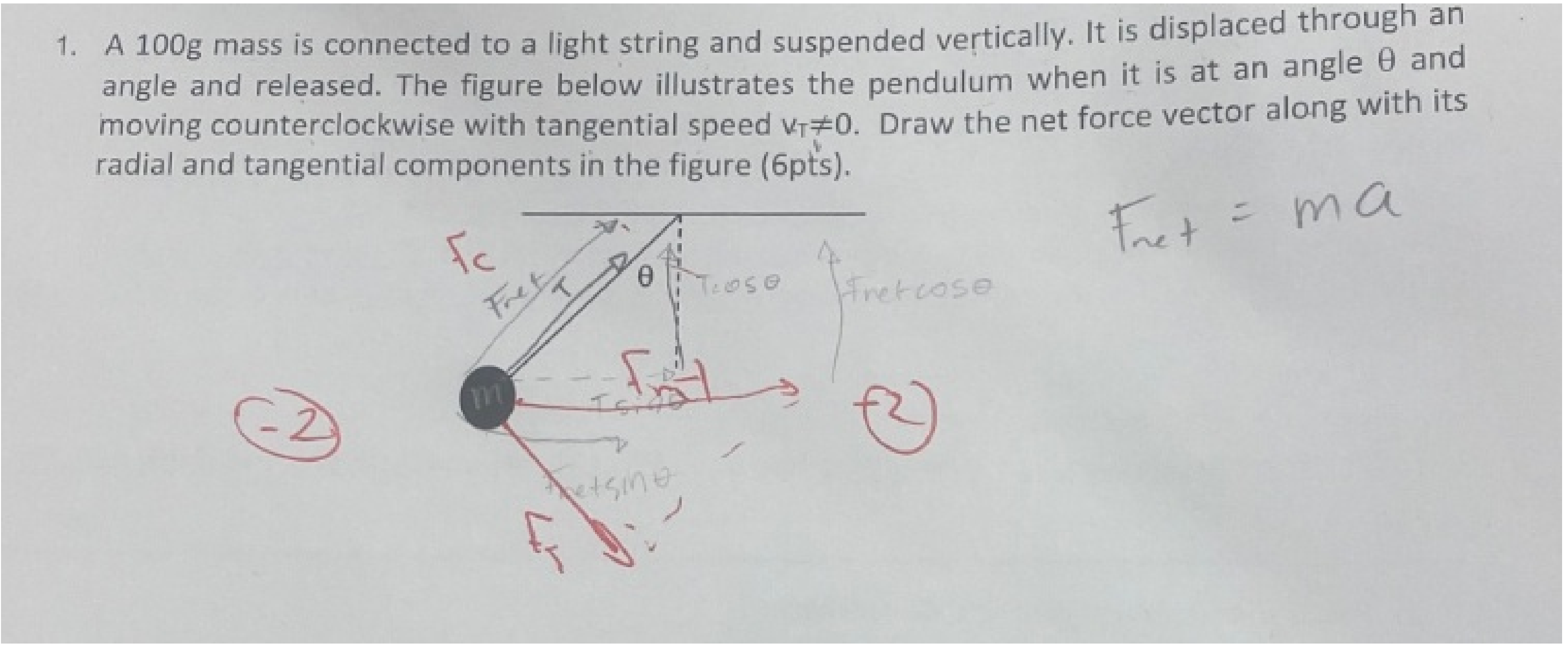
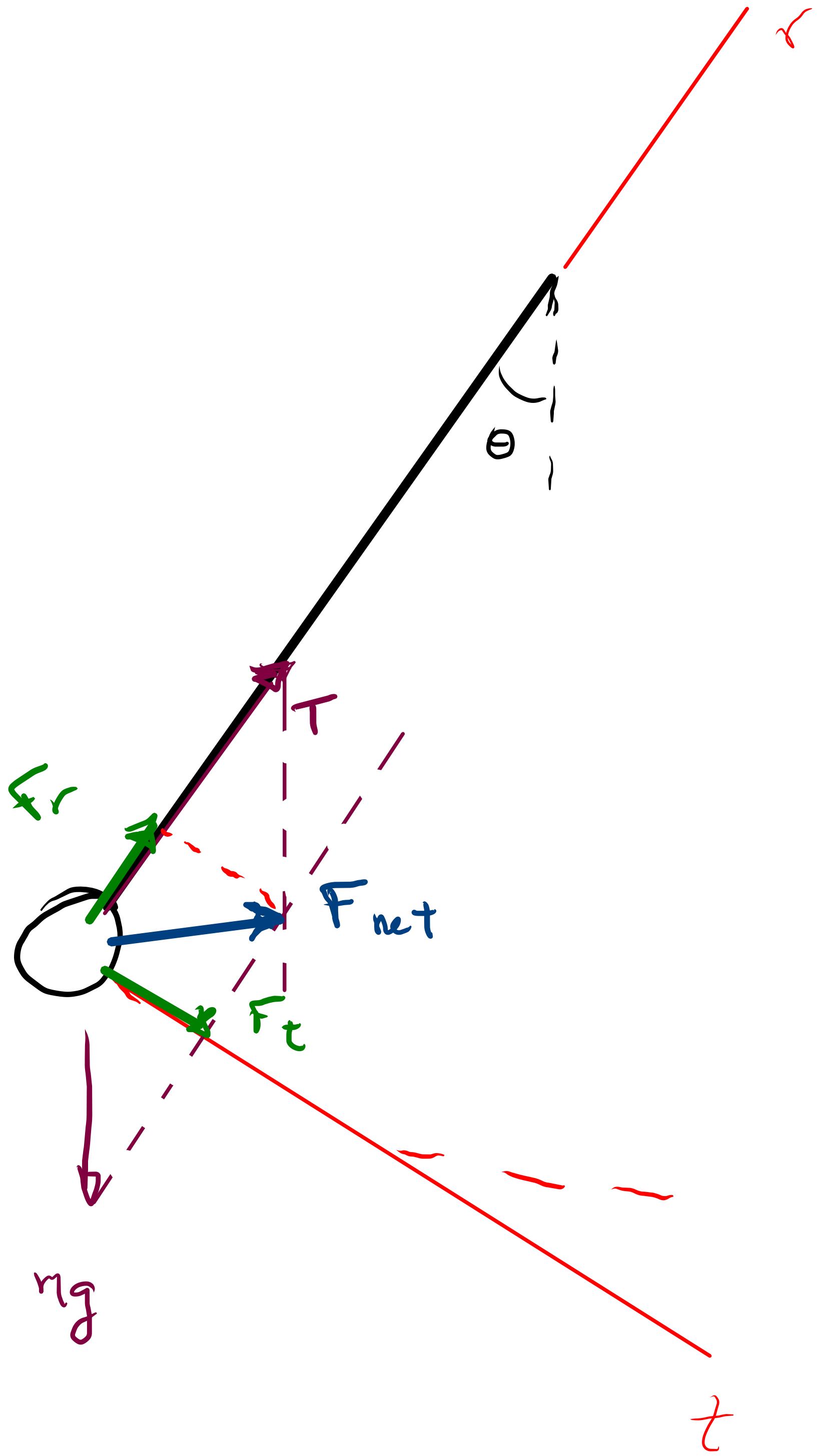
Clase Física
Karol Barroso

06/03/2023



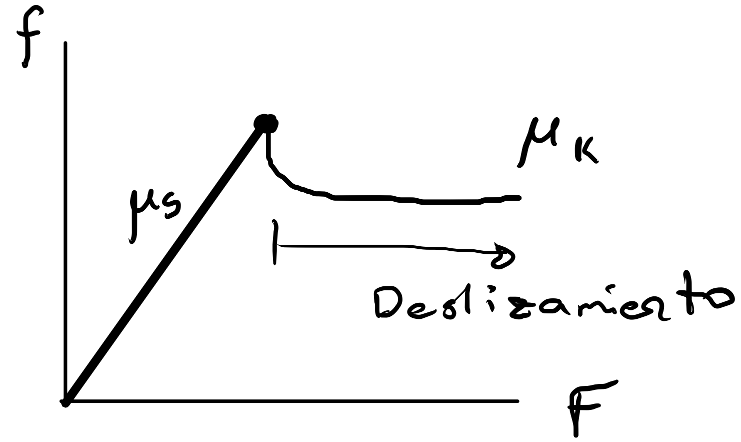
1. A 100g mass is connected to a light string and suspended vertically. It is displaced through an angle and released. The figure below illustrates the pendulum when it is at an angle θ and moving counterclockwise with tangential speed $v_T \neq 0$. Draw the net force vector along with its radial and tangential components in the figure (6pts).

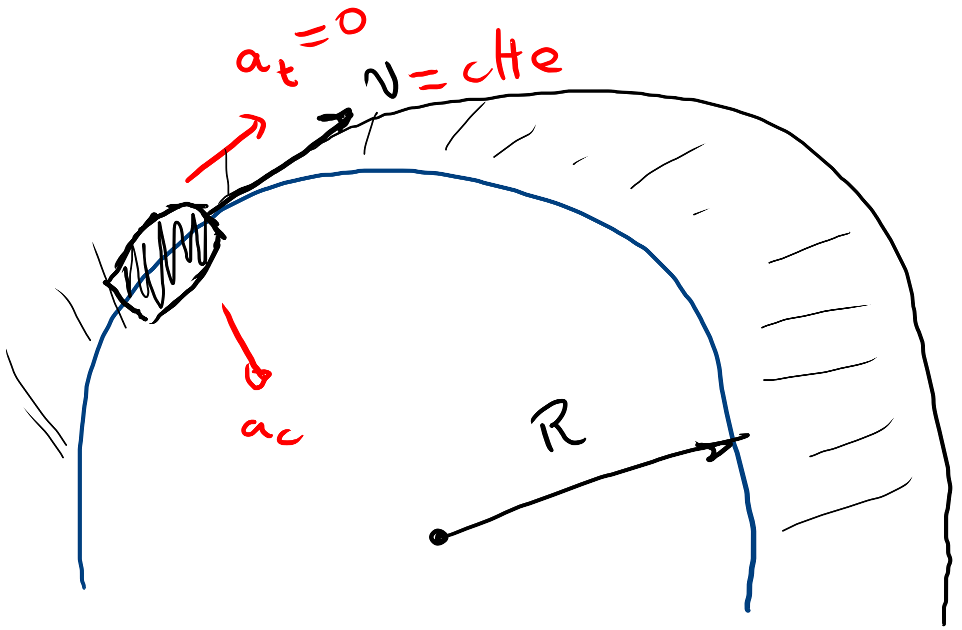
$F_{net} = ma$

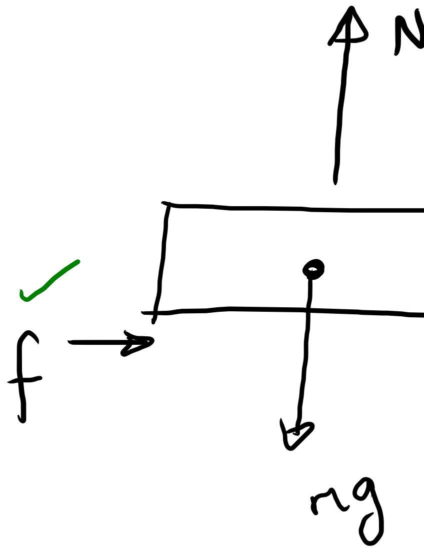


2. A car rounds a level curve of radius R at constant speed. The coefficient of static and kinetic friction between the tires and the road are μ_s and μ_k, respectively. What is the maximum safe speed around this curve (6pts-show work for partial credit)?

a. $\sqrt{\mu_s gR}$ b. $\sqrt{\frac{gR}{\mu_s}}$ C. $\sqrt{\mu_k gR}$ c. $\sqrt{\frac{gR}{\mu_k}}$ d. $\sqrt{\mu_s g}$







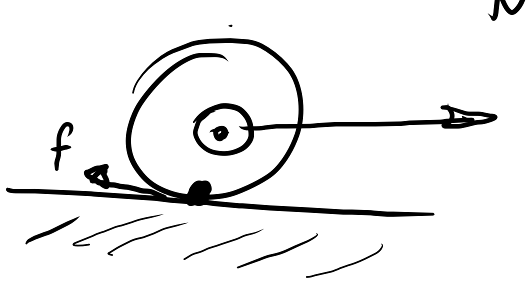
μ: mu

uwu

$N = mg$

$f = \mu_s N = \mu_s mg$

Rodadura pura



No slide $\rightarrow \mu_s$

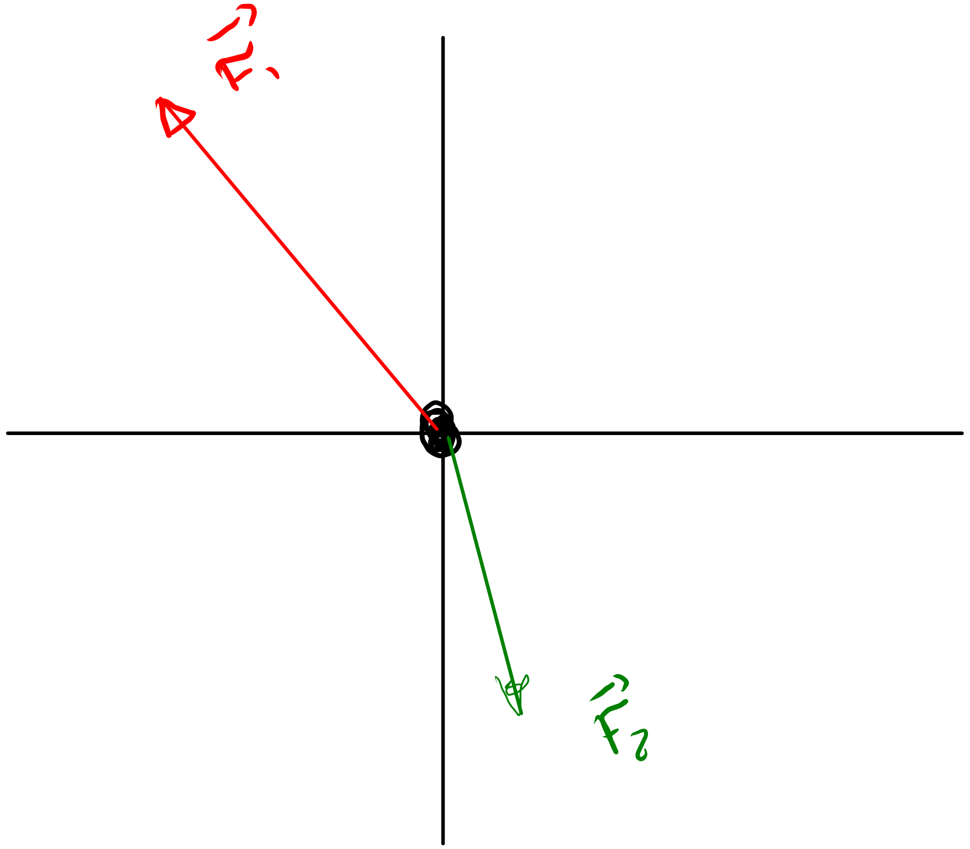
$$f = ma_c = \cancel{m}\frac{v^2}{R} = \mu_s \cancel{m} g$$

$$v^2 = \mu_s g R \longrightarrow \boxed{v = \sqrt{\mu_s g R}}$$

receive full credit. You must isolate the
problem.

1. Two forces given by $\vec{F}_1 = (-9\hat{i} + 15\hat{j})$ and $\vec{F}_2 = (3\hat{i} - 7\hat{j})$, act on a particle of mass 2.0kg that is initially at rest. What are the components of the particle's velocity at t=2.0s (12pts)?

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



$$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2$$

$$= (-9\hat{i} + 15\hat{j}) + (3\hat{i} - 7\hat{j})$$

$$\vec{F}_{net} = (-6\hat{i} + 8\hat{j}) = m\vec{a} = (2\,kg)\vec{a}$$

$$\vec{a} = \frac{(-6\hat{i} + 8\hat{j})}{2} \qquad \vec{a} = (-3\hat{i} + 4\hat{j})$$

$$\vec{a} = \frac{d\vec{v}}{dt} \qquad \int d\vec{v} = \int \vec{a}\,dt \qquad \vec{V} = (-3\hat{i} + 4\hat{j})t + \underbrace{C}_{\vec{v}_0}$$

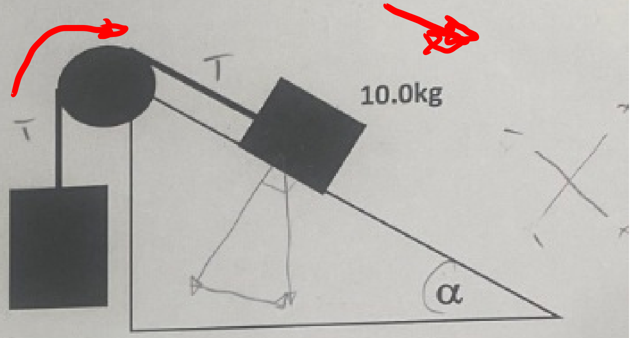
$$\vec{V}(0) = 0 + C = 0 \longrightarrow C = 0$$

$$\vec{V}(2) = (-3\hat{i} + 4\hat{j})(2)$$

$$\boxed{\vec{V}(2) = (-6\hat{i} + 8\hat{j})}$$

Physics 205 $\mu_k = 0.30$ $f = \mu_k n$

4. A 2.5kg mass is connected by string (via a pulley) with a 10.0kg mass. The angle, α, of the plane can be varied. The coefficient of kinetic friction between the block and the incline is 0.30.
   a. Calculate the acceleration of the objects if α=30°. **Don't forget to include a free-body diagram in your solution** (24pts).



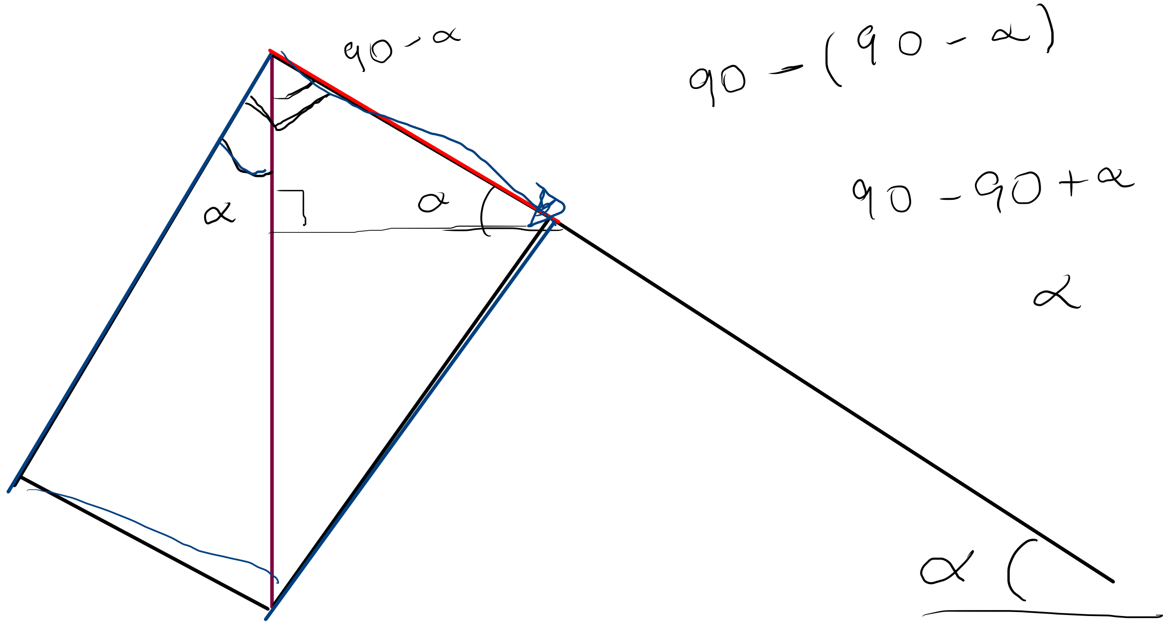
$T = mg = 24.5N$ NO! This means it doesn't move (3)

$n - mg\cos\alpha = 0$

$n = mg\cos\alpha = 84.87N$ $(10)(9.8)\cos 30°$

$$\sum F_x = Ma$$

$$-T - f + Mg\,sen\alpha = Ma \quad (II)$$

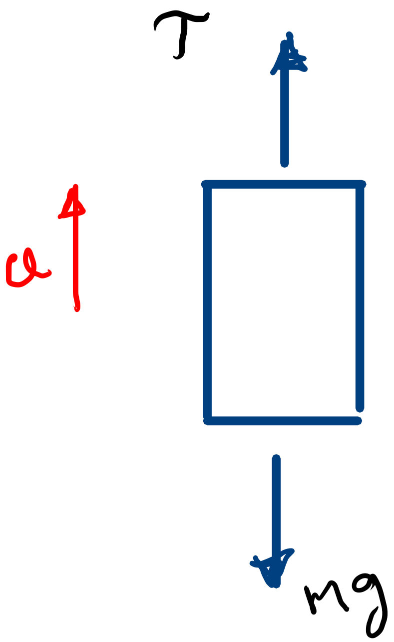


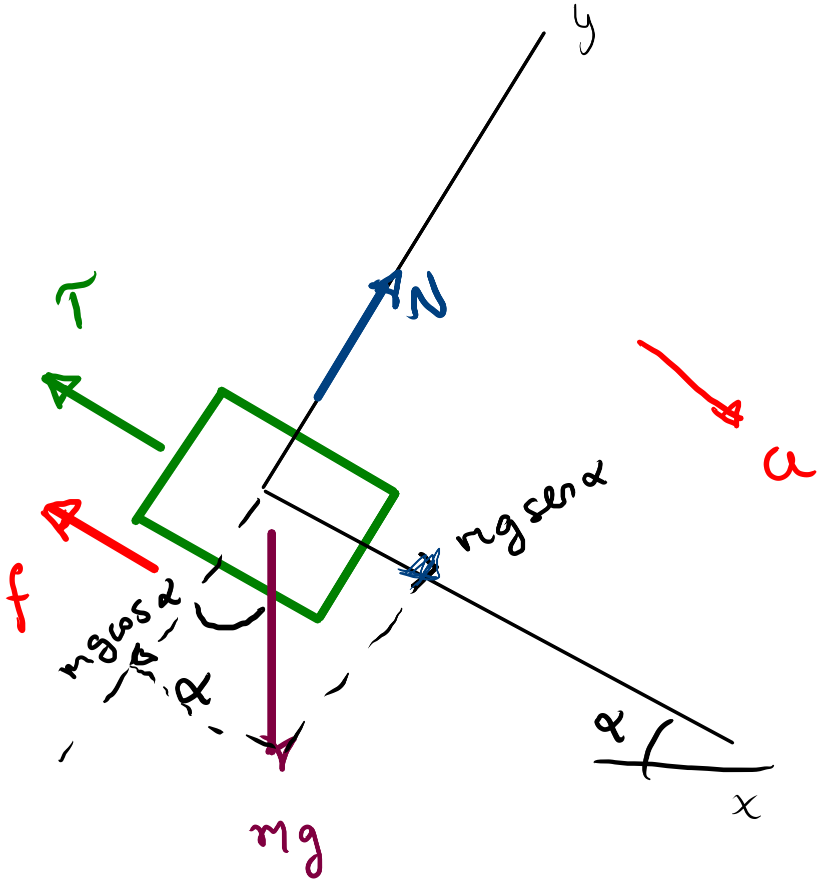
$90 - (90 - \alpha)$

$90 - 90 + \alpha$

α

(I) $T - mg = ma$





$$\sum F_y = 0 \quad (II)$$

$$N - Mg\cos\alpha = 0 \rightarrow N = Mg\cos\alpha$$

$$(\mathrm{I}) \quad T - mg = ma$$

$$(\mathrm{II}) \quad -T - f + Mg\,\mathrm{sen}\,\alpha = Ma$$

$$(\mathrm{III}) \quad N = Mg\cos\alpha$$

$$f = \mu_K N$$

$$f = \mu_K Mg\cos\alpha$$

$$T = ma + mg$$

Sustituyendo, resolvemos para "a"

$$-(ma + mg) - \mu_K Mg\cos\alpha + Mg\,\mathrm{sen}\,\alpha = Ma$$

$$-mg - \mu_K Mg\cos\alpha + Mg\,\mathrm{sen}\,\alpha = Ma + ma$$

$$a(M+m) = g\left[M(\mathrm{sen}\,\alpha - \mu_K\cos\alpha) - m\right]$$

$$a = \frac{\left[M(\mathrm{sen}\,\alpha - \mu_K\cos\alpha) - m\right]}{M+m}\,g$$

$$a = \frac{\left[M(\operatorname{sen}\alpha - \mu_k \cos\alpha) - m \right]}{M + m} g$$

$$a = \frac{\left[(10\,kg)(\operatorname{sen}30^\circ - 0{,}30 \cdot \cos 30^\circ) - 2{,}5\,kg \right]}{10\,kg + 2{,}5\,kg} (9{,}8\ m/s^2)$$

$$\boxed{a = -0{,}077\ m/s^2}$$

$(I)\quad T - mg = \cancel{ma}^{\to 0} \longrightarrow T = mg$

$(II)\quad -T - \cancel{f}^{\to 0} + Mg\,sen\alpha = \cancel{Ma}^{\to 0}$

$-m\cancel{g} + M\cancel{g}\,sen\alpha = 0$

$(III)\quad N = Mg\cos\alpha$

$M\,sen\alpha = m$

$sen\,\alpha = \dfrac{m}{M}$

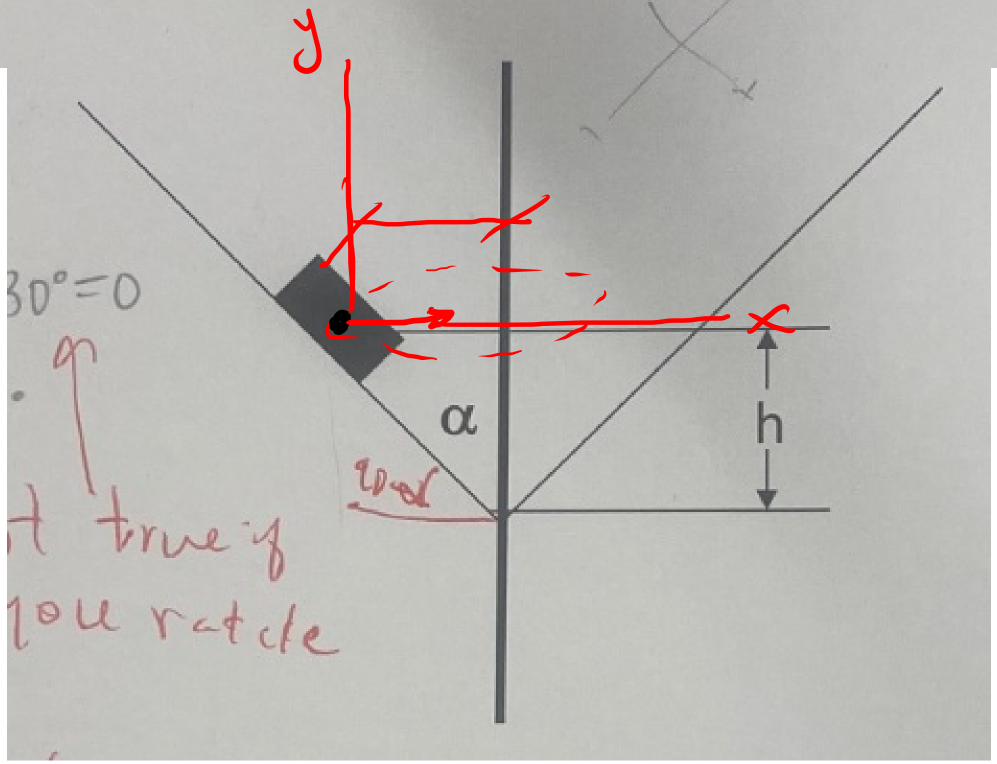
$\alpha = sen^{-1}\left(\dfrac{2{,}5}{10}\right)$

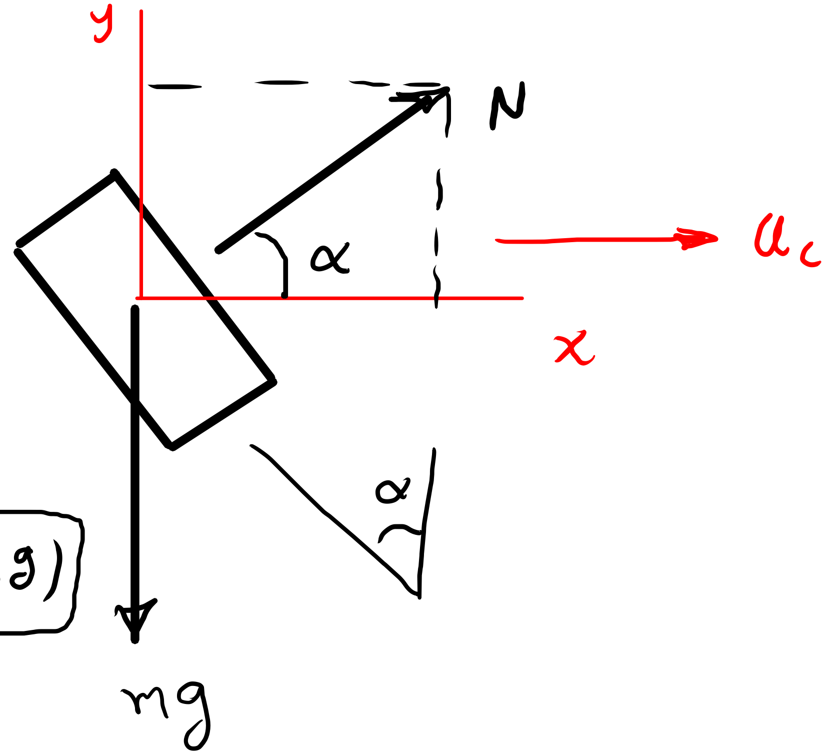
$\boxed{\alpha = 14{,}48^\circ}$

$\omega = \frac{2\pi}{T}$ $\quad v = \omega r$

5. A small block of mass m rotates inside an inverted cone whose axis is vertical. The mass traces a circular path and the time for one revolution is T. The walls of the cone are frictionless and make an angle α=30° with the vertical. What is the value of T such that the block maintains a constant height of h? Express your answer in terms of the given quantities and any numerical and physical constants (18pts)?

$\frac{mV^2}{r}$





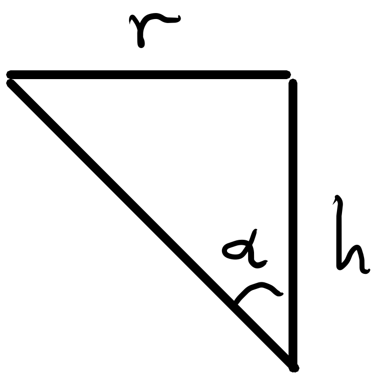
$$\boxed{T = \text{Función}(h, m, \alpha, g)}$$

$$\Sigma F_y = 0 \; ; \quad N \operatorname{sen} \alpha - mg = 0$$

$$N = \frac{mg}{\operatorname{sen} \alpha} \quad (\mathrm{I})$$

$$\Sigma F_x = m a_c \longrightarrow N \cos \alpha = m a_c \quad (\mathrm{II})$$

$$a_c = \frac{v^2}{r}$$



$$\tan \alpha = \frac{r}{h}$$

$$r = h \tan \alpha$$

$$T = \frac{1}{f_{req}} \longrightarrow f_{req} = \frac{1}{T}$$

$$\omega = 2\pi f_{req} \longrightarrow \omega = \frac{2\pi}{T}$$

$$v = r\omega \longrightarrow v = h\tan\alpha \cdot \frac{2\pi}{T}$$

$$a_c = h\tan\alpha \, \frac{4\pi^2}{T^2}$$

$$a_c = \frac{4\pi^2 h\tan\alpha}{T^2}$$

$$N = \frac{mg}{\operatorname{sen}\alpha} \quad (\mathrm{I})$$

$$N\cos\alpha = m a_c \quad (\mathrm{II})$$

$$a_c = \frac{v^2}{r} = \frac{r^2\omega^2}{r} = r\omega^2$$

$$a_c = h\tan\alpha \cdot \left(\frac{2\pi}{T}\right)^2$$

Sustituyo I en II

$$\frac{\cancel{m}g}{\operatorname{sen}\alpha} \cdot \cos\alpha = \cancel{m} \, \frac{4\pi^2 h\tan\alpha}{T^2}$$

$$\frac{\cancel{m}g}{\text{sen}\,\alpha} \cdot \cos\alpha = \cancel{m}\,\frac{4\pi^2 h \tan\alpha}{T^2}$$

$$T^2 = \frac{4\pi^2 h \tan\alpha}{\cos\alpha \cdot g} \cdot \text{sen}\,\alpha$$

$$T^2 = \frac{4\pi^2 h \tan\alpha}{g} \cdot \tan\alpha$$

$$T^2 = \frac{4\pi^2 h \tan^2\alpha}{g}$$

$$T = \sqrt{\frac{4\pi^2 h \tan^2\alpha}{g}}$$

$$\boxed{T = 2\pi \tan\alpha \sqrt{\frac{h}{g}}}$$

$$\tan 30^\circ = \frac{\sqrt{3}}{3}$$

$$\boxed{T = \frac{2\pi\sqrt{3}}{3}\sqrt{\frac{h}{g}}}$$