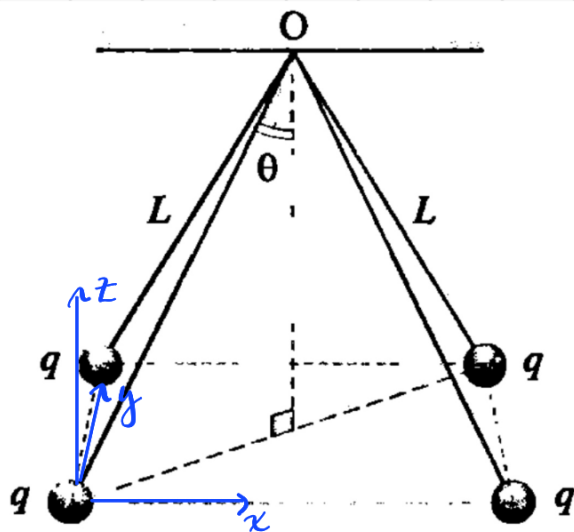
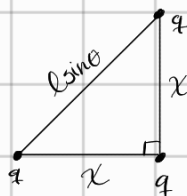
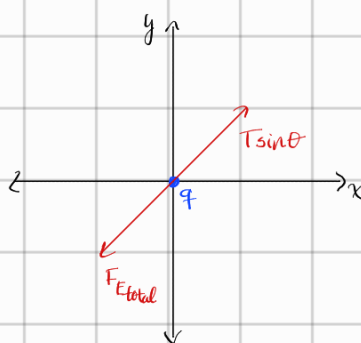
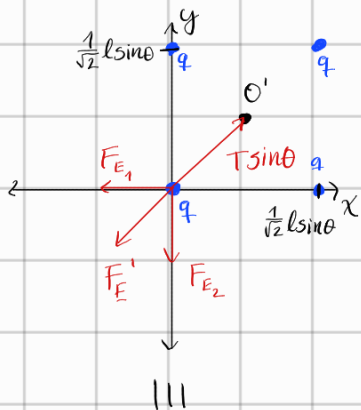


Preparcial 3



Como es un sistema en equilibrio y las cargas y longitudes de los hilos son iguales. Entonces, la $\sum \vec{F}_i = 0$ para cualquiera de las cargas es la misma para todas.

Plano xy



$$l^2 \sin^2 \theta = 2x^2$$

$$x = \frac{1}{\sqrt{2}} l \sin \theta$$

$$F_{E_1} = F_{E_2} = \frac{k q^2}{\frac{1}{2} l^2 \sin^2 \theta} = \frac{2k q^2}{l^2 \sin^2 \theta}$$

$$F'_E = \frac{k q^2}{l^2 \sin^2 \theta} = \frac{1}{2} F_{E_1}$$

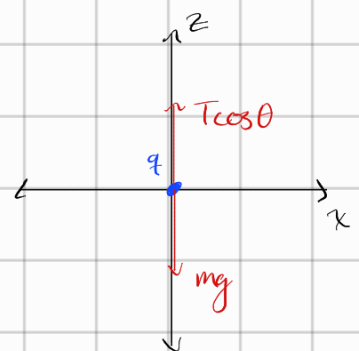
$$|F_{E_1}(-\hat{i}) + F_{E_2}(\hat{i})| = \sqrt{2 F_{E_1}^2} = \sqrt{2} F_{E_1}$$

Como $\vec{F}_{E_1} + \vec{F}_{E_2}$ queda en la misma dirección que \vec{F}'_E , entonces sumamos sus magnitudes.

$$F_{E_{\text{total}}} = \sqrt{2} F_{E_1} + \frac{1}{2} F_{E_1} = \frac{2\sqrt{2}+1}{2} F_{E_1}$$

$$\sum F_i = 0 : T \sin \theta = \frac{2\sqrt{2}+1}{2} F_{E_1}$$

Plano xz



$$T \cos \theta = mg$$

$$T = \frac{mg}{\cos \theta} \quad (2)$$

$$T = \frac{2\sqrt{2}+1}{2 \sin \theta} F_{E_1} = \frac{2\sqrt{2}+1}{2 \sin \theta} \left(\frac{2k q^2}{l^2 \sin^2 \theta} \right) = \frac{(2\sqrt{2}+1) k q^2}{l^2 \sin^3 \theta} \quad (1)$$

$$\textcircled{1} - \textcircled{2} \quad 0 = \frac{(2\sqrt{2}+1)kq^2}{l^2 \sin^3 \theta} - \frac{mg}{\cos \theta}$$

$$\frac{\sin^3 \theta}{\cos \theta} = \frac{(2\sqrt{2}+1)kq^2}{l^2 mg}$$

$$\frac{\sin^6 \theta}{\cos^2 \theta} = \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2$$

$$\frac{\sin^6 \theta}{(1-\sin^2 \theta)} = \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2$$

$$\sin^6 \theta = \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2 (1-\sin^2 \theta)$$

$$\sin^6 \theta = \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2 - \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2 \sin^2 \theta$$

$$\sin^6 \theta + \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2 \sin^2 \theta - \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2 = 0$$

$$u = \sin \theta \rightarrow u^6 + \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2 u^2 - \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2 = 0, \quad \theta = \sin^{-1}(u)$$

21. *Calculo de raíces en física:* Cuatro esferas de pesos iguales $w = 114.6 \text{ N}$ y cargas iguales $q = 3 \times 10^{-4} \text{ C}$ se encuentran en los extremos de hilos inelásticos y aislantes de longitudes $L = 5 \text{ m}$. Los que a su vez se encuentran unidos en O . Para la aplicación numérica use $g = 10 \text{ m/s}^2$ (Tomado de [5]).

$$u^6 + \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2 u^2 - \left(\frac{(2\sqrt{2}+1)kq^2}{l^2 mg} \right)^2 = 0$$

$$u^6 + \left(\frac{(2\sqrt{2}+1)9 \times 10^9 \cancel{\text{N m}^2 \text{C}^{-2}} (3 \times 10^{-4} \cancel{\text{C}})^2}{(5 \cancel{\text{m}})^2 114.6 \cancel{\text{N}}} \right)^2 u^2 - \left(\frac{(2\sqrt{2}+1)9 \times 10^9 \cancel{\text{N m}^2 \text{C}^{-2}} (3 \times 10^{-4} \cancel{\text{C}})^2}{(5 \cancel{\text{m}})^2 114.6 \cancel{\text{N}}} \right)^2 = 0$$

$$u^6 + \left(\frac{(2\sqrt{2}+1)270}{191} \right)^2 u^2 - \left(\frac{(2\sqrt{2}+1)270}{191} \right)^2 = 0$$

$$u^6 + \frac{(9+4\sqrt{2})72900}{36481} u^2 - \frac{(9+4\sqrt{2})72900}{36481} = 0, \quad u = \sin \theta, \quad \theta = \sin^{-1}(u)$$

Raíces del polinomio

$u = [(-0.8385682, 0.0),$
 $(-0.6852563, -0.9061868),$
 $(-0.6852563, 0.9061868),$
 $(0.6852563, -0.9061868),$
 $(0.6852563, 0.9061868),$
 $(0.8385682, 0.0)]$

Como $0 \leq \theta \leq \pi/2$,

$\theta \in \mathbb{R}$. Entonces
escogemos el valor
real positivo de u .

$$\theta = \sin^{-1}(0.8385)$$

$$\theta \approx 0.99 \text{ rad} \approx 57^\circ //$$

