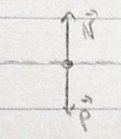
Exercício 11c - Capítulo 3

1) $m = 90\ kg$



a) $N = const. \Rightarrow a = 0\ m/s^2$

$N - P = 0 \Leftrightarrow N = P$

$\Leftrightarrow N = mg$

$\Leftrightarrow N = 90 \times 9,8$

$\Leftrightarrow N = 882\ N$

b) $N = const. \Rightarrow a = 0\ m/s^2$

$N - P = 0 \Leftrightarrow N = 882\ N$

c) $N + F_{ext} - P = 0 \Leftrightarrow$

$\Leftrightarrow N = P - F_{ext} \Leftrightarrow$

$\Leftrightarrow N = mg + ma$

$\Leftrightarrow N = m(g + a)$

$\Leftrightarrow N = 90 \times (9,8 + 3)$

$\Leftrightarrow N = 1152\ N$

d) $N = m(-a + g) \Leftrightarrow$

$\Leftrightarrow N = 90 \times (-3 + 9,8) \Leftrightarrow$

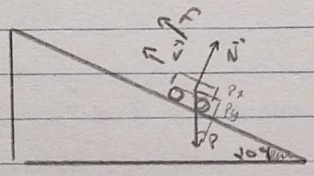
$\Leftrightarrow N = 612\ N$

e) $\vec{a} = \vec{g}$

$R = m(-g + g) \Leftrightarrow$

$\Leftrightarrow R = 0\ N$

2) $m = 1000\ kg$



a) M.R.U $\Rightarrow a = 0\ m/s \Rightarrow F_R = 0$

$F_R = F_x - P_x \Leftrightarrow F_x = P_x \Leftrightarrow F_x = mg \sin 20° = 3352\ N$

b) $a = 0,2\ m/s \Rightarrow F_R = 0,2 \times 1000 \Leftrightarrow F_R = 200\ N$

$F_R = F_x - P_x \Leftrightarrow F_x = F_R + P_x$

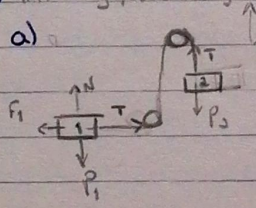
$\Leftrightarrow F_x = 200 + 3352$

$\Leftrightarrow F_x = 3552\ N$

c) $N = P_y = mg \cos 20° = 1000 \times 9,8 \times \cos 20° = 9209\ N$

3) $m1 = 50\ g$; $m2 = 80\ g$

a)

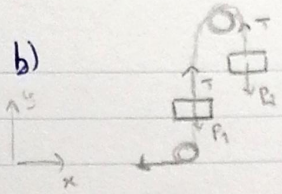


$$\begin{cases} T - P_x = m_2 \times a \\ T - f_1 = m_1 \times a \Leftrightarrow \\ N - P_1 = 0 \end{cases} \qquad \begin{cases} T = m_2 \times g + m_2 \times a = 0,08 \times 9,8 + 0,08 \times a \\ T = m_1 \times a + 1 = 0,05 \times a + 1 \end{cases}$$

$0,784 + 0,08a = 0,05a + 1 \Leftrightarrow 0,08a - 0,05a = 1 - 0,784 \Leftrightarrow a =$

$0,05a + 1 = 0,784 + 0,08a \Leftrightarrow$

b)



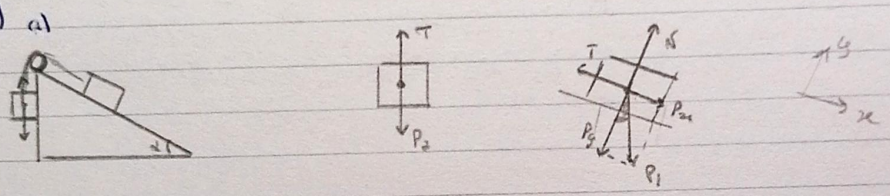
$$\begin{cases} T - P_2 = m_2 \times a \\ T = P_1 - F = m_1 \times a \end{cases} \Leftrightarrow \begin{cases} T = m_2 \times a - m_2 \times g \\ T = P_1 + F + m_1 \times a \end{cases}$$

$\Leftrightarrow m_2 \times a - m_2 \times g = m_1 \times g + 1 - m_1 \times a \Leftrightarrow a(m_1 + m_2) = m_1 \times g + 1 + m_2 \times g \Leftrightarrow$

$\Leftrightarrow a = [(m_1 \times g) + 1 + (m_2 \times g)] / (m_1 + m_2)$

$\Leftrightarrow a =$

4) a)

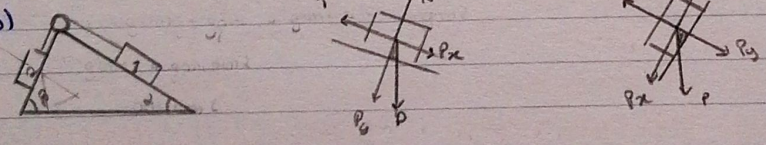


$$\begin{cases} T - P_2 = m_2 \times a \\ N - P_y = 0 \\ -T + P_x = m_1 \times a \end{cases}$$

$$\begin{cases} T = m_2 \times g + m_2 \times a \\ -(m_2 \times g) - m_2 \times a = m_1 \times a - m_1 \times g \times \sin\alpha \end{cases} \Leftrightarrow \begin{cases} T = m_2(g + a) \\ a(m_1 + m_2) = g(-m_2 + m_1 \sin\alpha) \end{cases} \Leftrightarrow a =$$

$$\begin{cases} T = m_2 \left[g + \left(g(m_1 \sin\alpha - m_2) / (m_1 + m_2) \right) \right] \\ a = [g(m_1 \sin\alpha - m_2)] / (m_1 + m_2) \end{cases} \Leftrightarrow \begin{cases} T = [(g m_1 m_2)(1 + \sin\alpha)] / (m_1 + m_2) \\ a = - \end{cases}$$

b)



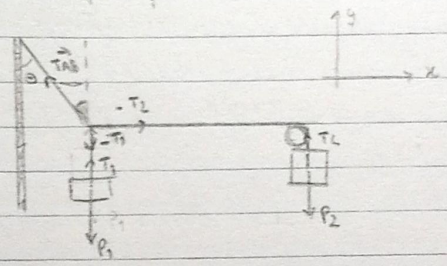
Compo 1: $\begin{cases} P_x - T = m_1 \times a \\ N - P_y = 0 \end{cases}$ Compo 2 $\begin{cases} T - P_x = m_2 \times a \\ N - P_y = 0 \end{cases}$

$$\begin{cases} m_1 \cdot g \sin\alpha - T = m_1 \times a \\ T - m_2 g \sin\beta = m_2 \times a \end{cases} \Leftrightarrow \begin{cases} m_1 \cdot g \cdot \sin\alpha - m_2 \times a - m_2 g \sin\beta = m_1 \times a \\ T = m_2 \times a + m_2 g \sin\beta \end{cases}$$

$$\begin{cases} a(m_1 + m_2) = g(\sin\alpha m_1 - m_2 \sin\beta) \\ T = m_2 \times \left[g(\sin\alpha m_1 - \sin\beta m_2) / (m_1 + m_2) \right] + m_1 g \sin\beta \end{cases} \begin{cases} a = [g(\sin\alpha m_1 - \sin\beta m_2)] / (m_1 + m_2) \\ T = [m_2 m_1 g - (\sin\beta + \sin\alpha)] / (m_1 + m_2) \end{cases}$$

5) $m_1 = 3\,kg$; $m_2 = 4\,kg$; $\theta = ?$; $T_{AB} = ?$

Sist. em eq. $= \sum \vec{F_i} = \vec{0}$

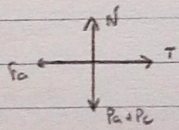


$$\begin{cases} -T_{AB}\sin\theta + m_2 g = 0 \\ T_{AB}\cos\theta - m_1 g = 0 \end{cases} \quad (T_2 = P_2,\ T_1 = P_1) \quad (\div) \quad \begin{cases} T_{AB}\sin\theta = m_2 g \\ T_{AB}\cos\theta = m_1 g \end{cases} \Rightarrow \tg\theta = \frac{m_2}{m_1} \ (\div)\ \theta = \tg^{-1}\left(\frac{4}{3}\right) = 53°$$

$$T_{AB} = (m_2 g)/\sin 53° = 49\,N$$

ii) $m_A = 10\,kg$; $m_B = 5\,kg$

$\mu_e = \mu_c = 0{,}10$



$|T| = |P_B| = m_B \cdot g$

a)

$$\begin{cases} N - P_a - P_c = 0 \\ T - F_a = 0 \end{cases} \quad (\div) \quad \begin{cases} N = (m_A + m_c)\,g \\ T = F_a \end{cases} \quad (\div) \quad \begin{cases} m_c = N/g - m_A \\ m_B \cdot g = \mu_e \cdot N \end{cases} \quad (\div)$$

$$(\div) \quad \begin{cases} m_c = N/g - m_A \\ N = m_B \cdot g/\mu_e \end{cases} \quad (\div) \quad \begin{cases} m_c = 245/9{,}8 - 10 \\ N = 245\,N \end{cases} \quad (\div) \quad \begin{cases} m_c = 15\,kg \end{cases}$$

b) $\begin{cases} N - P_a = 0 \\ T - F_a = (m_A + m_B)\,a \end{cases}$ $\quad F_a = N \times \mu_c = m_B \times g \times \mu_c = 19{,}6\,N$ $\quad T = m_B \times g = 49\,N$

$$a = (T - F_a)/(m_A + m_B) = (49 - 19{,}6)/(10 + 5) = 1{,}96\,m/s^2$$

12) $m = 0{,}4\,kg$; $a = 9{,}0\,m/s^2$

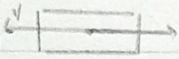
$F_R = m \times a$ (+) $P - F_a = m \times a$

(+) $F_a = -m \times a + mg$

(+) $F_a = m(g - a)$

(+) $F_a = 0{,}4 \times 0{,}8$

(+) $F_a = 0{,}32\,N$

13)  $F = -mKv$

- Princípio fundamental da dinâmica: $ma = -mKv \Leftrightarrow a = -Kv$
- v em função de t: $dv/dt = a \Leftrightarrow dv = a\,dt \Leftrightarrow dv = -Kv\,dT \Leftrightarrow dv/v = -K\,dt$

$$\int \frac{dv}{v} = \int -K\,dT = -KT + C1 \Rightarrow V(t=0) = Vo \Leftrightarrow \ln(Vo) = -K \cdot 0 + C1 \Leftrightarrow C1 = \ln(Vo)$$

↳ Logo: $\ln(V) = -KT + \ln(Vo) \Leftrightarrow \ln(V/Vo) = -KT \Leftrightarrow V/Vo = e^{-KT} \Leftrightarrow V = e^{-KT} \cdot Vo$

- x em função de t: $dx/dt = v \Leftrightarrow dx = v\,dt \Leftrightarrow dx = e^{-KT} \cdot Vo\,dt$

$$\Rightarrow \int_{xi}^{x1} dx = \int_{t_i}^{t1} e^{-KT} Vo\,dt \Leftrightarrow xf - xi^{0} =$$

14)

15) $R = 2\ cm = 0,02\ m$

$\rho_b = 1,50\ g/cm^3 = 1500\ Kg.m^{-3}$

$\rho_g = 1,26\ g/cm^3 = 1260\ Kg.m^{-3}$

$\eta_g = 0,833$

$v_{lim} = ?$

$V_{esfera} = \frac{4}{3}\pi R^3 = 34\ cm^3 = 3,4 \times 10^{-5}\ m^3$

$b = 6\pi \times \eta R = 6\pi \times 0,833 \times 0,02 = 0,31$

$v_{limite} = [(\rho_{esf} - \rho_{gle}) \times g \times V_{esf}] / b =$

$= (1500 - 1260) \times 9,8 \times (3,4 \times 10^{-5}) / 0,31 =$

$= 0,25\ m/s$

$m \times a = (\rho_{esf} - \rho_{gle}) g \cdot V_{co} - b v \Leftrightarrow$

$\Leftrightarrow (m - (\rho_{esf} - \rho_{gle}) \times g \cdot V_{co}) / -b = v$

$\Leftrightarrow v = (-0,05 + (1500 - 1260) \times 9,8 \times (3,4 \times 10^{-5})) / 0,31$

$\Leftrightarrow v = 0,09\ m/s$

$m = \rho \times V = 1500 \times 3,4 \times 10^{-5} = 0,05\ Kg$

22) $m = 200g = 0,200\,kg$

$l_{mola} = 50cm = 0,50cm$

$|F| = -K\Delta x \Leftrightarrow K = F/\Delta x = 1/0,01 = 100\,N/m$

M.S.U. $\Rightarrow v$ const $\Rightarrow a_t = 0\ m/s^2$

a) $T = 2s \Rightarrow \omega = \frac{2\pi}{T} \Leftrightarrow \omega = \pi\ rad/s$

$\vec{F_R} = \vec{F_{elástica}} = -K\Delta x\ \vec{n}$

$\vec{a} = -\vec{ac} \cdot \vec{n} = -v^2/r = -\omega^2 r \frac{\vec{r}}{r} = -\omega^2(l_{mola} + \Delta x)\,\vec{n}$

$\vec{F_R} = ma_c \Leftrightarrow -K\Delta x = -\omega^2(l_{mola} + \Delta x)$

$\Leftrightarrow K\Delta x = \omega^2 l_{mola} + \omega^2 \Delta x$

$\Leftrightarrow \Delta x(K - \omega^2) = \omega^2 l_{mola}$

$\Leftrightarrow \Delta x = [\omega^2 \times l_{mola}/(K - \omega^2)]$

$\Leftrightarrow \Delta x = [(\pi^2 \times 0,5)/(100 - \pi^2)]$

$\Leftrightarrow \Delta x = 0,055\ m$

Comprimento da mola = $\Delta x + l_{mola} = 0,055 + 0,5 = 0,555\ m$

b) $v = \omega r = \omega \times (l_{mola} + \Delta x) = \pi \times 0,51 = 1,60\,m/s$

$\Delta E_m = 0 \Leftrightarrow \frac{1}{2} m\omega^2 a + mgh_a = \frac{1}{2} m\omega^2 b + mgh_b^{\,0}$

$\Leftrightarrow \frac{1}{2} v_a^2 + gh_a = \frac{1}{2} v_b^2 + 0$

$\Leftrightarrow [\frac{1}{2}(1,60)^2 + 9,8 \times 0,50] \times 2 = v_b^2$

$\Leftrightarrow v_b = 3,5\,m/s$

23) $K = 400\ N/m$

a)

(1) $\begin{cases} N - P_1 + F\sin(30°) = 0 \\ T - F\cos(30°) = 0 \quad (1) \end{cases}$

(2) $T = P_2 = m_2 g = 4 \times 9,8 = 39,2\,N$

(1) $F\cos(30°) = T \Leftrightarrow K\Delta x \cos(30°) = 39,2\,N \Leftrightarrow \Delta x = 0,113\ m \Leftrightarrow \Delta x = 11,3cm$

b) $\begin{cases} N - P_1 + F\sin(30°) = 0 \\ T - F\cos(30°) - F_a = 0 \end{cases}$