Nama	: AFRIDA R.N.
NRP	: 5027201037
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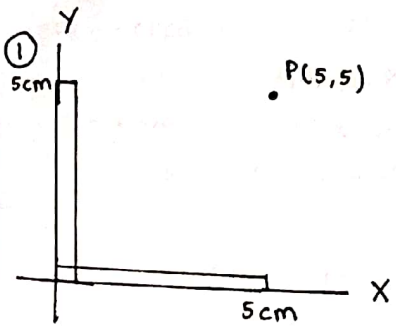
Mata Kuliah	: FISIKA 2
Nomor Kelas	: 8

① 

Diketahui :

$\lambda = 2.10^{-9}\ C/m$

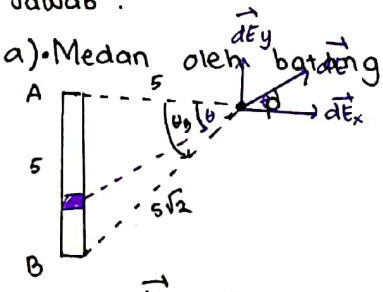
Ditanya :

a) $\vec{E}_P$?

b) $\vec{F}_P = \ldots ?$ $\quad q = -1,6.10^{-19}\ C$

Jawab :

a). Medan oleh batang vertikal



$\hat{r} = \cos\theta\hat{i} + \sin\theta\hat{j}$

$\sin\theta_A = 0 \quad ; \cos\theta_A = 1$

$\sin\theta_B = \frac{\sqrt{2}}{2} \quad ; \cos\theta_B = \frac{\sqrt{2}}{2}$

$$\vec{dE} = \frac{kdq}{r^2}\hat{r}$$

$$\vec{E} = \frac{k\lambda}{a}\int_{\theta_A}^{\theta_B}(\cos\theta\hat{i} + \sin\theta\hat{j})\,d\theta$$

$$= \frac{k\lambda}{a}\left[(\sin\theta_B - \sin\theta_A)(\hat{i}) + (\cos\theta_B - \cos\theta_A)(-\hat{j})\right]$$

$$= \frac{k\lambda}{a}\left[\left(\frac{\sqrt{2}}{2} - 0\right)\hat{i} + \left(\frac{\sqrt{2}}{2} - 1\right)-\hat{j}\right]$$

$$= \frac{k\lambda}{a}\left(\frac{\sqrt{2}}{2}\hat{i} + \left(-\frac{\sqrt{2}}{2}+1\right)\hat{j}\right)$$

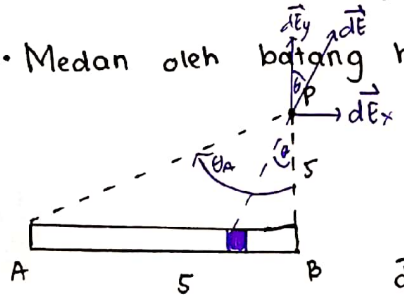
$$= \frac{9.10^9.2.10^{-9}}{5.10^{-2}}\left[\frac{\sqrt{2}}{2}\hat{i} + \left(-\frac{\sqrt{2}}{2}+1\right)(\hat{j})\right]$$

$$= 360\left[\frac{\sqrt{2}}{2}\hat{i} + \left(-\frac{\sqrt{2}}{2}+1\right)(\hat{j})\right]$$

$$= 180\sqrt{2}\,\hat{i} + \left(\frac{720 - 360\sqrt{2}}{2}\right)\hat{j}$$

$$= 180\sqrt{2}\,\hat{i} + (360 - 180\sqrt{2})\,\hat{j}\ \ N/c.$$

• Medan oleh batang horizontal



$\hat{r} = \sin\theta\hat{i} + \cos\theta\hat{j}$

$\sin\theta_A = \frac{\sqrt{2}}{2} \quad ; \cos\theta_A = \frac{\sqrt{2}}{2}$

$\sin\theta_B = 0 \quad ; \cos\theta_B = 1$

$$\vec{dE} = \frac{kdq}{r^2}\hat{r}$$

$$\vec{E} = \frac{k\lambda}{a}\int_{\theta_B}^{\theta_A}(\sin\theta\hat{i} + \cos\theta\hat{j})\,d\theta$$

$$= \frac{k\lambda}{a}\left[(-\cos\theta_A + \cos\theta_B)(\hat{i}) + (\sin\theta_A - \sin\theta_B)(\hat{j})\right]$$

$$= \frac{9.10^9.2.10^{-9}}{5.10^{-2}}\left[\left(-\frac{\sqrt{2}}{2}+1\right)(\hat{i}) + \left(\frac{\sqrt{2}}{2} - 0\right)(\hat{j})\right]$$

$$= 360\left[\frac{-\sqrt{2}+2}{2}\hat{i} + \frac{\sqrt{2}}{2}\hat{j}\right] = (180\sqrt{2} + 360)\hat{i} + 180\sqrt{2}\,\hat{j}\ \ N/c$$

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$\vec{E} = \vec{E_1} + \vec{E_2}$

$= 360\hat{\imath} + 360\hat{\jmath}$ N/C

$|\vec{E}| = \sqrt{360^2 + 360^2}$

$= 360\sqrt{2}$ N/C

• arah,

$\arctan\left(\frac{360}{360}\right)$

$= 45°$

Jadi, besar dan arah medan listrik di titik P $= 360\sqrt{2}$ N/C dan $\theta = 45°$

b) $\vec{F} = q.\vec{E}$

$= -1{,}6.10^{-19} . (360\hat{\imath} + 360\hat{\jmath})$

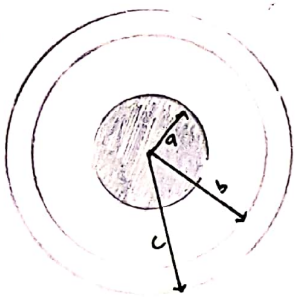
$= (-5{,}76.10^{-7}\hat{\imath} - 5{,}76.10^{-7}\hat{\jmath})$ N

$|\vec{F}| = \sqrt{(-5{,}76.10^{-7})^2 + (-5{,}76.10^{-7})^2}$

$= 5{,}76.10^{-7}.\sqrt{2}$

$= 8{,}146.10^{-7}$ N

②



Diketahui :

$q_{bola\ isolator} = +5Q$

$q_{bola\ konduktor} = -2Q$

a) • Medan listrik di $r < a$

$q_{en} = \frac{+5Q\,r^3}{a^3}$

$\oint \vec{E}.d\vec{A} = \frac{q_{en}}{\varepsilon_o}$

$\vec{E} = \frac{+5Q.r^3}{a^3} \cdot \frac{1}{\varepsilon_o} \cdot \frac{1}{4\pi r^2}$

$= \frac{+5Q}{a^3 \varepsilon_o 4\pi}\hat{r}$ N/C

• Medan listrik di $a < r < b$

$\oint \vec{E}.d\vec{A} = \frac{q_{en}}{\varepsilon_o}$

$\vec{E} = \frac{5Q}{\varepsilon_o 4\pi r^2}\hat{r}$ N/C.

• Medan listrik di $b < r < c$

$\vec{E} = 0$ (di dalam konduktor)

• Medan listrik di $r > c$

$\oint \vec{E}.d\vec{A} = \frac{q_{en}}{\varepsilon_o}$

$\vec{E} = \frac{3Q}{\varepsilon_o 4\pi r^2}\hat{r}$ N/C.

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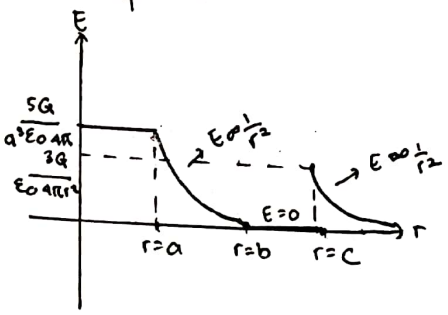
b) Distribusi muatan pada bola konduktor

Pada permukaan dalam (r=b) muatan = -5Q

Pada permukaan luar (r=c) muatan = +3Q

c) Grafik E ~ r



d) Potensial pada r < a

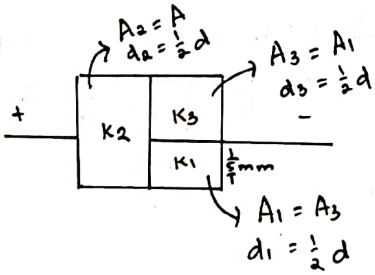
$$V = -\int_{\infty}^{c} E\,dr - \int_{c}^{b} E\,dr - \int_{b}^{a} E\,dr - \int_{a}^{r} E\,dr$$

$$= -\int_{\infty}^{c} \frac{3Q}{\varepsilon_0 4\pi r^2}\,dr - \int_{b}^{a} \frac{5Q}{\varepsilon_0 4\pi r^2}\,dr - \int_{a}^{r} \frac{5Q}{a^3 \varepsilon_0 4\pi}\,dr$$

$$= \frac{-3Q}{\varepsilon_0 4\pi}\left(-\frac{1}{c}\right) - \frac{5Q}{\varepsilon_0 4\pi}\left(-\frac{1}{a}+\frac{1}{b}\right) - \frac{5Q}{a^3\varepsilon_0 4\pi}(r-a)$$

$$= \frac{3Q}{4\pi c \varepsilon_0} + \frac{5Q}{\varepsilon_0 4\pi}\left(\frac{1}{b}-\frac{1}{a}\right) + \frac{5Q}{a^3\varepsilon_0 4\pi}(a-r) \quad \text{volt}$$

③



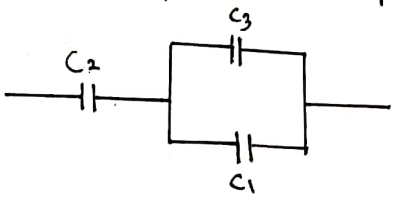
Diketahui :

$A = (1 \times 1)\ cm^2$

$d = 2\ mm$

$K_1 = 4$; $K_2 = 3$; $K_3 = 2$

a) Gambar kombinasi kapasitor



b) Kapasitansi total

$$C_1 = \frac{K_1 . \varepsilon_0 . (5.10^{-3})}{\frac{1}{2}.(2.10^{-3})} = 20\,\varepsilon_0\ F$$

$$C_2 = \frac{K_2 . \varepsilon_0 . (10^{-2})}{\frac{1}{2}.(2.10^{-3})} = 30\,\varepsilon_0\ F$$

$$C_3 = \frac{K_3 . \varepsilon_0 . (5.10^{-3})}{\frac{1}{2}(2.10^{-3})} = 10\,\varepsilon_0\ F$$

$$C_p = C_3 + C_1 = 30\,\varepsilon_0\ F$$

$$\frac{1}{C_{tot}} = \frac{1}{C_p} + \frac{1}{C_2}$$

$$= \frac{1}{30\varepsilon_0} + \frac{1}{30\varepsilon_0}$$

$$C_{tot} = 15\,\varepsilon_0$$

$$= 15 . 8{,}85 . 10^{-12}$$

$$= 1{,}33 . 10^{-10}\ F$$

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c) Diketahui $V = 5$ volt

$Q = ?$ $U = ?$

- $Q = C \cdot V$

$= 1{,}33 \cdot 10^{-10} \cdot 5$

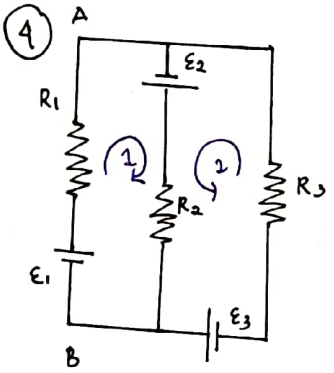
$= 6{,}65 \cdot 10^{-10}$ Coulomb

- $U = \frac{1}{2} \cdot Q \cdot V$

$= \frac{1}{2} \cdot 6{,}65 \cdot 10^{-10} \cdot 5$

$= 1{,}66 \cdot 10^{-9}$ Joule

④



Diketahui :

$R_1 = 10\,\Omega$ $\quad \mathcal{E}_1 = 12$ V

$R_2 = 5\,\Omega$ $\quad \mathcal{E}_2 = 6$ V

$R_3 = 10\,\Omega$ $\quad \mathcal{E}_3 = 9$ V

a) I pada masing-masing R ?

- loop 1

$-\mathcal{E}_1 - \mathcal{E}_2 + I_1 \cdot R_1 + (I_1 - I_2) R_2 = 0$

$-12 - 6 + I_1 \cdot 10 + (I_1 - I_2) 5 = 0$

$15 I_1 - 5 I_2 = 18$ ... ①

- loop 2

$-\mathcal{E}_2 + \mathcal{E}_3 + I_2 \cdot R_3 + (I_2 - I_1) \cdot R_2 = 0$

$-6 + 9 + 10 I_2 + 5 I_2 - 5 I_1 = 0$

$15 I_2 - 5 I_1 = -3$ ... ②

eliminasi dan subs ① dan ②

$I_1 = \frac{51}{40}$ A

$I_2 = \frac{9}{40}$ A

$I_3 = (I_1 - I_2)$ → dari loop 1

$= \left(\frac{51}{40} - \frac{9}{40}\right) = \frac{42}{40}$ A

Jadi, I pada $R_1 = \frac{51}{40}$ A ; pada $R_2 = \frac{42}{40}$ A ; pada $R_3 = \frac{9}{40}$ A

b) V_{AB} ?

- dari vertikal ke bawah

$V_{AB} = I_1 \cdot R_1 + \mathcal{E}_1$

$= \frac{51}{40} \cdot 10 + 12 = \frac{51}{4} + 12 = \frac{99}{4}$ volt