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Date

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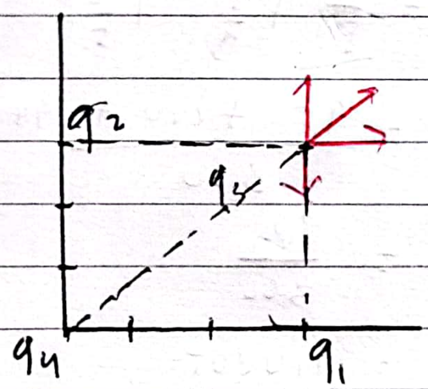
1. $q_1\ (4,0) = +2$ stat C

$q_2\ (0,3) = +5$ stat C $\qquad k = 1\ \text{dyne cm}^2/\text{stat C}^2$

$q_3\ (4,3) = +10$ stat C

$q_4\ (0,0) = -1$ stat C



Medan listrik pada posisi (0,0)

Jarak dari q_4 ke titik (0,0) adalah 0 cm, maka, medan listrik pada posisi (0,0) adalah

$$E = \frac{k \cdot q}{r^2}$$

$$E_{q_4} = \frac{1 \cdot (-1)}{(0)^2} = \frac{-1}{0} = \infty \text{ dyne/stat C}$$

Gaya Coulomb q_4

$$* F_{q_1} = \frac{k\, q_4 \cdot q_1}{r^2} = \frac{1(-1 \cdot 2)}{4^2} = \frac{2}{16} = \frac{1}{8} \text{ dyne}$$

$$* F_{q_2} = \frac{k \cdot q_4 \cdot q_2}{r^2} = \frac{1(-1 \cdot 5)}{3^2} = \frac{5}{9} \text{ dyne}$$

* $F_{q3} = \dfrac{k\, q_4\, q_3}{r^2}$

$= \dfrac{1\,(-1 \cdot 10)}{5^2}$

$= \dfrac{10}{25}$

$= \dfrac{2}{5}$ dyne

Gaya Coulomb yg dialami oleh q_4

$F_{q_4} = F_{q_1} + F_{q_2} + F_{q_3}$

$= \dfrac{1}{8} + \dfrac{5}{9} + \dfrac{2}{5}$

$= \dfrac{45 + 200 + 144}{360}$

$= \dfrac{389}{360}$

$= 1{,}0805$

potensial listrik pada titik (0,0)
Jarak dari q_4 ke titik (0,0) adalah 0 cm, potensial listrik disebabkan oleh q_4 di titik (0,0) adalah

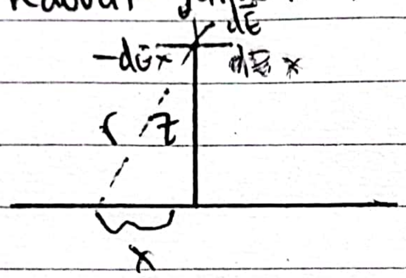
$V = \dfrac{k\, q_4}{r_4}$

$= \dfrac{1 \cdot (-1)}{0}$

$= \infty$ stat V

Potensial listrik yg tak terhingga menunjukkan bahwa ada potensial listrik yg sangat besar dititik (0,0) akibat muatan q_4

2. Sebuah kawat lurus panjangnya a, membawa muatan seragam λ, hitung medan listrik di titik P di atas kawat yang berjarak z di tengah-tengah kawat gambar.



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

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

$$E = \frac{1}{4\pi\varepsilon_0} \int_0^a \frac{\lambda\, dx}{r^2} \cos\theta$$
$$= \frac{1}{4\pi\varepsilon_0} \int_0^a \frac{\lambda\, dx}{(x^2+z^2)} \cos\theta$$
$$= \frac{xz}{4\pi\varepsilon_0} \int_0^a \frac{\lambda\, dx}{(x^2+z^2)} \cos\theta$$
$$= \frac{\lambda z}{4\pi\varepsilon_0} \int_0^a \frac{dx}{(x^2+z^2)^{3/2}}$$
$$= \frac{\lambda z}{4\pi\varepsilon_0} \left[\frac{x}{z^2\sqrt{x^2+z^2}}\right]_0^a$$
$$= \frac{\lambda z}{4\pi\varepsilon_0} \left[\frac{a}{z^2\sqrt{a^2+z^2}} - 0\right]$$
$$= \frac{\lambda z}{4\pi\varepsilon_0} \left[\frac{a}{z^2\sqrt{a^2+3^2}}\right]$$

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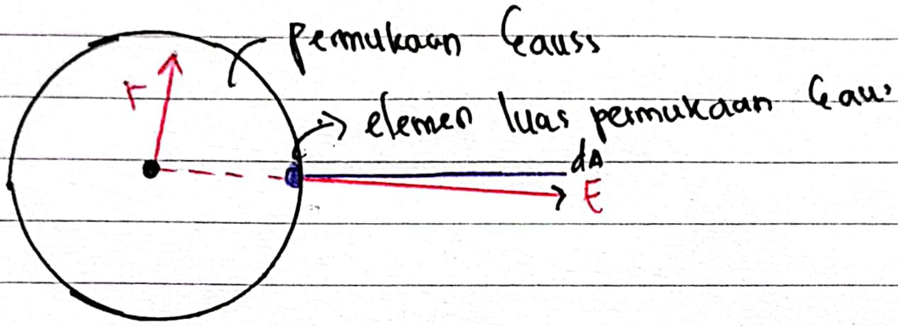
3. Hukum Gauss adalah besar fluks atau garis gaya listrik yang keluar dari suatu permukaan tertutup sebanding muatan yang dilingkupi oleh luasan tertutup



Fluks listrik pd permukaan Gauss

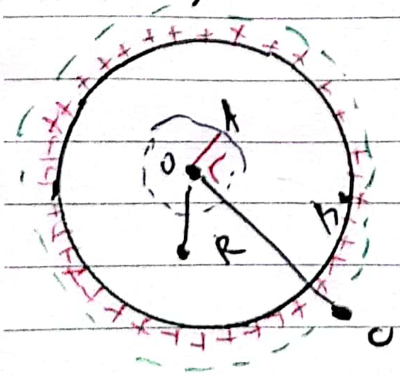
$$\Phi = \oint E \cdot dA = \oint E\, dA$$
$$= E \oint dA$$
$$= \left(\frac{1}{4\pi\varepsilon_0} \frac{q}{r^2}\right)\left(4\pi r^2\right)$$
$$= \frac{q}{\varepsilon_0}$$

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

$$\oint dA = A$$
$$= 4\pi r^2$$

Fluks listrik pada permukaan bola sebanding dgn muatan yang ada didalamnya

Hukum Gauss diterapkan dalam situasi dimana distribusi ~~[illegible]~~ Muatan memiliki simetri tertentu
contohnya



Medan listrik kulit bola
Berapakah medan listrik dikulit ?
Jawab :
E dikulit bola (titik B)

$$r = R$$
$$E = k\frac{Q}{r^2}$$

$$E = k\frac{Q}{R^2}$$

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4. Hitunglah 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. $\nabla \times V = \left(\frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k}\right) \times \left(x^2\hat{i} + 3xz^2\hat{j} - 2xz\hat{k}\right)$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ x^2 & 3xz^2 & -2xz \end{vmatrix}$$

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

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

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

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

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ xy & 2yz & 3xz \end{vmatrix}$$

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

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

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