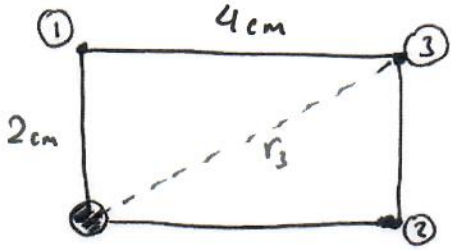
HW #2

(1)



$E = k_e \frac{|q|}{r^2}$, $|q| = 100\,nC = 100\times10^{-9}C$

Point 1 : $r_1 = 2cm = 0.02m$

$E_1 = 9\cdot10^9 \cdot \frac{100\times10^{-9}}{(0.02)^2} = \underline{2.25\times10^6 (N/C)}$

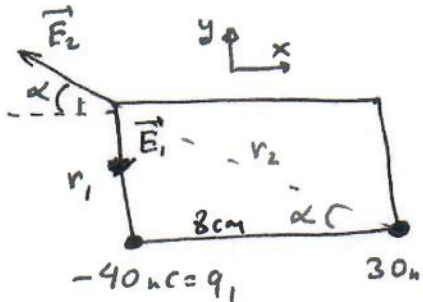
Point 2 : $r_2 = 4cm = 0.04m$

$E_2 = 9\cdot10^9 \cdot \frac{100\cdot10^{-9}}{(0.04)^2} = \underline{5.6\times10^5 (N/C)}$

Point 3 : $r_3 = \sqrt{2^2+4^2} = 4.47cm = 0.0447m$, then :

$E_3 = 9\cdot10^9 \cdot \frac{100\cdot10^{-9}}{(0.0447)^2} = \underline{4.5\times10^5 (N/C)}$

(2) $\vec{E}_{net} = \vec{E}_1 + \vec{E}_2$



$r_1 = 2cm = 0.02m$

$r_2 = \sqrt{2^2+8^2} = 8.25cm = 0.0825m$

$\cos\alpha = \frac{8}{8.25}$

$\sin\alpha = \frac{2}{8.25}$

Point 1 : $E_1 = k_e \frac{|q_1|}{r_1^2} = 9\times10^9 \cdot \frac{40\times10^{-9}}{(0.02)^2} = 9\times10^5 (N/C)$

$E_2 = k_e \frac{|q_2|}{r_2^2} = 9\times10^9 \cdot \frac{30\times10^{-9}}{(0.0825)^2} = 0.40\times10^5 (N/C)$

$\vec{E}_1 = (0; -E_1) = (0, -9\times10^5)$

$\vec{E}_2 = (-E_2\cdot\cos\alpha ; E_2\cdot\sin\alpha) = (-0.4\times10^5 \times \frac{8}{8.25} ; 0.4\times10^5 \times \frac{2}{8.25}) =$

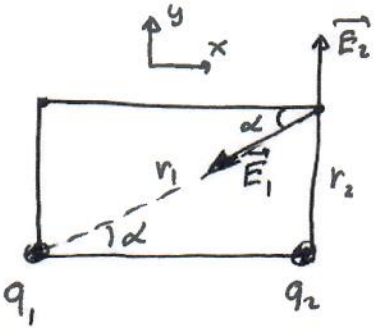
$= (-0.39\times10^5 ; 0.097\times10^5)$

then:

$\vec{E}_{net} = (-0.39\times10^5 ; 8.9\times10^5) \Rightarrow E_{net} = \sqrt{(0.39\times10^5)^2 + (8.9\times10^5)^2} =$

$= 8.9\times10^5 (N/C)$

Point 3



$r_2 = 2\,cm = 0.02\,m$

$r_1 = \sqrt{2^2 + 8^2} = 8.25\,cm = 0.0825\,m$

$\cos\alpha = \frac{8}{8.25}$; $\sin\alpha = \frac{2}{8.25}$

$$E_1 = k_e \frac{|q_1|}{r_1^2} = 9.10^9 \cdot \frac{40\times10^{-9}}{(0.0825)^2} = 0.53\times10^5 (N/C)$$

$$E_2 = k_e \frac{|q_2|}{r_2^2} = 9.10^9 \frac{30\times10^{-9}}{(0.02)^2} = 6.75\times10^5 (N/C)$$

$$\vec{E_1} = (-E_1\cos\alpha\ ;\ -E_1\cdot\sin\alpha) = \left(-0.53\times10^5 \cdot \frac{8}{8.25}\ ;\ -0.53\times10^5 \frac{2}{8.25}\right)$$

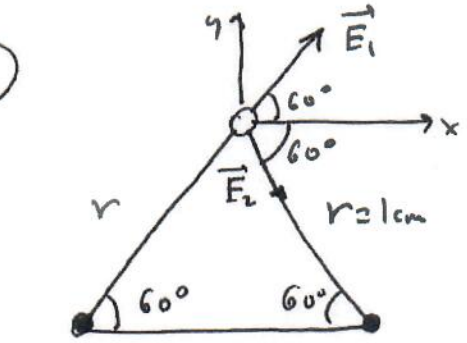
$$= (-0.51\times10^5\ ;\ -0.13\times10^5)$$

$$\vec{E_2} = (0\ ;\ E_2) = (0,\ 6.75\times10^5)$$

then:

$$\vec{E_{net}} = (-0.51\times10^5\ ;\ 6.62\times10^5) \Rightarrow \underline{E_{net} = 6.64\times10^5 (N/C)}$$

(3)



$q_1 = 4nC$ $\quad q_2 = -2nC$

$$E_1 = k_e \frac{|q_1|}{r^2} = 9.10^9 \cdot \frac{4\cdot10^{-9}}{(0.01)^2} = 36\cdot10^4 (N/C)$$

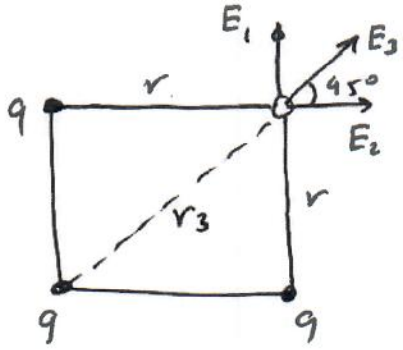
$$E_2 = k_e \frac{|q_2|}{r^2} = 9.10^9 \cdot \frac{2\cdot10^{-9}}{(0.01)^2} = 18\cdot10^4 (N/C)$$

$$\vec{E_1} = (E_1\cos60°\ ;\ E_1\cdot\sin60°) = (18\cdot10^4\ ;\ 31.2\cdot10^4)$$

$$\vec{E_2} = (E_2\cdot\cos60°\ ;\ -E_2\cdot\sin60°) = (9\cdot10^4\ ;\ -15.6\cdot10^4)$$

$$\vec{E_{net}} = (27\cdot10^4\ ;\ 15.6\cdot10^4) \Rightarrow E_{net} = \sqrt{E_x^2 + E_y^2} = \underline{31.2\cdot10^4 (N/C)}$$

(4)



$q = 10\,\mu C = 10 \cdot 10^{-6}\,C$ $\quad r = 1\,cm$

$r_3 = \sqrt{2}\,cm$

$E_1 = k_e \frac{q}{r^2} = 9 \cdot 10^9 \cdot \frac{10^{-5}}{(0.01)^2} = 9 \cdot 10^8 \left(N/C\right)$

$E_2 = E_1 = 9 \cdot 10^8 \left(N/C\right)$

$E_3 = k_e \frac{q}{r_3^2} = 4.5 \cdot 10^8 \left(N/C\right)$

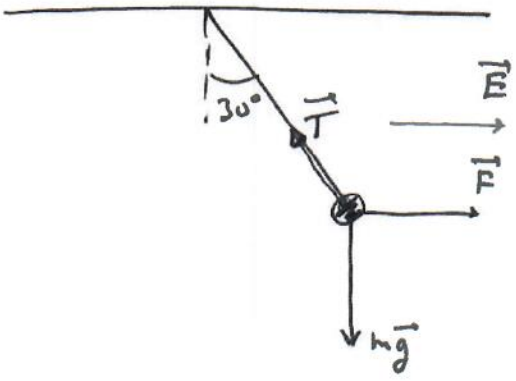
$\vec{E_1} = (0, E_1) = (0, 9 \cdot 10^8)$

$\vec{E_2} = (E_2, 0) = (9 \cdot 10^8, 0)$

$\vec{E_3} = (E_3 \cdot \cos 45°, E_3 \cdot \sin 45°) = (3.2 \cdot 10^8, 3.2 \cdot 10^8)$

$\vec{E_{net}} = (12.2 \cdot 10^8, 12.2 \cdot 10^8) \Rightarrow E_{net} = 17.25 \cdot 10^8 \left(N/C\right)$

(5)



$\vec{F} + m\vec{g} + \vec{T} = 0$, $F = qE$

$x: \quad q \cdot E = T \cdot \sin 30°$

$y: \quad mg = T \cos 30°$

then: $T = \frac{mg}{\cos 30°} \Rightarrow qE = mg \tan 30°$

$q = \frac{mg \cdot \tan 30°}{E} = \frac{5 \cdot 10^{-3} \cdot 9.8 \cdot 1/\sqrt{3}}{0.5 \cdot 10^5} = 0.69 \times 10^{-6}\,C$

(6)

σ_{co}

σ_{co}

$E_1 = E_2 = 2\pi k_e |\sigma| =$

$= 2 \cdot 3{,}14 \cdot 9 \cdot 10^9 \cdot 20 \cdot 10^{-6} = 1{,}13 \cdot 10^6 \ (N/C)$

$E_3 = k_e \frac{|Q|}{r^2} = 9 \cdot 10^9 \cdot \frac{30 \cdot 10^{-6}}{(0{,}1)^2} = 2{,}7 \times 10^7 \ (N/C)$

$E_{net} = \sqrt{(E_1 + E_2)^2 + E_3^2} = \sqrt{(2{,}26 \cdot 10^6)^2 + (2{,}7 \times 10^7)^2} =$

$= 27{,}1 \times 10^6 \ (N/C)$