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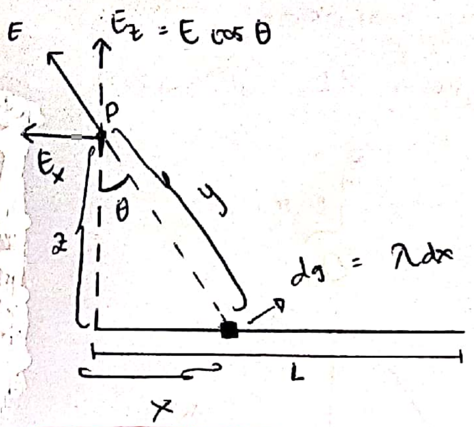
1.



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

- cari $\vec{E}_z$ dulu

$$\vec{E}_z = \frac{1}{4\pi\varepsilon_0} \int_0^L d\vec{E} \cos\theta$$

$$= \frac{1}{4\pi\varepsilon_0} \int_0^L \frac{dq}{r^2} = \frac{1}{\square} \int_0^L \frac{\lambda dx}{r^2} \cos\theta \Rightarrow \text{dimana } \boxed{\cos\theta = \frac{z}{r}}$$

$$\vec{E}_z = \frac{1}{\square} \int_0^L \frac{z \lambda dx}{r^3} = \frac{1}{\square} \int_0^L \frac{z \lambda dx}{(z^2+x^2)^{3/2}} \longrightarrow \frac{1}{4\pi\varepsilon_0} \lambda z \int_0^L \frac{dx}{(z^2+x^2)^{3/2}}$$

$$= \frac{z\lambda}{4\pi\varepsilon_0} \int_0^L \frac{dx}{(z^2+x^2)^{3/2}}$$

Lalu lihatlah daftar integral $\int_0^L \frac{dx}{(z^2+x^2)^{3/2}} = \frac{1}{z^2} \frac{x}{\sqrt{z^2+x^2}} \Big|_0^L$

maka, $\vec{E}_z = \frac{\lambda z}{4\pi\varepsilon_0} \cdot \frac{L}{z^2\sqrt{z^2+x^2}} = \frac{\lambda}{4\pi\varepsilon_0} \cdot \frac{L}{z\sqrt{z^2+x^2}}$

- cari $\vec{E}_x$ dulu

$$\vec{E}_x = -\frac{1}{4\pi\varepsilon_0} \int_0^L \frac{\lambda dx}{r^2} \sin\theta = -\frac{\lambda}{4\pi\varepsilon_0} \int_0^L \frac{x\,dx}{(z^2+x^2)^{3/2}}$$

ubahlah $\vec{E}_x$ ke kiri,

$$= -\frac{\lambda}{4\pi\varepsilon_0} \cdot \frac{1}{2} \cdot \int_0^L \frac{dx^2}{(z^2+x^2)^{3/2}}$$

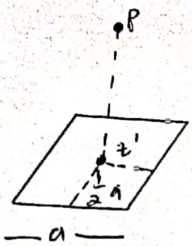
$$= -\frac{\lambda}{4\pi\varepsilon_0} \cdot \frac{1}{2} \cdot \left[-2 \frac{1}{(z^2+x^2)^{\frac{1}{2}}} \right|_0^L$$

$$= -\frac{\lambda}{4\pi\varepsilon_0} \left[-\left(\frac{1}{\sqrt{z^2+x^2}} - \frac{1}{z} \right) \right]$$

$$\vec{E}_x = -\frac{\lambda}{4\pi\varepsilon_0} \left[\frac{1}{z} - \frac{1}{\sqrt{z^2+x^2}} \right]$$

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

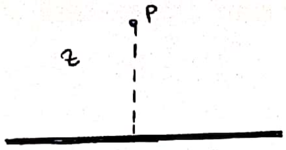
(2)

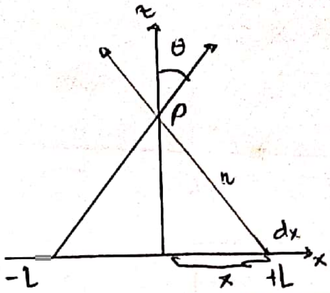


untuk menyelesaikan soal ini, gunakan contoh 3 yaitu kawat yang panjangnya 2L, dengan

$$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{2\lambda L}{z'^2}$$

- contoh soal 3





$$dE = \frac{1}{4\pi\varepsilon_0}\, 2\left(\frac{\lambda\, dx}{r^2}\right) \cos\theta\, \hat{k} \Rightarrow \boxed{\theta = \frac{z}{r} = \sqrt{z^2+x^2}}$$

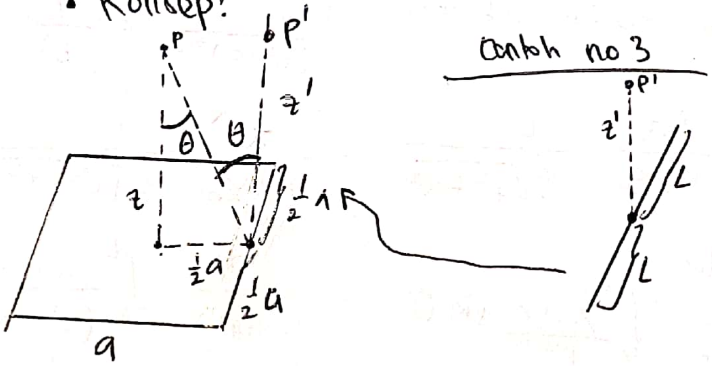
$$E = \frac{1}{4\pi\varepsilon_0} \int_0^L \frac{2\lambda z}{(z^2+x^2)^{3/2}}\, dx = \frac{2\lambda z}{4\pi\varepsilon_0} \left[\frac{x}{z^2\sqrt{(z^2+x^2)}}\right]\Bigg|_0^L$$

$$= \frac{1}{4\pi\varepsilon_0} \frac{2\lambda L}{z\sqrt{z^2+x^2}}$$

Kalau $(z \gg L)$, maka medan listrik pada kawat panjang $2L$ adalah =

$$\boxed{E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{2\lambda L}{z^2}}$$

- Konsep!



$P = P' \cos\theta$; karena ada 4 sisi, maka

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

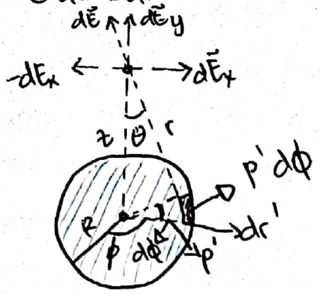
sehingga, $\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{2\lambda L}{z'^2} = 4 \cdot \frac{1}{4\pi\varepsilon_0} \frac{2\lambda L}{z'^2} \cos\theta$

karena $L = \frac{1}{2}a$, dan $z' = r = \sqrt{z^2 + (\frac{1}{2}a)^2}$

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

maka, $\vec{E} = 4 \cdot \frac{1}{4\pi\varepsilon_0} \frac{2\lambda(\frac{1}{2}a) \cdot z}{\left(z^2 + (\frac{1}{2}a)^2\right)\sqrt{z^2+(\frac{1}{2}a)^2}}$

③ • Gambar dulu elemen yang menimbulkannya.



$$ds = da = p \times e$$

$$= dp' \, p' d\phi$$

elemen dalam $da = p' ds' d\phi$

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

$$= dE \cos\theta$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \int_s \frac{\sigma \, da}{p^2} \cos\theta$$

$$= \frac{1}{4\pi\varepsilon_0} \int_0^R \int_0^{2\pi} \frac{\sigma}{p^2} \cos\theta \underbrace{r' \, dp' \, d\phi}_{da}$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \sigma z \int_0^R \int_0^{2\pi} \frac{p' \, dp' \, d\phi}{(p'^2 + z^2)^{3/2}}$$

$$= \frac{\cancel{2\pi} \sigma z}{\cancel{4\pi}_2 \varepsilon_0} \int_0^R \frac{p' \, dp'}{(p'^2 + z^2)^{3/2}}$$ ⇒ p' dibuat dalam bentuk diferensial, tetapi tidak merusak maknanya.

$$= \frac{\sigma z}{2\varepsilon_0} \int_0^R \frac{1}{2} \frac{d(p'^2 + z^2)}{(p'^2 + z^2)^{3/2}}$$ ⇒ $p'^2 = 2p'$

$$E = \frac{\pi z}{2\varepsilon_0} \int_0^R \frac{1}{2} \frac{d(2p' + z^2)}{(2p' + z^2)^{3/2}}$$