Newtonovy zákony:

1) $\frac{d\vec{v}}{dt} = 0 \rightarrow \vec{v}$ ... konst.

2) $\vec{F} = m \cdot \frac{d\vec{v}}{dt} = m \cdot \vec{a}$

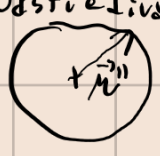
$\vec{a} = \frac{\vec{F}}{m}$

3) $\vec{F} = -\vec{F_s}$

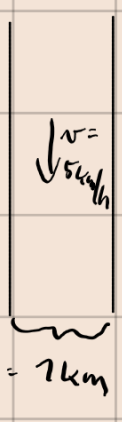
$\vec{F} = m \cdot \vec{a}$

$m \cdot \vec{a'} = m \cdot \vec{a} - m \cdot \vec{A} - m \cdot \vec{\omega} \times (\vec{\omega} \times \vec{r'}) - m\vec{\varepsilon} \times \vec{r'} - 2m\vec{\omega} \times \vec{v}$

$\vec{a}$ ... reálná síla; $\vec{A}$ ... díky zrychlenému posunu soustavy; $-m \cdot \vec{\omega} \times (\vec{\omega} \times \vec{r'})$ ... odstředivá; $-m\vec{\varepsilon} \times \vec{r'}$ ... Eulerova; $-2m\vec{\omega} \times \vec{v}$ ... Coriolis

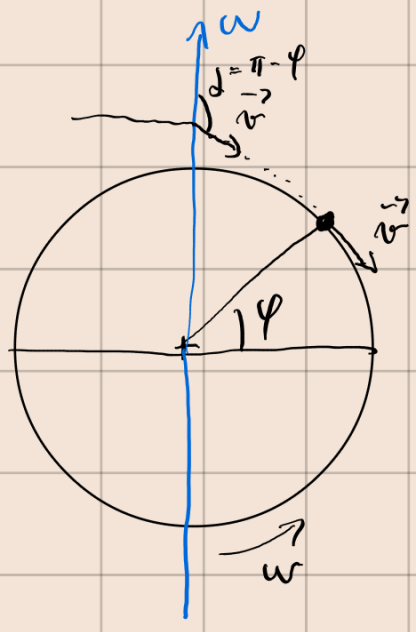


3.37 - Řeka

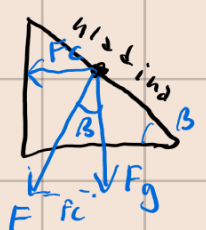


na 45. rovnoběžce

$\varphi = 45°$



$\vec{F_C} = -2m\vec{\omega} \times \vec{v'}$



$\Delta h = ?$ $\qquad \operatorname{tg}\beta = \frac{F_c}{F_g} = \frac{\Delta h}{d}$

$F_c = 2 m v' w \sin(\pi - \varphi) = 2 m v' w \sin\varphi$

$\frac{F_c}{F_g} = \frac{\Delta h}{d}$

$\frac{2 m v' w \sin\varphi}{m \cdot g} = \frac{\Delta h}{d}$

$w = \frac{2\pi}{T} = \frac{2\pi}{86400}$

$\frac{2 d v' w \sin\varphi}{g} = \Delta h$

$= 15\,mm$

Energie

$\vec{F} \cdot \vec{v} = m \cdot \frac{d\vec{v}}{dt} \cdot \vec{v} = m \cdot \frac{1}{2} \frac{d\vec{v}}{dt}(\vec{v} \cdot \vec{v}) = \frac{d}{dt}\left(\underbrace{\frac{1}{2} m \cdot v^2}_{\text{kinetická energie}}\right) = \frac{d E_{kin}}{dt}$

$\vec{F} \cdot \vec{v} = \frac{d E_{kin}}{dt}$

$\int_A^B d E_{kin} = \int_{t=0}^{t} \vec{F} \cdot \vec{v} \cdot dt = \int_0^S \vec{F} \cdot d\vec{s}$

$E_{kin}(t) - E_{kin}(0) = \int_0^S \vec{F} \cdot ds = A \ldots$ práce

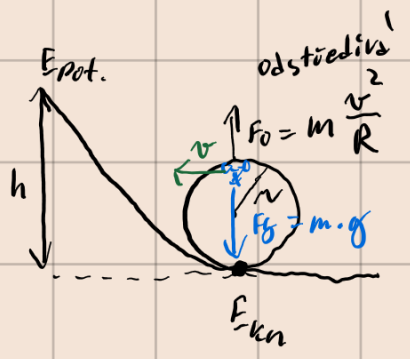
$\vec{F} = -\operatorname{Grad} E_{pot.} = -\operatorname{Grad} U = -\vec{\nabla} U$

$\nabla = \left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right)$

$E_{pot.} = m \cdot g \cdot z$

$-\nabla E_{pot.} = -(0, 0, m \cdot g) = -m\vec{g}$

3.17 - Artista



$F_0 = F_g$

$m \cdot \frac{v^2}{R} = m \cdot g \rightarrow \boxed{v^2 \geq R \cdot g}$

$\frac{1}{2} m \cdot v^2 + m \cdot g \, 2R = m \cdot g \cdot h$

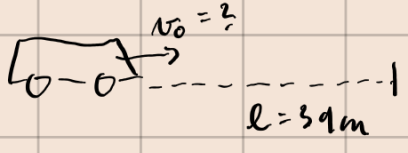
$\boxed{\frac{1}{2} v^2 + g \, 2R = g \cdot h}$

$\frac{1}{2} Rg + g \, 2R = g \cdot h$

$\frac{1}{2} R + 2R = h$

$h = 2R + \frac{R}{2} \geq \frac{5}{2} R$

3.22 - slepice



koef. smyk. tření o vozovku:

$\gamma = 0{,}5$

$\frac{1}{2} m v_0^2 = A_t$ ← všechna energie se dá do tření

$F_t = \gamma \cdot m \cdot g$

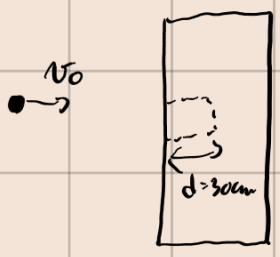
$A_t = \int F_t \cdot dl = F_t \cdot l = \gamma \cdot m \cdot g \cdot l$

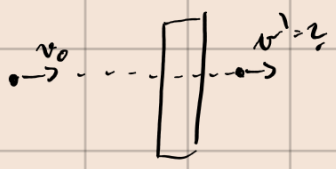
$\frac{1}{2} m \cdot g \cdot v_0^2 = \gamma \cdot m \cdot g \cdot l$

$\frac{1}{2} g v^2 = \gamma \cdot g \cdot l$

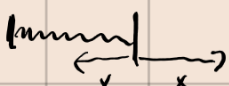
$v_0 = \sqrt{2 g l \cdot \gamma} = 20{,}6\ km/h$

Úkol 3.24 - Střely



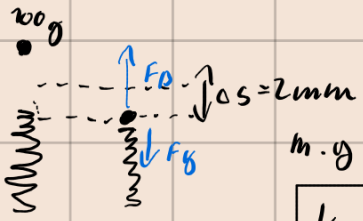


3.20 - Pružinový kanón



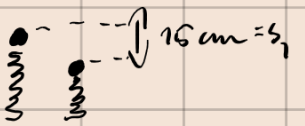
$F = -k \cdot \vec{x}$

k ... tuhost pružiny



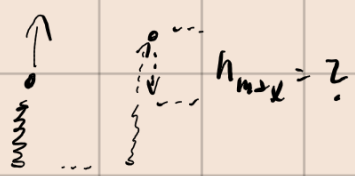
$m \cdot g = k \cdot \Delta s$

$$k = \frac{m \cdot g}{\Delta s}$$



$E_{pot.} = \frac{1}{2} k x^2$

$= \frac{1}{2} k \cdot s_1^2$



$E_{kin} = 0$

$E_{pot} = m \cdot g \cdot h_{max}$

$$\frac{1}{2} k s_1^2 = m \cdot g \cdot h_{max}$$

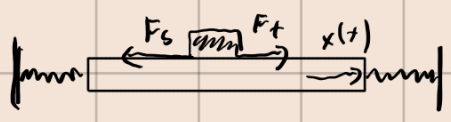
$$h_{max} = \frac{\frac{1}{2} k \cdot s_1^2}{} = \frac{1}{2} \frac{m \cdot g}{\Delta s} \cdot s_1^2 = \frac{s_1^2}{}$$

$m \cdot g$

205

3.32

$\mu = ?$



harm. kmitání

$T = 5s$

Objekt se začne smýkat, když $x_0 = 0{,}5m$

$F_{s_{max}} \geq F_t$

Harm. kmit:

$x(t) = x_0 \sin(\omega t + \varphi_0), \quad \omega = \frac{2\pi}{T}$

$v(t) = \dot{x} = \omega x_0 \cos(\omega t + \varphi_0)$

$a(t) = \dot{v} = -x\omega^2 \sin(\omega t + \varphi_0)$

$\vec{F} = m \cdot \vec{a} \Rightarrow F_s = -m \cdot \vec{a}$

$F_{s_{max}} \geq \mu \cdot m \cdot g$

$m x_0 \omega^2 = \mu \cdot m \cdot g$

$\mu = \frac{x_0 \omega^2}{g} = \frac{x}{g}\left(\frac{2\pi}{T}\right)^2 = 0{,}08$

$\mu \leq 0{,}08$