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C

UTS Kallsma

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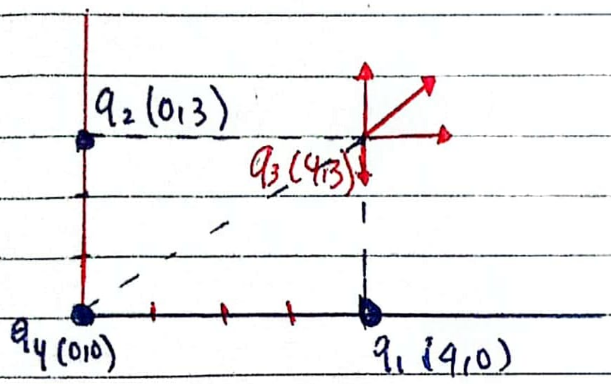
1. $q_1 (4,0) = +2$ stat.C
$q_2 (0,3) = +5$ stat.C
$q_3 (4,3) = +10$ stat C
$q_4 (0,0) = -1$ stat C

$k = 1 \text{ dyne} \cdot cm^2 / \text{stat} \cdot c^2$



* 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

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

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

* Gaya Coulomb q_4

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

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

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* $F_{q_3} = \frac{k\ q_4 q_3}{r^2}$

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

$= \frac{10}{25} = \frac{2}{5}$ dyne

Gaya coulomb yang dialami oleh muatan q_4

~~$F_{total} = F_{q_1} + F$~~

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

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

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

$= \frac{389}{360} = 1,0805$

* 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

$V = \frac{k\ q_4}{r_4}$

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

$= \infty$ stat V

Potensial listrik yang tak terhingga menunjukkan bahwa ada potensial listrik yang sangat besar di titik (0,0) akibat muatan q_4.

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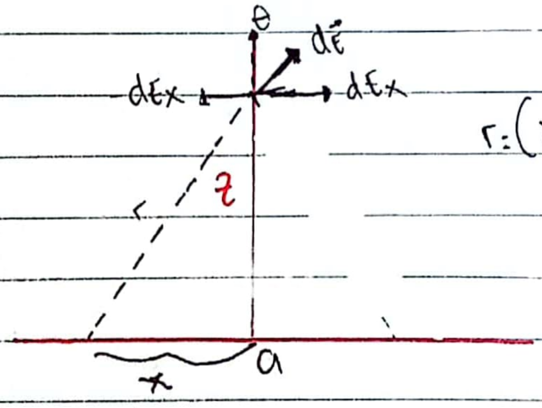
2. Sebuah kawat lurus panjangny a, membawa muatan seragam λ. hitung medan listrik di titik P di atas kawat yang berjarak z di tengah-tengah kawat



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

$$d\vec{E} = dE_y + dE_x$$

$$d\vec{E} = dE_y$$

$$dE_y = dE \cos\theta$$

$$E = \frac{1}{4\pi\varepsilon_0} \int_0^a \frac{\lambda\, dx}{r^2} \cos\theta$$

$$= \frac{1}{4\pi\varepsilon_0} \int_0^a \frac{\lambda\, dx}{(x^2+z^2)} \cos\theta$$

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

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

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

$$= \frac{\lambda z}{4\pi\varepsilon_0} \left[\frac{a}{z^2 \sqrt{a^2+z^2}} - 0 \right]$$

$$= \frac{\lambda z}{4\pi\varepsilon_0} \left[\frac{a}{z^2 \sqrt{a^2+z^2}} \right]$$

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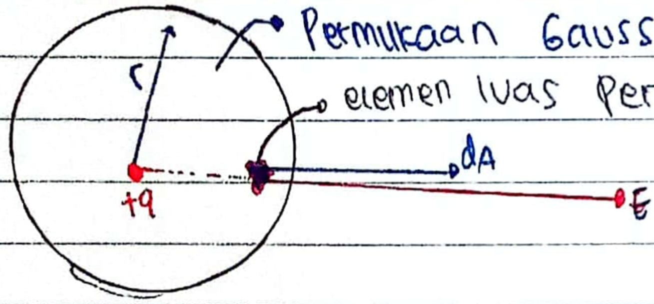
3. Hukum Gauss adalah besar fluks atau garis gaya listrik yang keluar dari suatu permukaan tertutup sebanding muatan yang dilingkupi oleh luasan tertutup



[Fluks listrik pada Permukaan Gauss]

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

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

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

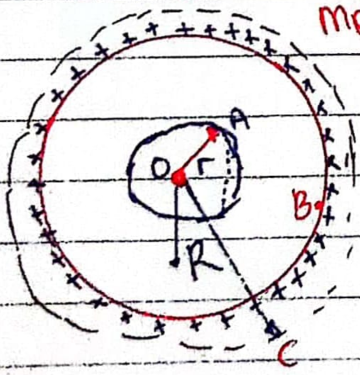
$$\phi_c = \frac{q}{\varepsilon_0}$$

Fluks listrik pada permukaan bola sebanding dengan muatan yang ada didalamnya.

Hukum Gauss diterapkan dalam situasi dimana distribusi muatan memiliki simetri tertentu.

Contohnya.

Medan listrik kulit bola



Berapakah medan listrik di kulit?

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Jawab

E di kulit bola (titik B)

$r = R$

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

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

JOYKO 30 Lines, 8 mm

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

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

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

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

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

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

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

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

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

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

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

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

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