Gabarito Ensaio P2 – Física I – IO 2013

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① Trenó $m_T = 90\,kg$ $v_T = 11\,m/s$

Neve $m_N = 20\,kg$ $h = 5\,m$

(a) $m_T v_T = (m_T + m_N) v_F$ $\quad v_F = \dfrac{m_T}{m_T + m_N} v_T = \dfrac{90}{110} \cdot 11$

$$\underline{v_F = 9\,m/s}$$

(b) $\xrightarrow{x}$ $J_x = \Delta p_x = m_T (v_F - v_T) = \underline{-180\,N\,s}$

$\uparrow y$ $\quad J_y = -m_N v_N$

$\frac{1}{2} m_N v_N^2 = m_N g h$ $\quad v_N = \sqrt{2gh} = \sqrt{20 \times 5}$

$$\underline{v_N = 10\,m/s}$$

$$J_y = -20 \times 10 = \underline{-200\,N\,s}$$

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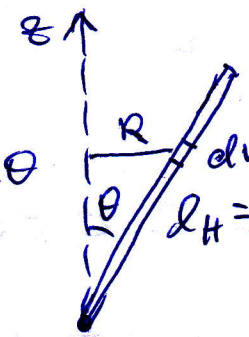
②



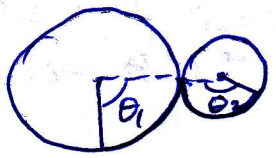
$R = \ell \operatorname{sen}\theta$ $\quad dm = \dfrac{d\ell}{\ell_H} \times m_H$ $\quad \ell_H = 2\,m$

$\frac{1}{2} I_z = \int_{\text{1 haste}} R^2\,dm$ ← 1 haste

↑ 2 hastes iguais

$$\frac{1}{2} I_z = \int_0^{\ell_H} (\ell \operatorname{sen}\theta)^2 \frac{m_H}{\ell_H} d\ell = \frac{m_H}{\ell_H} \operatorname{sen}^2\theta \int_0^{\ell_H} \ell^2 d\ell$$

$$I_z = \frac{2 m_H}{\ell_H} \operatorname{sen}^2\theta \frac{\ell_H^3}{3} = \frac{2}{3} \frac{1{,}5}{2} \frac{1}{4} \cancel{8} = \underline{1\,kg\,m^2}$$

③ 

$R_1\theta_1 = R_2\theta_2$ $\quad R_1 = 1\,m$

$\Rightarrow R_1\alpha_1 = R_2\alpha_2$ $\quad R_2 = 0{,}25\,m = 1/4\,m$

$\alpha_1 = 2\,rad/s^2$

(a) $\alpha_2 = \frac{R_1}{R_2}\alpha_1 = 4\alpha_1 = \underline{8\,rad/s^2}$

(b) $\tau_2 = I_{cm}\alpha_2 = \frac{1}{8}\times 8 = \underline{1\,Nm}$

$\tau_2 = F_a R_2$ $\quad F_a = \frac{1}{1/4} = \underline{4\,N}$

(c) $\tau_1 = F_a R_1 = \underline{4\,Nm}$

④ $m = 0{,}5\,kg$ $\quad R_E^2 = 0{,}01 \times \frac{5}{6}\,m$ $\quad \omega_0 = 2\,rad/s$

$D = 1\,m$

(a) $I = \frac{2}{5}m_E R_E^2 + 2\left(\frac{2}{5}m_E R_E^2 + m_E D^2\right)$

$I = \frac{6}{5}m_E R_E^2 + 2m_E D^2$

$I = \frac{6}{5}\times 0{,}5 \times 0{,}01 \times \frac{5}{6} + 2\times 0{,}5 \times 1^2$

$I = 0{,}005 + 1 = 1{,}005\,kg\,m^2$

(b) $I \approx 1\,kg\,m^2$

$L = I\omega = 1\times 2 = \underline{2\,kg\,m^2/s^2}$

$E_c = \frac{1}{2}I\omega^2 = \frac{1}{2}\times 1\times 2^2 = 2\,J$

(c) $p = mv = 2m v_{cm}$

$$v_{cm} = \frac{v}{2} = \frac{D\omega_0}{2} = 1 \text{ m/s}$$

(d) $$I_{cm} = 2m\left(\frac{D}{2}\right)^2 = \frac{mD^2}{2} = \frac{0{,}5 \times 1^2}{2} = 0{,}25 \text{ kg m}^2$$

$$\omega = \frac{v}{2} \Big/ \frac{D}{2} = \frac{v}{D} = \frac{2}{1} = 2 \text{ rad/s} = \omega_0$$