No.

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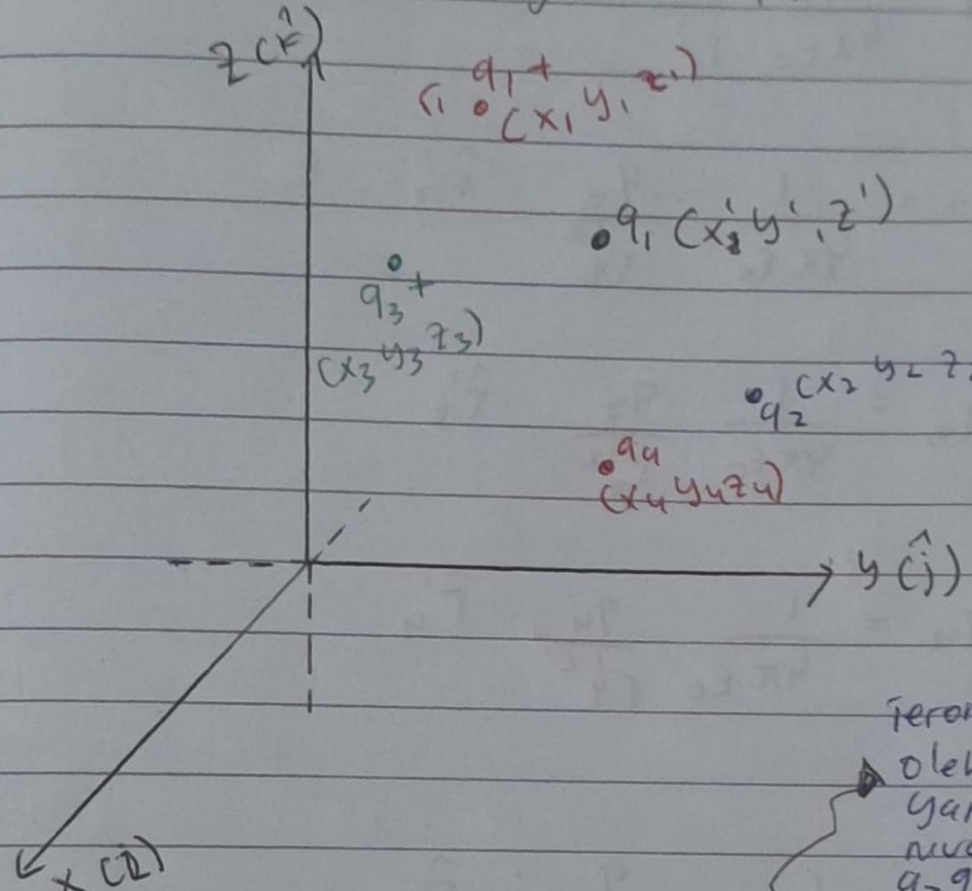
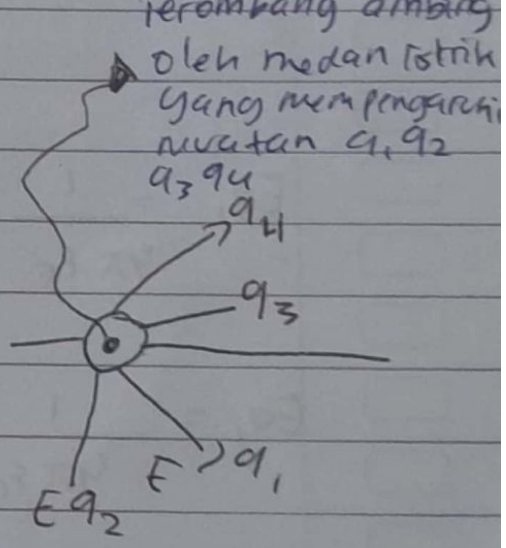
Medan listrik yang dihasilkan oleh banyak muatan





$$q_1 < q_2 < q_3 < q_4$$

$$E_{total} = E_{q_1} = E_{q_1} + E_{q_2} + E_{q_3} + E_{q_4}$$

$$E_{q_1} = \frac{1}{4\pi\varepsilon_0} \frac{q_1}{r_1'} \cdot \hat{r}_1'$$

$$E_{q_2} = \frac{1}{4\pi\varepsilon_0} \frac{q_2}{r_2'^2} \hat{r}_2'$$

$$E_{q_3} = \frac{1}{4\pi\varepsilon_0} \frac{q_3}{r_3'^2} \hat{r}_3'$$

$$E_{q_4} = \frac{1}{4\pi\varepsilon_0} \frac{q_4}{r_4'^2} \hat{r}_4'$$

$$E_{q_1} = \frac{1}{4\pi\varepsilon_0} \frac{q_1}{r_1'^2} \hat{r}_1$$

$$E_{q_1} = \frac{1}{4\pi\varepsilon_0} \frac{q_1}{[(\Delta x_1'^2 + \Delta y_1' + \Delta z_1'^2)^{1/2}]^2} \cdot$$

$$\frac{\Delta x_1' \hat{i} + \Delta y_1' \hat{j} + \Delta z \hat{i} \hat{k}}{(\Delta x i^2 + \Delta y_1'^2 + \Delta z_1'^2)^{1/2}}$$

$$E_{q_1} = \frac{1}{4\pi\varepsilon_0} \frac{q_1}{(\Delta x_1'^2 + \Delta y_1'^2 + \Delta z_1'^2)(\Delta x_1'^2 + \Delta y_1'^2 + \Delta z_1'^2)^{1/2}}$$

rapat muatan ⇒ kuantitas muatan yang terdistribusikan pada bidang, ruang, garis tertentu

★ rapat muatan luas (da')

$$\sigma = \frac{dq'}{da'}$$

★ Rapat muatan panjang (ds') atau (di')

$$\lambda = \frac{dq'}{dq'} \quad \text{atau} \quad \lambda = \frac{ds'}{dq'}$$

★ Rapat muatan volume ($d\tau'$) atau (dv')

$$\rho = \frac{dq'}{dv'}$$

$$\rho = \frac{d\tau'}{dq'}$$

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Muatan yang tersebar pada bidang

$\lambda = \frac{q}{l}$ → keliling $\quad ds = \frac{S}{N}$ → $L = 2\pi r$

$\partial L = 2\pi \partial r$

$\lambda = \frac{q}{k}$

$\lambda = \frac{q}{2\pi r}$ $\quad$ $\lambda = \frac{q}{L}$ (penuh)

sebagian $\quad \lambda = \frac{\partial q}{\partial L} \rightarrow \partial q = \lambda \cdot \partial L$

Medan listrik

$E Q = \frac{1}{4\pi \varepsilon_0} \frac{Q}{r^2}$

$E \partial q = \frac{1}{4\pi \varepsilon_0} \frac{\partial q}{b^2}$

$E \partial q = \frac{1}{4\pi \varepsilon_0} \frac{\lambda \partial L}{(r^2 + x^2)}$

(sin)

$E \partial qy = E \partial q \cdot \sin\theta = \frac{1}{4\pi\varepsilon_0} \int \frac{\lambda \partial L}{(r^2+x^2} \sin\theta$

$= \frac{1}{4\pi\varepsilon_0} \int \frac{\lambda \partial L}{(r^2+x^2)} \frac{r}{(r^2+x^2)^{1/2}}$

Cos →

$$E\,dq_y = E\,dq\cos\theta = \frac{1}{4\pi\varepsilon_0}\int \frac{\lambda\,dl}{(r^2+x)}\cos\theta$$

$$= \frac{1}{4\pi\varepsilon_0}\int \frac{\lambda\,dl}{(r^2+x^2)}\cdot\frac{x}{(r^2+x^2)^{1/2}}$$

$$E\,dq_x = E\,dx\cos\theta = \frac{1}{4\pi\varepsilon_0}\int \frac{\lambda\,dL}{(r^2+x^2)}\cos\theta$$

$$Ep = \vec{E}_{px} = \frac{1}{4\pi\varepsilon_0}\int \frac{\lambda\,dl}{(r^2+x^2)}\cdot\frac{x}{(r^2+x^2)^{1/2}}$$

$$Ep = \frac{1}{4\pi\varepsilon_0}\frac{\lambda x}{(r^2+x^2)^{3/2}}\int dl$$

$dL = 2\pi dr$

$$Ep = \frac{1}{4\pi\varepsilon_0}\frac{\lambda x}{(r^2+x^2)^{3/2}}\int 2\pi\,dr$$

$$Ep = \frac{1}{4\pi\varepsilon_0}\frac{\lambda x}{(r^2+x^2)^{3/2}}\,2\pi\int dr$$

$$Ep = \frac{1}{4\pi\varepsilon_0}\frac{\lambda x}{(r^2+x^2)^{3/2}}\,2\pi\,[r]_0^r$$

$$Ep = \frac{1}{4\pi\varepsilon_0}\frac{(\lambda 2\pi r)x}{(r^2+x^2)^{3/2}}$$

$$Ep = \frac{1}{4\pi\varepsilon_0}\cdot\frac{qx}{(r^2+x^2)^{3/2}}$$

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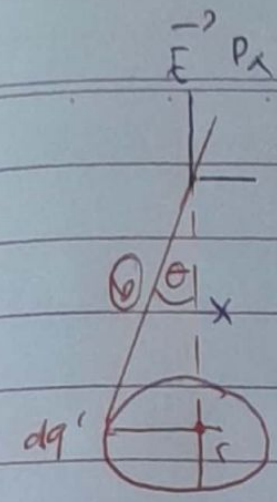

Tugas

Diketahui

$r = 3\,cm$

$x = 4\,cm$

$b = 5\,cm$

$Q = 14\,nC$

$q = \lambda \cdot 2\pi r$

$E_P = ?$

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$$E_{px} = \frac{1}{4\pi\varepsilon_0} \frac{qz}{(A^2 + x^2 y^{1/2})^3}$$

$$\vec{E}_{px} = \frac{1}{4\pi\varepsilon_0} \frac{q_x}{b^5}$$

$$\vec{E}_{px} = \frac{1}{4\pi\varepsilon_0} q \frac{1}{b^2} \frac{x}{b^1}$$

$$= \frac{1}{4\pi\varepsilon_0} q \frac{1}{b^2} \frac{x}{b} \left(\frac{r^2}{r^3}\right)$$ → karena sama dengan 1

$$= \frac{1}{4\pi\varepsilon_0} \frac{q}{r^2} \frac{r^2}{b^2} \frac{x}{b}$$

karena nilai $\frac{r}{b} = \sin\theta$ dan $\frac{x}{b} = \cos\theta$ maka

persamaan di atas dapat dirumus

$$E_{px} = \frac{1}{4\pi\varepsilon_0} \frac{q}{r^2} \frac{r^2}{b^2} \frac{x}{b}$$

$$= \frac{1}{4\pi\varepsilon_0} \frac{q}{r^2} \sin^2\theta \cos\theta$$

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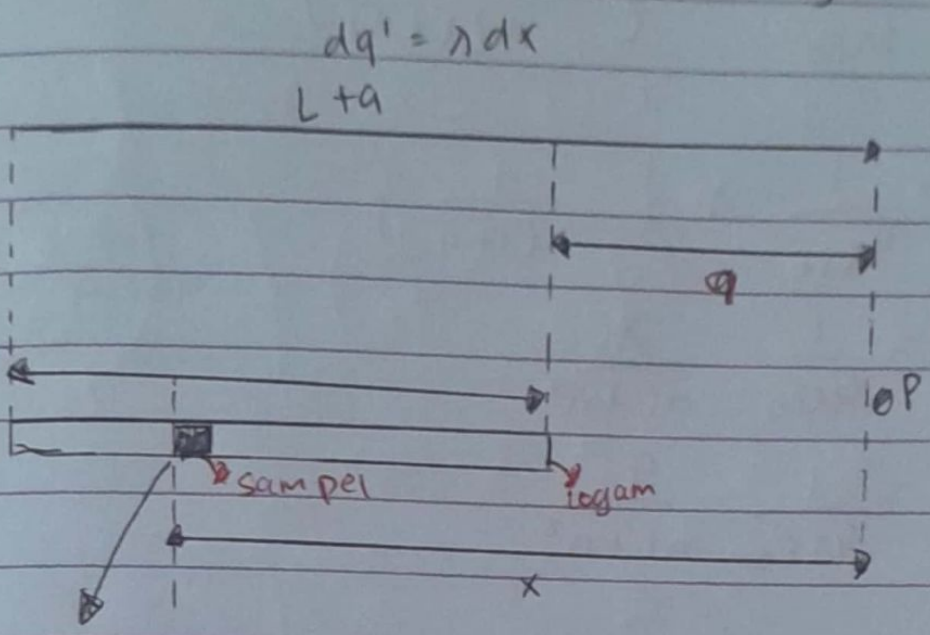
Medan listrik oleh muatan Batang



Medan yang dihasilkan elemen tersebut pada titik P adalah

$$\vec{E_p} = k \int \frac{dq'}{r^2}$$

$$\vec{Ep} = \frac{1}{4\pi\varepsilon_0} \frac{\lambda dl'}{x^2}$$

$$= \frac{1}{4\pi\varepsilon_0} \lambda \int_0^{L+a} \frac{dx}{x^2}$$

$$= \frac{1}{4\pi\varepsilon_0} \lambda \int_0^{L+a} \left(\frac{1}{x^2}\right) dx$$

$$= \frac{1}{4\pi\varepsilon_0} \lambda \left[-\frac{1}{x}\right]_0^{L+a}$$

$$= \frac{1}{4\pi\varepsilon_0} \lambda \left[\left\{\frac{1}{(L+a)}\right\} - \left\{\frac{1}{a}\right\}\right]$$

$$= \frac{1}{4\pi\varepsilon_0} \lambda \left[\left\{\frac{1}{a}\right\} - \left\{\frac{1}{L+a}\right\}\right]$$

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

$$= -\left\{\frac{q}{a(L+a)}\right\}\Big]$$

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$$\vec{E}_p = \frac{1}{4\pi\varepsilon_0} \lambda \left\{ \frac{a(1+a) - a}{a(1+a)} \right\}$$

$$= \frac{1}{4\pi\varepsilon_0} \lambda \left\{ \frac{1}{a(1+a} \right\}$$

$$= \frac{1}{4\pi\varepsilon_0} \frac{\lambda l}{a l + a^2}$$

$$\vec{E}_p = \frac{1}{4\pi\varepsilon_0} \frac{q}{a l + a^2}$$

Jika jarak a sangat besar sehingga $a \gg\gg 1$, maka nilai medan listrik yang ditimbulkan muatan

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Potensial Listrik

(Skalar / seperti energi potensial)

$$F_g = -G \frac{M_1 m_2}{r^2} \hat{r}$$

↳ $w = mg$

$g = \frac{w}{m} \rightarrow w = F_g$

$g = \frac{F_g}{m}$ → massa benda uji

$g = -G \frac{\frac{M_1 m_2}{r^2} \hat{r}}{m_2}$

$g = -G \frac{M_1}{r^2} \hat{r}$ → potensial

$W = F \cdot \Delta s$

$W = \int_{s_1}^{s_2} F \cdot \partial s$ → usaha

$W = \int_{r_A}^{r_B} F_g \cdot \partial r$

$W = \int_{r_A}^{r_B} \left(-\frac{G M m_1}{r^2} \right) \partial r$

$W = \int_{r_A}^{r_B} \left(-G M m_1 r^2 \right) \partial r$