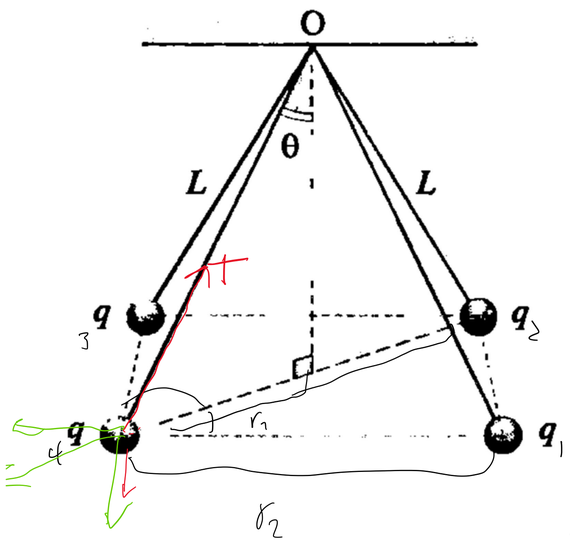
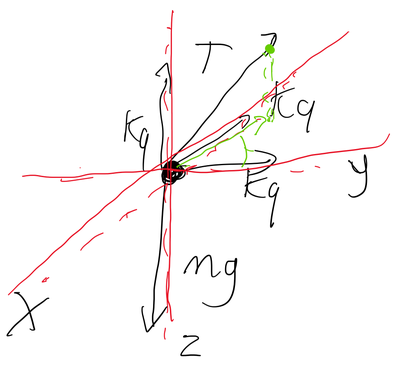
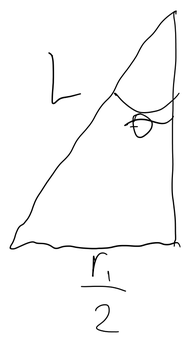
Preparcial 3

miércoles, 8 de noviembre de 2023 3:43 p.m.

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







$$\sin\theta = \frac{\frac{r_1}{2}}{L} \qquad \sin\theta = \frac{r_1}{2L}$$

$$f_1 = \frac{kq^2}{(\sqrt{2}L\sin\theta)^2} \qquad f_2 = \frac{kq^2}{(2L\sin\theta)^2}$$

$$f_y = T\cos\theta - mg = 0$$

$$f_y = T = \frac{mg}{\cos\theta}$$

$$\sin 45^\circ = \frac{r_2}{r_1}$$

$$r_1 \sin 45^\circ = r_2 \qquad r_1 = 2\sin\theta L$$

$$r_1 \frac{\sqrt{2}}{2} = r_2 \qquad r_2 = \sqrt{2}\sin\theta L$$

$$2\sin\theta L \frac{\sqrt{2}}{2} = r_2$$

$$f_x = kq^2\left(\frac{1}{(2L\sin\theta)^2} + \frac{\sqrt{2}}{(\sqrt{2}L\sin\theta)^2}\right) = T\sin\theta$$

$$kq^2\left(\frac{1}{4L^2\sin^2\theta} + \frac{\sqrt{2}}{2}\,\frac{1}{L^2\sin^2\theta}\right) = T\sin\theta$$

$$\frac{kq^2}{L^2}\left(\frac{1}{4\sin^2\theta} + \frac{\sqrt{2}}{2}\,\frac{1}{\sin^2\theta}\right) = mg\tan\theta$$

$$\frac{kq^2}{L^2}\left(\frac{1}{4} + \frac{\sqrt{2}}{2}\right)\frac{1}{\sin^2\theta} = \frac{mg\sin\theta}{\cos\theta}$$

$$\frac{kq^2}{L^2}\left(\frac{1}{4} + \frac{\sqrt{2}}{2}\right)\cos\theta = mg\sin^3\theta$$

$$\frac{kq^2}{L^2mg}\left(\frac{1}{4} + \frac{\sqrt{2}}{2}\right) = C$$

$$C^2\cos^2\theta = \sin^6\theta$$

$$C^2(1 - \sin^2\theta) = \sin^6(\theta)$$

$$C^2 - C^2\sin^2\theta = \sin^6(\theta)$$

$$0 = \sin^6(\theta) + C^2\sin^2\theta - C^2$$