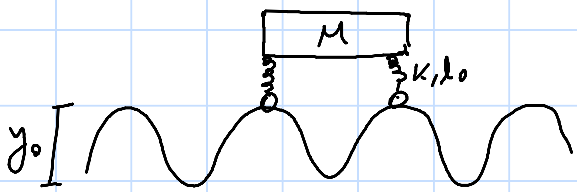
P1)



$$y_c = y_0 \cos\left(\frac{2\pi}{L_x} x\right)$$

a) $$m\ddot{y} = \sum F = -K((y - y_c) - l_0) - mg$$

$$\Rightarrow m\ddot{y} = -K\left(y - y_0\cos\left(\frac{2\pi}{L_x}x\right) - l_0\right) - mg$$

$$\ddot{y} + \frac{K}{m}y = \frac{K y_0}{m}\cos\left(\frac{2\pi}{L_x}x\right) + \frac{K}{m}l_0 - g$$

$$\Rightarrow \ddot{y} + \frac{K}{m}y - \frac{K}{m}l_0 + g = \frac{K}{m}y_0\cos\left(\frac{2\pi}{L_x}x\right)$$

$$\ddot{y} + \frac{K}{m}\left(y - l_0 + \frac{mg}{K}\right) = \frac{K y_0\cos\left(\frac{2\pi}{L_x}x\right)}{m}$$

C.V. $\tilde{y} = y - l_0 + mg/K \Rightarrow \dot{\tilde{y}} = \dot{y} \Rightarrow \ddot{\tilde{y}} = \ddot{y}$

$$\ddot{\tilde{y}} + \frac{K}{m}\tilde{y} = \frac{K y_0}{m}\cos\left(\frac{2\pi}{L_x}x\right)$$

Luego, para movimiento forzado $\ddot{x} + w_0^2 x = A\cos(\Omega_0 t)$

v es lineal $\Rightarrow v = x/t \Rightarrow vt = x$

Entonces $\ddot{\tilde{y}} + \frac{K}{m}\tilde{y} = \frac{K y_0}{m}\cos\left(\frac{2\pi}{L_x}vt\right) \Rightarrow \Omega_0 = \frac{2\pi v}{L_x}$

b)

$$\ddot{\tilde{y}} + \frac{K}{m} y = \frac{K y_0}{m} \cos\left(\frac{2\pi}{Lx} v t\right)$$

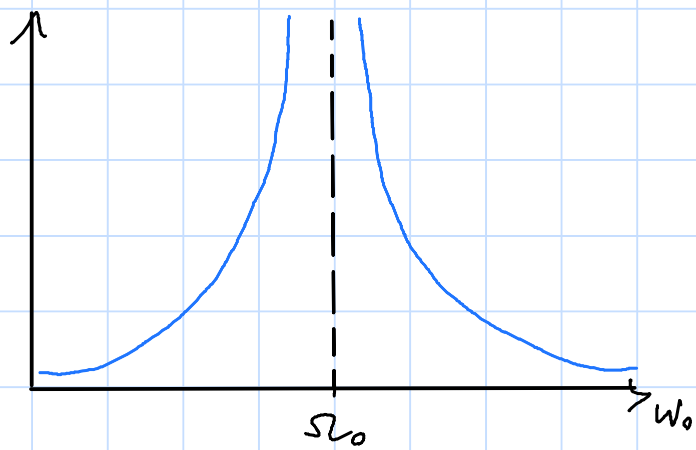
$$w_0 = \sqrt{\frac{K}{m}} \quad , \quad \tilde{y} = \tilde{y}_h + \tilde{y}_p$$

$$\tilde{y}_h = A\cos(w_0 t) + B\,\text{sen}(w_0 t)$$

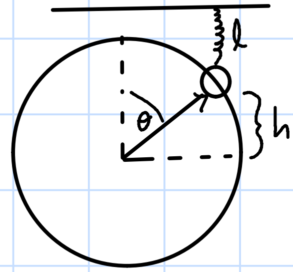
$$\tilde{y}_p = \frac{K y_0}{m(w_0^2 - \Omega_0^2)} \cos(\Omega_0 t)$$

$$y = A\cos(w_0 t) + B\cos(w_0 t) + \frac{K y_0}{m(w_0^2 - \Omega_0^2)} \cos(\Omega_0 t)$$

c)



P2



a) $U_p = mgh$

$U_e = K(l - R/2)^2$

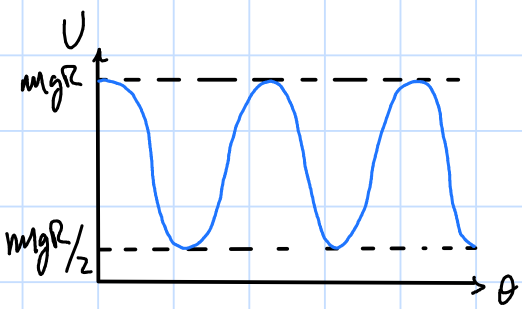
$$h = R\cos(\theta) \Rightarrow l = 3R/2 - R\cos(\theta)$$

$$U = mgR\cos(\theta) + K(R - R\cos(\theta))^2$$

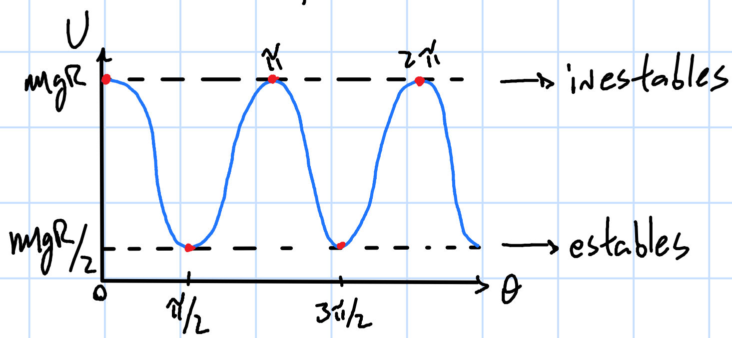
$K = mg/R$ (por enunciado)

Esto faltó en el aux

$$\Rightarrow U = \frac{mgR}{2}\left(1 + \cos^2(\theta)\right)$$



b) Puntos de equilibrio

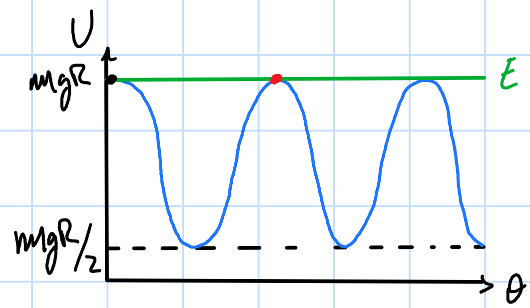


c) Buscamos puntos de retorno

$$E = \frac{1}{2} m v^2 + U$$

En equilibrio $v = 0 \Rightarrow E = U$

Evaluando $E(t=0) = \frac{mgR}{2}\left(1 + \cancelto{1}{\cos(0)}\right) = mgR$



$\Rightarrow$ Se detiene en π

Luego $W = -\int \nabla U \, d\vec{r} = -\int_A^B \frac{\partial U}{\partial \theta} d\theta = U_A - U_B$

$$W = U(\theta = 0) - U(\theta = \pi) = -2mgR$$