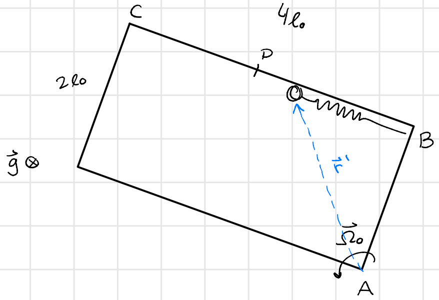
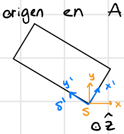
P1



¿Qué sist usar? origen en A para S y S'

y S' rota con vel. angular $\vec{\Omega}_0$



luego $\vec{\Omega} = \vec{\Omega}_0 = \Omega_0 \hat{z}$ ← cte

$\vec{A}_0 = 0$

$$\vec{r}\,' = x\hat{x}' + y\hat{y}'$$

$$\vec{v}\,' = \dot{x}\hat{x}' + \dot{y}\hat{y}'$$

ssi no se despega de la pared

$$F_{neta} = -K(y' - \ell_0)\hat{y}' - N\hat{x}'$$

$$\vec{\Omega}\times\vec{\Omega}\times\vec{r}\,' = \vec{\Omega}\times\Omega_0(x\hat{y}' - y\hat{x}') = \Omega_0^2(-x\hat{x}' - y\hat{y}')$$

$$\vec{\Omega}\times\vec{v}\,' = \Omega_0(\dot{x}\hat{y}' - \dot{y}\hat{x}')$$

$$\boxed{m\vec{a} = \vec{F}^{\,neta} - \cancel{m\vec{A}_0}^{\,0} - 2m\vec{\Omega}\times\vec{v} - m\vec{\Omega}\times(\vec{\Omega}\times\vec{r}) - \cancel{m\dot{\vec{\Omega}}\times\vec{r}}^{\,0}}$$

en eq $\vec{a} = 0$, $\dot{x} = \dot{y} = 0$ (si yo dejo mi masa quieta en el equilibrio se quedará ahí, por eso puedo asumir $\dot{x} = \dot{y} = 0$)

$$0 = -K(y_{eq} - \ell_0)\hat{y}' - N\hat{x}' - 2m\Omega_0\cancel{(\dot{x}\hat{y}' - \dot{y}\hat{x}')}^{\,0} - m\Omega_0^2(-x_{eq}\hat{x}' - y_{eq}\hat{y}')$$

y queremos que $x_{eq} = 2\ell_0$, $y_{eq} = 2\ell_0$ (Punto D)

$$0 = -K\ell_0\hat{y}' - N\hat{x}' + 2\ell_0 m\Omega_0^2(\hat{x}' + \hat{y}')$$

veamos la ecuación en $\hat{y}'$

$$0 = -K\cancel{\ell_0} + 2\cancel{\ell_0}m\Omega_0^2$$

$$\boxed{\Omega_0^2 = \frac{K}{2m}}$$

ec. en $\hat{y}'$:

$$m\ddot{y} = -K(y - \ell_0) + m\Omega_0^2 y$$

$\Omega_0^2 = \frac{K}{2m}$, $y = 2\ell_0 + \varepsilon$

$$m\ddot{\varepsilon} = -K(\cancel{\ell_0} + \varepsilon) + \frac{K}{2}(\cancel{2\ell_0} + \varepsilon)$$

$$m\ddot{\varepsilon} = -K\varepsilon + \frac{K}{2}\varepsilon$$

$$\ddot{\varepsilon} + \underbrace{\frac{K}{2m}}_{\omega^2}\varepsilon = 0$$

$$\boxed{\omega^2 = \frac{K}{2m}}$$

b) ecs de mov:

$$m\ddot{x} = -N + 2m\Omega_0\dot{y} + m\Omega_0^2 x$$

$$m\ddot{y} = -K(y - \ell_0) - 2m\Omega_0\dot{x} + m\Omega_0^2 y$$

mientras no se levante $\dot{x} = \ddot{x} = 0 \wedge x = 2\ell_0$

(1) $0 = -N + 2m\Omega_0\dot{y} + m\Omega_0^2 2\ell_0$

(2) $m\ddot{y} = -K(y - \ell_0) + m\Omega_0^2 y$

$$m\dot{y}\frac{d\dot{y}}{dy} = (m\Omega_0^2 - K)y + K\ell_0$$

$$m\frac{\dot{y}^2}{2}\Big|_0^{\dot{y}} = (m\Omega_0^2 - K)\frac{y^2}{2}\Big|_{4\ell_0}^{y} + K\ell_0\, y\Big|_{4\ell_0}^{y}$$

$$\dot{y}^2 = (\Omega_0^2 - K/m)(y^2 - 16\ell_0^2) + 2\left(\frac{K\ell_0}{m}y - \frac{4K\ell_0^2}{m}\right)$$

Reemplazo en (1)

ojo el signo (es (-) porque la masa parte en C y se mueve hacia B $\longrightarrow$ dirección $-\hat{j}'$)

$$N = -2m\Omega_0 \sqrt{(\Omega_0^2 - K/m)(y^2 - 16 l_0^2) + 2\frac{K l_0}{m} y - \frac{8K l_0^2}{m}} + 2m\Omega_0^2 l_0$$

$\Omega_0^2 = K/2m$

$$N = -\sqrt{2mK} \left(-\frac{K}{2m}\left(y^2 - \cancel{16 l_0^2}\right) + 2\frac{K l_0}{m} y - \cancel{\frac{8K l_0^2}{m}} \right)^{1/2} + K l_0$$

Cuando se levanta $N = 0$

$$0 = -\sqrt{2mK} \left(-\frac{K}{2m} y^2 + 2\frac{K l_0}{m} y \right)^{1/2} + K l_0$$

$$\left(-\frac{K}{2m} y^2 + 2\frac{K l_0}{m} y \right)^{1/2} = \sqrt{\frac{K}{2m}}\, l_0$$

$$-\frac{K}{2m} y^2 + \frac{2K l_0}{m} y = \frac{K}{2m} l_0^2$$

$$0 = y^2 - 4 l_0 y + l_0^2 \implies y = \frac{4 l_0 \pm \sqrt{16 l_0^2 - 4 l_0^2}}{2}$$

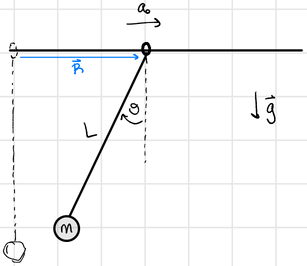
$$y = \frac{4 l_0 \pm 2\sqrt{3}\, l_0}{2}$$

$$y = l_0 (2 \pm \sqrt{3})$$

nos quedamos con el máx y, porque es el que pasa antes

$$\boxed{y = l_0 (2 + \sqrt{3})}$$

P21



a) S' sist. en el péndulo y S en el origen $\quad S' = S + \vec{R} = S + x\hat{x}$

$\Rightarrow \vec{\Omega} = 0$ no rota

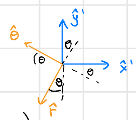
$\vec{A}_0 = \ddot{x}\,\hat{x} = a_0\,\hat{x}$ dato

Ocupando la ecuación

$$m\vec{a} = \vec{F}^{\,neta} - m\underbrace{\vec{A}_0}_{a_0\hat{x} \,=\, a_0\hat{x}'} - \cancel{2m\vec{\Omega}\times\vec{v}}^{\,0} - \cancel{m\vec{\Omega}\times(\vec{\Omega}\times\vec{r})}^{\,0} - \cancel{m\dot{\vec{\Omega}}\times\vec{r}}^{\,0}$$

$$\vec{F}_{neta} = -mg\,\hat{y}' + T\sin\theta\,\hat{x}' + T\cos\theta\,\hat{y}'$$

$$m\vec{a} = -mg\,\hat{y}' + T\sin\theta\,\hat{x}' + T\cos\theta\,\hat{y}' - ma_0\,\hat{x}'$$



$$\hat{y}' = -\hat{r}\cos\theta + \hat{\theta}\sin\theta$$

$$\hat{x}' = -\hat{r}\sin\theta - \hat{\theta}\cos\theta$$

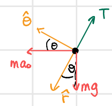
$$ma_r\hat{r} + ma_\theta\hat{\theta} = -mg\left(-\hat{r}\cos\theta + \hat{\theta}\sin\theta\right) - T\hat{r} - ma_0\left(-\hat{r}\sin\theta - \hat{\theta}\cos\theta\right)$$

$$\Rightarrow \boxed{\begin{aligned} m(\cancel{\ddot{r}}^{\,0} - r\dot{\theta}^2) &= mg\cos\theta - T + ma_0\sin\theta \\ m(r\ddot{\theta} - \cancel{2\dot{r}\dot{\theta}}^{\,0}) &= -mg\sin\theta + ma_0\cos\theta \end{aligned}}$$

otra forma

DCL

se puede hacer un DCL con todas las f's (ficticias incluidas)



$F_r = -T + mg\cos\theta + ma_0\sin\theta$

$F_\theta = -mg\sin\theta + ma_0\cos\theta$

$$mL\dot{\theta}^2 = mg\cos\theta + ma_0\sin\theta - T$$

$$mL\ddot{\theta} = -mg\sin\theta + ma_0\cos\theta$$

$$mL\,\dot{\theta}\frac{d\dot{\theta}}{d\theta} = -mg\sin\theta + ma_0\cos\theta$$

$$\cancel{m}L\,\frac{\dot{\theta}^2}{2} = \cancel{m}\left(-g\int_0^\theta \sin\theta'\,d\theta' + a_0\int_0^\theta \cos\theta'\,d\theta'\right)$$

$$\dot{\theta}^2 = \frac{2}{L}\left(+g\cos\theta'\Big|_0^\theta + a_0\sin\theta'\Big|_0^\theta\right)$$

$$\dot{\theta}^2 = \frac{2}{L}\left(g(\cos\theta - 1) + a_0\sin\theta\right)$$

en el máx $\dot{\theta} = 0$

$$\Rightarrow 0 = \frac{2}{L}\left(g(\cos\theta_{max} - 1) + a_0\sin\theta_{max}\right)$$

$$-\cos\theta_{max} = \frac{a_0}{g}\sin\theta_{max} - 1 \qquad /(\,)^2$$

$$\cos^2\theta_{max} = \frac{a_0^2}{g^2}\sin^2\theta_{max} - 2\frac{a_0}{g}\sin\theta_{max} + 1$$

$$\cancel{1} - \sin^2\theta_{max} = \frac{a_0^2}{g^2}\sin^2\theta_{max} - 2\frac{a_0}{g}\sin\theta_{max} + \cancel{1}$$

$$0 = \left[\left(\frac{a_0^2}{g^2} + 1\right)\sin\theta_{max} - 2\frac{a_0}{g}\right]\sin\theta_{max}$$

$\hookrightarrow \theta = 0$ ó $\theta = \pi$ ninguna tiene sentido físico

$$\frac{2a_0}{g} = \left(\frac{a_0^2}{g^2} + 1\right)\sin\theta_{max}$$

$$2\frac{a_0}{\cancel{g}} = \left(\frac{a_0^2 + g^2}{g^{\cancel{2}}}\right)$$

$$\frac{2a_0 g}{a_0^2 + g^2} = \sin\theta_{max}$$