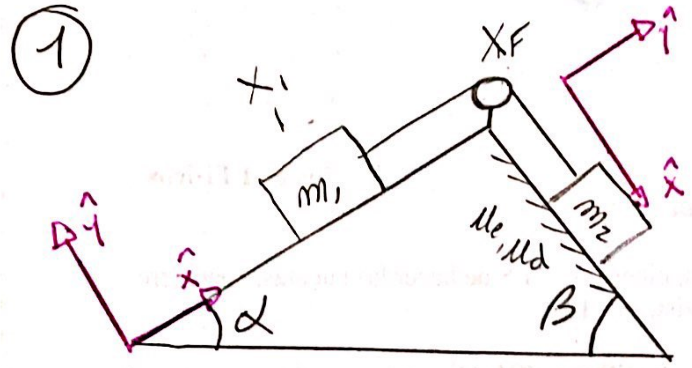
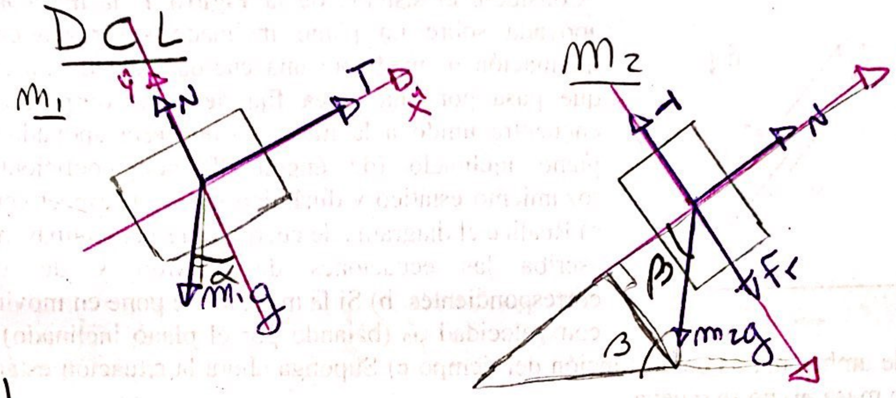
(1)



(a) DCL



Newton

$\underline{m_1}$ $(\hat{x})$ $T - m_1 g \operatorname{sen} \alpha = m_1 \ddot{x}_1$

$(\hat{y})$ $N - m_1 g \cos \alpha = m_2 \ddot{y}_1$

$\underline{m_2}$ $(\hat{x})$ $m_2 g . \operatorname{sen} \beta + F_{re} - T = m_2 \ddot{x}_2$

$(\hat{y})$ $N - m_2 g \cos \beta = m_2 \ddot{y}_2 = 0$

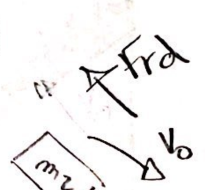
$\hookrightarrow \boxed{N = m_2 g \cos \beta}$

Vínculos

$L = x_2 + x_F - x_1 \rightarrow$ $\boxed{\dot{x}_2 = \dot{x}_1}$

$\boxed{\ddot{x}_2 = \ddot{x}_1}$

$\boxed{\ddot{y}_1 = \ddot{y}_2 = 0}$



(b) $\underline{m_1}$ $(\hat{x})$ $T - m_1 g \operatorname{sen} \alpha = m_1 \ddot{x}$ (1)

$\underline{m_2}$ $(\hat{x})$ $m_2 g \operatorname{sen} \beta - \mu d . m_2 g . \cos \beta - T = m_2 \ddot{x}$ (2)

$\Rightarrow$ SUMO (1) + (2)

$$-m_1 g \,\text{sen}\,\alpha + m_2 g \,\text{sen}\,\beta + \mu_d m_2 \cos\beta = (m_1+m_2)\,\ddot{x}_2$$

$$\boxed{\frac{g\left(-m_1 \,\text{sen}\,\alpha + m_2(\text{sen}\,\beta - \cos\beta\,\mu_d)\right)}{(m_1+m_2)} = \ddot{x}} = a$$

→ Ambas masas realizan un MRUV.

$$\ddot{x}_2 = \frac{d\dot{x}_2}{dt} \Rightarrow a\,dt = d\dot{x}_2$$

$$\int_{t=0}^{t} a\,dt = \int_{+V_0}^{V} d\dot{x}_2 \Rightarrow v(t) = V_0 + a.t$$

$$V = \frac{dx}{dt} \longrightarrow \boxed{x_2(t) = x_{02} + V_0 t + \frac{a}{2}t^2}$$

↳ con a hallada arriba.

Para x_1 uso vínculo:

$$x_1 = x_2 + x_F - L$$

$$\boxed{x_1 = (x_{02} + x_F - L) + V_0.t + \frac{a}{2}t^2}$$

(c) Mínima para que m_2 no se mueva

↳ Si le saco un poco m_2 se mueve para abajo → Frestático apunta hacia arriba

3

$(m_1)\ (\hat{x})\quad T - m_1 g \operatorname{sen}\alpha = m_1 \ddot{x} = 0$

$(\hat{x})\quad m_2 g \operatorname{sen}\beta - F_{re} - T = m_2 \ddot{x} = 0$

<u>SUMO</u>

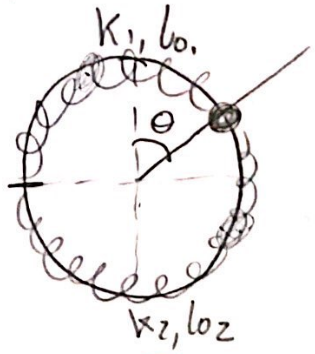
$$-m_1 g \operatorname{sen}\alpha + m_2 g \operatorname{sen}\beta - F_{re} = 0$$

$$F_{re} = m_1 g \operatorname{sen}\alpha - m_2 g \operatorname{sen}\beta \leq \mu_e . N$$

$$m_1 \cancel{g} \operatorname{sen}\alpha - m_2 \cancel{g} \operatorname{sen}\beta \leq \mu_e . m_2 \cancel{g} \cos\beta$$

$$\boxed{m_1 \leq \frac{m_2 (\mu_e \cos\beta + \operatorname{sen}\beta)}{\operatorname{sen}\alpha}}$$

②

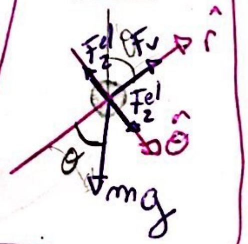


$- k_1 = k_2 = k$

$- l_{01} = \frac{\pi}{2} . R \qquad - l_{02} = \frac{3}{2}\pi . R$

Vínculos $\rightarrow r = R \quad \dot{r} = \ddot{r} = 0$

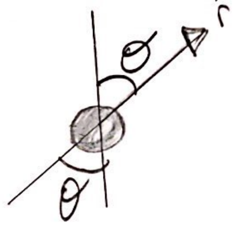
(a) DCL



Newton

$(\hat{r}) \ -mg . \cos\theta + F_v = -mR\dot{\theta}^2$

$(\hat{\theta}) \ -kR\theta - kR\theta + mg . \operatorname{sen}\theta = mR\ddot{\theta}$



$F^{el}_2 = kR\left(\frac{3}{2}\pi - \theta - \frac{3}{2}\pi\right) = -kR\theta$

$F^{el}_1 = -kR\left(\frac{\pi}{2} + \theta - \frac{\pi}{2}\right) = -kR\theta$

Ec. Mov

$(\hat{\theta}) \ -2kR\theta + mg \operatorname{sen}\theta = mR\ddot{\theta}$

$$\boxed{\ddot{\theta} = \frac{g}{R}\operatorname{sen}\theta - \frac{2k}{m}\theta}$$

(b) $\frac{d\dot{\theta}}{d\theta} . \frac{d\theta}{dt} = \frac{g}{R}\operatorname{sen}\theta - 2\frac{k}{m}\theta$

$$\int_0^{\dot{\theta}} \dot{\theta}\, d\dot{\theta} = \int_{\theta=\pi/2}^{\theta} \frac{g}{R}\operatorname{sen}\theta - 2\frac{k}{m}\theta\, d\theta$$

$$\frac{\dot{\theta}^2}{2} = -\frac{g}{R}\cos\theta - 2\frac{k}{m}\frac{\theta^2}{2}\Big|_{\pi/2}^{\theta}$$

$$\frac{\dot{\theta}^2}{2} = -\frac{g}{R}\cos\theta - \frac{k}{m}\theta^2 + \frac{k}{m}\frac{\pi^2}{4} = -\frac{g}{R}\cos\theta - \frac{k}{m}\left(\theta^2 - \frac{\pi^2}{4}\right)$$

$$F_v = 2mg\cos\theta + 2kR\left(\theta^2 - \frac{\pi^2}{4}\right) + mg\cos\theta \; \llcorner 2$$

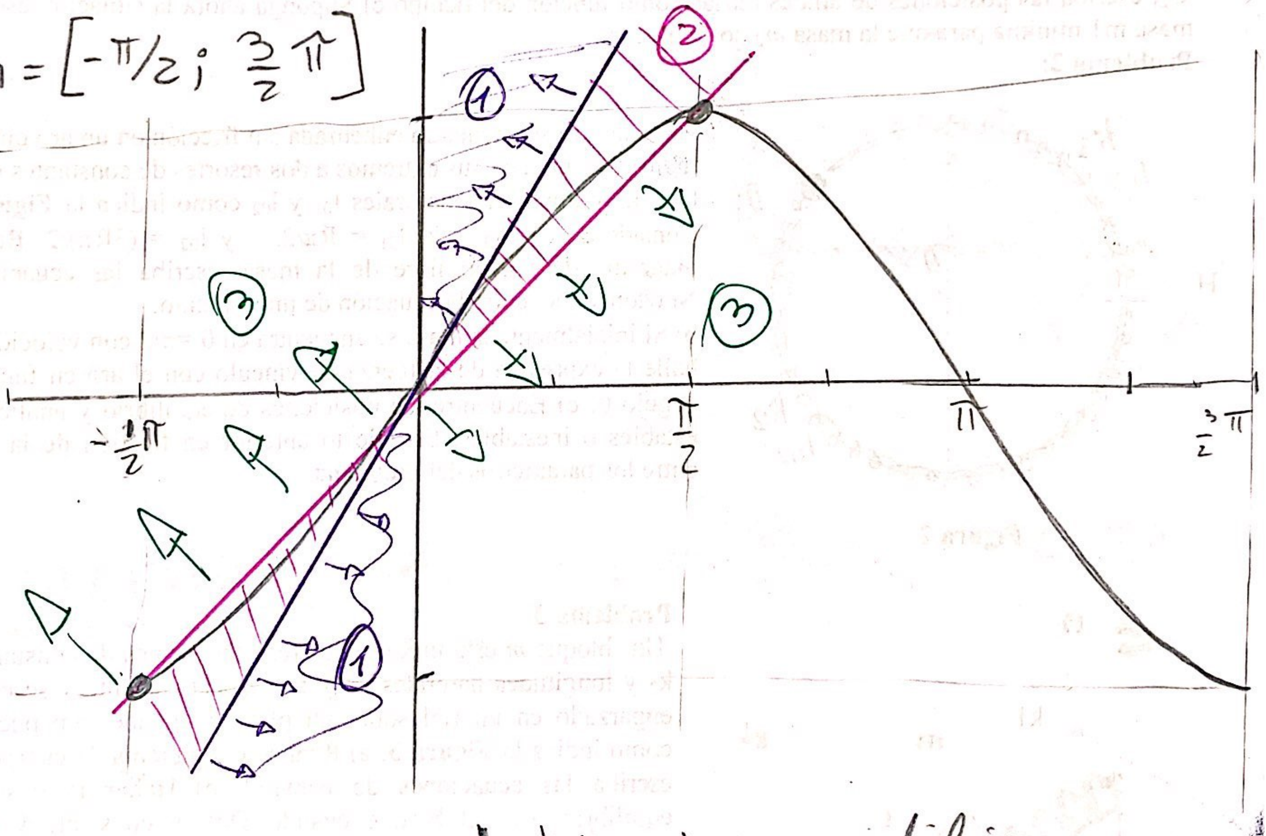
$$\boxed{F_v = 3mg\cos\theta + 2kR\left(\theta^2 - \frac{\pi^2}{4}\right)}$$

(c) $\theta_{eq} \Rightarrow \theta / \dot{\theta} = 0$

$(\hat{\theta})\; -2kR\theta + mg\,\text{sen}\,\theta = 0$

$$\boxed{\text{sen}\,\theta = \frac{2kR\theta}{mg}}$$

$\text{Dom} = \left[-\pi/2;\ \frac{3}{2}\pi\right]$



① Si $\dfrac{2kR}{mg} > 1 \rightarrow\ !$ pto de equilibrio $\theta = 0$

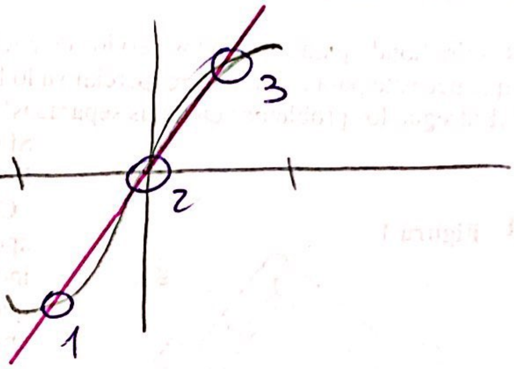
② Pendiente → Recta tiene que pasar por

$\left(-\frac{1}{2}\pi; -1\right)$ y $\left(\frac{\pi}{2}; 1\right)$ $\quad m = \dfrac{1-(-1)}{\frac{\pi}{2} - \left(-\frac{1}{2}\pi\right)} = \dfrac{2}{\pi}$

L3

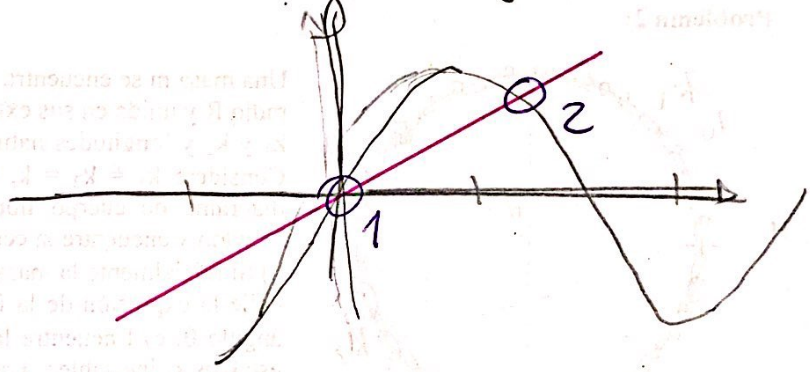
2

$$\text{Si } 1 < \frac{2kR}{mg} < \frac{2}{\pi} \rightarrow \text{Hay 3 ptos de equilibrio}$$



3

$$\text{Si } \frac{2kR}{mg} > \frac{2}{\pi} \rightarrow \text{Hay 2 ptos de eq}$$

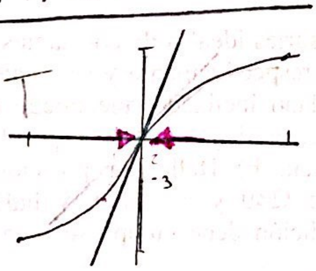


ESTABILIDAD

Fuerza = SENO - RECTA

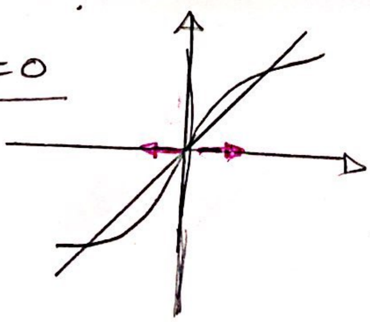
1

$\boxed{\theta_{eq} = 0}$

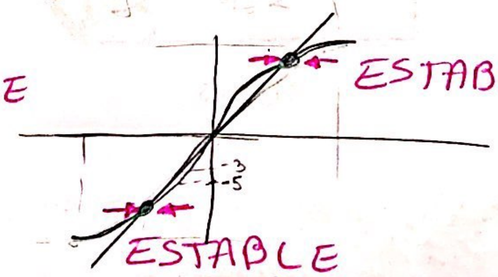


ESTABLE

2 $\theta_{eq} = 0$

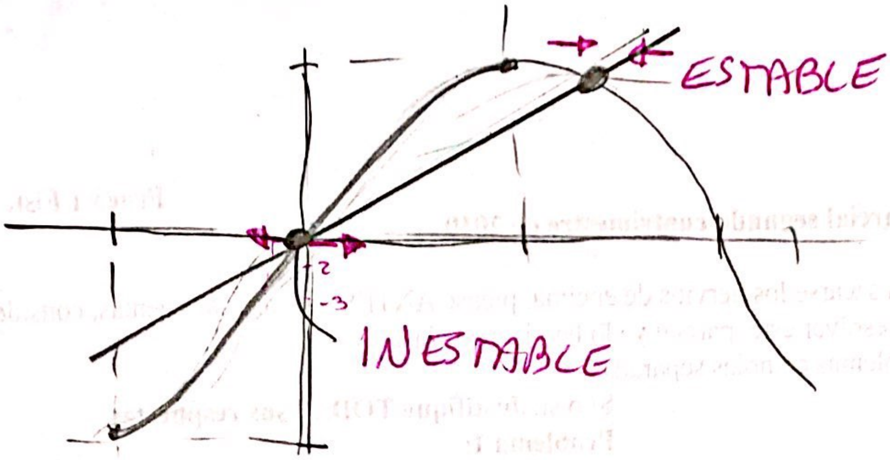


INESTABLE

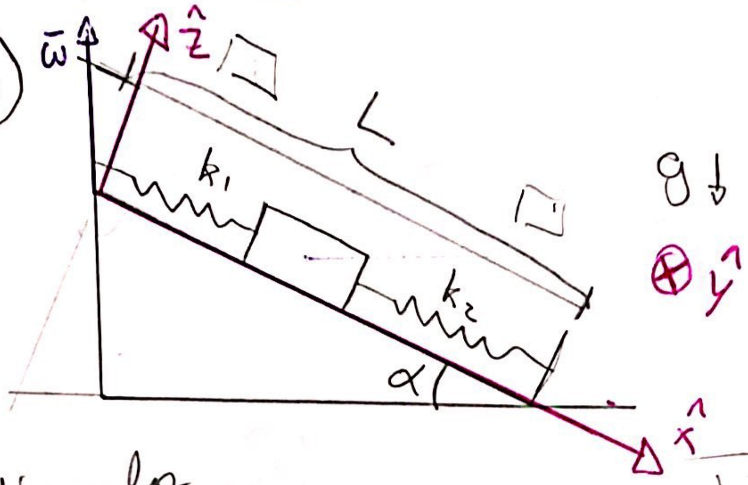


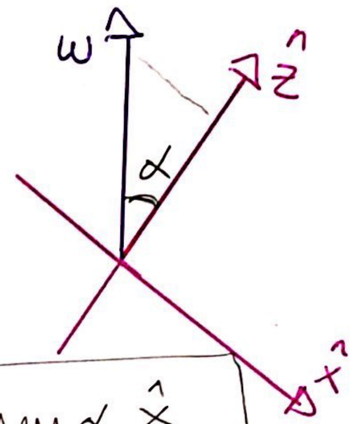
3

4



③

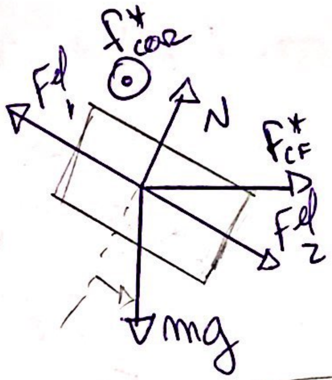




Vínculo $L=$

$$\boxed{\bar{\omega} = -\omega . \operatorname{sen}\alpha\, \hat{x} + \omega \cos\alpha\, \hat{z}}$$

(a)



$$f^*_{cF} = -m\left(\bar{\omega} \wedge (\bar{\omega} \wedge \bar{r})\right) \qquad \boxed{\bar{r} = x\,\hat{x}} \quad \boxed{\bar{v} = \dot{x}\,\hat{x}}$$

$$f^*_{COR} = 2m\, \bar{v} \times \bar{\omega}$$

$$\boxed{f^*_{cor} = -2m\,\dot{x}\,\omega \cos\alpha\, \hat{y}}$$

$$\boxed{f^*_{cF} = m\omega^2 \cos^2\alpha\, x\, \hat{x} + \omega^2 \operatorname{sen}\alpha \cos\alpha\, x\, \hat{z}}$$

$$\boxed{F^{el}_1 = -k_1(x - l_{01})} \qquad \boxed{F^{el}_2 = k_2(L - x - l_{02})}$$

Newton

$$\boxed{\begin{aligned}
&(\hat{x})\ -k_1(x - l_{01}) + k_2(L - x - l_{02}) + m\omega^2\cos^2\alpha\, x + mg\operatorname{sen}\alpha = m\ddot{x} \\
&(\hat{y})\ F_{v_y} - 2m\,\dot{x}\,\omega\cos\alpha = m\ddot{y} = 0 \\
&(\hat{z})\ -mg\cos\alpha + N + \omega^2 \operatorname{sen}\alpha \cos\alpha\, x = m\ddot{z} \\
&\qquad = 0
\end{aligned}}$$

(b) x_{eq} tq. $\ddot{x} = 0$

$$-k_1 x + k_1 l_{01} + k_2(L - l_{02}) - k_2 x + m\omega^2\cos^2\alpha\, x + mg\operatorname{sen}\alpha = 0$$

$$k_2(L - l_{02}) + m\omega^2\cos^2\alpha\, x + mg\operatorname{sen}\alpha + k_1 l_{01} = (k_1 + k_2) . x$$

$$\cancel{x = \frac{k_1 l_{01} + k_2(L - l_{02}) + m\omega^2\cos^2\alpha + mg\,\mathrm{sen}\,\alpha}{k_1 + k_2}}$$

$$\cancel{\Rightarrow x}$$

$$x\left(k_1 + k_2 - m\omega^2\cos^2\alpha\right) = k_2(L - l_{02}) + mg\,\mathrm{sen}\,\alpha + k_1 l_{01}$$

$$\boxed{x = \frac{k_2(L - l_{02}) + mg\,\mathrm{sen}\,\alpha + k_1 l_{01}}{\left(k_1 + k_2 - m\omega^2\cos^2\alpha\right)}}$$

↳ Condición → $x > 0$

$$\Rightarrow \quad k_1 + k_2 - m\omega^2\cos^2\alpha > 0$$

$$k_1 + k_2 > m\omega^2\cos^2\alpha$$

$$\boxed{\omega^2 < \frac{k_1 + k_2}{m\cos^2\alpha}}$$