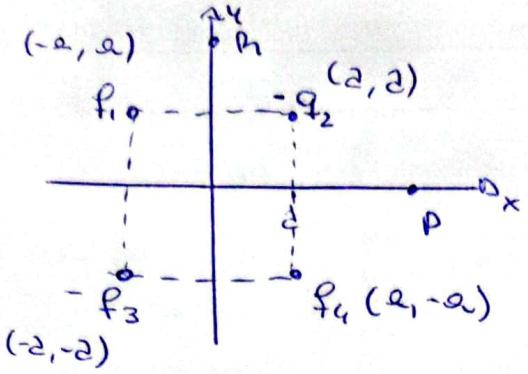
Problema 1

$|q| = |q_1| = |q_2| = |q_3| = |q_4| = 2\times10^{-12}\,C$



$a = 2\times10^{-2}\,m$

$P = (10a, 0)$

$R = (0, 10a)$

$k = 9\times10^{9}\,\frac{N\,m^2}{C^2}$

$q_p = 3\times10^{-12}\,C$

2- $\vec{r} = (10a, 0)$, $\vec{r}_1' = (-a, a)$, $\vec{r}_2' = (a, a)$, $\vec{r}_3' = (-a, -a)$, $\vec{r}_4' = (a, -a)$

$\vec{r}_1 = \vec{r} - \vec{r}_1' = (11a, -a)$ $\qquad$ $\vec{r}_3 = \vec{r} - \vec{r}_3' = (11a, a)$

$\vec{r}_2 = \vec{r} - \vec{r}_2' = (9a, -a)$ $\qquad$ $\vec{r}_4 = \vec{r} - \vec{r}_4' = (9a, a)$

$|r_1| = |r_3| = 11{,}04\,a$

$|r_2| = |r_4| = 9{,}05\,a$

$$\vec{F} = k\cdot\frac{q_1\cdot q_2}{|r|^3}\vec{r}$$

$$\vec{F} = k\,q_p\cdot q\left[\frac{(11a,-a)}{|\vec{r}_1|^3} - \frac{(9a,-a)}{|\vec{r}_2|^3} - \frac{(11a,a)}{|\vec{r}_3|^3} + \frac{(9a,a)}{|\vec{r}_4|^3}\right]$$

$$F_x = k\,q_p\cdot q\left[\frac{11a}{r_1^3} - \frac{9a}{r_2^3} - \frac{11a}{r_1^3} + \frac{9a}{r_2^3}\right] = 0$$

$$F_y = k\,q_p\,q\left[\frac{-a}{(11{,}04a)^3} + \frac{a}{(9{,}05a)^3} - \frac{a}{(11{,}04a)^3} + \frac{a}{(9{,}05a)^3}\right]$$

$F_y = 2{,}61\times10^{-14}$

$$\vec{F} = 2{,}61\times10^{-14}\,\frac{N}{C}\,\hat{j}$$

b- $W = \Delta V = V_R - V_P$

$V = k \cdot \frac{f}{r}$

Para el punto R

$\vec{r}_1 = (a, 9a)$, $\vec{r}_2 = (a, 9a)$, $\vec{r}_3 = (a, 11a)$, $\vec{r}_4 = (-a, 11a)$

$|\vec{r}_1| = |\vec{r}_2|$; $|\vec{r}_3| = |\vec{r}_4|$

$V_P = k f \left[\frac{1}{r_1} - \frac{1}{r_2} - \frac{1}{r_1} + \frac{1}{r_2} \right] = 0$

$V_R = k \cdot f \left[\frac{1}{r_1} - \frac{1}{r_1} - \frac{1}{r_3} + \frac{1}{r_3} \right] = 0$

$\Big\} \rightarrow \boxed{W = 0}$

c- $\vec{F} = k f_P f_1 \left[-\frac{(11a, -a)}{|r_1|^3} + \frac{(9a, -a)}{|r_2|^3} + \frac{(11a, a)}{|r_1|^3} - \frac{(9a, a)}{|r_2|^3} \right]$

$F_x = k f_P f_1 \left[-\frac{11a}{r_1^3} + \frac{9a}{r_2^3} + \frac{11a}{r_1^3} - \frac{9a}{r_2^3} \right] = 0$

$F_y = k f_P f_1 \left[\frac{a}{r_1^3} - \frac{a}{r_2^3} + \frac{a}{r_1^3} - \frac{a}{r_2^3} \right] = -2,61 \times 10^{-14}$

$\boxed{\vec{F} = -2,61 \times 10^{-14} \frac{N}{C} \hat{j}}$