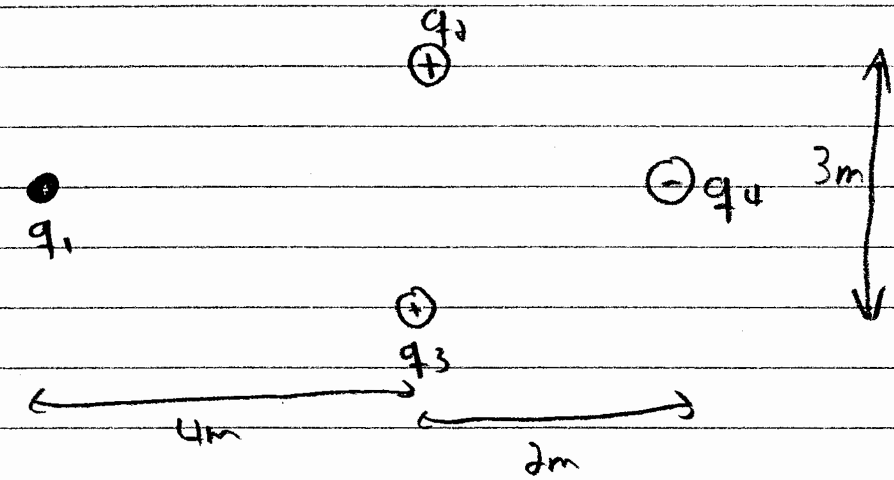
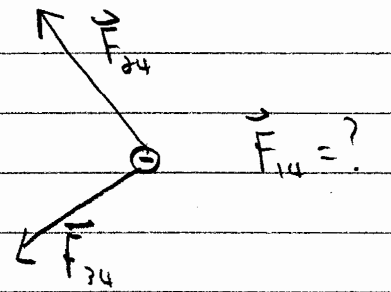
Assignment 10



$q_1 = ?$
$q_2 = 3 \times 10^{-6} C$
$q_3 = 3 \times 10^{-6} C$
$q_4 = -2 \times 10^{-6} C$

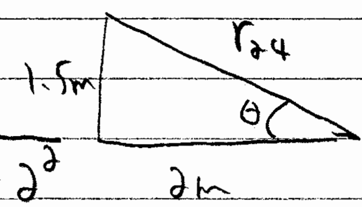
F.B.D.



equilibrium: $\vec{F}_{24} + \vec{F}_{34} + \vec{F}_{14} = 0.$

$$|F_{24}| = \frac{K q_2 q_4}{(r_{24})^2} = \frac{(9 \times 10^9 \, N \frac{m^2}{C^2})(3 \times 10^{-6} C)(2 \times 10^{-6} C)}{(2.5)^2}$$

r_{24}



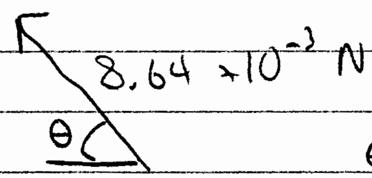
$r_{24} = \sqrt{(1.5)^2 + 2^2}$

$|F_{24}| = 8.64 \times 10^{-3} N$

$\tan\theta = \frac{1.5m}{2m}$

$\theta = 36.9°$

$\vec{F}_{24}$:



$\theta = 36.9°$

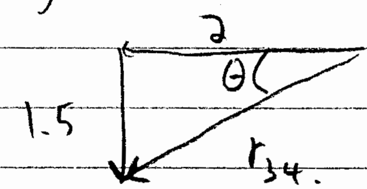
$F_{24x} = (8.64 \times 10^{-3} N) \cos 36.9°$
$F_{24x} = -6.91 \times 10^{-3} N$

$F_{24y} = (8.64 \times 10^{-3} N)(\sin 36.9)$
$F_{24y} = 5.19 \times 10^{-3} N$

F_{34} :

$|F_{34}| = \dfrac{K q_3 q_4}{(r_{34})^2} = \dfrac{(9 \times 10^9 N \frac{m^2}{C^2})(3 \times 10^{-6} C)(2 \times 10^{-6} C)}{(2.5m)^2}$

$\longrightarrow r_{34} = \sqrt{1.5^2 + 2^2}$



$|F_{34}| = 8.64 \times 10^{-3} N$

$F_{34x} = (8.64 \times 10^{-3} N) \cos 36.9°$
$= -6.91 \times 10^{-3} N$

$\tan\theta = \frac{1.5}{2}$

$\theta = 36.9°$

$F_{34y} = (8.64 \times 10^{-3} N) \sin 36.9°$

$F_{34y} = -5.19 \times 10^{-3} N.$

Using Equilibrium condition:

$\hat{y}$: $F_{24y} + F_{34y} + F_{14y} = 0$

$5.19 \times 10^{-3} - 5.19 \times 10^{-3} + F_{14y} = 0$

$\underline{F_{14y} = 0}$

$\hat{x}$: $F_{24x} + F_{34x} + F_{14x} = 0$

$-6.91 \times 10^{-3}\,N - 6.91 \times 10^{-3}\,N + F_{14x} = 0$

$F_{14x} = 1.38 \times 10^{-2}\,N$

in the positive x dir.

$\therefore \vec{F}_{14} = 1.38 \times 10^{-2}\,N\ \hat{x}$

to get q_1

$$|F_{14}| = \frac{K q_1 q_4}{(r_{14})^2}$$

$$q_1 = \frac{|F_{14}|(r_{14})^2}{K q_4} = \frac{(1.38 \times 10^{-2}\,N)(6m)^2}{(9 \times 10^9\,N\,m^2/C^2)(2 \times 10^{-6}\,C)}$$

$q_1 = 2.76 \times 10^{-5}\,C$

since F_{14} points in the POSITIVE $\hat{x}$ dir q_1 must be negative.

$$\boxed{q_1 = -2.76 \times 10^{-5}\,C}$$