Kalisma

Pet. 4.

No. 7 Maret 2024
Date

Gaya Listrik

Hukum Coulomb

a) Gaya yang dilakukan oleh satu muatan titik pada muatan titik, lainnya bekerja sepanjang garis yang menghubungkan kedua muatan tersebut. Besarnya gaya berbanding terbalik kuadrat jarak kedvannya berbanding terbalik kuadrat jarak kedvannya.

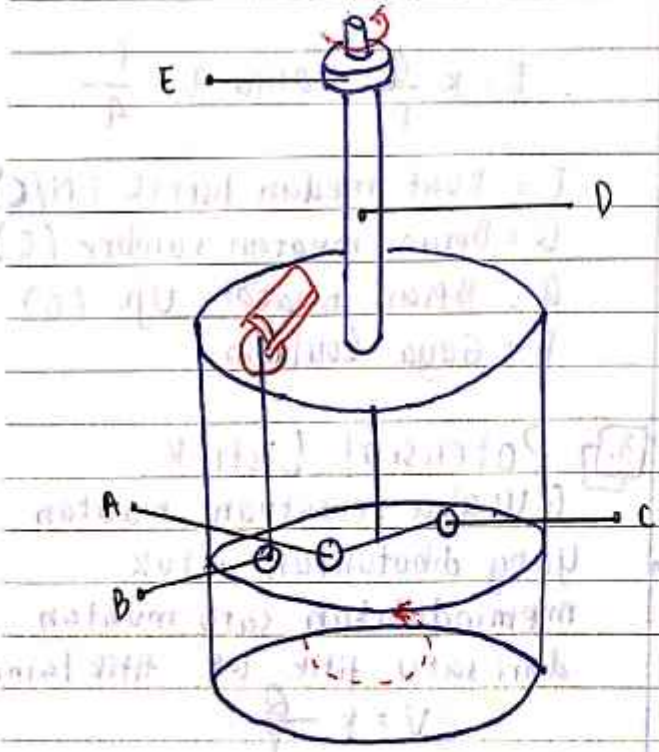
b) Gaya tolak menolak → muatan sama

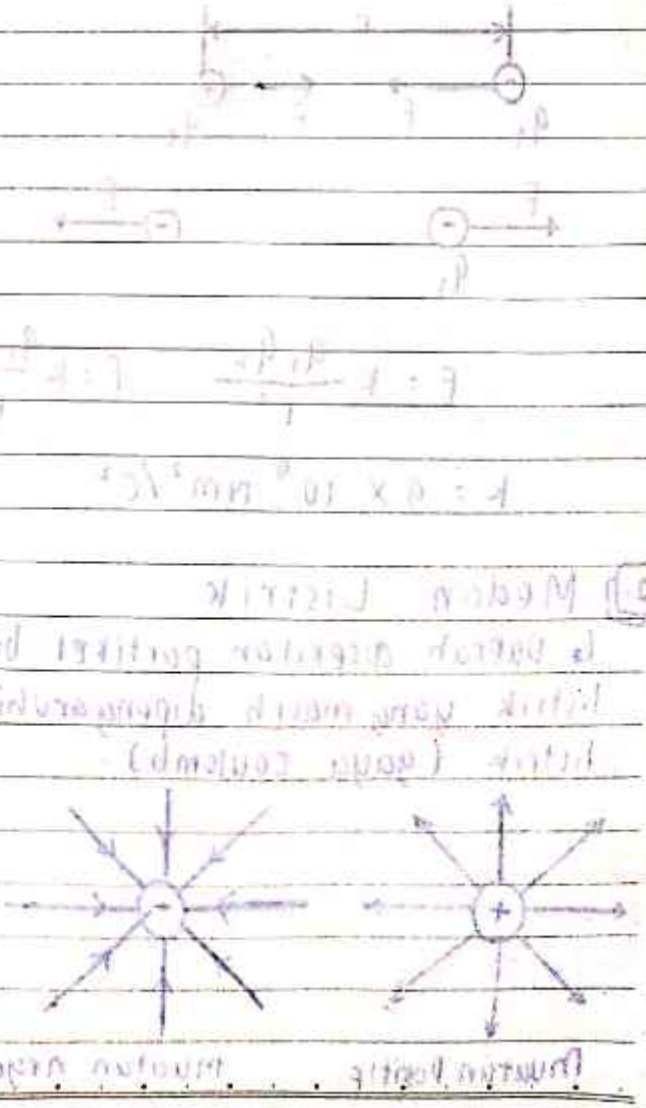
c) Gaya tarik menarik → muatan beda.

$$F_{12} = \frac{k q_1 \cdot q_2}{r_{12}^2} \hat{r}_{12}$$

Dengan,

$k = 8,99 \times 10^9 \ N \cdot m^2/C^2$





No
Date

Listrik statis

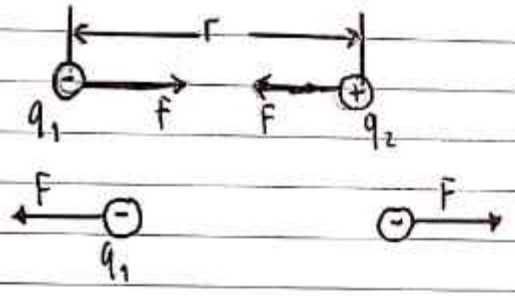
↳ suatu fenomena listrik yang ditimbulkan ketika partikel bermuatan ditransfer dari satu benda ke benda lain. Hal ini terjadi karena adanya dua buah benda yang saling bergesekan.

Muatan Listrik atom terdiri dari dua bagian, yakni { Inti atom, Kulit atom

- Inti Atom : Proton (+) dan neutron (netral)
- Kulit atom : elektron (-)

1. Gaya Coulomb

↳ Besarnya gaya listrik yang terjadi antara dua benda yang bermuatan dengan jarak benda / yang memiliki jarak.

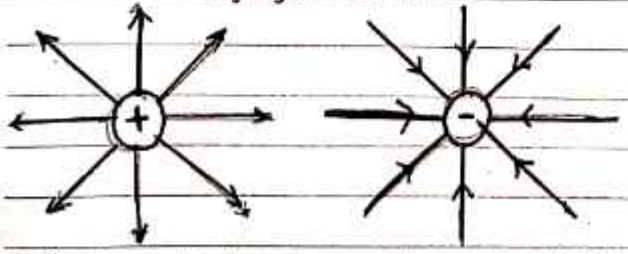


$$F = k\frac{q_1 q_2}{r^2} \qquad F = k\frac{q_1 q_2}{r^2}\vec{r}$$

$k = 9 \times 10^9\ Nm^2/C^2$

2. Medan Listrik

↳ Daerah disekitar partikel bermuatan listrik yang masih dipengaruhi gaya listrik (gaya coulomb).



Muatan Positif muatan negatif

↳ Benda bermuatan yang menghasilkan medan listrik disebut muatan sumber. Sedangkan, muatan lain yang diletakkan dalam pengaruh medan listrik muatan sumber disebut sebagai muatan uji.

$$E = k\frac{Q}{r^2} \text{ atau } E = \frac{F}{q}$$

E = kuat medan listrik (N/C)
Q = Besar muatan sumber (C)
q = Besar muatan uji (C)
F = Gaya Coulomb.

3. Potensial Listrik

↳ Usaha persatuan muatan yang dibutuhkan untuk memindahkan satu muatan dari satu titik ke titik lainnya.

$$V = k\frac{Q}{r}$$

V : potensial listrik.

4. Energi Potensial Listrik

↳ Energi atau usaha yg dibutuhkan untuk memindahkan muatan listrik dari satu titik ke titik lainnya.

$$Ep = k\frac{q_1 q_2}{r}$$

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No. 21 Maret 2024
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Hukum Coulomb

$$F_{q_1 q_2} = k \frac{q_1 q_2}{r^2} \qquad k = \frac{1}{4\pi\varepsilon_0}$$

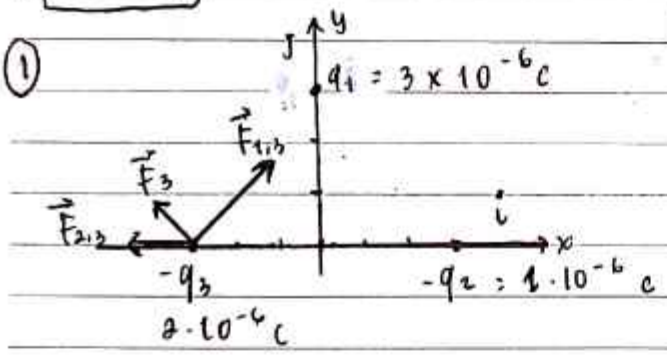
semakin besar muatan semakin besar gayanya.

$F \approx q_1 q_2$

$F_{q_1 q_2} = \frac{1}{r^2}$

contoh

①



$$\vec{F}_{1,3} = k \cdot \frac{q_1 q_3}{r_{1,3}} \hat{r}_{1,3}$$

$$\hat{r}_{xy} = \frac{x\hat{i} + y\hat{j}}{\sqrt{x^2 + y^2}}$$

$$\hat{r}_{xy} = \frac{\vec{r}_{xy}}{|\vec{r}_{xy}|}$$

Jawab:

$$\vec{F}_{1,3} = k \frac{3\times10^{-6} \cdot 2\times10^{-6}}{(\sqrt{3^2+3^2})^2} \cdot \frac{3\hat{j} - 3\hat{i}}{\sqrt{3^2+3^2}}$$

$$= 9\times10^{9} \frac{(2\times10^{-6})(3\times10^{-6})}{(\sqrt{3^2+3^2})^2} \cdot \frac{3\hat{j} - 3\hat{i}}{\sqrt{3^2+3^2}}$$

$$= 9\times10^{-3} \cdot \frac{6}{18} \cdot \left(\frac{3\hat{j} - 3\hat{i}}{3\sqrt{2}}\right)$$

$$= \cancel{9}^{3} \times 10^{-3} \cdot \frac{1}{\cancel{3}} \cdot \left(\frac{3\hat{j} - 3\hat{i}}{3\sqrt{2}}\right)$$

$$= 3\times10^{-3} \left(\frac{3\hat{j} - 3\hat{i}}{3\sqrt{2}}\right)$$

$$= \frac{9\hat{j}}{3\sqrt{2}} - \frac{3\hat{i}}{3\sqrt{2}} \cdot 10^{-3} \text{ N}$$

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$$F_{2,3} = K \cdot \frac{q_2 \cdot q_3}{r_{2,3}^2} \hat{r}_{2,3}$$

$$= 9 \times 10^9 \ Nm^2/C^2 \ \frac{(1.10^{-6} C)(2\,10^{-6} C)}{5^2} \cdot \frac{(5i - 0j)}{(\sqrt{5^2+0^2})}$$

$$= 9 \times 10^{-3} \cdot \frac{2}{25} \cdot \frac{5}{\sqrt{25}}$$

$$= \frac{9.2 \times 10^{-3}}{25} \cdot \frac{5}{5}$$

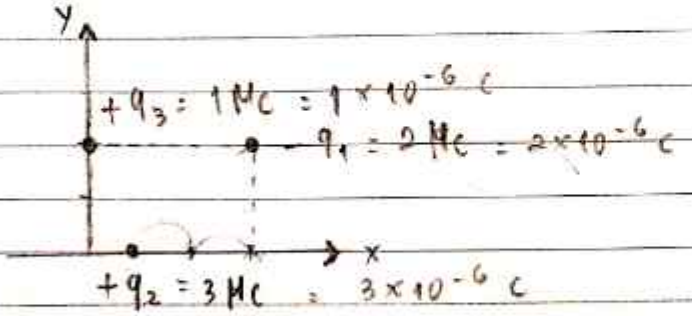
$$= \frac{18}{25} \times 10^{-3} \ i \ N$$

$$F_3 = F_{1,3} + F_{2,3}$$

$$= \left(\frac{9\hat{j}}{3\sqrt{2}} - \frac{9\hat{i}}{3\sqrt{2}} \right) 10^{-3} + \frac{18 i}{25} 10^{-3}$$

$$= \frac{9}{3\sqrt{2}} \times 10^{-3} \hat{j} \ N - \left(\frac{9}{3\sqrt{2}} + \frac{18}{25} \right) 10^{-3} \hat{i} \ N$$

(2)



hit : $-F_{2,1}$?
$-F_{3,1}$?

$$F_{2,1} = K \frac{q_1 \cdot q_2}{r_{1,2}^2} \hat{r}_{1,2}$$

$$= 9 \times 10^9 \frac{(2 \times 10^{-6})(3 \times 10^{-6})}{(\sqrt{2^2+2^2})^2} \left(\frac{2\hat{i} + 2\hat{j}}{\sqrt{2^2+2^2}} \right)$$

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$$F_{2,1} = 9 \times 10^{-3} \frac{6}{(\sqrt{8})^2} \left(\frac{2\hat{i} + 2\hat{j}}{\sqrt{8}} \right)$$

$$= 9 \times 10^{-3} \frac{6}{8} \cdot \left(\frac{2\hat{i} + 2\hat{j}}{\sqrt{8}} \right)$$

$$= \frac{27}{4} 10^{-3} \left(\frac{2\hat{i} + 2\hat{j}}{2\sqrt{2}} \right)$$

$$F_{2,1} = \left(\frac{54\hat{i}}{8\sqrt{2}} + \frac{54\hat{j}}{8\sqrt{2}} \right) \times 10^{-3} \text{ N}$$

$$F_{3,1} = K \frac{q_3 q_1}{r_{3,1}^2} \hat{r}_{3,1}$$

$$= 9 \times 10^9 \frac{(1 \times 10^{-6})(2 \times 10^{-6})}{3^2} \left(\frac{3\hat{i} - 0\hat{j}}{\sqrt{3^2}} \right)$$

$$= 2 \times 10^{-3} \times \frac{2}{2} \times \frac{3}{3} \times \frac{1}{1}$$

$$F_{3,1} = 2 \times 10^{-3} \hat{i} \text{ N}$$

$$F_1 (\text{total}) = F_{2,1} + F_{3,1}$$

$$= \left(\frac{54\hat{i}}{8\sqrt{2}} + \frac{54\hat{j}}{8\sqrt{2}} \right) 10^{-3} + (2 \times 10^{-3} \hat{i})$$

$$= \left(\frac{54\hat{i}}{8\sqrt{2}} \times 10^{-3} + 2 \times 10^{-3} \hat{i} \text{ N} \right) + \frac{54}{8\sqrt{2}} \times 10^{-3} \hat{j} \text{ N}$$

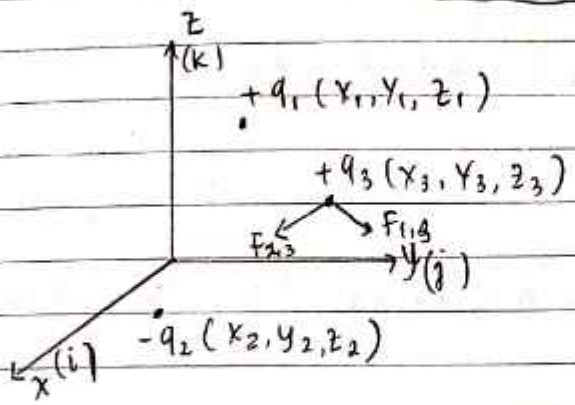
Kalisma

28 Maret 2024.

No.
Date

Hukum Coulomb

Tiga Dimensi



- Rumus untuk Dua Dimensi

$$\vec{F}_{1,2} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1 q_2}{r_{1,2}^2} \hat{r}_{1,2}$$

$$\hat{r}_{1,2} = \Delta x\,\hat{i} + \Delta x\,\hat{j}$$

$$(x_2 - x_1) + (y_2 - y_1)$$

$$\hat{r}_{1,2} = \frac{\Delta x\,\hat{i} + \Delta y\,\hat{j}}{\sqrt{\Delta x^2 + \Delta y^2}}$$

$$r_{1,2} = |\vec{r}_{1,2}|$$

$$\vec{F}_{1,2} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r_{1,2}^2} \left(\frac{\Delta x\,\hat{i} + \Delta y\,\hat{j}}{\sqrt{\Delta x^2 + \Delta y^2}} \right)$$

$$|r_{13}|^2 \quad (r_{13})$$

$$r_{13} = |\vec{r}_{13}|$$

$$= \vec{F}_{1,2} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{|\vec{r}_{1,2}|^3} (\Delta x\,\hat{i} + \Delta x\,\hat{j})$$

$$\Delta x = x_3 - x_1$$
$$\Delta y = y_3 - y_1$$
$$\Delta z = z_3 - z_1$$

$$\vec{F}_{1,3} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_3}{r_{13}^2} \frac{\Delta x_{13}\,\hat{i} + \Delta y_{13}\,\hat{j} + \Delta z_{13}\,\hat{k}}{\sqrt{\Delta x_{13}^2 + \Delta y_{13}^2 + \Delta z_{13}^2}}$$

$$\vec{F}_{1,3} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_3}{r_{13}^2} \frac{(\Delta x_{13}\,\hat{i} + \Delta y_{13}\,\hat{j} + \Delta z_{13}\,\hat{k})}{|\vec{r}_{13}|}$$

$$\vec{F}_{1,3} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_3}{|\vec{r}_{13}|^3} (\Delta x\,\hat{i} + \Delta y\,\hat{j} + \Delta z\,\hat{k})$$

$$|\vec{r}_{13}| = \sqrt{\Delta x_{13}^2 + \Delta y_{13}^2 + \Delta z_{13}^2}$$

$$= (\Delta x_{13}^2 + \Delta y_{13}^2 + \Delta z_{13}^2)^{1/2}$$

$$|\vec{r}_{1,3}|^3 = (\Delta x_{13}^2 + \Delta y_{13}^2 + \Delta z_{13}^2)^{3/2}$$

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$$\vec{F}_{2,3} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_2 q_3}{|\vec{r}_{2,3}|^2} \cdot \frac{\Delta x_{23}\,\hat{i} + \Delta y_{23}\,\hat{j} + \Delta z_{23}\,\hat{k}}{|\vec{r}_{23}|}$$

$$\vec{F}_{2,3} = \frac{1}{4\pi\varepsilon_0} \frac{q_2 \cdot q_3}{|\vec{r}_{2,3}|^3} \Delta x_{23}\,\hat{i} + \Delta y_{2,3}\,\hat{j} + \Delta z_{23}\,\hat{k}$$

$$\vec{F}_3 = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_1 q_3}{|\vec{r}_{13}|^3}(\Delta x_{13}\,\hat{i} + \Delta y_{13}\,\hat{j} + \Delta z_{13}\,\hat{k}) + \frac{q_2 q_3}{|\vec{r}_{23}|^3}\Delta x_{23}\,\hat{i} + \Delta y_{23}\,\hat{j} + \Delta z_{23}\,\hat{k}\right]$$

(misal q; misal b)

$$\vec{F}_3 = \frac{1}{4\pi\varepsilon_0}\left[(a\cdot\Delta x_{13} + b\,\Delta x_{23})\,\hat{i} + (a\cdot\Delta y_{13} + b\cdot\Delta y_{23})\,\hat{j} + (a\cdot\Delta z_{13} + b\cdot\Delta z_{23})\,\hat{k}\right]$$

$$\vec{F}_3 = K\left[\left(\frac{q_1 q_3}{|\vec{r}_{13}|^3}\cdot\Delta x_{13} + \frac{q_1 q_3}{|\vec{r}_{23}|^3}\Delta x_{23}\right)\hat{i} + \left(\frac{q_1 q_3}{|\vec{r}_{13}|^3}\Delta y_{13} + \frac{q_1 q_3}{|\vec{r}_{23}|^3}\Delta y_{23}\right)\hat{j} + \left(\frac{q_1 q_3}{|\vec{r}_{13}|^3}\Delta z_{13} + \frac{q_2 q_3}{|\vec{r}_{23}|^3}\Delta z_{23}\right)\hat{k}\right]$$