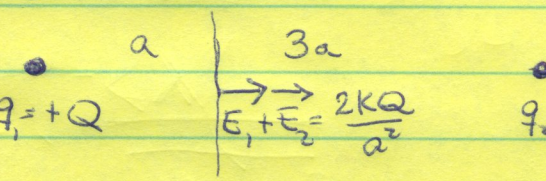
HOMEWORK PHYSICS WEEK 1

(6) $F_1 = \frac{K q_A q_B}{r_1^2}$ $\quad q_B = \frac{F_1 r_1^2}{K q_A}$ BEFORE

AFTER: $F_2 = \frac{K q_A q_B}{r_2^2} = \frac{K q_A F_1 r_1^2}{r_2^2 K q_A} = F_1\left(\frac{r_1^2}{r_2^2}\right)$

$F_2 = 2.62\mu N\left(\frac{13.7^2}{17.7^2}\right)$ $\quad \boxed{F_2 = 1.57\mu N}$

(12) case #1



$\frac{K q_1}{r_1^2} + \frac{K q_2}{r_2^2} = \frac{2KQ}{a^2}$

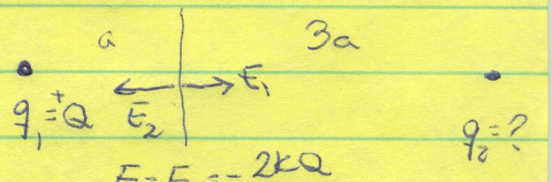
$\frac{K(Q)}{a^2} + \frac{K q_2}{9a^2} = \frac{2KQ}{a^2}$

$\frac{9KQ}{9a^2} + \frac{K q_2}{9a^2} = \frac{18KQ}{9a^2}$

$9Q + q_2 = 18Q$

$\boxed{q_2 = 9Q}$

case #2

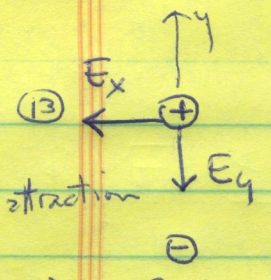


$E_1 - E_2 = -\frac{2KQ}{a^2}$

$\frac{9KQ}{9a^2} - \frac{K q_2}{9a^2} = -\frac{2KQ \cdot 9}{a^2 \cdot 9}$

$9Q - q_2 = -18Q$

$\boxed{27Q = q_2}$

(13) 

6nC ⊕ ⟶ x

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

a) $E_x = \frac{8.99\times10^{9}\times6\times10^{-9}}{(0.30)^2} = -599.33\,\hat{i}$

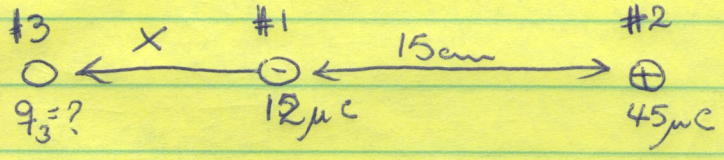
$E_y = \frac{8.99\times10^{9}\times3\times10^{-9}}{(0.10)^2} = +2697\,\hat{j}$

$\vec{E} = (-599.33\,\hat{i} + 2697\,\hat{j})\ N/C$

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

$\vec{F} = 5\times10^{-9}\,C\,(-599.33\,\hat{i} + 2697\,\hat{j})\ N/C$

$\vec{F} = (-3\,\hat{i} + 13.5\,\hat{j})\ \mu C$

(53) 

Looking at the magnitudes of q_1 and q_2, q_3 must be to the left of the origin

a) at point 3:

$E_{13} = E_{23}$

$\frac{K\,12\mu C}{x^2} = \frac{K\,45\mu C}{(x+15)^2}$

$12(x+15)^2 = 45x^2$

$12(x^2+30x+225) = 45x^2$

$12x^2+360x+2700 = 45x^2$

$0 = 33x^2 - 360x - 2700$

$\boxed{x = 16cm}$ ~~$x = -5.1cm$~~

this is the only way.

b) at point 1: $E_{13} = E_{12}$

$\frac{Kq_3}{16^2} = \frac{Kq_2}{15^2}$

$q_3 = \left(\frac{16^2}{15^2}\right)45\mu C$

$q_3 = 51.2\mu C$

it must be positive