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Prodi : Pendidikan Fisika (B).

Mata Kuliah : Kelistrikan & Kemagnetan.

Pemecahan Kasus Muatan Listrik

- Seorang putri memakai cincin dari perak $^{107.9}_{47}\text{Ag}$ 4.2 gram, dan dilapisi emas $^{197}_{79}\text{Au}$ 0.8 gr. Berapa jumlah elektron dalam cincin putri tersebut.

Jawaban : $\Rightarrow$ Jumlah atom = N

$$N = \frac{N_A \times \text{massa (gr)}}{M_r}$$

$$\begin{aligned} N_{\text{total}} &= \frac{N_A \times \text{massa Ag}}{M_r \text{ Ag}} + \frac{N_A \times \text{massa Au}}{M_r \text{ Au}} \\ &= \frac{6.02 \cdot 10^{23} \times 4.2}{107.9} + \frac{6.02 \cdot 10^{23} \times 0.8}{197} \\ &= 2.34 \cdot 10^{22} + 2.44 \cdot 10^{21} \\ &= 2.58 \cdot 10^{22} \end{aligned}$$

 $\Rightarrow$ Muatan total (Q)

Karena Ag punya 47 elektron dan Au 79 elektron maka jumlah elektron atom tersebut 126 elektron.

$$\begin{aligned} Q &= N \times \text{jumlah elektron} \times e \\ &= 2.58 \cdot 10^{22} \times 126 \times 1.6 \cdot 10^{-19} \\ &= 5.2 \times 10^5 \text{ C.} \end{aligned}$$

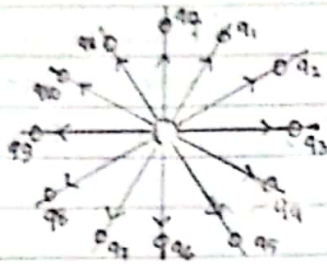
Jadi, untuk massa cincin 5 gr mempunyai muatan $5.2 \times 10^5 \text{ C}$, hal ini berarti dalam massa cincin 5 gr terdapat :

$$\frac{5.2 \times 10^5}{1.6 \times 10^{-19}} = 3.25 \times 10^{24} \text{ elektron.}$$

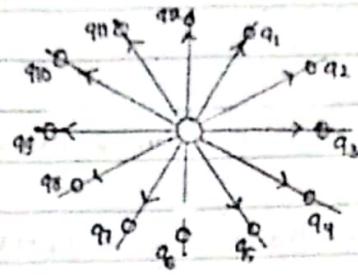
Kasus Gaya Listrik.

- (*) Diabelas muatan sumber q yang terletak di sudut-sudut polygon 12 sisi (tampak seperti angka pada jam) berapa gaya total pada muatan uji Q dipusat ?

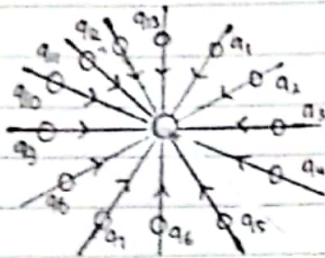
a.



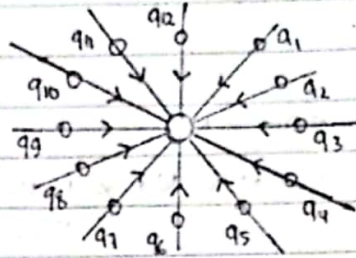
b.



c.



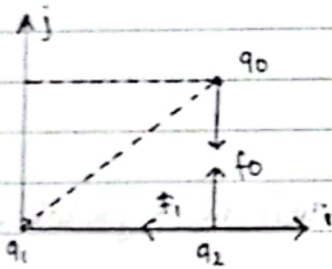
d.



e. $q_1 = 25 \text{ nC} \rightarrow (0,0) \text{ m}$

$q_2 = -10 \text{ nC} \rightarrow (4,0) \text{ m}$

$q_0 = 10 \text{ nC} \rightarrow (4,3) \text{ m}$



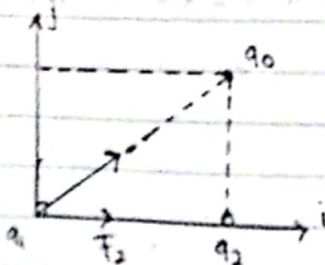
$$\vec{F} = q_0 k \left\{ \frac{q_1}{r_{q_1}^2} \hat{r}_{q_1} + \frac{q_2}{r_{q_2}^2} \hat{r}_{q_2} \right\}$$

$$= 10.9 \times 10^9 \left\{ \frac{25}{16} + \frac{(-10)}{16} (i) \right\}$$

f. $q_1 = 25 \text{ nC} \rightarrow (0,0)$

$q_2 = -15 \text{ nC} \rightarrow (4,0)$

$q_0 = 20 \text{ nC} \rightarrow (4,3)$

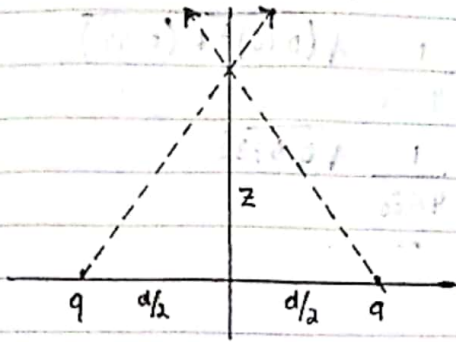


$$\vec{F} = q_0 k \left\{ \frac{q_1}{r_{q_1}^2} \hat{r}_{q_1} + \frac{q_2}{r_{q_2}^2} \hat{r}_{q_2} \right\}$$

$$= 20.9 \times 10^9 \left\{ \frac{25}{16} + \frac{(-15)}{16} (i) \right\}$$

Kasus: Medan Listrik

(a)



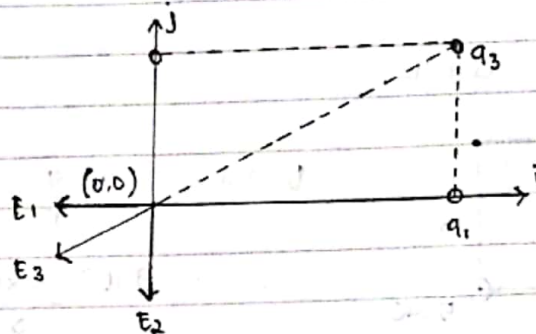
(b)

$$q_1 (4,0) = 2 \text{ C}$$

$$q_2 (0,3) = 5 \text{ C}$$

$$q_3 (4,3) = 10 \text{ C}$$

Medan listrik Posisi (0,0)



$$\vec{E}_1 = \frac{1}{4\pi\epsilon_0} \frac{2}{16} \vec{j}$$

$$\text{Medan oleh } q_2 \vec{E}_2 = \frac{1}{4\pi\epsilon_0} \frac{5}{9} (\vec{i})$$

$$\begin{aligned} \text{Medan oleh } q_3 \vec{E}_3 &= \frac{1}{4\pi\epsilon_0} \frac{10}{25} \left(\frac{4\vec{i} + 3\vec{j}}{5} \right) \\ &= \frac{1}{4\pi\epsilon_0} \left(\frac{40}{125} \vec{i} + \frac{30}{125} \vec{j} \right) \end{aligned}$$

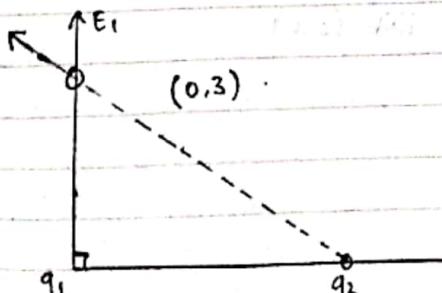
$$\text{Medan total : } \vec{E} = \frac{1}{4\pi\epsilon_0} \left[\left(\frac{5}{9} + \frac{40}{125} \right) \vec{i} + \left(\frac{2}{16} + \frac{30}{125} \right) \vec{j} \right]$$

$$\vec{E} = \frac{1}{4\pi\epsilon_0} \sqrt{(0,47)^2 + (0,8)^2} = 8,35 \times 10^3 \text{ N/C}$$

(c)

$$q_1 = -5 \mu\text{C} \rightarrow (0,0)$$

$$q_2 = 10 \mu\text{C} \rightarrow (4,0)$$

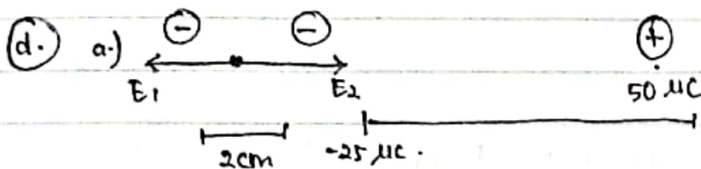


$$\text{Medan oleh } q_1 \vec{E}_1 = \frac{1}{4\pi\epsilon_0} \frac{5}{25} \left(\frac{4\vec{i} + 3\vec{j}}{5} \right)$$

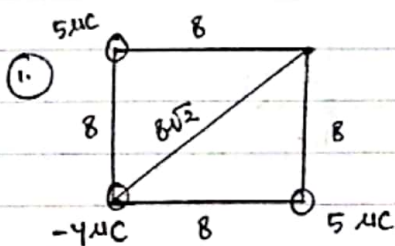
$$= \frac{1}{4\pi\epsilon_0} \left(\frac{20}{125} \vec{i} + \frac{15}{125} \vec{j} \right)$$

$$\text{oleh } q_2 \vec{E}_2 = \frac{1}{4\pi\epsilon_0} \frac{10}{16} (\vec{j})$$

$$\begin{aligned} \text{Total } \vec{E} &= \frac{1}{4\pi\epsilon_0} \left[\left(\frac{20}{125} \right) \hat{i} + \left(\frac{10}{16} + \frac{15}{125} \right) \hat{j} \right] \\ &= \frac{1}{4\pi\epsilon_0} \sqrt{(0,16)^2 + (0,74)^2} \\ &= \frac{1}{4\pi\epsilon_0} \sqrt{0,5732} \end{aligned}$$

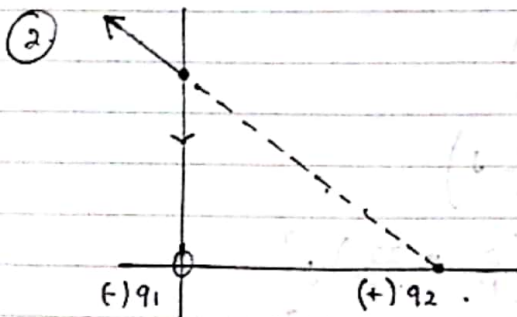


Kasus Potential Listrik

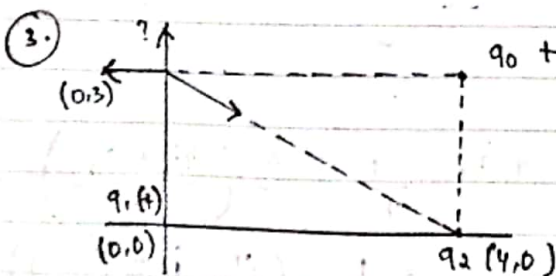


$$V_{\text{total}} = \sum k \frac{q}{r}$$

$$\begin{aligned} &= \frac{9 \cdot 10^9 \cdot 5 \cdot 10^{-6}}{8} + \frac{5 \cdot 10^{-6} \cdot 9 \cdot 10^9}{8} - \frac{4 \cdot 10^{-6} \cdot 9 \cdot 10^9}{8\sqrt{2}} \\ &= 5,62 \times 10^3 + 5,62 \times 10^3 - 6,36 \cdot 10^3 \\ &= 17,6 \times 10^3 \\ &= 1,76 \times 10^4 \text{ Volt} \end{aligned}$$



$$\begin{aligned} V &= \frac{kq_1}{r_1} + \frac{kq_2}{r_2} \\ &= 9 \cdot 10^6 \left(\frac{5}{3} + \frac{10}{4} \right) \\ &= 3,75 \cdot 10^7 \frac{\text{dyne cm}}{\mu\text{C}} \end{aligned}$$



$$\begin{aligned} q_1(0,0) &= 25 \mu\text{C} \\ q_2(4,0) &= -15 \mu\text{C} \\ q_0(4,3) &= 20 \mu\text{C} \\ \text{Carilah titik } (0,3) \end{aligned}$$