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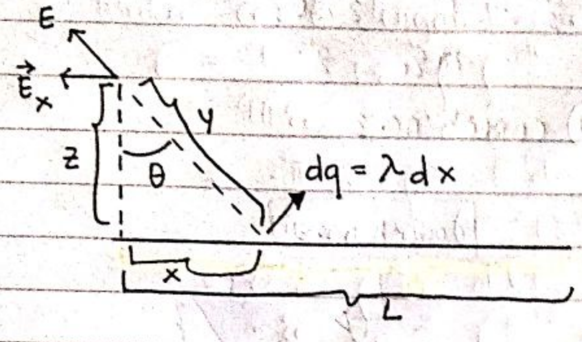
1.



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

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

Ambil $\vec{E}_z = \frac{1}{4\pi\varepsilon_0}\int_0^L \frac{dq}{r^2} = \frac{1}{\square}\int_0^L \frac{\lambda\, dx}{r^2}\cos\theta$

$$\cos\theta = \frac{z}{r}$$

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

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

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

$$= \frac{1}{4\pi\varepsilon_0}\lambda z\left[\frac{1}{z^2}\frac{x}{\sqrt{z^2+x^2}}\Big|_0^L\right]$$

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

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

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

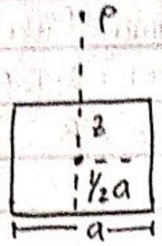
$$= -\frac{\lambda}{4\pi\varepsilon_0}\cdot\frac{1}{2}\left[-2\frac{1}{(z^2+x^2)^{1/2}}\Big|_0^L\right]$$

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

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

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

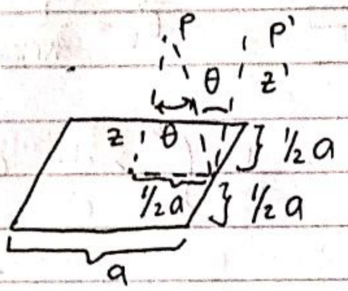
Dipindai dengan CamScanner

2) 

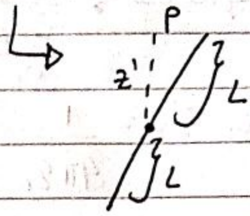
Solusi : Untuk menyelesaikan Soal disamping gunakan Contoh no.3 yaitu kawat yang Panjangnya $2L$, dengan
$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{2\lambda L}{z'^2}$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{2\lambda L}{z'^2} \longrightarrow \text{hasil contoh no. 3}$$

konsepnya :



$\boxed{\text{Contoh no. 3}}$



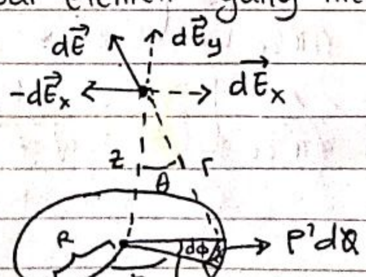
$P = P'\cos\theta$, karena ada 4 sisi, maka
$P = 4P'\cos\theta$, sehingga
$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{2\lambda L}{z'^2} = 4 \cdot \frac{1}{4\pi\varepsilon_0}\frac{2\lambda L}{z'^2}\cos\theta$$
karena $L = 1/2a$ dan $z' = r = \sqrt{z^2+(1/2a)^2}$, $\cos\theta = \dfrac{z}{\sqrt{z^2+(1/2a)^2}}$

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

3. Tentukan medan listrik berjarak z diatas pusat permukaan ke bentuk lingkaran dengan jari" R yang membawa permukaan seragam.

Pemecahan :

1.) Gambar elemen yang menimbulkan dititik



elemen luas

$\longrightarrow ds = da = P \times l$
$= dr' \cdot p' d\phi$
$da = r' dr' d\phi$

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

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\int_0^R\int_0^{2\pi}\frac{r}{r^2}\cos\theta\,.\underbrace{p'dr'd\phi}_{da} \longrightarrow \vec{E} = \frac{1}{4\pi\varepsilon_0}\int_s\frac{\sigma da}{r^2}\cos\theta$$

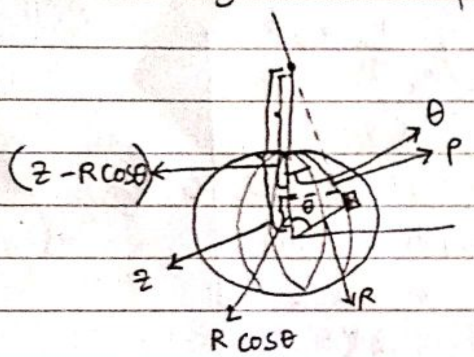
$\cos\theta$ dengan r^2, sehingga jadi

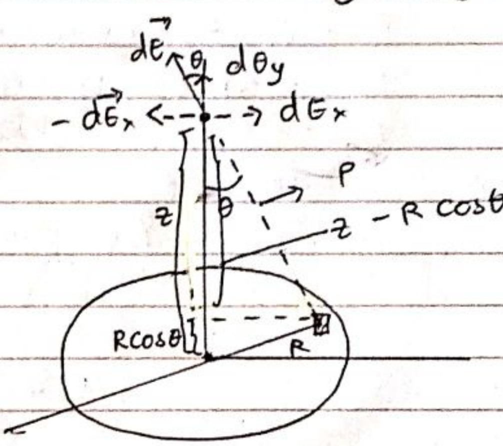
$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\,rz\int_0^R\int_0^{2\pi}\frac{p'dp'd\phi}{(p'^2+z^2)^{3/2}}$$

$$= \frac{2\pi rz}{4\pi\varepsilon_0}\int_0^R\frac{p'dr'}{(p'^2+z^2)^{3/2}}$$, p' dibuat dalam bentuk diferensial tapi tidak mengubah makna

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

4. Bola tipis bermuatan terdistribusi ~~muat~~ merata. hitung energi listrik sejauh z dari pusat O





Pandang p

$$P = [(R\sin\theta)^2 + (z - R\cos\theta)^2]^{1/2}$$

$$= [R^2\sin^2\theta + (z^2 + R^2\cos^2\theta - 2Rz\cos\theta)]^{1/2}$$

$$= [R^2(\sin^2\theta + \cos^2\theta) + z^2 - 2Rz\cos\theta]^{1/2}$$

$$P = R^2 + z^2 - 2Rz\cos\theta)^{1/2}$$

$$dE = \overset{0}{d\vec{E}_x} + dE_y$$

$$dE = dE\cos\theta$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\int_0^\pi\int_0^{2\pi}\frac{r\,da\cos\theta}{p^2} \cancel{= \frac{1}{4\pi\varepsilon_0}\int_0^\pi\int_0^{2\pi}\sigma(z-R\cos\theta)}$$

$$= \frac{1}{4\pi\varepsilon_0}\int_0^\pi\int_0^{2\pi}\frac{r(z-R\cos\theta)R^2\sin\theta\,d\theta\,d\phi}{(R^2z^2 - 2Rz\cos\theta)^{3/2}}$$