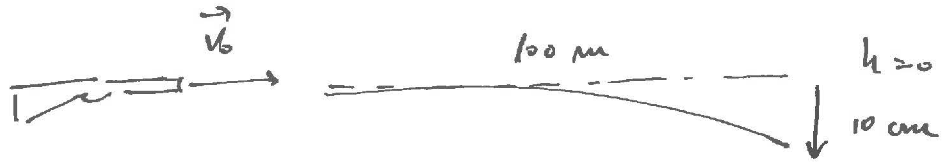
Tarde 26/5/2021 Mec. Clásica:

$\boxed{I}$

1) 

$$\begin{cases} x = v_0 T \\ y = -\frac{1}{2} g T^2 \end{cases} \Rightarrow \begin{cases} 100 = v_0 T \\ -0{,}1 = -\frac{1}{2} 10\, T^2 \end{cases} \Rightarrow \begin{cases} \text{---} \\ T^2 = 2 \times 0{,}01 \end{cases}$$

$$\begin{cases} v_0 = \frac{100}{0.1\sqrt{2}} \simeq 700 \ m/s \\ T = 0{,}1\sqrt{2} \ s \end{cases}$$

2) $d = 240 \ m$

$$v_f = 120 \ Km/h = \frac{120000 \ m}{3600 \ s} \simeq 33{,}3 \ m/s$$

Usando

$$v_f^2 - v_0^2 = 2a\Delta x \Rightarrow a = \frac{1}{2} \frac{v_f^2 - v_0^2}{\Delta x}$$

$$= \frac{1}{2} \frac{(33.3)^2}{240}$$

$$\simeq 2{,}31 \ m/s^2$$

3) A força centrípeta é perpendicular à velocidade

4) Dados:

$\dot{\theta} = 3\ rad/s$

$L = 0.5\ m$

$r = 0.4\ \theta$

Então

$r = 0,4\theta \Rightarrow \dot{r} = 0,4\dot{\theta} = 0,4 \times 3 = 1,2\ m/s$

Velocidade:

$$\vec{v} = \dot{r}\hat{e}_r + r\dot{\theta}\hat{e}_\theta = 1,2\ \hat{e}_r + 0.5 \times 3\ \hat{e}_\theta$$

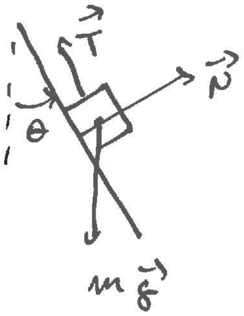
$$= 1.2\ \hat{e}_r + 1.5\ \hat{e}_\theta$$

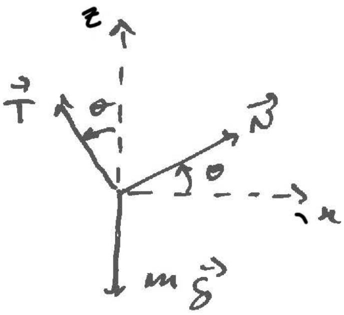
5) $W(\vec{F}_a) = \Delta E_m$

$$\Rightarrow -\mu m_2 g d = \frac{1}{2}(m_1 + m_2)v^2 - m_1 g d$$

$\boxed{II}$

a)





b) <u>Princípio fundamental da dinâmica</u>:

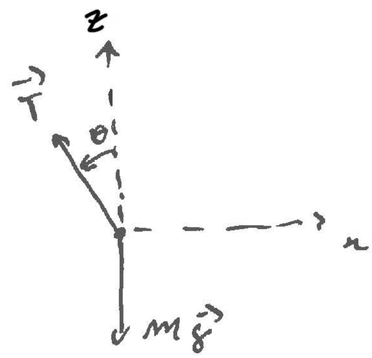
$$\vec{T} + \vec{P} + \vec{N} = 0$$

$$\rightarrow \begin{cases} -T\sin\theta + N\cos\theta = 0 \\ T\cos\theta - mg + N\sin\theta = 0 \end{cases} \qquad \begin{cases} N = T\,\mathrm{tg}\,\theta = T/\sqrt{3} \\ T\frac{\sqrt{3}}{2} - 60 + \frac{T}{\sqrt{3}} \times \frac{1}{2} = 0 \end{cases}$$

$$\rightarrow \begin{cases} \text{———} \\ T\left(\frac{\sqrt{3}}{2} + \frac{1}{2\sqrt{3}}\right) = 60 \end{cases} \qquad \Bigg|\; T = \frac{60}{1.1547} \simeq 52\,N$$

c)

i)

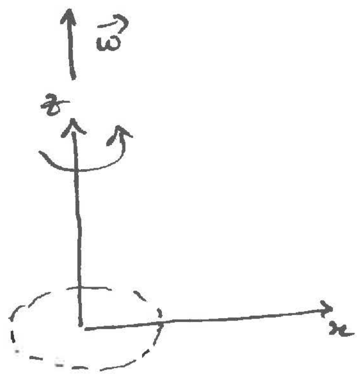


$$\begin{cases} T\cos\theta = mg \\ T\sin\theta = m\omega^2 R \end{cases} \qquad \begin{cases} T = \dfrac{mg}{\sqrt{3}/2} = \dfrac{120}{\sqrt{3}} = 69{,}3\ \text{N} \\ \cancel{m}g\,\dfrac{\sin\theta}{\cos\theta} = \cancel{m}\,\omega^2 R \end{cases}$$

$R = L \sin 30° = 1\ \text{m}$

$$\begin{cases} \text{---} \\ \omega^2 = \dfrac{g}{R}\,\text{tg}\,\theta \end{cases} \qquad \begin{cases} \omega = \sqrt{\dfrac{g}{R}\,\text{tg}\,\theta} = \sqrt{\dfrac{g}{R}\,\dfrac{1}{\sqrt{3}}} = \sqrt{\dfrac{10}{\sqrt{3}}} \simeq 2{,}4\ \text{rad/s} \end{cases}$$

ii)



Acel. coriolis

$$-2\vec{\omega} \times \vec{v}\,' = -2\vec{\omega} \times \vec{0} = \vec{0}$$

Acel. centrífuga:

$$-\vec{\omega} \times (\vec{\omega} \times \vec{r}) = -2{,}4\,\hat{k} \times (2{,}4\,\hat{k} \times 1\,\hat{i})$$

$$= -2{,}4\,\hat{k} \times 2{,}4\,\hat{j}$$

$$= (2{,}4)^2\,\hat{i}$$

$$= 5{,}76\,\hat{i}$$

$\boxed{III}$

a) $\vec{F}_1 = -\nabla U_1 = -\frac{\partial U_1}{\partial x}\hat{\imath} - \frac{\partial U_1}{\partial y}\hat{\jmath} - \cancel{\frac{\partial U_1}{\partial z}}\hat{k}$

$\cancel{} \to 0$

$= -2x\,\hat{\imath} - \hat{\jmath}$

b) Tem energia potencial, logo sim.

c) <u>Pontos de equil.</u>:

$\vec{F}_1 + \vec{F}_2 = \vec{0} \Rightarrow -2x\,\hat{\imath} - \hat{\jmath} + y\,\hat{\imath} - x\,\hat{\jmath} = \vec{0}$

$\Rightarrow (-2x + y)\,\hat{\imath} + (-1 - x)\,\hat{\jmath} = \vec{0}$

$\Rightarrow \begin{cases} -2x + y = 0 \\ -1 - x = 0 \end{cases}$

$\Rightarrow \begin{cases} y = -2 \\ x = -1 \end{cases}$

d) $W(\vec{F}_1 + \vec{F}_2) = \Delta E_c$

$\Rightarrow \underbrace{\int_1^3 F_y\,dy}_{\text{com } x=1} = \underbrace{\int_1^3 (-1-x)\,dy}_{x=1} = \int_1^3 (-2)\,dy = -2y\Big|_1^3 = -4N$

<u>conclusão</u>: $\Delta E_c = -4N$