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UTS KALISMA

2. a. dik : L = L (panjang batang)
rapat muatan = λ
P berjarak z dari ujung batang

$$dq = \lambda \cdot dx$$
$$r = \sqrt{((L-x)^2 + z^2}$$

dit : EP atas ujung kawat

$$dE = \frac{1}{4\pi\varepsilon_0} \cdot \frac{dq}{r^2}$$
$$= \frac{1}{4\pi\varepsilon_0} \cdot \frac{\lambda\, dx}{(L-x)^2 + z^2}$$
$$d\bar{E}_z = d\bar{E} \cdot \frac{z}{r}$$
$$= \frac{1}{4\pi\varepsilon_0} \cdot \frac{\lambda z\, dx}{((L-x)^2 + z^2)^{3/2}}$$
$$\bar{E} = \int_0^L d\bar{E}_z = \frac{\lambda z}{4\pi\varepsilon_0} \int_0^L \frac{dx}{((L-x)^2 + z^2)^{3/2}}$$
$$= \frac{\lambda z}{4\pi\varepsilon_0} \int_0^L \frac{du}{(u^2 + z^2)^{3/2}}$$
$$\bar{E} = \frac{\lambda z}{4\pi\varepsilon_0} \cdot \frac{L}{z^2\sqrt{L^2 + z^2}}$$
$$E = \frac{\lambda}{4\pi\varepsilon_0} \cdot \frac{L}{z\sqrt{L^2 + z^2}}$$

b. Dik : P berjarak vertikal z dari kawat, kawat membentang dari $-\frac{1}{2}$ ke $\frac{1}{2}$

$$dq = \lambda \cdot dx$$
$$r = \sqrt{x^2 + z^2}$$

Dit : Ep tengah dengan
Jawab :

$$d\bar{E} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{dq}{r^2}$$
$$= \frac{1}{4\pi\varepsilon_0} \cdot \frac{\lambda\, dx}{x^2 + z^2}$$

$$dE_y = dE \cdot \cos\theta = dE \cdot \frac{z}{\sqrt{x^2+z^2}}$$

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

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

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

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

$$E = \frac{\lambda}{4\pi\varepsilon_0} \cdot \frac{L}{z\sqrt{(L/2)^2+z^2}}$$

3. Dik Rapat muatan : σ

$r = R$.

Dit : E pada bola (dalam & luar) ?

Jawab :

E dalam : $0 \rightarrow r < R$

$$Q = \sigma \cdot A$$
$$= \sigma \cdot 4\pi R^2$$
$$E = k\frac{Q}{r^2}$$
$$= \frac{1}{4\pi\varepsilon_0} \cdot \frac{\sigma \cdot 4\pi R^2}{r^2}$$

$$E = \frac{\sigma R^2}{\varepsilon_0 r^2} \rightarrow E_{luar} = \frac{\sigma R^2}{\varepsilon_0 r^2} \rightarrow r \geq R.$$

4. Dik : $\vec{E} = kr^5\hat{r}$

$r = 0$

dit : a. $\rho(r)$

b. Q_{total}

Jawab :

a. $\nabla \cdot \vec{E} = \frac{1}{r^2}\frac{d}{dr}(r^2 \cdot Er)$

$= \frac{1}{r^2}\frac{d}{dr}(kr^5)$

$= \frac{1}{r^2} \cdot 5kr^4 = 5kr^2$

$\rho(r) = \varepsilon_0 (\nabla \cdot \vec{E})$

$= 5k\varepsilon_0 r^2$

b. $Q = \int_V \rho \, dV$

$= \int_0^R 5 k_e \alpha r^2 \cdot 4\pi r^2 \, dr$

$= 20\pi k \varepsilon_0 \int_0^R r^4 \, dr$

$= 20\pi k \varepsilon_0 \cdot \frac{R^5}{5}$

$Q = 4\pi k \varepsilon_0 R^5$

5. Dik : P sejauh z dr atas persegi ($s \times s = s$)

Dit : $\vec{E}P$?

Jawab :

$E_z = \frac{2k\lambda \sin\theta}{z}$; $\theta = \tan^{-1}\left(\frac{s}{2z}\right)$

$E = 4 \cdot \frac{2k\lambda \sin\theta}{z} \rightarrow 4$ sisi

$= \frac{8k\lambda \sin\theta}{z}$; $\sin(\tan^{-1}(x)) = \frac{x}{\sqrt{1+x^2}}$

$E = \frac{8k\lambda}{z} \cdot \frac{s}{2z\sqrt{1+(s/2z)^2}}$

$E = \frac{4k\lambda s}{z^2\sqrt{1+s^2/4z^2}}$