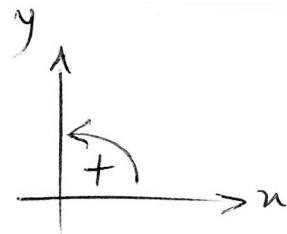
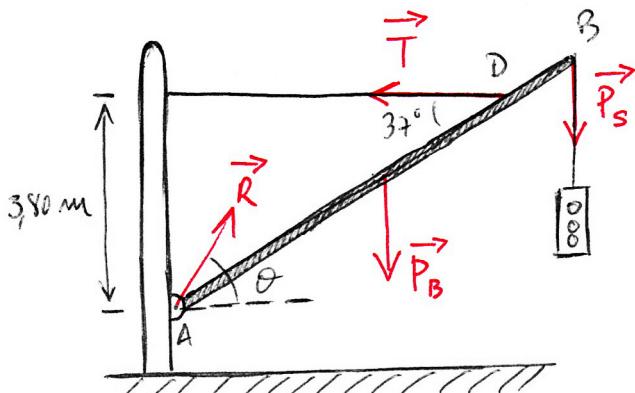


1.

$$l = 7,5 \text{ m}$$

$$m_B = 8 \text{ Kg}$$

$$m_S = 12 \text{ Kg}$$

$$\begin{cases} \sum F_n = 0 & -T + R_n = 0 \\ \sum F_y = 0 & R_y - P_B - P_S = 0 \\ \sum M_A = 0 & -\frac{l}{2} \cos 37^\circ P_B - l \cos 37^\circ P_S + 3,80 T = 0 \end{cases}$$

$$\begin{cases} R_n = T \\ R_y = m_B g + m_S g = 8 \times 9,8 + 12 \times 9,8 = 196 \\ 3,80 T = 3,75 \times \cos 37^\circ \times 8 \times 9,8 + 7,5 \times \cos 37^\circ \times 12 \times 9,8 = 939,2 \end{cases}$$

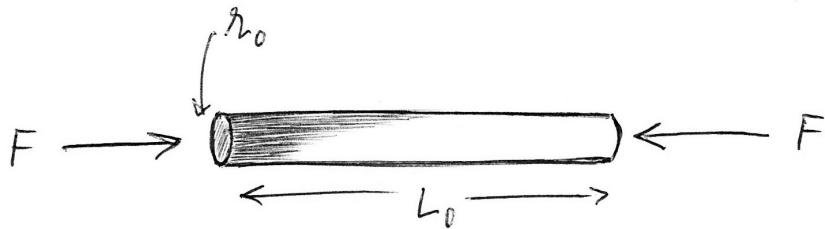
$$\begin{cases} R_n = 247,2 \text{ N} \\ R_y = 196 \text{ N} \\ T = 247,2 \text{ N} \end{cases} \quad R = \sqrt{R_n^2 + R_y^2} = \sqrt{247,2^2 + 196^2} = 315,5 \text{ N}$$

$$1.1 \quad T = \underline{\underline{247,2 \text{ N}}}$$

$$1.2 \quad \vec{R} = \underline{\underline{247,2 \hat{i} + 196 \hat{j}}} \text{ (N)} , \quad \|\vec{R}\| = \underline{\underline{315,5 \text{ N}}}$$

$$\tan \theta = \frac{196}{247,2} \Rightarrow \theta = \underline{\underline{38,4^\circ}}$$

2.



$$L_0 = 1 \text{ m}$$

$$d_0 = 8 \text{ cm}$$

$$F = -1,0 \times 10^5 \text{ N}$$

$$Y = 1,0 \times 10^{10} \text{ N/m}^2$$

$$\sigma' = 0,35$$



$$\boxed{\begin{aligned} 2.3 \quad B &= \frac{Y}{3(1-2\sigma')} \\ B &= \frac{1,0 \times 10^{10}}{3(1-2 \times 0,35)} = \\ &= 1,11 \times 10^{10} \text{ Pa} \end{aligned}}$$

$$\underline{2.1} \quad \frac{F}{A} = Y \frac{\Delta L}{L_0} \Leftrightarrow \Delta L = \frac{FL_0}{AY} \Leftrightarrow$$

$$\Delta L = \frac{-1,0 \times 10^5 \times 1}{\pi \times 0,04^2 \times 1,0 \times 10^{10}} = -1,989 \times 10^{-3} \text{ m} = \underline{-1,989 \text{ mm}}$$

$$\underline{2.2} \quad \Delta V = V - V_0 =$$

$$= \pi r^2 L - \pi r_0^2 L_0 =$$

$$= \pi (r^2 L - r_0^2 L_0) =$$

$$= \pi [(r_0 + \Delta r)^2 (L_0 + \Delta L) - r_0^2 L_0]$$

$$L = L_0 + \Delta L$$

$$r = r_0 + \Delta r$$

$$\sigma' = - \frac{\delta r}{\delta L} = - \frac{\frac{\Delta r}{r_0}}{\frac{\Delta L}{L_0}}$$

$$\Delta r = -\sigma' \frac{\Delta L}{L_0} r_0$$

$$\therefore \Delta r = -0,35 \times \frac{-1,989 \times 10^{-3}}{1} \times 0,04 = \\ = 2,7846 \times 10^{-5} \text{ m}$$

$$\therefore \Delta V = \pi \left[(0,04 + 2,7846 \times 10^{-5})^2 \times (1 - 1,989 \times 10^{-3}) - 0,04^2 \times 1 \right]$$

$$= -3,01 \times 10^{-6} \text{ m}^3$$

$$\underline{3.} \quad m = 1300 \text{ kg}$$

$$F_g = 2800 \text{ N}$$

$$\underline{3.1} \quad F_g = G \frac{M_T m}{(R_T + h)^2} \Leftrightarrow (R_T + h)^2 = \frac{G M_T m}{F_g}$$

$$R_T + h = \sqrt{\frac{G M_T m}{F_g}} \Leftrightarrow h = \sqrt{\frac{G M_T m}{F_g}} - R_T$$

$$h = \sqrt{\frac{6,67 \times 10^{-11} \times 5,98 \times 10^{24} \times 1300}{2800}} - 6,38 \times 10^6$$

$$\underline{h = 7,23 \times 10^6 \text{ m}}$$

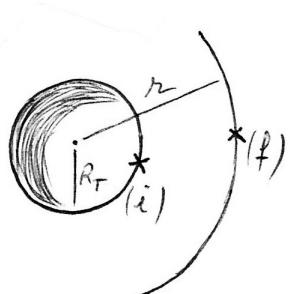
$$\underline{3.2} \quad \Delta E = E_f - E_i = E_{\text{orb}} - E_{P,T} =$$

$$= \left(-G \frac{M_T m}{2r} \right) - \left(-G \frac{M_T m}{R_T} \right) =$$

$$= G M_T m \left(-\frac{1}{2r} + \frac{1}{R_T} \right) =$$

$$= 6,67 \times 10^{-11} \times 5,98 \times 10^{24} \times 1300 \left(\frac{-1}{2 \times 1,36 \times 10^7} + \frac{1}{6,38 \times 10^6} \right)$$

$$= 6,22 \times 10^{10} \text{ J} = \underline{62,2 \text{ GJ}}$$



i) Estado inicial. Só tem energia potencial gravitacional.

f) Estado final. tem a energia correspondente à órbita que ocupa.

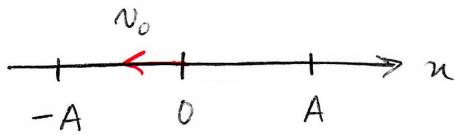
4.

$$K = 120 \text{ N/m}$$

$$T = 0,5 \text{ s}$$

$$x_0 = 0$$

$$v_0 = -1 \text{ m/s}$$

4.1

$$\omega^2 = \frac{K}{m} \Leftrightarrow m = \frac{K}{\omega^2} = \frac{120}{(4\pi)^2} \approx \underline{\underline{0,76 \text{ kg}}}$$

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{0,5} = 4\pi \text{ rad/s}$$

4.2

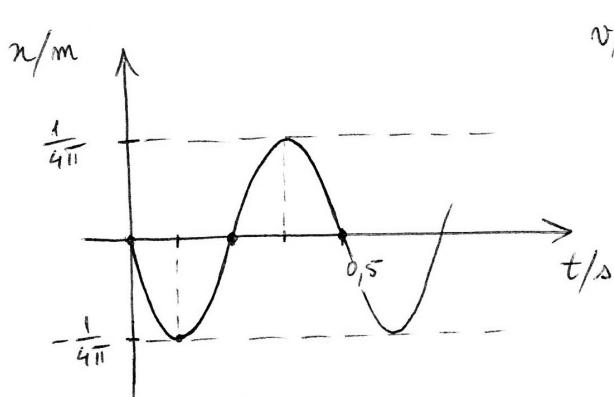
$$x = A \cos(\omega t + \phi), \quad v = -A\omega \sin(\omega t + \phi)$$

$$A = \sqrt{x_0^2 + \left(\frac{v_0}{\omega}\right)^2} = \sqrt{0^2 + \left(\frac{-1}{4\pi}\right)^2} = \frac{1}{4\pi} \approx \underline{\underline{0,0796 \text{ m}}}$$

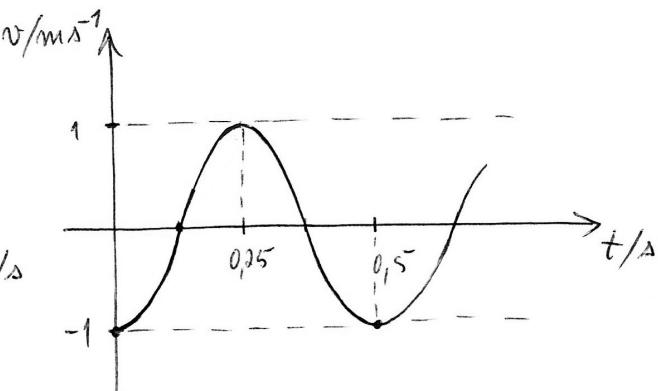
$$v_0 = -A\omega \sin \phi$$

$$-1 = -\frac{1}{4\pi} \times 4\pi \sin \phi \Rightarrow \sin \phi = 1 \Rightarrow \phi = \frac{\pi}{2}$$

$$\therefore \underline{\underline{x(t) = \frac{1}{4\pi} \cos(4\pi t + \frac{\pi}{2})}}, \quad \underline{\underline{v(t) = -\sin(4\pi t + \frac{\pi}{2})}}$$



Paulo Ribeiro



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