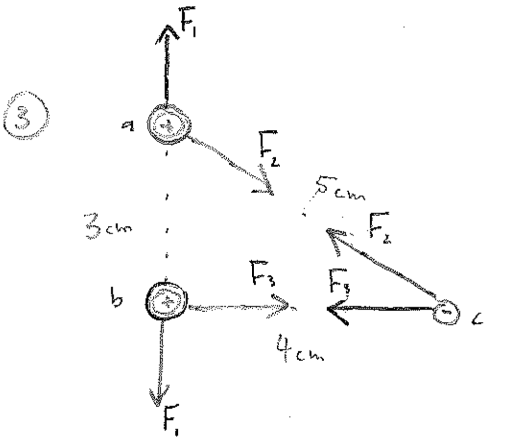
Electrostatics: E-static Force of Point Charges (Ch 18)

(1) $F = \frac{kQq}{d^2} = \frac{(9\times10^{9}\,\frac{Nm^2}{C^2})(6\times10^{-6}C)(4\times10^{-6}C)}{(1.6\times10^{-2}m)^2} = 843.75N \approx \boxed{840N \text{ attractive}}$

(2) $F = \frac{kQq}{d^2} \Rightarrow d = \sqrt{\frac{kQq}{F}} = \sqrt{\frac{9\times10^{9}\,\frac{Nm^2}{C^2}(1.6\times10^{-19}C)^2}{2.2\times10^{-11}}} = \boxed{3.2\times10^{-9}m}$

(3)



$F_1 = \frac{kQ_aQ_b}{(0.03)^2} = 75N$

$F_2 = \frac{kQ_aQ_c}{(0.05)^2} = 18N$

$F_3 = \frac{kQ_bQ_c}{(0.04)^2} = 33.75N$

(a.) $\vec{F}_a = \vec{F}_1 + \vec{F}_2$

$\hat{x}: \ \Sigma \vec{F}_x = F_2\cos\theta = 14.4N$ right

$\hat{y}: \ \Sigma F_y = F_1 - F_2\sin\theta = 64.2\,N$ up

$\vec{F}_a = \boxed{65.8N\ @\ 77.4° \text{ above } +x}$

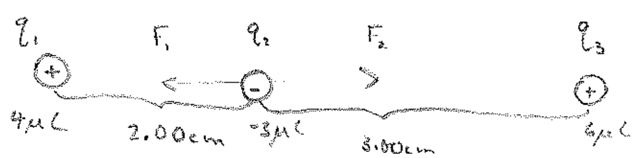
(b.) $\vec{F}_c = \vec{F}_2 + \vec{F}_3$

$\hat{x}: \ \Sigma F_x = F_3 + F_2\cos\theta = 48.15N$ left

$\hat{y}: \ \Sigma F_y = F_2\sin\theta = 10.8N$ up

$\vec{F}_c = \boxed{49.3N\ @\ 12.6° \text{ above } -x}$

(4)



$F_1 = \frac{kq_1q_2}{(0.02)^2} = 270N$ left

$F_2 = \frac{kq_3q_2}{(0.03)^2} = 180N$ right

$\boxed{\vec{F} = 90.0N \text{ left}}$

(5) $E = \frac{F}{q} = \frac{4.0\times10^{-6}\,N}{2.0\times10^{-9}\,C} = 2.0\times10^{3}\ N/C$

$\boxed{\vec{E} = 2.0\times10^{3}\ N/C \ \text{left}}$

(6) $E = \frac{F}{q} = 2.0\times10^{3}\ N/C$

$\boxed{\vec{E} = 2.0\times10^{3}\ N/C \ \text{right}}$

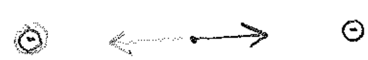
(7) $E = \frac{kq}{r^2} = \frac{9\times10^{9}\,\frac{Nm^2}{C^2}\,(1.6\times10^{-19}\,C)}{(1\times10^{-3}\,m)^2} = 1.44\times10^{-3}\ N/C$

$\boxed{\vec{E} = 1.44\times10^{-3}\ N/C \ \text{left}}$

(8) $\boxed{E = 1.44\times10^{-3}\ N/C \ \text{right}}$

(9) $\boxed{0\ N/C}$

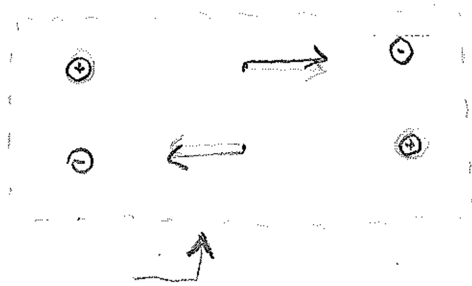
(10) $\boxed{0\ N/C}$



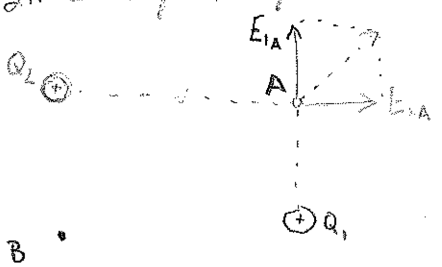
(11) $\vec{E} = \vec{E}_+ + \vec{E}_-$

$E = 2(1.44\times10^{-3}\ N/C) = 2.88\times10^{-3}\ N/C$

dir'n depends upon how they are arranged



(12)



$E_{2A} = \frac{kQ_2}{r_1^2} = \frac{9\times10^{9}\,\frac{Nm^2}{C^2}(12\times10^{-9}\,C)}{(6.0\times10^{-2})^2} = 3\times10^{4}\ N/C$ $\left(\vec{E}_{2B} = 1.2\times10^{5}\ N/C \ \text{down}\right)$

$E_{1A} = \frac{kQ_1}{r_2^2} = \frac{9\times10^{9}\,\frac{Nm^2}{C^2}\,(4\times10^{-9}\,C)}{(3.0\times10^{-2})^2} = 4\times10^{4}\ N/C$ $\left(\vec{E}_{1B} = 1.0\times10^{4}\ N/C \ \text{left}\right)$

$\sum \vec{E}_A = \vec{E}_{1A} + \vec{E}_{2A} = 5.0\times10^{4}\ N/C$ [53° above +x]

$\sum \vec{E}_B = \vec{E}_{1B} + \vec{E}_{2B} = 1.2\times10^{5}\ N/C$ [85° below −x]