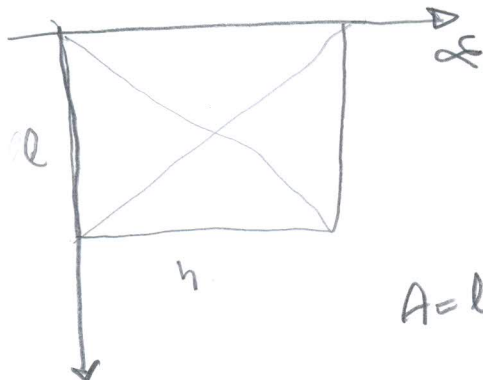


$l = 0,2 \text{ m}$
 $M = 3 \text{ kg}$
 $m = 10 \cdot 10^{-3} \text{ kg} = 10^{-2} \text{ kg}$
 a)



$$\rho = \frac{M}{A}$$

$$M = \rho \cdot A$$

$$dm = \rho \cdot dx \cdot dy$$

$$I = \int r^2 \cdot dm$$

$$A = l \cdot h$$

$$I_{\text{eixo}} = \int_0^h \int_0^l x^2 \rho \cdot dx \cdot dy = \frac{h l^3}{3} \rho = \frac{A \rho l^2}{3} = \frac{M l^2}{3}$$

$$\Rightarrow I_y = \frac{M l^2}{3}$$

$$b) I_{\text{bole+modelo}} = \frac{M l^2}{3} + m \left(\frac{l}{2} \right)^2 = \frac{M l^2}{3} + \frac{m l^2}{4}$$

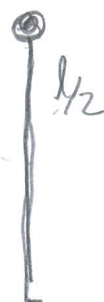
$$= 0,40 + 0,001 = 0,401$$

c)

$$v = 328 \text{ m/s}$$

$$L = r \wedge p$$

$$L^{(i)} = m v \frac{l}{2}$$



$$\Rightarrow m v \frac{l}{2} = l^2 \left(\frac{M}{3} + \frac{m}{4} \right) \omega$$

$$L^{(f)} = I_{\text{bole+modelo}} \cdot \omega$$

$$\omega = \frac{m v / 2}{\left(\frac{M}{3} + \frac{m}{4} \right) l} = \frac{3,42}{(1 + 0,0025) \cdot 0,2} = \frac{1,6}{0,2005} = 7,9 \frac{\text{rad}}{\text{s}} \approx 8 \frac{\text{rad}}{\text{s}}$$

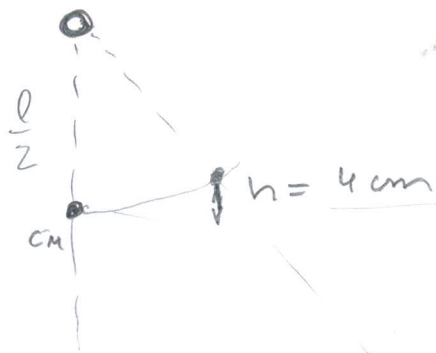
$$d) E_m^{(k)} = \frac{1}{2} I \omega^2 = \frac{1}{2} \left(\frac{M l^2}{3} + \frac{m l^2}{4} \right) \omega^2$$

$$E_m^{(p)} = (M+m) g h = 3,01 \cdot 10 h = 30,1 h$$

$$E_m^{(k)} = \frac{1}{2} 1,005 \cdot 0,2^2 \cdot 7,9^2 = 1,25 \text{ J}$$

$$30,1 h = 1,25 \Rightarrow h = 0,04 \text{ m}$$

$$= 4 \text{ cm}$$



$$e) E_m^{(k)} = \frac{m v^2}{2} = \frac{10^{-2} \cdot 328^2}{2} = 537,92 \text{ J}$$

$$E_m^{(p)} = \frac{1}{2} I \omega^2 = 1,25 \text{ J}$$

$$\Delta E_m = 1,25 - 537,92 = -536,67 \text{ J}$$

① $h = 0,2 \text{ m} \Rightarrow$ que o quadro
dará uma volta completa

$$E_m^{(K)} = 30,1 \cdot 0,2 = 6,02 \text{ J}$$

$$E_m^{(L)} = \frac{1}{2} 1,005 \cdot 0,2^2 \omega^2$$

$$0,0201 \omega^2 = 6,02$$

$$\omega^2 = 299,5 \Rightarrow \omega = 17,3 \text{ rad/s}$$

$$L^{(K)} = L^{(L)} \Rightarrow v = \frac{2l}{m} \left(\frac{M}{3} + \frac{Ml}{4} \right) \omega$$

$$v = \frac{2 \cdot 0,2}{10^{-2}} \cdot (1,005) \cdot 17,3 = 695,7 \text{ m/s}$$