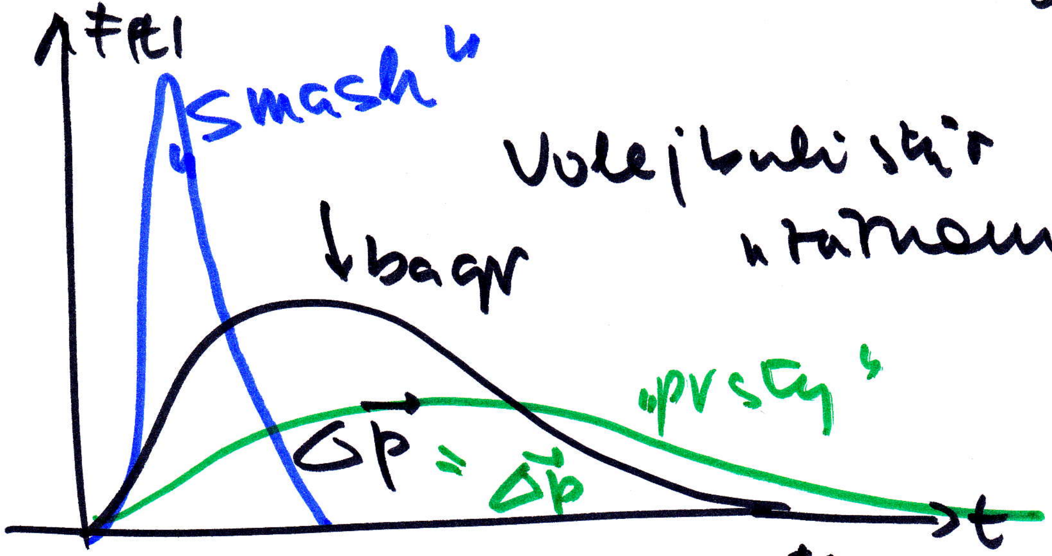
Dobrý den

14. přednáška
6.11.09



$$\vec I = \Delta\vec p \quad \left(= \int_{t_1}^{t_2} \vec F(t)\,dt\right)$$

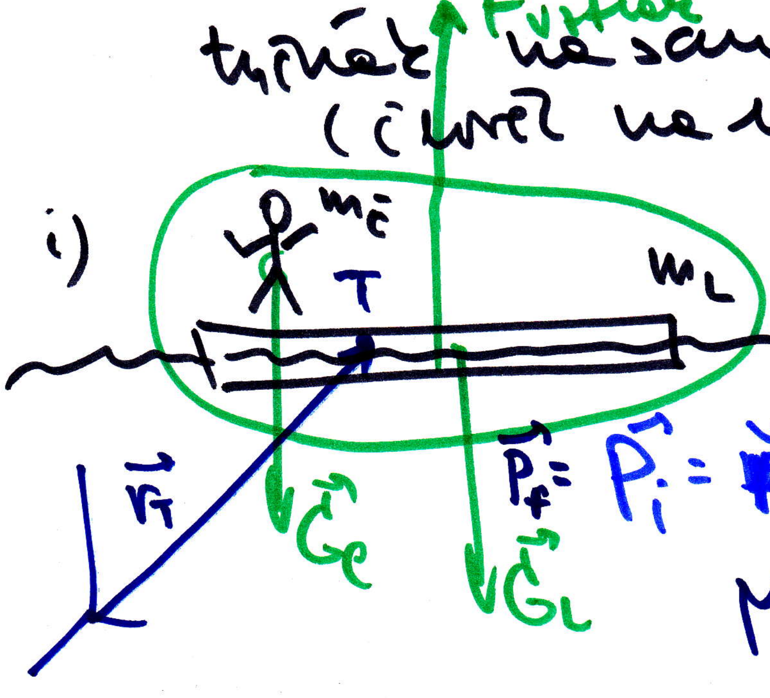
II. VI & I. VI

fertovné příklady

① ZZH: (I. VI)

tuňák na saních
(člověk na loďce)...

i)

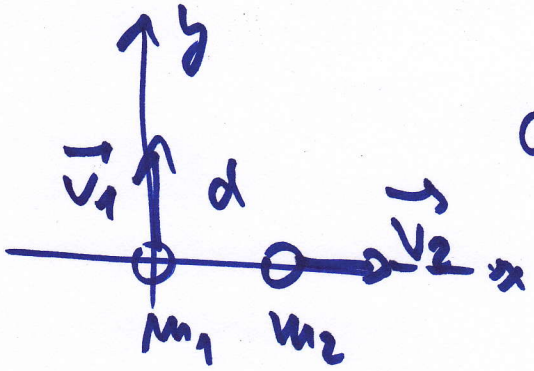


$\vec F_V^{ext} = \vec 0 \Rightarrow \vec P = konst$

$\vec P_f = \vec P_i = \vec p_{č,i} + \vec p_{L,i} = \vec 0 = \vec P$

$M\vec a_T = \vec 0 \quad \vec v_T = \vec 0 \quad \vec r_T = \overrightarrow{konst}$

ii)



dolw $m_1, \vec{v}_1, m_2, \vec{v}_2$

$\vec{v}_1 = (0, v_1, 0)$

$\vec{v}_2 = (v_2, 0, 0)$

$\vec{r}_1(t) = (0, v_1 t, 0)$

$\vec{r}_2(t) = (d + v_2 t, 0, 0)$

$$\vec{r}_T(t) = \frac{\sum m_i \vec{r}_i(t)}{\sum m_i} = \frac{1}{m_1+m_2}\left(m_2 d + m_2 v_2 t;\ m_1 v_1 t;\ 0\right)$$

$$\vec{r}_T = \vec{v}_T = \frac{1}{m_1+m_2}\left(m_2 v_2;\ m_1 v_1;\ 0\right)$$

pokud $v_1 = v_2 = v$

$\vec{r}_1 = (0;\ vt;\ 0)$

$\vec{r}_2 = (d + vt;\ 0;\ 0)$

$$x_T(t) = \frac{1}{m_1+m_2}\, m_2 (d + vt)$$

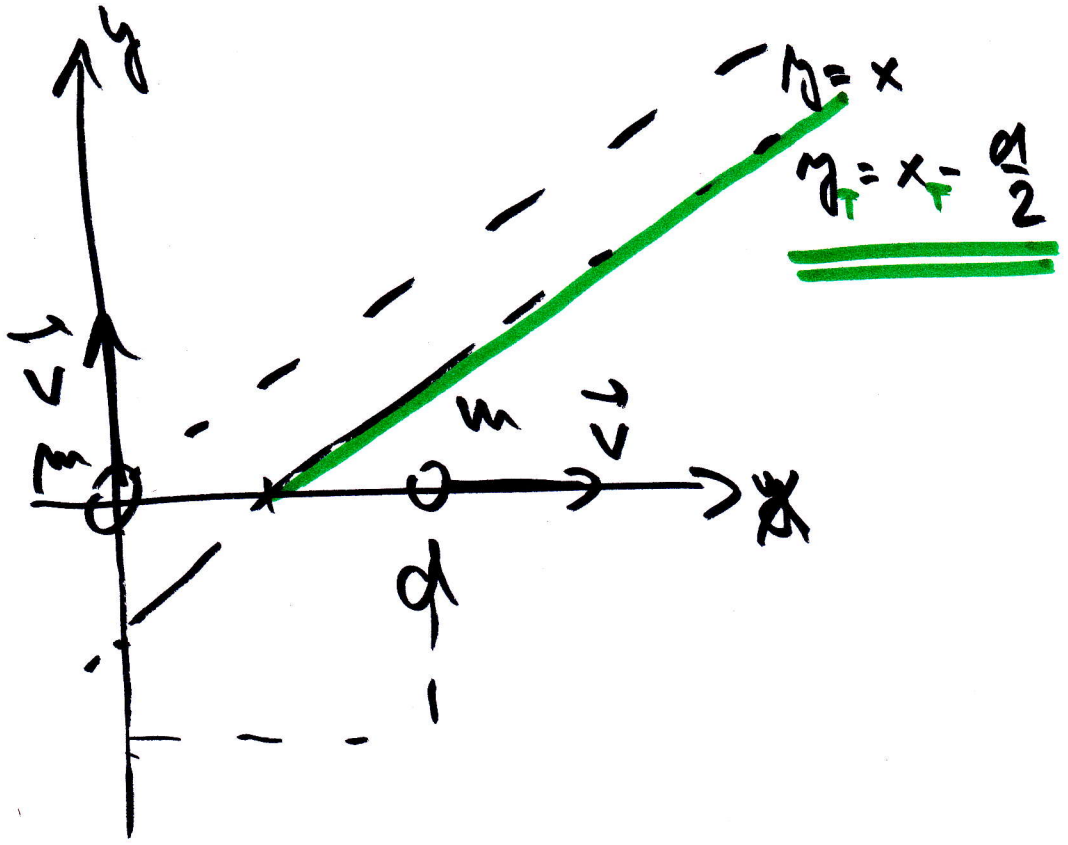
$m_1 = m_2 = m$

$$y_T(t) = \frac{m_1}{m_1+m_2}\, vt$$

$$x_T = \frac{m}{m_1+m_2}\, d + \frac{m}{m_1+m_2}\, vt = \frac{dm}{m_1+m} + y_T$$

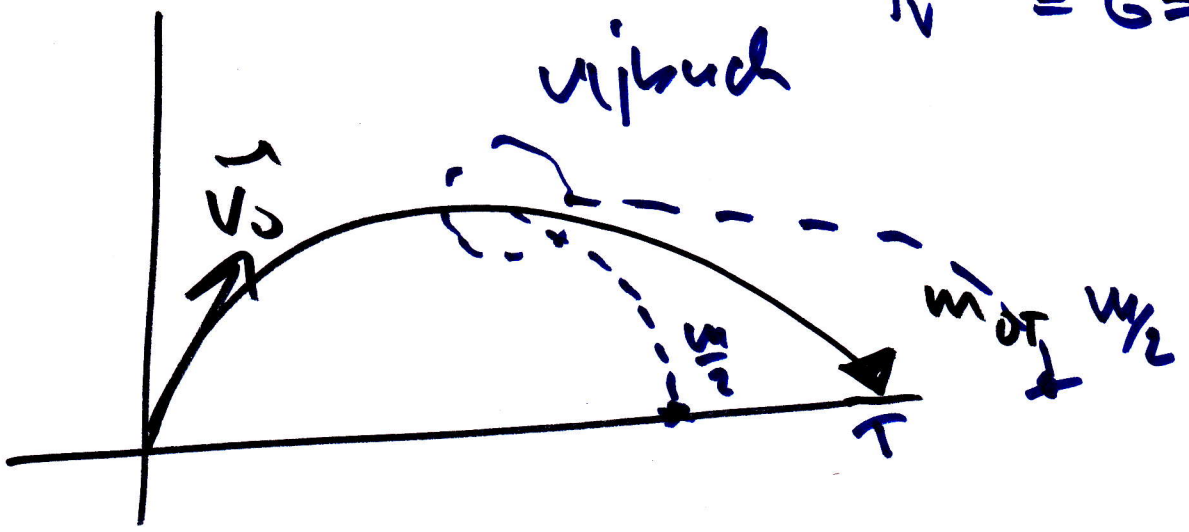
$$y_T(x_T) = x_T - \frac{md}{2m} \qquad (m_1 = m_2 = m)$$

$$y_T = x_T - \frac{d}{2}$$



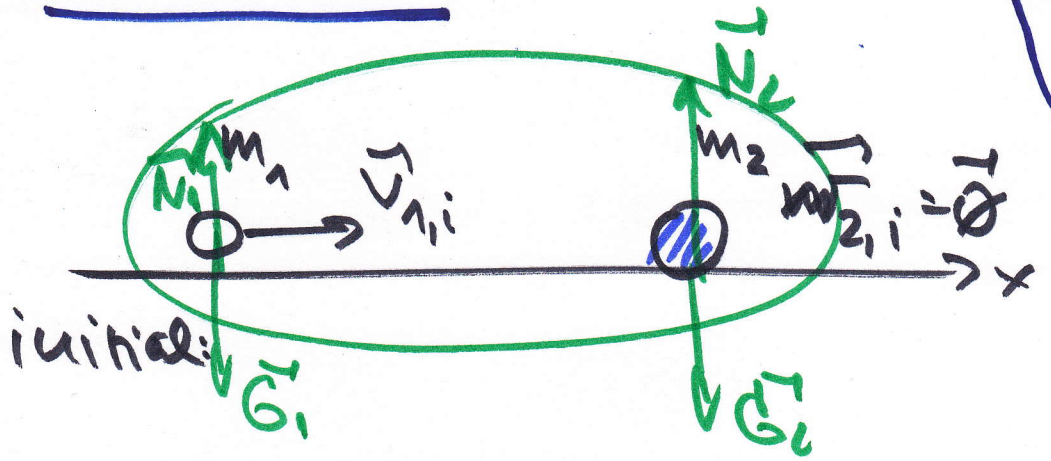
iii) výbuch okamžitě zničí raketu

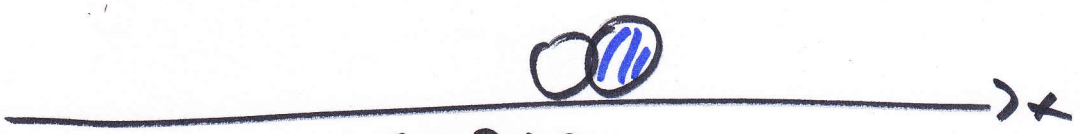
$$\vec{F}_v^{ext} = \vec{G} = M\vec{a}_T$$



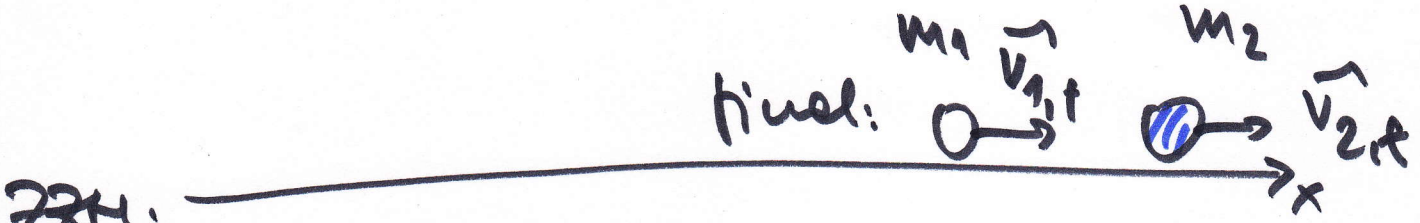
SRÁŽKY

$\vec{F}_i = \vec{F}_t$
$\vec{F}_{výsl} = \vec{0}$





Srážka



ZH: $m_1 \vec{v}_{1,i} + m_2 \vec{v}_{2,i} = m_1 \vec{v}_{1,f} + m_2 \vec{v}_{2,f}$

NAVÍC (může)
ZE: $\frac{1}{2} m_1 v_{1,i}^2 + \frac{1}{2} m_2 v_{2,i}^2 = \frac{1}{2} m_1 v_{1,f}^2 + \frac{1}{2} m_2 v_{2,f}^2$

{ DOKONALE PRUŽNÁ SRÁŽKA

Ⓐ NEPOHYBLIVÝ „TERČ", MÍČ NA NĚJ
POHYBLIVÝ „PROJEKTIL"

2: dáno m_1, m_2 $v_{1,i}$

$$v_{1,f} = \frac{m_1 - m_2}{m_1 + m_2} v_{1,i}$$

$$v_{2,f} = \frac{2m_2}{m_1 + m_2} v_{1,i}$$

} *

$m_1 v_{1,i} = m_1 v_{1,f} + m_2 v_{2,f} \Rightarrow m_1 (v_{1,i} - v_{1,f}) = m_2 v_{2,f}$

$\frac{1}{2} m_1 v_{1,i}^2 = \frac{1}{2} m_1 v_{1,f}^2 + \frac{1}{2} m_2 v_{2,f}^2 \Rightarrow \frac{1}{2} m_1 (v_{1,i}^2 - v_{1,f}^2) = \frac{1}{2} m_2 v_{2,f}^2$

$(v_{1,i} + v_{1,f})(v_{1,i} - v_{1,f})$

$\frac{\Delta}{v_{1,i} + v_{1,f}} = \frac{\Delta}{v_{2,f}}$

Podle NEW DG

Diskuze *: SLOUPA reaguje m_1 projektil

$m_1 \ll m_2$ target $m_2 \gg m_1$

$v_{1,f} = \frac{\frac{m_1}{m_2} - 1}{\frac{m_1}{m_2} + 1} v_{1,i}$ mnohdy $\frac{m_1}{m_2} + 1$

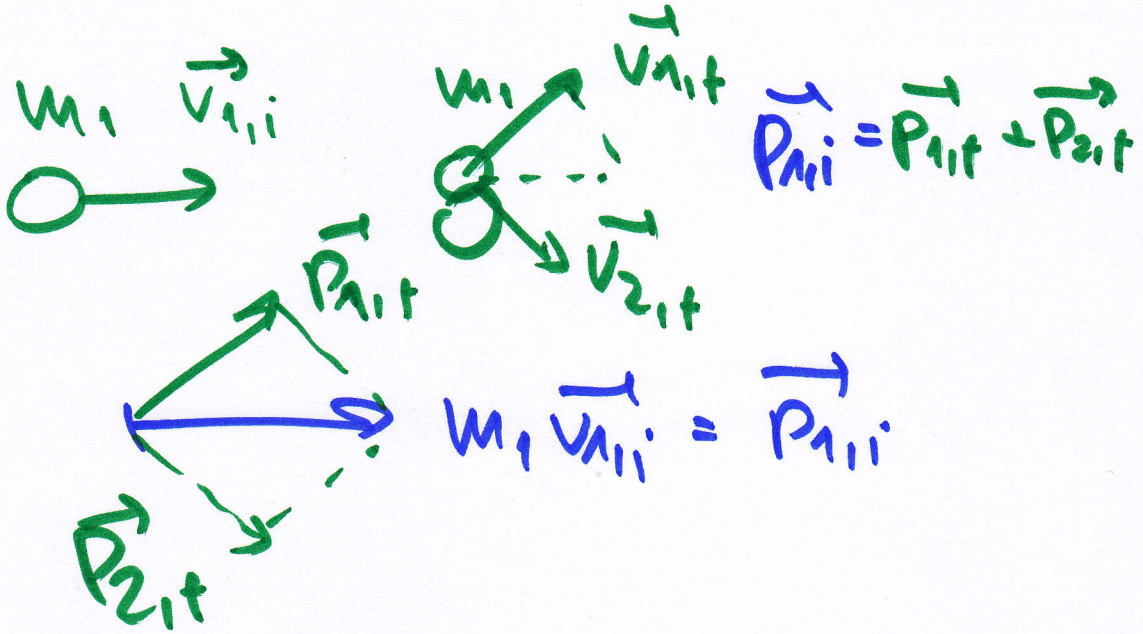
$v_{2,f} = \frac{2\frac{m_1}{m_2}}{\frac{m_1}{m_2} + 1} v_{1,i}$

$$v_{1,f} = \frac{m_1 - m_2}{m_1 + m_2} v_{1,i} + \frac{2m_2}{m_1 + m_2} v_{2,i}$$

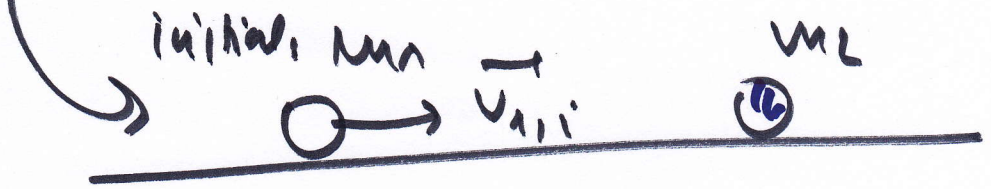
$$v_{2,f} = \frac{2m_1}{m_1 + m_2} v_{1,i} + \frac{m_2 - m_1}{m_1 + m_2} v_{2,i}$$

se suivre ±

? SIGMA SDAFTRA ? VEKTOROVĚ



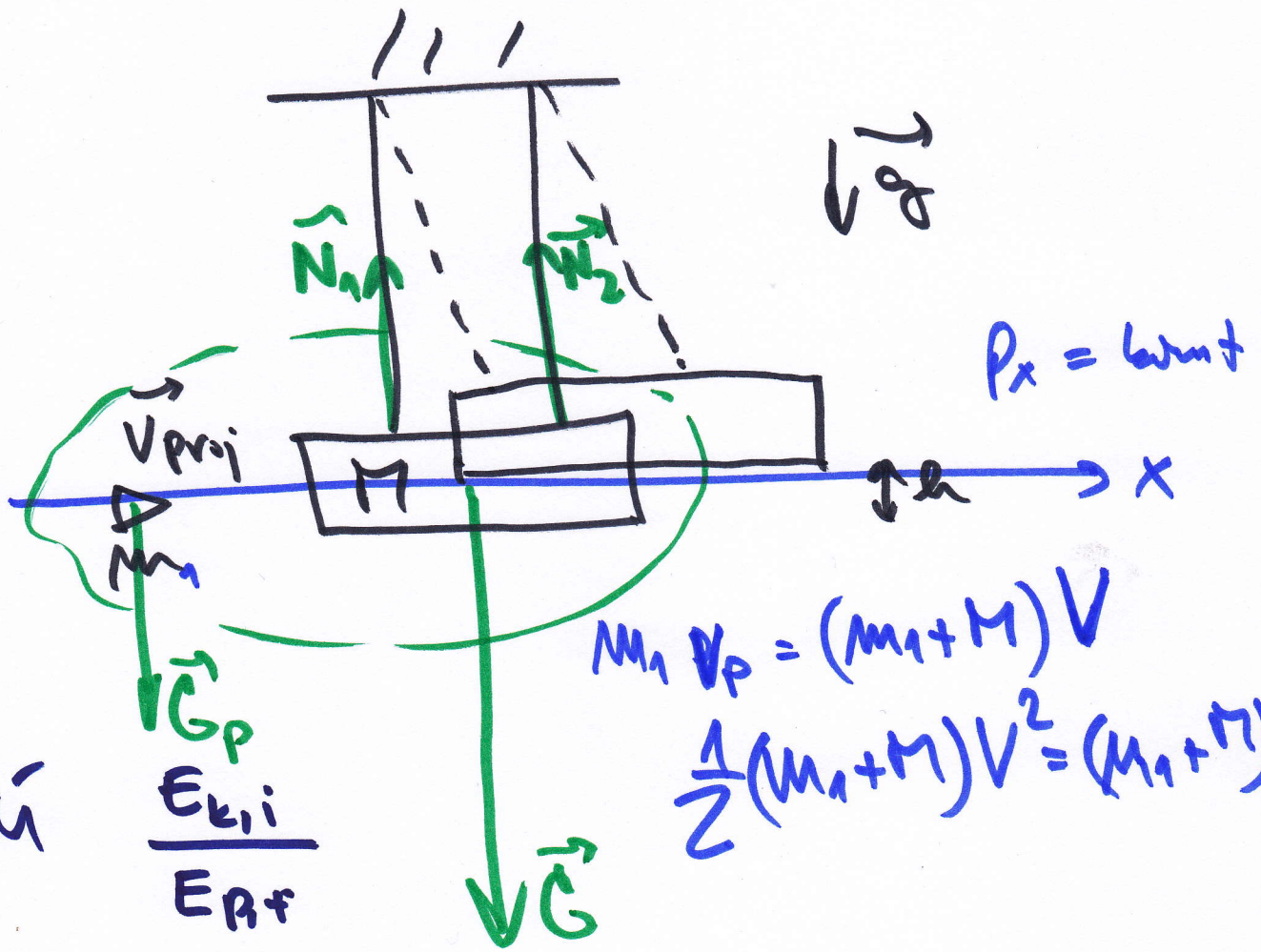
(DOKONALÁ) NEPRUŽNÁ SRÁŽKA



⚠ ZTRÁTA PLATÍ ⚠ ZTRÁTA $\underline{\underline{\text{JE}}}$ (vždy)

$\vec{P} = M\vec{v}_T$: $m_1 v_{1,i} + m_2 v_{2,i} = (m_1 + m_2) v_T$

Příklad: Balistické kyvadlo:

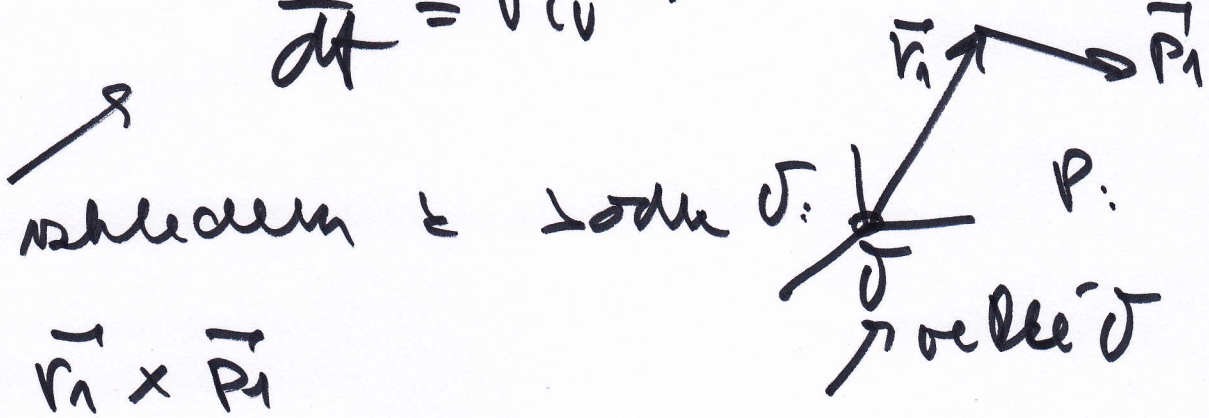


$m_1 v_p = (m_1 + M) V$

$\frac{1}{2}(m_1 + M) V^2 = (m_1 + M) g h$

DÚ $\frac{E_{k,i}}{E_{pf}}$

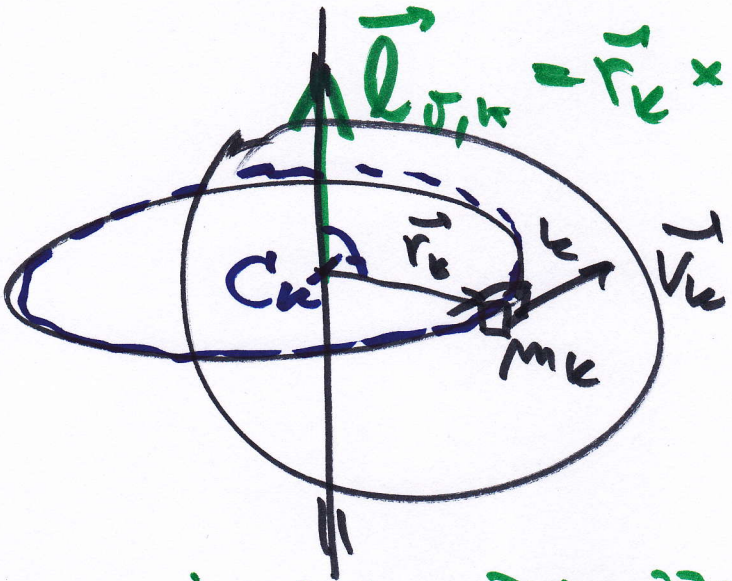
II. VI $\quad \frac{d\vec{L}}{dt} = \vec{M}_{vn}$



moment hybnosti k bodu O:

$\vec{L}_1 = \vec{r}_1 \times \vec{p}_1$

Definujme tuhé těleso, ale nejen jde o (malé σ)



$\vec{L}_{\sigma,k} = \vec{r}_k \times m_k \vec{v}_k$

$\vec{L}_\sigma = \sum_k \vec{L}_{\sigma,k}$

$= \sum_k \vec{r}_k \times m_k \vec{v}_k$

Víš kinetické mechanice:

$|\vec{L}_\sigma| = |\sum \vec{L}_k| = \ldots = \sum |\vec{L}_k| = \sum r_k m_k v_k$

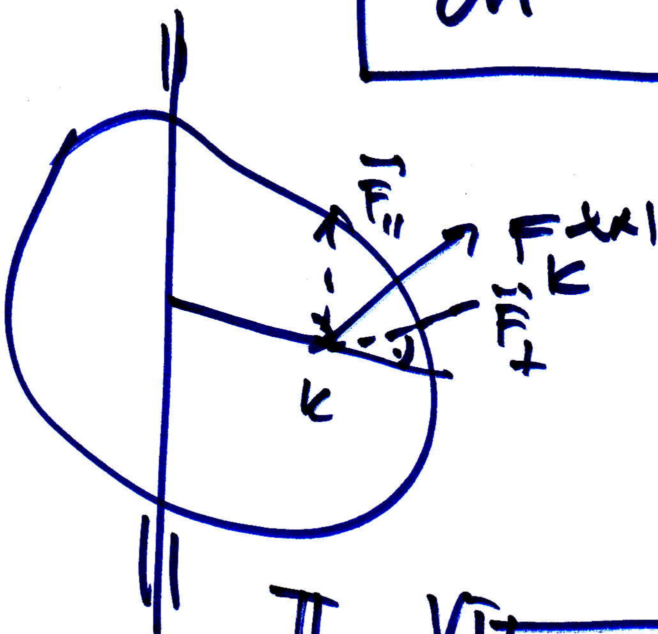
$= \left(\sum m_k r_k^2\right) \omega = I\omega$

$$\vec{L}_\sigma = I\vec{\omega}$$

$$\vec{L}_0 = I\vec{\omega}$$

$$\frac{d\vec{L}_0}{dt} = I\frac{d\vec{\omega}}{dt}$$

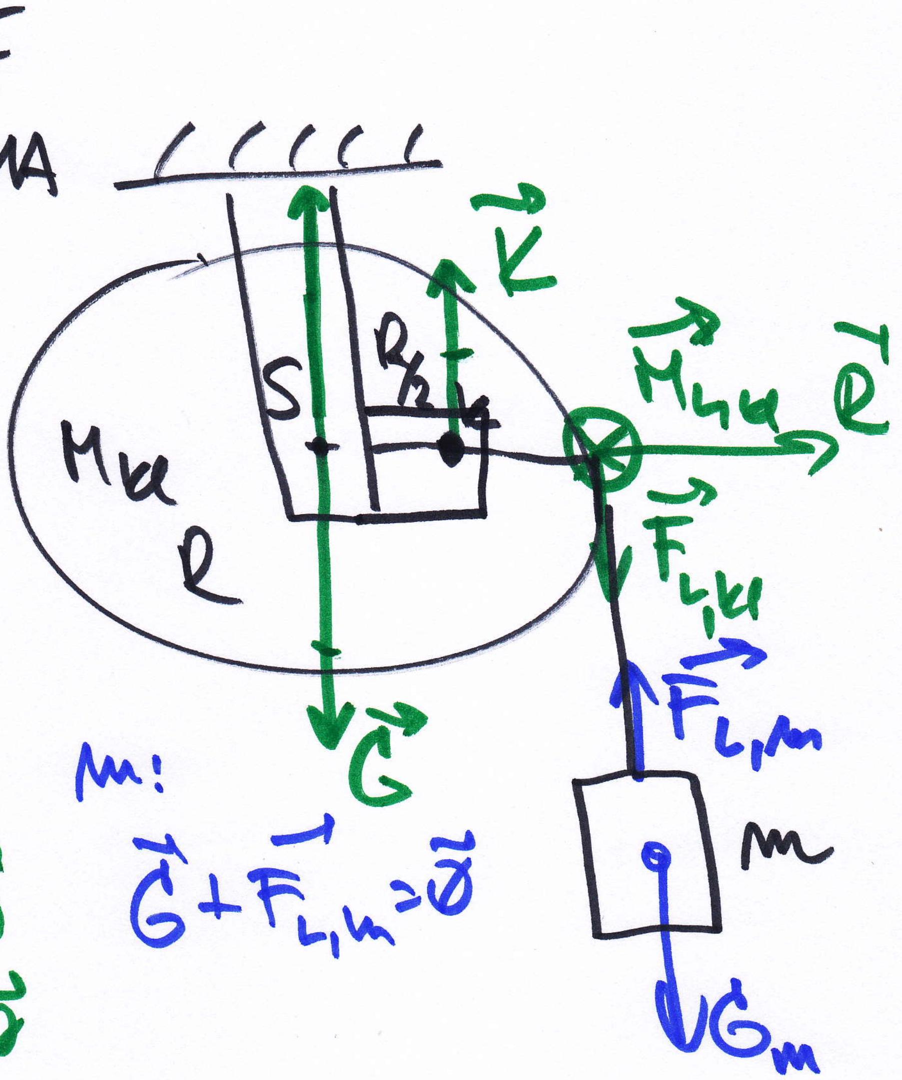
$$\boxed{\frac{d\vec{L}_0}{dt} = I\vec{\varepsilon}} = \underline{\underline{\vec{M}^{ext}_{v,o}}}$$



II. VT
tuhé těleso
(pevná osa)

$$\boxed{\vec{M}^{ext}_{v,o} = I\vec{\varepsilon}}$$

HMOTNÁ KLADKA



1) kladka zajištěna kolíkem K

kladka:

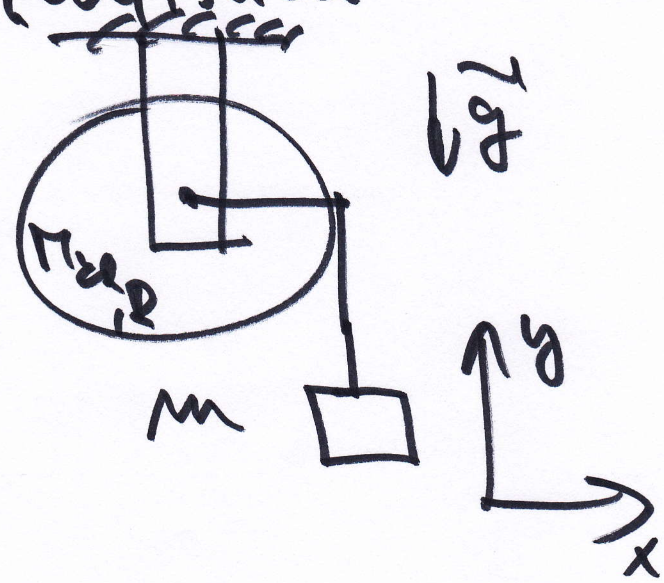
$\vec{M}_y^{ka} = \vec{0}$

$\vec{F}_{v,ka}^{ka} = \vec{0}$

m:

$\vec{G} + \vec{F}_{L,m} = \vec{0}$

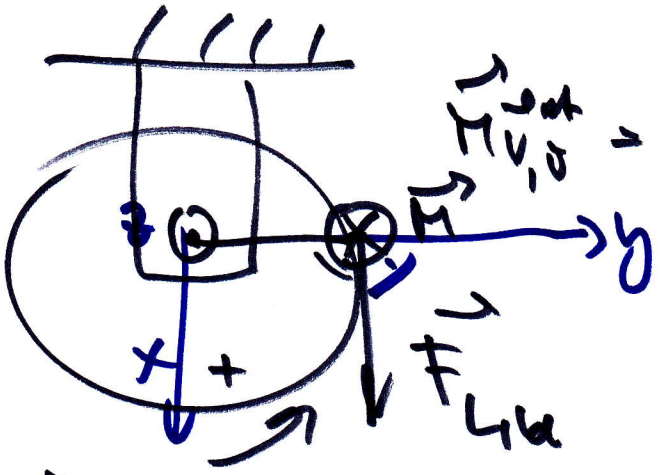
2) „odjištěná" kladka:



m:

$$\ddot{y} = \frac{-m}{m + \frac{1}{2} M_{ka}} g$$

Kladka:



$\vec{M}_{V,O}^{zm} = I\vec{\varepsilon}$

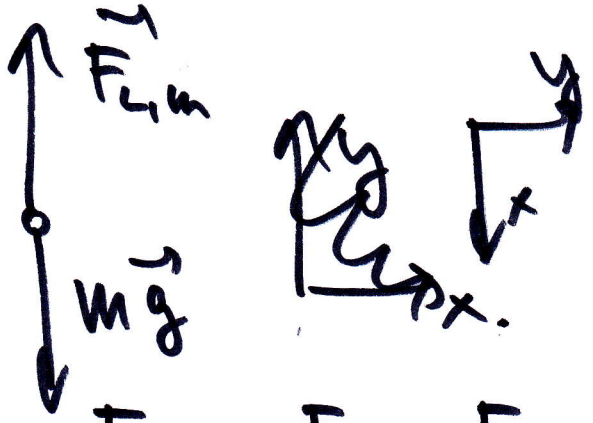
$\vec{R} \times \vec{F}_{L,kl} = I\vec{\varepsilon}$

$$R F_{L,kl} \sin 90° (-\vec{k}) = I \varepsilon \vec{k}$$

Těleso m:

$\vec{F}_V^{zm} = m\vec{a}$

$$-F_{L,m} + mg = m\ddot{x}$$



$a_T = R\varepsilon = -\ddot{x}$!

$F_{L,m} = F_{L,kl} = F_L$

$$+ R F_L = I\left(+\frac{\ddot{x}}{R}\right)$$

$$-F_L + mg = m\ddot{x} \quad / R$$

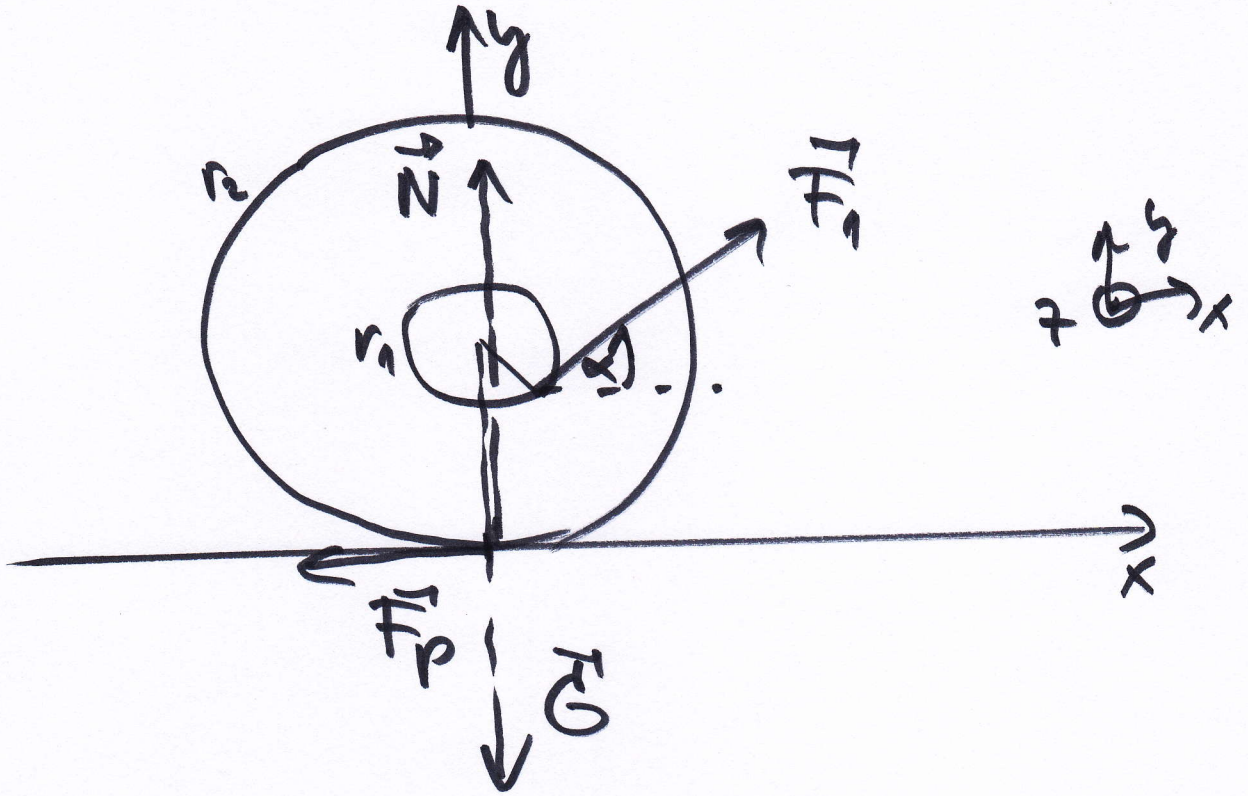
$$Rmg = I\frac{\ddot{x}}{R} + m\ddot{x}R \quad / R$$

$I_O = \frac{1}{2}MR^2$

$$\ddot{x}\left(m + I/R^2\right) = mg$$

$$\ddot{x} = \frac{m}{m + \frac{1}{2}M_{kl}}\, g$$

„Bajićeva špulka niti“ 12/12



$\ddot{x}(\alpha)$ DG

$(r_2 = 2r_1)$