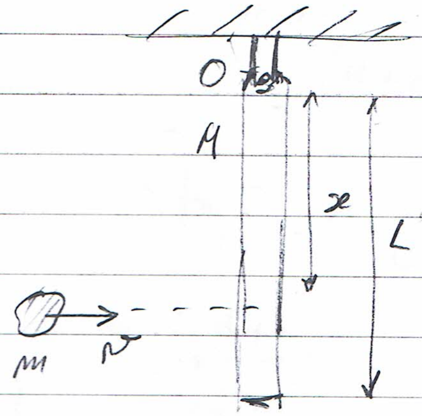
2do Parcial Física 1 - Tecnólogo - 07/12/2020

Ejercicio 1.



$L = 1\,m \qquad m = M/10$

$x = 0.8\,L \qquad v = 2.0\ m/s$

Conservación de momento angular $\vec{L}$ respecto a O

$m v x = I_{OM}\,\omega + I_{Om}\,\omega$

$I_o = I_{OM} + I_{Om}$

$I_{OM} = I_{CM} + M\left(\frac{L}{2}\right)^2 = \frac{ML^2}{12} + \frac{ML^2}{4} = \frac{ML^2}{3}$

$I_{Om} = m v' x = m x^2 \omega \Rightarrow m v x = \frac{ML^2}{3}\omega + m x^2 \omega$

$\frac{M}{10} v\, 0.8L = \frac{ML^2}{3}\omega + \frac{M}{10}(0.8L)^2\omega \Rightarrow$

$0.08\, v = \frac{1}{3}\omega L + 0.064 L\omega \simeq 0.397\,\omega L \Rightarrow$

a) $\omega = \frac{0.08}{0.397}\frac{v}{L} \Rightarrow \boxed{\omega \simeq 0.20\,\frac{v}{L}}$

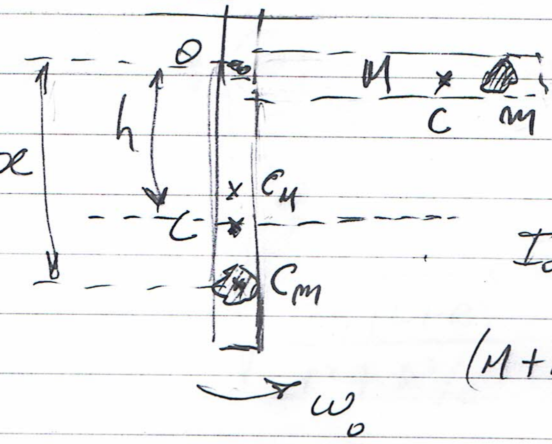
(sigue →)

Ejercicio 1 (continuación)

b) Conservación de la energía (después del impacto)

$$\frac{I_0 \omega^2}{2} = (M+m) g h$$

C = centro de masa del sistema



$$I_0 = I_{0M} + I_{0m} = \frac{ML^2}{3} + m x^2$$

$$I_0 = \frac{ML^2}{3} + \frac{M}{10}(0.8L)^2 = 0.397\, ML^2$$

$$(M+m) h = M\frac{L}{2} + m x \quad \left(h = \text{c.M. del sistema}\right)$$

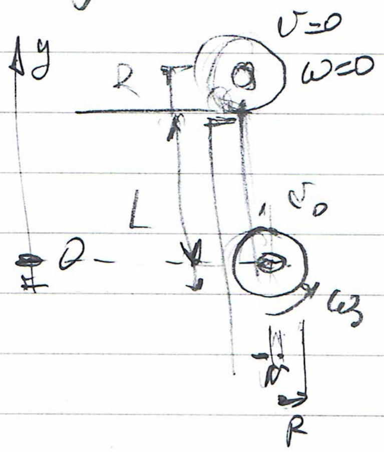
$$\frac{11}{10} M h = \frac{ML}{2} + \frac{M}{10} \times 0.8L \Rightarrow h = 0.527\, L$$

$$\Rightarrow 0.397\, \cancel{M} L^2 \frac{\omega^2}{2} = \frac{11}{10} \cancel{M} g \cdot 0.527\, L \Rightarrow \boxed{\omega = 5{,}35\, \frac{rad}{s}}$$

Según la parte a): $\omega = 0{,}20\, \frac{v}{L} \Rightarrow$

$$v = \frac{5{,}35 \times 1m}{0{,}20} = \boxed{26{,}75\, m/s = v} \quad b)$$

Ej. 2



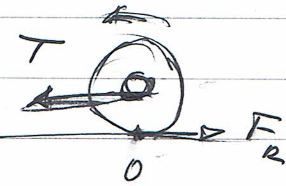
$v_0 = \omega_0 r$

Energía: $\frac{1}{2}Mv_0^2 + \frac{1}{2}I_c\omega_0^2 = Mg(L+R)$

$\frac{1}{2}\cancel{M}\omega_0^2 r^2 + \frac{1}{2}\frac{1}{2}\cancel{M}R^2\omega_0^2 = \cancel{M}g(L+R)$

$\frac{\omega_0^2}{2}\left(r^2 + \frac{R^2}{2}\right) = g(L+R)$

a) $\omega_0 = \sqrt{\dfrac{2g(L+R)}{r^2+R^2/2}}$



i) $\boxed{T - F_R = Ma_c}$ $\qquad \tau_0 = I_0\alpha = I_0\frac{a_c}{R}$

$\tau_0 = T(R-r) = \left(\frac{1}{2}MR^2 + MR^2\right)\frac{a_c}{R} = \frac{3}{2}MRa_c$

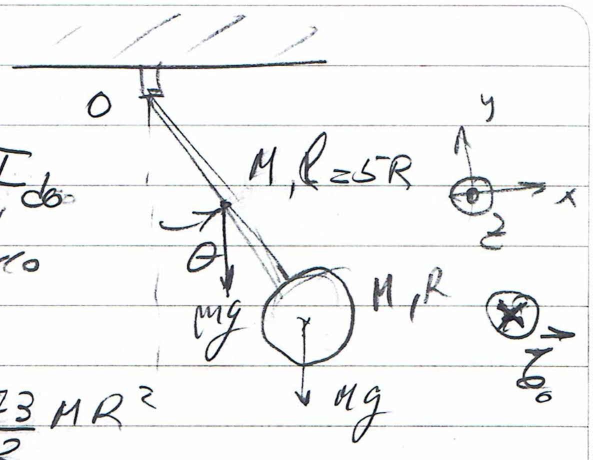
ii) $\boxed{\dfrac{2T(R-r)}{3MR} = a_c}$ $\qquad$ de i), ii) $T - F_R = \dfrac{2T\cancel{M}(R-r)}{3\cancel{M}R}$

$T - F_R = \frac{2T}{3}\left(1-\frac{r}{R}\right) \Rightarrow T - \frac{2T}{3}\left(1-\frac{r}{R}\right) = F_R$

$\frac{1}{3}T + \frac{2T}{3}\frac{r}{R} = F_R \Rightarrow \frac{T}{3}\left(1+\frac{2r}{R}\right) = F_R \leq \mu_s Mg$

b) $T \leq \dfrac{3\mu_s Mg}{1+2r/R}$

Ejercicio 3 (2do Parcial)



$\tau_0 = I_0 \ddot{\theta}$ $I_0 = I_{v0} + I_{d0}$ (varilla, disco)

$I_{v0} = \frac{1}{3} M l^2 = \frac{25}{3} M R^2$

$I_{d0} = \frac{1}{2} M R^2 + M(l+R)^2 = \frac{73}{2} M R^2$

$I_0 = \frac{25}{3} M R^2 + \frac{73}{2} M R^2 = \boxed{\frac{269}{6} M R^2}$

R = 5 cm

$\tau_0 = -Mg\frac{l}{2}\operatorname{sen}\theta - Mg(l+R)\operatorname{sen}\theta =$

$= -Mg\operatorname{sen}\theta\left(\frac{5}{2}R + 6R\right) = -\frac{17}{2} MgR\operatorname{sen}\theta$

$\tau_0 \simeq -\frac{17}{2} MgR\theta$ (pequeñas oscilaciones)

$\Rightarrow -\frac{17}{2} MgR\theta = I_0\ddot{\theta} = \frac{269}{6} M R^2 \ddot{\theta} \Rightarrow$

a) $\boxed{\ddot{\theta} + \frac{51}{269}\frac{g}{R}\theta = 0}$

$\Omega^2 = \frac{51}{269}\frac{g}{R} = \frac{51 \times 9{,}8}{269 \times 0.05} = 37{,}15 \Rightarrow \Omega = 6{,}10 \ \frac{1}{s}$

b) $T = \frac{2\pi}{\Omega} = 1.03\ s$