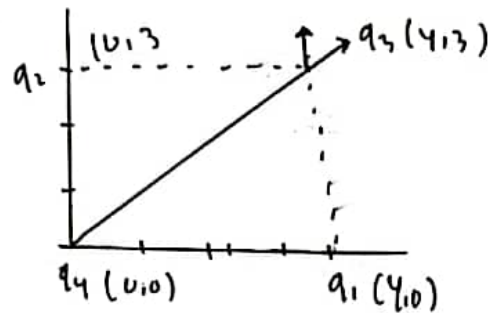


Senin, 15 April 2024

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Kelas: 22A / 2213022023
" UTS KALAMATI "

1. Jawaban:



a). Gaya Coulumb yang dialami q_4

$$F = k \frac{(q_1 - q_4)}{r^2}$$

Jarak q_1 dan q_2

$$\sqrt{(0-0)^2 + (0-0)^2} = 0 \text{ cm}$$

Gaya Coulumb

$$F_{q_4 \cdot 1} = k \frac{q_4 \cdot q_1}{r^2}$$
$$= 1 \cdot \frac{-1 \cdot 2}{0^2}$$

$$= 0$$

$$F_{14} = k \frac{q_1 \cdot q_4}{r^2}$$

$$= 1 \cdot \frac{0 \cdot 2}{0^2} = 0 \rightarrow \text{Gaya Coulumb tidak terdemonstrasi.}$$

b. Medan listrik pada titik (0,0) muatan q_4

$$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \hat{r}, \text{ Medan } \vec{r} = \frac{\vec{r}}{r}$$

$$\rightarrow q_1 \vec{E}_1 = \frac{1}{4\pi\epsilon_0} \frac{2}{16} (\hat{i})$$

$$\rightarrow q_2 \vec{E}_2 = \frac{1}{4\pi\epsilon_0} \frac{5}{9} (\hat{j})$$

$$\rightarrow q_3 \vec{E}_3 = \frac{1}{4\pi\epsilon_0} \frac{10}{25} \left(\frac{4\hat{i} + 3\hat{j}}{5} \right) = \frac{1}{4\pi\epsilon_0} \left(\frac{40}{125} \hat{i} + \frac{30}{125} \hat{j} \right)$$

$$\rightarrow q_4 \vec{E}_4 = \frac{1}{4\pi\epsilon_0} \frac{-1}{0}$$

$$\begin{aligned} \vec{E}_{\text{total}} &= \frac{1}{4\pi\epsilon_0} \left[\left(\frac{2}{16} + \frac{40}{125} \right) (\hat{i}) + \left(\frac{5}{9} + \frac{30}{125} \right) (\hat{j}) \right] \\ &= \frac{1}{4\pi\epsilon_0} \sqrt{(0,47)^2 + (0,0)^2} = 9 \cdot 10^9 \cdot 0,922 \end{aligned}$$

$$= 8,31 \cdot 10^9 \text{ N/C}$$

c. Potensial listrik pada titik (0,0)

$$V = k \left(\frac{q_1}{r_1} + \frac{q_2}{r_2} + \frac{q_3}{r_3} + \frac{q_4}{r_4} \right)$$

$$V = 1 \text{ dyne} \cdot \text{cm} / \mu\text{C} \left(\frac{2}{9} + \frac{5}{3} + \frac{10}{5} + \frac{-1}{0} \right)$$

$$V = 1 \text{ dyne} \cdot \text{cm} / \mu\text{C} \left(\frac{1}{2} + \frac{5}{3} + \frac{2}{1} + \text{undefined} \right)$$

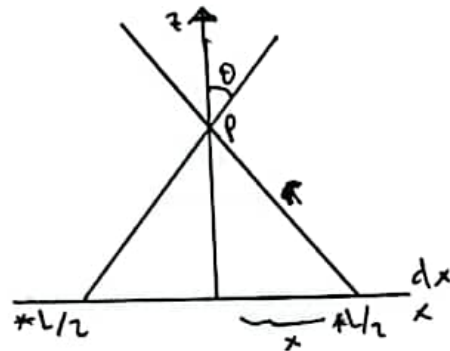
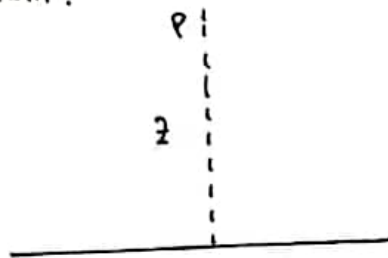
$$V = 1 \text{ dyne} \cdot \text{cm} / \mu\text{C} \left(\frac{25}{6} \right)$$

$$V = \frac{25}{6} = 4,16 \text{ dyne} \cdot \text{cm} / \mu\text{C}$$

Jadi potensial pada titik (0,0) adalah $4,16 \text{ dyne} \cdot \text{cm} / \mu\text{C}$.

2). Sebuah kawat lurus panjangnya a , Membawa muatan seragam λ .
 Hitung medan listrik di titik P di atas kawat yang berjarak
 di tengah-tengah kawat!

Jawaban:



$$dE = k \frac{dq}{r^2}, \lambda = \frac{q}{L} = \frac{dq}{dy}$$

~~2+.~~

$$L = z \gg y$$

$$E_P = k \frac{q}{z^2} = \frac{1}{z^2} : k \frac{q}{z^2}$$

$$z \ll y$$

$$E_P = k \frac{q}{z^2} \frac{1}{2} \sim \frac{2k}{z} \frac{q}{2} \lambda$$

$$= \frac{3k}{z} : \lambda k = \frac{1}{4\pi\epsilon_0}$$

$$E_P = \int dr \cos \theta$$

$$= \int k \frac{dq}{r^2} \cos \theta$$

$$= \int k \lambda dy \frac{\cos \theta}{r^2}$$

$$E_P = \int k \lambda \frac{\cos \theta}{r^2} dy \quad y(\theta)$$

$$\tan \theta = \frac{y}{z}, y = z \tan \theta, \sin \theta = \frac{y}{r}$$

$$\cos \theta = \frac{z}{r} \quad dy = z \frac{1}{\cos^2 \theta} d\theta \quad r = \sqrt{z^2 + y^2}$$

$$E_P = \int k \lambda \cos \theta \cdot z \frac{d\theta}{\cos^2 \theta} = \int k \lambda \frac{z}{\cos \theta} d\theta$$

$$= \int k \lambda \frac{z}{r} \frac{d\theta}{\cos \theta} = \int k \lambda \frac{z}{r^2} \frac{d\theta}{\cos \theta}$$

$$= \int k \lambda \frac{z}{r^2} \frac{d\theta}{\cos \theta} = \int k \lambda \frac{z}{r^2} \frac{d\theta}{\cos \theta}$$

$$E_P = \frac{k\lambda}{2r} \left(\frac{1}{\cos \theta} - \frac{1}{\cos \theta} \right)$$

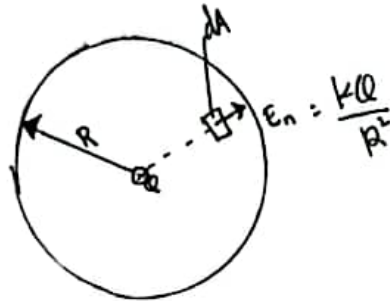
$$E_P = \frac{k\lambda}{2r} L = \frac{k\lambda}{2} \frac{L}{\sqrt{z^2 + y^2}}$$

$$E_P = k \frac{q}{z^2} \frac{1}{\sqrt{1 + y^2/z^2}} = k \frac{q}{z^2} \frac{1}{\sqrt{1 + (L/2z)^2}}$$

- 3). Apa yang anda ketahui tentang hukum Gauss. (Jelaskan secara Verbal, Lalu gambar Permukaan Gauss, dan jelaskan secara Simbolik (rumus) Sesuai d/definisi dan gambar yang anda kemukakan - Dimana hukum Gauss diterapkan dan beri contoh!

Jawaban:

Hukum Gauss merupakan suatu permukaan bola berjari-jari R yang pusatnya terletak di muatan titik Q . Medan listrik di Sebrang permukaan tegak lurus terhadap permukaan tersebut dan memiliki besar.

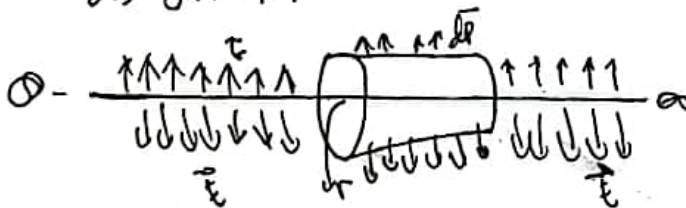


Suatu permukaan berbentuk bola yang melingkupi muatan titik Q . Jumlah garis medan listrik yang melintasi permukaan ini akan bergerak melintasi semua bagian permukaan yang melingkupi Q . Fluksnya dapat dengan mudah dihitung untuk permukaan bola. Fluks ini besarnya adalah E_n kali luas permukaan $4\pi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

$$\oint E_n dA = 4\pi kQ \rightarrow \text{Persamaan Gauss dalam bentuk Integral}$$

$$\text{atau } \oint E_n dA = \frac{Q_{in}}{\epsilon_0}$$

Aplikasi Hukum Gauss $\rightarrow$ a). Pada kawat panjang lurus, ds jari-jari R .



9). Hitunglah Curl atau Rotasi dari fungsi Vektor : S

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

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

Jawaban:

$$a). \nabla \times V = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ x^2 & 3xz & -2xz \end{vmatrix}$$

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

$$\nabla \times V : 2\hat{i} + 6x\hat{j}$$

$$b). \nabla \times V = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ xy & 2yz & 3xz \end{vmatrix}$$

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