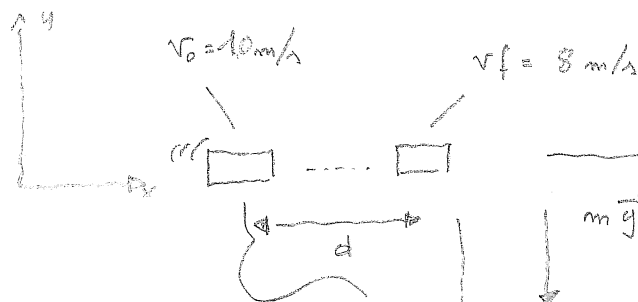


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ETAPE 1

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

$$-mg = a$$

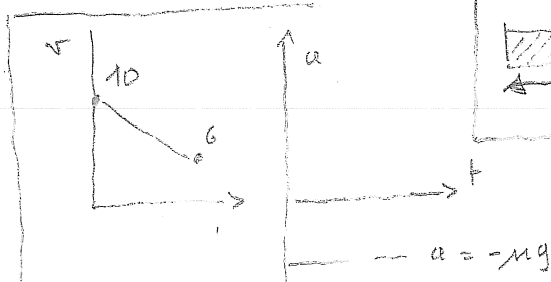
$$m\vec{g} = \begin{bmatrix} 0 \\ -mg \end{bmatrix}$$

$$\vec{f} = \begin{bmatrix} -\mu mg \\ 0 \end{bmatrix}$$

$$\vec{N} = \begin{bmatrix} 0 \\ mg \end{bmatrix}$$

DYNAMIQUE

$$\vec{a} = \begin{bmatrix} -\mu g \\ 0 \end{bmatrix} = \begin{bmatrix} -a \\ 0 \end{bmatrix}$$



ON DECELERE!
L'ACCELERATION EST NEGATIVE

CINEHATIQUE

ETAPE 2

$$\begin{aligned} x(0) &= 0 \\ v(0) &= v_0 \end{aligned}$$

$$\begin{aligned} x(t) &= d \\ v(t) &= v_f \end{aligned}$$

$$x(t) = v_0 t - \frac{at^2}{2} \quad (1)$$

$$v(t) = v_0 - at \quad (2)$$

$$t = \frac{v_0 - v_f}{a}$$

EN INSERANT DANS (1)

$$d = v_0 \left(\frac{v_0 - v_f}{a} \right) - \frac{a}{2} \left(\frac{v_0 - v_f}{a} \right)^2$$

$$= \frac{1}{2a} \left[2v_0^2 - 2v_0 v_f - v_0^2 + v_f^2 + 2v_0 v_f \right]$$

$$a = \frac{v_0^2 - v_f^2}{2d}$$

VALEURS
NUMERIQUES

$$a = \frac{100 - 64}{2 \times 12} = \frac{36}{24} = 1,5 \text{ m/s}^2$$

$$f = 0,09 \times 1,5 = 0,135 \text{ N}$$

$$\mu = \frac{0,135}{0,09} = 0,15 \quad \text{ASSEZ COHERENT}$$

CELA NE SERT A RIEN
D'ETUDIER CETTE RELATION!
IL VAUT MIEUX S'ENTRAINER
A LA DEDUIRE CHAQUE FOIS (si, si!)

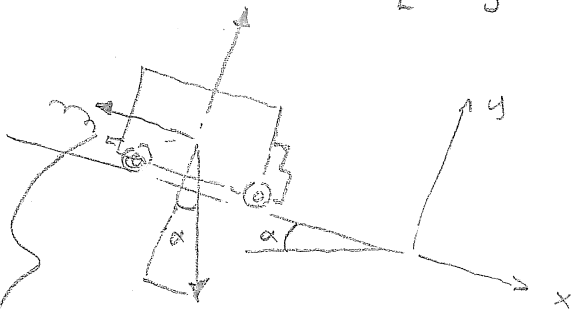
$$\vec{a} = \begin{bmatrix} -1,5 \\ 0 \end{bmatrix}$$

DECELERATION



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$$\vec{N} = \begin{bmatrix} 0 \\ mg \cos \alpha \end{bmatrix}$$



$$m\vec{g} = \begin{bmatrix} mg \sin \alpha \\ -mg \cos \alpha \end{bmatrix}$$

$$\vec{f} = \begin{bmatrix} -f \\ 0 \end{bmatrix}$$

EN DESCENTE

$$ma = -f + mg \sin \alpha$$

$$= 0$$

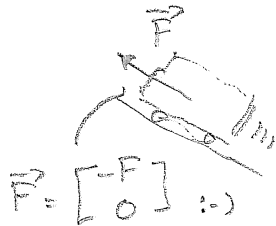
$$f = mg \sin \alpha$$

EN MONTÉE

$$ma = -F + f + mg \sin \alpha$$

$$= 0$$

$$= mg \sin \alpha \quad (-)$$



$$\vec{F} = \begin{bmatrix} -F \\ 0 \end{bmatrix} \quad (-)$$

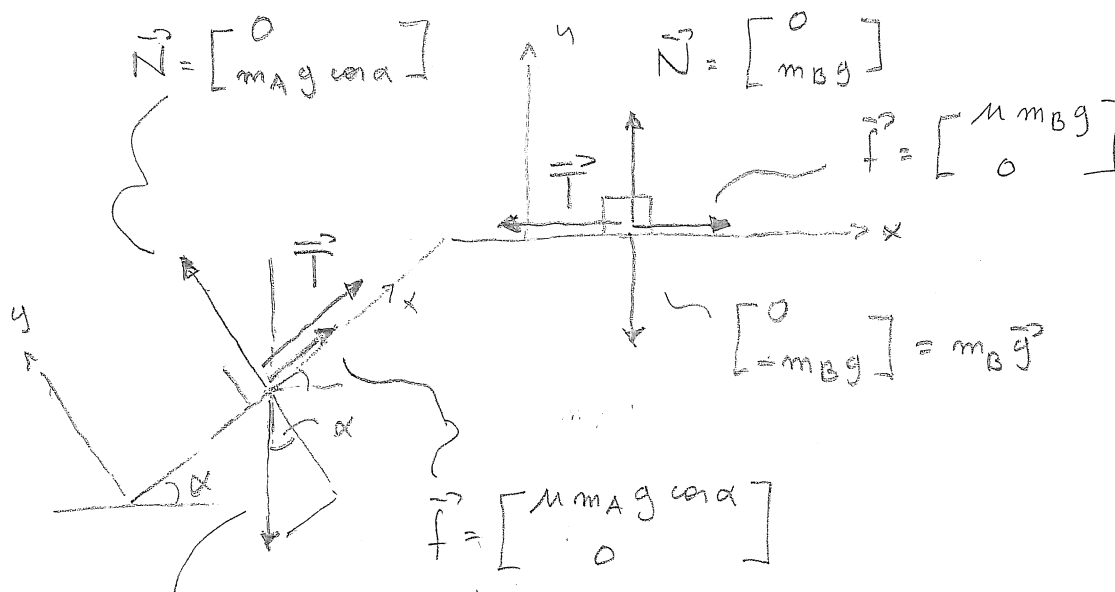
LA FORCE EST NEGATIVE POUR QUE LE CANNON REMONTE

$$F = 2mg \sin \alpha$$

VALEUR NUMERIQUE

$$F = 2 \times 3000 \times 9,81 \times \sin(50)$$

$$5130 \text{ [N]}$$

EQUILIBRE
VERTICAL : IMMEDIATEQUILIBRE
VERTICAL : IMMEDIAT

$$\begin{bmatrix} -m_A g \sin \alpha \\ -m_A g \cos \alpha \end{bmatrix}$$

$$\sum \vec{F} = 0$$

VITESSE
CONSTANTE

CORPS A

$$T - m_A g \sin \alpha + \mu m_A g \cos \alpha = 0$$

$$\sum \vec{F} = 0$$

VITESSE
CONSTANTE

CORPS B

$$-T + \mu m_B g = 0$$

$$\mu g (m_B + m_A \cos \alpha) = m_A g \sin \alpha$$

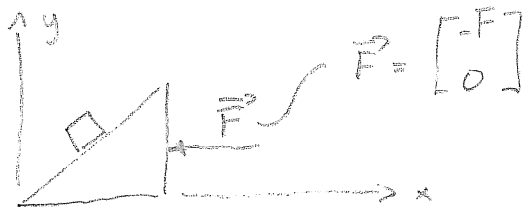
$$\mu = \frac{m_A \sin \alpha}{(m_B + m_A \cos \alpha)}$$

VALEURS
NUMERIQUES

$$\left. \begin{array}{l} \sin(30^\circ) = 1/2 \\ \cos(30^\circ) = \sqrt{3}/2 \end{array} \right\} \text{A CONNAÎTRE}$$

$$\mu = \frac{1/2}{(2/5 + \sqrt{3}/2)} = \frac{1}{(4/5 + \sqrt{3})} = 0,395$$

$$T = 0,395 \times 9,81 \times 2 = 7,75 \text{ [N]}$$

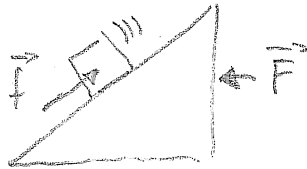
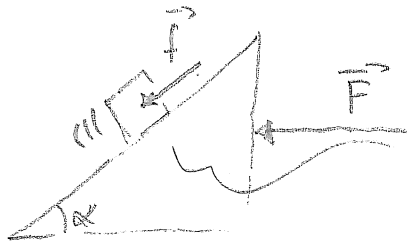


$$a = \frac{F}{(M+m)}$$

$$\vec{a} = \begin{bmatrix} -a \\ 0 \end{bmatrix}$$

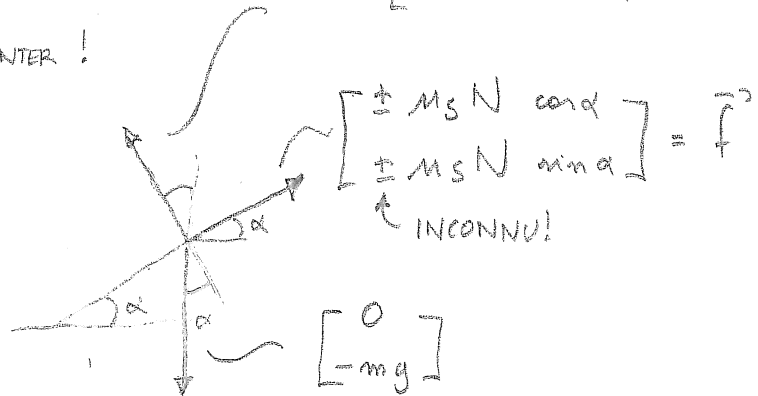
$$\vec{F} = \begin{bmatrix} -F \\ 0 \end{bmatrix}$$

$\vec{F}$ EST MAXIMAL
LE BLOC DU DESSUS VOUDRAIT MONTER !



$\vec{F}$ MINIMAL
LE BLOC VOUDRAIT DESCENDRE

$$\vec{N} = \begin{bmatrix} -N \sin \alpha \\ N \cos \alpha \end{bmatrix}$$



$$\begin{bmatrix} \pm \mu_s N \cos \alpha \\ \pm \mu_s N \sin \alpha \end{bmatrix} = \vec{f}$$

↑ INCONNU!

$$\begin{bmatrix} 0 \\ -mg \end{bmatrix}$$

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

BLOC
DU DESSUS!

$$\begin{cases} -ma = \mu_s N \cos \alpha - N \sin \alpha \\ 0 = -mg + \mu_s N \sin \alpha + N \cos \alpha \end{cases}$$

EN
INJECTANT

ET

$$N = \frac{mg}{(\cos \alpha + \mu_s \sin \alpha)}$$

DANS L'EQUATION HORIZONTALE ...

$$-m \frac{F}{(M+m)} = mg \frac{(\mu_s \cos \alpha - \sin \alpha)}{(\cos \alpha + \mu_s \sin \alpha)}$$

CONCLUSION

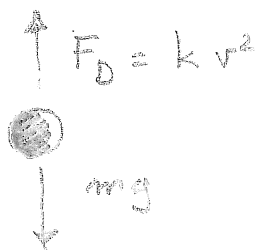
$$3,9 \leq F \leq 71,0 \text{ [N]}$$

$$a = \frac{F}{(M+m)}$$

$$F = (M+m) \frac{(\sin \alpha - \mu_s \cos \alpha)}{(\cos \alpha + \mu_s \sin \alpha)} g = 3,9 \text{ [N]}$$

$$F = (M+m) \frac{(\sin \alpha + \mu_s \cos \alpha)}{(\cos \alpha - \mu_s \sin \alpha)} g = 71,0 \text{ [N]}$$

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$$ma = mg - kv^2$$

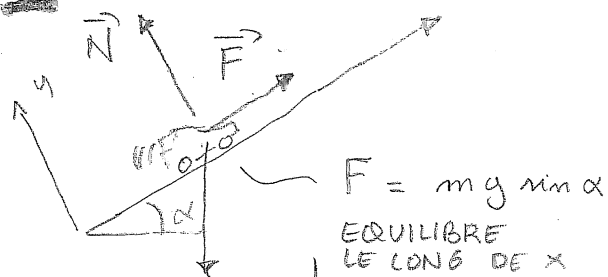
$$\begin{cases} = 0 \\ \end{cases} \quad \left\{ \begin{array}{l} v_L = \sqrt{\frac{mg}{k}} \end{array} \right.$$

LORSQUE $v = v_L/2$

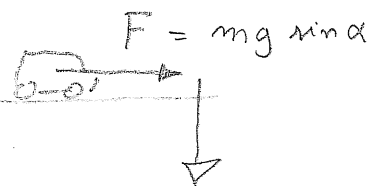
$$F = k \left(\frac{v_L}{2} \right)^2$$

$$= k \frac{mg}{4k} = \frac{mg}{4} = \frac{20 \cdot 9.8}{4} = 49 \text{ [N]}$$

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OBSERVONS
QU'ON PEUT
OUBLIER LE
FROTTEMENT CAR
IL EST IDENTIQUE DANS
LES DEUX CAS (α)
SI ! SI !



ACCELERATION
SUR ROUTE
HORIZONTALE

$$a = g \sin \alpha = 1.7 \text{ [m/s}^2\text{]}$$

9.81

 $\alpha = 10^\circ$
PAR EXEMPLE

(a) DANS LA MONTEE

$$F = mg \sin \alpha + f$$

SUR ROUTE HORIZONTALE

$$ma = F - f$$

$$mg \sin \alpha + f - f$$

$$a = g \sin \alpha$$

AVEC LE FROTTEMENT !