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UTS ELEKTRODINAMIKA

1) The object can be called the positive charged, if it is...

B. The object has the lack of electrons

Solution: Positive charged (muatan positif) adalah muatan yang memiliki sifat positif. Muatan listrik positif dapat dikatakan apabila muatan proton lebih besar daripada elektron. Sehingga muatan positif akan kekurangan elektron

2) E. 0,25

Solution:

Diketahui: $r = 2$ meter menjadi $2x \rightarrow r = 4$ meter

Diketahui: $k = 9 \times 10^{-9}$

Ditanya: $F = ?$

Jawab:

$$\frac{F_1}{F_2} = \left(\frac{r_2}{r_1}\right)^2$$

$$\frac{F_1}{F_2} = \left(\frac{2 \times r_1}{r_1}\right)^2$$

$$F_2 = \frac{2}{4^2} F_1$$

$$F_2 = \frac{4}{16} F_1$$

$$F_1 = \frac{1}{4} F_1$$

3) A. 0,054 N

Solution:

Diketahui: $k = 9 \times 10^9 \text{ N m}^2/\text{C}^2$

$q_1 = -9 \text{ N C}$

$q_2 = +6 \text{ N C}$

$r = 3 \text{ m}$

Ditanya: $F = ?$

$$\text{Jawab: } F = k \frac{q_1 q_2}{r^2} = 9 \times 10^9 \text{ N m}^2/\text{C}^2 \cdot \frac{(9 \times 6) \text{ N C}}{3^2}$$

$$F = 9 \times 10^9 \text{ N m}^2/\text{C}^2 \cdot \frac{9 \times 10^{-6} \text{ C} \times 6 \times 10^{-6} \text{ C}}{9}$$

$$F = 54 \times 10^{-3} \text{ N} = 0,054 \text{ N}$$

4) E $F\sqrt{3}$

Solusi :

Diketahui : • muatan A mengalami tolak menolak dengan B

$$F_{ab} = K \frac{q_a \cdot q_b}{r^2}$$

• muatan A mengalami interaksi tolak menolak dengan C

$$F_{ac} = K \frac{q_a \cdot q_c}{r^2}$$

Ditanya : F_c ?

$$\text{Jawab : } F = \frac{K \cdot q^2}{r^2}$$

Resultan gaya yang dialami di titik A

$$F_c^2 = (F_{ab})^2 + (F_{bc})^2 + 2 \times F_{ab} \times F_{ac} \times \cos 60^\circ$$

$$F_c^2 = F_2 + F_2 + (2 \times F \times F \times \frac{1}{2})$$

$$F_c^2 = 3 F_2 = F\sqrt{3}$$

5) c. 100 N

Solusi :

$$\text{Diketahui : } q_1 = 24 \mu\text{C} = 24 \times 10^{-6} \text{ C}$$

$$\epsilon = 3$$

$$q_2 = 20 \mu\text{C} = 2 \times 10^{-5} \text{ C}$$

$$r = 12 \text{ cm} = 12 \times 10^{-2} \text{ m}$$

Ditanya : $F = ?$

Jawab :

$$F = \frac{K}{\epsilon} \times \frac{q_1 \times q_2}{r^2}$$

$$F = \frac{9 \times 10^9}{3} \times \frac{2 \times 10^{-5} \times 24 \times 10^{-6}}{(12 \times 10^{-2})^2}$$

$$F = \frac{9 \times 10^9}{3} \times \frac{2 \times 10^{-5} \times 24 \times 10^{-6}}{144 \times 10^{-4}}$$

$$F = 3 \times 10^9 \times \frac{2 \times 10^{-5} \times 24 \times 10^{-6}}{144 \times 10^{-4}}$$

$$F = 10^2$$

$$F = 100 \text{ N}$$

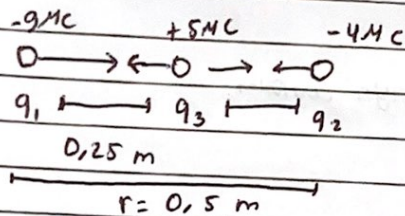
6) B. 3,6 N move to the left

Solusi:

Diketahui : $q_1 = -9 \mu C = -9 \times 10^{-6} C$
 $q_2 = -4 \mu C = -4 \times 10^{-6} C$
 $q_3 = +1 \mu C = +5 \times 10^{-6} C$
 $r = 50 \text{ cm} = 0,5 \text{ m}$

Ditanya : F ?

Jawab



$$F_1 = k \frac{q_1 q_3}{(r_{13})^2}$$

$$F_1 = 9 \times 10^9 \frac{9 \times 10^{-6} \times 5 \times 10^{-6}}{(0,25)^2}$$

$$F_1 = \frac{405 \times 10^{-3}}{625 \times 10^{-4}} = \underline{\underline{6,48 \text{ N}}}$$

$$F_2 = k \frac{q_2 q_3}{(r_{23})^2}$$

$$F_2 = 9 \times 10^9 \frac{(4 \times 10^{-6}) \times (5 \times 10^{-6})}{(0,25)^2}$$

$$F_2 = 9 \times 10^9 \frac{20 \times 10^{-12}}{0,0625}$$

$$F_2 = \frac{180 \times 10^{-3}}{625 \times 10^{-4}}$$

$$F_2 = 2,88 \text{ N}$$

$$F_3 = F_1 - F_2 = 6,48 - 2,88$$

$$= \underline{\underline{3,6 \text{ N} \text{ ke arah kiri}}}$$

7)

Solusi

$$F_{AC} = \frac{k \cdot q_B \cdot q_C}{r^2}$$

$$= 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2} \times \frac{60 \times 10^{-9} \text{ C} \cdot 30 \times 10^{-9} \text{ C}}{(2 \times 10^{-2})^2}$$

$$= \frac{16200 \times 10^{-18} \text{ N}}{4 \times 10^{-4}}$$

$$= 40,5 \times 10^{-3} \text{ N}$$

$$F_C = \sqrt{(F_{AC})^2 + (F_{BC})^2}$$

$$F_C = \sqrt{13,5 \times 10^{-3} \text{ N} + 40,5 \times 10^{-3} \text{ N}}$$

$$F_C = \sqrt{54 \times 10^{-3} \text{ N}} = \underline{\underline{2,3 \text{ N}}}$$

8) $0,33 r$, r tidak diketahui

Solusi

Diketahui :

$$q_a = -2 \mu C$$

$$q_b = +8 \mu C$$

$$q_c = +3 \mu C$$

Ditanyakan : x ? (Jarak) antara a dan c

Jawab :

Misalnya jarak $a c$ adalah x dan jarak antara a dan b adalah r

Berdasarkan hukum coulomb.

$$F = k \frac{q_1 q_2}{r^2} \quad \text{Maka, agar } c \text{ tidak terpengaruh gaya coulomb.}$$

$$F_{ca} = F_{cb}$$

$$\frac{k q_c q_a}{x^2} = \frac{k q_c q_b}{(r-x)^2}$$

$$\frac{q_a}{x^2} = \frac{q_b}{(r-x)^2}$$

$$\frac{2}{x^2} = \frac{8}{(r-x)^2}$$

$$\frac{1}{x^2} = \frac{4}{(r-x)^2}$$

$$\frac{1}{x} = \frac{2}{(r-x)}$$

$$2x = r - x$$

$$3x = r$$

$$x = \frac{1}{3} r$$

$$x = 0,33 r$$

Jadi, jarak c dan a tidak dipengaruhi oleh gaya coulomb adalah $0,33$ kali jarak a ke b .

9) D. 3 M

Diketahui : $q_1 = 5 \mu C$

$q_2 = 5 \mu C$

$F = 0.025 \text{ N}$

Ditanya : r ?

Jawab :

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

$$0.025 = \frac{9 \times 10^9 \times 5 \times 10^{-6} \times 5 \times 10^{-6}}{r^2}$$

$$r^2 = \frac{9 \times 10^9 \times 25 \times 10^{-12}}{0.025}$$

$$r^2 = 9 \times 10^9 \times 1000 \times 10^{-12}$$

$$r^2 = 9$$

$$r = \sqrt{9} = 3 \text{ m}$$

10) $\frac{180 \cdot 10^{-1}}{r^2} \rightarrow$ tidak ada jawaban

Solusi

Diketahui

$$Q_1 = Q_3 = 50 \mu C = 5 \times 10^{-5}$$

$$q_2 = 40 \mu C = 4 \times 10^{-5}$$

Jawab :

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

$$= \frac{9 \times 10^9 \times 5 \times 10^{-5} \cdot 4 \times 10^{-5}}{r^2}$$

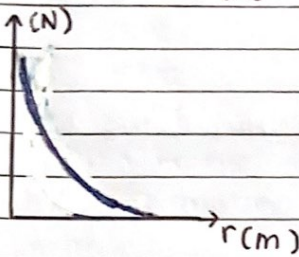
$$= \frac{9 \times 10^9 \times 5 \times 10^{-5} \cdot 4 \times 10^{-5}}{r^2}$$

$$= \frac{180 \cdot 10^{-1}}{r^2}$$

Essay

Grafik efek gaya coulomb terhadap jarak

1)



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

F berbanding terbalik dengan kuadrat r
Yang artinya jika r membesar maka
F mengecil, sebaliknya jika r mengecil
maka F membesar

2) Diketahui : $q_1 = +8 \mu C = +8 \times 10^{-6} C$

$$q_2 = -4 \mu C = -4 \times 10^{-6} C$$

$$r = 2 m$$

Ditanya : $F = ?$

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

$$F = 9 \times 10^9 \times \frac{8 \times 10^{-6} \times 4 \times 10^{-6}}{2^2}$$

$$F = 9 \times 10^9 \times \frac{32 \times 10^{-12}}{4}$$

$$F = 9 \times 10^9 \times 8 \times 10^{-12}$$

$$F = 72 \times 10^{-3}$$

$$F = 0,072 N$$

3) Diketahui : $q_1 = 24 \mu\text{C} = 24 \times 10^{-6}$
 $q_2 = 18 \mu\text{C} = 18 \times 10^{-6} \text{ C}$
 $r = 12 \text{ m}$

Ditanya : a. F saat di udara

b. F saat di material dengan relatif permitivitas 2.

Jawab :

A) $F = \frac{k \cdot q_1 \cdot q_2}{r^2} = \frac{9 \times 10^9 \cdot 432 \times 10^{-12}}{144}$

$F = 9 \times 10^9 \cdot 3 \times 10^{-12}$

$F = 27 \times 10^{-3}$

$F = 0,027 \text{ N}$

$F = 0,072 \text{ N} \rightarrow F \text{ di udara}$

B) $F = \frac{k}{\epsilon} \cdot \frac{q_1 \cdot q_2}{r^2}$

$F = \frac{9 \times 10^9}{2} \cdot \frac{24 \times 10^{-6} \times 18 \times 10^{-6}}{144}$

$F = 4,5 \times 10^9 \cdot \frac{432 \times 10^{-12}}{144}$

$F = 4,5 \times 10^9 \cdot 3 \times 10^{-12}$

$F = 13,5 \times 10^{-3}$

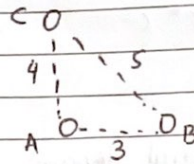
$F = 0,0135 \text{ N} \rightarrow F \text{ di relatif permitivitas 2.}$

4) Diketahui:

$$q_A = +6 \mu C$$

$$q_B = -6 \mu C$$

$$q_C = +4 \mu C$$



$$k = 9 \times 10^9 \text{ N m}^2/\text{C}^2$$

Ditanya: F? Pada B

a. Jika muatan di udara

b. Jika muatan dengan permitivitas relatif 6 ($\epsilon_r = 6$)

Jawab:

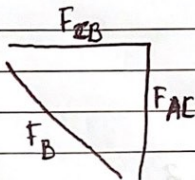
• Gaya muatan A dan B

$$F_{AB} = k \frac{q_A q_B}{(r_{AB})^2} = 9 \times 10^9 \frac{6 \times 6}{(3)^2} = 9 \times 10^9 \frac{36}{9} = 36 \times 10^9 \text{ N}$$

• Gaya muatan B dan C

$$F_{BC} = k \frac{q_B q_C}{(r_{BC})^2} = 9 \times 10^9 \frac{6 \times 4}{(4)^2} = 9 \times 10^9 \frac{24}{16} = 13,5 \times 10^9 \text{ N}$$

• Gaya muatan B



$$\begin{aligned} F_B &= \sqrt{(F_{AB})^2 + F_{BC}^2 + 2 \times F_{AB} \times F_{BC} \times \cos 90} \\ &= \sqrt{36 \times 10^9 + 13,5 \times 10^9 + (2 \times 36 \times 10^9 \times 13,5 \times 10^9 \times 0)} \\ &= \sqrt{49,5 \times 10^9} \\ &= 7,03 \times 10^3 \end{aligned}$$

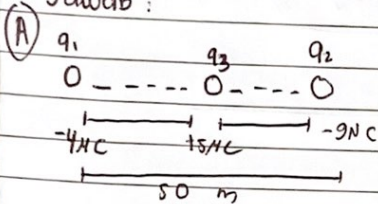
5) Diketahui = $q_1 = -4 \mu C = -4 \times 10^{-6} C$
 $q_2 = -9 \mu C = -9 \times 10^{-6} C$
 $q_3 = +5 \mu C = +5 \times 10^{-6} C$
 $r_{23} = 50 \text{ m}$

Ditanya =

a. F_3 di tengah

b. Dimana muatan $+5 \mu C$ agar tidak terpengaruh gaya coulomb.

Jawab :



$$F_1 = k \frac{q_1 q_3}{(r_{13})^2}$$

$$F_1 = 9 \times 10^9 \times \frac{4 \times 10^{-6} \times 5 \times 10^{-6}}{(25)^2}$$

$$F_1 = 9 \times 10^9 \times 0,032 \times 10^{-12}$$

$$F_1 = 0,288 \times 10^{-3} \text{ N}$$

$$F_2 = k \frac{q_2 q_3}{(r_{23})^2}$$

$$F_2 = 9 \times 10^9 \times \frac{9 \times 10^{-6} \times 5 \times 10^{-6}}{(25)^2}$$

$$F_2 = 9 \times 10^9 \times \frac{45 \times 10^{-12}}{625}$$

$$F_2 = 0,648 \times 10^{-3}$$

$$F_3 = F_2 - F_1$$

$$= 0,648 \times 10^{-3} - 0,288 \times 10^{-3}$$

$$= 0,36 \times 10^{-3} \text{ N mendekati } q_2$$

(B) $F_{13} = F_{23}$

$$k \frac{q_1 q_3}{(r_{13})^2} = k \frac{q_2 q_3}{(r_{23})^2}$$

$$\frac{q_1}{(r_{13})^2} = \frac{q_2}{(r_{23})^2}$$

$$\frac{4 \times 10^{-6}}{r_{13}^2} = \frac{9 \times 10^{-6}}{(r - r_{13})^2}$$

$$\frac{2}{r_{13}} = \frac{3}{r - r_{13}}$$

$$2r - 2r_{13} = 3r_{13}$$

$$5r_{13} = 2r$$

$$r_{13} = \frac{2}{5} r$$