2ª série - Física Geral

$\downarrow F_e$

$\uparrow F_T$

1.

$F_g = mg$ (2ª lei) $\quad a \equiv g$.

$F_e = m_e g_e \overset{3^a \text{ lei}}{=} F_T = m_T g_T \qquad g_e = g = 9.8\, ms^{-2}$

$\therefore\ g_T = \frac{m_e}{m_T} g = 98 \times 10^{-24}\, ms^{-2}$

2. $a = $ const.

$v = \underset{0}{v_0} + at \qquad v_f = 35 \Rightarrow \qquad a = 14 \times 10^{2}\, ms^{-2}$

(2ª lei) $F = ma$

$= 70 \times 10\ N \qquad$ força na bola $\overset{3^a \text{ lei}}{=}$ força no pé

3. a)

Na esfera $\vec{T}_3 + \vec{P} = 0 \qquad T_3 = mg = 49N$.

No ponto onde as cordas se juntam

$\vec{T}_1 + \vec{T}_2 + \vec{T}'_3 = 0$

$\vec{T}'_3 = -\vec{T}_3$

$$\left\{ -T_1 \cos\alpha\, \vec{u}_x + T_1 \sin\alpha\, \vec{u}_y + T_2 \cos\beta\, \vec{u}_x + T_2 \sin\beta\, \vec{u}_y - T_3 \vec{u}_y = 0 \right.$$

$\alpha = 40^\circ \qquad \beta = 50^\circ$

$$\begin{cases} -T_1 \cos\alpha + T_2 \cos\beta = 0 \\ T_1 \sin\alpha + T_2 \sin\beta - T_3 = 0 \end{cases}$$

Substituindo T_3, α e β fica

$T_1 = 32N$

$T_2 = 38N$

b) $\alpha = 60°$

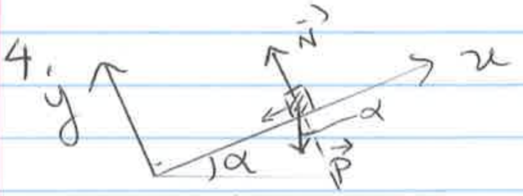
Análise semelhante p. a espera. $T_3 = mg = 98\,N$.

No ponto de contacto das cordas:

$\vec{T}_1 + \vec{T}_2 + \vec{T}'_3 = 0$ $\qquad \vec{T}'_3 = -\vec{T}_3 \qquad T_3 = mg$.

$$\begin{cases} -T_1 \cos\alpha + T_2 = 0 \\ T_1 \sin\alpha - T_3 = 0 \end{cases} \Rightarrow \begin{array}{l} T_1 = 57\,N \\ T_2 = 11\times10\,N \end{array}$$

4.



$\vec{N} + \vec{P} = m\vec{a}$

$N\vec{u}_y - mg\cos\alpha\,\vec{u}_y - mg\sin\alpha\,\vec{u}_x = -ma\,\vec{u}_x$

$$\begin{cases} N = mg\cos\alpha \\ a = g\sin\alpha = 2{,}5\,m\,s^{-2} \end{cases} \qquad \vec{a} = -a\vec{u}_x$$

Em $t=0$, $\vec{v}_0 = 0$ e $\vec{r}_0 = l\,\vec{u}_x$

Na direcão x: $\quad x = x_0 + v_0 t + \frac{1}{2}at^2$

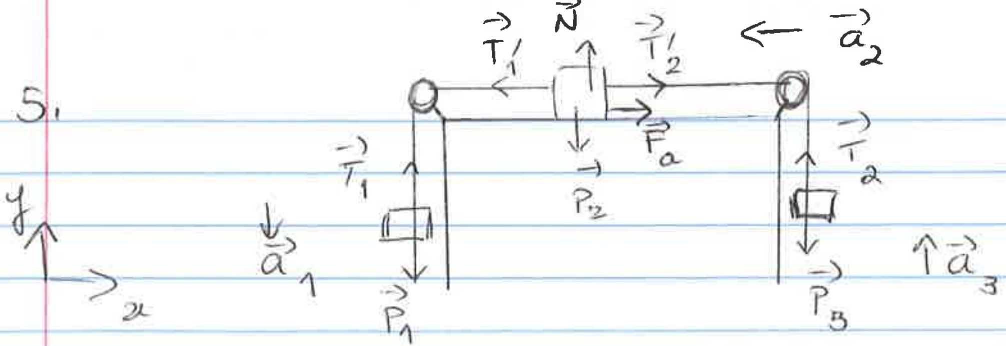
$x = l - \frac{1}{2}g\sin\alpha\, t^2$

Na pos. final $x=0 \Rightarrow t = \sqrt{\dfrac{2l}{g\sin\alpha}}$

$v = v_0 + at = -g\sin\alpha\, t = -g\sin\alpha\sqrt{\dfrac{2l}{g\sin\alpha}} = -\sqrt{10}\,ms^{-1}$

$= -3{,}2\,ms^{-1}$

5.



$$|\vec{T}_1'| = |\vec{T}_1| \qquad |\vec{T}_2'| = |\vec{T}_2| \qquad |\vec{F}_a| = \mu |\vec{N}|$$

$$|\vec{a}_1| = |\vec{a}_2| = |\vec{a}_3| = a$$

1: $\vec{P}_1 + \vec{T}_1 = m_1 \vec{a}_1$

2: $\vec{P}_2 + \vec{N} + \vec{T}_1' + \vec{T}_2' + \vec{F}_a = m_2 \vec{a}_2$

3: $\vec{P}_3 + \vec{T}_2 = m_3 \vec{a}_3$

$$\begin{cases} -m_1 g + T_1 = -m_1 a \\ -m_2 g + N = 0 \\ -T_1 + T_2 + F_a = -m_2 a \\ -m_3 g + T_2 = m_3 a \end{cases}$$

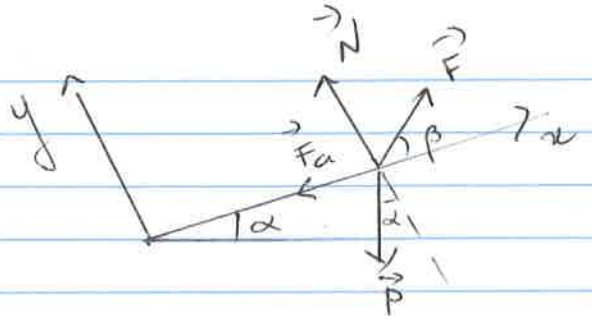
$$a = \frac{m_1 - \mu m_2 - m_3}{m_1 + m_2 + m_3} g = 3.2 \text{ m s}^{-2}$$

$$T_2 = m_3 g \left(1 + \frac{m_1 - \mu m_2 - m_3}{m_1 + m_2 + m_3} \right) = 13 \text{ N}.$$

$$T_1 = m_1 g \left(1 - \frac{m_1 - \mu m_2 - m_3}{m_1 + m_2 + m_3} \right) = 26 \text{ N}.$$

$$\begin{cases} \vec{a}_1 = -3.2\, \vec{u}_y \\ \vec{a}_2 = -3.2\, \vec{u}_x \\ a_3 = 3.2\, \vec{u}_y. \end{cases}$$

6.



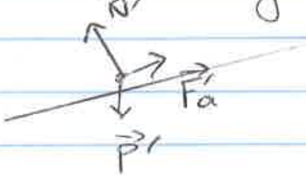
$$|\vec{F_a}| = \mu |\vec{N}|$$

$$\vec{v} = \text{const} \Rightarrow \vec{a} = 0.$$

$$\vec{F} + \vec{P} + \vec{N} + \vec{F_a} = m\vec{a} = 0$$

$$\begin{cases} F\cos\beta - P\sin\alpha - \mu N = 0 \\ F\sin\beta - P\cos\alpha + N = 0 \end{cases} \Rightarrow \mu = \frac{F\cos\beta - P\sin\alpha}{-F\sin\beta + P\cos\alpha} = 0{,}76$$

Quando escorrega:



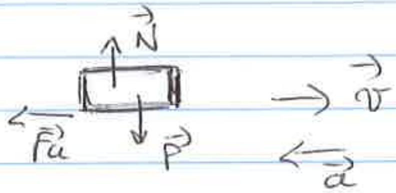
$$m' = m + m_R.$$
$$\vec{P}' = \vec{P} + \vec{P}_R$$

$$\vec{P}' + \vec{N}' + \vec{F}_a' = m'\vec{a}$$

$$\begin{cases} -P'\sin\alpha + \mu N' = -m'a \\ -P'\cos\alpha + N' = 0 \end{cases}$$

$$a = g(\sin\alpha - \mu\cos\alpha) = 1.0\ m s^{-2}$$

7.



$$|\vec{F}_{as}| \leq \mu_s |\vec{N}|$$

$$\vec{N} + \vec{P} + \vec{F_a} = m\vec{a}$$

$$\begin{cases} N - mg = 0 \\ F_{as} = ma \end{cases} \Rightarrow a \leq \mu_s g.$$

Distância mínima $\Rightarrow$ a máxima. $a = \mu_s g$

Caixa não escorrega se a aceleração do camião for igual à sua.

$a = \mu_s g$

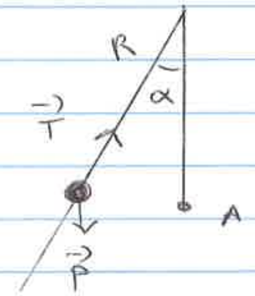
$v = v_0 - at$

$x = \underset{0}{\underset{\parallel}{x_0}} + v_0 t - \frac{1}{2} a t^2$

para qdo $v = 0 \Rightarrow t = \frac{v_0}{a}$

$x = \frac{1}{2} \frac{v_0^2}{a} = \frac{1}{2} \frac{v_0^2}{\mu_s g} = \underline{\underline{29\,m}}$

8.

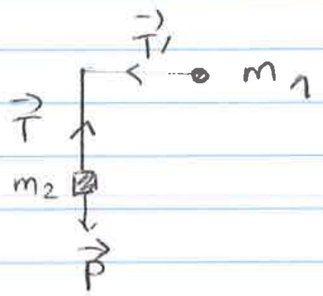


$\vec{u}_r$: $-mg\cos\alpha + T = m\frac{v^2}{R}$

$T = m\frac{v^2}{R} + mg\cos\alpha$.

$\alpha = 0$: $T = m\frac{v^2}{R} + mg = 137\,N > T_{max}$ não é seguro.

9.

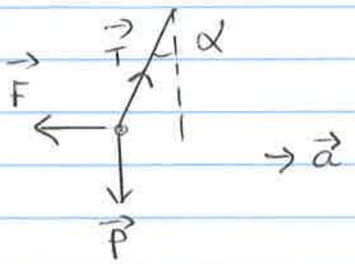


$\vec{P} + \vec{T} = 0 \Rightarrow T = m_2 g = 9{,}8\,N$.

$|\vec{T'}| = |\vec{T}| \Rightarrow T' = m_2 g$.

$T' = m_1 a_c \Rightarrow m_2 g = m_1 \frac{v^2}{R}$ $\quad v = 6{,}3\,ms^{-1}$

10.



$$\vec{F} = -m\vec{a}$$

$$\vec{P} + \vec{T} + \vec{F} = 0$$

$$-mg\,\vec{u_y} + T\cos\alpha\,\vec{u_y} + T\sin\alpha\,\vec{u_x} - ma\vec{u_x} = 0.$$

$$\begin{cases} -mg + T\cos\alpha = 0 \\ T\sin\alpha - ma = 0 \end{cases} \qquad \begin{cases} tg\,\alpha = \frac{a}{g} \\ T = \frac{mg}{\cos\alpha}. \end{cases}$$

$$\alpha = 17^\circ \qquad T = 5{,}1\,N.$$

11. Figura nos slides.

$$\vec{P} + \vec{T} = m\vec{a_c}$$

$$-mg\,\vec{u_y} + T\cos\alpha\,\vec{u_y} + T\sin\alpha\,\vec{u_x} = m a_c \vec{u_x}$$

$$\begin{cases} -mg + T\cos\alpha = 0 \\ T\sin\alpha = m a_c \end{cases} \qquad T = \frac{mg}{\cos\alpha.} = 79\times 10\,N$$

$$a_c = \frac{T\sin\alpha}{m.} = 0{,}86\,ms^{-2}.$$