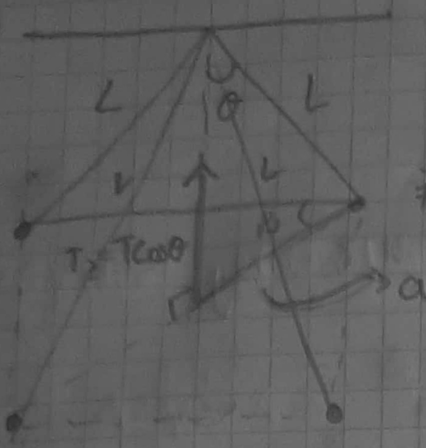
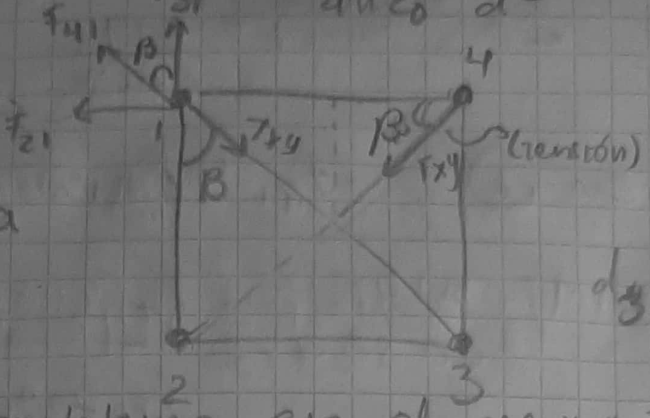
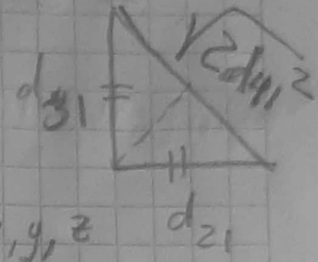
Preparcial 3

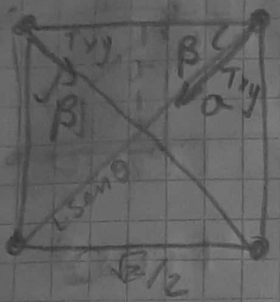


$$F_e = \frac{q^2}{4\pi\varepsilon_0}\frac{1}{d^2} = \lambda$$





- Ver el problema en el eje x, y, z



$a = L\,\mathrm{sen}\,\theta$

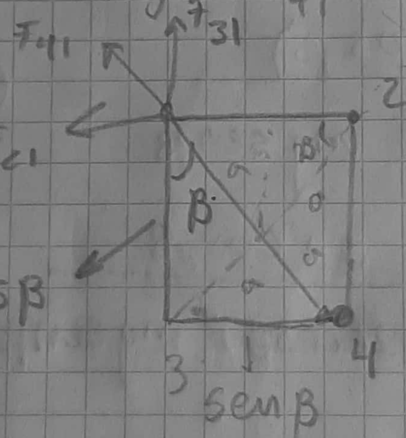
$T_{xy} = T\,\mathrm{Sen}\,\theta$ ↳ tensión

$T_z = T\cos\theta$

Distancias: $d_{21} = 2L\,\mathrm{sen}\,\theta\cos\beta$

$d_{31} = 2L\,\mathrm{sen}\,\theta\cos\beta$ $d_{41} = \sqrt{2}\,(2L\,\mathrm{sen}\,\theta\cos\beta)$

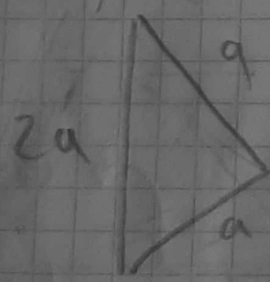
Ya que



$\beta = 45°$

$\cos\beta = \frac{\sqrt{2}}{2}$

L Sen



Como $a = L\,\mathrm{sen}\,\theta$

$2a = 2L\,\mathrm{sen}\,\theta$

Sumatoria de fuerzas

① $\Sigma F_x = -F_{21_e} - F_{41_e}\,\mathrm{Sen}\,\beta + T_{xy}\,\mathrm{sen}\,\beta = 0$

② $\Sigma F_y = F_{1_e} + F_{41_e}\cos\beta - T_{xy}\cos\beta = 0$

③ ΣF_z : $T = \dfrac{mg}{\cos\theta}$

$\Rightarrow$ En ① ; $-F_{21} - F_{41}\,\operatorname{sen}\beta + T_{xy}\,\operatorname{sen}\beta = 0$

Como $T = \dfrac{mg}{\cos\theta}$; $-\lambda \dfrac{1}{(2L\operatorname{sen}\theta\cos\beta)^2} - \lambda \dfrac{\cos\beta}{2(2L\operatorname{sen}\theta\cos\beta)^2}$

$+ \; mg\tan\theta\operatorname{sen}\beta = 0$

Ya que $T = \dfrac{mg}{\cos\theta}$ y

Tenemos

$T_{xy} = T\operatorname{sen}\theta$

$T_z = T\cos\theta$

Entonces $T_{xy} = \dfrac{mg\operatorname{sen}\theta}{\cos\theta} = mg\tan\theta$

$$\frac{\lambda(1+\cos\beta)}{(2L\cos\beta)^2\, mg\operatorname{sen}\beta} = \tan\theta$$

$$\frac{q^2}{4\pi\varepsilon_0}\left(\frac{1+\cos\beta}{(2L\cos\beta)^2\, mg\operatorname{sen}\beta}\right) = \tan\theta\operatorname{sen}^2\theta$$

$$F_k = \frac{q^2}{4\pi\varepsilon_0(4\cos^2\beta)L^2}$$

$$\frac{q^2}{4\pi\varepsilon_0 L^2}$$

$\theta \ll 1$

Además $\boxed{\dfrac{F_G}{F_e} \ll 1}$

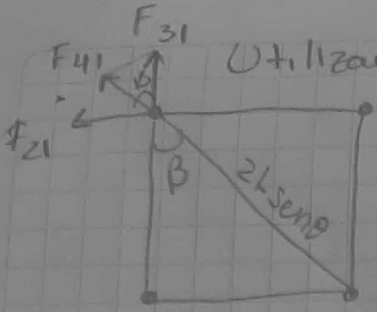
$\rightarrow \tan\theta \approx \theta$ $\quad \operatorname{sen}\theta \approx \theta$

Entonces ~~$\operatorname{sen}\theta \Leftrightarrow \theta$~~ $\operatorname{sen}\theta \approx \theta$

$$\frac{q^2}{4\pi\varepsilon_0}\left(\frac{1+\cos\beta}{(2L\cos\beta)^2\, mg \operatorname{sen}\beta}\right) \approx \theta^3$$

$$\theta = \sqrt[3]{\frac{(3\times 10^{-4})^2\,(1+\sqrt{2}/2)}{4\pi\varepsilon_0\, 4(5)^2\, 2/4\, (114{,}6N)\, \sqrt{2}/2}} \approx 0{,}69$$

Escaneado con CamScanner



Utilizando la expresión

$$F_e = -F_{21} - F_{41} - F_{31}$$

$$F_{21} = \frac{kq^2}{2L^2 sen^2\theta}(-\hat{i}) \qquad F_{31} = \frac{kq^2}{2L^2 sen^2\theta}(\hat{j}\,\hat{i})$$

$$F_{41} = \frac{kq^2}{4L\,sen^2\theta}\left(\frac{\sqrt{2}}{2}\right)\hat{i} + \frac{kq^2}{4L^2 sen^2\theta}\left(\frac{\sqrt{2}}{2}\right)\hat{j}$$

$$Fe_T = \left(-\frac{kq^2}{2L^2 sen^2\theta} + \frac{\sqrt{2}}{2}\frac{kq^2}{4L\,sen^2\theta}\right)\hat{i} + \left(\frac{kq^2}{2L^2 sen^2\theta} + \frac{\sqrt{2}}{2}\frac{kq^2}{4L^2 sen^2\theta}\right)\hat{j}$$

$$\downarrow \qquad\qquad\qquad \downarrow$$

$$-\frac{1}{2} + \frac{\sqrt{2}}{8} = \frac{-4+\sqrt{2}}{8} \qquad\qquad \frac{1}{2} + \frac{\sqrt{2}}{8} = \frac{4+\sqrt{2}}{2}$$

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

$$= \left(\frac{4+\sqrt{2}}{8}\right)\cdot\frac{\sqrt{2}\,kq^2}{L^2 sen^2\theta}$$

Como vimos anteriormente

$$T_z = T\cos\theta \qquad T_{xy} = T\,sen\,\theta$$

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

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

$$\frac{kq^2}{L^2 sen^2\theta}\left(\frac{4\sqrt{2}+2}{8}\right) = T\,sen\theta \qquad \text{Al Igualar}$$

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

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

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

Nos queda

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

$$\Rightarrow \operatorname{sen}^6\theta = \frac{k^2q^4}{L^4(mg)^2}\left(\frac{4\sqrt{2}+2}{8}\right)^2 \operatorname{sen}^2\theta$$

$$- \frac{k^2q^4}{L^2(mg)^2}\left(\frac{4\sqrt{2}+2}{8}\right)^2 = 0$$

$\boxed{\text{En python, resolver}}$