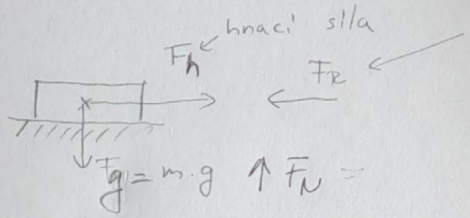
DYNAMIKA POHYBU, PRÁCE A VÝKON

1. Newtonův zákon: $\sum \underline{F} = 0 \Leftrightarrow \frac{d\underline{v}}{dt} = 0$ (= zákon setrvačnosti)

2. Newtonův zákon: $\underline{F} = \frac{d\underline{p}}{dt}$; $\underline{p} = m \cdot \underline{v}$ (= zákon síly)

3. Newtonův z.: $\underline{F}_A = -\underline{F}_B$ (= zákon akce a reakce)

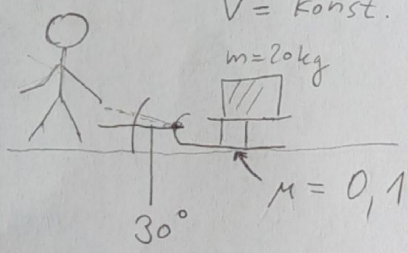
$F = m \cdot a$



$F_h = F_R$

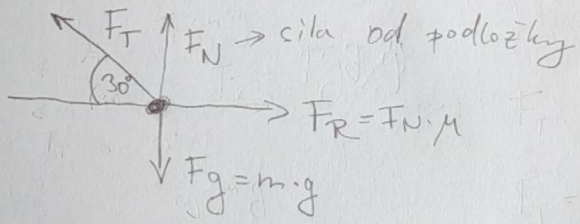
$F_R = F_N \cdot \mu$; μ... součinitel smykového tření $\leftarrow (0,1)$

PŘ



1) Napínací síla ve šňůře $F_T = ?$ (tažná síla)

2) Třecí síla $F_R = ?$



$\uparrow$: $F_T \cdot \sin 30° + F_N - F_g = 0$ ($F_N = F_g - \overbrace{F_T \cdot \sin 30°}^{\text{nadlehčení}}$)

$-F_T \cdot \sin 30° + m \cdot g = F_N$

$\rightarrow$: $-F_T \cdot \cos 30° + F_N \cdot \mu = 0$

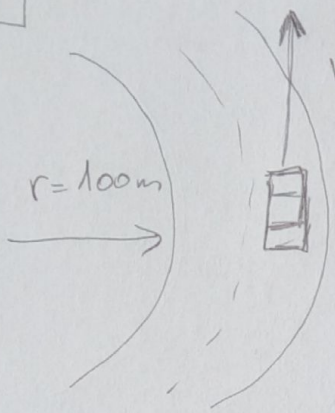
$-F_T \cdot \cos 30° + (-F_T \cdot \sin 30° + m \cdot g) \cdot \mu = 0$

$-F_T \cdot \cos 30° - 0,1 \cdot \sin 30° \cdot F_T + 20 \cdot 9,81 \cdot 0,1 = 0$

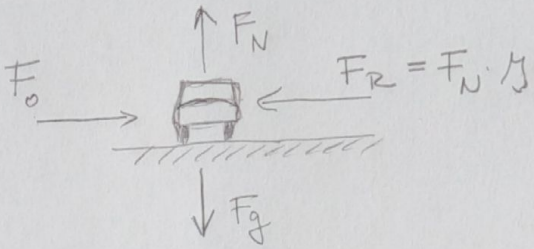
$$F_T = \frac{20 \cdot 9,81 \cdot 0,1}{\cos 30° + 0,1 \sin 30°}$$

$F_T = \underline{21,4\ N}$

PŘ



Dostane auto smyk?



$\uparrow: F_N = F_g = m \cdot g$

$\rightarrow F_0 \geq F_R$

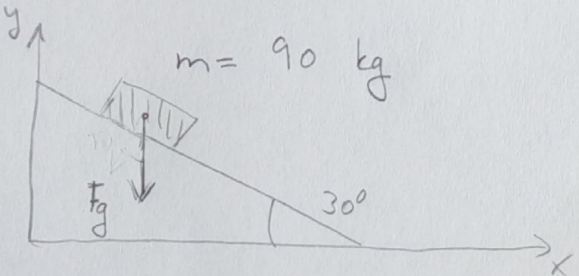
$m \frac{v^2}{r} \geq m \cdot g \cdot \mu$

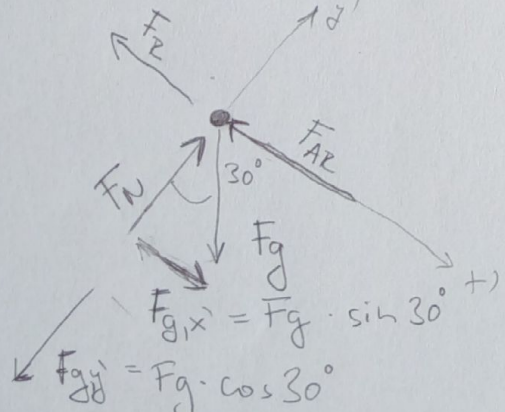
$v > \sqrt{r \cdot g \cdot \mu}$

$v > \sqrt{100 \cdot 9{,}81 \cdot 0{,}3}$

$v > 17{,}16 \text{ m/s}$ ✓

PŘ





- odpor vzduchu $F_{AR} = k \cdot v_1^2$
- $k = 0{,}6227$
- $\mu = 0{,}1$
- $v_{max} = ?$ (síly se dostanou do rovnováhy, $\Rightarrow a = 0$)

$\nearrow: F_N - F_g \cdot \cos 30° = 0$

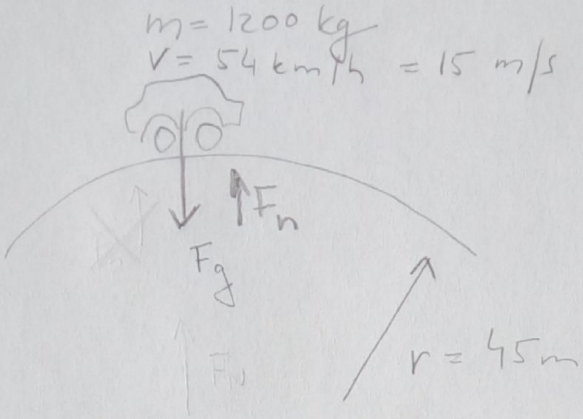
$F_N = m \cdot g \cdot \cos 30° = 90 \cdot 9{,}81 \cdot \cos 30°$

$F_N = 764{,}6 \text{ N}$

$\searrow: 90 \cdot g \cdot \sin 30° - 0{,}6227 v^2 - 764{,}6 \cdot 0{,}1 = 0$

$V = \sqrt{\frac{90 \cdot 9{,}81 \cdot \sin 30° - 76{,}46}{0{,}6227}} = \underline{\underline{24{,}21 \text{ m/s}}}$

PŘ



F_N v nejvyšším bodě?

$$a_n = \frac{v^2}{r} = \frac{15^2}{45} = 5\ m\,s^{-2}$$

$$F_n = m \cdot a_n = 1200 \cdot 5 =$$

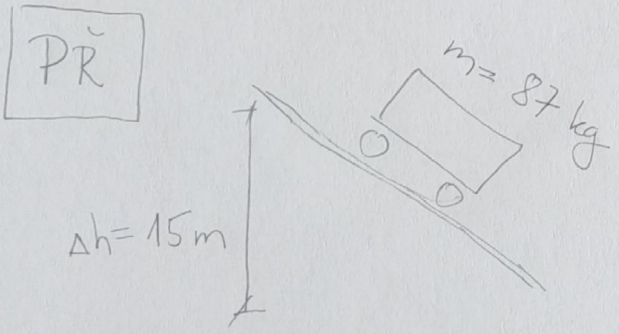
$$F_g = m \cdot g$$

$$\uparrow: F_N + F_n - F_g = 0$$

$$m \cdot a_n + F_N - m \cdot g = 0$$

$$F_N = m \cdot (g - a_n) = 1200 \cdot (9{,}81 - 5) = \underline{5\,772\ N}$$

PŘ



- odpor zanedbejte

$v_0 = 7\ km/h = 1{,}94\overline{4}\ m/s$

$v_{max} = ?$

$$E_k = \frac{1}{2} m v^2$$

$$E_p = m \cdot g \cdot h$$

$$E_{k,max} = E_{k,0} + E_p$$

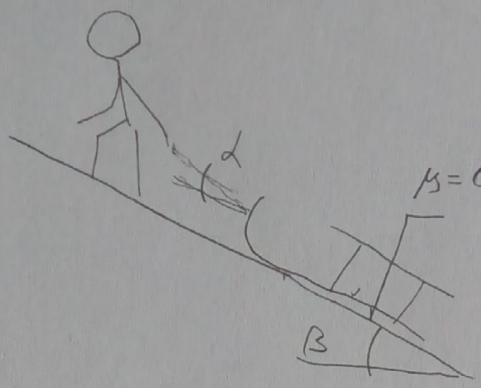
$$\frac{1}{2} m v_{max}^2 = \frac{1}{2} m v_0^2 + m \cdot g \cdot h$$

$$v_{max} = \sqrt{v_0^2 + 2gh}$$

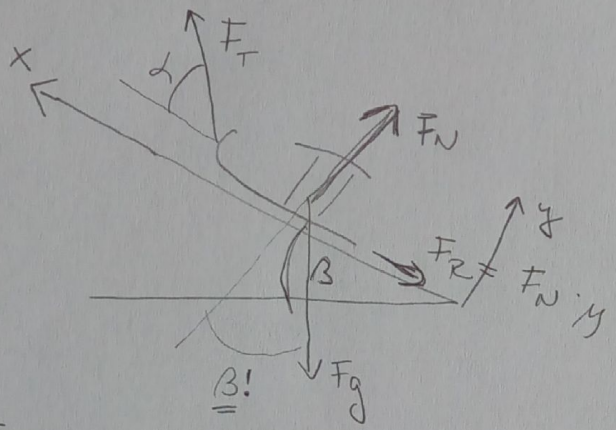
$$v_{max} = \sqrt{1{,}94\overline{4}^2 + 2 \cdot 9{,}81 \cdot 15}$$

$$v_{max} = 17{,}27\ m/s = \underline{62{,}2\ km/h}$$

PŘ



Najděte α, aby tažná síla byla nejmenší!



$\sum \underline{F} = m \cdot a$, konst. $v \Rightarrow a = 0 \Rightarrow \sum \underline{F} = 0$

$\uparrow y$: $F_T \cdot \sin\alpha + F_N - F_g \cdot \cos B = 0$

$F_N = F_g \cdot \cos B - F_T \cdot \sin\alpha$

Šikmá rovina ⇒ rozklad F_g

$\leftarrow x$: $F_T \cdot \cos\alpha - F_g \cdot \sin B - F_N \cdot \mu = 0$

$F_T \cdot \cos\alpha = F_g \cdot \sin B + (F_g \cdot \cos B - F_T \cdot \sin\alpha)\mu$

$F_T \cdot \cos\alpha + F_T \sin\alpha \, \mu = F_g \cdot \sin B + F_g \cdot \cos B \cdot \mu$

$$F_T = \frac{F_g \sin B + F_g \cdot \cos B \cdot \mu}{\cos\alpha + \sin\alpha \, \mu}$$

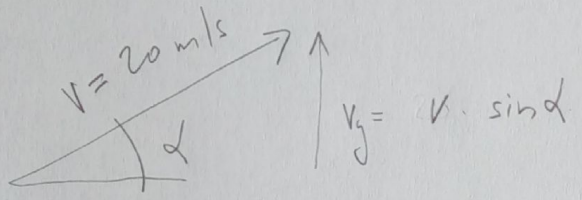
$$\frac{dF_T}{d\alpha} = F_g \left(\sin B + \mu \cos B\right) \frac{-(\mu \cos\alpha - \sin\alpha)}{(\mu \sin\alpha + \cos\alpha)^2} = 0$$

(alt. v Excelu / Pyth. ...)

$\Downarrow$

$\alpha = 5° 43'$

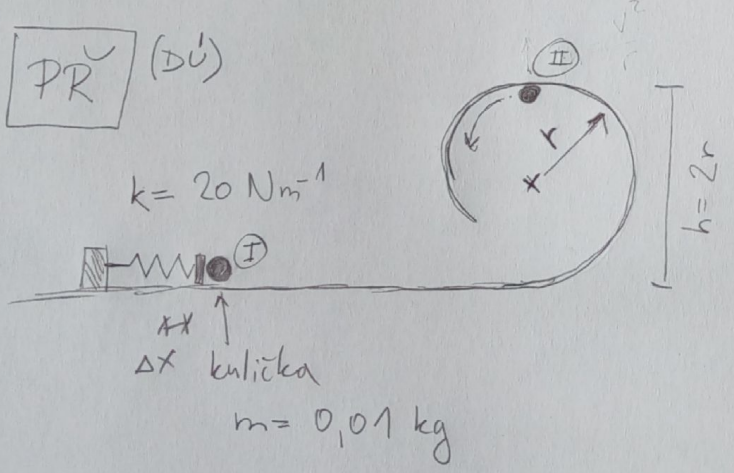
PŘ Auto o hmotnosti $m = 1200\ kg$ má výkon motoru $P = 33\ kW$. Jaký je max. sklon kopce, který dokáže vyjet rychlostí $72\ km/h$?



$$P = \frac{W}{t} = \frac{m \cdot g \cdot h}{t} = m \cdot g \cdot v_y \cdot \sin\alpha$$

$$\alpha = \sin^{-1}\left(\frac{P}{m \cdot g \cdot v}\right) = \sin^{-1}(0{,}14) \Rightarrow \underline{\underline{\alpha = 8°}}$$

PŘ (DÚ)

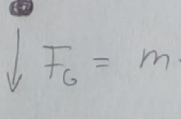


kulička vystřelená pomocí pružiny o tuhosti $k = 20\ Nm^{-1}$ musí obětnout celou kruhovou smyčku o poloměru $r = 0{,}1\ m$. Určete potřebné stlačení pružiny ΔX. Odpor zanedbejte.

$$F_s = k\,\Delta x$$

$$E_s = \int_0^{\Delta x} k\,x\,dx = \left[k\frac{x^2}{2}\right]_0^{\Delta x} = \frac{1}{2}k(\Delta x)^2$$

$$E_s^{I} = E_k^{II} + E_p^{II}$$



$$\frac{1}{2} k \Delta x^2 = \frac{1}{2} m v_{min}^2 + m \cdot g \cdot 2r$$

$a_n = g$

$\frac{v_{min}^2}{r} = g$

$v_{min}^2 = \sqrt{g \cdot r}$

$$\Delta x = \sqrt{\frac{m \cdot g \cdot r + 4 m \cdot g \cdot r}{k}} = \sqrt{\frac{5 m \cdot g \cdot r}{k}} = \sqrt{\frac{5 \cdot 0{,}01 \cdot 9{,}81 \cdot 0{,}1}{20}} =$$

$= 0{,}05 \text{ m} = 5 \text{ cm}$