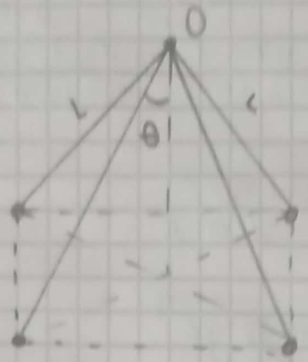
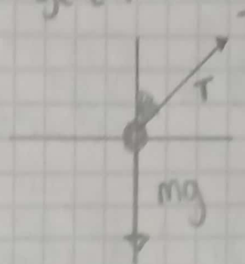
: Preparcial :



: Sumatoria de fuerzas :

Eje z :

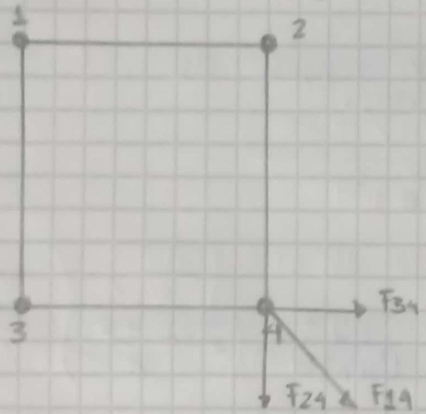


$\Sigma F_z = T\cos\theta - mg = 0$

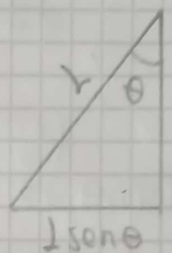
Plano xy:

$|Fe| = T_{xy}\,\text{sen}\theta$

Para hallar la fuerza eléctrica, se debe tener en cuenta el cuadrado en donde interactúan las partículas cargadas.

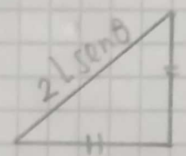


Para calcular la distancia de los lados, hay que tener en cuenta l.



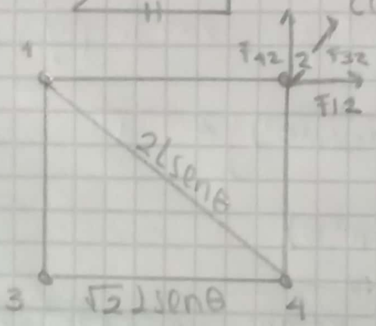
mitad de la diagonal del cuadrado tiene un valor de l senθ. Así que la diagonal total es de 2 l senθ.

Ahora, a partir de esta diagonal, es posible hallar los lados del cuadrado:



$2l\,\text{sen}\theta = \sqrt{c.o^2 + c.a^2}$

$co = ca$ $\quad co = \sqrt{2}\,l\,\text{sen}\theta$



$|Fe| = F_{42} + F_{12} + F_{32}$

$F_{42} = \frac{Kq^2}{(\sqrt{2}\,l\,\text{sen}\theta)^2}\,\hat{i} = \frac{Kq^2}{2l^2\text{sen}^2\theta}\,\hat{i}$

$F_{12} = \frac{Kq^2}{(\sqrt{2}\,l\,\text{sen}\theta)^2} + \hat{j} = \frac{Kq^2}{2l^2\text{sen}\theta}\,\hat{j}$

$F_{32} = \frac{Kq^2}{(2l\,\text{sen}\theta)^2} = \frac{Kq^2}{4l^2\text{sen}^2\theta}\,(\cos 45^\circ, \text{sen}\,45^\circ)$

$= \frac{Kq^2}{4l^2\text{sen}^2\theta}\left(\frac{\sqrt{2}}{2}\right)\hat{i} + \frac{Kq^2}{4l^2\text{sen}^2\theta}\left(\frac{\sqrt{2}}{2}\right)\hat{j}$

Despues, se deben sumar las componentes para hallar el valor de la fuerza electrica.

$$Fe = \frac{Kq^2}{2L^2 sen^2\theta}\hat{\imath} + \frac{Kq^2}{4L^2 sen^2\theta}\left(\frac{\sqrt{2}}{2}\right)\hat{\imath} + \frac{Kq^2}{2L^2 sen^2\theta}\hat{\jmath} + \frac{Kq^2}{4L^2 sen^2\theta}\left(\frac{\sqrt{2}}{2}\right)\hat{\jmath}$$

$$= \frac{Kq^2}{L^2 sen^2\theta}\left(\frac{4+\sqrt{2}}{8}\right)\hat{\imath} + \frac{Kq^2}{L^2 sen^2\theta}\left(\frac{4+\sqrt{2}}{8}\right)$$

$$|Fe| = \sqrt{\left(\frac{Kq^2}{L^2 sen^2\theta}\left(\frac{4+\sqrt{2}}{8}\right)\right)^2 + \left(\frac{Kq^2}{L^2 sen^2\theta}\left(\frac{4+\sqrt{2}}{8}\right)\right)^2}$$

$$= \sqrt{\frac{K^2q^4}{L^4 sen^4\theta}\left(\frac{4+\sqrt{2}}{8}\right)^2 + \frac{K^2q^4}{L^4 sen^4\theta}\left(\frac{4+\sqrt{2}}{8}\right)^2}$$

$$= \sqrt{\frac{2K^2q^4}{L^4 sen^4\theta}\left(\frac{4+\sqrt{2}}{8}\right)^2} = \underbrace{\frac{\sqrt{2}\cdot Kq^2}{L^2 sen^2\theta}\left(\frac{4+\sqrt{2}}{8}\right)}$$

Posteriormente, se debe despejar la tension de ambas sumatorias de fuerzas:

$$\Sigma F_z = T\cos\theta - mg = 0 \qquad ; \quad T = \frac{mg}{\cos\theta}$$
$$T\cos\theta = mg$$

$$\Sigma F_{xy} = |Fe| = T sen\theta$$

$$\frac{Kq^2}{L^2 sen^2\theta}\left(\frac{4\sqrt{2}+2}{8}\right) = T sen\theta \Rightarrow T = \frac{Kq^2}{L^2 sen^3\theta}\left(\frac{4\sqrt{2}+2}{8}\right)$$

Ahora, se igualan las tensiones

$$\frac{mg}{\cos\theta} = \frac{Kq^2}{L^2 sen^3\theta}\left(\frac{4\sqrt{2}+2}{8}\right)$$

$$\frac{sen^3\theta}{\cos\theta} = \frac{Kq^2}{L^2 mg}\left(\frac{4\sqrt{2}+2}{8}\right)$$

$$\frac{sen^3\theta}{\sqrt{1-sen^2\theta}} = \frac{Kq^2}{L^2 mg}\left(\frac{4\sqrt{2}+2}{8}\right)$$

$$(sen^3\theta)^2 = \left(\frac{Kq^2}{L^2 mg}\left(\frac{4\sqrt{2}+2}{8}\right)\left(\sqrt{1-sen^2\theta}\right)\right)^2$$

$$sen^6\theta = \frac{K^2q^4}{L^4m^2g^2}\left(\frac{4\sqrt{2}+2}{8}\right)^2(1-sen^2\theta)$$

$$sen^6\theta + \frac{K^2q^4}{L^4m^2g^2}\left(\frac{4\sqrt{2}+2}{8}\right)^2 sen^2\theta - \frac{K^2q^4}{L^4m^2g^2}\left(\frac{4\sqrt{2}+2}{8}\right)^2 = 0$$