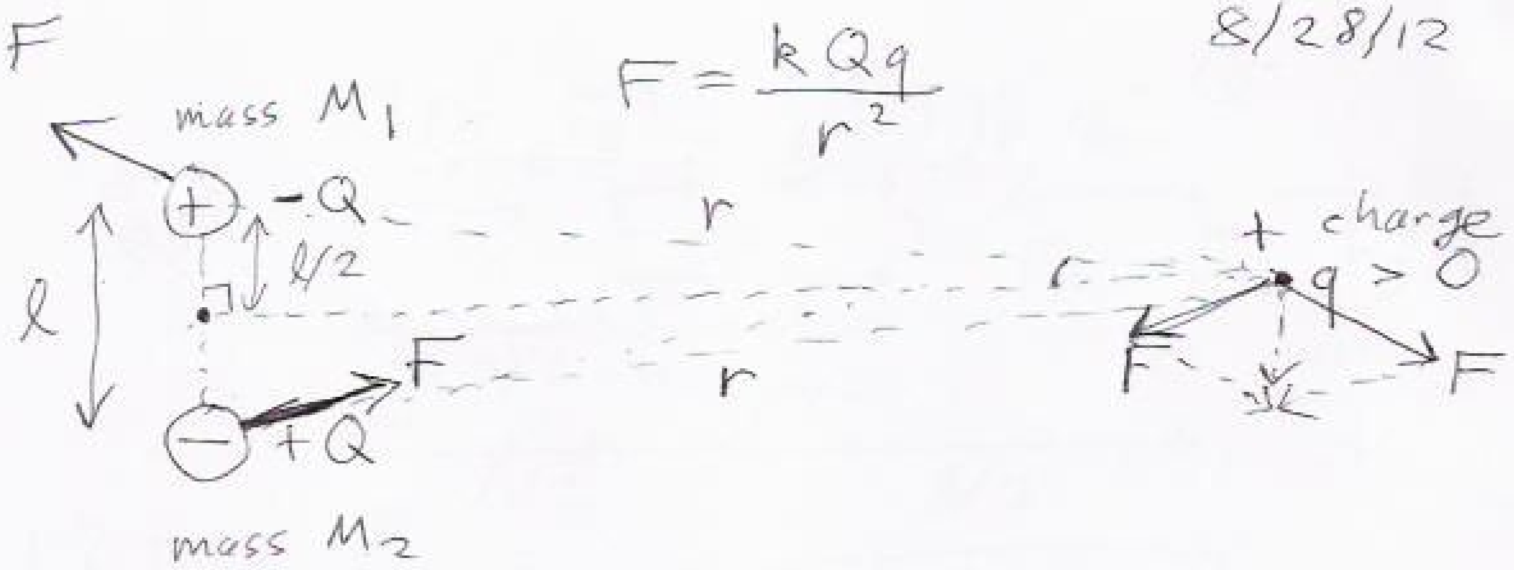
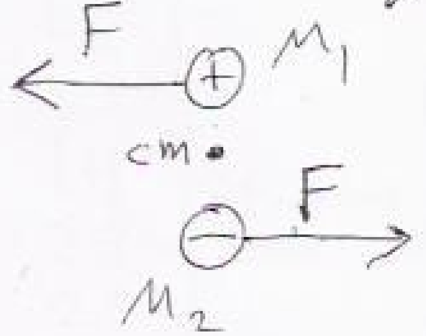
8/28/12

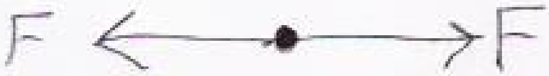
$$F = \frac{kQq}{r^2}$$



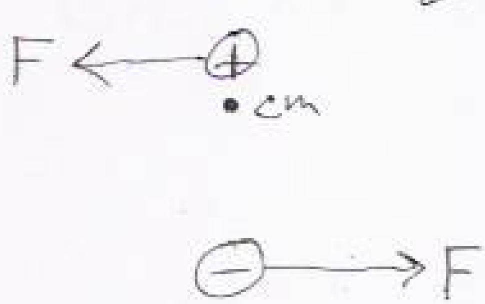
$M_1 = M_2$:

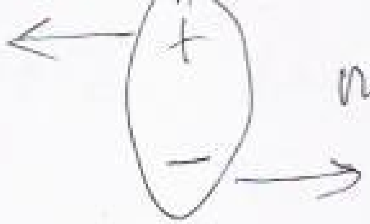
$r >> l$:





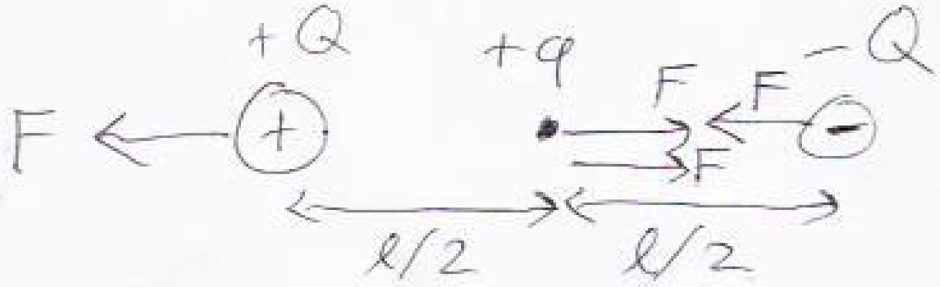
$M_1 > M_2$:

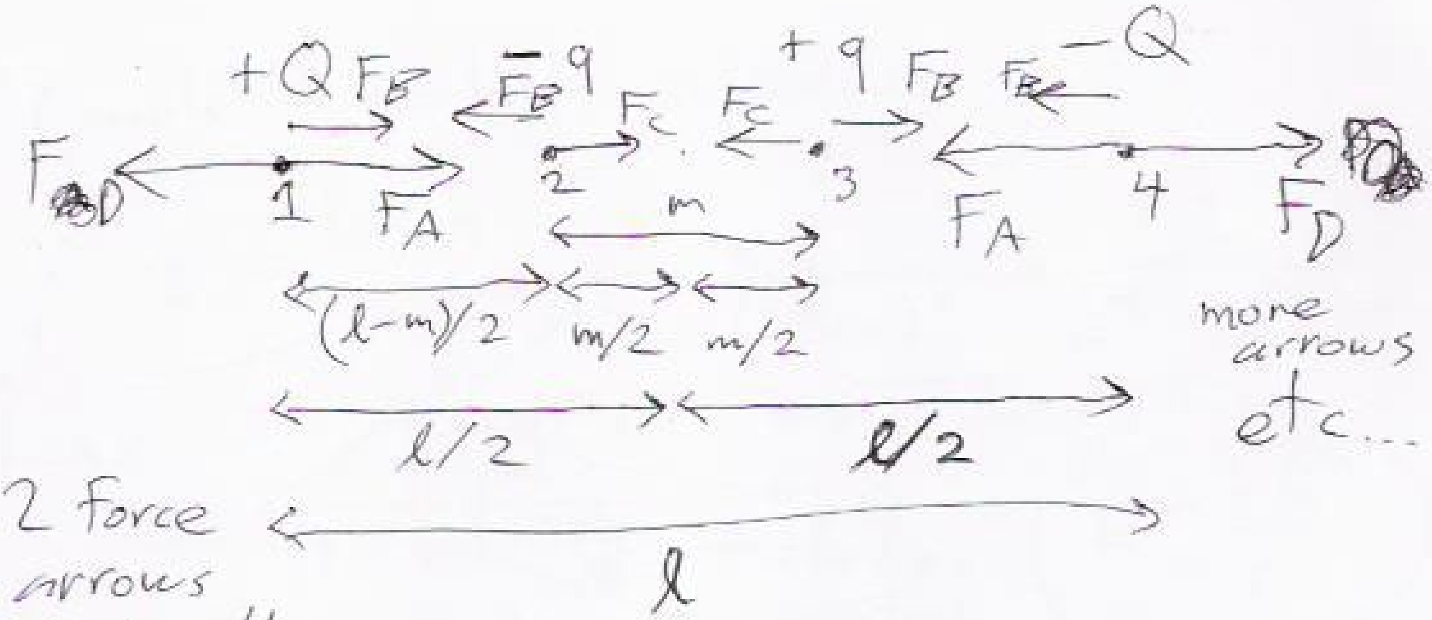




net force $\vec{0}$ (approx)

net torque $\neq \vec{0}$





12 force arrows all together

12	6 interactions
13	
14	
23	
24	
34	

$$F_A = kQ^2/l^2 \quad 14$$

$$F_B = kQq/((l-m)/2)^2 \quad 12, 34$$

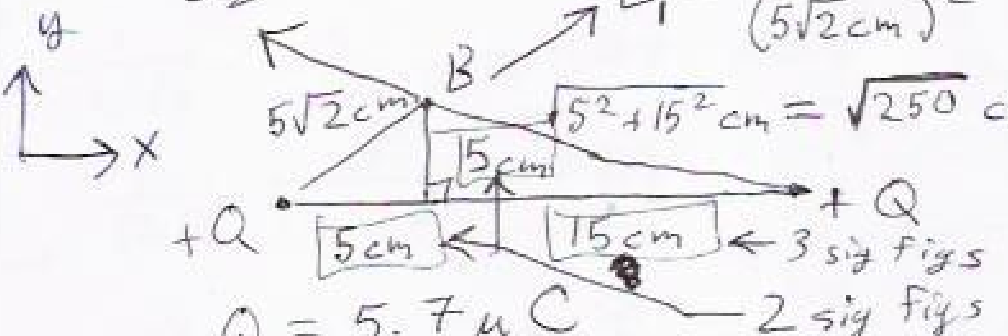
$$F_C = kq^2/m^2 \quad 23$$

$$F_D = kQq/((l+m)/2)^2 \quad 13, 24$$

Ch. 21 #42 done in class...

Completed ~~Partial~~ solution:

$$E_2 = \frac{kQ}{250\,\text{cm}^2} \qquad E_1 = \frac{kQ}{(5\sqrt{2}\,\text{cm})^2} = \frac{kQ}{50\,\text{cm}^2}$$



$\sqrt{5^2+15^2}\,\text{cm} = \sqrt{250}\,\text{cm} = 5\sqrt{10}\,\text{cm}$

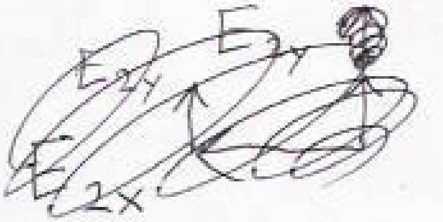
← 3 sig figs

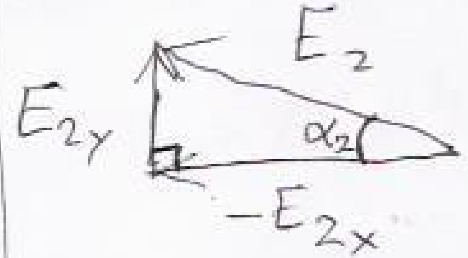
2 sig figs

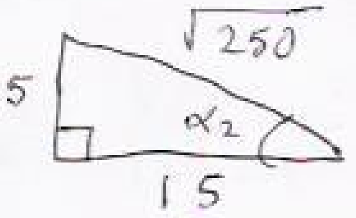
$Q = 5.7\,\mu C$

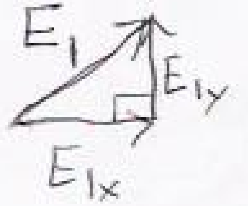
$$E = \frac{kQ}{r^2}$$

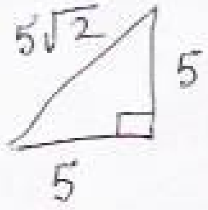
$\vec{E}$ @ B: ~~$\tan\alpha_2 = |E_{2y}|/|E_{2x}| = 5\text{cm}/15\text{cm} = 1/3$~~











$$\frac{-E_{2x}}{E_2} = \frac{15}{\sqrt{250}} \qquad \frac{E_{2y}}{E_2} = \frac{5}{\sqrt{250}}$$

$$\frac{E_{1x}}{E_1} = \frac{5}{5\sqrt{2}} \Rightarrow E_{1x} = \frac{E_1}{\sqrt{2}}$$

$$E_{2x} = \frac{-15E_2}{\sqrt{250}} \qquad E_{2y} = \frac{5E_2}{\sqrt{250}}$$

$$\frac{E_{1y}}{E_1} = \frac{5}{5\sqrt{2}} \Rightarrow E_{1y} = \frac{E_1}{\sqrt{2}}$$

$$E_{2x} = \frac{-15kQ}{250^{3/2}\,\text{cm}^2} \qquad E_{2y} = \frac{5kQ}{250^{3/2}\,\text{cm}^2}$$

$$E_{1x} = E_{1y} = \frac{kQ}{50\sqrt{2}\,\text{cm}^2}$$

$$E_x = E_{1x} + E_{2x} = \frac{kQ}{\text{cm}^2}\left(\frac{1}{50\sqrt{2}} - \frac{15}{250^{3/2}}\right)$$

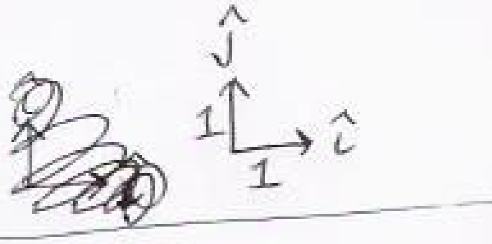
$$E_y = E_{1y} + E_{2y} = \frac{kQ}{\text{cm}^2}\left(\frac{1}{50\sqrt{2}} + \frac{5}{250^{3/2}}\right)$$

$\vec{E}$ @ B $= E_x \hat{i} + E_y \hat{j} = (9.3 \times 10^{7} \hat{i} + 1.4 \times 10^{8} \hat{j}) \frac{N}{C}$

$$\frac{kQ}{cm^2} = \frac{(8.99 \times 10^9 \, N \cdot m^2/C^2)}{(10^{-2} m)^2} (5.7 \times 10^{-6} C) = 5.12 \times 10^{8} \frac{N}{C}$$

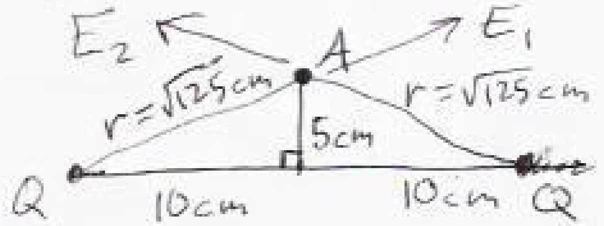
$$\frac{1}{50\sqrt{2}} - \frac{15}{250^{3/2}} = 1.035 \times 10^{-2}$$

$$\frac{1}{50\sqrt{2}} + \frac{5}{250^{3/2}} = 1.541 \times 10^{-2}$$

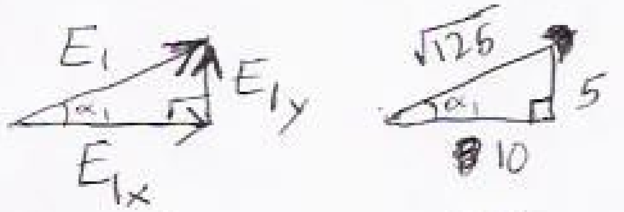


$$\vec{E} \text{ @ } B = E_x \hat{i} + E_y \hat{j} = \boxed{(5.3 \hat{i} + 7.9 \hat{j}) 10^6 \, N/C}$$

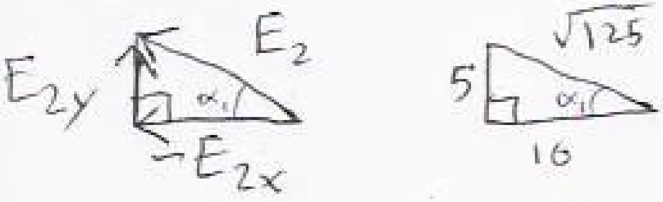
Similar computation of $\vec{E}$ @ A:



$$E_1 = E_2 = \frac{kQ}{r^2} = \frac{kQ}{125 \, cm^2}$$



$$E_{1x} = E_1 \frac{10}{\sqrt{125}} \qquad E_{1y} = E_1 \frac{5}{\sqrt{125}}$$



$$E_{2x} = -E_2 \frac{10}{\sqrt{125}} \qquad E_{2y} = E_2 \frac{5}{\sqrt{125}}$$

$$E_1 = E_2 \Rightarrow E_{1x} + E_{2x} = 0 \;\&\; E_{1y} + E_{2y} = 2E_{1y}$$

$$\vec{E} \text{ @ } A = \underbrace{E_x}_{0} \hat{i} + E_y \hat{j} = 2E_{1y} \hat{j} = \frac{10}{125^{3/2}} \frac{kQ}{cm^2} = \boxed{(3.7 \hat{j}) 10^6 \frac{N}{C}}$$

magnitude: $E @ B = \sqrt{5.3^2 + 7.9^2}\, 10^6 \frac{N}{C}$

(recall $E = |\vec{E}|$) $= \boxed{9.5 \times 10^6 N/C}$

direction: $\hat{E} @ B = \frac{5.3\hat{\imath} + 7.9\hat{\jmath}}{9.5} \simeq \boxed{0.56\hat{\imath} + 0.83\hat{\jmath}}$

(recall $\hat{E} = \vec{E}/|\vec{E}|$)

magnitude: $E @ A = 3.7 \times 10^6 N/C$

direction $E @ A = \hat{\jmath}$