

$$= \frac{\lambda}{4\pi\varepsilon_0}(x_0 - x)^{-1}\Big|_0^2$$

$$= \frac{\lambda}{4\pi\varepsilon_0}\left(\frac{1}{x_0 - x}\right)\Big|_0^2$$

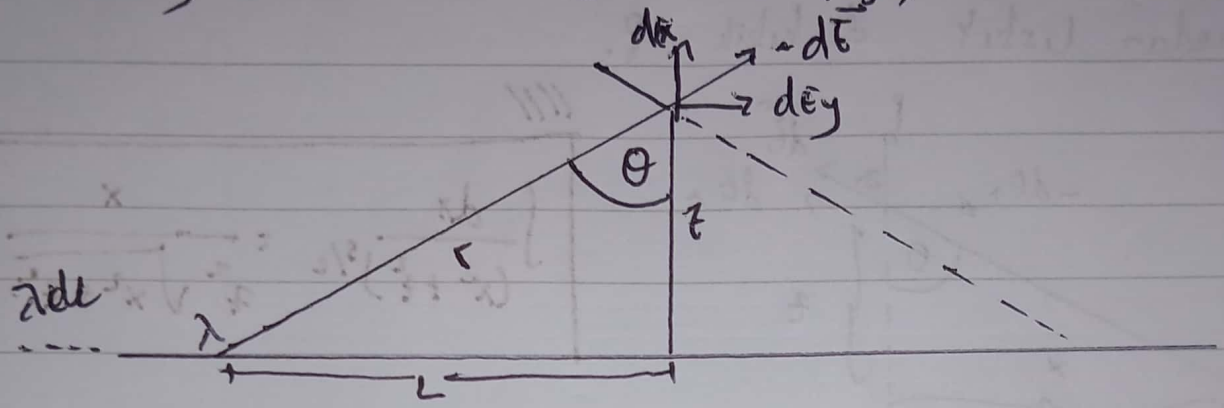
$$= \frac{\lambda}{4\pi\varepsilon_0}\left(\frac{1}{x_0 - 2} - \frac{1}{x_0 - 0}\right)$$

$$= \frac{\lambda}{4\pi\varepsilon_0}\left(\frac{1}{x_0 - L} - \frac{1}{x_0}\right)$$

$$= \frac{\lambda}{4\pi\varepsilon_0}\left(\frac{L}{x_0(x_0 - L)}\right)$$

Soal no 2 hal 51

Hitung medan listrik sejauh z, panjang λ = homogen



$x = -\infty$ $\quad \cos\theta = \frac{z}{r}$ $\quad \tan = \frac{x}{z}$

$\theta = -\frac{\pi}{2}$ $\quad r = \frac{z}{\cos\theta}$ $\quad x = z \tan\theta$

$\omega = \frac{\pi}{2}$

$dx = \cos^2\theta$

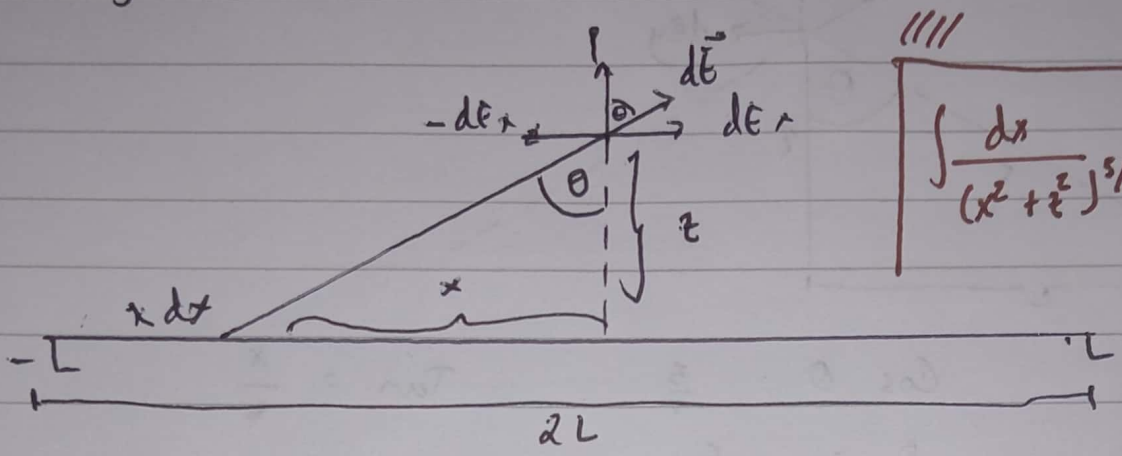
$$\vec{E} = dE_x + dE_y$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \int_{-\infty}^{\infty} \frac{\lambda\, dx}{r^2} \cos\theta$$

$$= \frac{\lambda}{4\pi\varepsilon_0} \int_{-\infty}^{\infty} r^2\, dx \cos\theta$$

Soal no. 3. Hal 52

Hitunglah medan listrik di titik P.



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

$d\vec{E} = dE_y + d\vec{E}_x$ saling meniadakan

$= dE_y$

$dE_y = dE \cos\theta$

$\vec{E} = \frac{1}{4\pi\varepsilon_0} \int_{-L}^{L} \frac{\lambda dL}{r^2} \cos\theta$

$\vec{E} = \frac{2\lambda}{4\pi\varepsilon_0} \int_{0}^{L} \frac{\lambda dx}{(x^2+z^2)} \cos\theta$

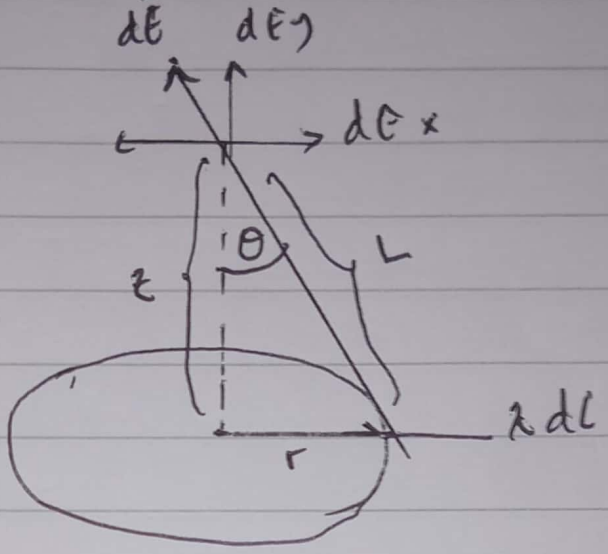
$\vec{E} = \frac{2\pi z}{4\pi\varepsilon_0} \int_{0}^{L} \frac{dx}{(x^2+z^2)^{3/2}}$

$= \frac{2\pi z}{4\pi\varepsilon_0} \left(\frac{x}{z^2\sqrt{x^2+z^2}} \right)\Big|_0^L$ Ganti nilai $x \to L$

$= \frac{2\lambda z}{2\pi\varepsilon_0} \left(\frac{L}{L^2\sqrt{L^2+z^2}} \right) - 0$

Soal no 3 hal 53

3. Hitung medan listrik.



Jawab :

$$E = \frac{1}{4\pi\varepsilon_0} \int_0^{2\pi} \frac{z\lambda\, dL}{(z^2+r^2)^{3/2}}$$

$$= \frac{z\lambda}{4\pi\varepsilon_0 (z^2+r^2)^{3/2}} \int_0^{2\pi r} dL$$

$$= \frac{z\lambda}{4\pi\varepsilon_0 (z^2+r^2)^{3/2}} \cdot L \Big|_0^{2\pi r}$$

$$= \frac{z\lambda}{4\pi\varepsilon_0 (z^2+r^2)^{3/2}} (2\pi R - R)$$

$$= \frac{z\lambda}{4\pi\varepsilon_0 (z^2+r^2)^{3/2}} \cdot \frac{2\pi r}{2}$$