5) a) $E_i = E_f \Rightarrow \frac{mv^2}{2} = \frac{Kx^2}{2} \Rightarrow mv^2 = Kx^2$; $x = 13{,}3 \cdot 10^{-2}$ m

$m = 1$ Kg $K = 2 \cdot 10^2$ N/m $m_0 = 20g = 2 \cdot 10^{-2}$ Kg

$2 \cdot 10^{-2} \cdot v^2 = 2 \cdot 10^2 \cdot (13{,}3 \cdot 10^{-2})^2$

$2 \cdot 10^{-2} \cdot v^2 = 2 \cdot 10^2 \cdot 13{,}3^2 \cdot 10^{-4} \Rightarrow V = 13{,}3$ m/s

b) Conservação do momento: $p_i = p_f$

$2 \cdot 10^{-2} \cdot 13{,}3 = (1 + 2 \cdot 10^{-2}) \cdot V'$

$2{,}66 \cdot 10^{-1} = 1{,}02 \cdot V \Rightarrow V = 133/510$ m/s

Energia mecânica antes:

$\frac{2 \cdot 10^{-2} \cdot 13{,}3^2}{2} = 13{,}3^2 \cdot 10^{-2}$

Energia mecânica depois:

$\frac{(1+2 \cdot 10^{-2}) \cdot (133/510)^2}{2} = 0{,}56 \cdot (133/510)^2$

Fração perdida:

$\frac{0{,}56 \cdot (133/510)^2}{13{,}3^2 \cdot 10^{-2}} = \frac{56 \cdot 10^{-2+2}\, 133^2 \cdot 10^2}{133^2 \cdot 510^2} = \frac{56 \cdot 10^2}{51^2 \cdot 10^2} = \frac{56}{2601}$

6) a) $\frac{m_1 v_1^2}{2} = \frac{m_1 v_1'^2}{2} \Rightarrow v_1'^2 = v_1^2 \Rightarrow \vec{v}_1' = \pm \vec{v}_1$

$0{,}8 \cdot 3\hat{i} + 1{,}2 \cdot (2\hat{i} - 1\hat{j}) = 0{,}8 \cdot 3\hat{j} + 1{,}2\vec{v}_2'$

$2{,}4\hat{i} + 2{,}4\hat{i} - 1{,}2\hat{j} = 2{,}4\hat{j} + 1{,}2\vec{v}_2'$

$4{,}8\hat{i} - 1{,}2\hat{j} - 2{,}4\hat{j} = 1{,}2\vec{v}_2' \Rightarrow 1{,}2\vec{v}_2' = 4{,}8\hat{i} - 3{,}6\hat{j}$

$\vec{v}_2' = 4\hat{i} - 3\hat{j}$

b) Colisão elástica = quando se conserva a energia e o momento linear

colisão inelástica = a energia cinética não se conserva

Energia cinética inicial:

$\frac{0{,}8 \cdot 3^2}{2} + \frac{1{,}2(2\hat{i} - 1\hat{j})^2}{2} = 3{,}6 + 3 = 6{,}6$ J

Energia cinética final:

$\frac{0{,}8 \cdot 3^2}{2} + \frac{1{,}2(4\hat{i} - 3\hat{j})^2}{2} = 3{,}6 + 15 = 18{,}6$ J

$\Big\}$ colisão inelástica

7) a) $I_0 = \sum mr^2 = md^2 + m4d^2 + m9d^2$

$I_0 = 14md^2$

8) a)

9) a) $\omega = \frac{V}{R}$

b) $\vec{L} = mR^2\omega = mR\vec{V}$

c) $\tau = I\frac{a}{R}$ $\quad I = mR^2$

$\tau = mRa$ $\quad a = a_{cp} = \frac{V^2}{R}$

$\tau = mR \cdot \frac{V^2}{R} \Rightarrow \tau = mV^2$

d) $\alpha = \frac{a}{R} = \frac{V^2}{R^2}$

8) $I = I_1 + I_2 + I_3 + I_4$

a) Cada barra tem $I_{barra} = \frac{Md^2}{12}$

O centro de massa de cada barra está localizada a $\frac{d}{2}$ e $\frac{3d}{2}$ de O respectivamente. Assim, temos:

$I = \left[I_{barra} + M\left(\frac{d}{2}\right)^2\right] + md^2 +$

$+ \left[I_{barra} + M\left(\frac{3d}{2}\right)^2\right] + m(2d)^2$

$I = \frac{8}{3}Md^2 + 5md^2 \Rightarrow I = d^2\left(\frac{8}{3}M + 5m\right)$

$I = (5,6\cdot10^{-2})^2\cdot\left(\frac{8}{3}\cdot1,2+5\cdot0,85\right)$

$I = 0,023\ Kg\cdot m^2$

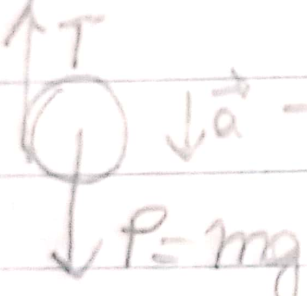
b) $K = \frac{1}{2}I\omega^2 = \frac{0,023\cdot(0,30)^2}{2}$

$K = 0,001035\ J$

10) a) $\tau = I\alpha$ $\quad F = M\cdot a$ $\quad a = R\alpha$

$TR = \frac{1}{2}MR^2\cdot\left(\frac{a}{R}\right) \Rightarrow T = \frac{1}{2}ma$

b)



$T = mg - ma$

Lembrando que $T = \frac{1}{2}ma$, temos:

$\frac{1}{2}ma = mg - ma$

$a = \frac{2}{3}g$

c)

12) a) $K = \frac{1}{2} I \omega^2 \qquad I = \frac{1}{2} m R^2$

$\omega = \left(700 \frac{rev}{min}\right)\left(\frac{1\,min}{60s}\right)\left(\frac{2\pi\,rad}{rev}\right)$

$\omega = \frac{70\pi}{3}\,rad/s$

$K = \frac{1}{2}\left(\frac{1}{2} m R^2\right)\left(\frac{70\pi}{3}\right)$

$K = \frac{1}{4}\,2\cdot(7\cdot10^{-2})^2\,\frac{70\pi}{3}$

$K = \frac{1}{2}\cdot 49\cdot10^{-4}\cdot\frac{70\pi}{3} = 0{,}18\,J$

b) $a_{cp} = \frac{V^2}{R} = \omega^2 R$

$\alpha = \frac{a}{R} = \frac{\omega^2 R}{R} \Rightarrow \alpha = \omega^2$

$\alpha = \left(\frac{70\pi}{3}\right)^2 = 5373{,}4\,rad/s^2$

c) $\tau = I\alpha = mR^2\cdot\alpha$

$\tau = 2\cdot(7\cdot10^{-2})^2\cdot 5373{,}4$

$\tau = 52{,}7\,N\cdot m$