No.

Date

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UTS KALISMA

① . Diketahui :

$q_1 (4,0) = 2$ Stat C
$q_2 (0,3) = 5$ Stat C
$q_3 (4,3) = 10$ Stat C
$q_4 (0,0) = -1$ Stat C
$k = 1$ dyne . cm^3 / Stat C

a) . Menghitung Gaya Couloumb oleh Muatan q_4

Rumus Gaya Couloumb

$$F = \frac{k|q_1 q_2|}{r^2}$$

-. Mencari Jarak

$$q_4 \rightarrow q_1 = \sqrt{((0-4)^2 + (0-0)^2)}$$
$$= 4$$
$$q_4 \rightarrow q_2 = \sqrt{((0-0)^2 + (0-3)^2)}$$
$$= 3$$
$$q_4 \rightarrow q_3 = \sqrt{((0-4)^2 + (0-3)^2)}$$
$$= 5$$

-. Gaya Couloumb

$$q_4 \text{ dan } q_1 = \frac{k|2(-1)|}{4^2}$$
$$= 0{,}125 \text{ dyne}$$

$$q_4 \text{ dan } q_2 = \frac{k|5(-1)|}{3^2}$$
$$= 0{,}556 \text{ dyne}$$

$$q_4 \text{ dan } q_3 = \frac{k|10(-1)|}{5^2}$$
$$= 0{,}4 \text{ dyne}$$

Jadi, total gaya Couloumb yg dialami oleh Muatan q_4 :
$0{,}125 + 0{,}556 + 0{,}4 = 1{,}081$ dyne.

b) . Menghitung medan listrik pada titik (0,0)

$$\text{Rumus } E = \frac{k \Sigma |q_i|}{r^2}$$

-. Jarak antara

$$(0,0) \text{ dan } q_1 = \sqrt{((0-4)^2 + (0-0)^2)}$$
$$= 4 \text{ cm}$$

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$(0,0)$ dan $q_2 = \sqrt{((0-0)^2 + (0-3)^2)}$
$= 3$ cm
$(0,0)$ dan $q_3 = \sqrt{((0-4)^2 + (0-3)^2)}$
$= 5$ cm
$(0,0)$ dan $q_4 = \sqrt{((0-0)^2 + (0-0)^2)}$
$= 0$ cm

Medan listrik
$(0,0) = k\left(\frac{|2|}{4^2} + \frac{|5|}{3^2} + \frac{|10|}{5^2} + \frac{(1-0)}{0^2}\right)$

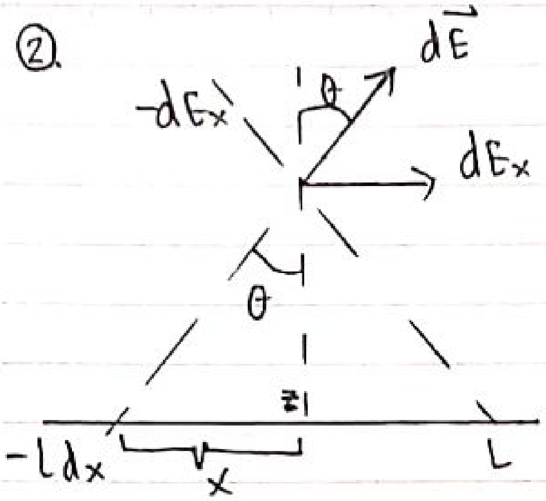
$= 1,667$ dyne / stat C

c) Menghitung potensial listrik pada titik (0.0)

$V = k \sum \frac{q_i}{r}$

Jarak antara
$(0,0)$ dan $q_1 = \sqrt{((0-4)^2 + (0-0)^2}$
$= 4$ cm
$(0,0)$ dan $q_2 = \sqrt{0-0)^2}$
$= 0$ cm

2.



$$r = (x^2 + z^2)^{\frac{1}{2}}$$

$$d\vec{E} = dE_y + dE_x$$
$$d\vec{E} = dE_y$$
$$d\vec{E}_y = dE \cos\theta$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \int_{-L}^{L} \frac{\lambda\, dl}{r^2} \cos\theta$$

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

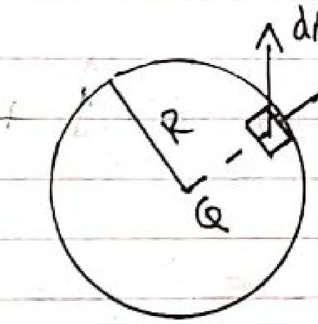
$$\vec{E} = \frac{2\lambda z}{4\pi\varepsilon_0} \int_0^L \frac{dx}{(x^2+z^2)^{3/2}}$$

$$\vec{E} = \frac{2\lambda z}{4\pi\varepsilon_0} \left(\frac{x}{z^2\sqrt{x^2+z^2}} \right) \Bigg|_0^L$$

$$= \square \left[\frac{1}{z^2\sqrt{L^2+z^2}} - \frac{0}{z^2\sqrt{0+z^2}} \right]$$

$$= \square \left[\frac{l}{z^2\sqrt{L^2+z^2}} \right.$$

③. Hukum Gauss merupakan suatu permukaan bola berjari-jari R yang pusatnya terletak ~~dimuat~~ dimuatan titik Q. Medan listrik di sebarang tempat pada permukaan tegak lurus terhadap permukaan tersebut dan memiliki besar.



$E = \frac{kQ}{R^2}$

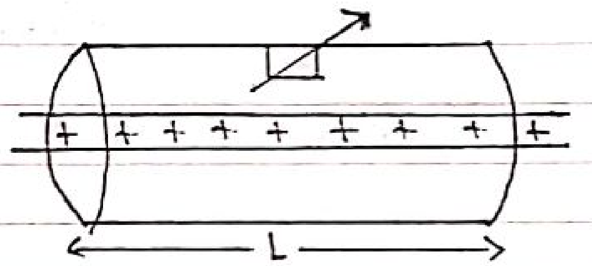
Suatu permukaan berbentuk bola yang melingkupi muatan titik Q. Jumlah garis medan listrik yang melintasi permukaan ini akan bergerak melintasi semua bagian yg melingkupi Q. Fluksnya dapat dengan mudah dihitung untuk permukaan berbentuk bola. Fluksnya ini besarnya adalah E_n kali luas permukaan $4\pi R^2$

Secara matematika dirumuskan:

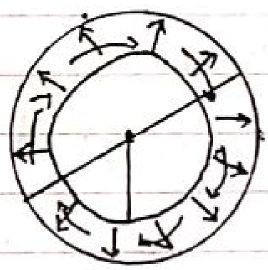
$\oint E_n \, dA = 4\pi k Q \rightarrow$ Pers Gauss dlm Integral

atau $\oint E_n \, dA = \frac{Q_{in}}{\varepsilon_0}$

Contoh aplikasi hukum Gauss
=> pada kawat lurus panjang, ds. jari-jari R



Contoh Soal:



Hitung $\vec{E}$ pada
a). $r < R$
b). $r > R$

$\oint_c \vec{E} \, da = \frac{Q_{inc}}{G_0}$

$\vec{E} = (4\pi r^2) = \frac{Q_{inc}}{G}$

Medan $< a = 0 \rightarrow \vec{E}$

$a < r < b$

$\oint \vec{E} . da = \frac{Q}{\varepsilon_0}$

$$E(4\pi r^2) = \frac{1}{\varepsilon_0} \iiint \rho \, da$$

$$= \frac{1}{\varepsilon_0} \int_0^a \int_0^\pi \int_\pi^{2\pi} r \sin\theta$$

$$d\theta \, d\phi \, d6$$

$$\vec{E}(4\pi r^2) = \frac{4\pi}{\varepsilon_0} \int_0^a r^2 dr$$

$$= \frac{4\pi}{\varepsilon_0} \left(\frac{1}{3} r^3 \right)_0^a$$

$$\vec{E}(4\pi r^2) = \frac{\frac{4}{3}\pi a^3}{\varepsilon_0}$$

$$\vec{E} = \frac{\rho a^3}{3 \varepsilon r^2} \hat{r}$$

$\vec{E} \rightarrow r > b$

$$\oint \vec{E} \cdot \vec{da} = \frac{Q}{\varepsilon_0}$$

$$\vec{E} \cdot (4\pi r^2) = \frac{1}{\varepsilon_0} \int_a^b \int_0^{3\pi}$$

$$\int_0^\pi \rho \sin\theta \, d\theta$$

$$d\phi \, dr$$

$r > b$

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④. Menghitung Curl atau rotasi dari fungsi Vektor :

a). $V_1 = x^2\hat{i} + 3xz^2\hat{j} - 2xz\hat{k}$

b). $V_2 = xy\hat{i} + 2yz\hat{j} + 3xz\hat{k}$

Jawab :

a). Curl terhadap V_1

$$\nabla \times \vec{V}_1 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ V_x & V_y & V_z \end{vmatrix}$$

$$= \left(\frac{\partial(-2xz)}{\partial y} - \frac{\partial(3xz^2)}{\partial z}\right)\hat{i} + \left(\frac{\partial(x^2)}{\partial z} - \frac{\partial(-2xz)}{\partial x}\right)\hat{j}$$

$$+ \left(\frac{\partial(3xz^2)}{\partial x} - \frac{\partial(x^2)}{\partial y}\right)\hat{k}$$

$$= (0 - 6xz)\hat{i} + (0 + 2z)\hat{j} + (3z^2 - 0)\hat{k}$$

$$= -6xz\hat{i} + 2z\hat{j} + 3z^2\hat{k}$$

b). Curl terhadap V_2

$$\nabla \times \vec{V}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ V_x & V_y & V_z \end{vmatrix} \qquad \nabla \times \vec{V}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ xy & 2yz & 3xz \end{vmatrix}$$

$$= \left(\frac{\partial(3xz)}{\partial y} - \frac{\partial(2yz)}{\partial z}\right)\hat{i} + \left(\frac{\partial(xy)}{\partial z} - \frac{\partial(3xz)}{\partial x}\right)\hat{j} + \left(\frac{\partial(2yz)}{\partial x} - \frac{\partial(xy)}{\partial y}\right)\hat{k}$$

$$= (0 - 2y)\hat{i} + (0 - 3z)\hat{j} + (0 - x)\hat{k} = -2y\hat{i} - 3z\hat{j} - x\hat{k}$$