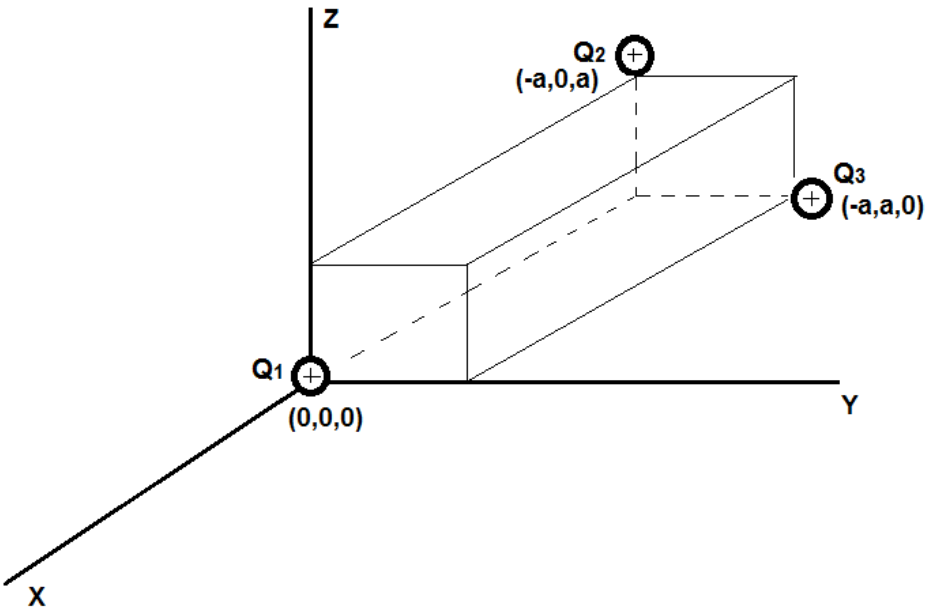
PROBLEMA 2

Calcular la fuerza resultante F_R que las cargas Q_1 y Q_2 ejercen sobre la carga Q_3 en la siguiente figura. $Q_1 = 4x10^{-9}coul$, $Q_2 = 2x10^{-9}coul$, $Q_3 = 2x10^{-9}coul$, $a = 10^{-1}m$



Solución: La fuerza resultante sobre la carga Q3 es:

$$\overrightarrow{F_{R3}} = \overrightarrow{F_{13}} + \overrightarrow{F_{23}}$$

La fuerza que ejerce la carga Q1 sobre la carga Q3 es:

$$\overrightarrow{F_{13}} = K.\frac{Q_1 Q_3}{{r_{13}}^3}.\overrightarrow{r_{13}}$$

$$\overrightarrow{r_{13}} = \overrightarrow{r_3} - \overrightarrow{r_1} = \left(-10^{-1}, 10^{-1}, 0\right) - (0,0,0) = \left(-10^{-1}, 10^{-1}, 0\right)$$

$$\overrightarrow{r_{13}} = \left(-10^{-1}, 10^{-1}, 0\right) = -10^{-1}i + 10^{-1}j + 0k$$

$$r_{13} = \sqrt{(-10^{-1})^2 + (10^{-1})^2 + 0^2} = 0{,}141m$$

$$\overrightarrow{F_{13}} = K.\frac{Q_1 Q_3}{{r_{13}}^3}.\overrightarrow{r_{13}} = 9x10^9 \frac{N.m^2}{C^2} * \frac{4x10^{-9}coul * 2x10^{-9}coul}{(0{,}141m)^3} * \left(-10^{-1}, 10^{-1}, 0\right)m$$

$$\overrightarrow{F_{13}} = \frac{7{,}2x10^{-8}}{(0{,}141m)^3}\left(-10^{-1}, 10^{-1}, 0\right) = \left(\frac{7{,}2x10^{-8}}{(0{,}141)^3} * \left(-10^{-1}\right), \frac{7{,}2x10^{-8}}{(0{,}141)^3} * \left(10^{-1}\right), 0\right)$$

$$\overrightarrow{F_{13}} = (-2{,}56x10^{-6}, 2{,}56x10^{-6}, 0)N$$

$$\overrightarrow{F_{13}} = -2{,}56x10^{-6}\, i + 2{,}56x10^{-6}\, j + 0k$$

La Fuerza resultante que ejerce la carga Q2 sobre la carga Q3 es:

$$\overrightarrow{F_{23}} = K.\frac{Q_2 Q_3}{{r_{23}}^3}.\overrightarrow{r_{23}}$$

$$\overrightarrow{r_{23}} = \vec{r_3} - \vec{r_2} = \left(-10^{-1}, 10^{-1}, 0\right) - \left(-10^{-1}, 0, 10^{-1}\right) = \left(0, 10^{-1}, -10^{-1}\right)$$

$$\overrightarrow{r_{23}} = \left(0, 10^{-1}, -10^{-1}\right)$$

$$r_{23} = \sqrt{0^2 + (10^{-1})^2 + (-10^{-1})^2} = 0{,}141m$$

$$\overrightarrow{F_{23}} = 9x10^9 \frac{N.m^2}{C^2} * \frac{2x10^{-9}coul * 2x10^{-9}coul}{(0{,}141m)^3} * \left(0, 10^{-1}, -10^{-1}\right)$$

$$\overrightarrow{F_{23}} = \frac{3{,}6x10^{-8}}{(0{,}141)^3} * \left(0, 10^{-1}, -10^{-1}\right) = \left(\frac{3{,}6x10^{-8}}{(0{,}141)^3}(0), \frac{3{,}6x10^{-8}}{(0{,}141)^3}\left(10^{-1}\right), \frac{3{,}6x10^{-8}}{(0{,}141)^3}\left(-10^{-1}\right)\right)$$

$$\overrightarrow{F_{23}} = \left(0, 1{,}28x10^{-6}, -1{,}28x10^{-6}\right) N$$

$$\overrightarrow{F_{23}} = (0i + 1{,}28x10^{-6}j - 1{,}28x10^{-6}k)N$$

Por lo tanto, la fuerza resultante sobre la carga Q3 es:

$$\overrightarrow{F_{R3}} = \overrightarrow{F_{13}} + \overrightarrow{F_{23}}$$

$$\overrightarrow{F_{R3}} = (-2{,}56x10^{-6}\, i + 2{,}56x10^{-6}\, j + 0k) + (0i + 1{,}28x10^{-6}j - 1{,}28x10^{-6}k)$$

$$\overrightarrow{F_{R3}} = -2{,}56x10^{-6}\, i + 3{,}84x10^{-6}j - 1{,}28x10^{-6}k$$

$$F_{R3} = \sqrt{\left(-2{,}56x10^{-6}\right)^2 + \left(3{,}84x10^{-6}\right)^2 + (-1{,}28x10^{-6})^2} = 4{,}78x10^{-6}N$$

Cosenos directores.

$$cos\alpha = \frac{-2{,}56x10^{-6}}{4{,}78x10^{-6}} \qquad \alpha = cos^{-1}\left(\frac{-2{,}56x10^{-6}}{4{,}78x10^{-6}}\right) = 122{,}38º$$

$$cos\beta = \frac{3{,}84x10^{-6}}{4{,}78x10^{-6}} \qquad \beta = cos^{-1}\left(\frac{3{,}84x10^{-6}}{4{,}78x10^{-6}}\right) = 36{,}54º$$

$$cos\gamma = \frac{-1{,}28x10^{-6}}{4{,}78x10^{-6}} \qquad \gamma = cos^{-1}\left(\frac{-1{,}28x10^{-6}}{4{,}78x10^{-6}}\right) = 105{,}53º$$