1. $Q_1 = -2 \cdot 10^4\ C \quad (4,0,0)$

$Q_2 = 4 \cdot 10^6\ C \quad (0,-2,0)$

$Q_3 = 2 \cdot 10^4\ C \quad (0,0,4)$

$P(1,2,1) \quad r_{1p} = \begin{pmatrix} 4 \\ 0 \\ 0 \end{pmatrix} - \begin{pmatrix} 1 \\ 2 \\ 1 \end{pmatrix} = \begin{pmatrix} 3 \\ -2 \\ -1 \end{pmatrix}$

$E = k \cdot \frac{q}{r^2} \cdot \vec{r} \quad |r_{1p}| = \sqrt{3^2 + (-2)^2 + (-1)^2} = \sqrt{14}$

$r_{2p} = \begin{pmatrix} 0 \\ -2 \\ 0 \end{pmatrix} - \begin{pmatrix} 1 \\ 2 \\ 1 \end{pmatrix} = \begin{pmatrix} -1 \\ -4 \\ -1 \end{pmatrix} \qquad r_{3p} = \begin{pmatrix} 0 \\ 0 \\ 4 \end{pmatrix} - \begin{pmatrix} 1 \\ 2 \\ 1 \end{pmatrix} = \begin{pmatrix} -1 \\ -2 \\ 3 \end{pmatrix}$

$|r_{2p}| = \sqrt{(-1)^2 + (-4)^2 + (-1)^2} = \sqrt{18} = 3\sqrt{2} \qquad |r_{3p}| = \sqrt{(-1)^2 + (-2)^2 + (3)^2} = \sqrt{14}$

$E_1 = \frac{9 \cdot 10^9 \cdot (-2) \cdot 10^4}{(\sqrt{14})^2} (3i - 2j - k) = \frac{-\cancel{18}^{9} \cdot 10^{13}}{\cancel{14}\,7} = -\frac{9}{7} \cdot 10^{13} \cdot (3i - 2j - k)$

$= \left(-\frac{27}{7}\hat{i} + \frac{18}{7}\hat{j} + \frac{9}{7}k\right) 10^{13}$

$E_2 = \frac{9 \cdot 10^9 \cdot 4 \cdot 10^4}{(\sqrt{18})^2} \cdot (-i - 4j - k) = \frac{\cancel{36}^{2} \cdot 10^{13}}{\cancel{18}} = 2 \cdot 10^{13}\ (-i - 4j - k)$

$= (-2\hat{i} - 8\hat{j} - 2\hat{k}) \cdot 10^{13}$

$E_3 = \frac{9 \cdot 10^9 \cdot 2 \cdot 10^4}{(\sqrt{14})^2} (-i - 2j + 3k) = \frac{\cancel{18}^{9} \cdot 10^{13}}{\cancel{14}\,7} = \frac{9}{7} \cdot 10^{13}\ (-i - 2j + 3k)$

$= \left(-\frac{9}{7}\hat{i} - \frac{18}{7}\hat{j} + \frac{27}{7}\hat{k}\right) \cdot 10^{13}$

$\vec{E}_p = \vec{E}_{1p} + \vec{E}_{2p} + \vec{E}_{3p}$

$= \left(-\frac{27}{7}\hat{i} + \frac{18}{7}\hat{j} + \frac{9}{7}\hat{k}\right) + (-2\hat{i} - 8\hat{j} - 2\hat{k}) + \left(-\frac{9}{7}\hat{i} - \frac{18}{7}\hat{j} + \frac{27}{7}\hat{k}\right)$

$= (-7{,}14\hat{i} - 8\hat{j} + 3{,}14\hat{k}) \cdot 10^{13}$

$|E_p| = \sqrt{(-7{,}14 \cdot 10^{13})^2 + (8 \cdot 10^{13})^2 + (3{,}14 \cdot 10^{13})^2}$

$= 11{,}2 \cdot 10^{13}\ N/C$

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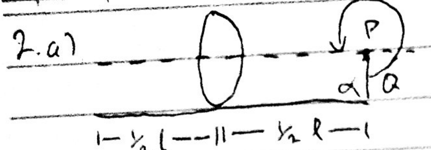
$F = E_{total\,p} \cdot Q_{pusat} = 11{,}2 \cdot 10^{13}\ Q_p\ N$

2.a)



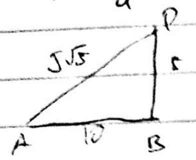
b) $F = E \cdot q$

$= \left(\frac{kq}{5\times10^{-2}}\left(1+\frac{2\sqrt{5}}{5}\right) + kq\frac{2}{125\sqrt{5}}\right)i$

$+ \left(\frac{kq}{5\times10^{-2}}\cdot\frac{\sqrt{5}}{5}\right)j \cdot 10^{-7}$

E_p oleh batang

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



$\lambda = \frac{Q}{L}$

$Q = \lambda . L$

$= \frac{kq}{a}\left[(1-(-2\sqrt{5}/5))i + (0-(-\sqrt{5}/5))j\right]$

$= \frac{kq}{5AB}\left[\left(1+\frac{2\sqrt{5}}{5}\right)i + \frac{\sqrt{5}}{5}j\right]$

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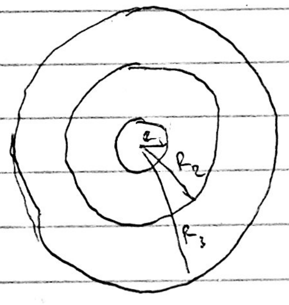
E_p oleh cincin

$E_p = kq\left(\frac{b}{\sqrt{(a^2+b^2)^3}}\right)i$

$= kq\left(\frac{10}{\sqrt{(125)^3}}\right)i$

$= kq\left(\frac{10}{125\sqrt{125}}\right)i \rightarrow kq\left(\frac{2}{125\sqrt{5}}\right)$

3.



(b) $Q_2 + Q_3 = -3Q$

$R_1 = +Q$

$Q_{luar} = -2Q$

$Q_{dalam} = -Q$

$-3Q - (-2Q) = -Q$

a). $\vec{E_A} = 0\ N/C$

$\vec{E_E} = 0\ N/C$

$\oint \vec{E_D} dA = \frac{Q}{\varepsilon_0}$

$\vec{E_D}\, 4\pi R^2 = \frac{Q}{\varepsilon_0}$

$\vec{E_p} = \frac{Q}{4\pi R^2 \varepsilon_0}$

$= \frac{+Q}{4\pi R_0^2 \varepsilon_0}\ N/C$

c) $dV_{BC} = -E\,dr$

$\int dV_{BC} = -\int_C^B E\,dr$

$V_{BC} = -\int_C^B \frac{Q}{4\pi r^2 \varepsilon_0}\,dr$

$V_{BC} = -\frac{Q}{4\pi\varepsilon_0}\int_C^B \frac{1}{r^2}\,dr$

$V_{BC} = \frac{-Q}{4\pi\varepsilon_0}\left(\frac{1}{r_b} + \frac{1}{r_c}\right)$

$V_{BC} = \frac{Q}{4\pi\varepsilon_0 r_b} - \frac{Q}{4\pi\varepsilon_0 r_c}$

$= \frac{Q}{4\pi\varepsilon_0}\left(\frac{1}{r_b} - \frac{1}{r_c}\right)$

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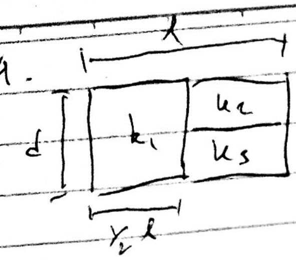
1.



$C = \varepsilon_0 \cdot \frac{A}{d} \cdot k$

a) $k_2 k_3$ = seri k_1 = paralel

$k_2 k_3 = \frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{C_{seri\,23}}$

$C_{total} = C_1 + C_{seri\,23}$

$C_{seri} = \frac{1}{0{,}14\,\varepsilon_0} + \frac{1}{0{,}05\,\varepsilon_0} = \frac{190}{7} = \frac{7}{190}$

$C_{total} = \frac{12}{100}\,\varepsilon_0 + \frac{7}{190}\,\varepsilon_0$

$= 0{,}16 \cdot \varepsilon_0 \text{ F}$

b) $C_1 = \varepsilon_0 \cdot \frac{0{,}5 \cdot 10^{-4}}{2 \cdot 10^{-3}} \cdot 4{,}9$

$\approx 0{,}12 \cdot \varepsilon_0 \text{ F}$

$C_2 = \varepsilon_0 \cdot \frac{0{,}25 \cdot 10^{-4}}{10^{-3}} \cdot 5{,}6$

$\approx 0{,}14 \cdot \varepsilon_0 \text{ F}$

$C_3 = \varepsilon_0 \cdot \frac{0{,}25 \cdot 10^{-4}}{10^{-3}} \cdot 2{,}1$

$\approx 0{,}05 \cdot \varepsilon_0 \text{ F}$