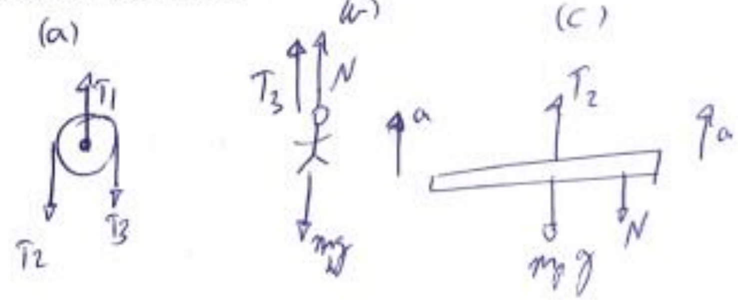
Questão 1

GABARITO Q1:



MONTANDO AS EQS:

(a):

$$T_1 - T_2 - T_3 = 0 \quad (1)$$

$$T_3 + N - m_h g = m_h a \quad (2) \qquad \text{mas } T_2 = T_3$$

$$T_2 - m_p g - N = m_p a \quad (3)$$

a = 2,25
b = 2,25

logo $T_1 = 2T_2$

de (3): $T_2 - N = m_p(a+g)$

de (2): $T_2 + N = m_h(a+g)$

(3)+(2): $2T_2 = (a+g)\cdot(m_p+m_h) \Rightarrow T_2 = \frac{1}{2}(m_p+m_h)\cdot(a+g)$

(3)-(2): $2N = (a+g)(m_h-m_p) \Rightarrow N = \frac{1}{2}(m_h-m_p)\cdot(a+g)$

p/ $a = \frac{g}{4}$; $m_h = 80$ kg e $m_p = 40$ kg

$$T_2 = \frac{1}{2}(120)\cdot\left(g+\frac{g}{4}\right) = 60\left(\frac{5}{4}g\right) = 75\cdot g \quad \begin{cases} 750N & p/\ g=10 \\ 735N & p/\ g=9{,}8 \end{cases}$$

$$N = \frac{1}{2}(40)\cdot\left(\frac{g}{4}+g\right) = 20\cdot\left(\frac{5g}{4}\right) = 25\cdot g \quad \begin{cases} 250N \\ 245N \end{cases}$$

2

Se $T_1 = 2T_2$

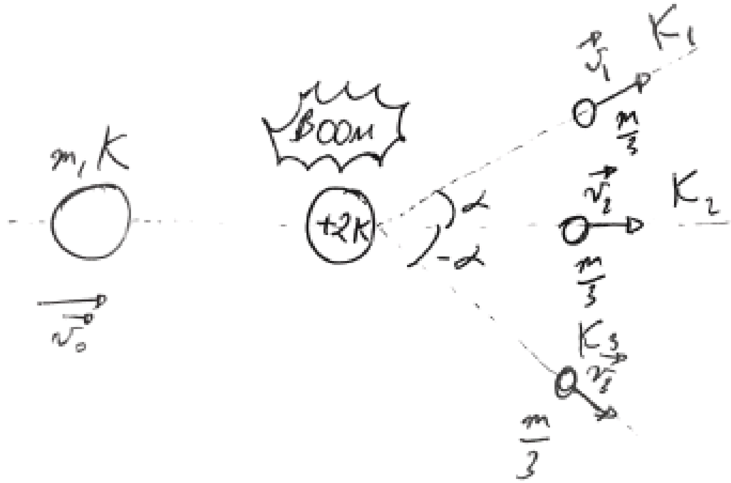
$T_1 = 2\cdot 750 = 1500\,N$

ou $2\cdot 735 = 1470\,N$

Questão 2

GABARITO:

①



P/ CONS MOMENTO:

$$\vec{P} = \vec{P}_1 + \vec{P}_2 + \vec{P}_3$$

$$m \cdot \vec{v}_0 = \frac{1}{3} m \vec{v}_1 + \frac{1}{3} m \vec{v}_2 + \frac{1}{3} m \vec{v}_3$$

Em x: $$m \cdot v_0 = \frac{1}{3} m v_1 \cos\alpha + \frac{1}{3} m v_2 + \frac{1}{3} m v_3 \cos(-\alpha)$$

Como $\cos(-\alpha) = \cos(\alpha)$:

$$m \cdot v_0 = \frac{1}{3} m v_1 \cdot \cos\alpha + \frac{1}{3} m v_2 + \frac{1}{3} m v_3 \cos\alpha \qquad (1)$$

Em y: $$0 = \frac{1}{3} m v_1 \operatorname{sen}\alpha + \frac{1}{3} m v_3 \operatorname{sen}(-\alpha)$$

Como $\operatorname{sen}(-\alpha) = -\operatorname{sen}(\alpha)$:

$$0 = \frac{1}{3} m v_1 \cdot \operatorname{sen}\alpha - \frac{1}{3} m v_3 \operatorname{sen}\alpha \qquad (2)$$

$$\therefore \quad v_1 = v_3 \qquad (3)$$

(3) em (1): $m \cdot v_0 = \frac{2}{3} m\, v_1 \cdot \cos\alpha + \frac{1}{3} m\, v_2$ ②

logo: $v_2 = 3v_0 - 2v_1 \cos\alpha$ (4)

Por energia temos:

$$K + 2K = K_{(1)} + K_{(2)} + K_{(3)}$$

$$\frac{1}{2} m v_0^2 + 2 \cdot \frac{1}{2} m v_0^2 = \frac{1}{2} \frac{m}{3} v_1^2 + \frac{1}{2} \cdot \frac{m}{3} \cdot v_2^2 + \frac{1}{2} \frac{m}{3} \cdot v_3^2$$

$$9 v_0^2 = v_1^2 + v_2^2 + v_3^2 \qquad (5)$$

de (3): $v_1 = v_3$

$$\therefore\ 9 v_0^2 = 2 v_1^2 + v_2^2 \qquad (6)$$

(4) em (6): $9v_0^2 = 2v_1^2 + (3v_0 - 2v_1 \cdot \cos\alpha)^2 = 2v_1^2 + 9v_0^2 - 12 v_0 v_1 \cos\alpha + 4v_1^2 \cdot \cos^2\alpha$

$$2 v_1^2 (1 + 2\cos^2\alpha) = 12 v_0 \cdot v_1 \cdot \cos\alpha$$

$$v_1 (1 + 2\cos^2\alpha) = 6 v_0 \cdot \cos\alpha$$

$$v_1 = v_3 = \frac{6 v_0 \cdot \cos\alpha}{1 + 2\cos^2\alpha}$$ como $\cos(60°) = \frac{1}{2}$

$$v_1 = v_3 = \frac{3v_0}{1+\frac{1}{2}} = 2v_0$$

SUB. EM (4): $v_2 = 3v_0 - \frac{12v_0 \cdot \cos^2\alpha}{1+2\cos^2\alpha} =$

$$v_2 = \frac{3v_0(1+2\cos^2\alpha - 4\cos^2\alpha)}{1+2\cos^2\alpha} = \frac{3v_0(1-2\cos^2\alpha)}{1+2\cos^2\alpha}$$

$$\therefore v_2 = \frac{3v_0\left(1-\frac{1}{2}\right)}{1+\frac{1}{2}} = v_0$$

RESPOSTAS: $v_0 = v_2$

$$v_1 = v_3 = \frac{6v_0 \cdot \cos\alpha}{1+2\cos^2\alpha} = 2v_0$$

Questão 3-)

a) A aceleração segue diretamente da 2ª Lei de Newton

$$\vec{a}(t) = \frac{\vec{F}(t)}{m} \Rightarrow \vec{a}(t) = \frac{F_0}{m}\left[1 - \frac{(t - T/2)^2}{(T/2)^2}\right]\hat{i} = \frac{4F_0}{m}\left(t - \frac{t^2}{T}\right)\hat{i}$$

Como $\vec{a}(t) = \frac{d\vec{v}(t)}{dt} \Rightarrow \int_{\vec{v}(0)}^{\vec{v}(t)} d\vec{v} = \int_0^t \vec{a}(t')dt' = \frac{4F_0}{mT}\int_0^t \left(t' - \frac{t'^2}{T}\right)dt'$

$$\vec{v}(t) - \vec{v}(0) = \frac{4F_0}{m}\left(\frac{t^2}{2} - \frac{t^3}{3T}\right)\hat{i} \Rightarrow \boxed{\vec{v}(t) = \frac{4F_0}{mT}\left(\frac{t^2}{2} - \frac{t^3}{3T}\right)\hat{i}}$$

b) Pelo teorema do Impulso: $\vec{I} = \Delta\vec{p} = m\Delta\vec{v} = m(\vec{v}(T) - \cancel{\vec{v}(0)})$

Logo, $\vec{I} = m\vec{v}(T) = m\left(\frac{2F_0T}{3m}\right)\hat{i} \Rightarrow \boxed{\vec{I} = \frac{2F_0T}{3}\hat{i}}$

$$\vec{F}_{med} = \frac{\vec{I}}{T} \Rightarrow \boxed{F_{med} = \frac{2F_0}{3}\hat{i}}$$

$$K = \frac{1}{2}m v^2(T) \Rightarrow K = \frac{1}{2}m\left(\frac{2F_0T}{3m}\right)^2 \Rightarrow \boxed{K = \frac{2F_0^2T^2}{9m}}$$

c) Da solução do item a) ou da expressão da energia cinética do item b) $\Rightarrow \underbrace{\vec{v}(T)}_{\text{depois do chute}} = \frac{2F_0T}{3m}\hat{i}$

logo: $\underbrace{\vec{v}_D}_{\text{depois de percorrer } D} = \frac{2}{3}\left(\frac{2F_0T}{3m}\right)\hat{i}$

Como a redução na velocidade se dá pela ação do atrito temos do teorema trabalho-energia cinética $K_D - K_i = W_{fat}$

$$\Rightarrow \frac{1}{2}m v_D^2 - \frac{1}{2}m v^2(T) = -\mu_c m g D \Rightarrow \frac{1}{2}m\left(\frac{4F_0T}{9m}\right)^2 - \frac{1}{2}m\left(\frac{2F_0T}{3m}\right)^2 = -\mu_c m g D$$

$$\Rightarrow \frac{8F_0^2T^2}{81m} - \frac{2F_0^2T^2}{9m} = -\mu_c m g D \Rightarrow -\frac{10F_0^2T^2}{81m} = -\mu_c m g D \Rightarrow \boxed{F_0 = \frac{9m}{T}\sqrt{\frac{\mu_c g D}{10}}}$$