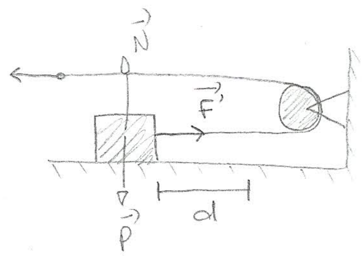
1)




Dados:

$|\vec{F}| = 100\,N$

$v = cte$

$d = 10\,m$

a) $|\vec{F}| = |\vec{F'}| = 100\,N$ e $\tau_F = \tau_{F'}$. Logo:

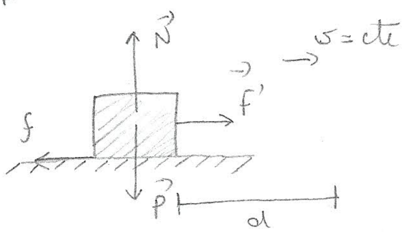
$$\boxed{\tau_{F'} = F' . d . \cos\theta}$$

$$\tau_{F'} = (100\,N).(10\,m).\cos(0)$$

$$\tau_{F'} = (100\,N).(10\,m).(1) = 1000\,J$$

$$\boxed{\tau_F = \tau_{F'} = 1000\,J}$$

b)




Pela 1ª Lei de Newton:

$\Sigma F = 0$, uma vez que $v = cte$

$$F' - f = 0$$

$$F' = f = 100\,N$$

$$\boxed{\tau_f = f . d . \cos\theta}$$

$$\tau_f = (100\,N).(10\,m).\cos(180°)$$

$$\tau_f = (100\,N).(10\,m).(-1)$$

$$\therefore \boxed{\tau_f = -1000\,J}$$

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2)

Dados:

$m = 60\,kg$

$g = 10\,m/s^2$

A pessoa sobe 5 degraus de 18 cm cada. O deslocamento vertical da pessoa na subida totaliza $5 \times 18\,cm = 90\,cm$.

O trabalho da força peso na subida é dado por:

$$\boxed{\tau_P = P . d . \cos\theta}$$

$$\tau_P = (mg).(h - h_0).\cos(180°)$$

$$\therefore \boxed{\tau_P = -mgh}$$

$$\tau_P = (60\,kg).(10\,m/s^2).(0{,}9\,m)$$

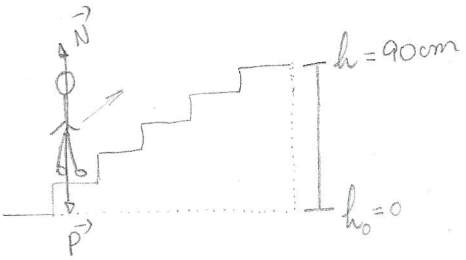
$$\tau_P = -540\,J$$

Considerando que não houve variação da velocidade da pessoa na subida temos:

$$\boxed{\tau_R = \tau_P + \tau_N = 0}$$

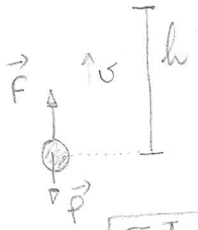
$$\tau_N = -\tau_P$$

$$\therefore \tau_N = -(-540\,J) = 540\,J$$



3) 2ª $v = cte$ para todos os casos

(I)



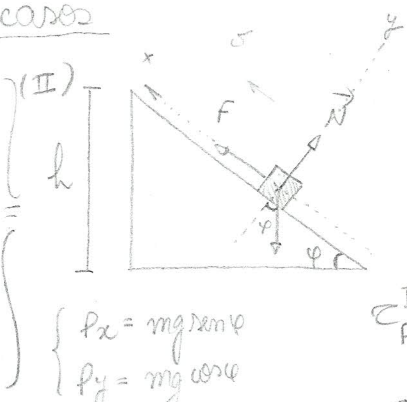
$\sum F = 0$

$F - P = 0$

$\boxed{F_I = mg}$

$\boxed{\tau_F^I = mgh}$

(II)



$\begin{cases} P_x = mg \operatorname{sen}\varphi \\ P_y = mg \cos\varphi \end{cases}$

$\varphi = 30°$

$\operatorname{sen}\varphi = 1/2$

$\cos\varphi = \sqrt{3}/2$

$\sum F = 0$

$F - mg \operatorname{sen}\varphi = 0$

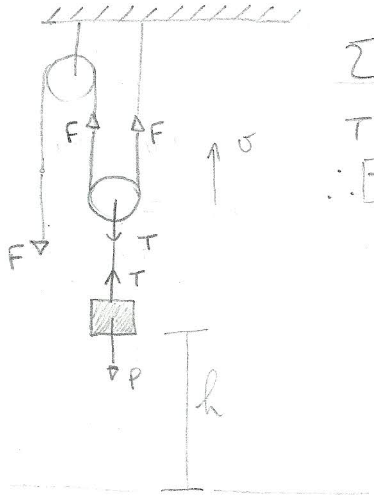
$\boxed{F_{II} = mg \operatorname{sen}\varphi = \frac{mg}{2}}$

$\tau_F^{II} = mg \operatorname{sen}\varphi \cdot d$

$\tau_F^{II} = mg\left(\frac{h}{d}\right) \cdot d$

$\therefore \boxed{\tau_F^{II} = mgh}$

(III)



$\sum F = 0$

$T - P = 0$

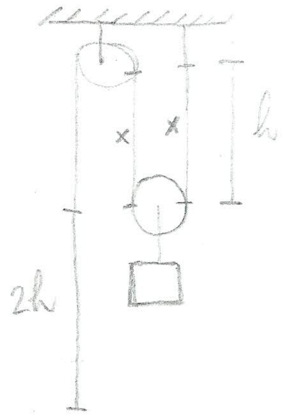
$\therefore \boxed{T = P}$

$\sum F = 0$

$F + F - P = 0$

$2F = P$

$\boxed{F_{III} = \frac{1}{2}P = \frac{1}{2}mg}$



$\tau_F^{III} = \frac{1}{2}mg \cdot 2h$

$\therefore \boxed{\tau_F^{III} = mgh}$

(01) V

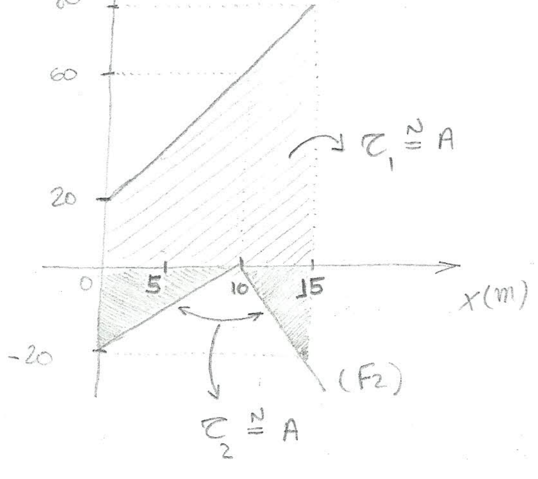
(02) V

(04) V

4)

Dados:

$m = 12\,kg$



a) $|\tau_1| = \frac{(B+b) \times h}{2} = \frac{(80+20) \times 15}{2} = 750\,J$

b) $|\tau_2| = \frac{(B \cdot h)}{2} + \frac{(B \cdot h)}{2} = \frac{10 \cdot 20}{2} + \frac{5 \cdot 20}{2} = 150\,J$

como as áreas que compõem $|\tau_2|$ estão abaixo do eixo $Ox$, $\tau_2 < 0$.

$\tau_2 = -150\,J$

c) $\tau_R = \tau_1 + \tau_2 = (750\,J) + (-150\,J)$

$\therefore \boxed{\tau_R = 600\,J}$

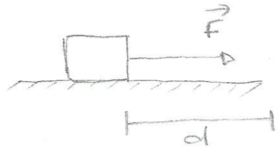
5) (plano horizontal, força horizontal e $\tau > 0$)

Dados:

$|\vec{F}| = 50\,N$

$\tau_F = 400\,J$

$d = ?$

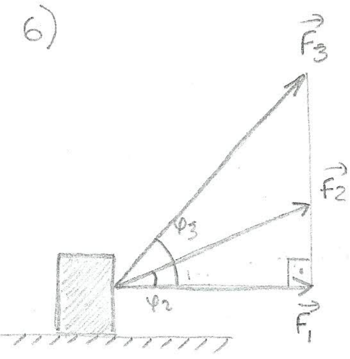


$\tau_F = F \cdot d$

$\boxed{d = \frac{\tau_F}{F}}$ → $d = \frac{400\,J}{50\,N}$

$\therefore \boxed{d = 8\,m}$

6)



$\begin{cases} F_{2x} = F_2 \cos\varphi_2 \\ F_{2y} = F_2 \operatorname{sen}\varphi_2 \end{cases}$

$\begin{cases} F_{3x} = F_3 \cos\varphi_3 \\ F_{3y} = F_3 \operatorname{sen}\varphi_3 \end{cases}$

* Relações trigonométricas importantes

$\operatorname{sen}^2\varphi + \cos^2\varphi = 1$

$\cos^2\varphi = 1 - \operatorname{sen}^2\varphi$

$F_2^2 = F_1^2 + F_{2y}^2$

$F_2^2 = F_1^2 + (F_2 . \operatorname{sen}\varphi_2)^2$

$F_2^2 = F_1^2 + F_2^2 . \operatorname{sen}^2\varphi_2$

$F_2^2 - F_2^2 . \operatorname{sen}^2\varphi_2 = F_1^2$

$F_2^2 (1 - \operatorname{sen}^2\varphi_2) = F_1^2$

$F_2^2 . \cos^2\varphi_2 = F_1^2$

$\therefore \boxed{F_1 = F_2 . \cos\varphi_2}$

=

$F_3^2 = F_1^2 + F_{3y}^2$

$F_3^2 = F_1^2 + (F_3 \operatorname{sen}\varphi_3)^2$

$F_3^2 = F_1^2 + F_3^2 . \operatorname{sen}^2\varphi_3$

$F_3^2 - F_3^2 \operatorname{sen}^2\varphi_3 = F_1^2$

$F_3^2 (1 - \operatorname{sen}^2\varphi_3) = F_1^2$

$F_3^2 \cos^2\varphi_3 = F_1^2$

$\therefore \boxed{F_1 = F_3 . \cos\varphi_3}$

→ A caixa é arrastada de A para B, da esquerda para a direita. As componentes horizontais de $\vec{F_2}$ e $\vec{F_3}$ têm mesmo módulo direção e sentido de $\vec{F_1}$. Além disso, as componentes horizontais de $\vec{F_2}$ e $\vec{F_3}$ e $\vec{F_1}$ têm a mesma direção e o mesmo sentido do deslocamento.

Logo, $\boxed{\tau_1 = \tau_2 = \tau_3}$ (c)

7)

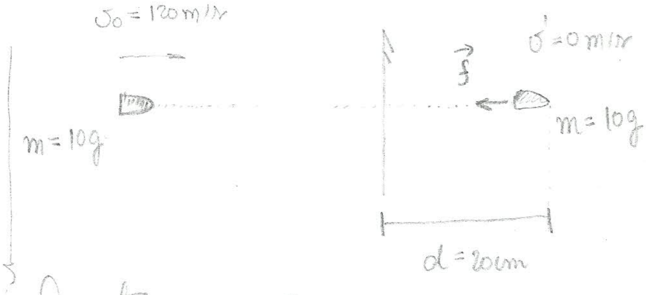
**Dados:**

$m = 10g = 0{,}01\,Kg$

$v_0 = 120\,m/s$

$d = 20cm = 0{,}2\,m$

$v' = 0\,m/s$




Do teorema Trabalho - Energia Cinética temos:

$\boxed{\tau_R = \Delta K}$, onde $K = \frac{1}{2}mv^2$

$\tau_f = \left(\frac{1}{2}mv'^2 - \frac{1}{2}mv_0^2\right)$

$\tau_f = -\frac{1}{2}mv_0 = -\frac{1}{2}(0{,}01\,kg).(120\,m/s)^2$

$\therefore\ \tau_f = -72\,J$

$\boxed{\tau_f = f.d}$

$f = \frac{\tau_f}{d} = \frac{-72\,J}{0{,}2\,m} = -360\,N = -3{,}6\times10^{-2}\,N$

$\therefore\ \boxed{|\vec{f}| = 3{,}6\times10^{-2}\,N}$

8)

**Dados:**

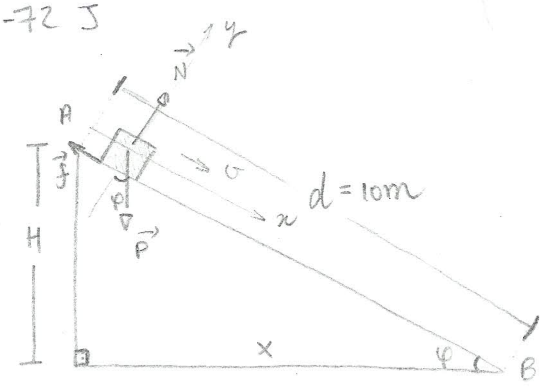
$m = 2{,}0\,Kg$

$v_0 = 5{,}0\,m/s$

$|\vec{f}| = 7{,}5\,N$

$d = 10m$

$g = 10\,m/s^2$




$\begin{cases} P_x = P\,sen\varphi \\ P_y = P\cos\varphi \end{cases}$

$\boxed{\tau_f = -f.d}$

$\tau_{Px} = Px.d = P.sen\varphi.d$

$\boxed{\tau_{Px} = P.\left(\frac{H}{d}\right).d = P.h = mgH}$

$\boxed{\tau_R = \tau_f + \tau_{Px}}$

$\tau_R = -f.d + mgH$

2o Teorema Trabalho - Energia Cinética:

$\boxed{\tau_R = \Delta K = (K' - K_0)}$, com $K = \frac{1}{2}mv^2$

Temos: $-f.d + mgH = 0 - \frac{1}{2}mv_0^2$

$-f.d + mgH = -\frac{1}{2}mv_0^2$

$mgH = -\frac{1}{2}mv_0^2 + f.d$

$H = \frac{f.d}{mg} - \frac{mv_0^2}{2mg}$

$\therefore\ \boxed{H = \frac{f.d}{m.g} - \frac{v_0^2}{2g}}$

$H = \frac{7{,}5N.\,10m}{2{,}0Kg.\,10m/s^2} - \frac{(5{,}0m/s)^2}{2.(10\,m/s^2)}$

$\therefore\ \boxed{H = 2{,}5m}$

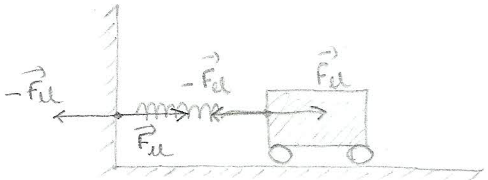
a)

Dados:

$K = 200 \frac{N}{m}$

$x = 20\,cm = 0{,}2\,m$

$m = 2{,}0\,kg$




a) $|\vec{F}_{el}| = K \cdot x = 200 \frac{N}{m} \cdot 0{,}2\,m$

$\therefore \boxed{|\vec{F}_{el}| = 40\,N}$

b) $\tau_{F_{el}} = \frac{1}{2} K x^2$

$\tau_{F_{el}} = \frac{1}{2}(200 \frac{N}{m}) \cdot (0{,}2m)^2$

$\therefore \boxed{\tau_{F_{el}} = 4\,J}$

c) $\tau = \left(\frac{1}{2} m v'^2 - \frac{1}{2} m v_0^2\right)$

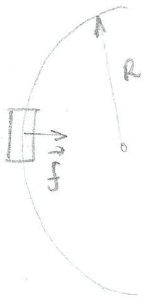
$v_0 = 0\,m/s$

$v' = ?$

$\tau = \frac{1}{2} m v'^2$

$4\,J = \frac{1}{2}(2{,}0kg) \cdot v'^2$ $\rightarrow$ $\boxed{v' = 2\,m/s}$

10) Dados: $M$, $R$, $\mu$




$\begin{cases} F_c = M \cdot a_c \\ a_c = \frac{v^2}{R} \end{cases} \rightarrow \boxed{F_c = M \cdot \frac{v^2}{R}}$

$\boxed{f = \mu \cdot N = \mu m g}$

$f = F_c$

$\mu \cancel{M} g = \cancel{M} \cdot \frac{v^2}{R}$

$\mu g = \frac{v^2}{R}$ $\rightarrow$ $\boxed{v = \sqrt{\mu R g}}$

— $\shortparallel$ —