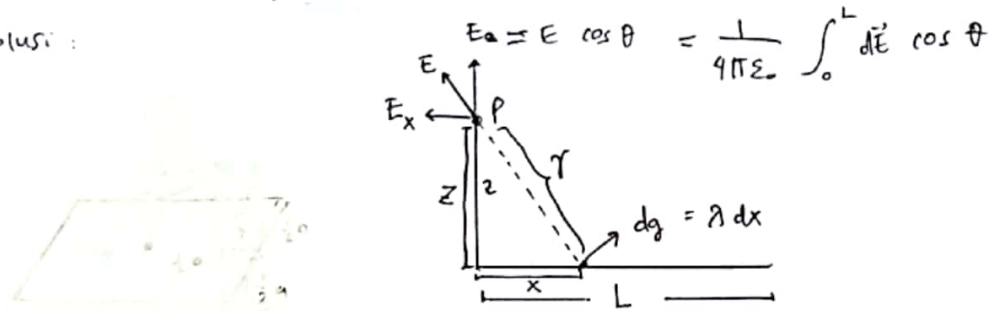


- ① Hitung medan listrik pada salah satu ujung kawat yang panjangnya L yang membawa muatan seragam λ . Bagaimana besar E , jika $z \gg L$.

* Solusi :



$$\vec{E} = \vec{E}_z + \vec{E}_x$$

$$\vec{E}_z = \frac{1}{4\pi\epsilon_0} \int_0^L d\vec{E} \cos \theta$$

$$\vec{E}_z = \frac{1}{4\pi\epsilon_0} \int_0^L \frac{\lambda dx}{r^2} \cos \theta \quad ; \text{Dimana : } \cos \theta = \frac{z}{r}$$

$$\vec{E}_z = \frac{1}{4\pi\epsilon_0} \int_0^L \frac{z \lambda dx}{r^3}$$

$$\vec{E}_z = \frac{1}{4\pi\epsilon_0} \int_0^L \frac{z \lambda dx}{(z^2 + x^2)^{3/2}}$$

$$\vec{E}_z = \frac{z\lambda}{4\pi\epsilon_0} \int_0^L \frac{dx}{(z^2 + x^2)^{3/2}}$$

$$\vec{E}_z = \frac{1}{4\pi\epsilon_0} \cdot \lambda z \left[\frac{1}{z^2} \frac{x}{\sqrt{z^2 + x^2}} \right]_0^L$$

$$\vec{E}_z = \frac{\lambda z}{4\pi\epsilon_0} \cdot \frac{L}{z^2 \sqrt{z^2 + x^2}}$$

$$\vec{E}_z = \frac{\lambda}{4\pi\epsilon_0} \cdot \frac{L}{z \sqrt{z^2 + x^2}}$$

$$\vec{E}_x = -\frac{1}{4\pi\epsilon_0} \int_0^L \frac{\lambda dx}{r^2} \sin \theta$$

$$= -\frac{\lambda}{4\pi\epsilon_0} \int_0^L \frac{x dx}{(z^2 + x^2)^{3/2}}$$

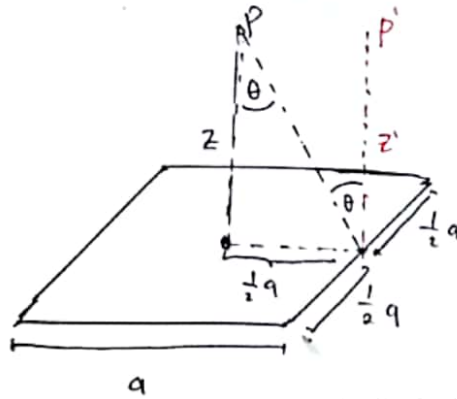
$$= -\frac{\lambda}{4\pi\epsilon_0} \cdot \frac{1}{2} \int_0^L \frac{dx^2}{(z^2 + x^2)^{3/2}}$$

$$= -\frac{\lambda}{4\pi\epsilon_0} \cdot \frac{1}{2} \left[-2 \frac{1}{(z^2 + x^2)^{1/2}} \right]_0^L = -\frac{\lambda}{4\pi\epsilon_0} \left[-\left(\frac{1}{\sqrt{z^2 + x^2}} \right) - \left(-\frac{1}{z} \right) \right]$$

$$= -\frac{\lambda}{4\pi\epsilon_0} \left(\frac{1}{z} - \frac{1}{\sqrt{z^2 + x^2}} \right)$$

- ② Hitung medan listrik sejauh z dari titik tengah loop segi empat panjang yang membawa muatan seragam λ . Gunakan contoh nomor 3 pada permasalahan ini.

* Solusi:



$$P = P' \cos \theta \Rightarrow P = 4P' \cos \theta$$

Ditentukan: $L = \frac{1}{2}$

$$z' = r = \sqrt{z^2 + \left(\frac{1}{2}a\right)^2}$$

$$\cos \theta = \frac{z}{\sqrt{z^2 + \left(\frac{1}{2}a\right)^2}}$$

Dengan menggunakan rumus seperti pada

contoh No. 3 yaitu: $E = \frac{1}{4\pi\epsilon_0} \frac{2\lambda L}{z'^2}$

Maka,

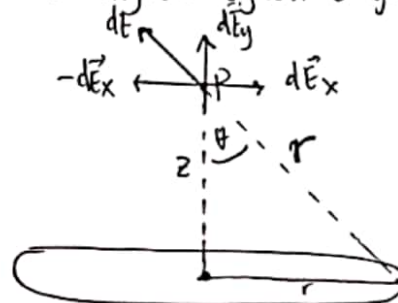
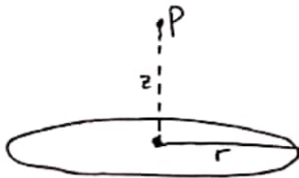
Memiliki 4 sisi

$$\vec{E} = 4 \frac{1}{4\pi\epsilon_0} \cdot \frac{2\lambda \left(\frac{1}{2}a\right)}{z'^2}$$

$$\vec{E} = 4 \frac{1}{4\pi\epsilon_0} \cdot \frac{2\lambda \left(\frac{1}{2}a\right) \cdot z}{\left(z^2 + \left(\frac{1}{2}a\right)^2\right) \sqrt{z^2 + \left(\frac{1}{2}a\right)^2}}$$

$$\vec{E} = \frac{1}{4\pi\epsilon_0} \cdot \frac{4\lambda a z}{\left(z^2 + \frac{a^2}{4}\right) \sqrt{z^2 + \frac{a^2}{4}}}$$

- ③ Hitung medan listrik di atas pusat kawat melingkar sejauh z yang membawa muatan seragam λ .



$$d\vec{E} = d\vec{E}_y + d\vec{E}_x = 0$$

$$= dE \cos \theta$$

$$\bullet \vec{E} = \frac{1}{4\pi\epsilon_0} \int \sigma da$$