Föreläsning 6, mekanik 1.

Impulslagen

Newton II : $\bar{F} = \dot{\bar{p}}$

Rörelsemängd $\bar{p} = m\bar{v}$

Integrera:

$$\boxed{\underbrace{\int_{t_1}^{t_2} \bar{F}\,dt}_{\bar{I}} = \int_{t_1}^{t_2} \frac{d\bar{p}}{dt}\,dt = \underbrace{\bar{p}(t=t_2)}_{\bar{p}_2} - \underbrace{\bar{p}(t=t_1)}_{\bar{p}_1}}$$

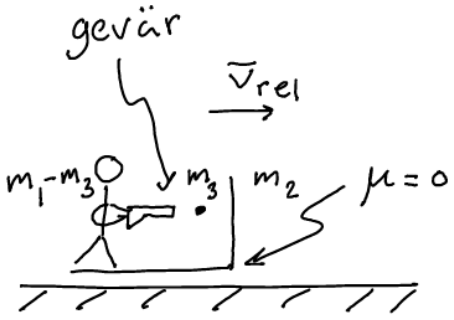
$\bar{I}$: impulsen av $\bar{F}$

System av partiklar:

$$\boxed{\underbrace{\int_{t_1}^{t_2} \bar{F}^{ext}\,dt}_{\bar{I}^{ext}} = \sum_{i=1}^{n} \bar{p}_2^{\,i} - \sum_{i=1}^{n} \bar{p}_1^{\,i}}$$

$\bar{p}^{\,i} = m_i \cdot \bar{v}_i$

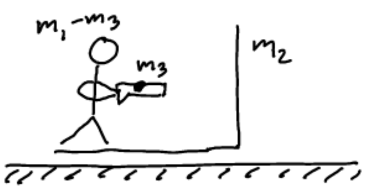
63)



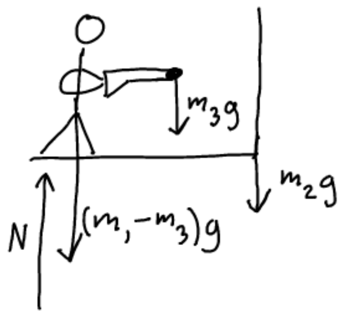
a) $v_{kälke}$ efter skott

b) $v'_{kälke}$ då m_3 stannat i m_2

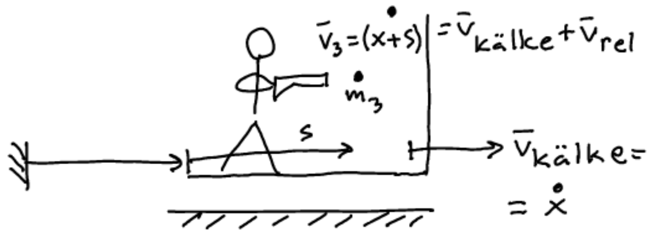
$t = 0$



Frilägg $0 \le t < t_e$



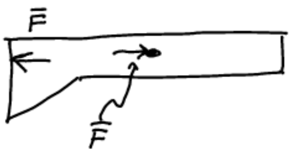
$\underline{t = t_e}$ $\dot{x} + \dot{s} =$



Impulslagen $\left(\bar{I}^{ext} = \sum \bar{p}^i(t_e) - \sum \bar{p}^i(0)\right)$:

$$\rightarrow : \; 0 = \underbrace{(m_1 - m_3)\bar{v}_{kälke} + m_2 \bar{v}_{kälke} + m_3(\bar{v}_{kälke} + \bar{v}_{rel})}_{*}$$

$$-[0 + 0 + 0] \Leftrightarrow \bar{v}_{kälke} = -\frac{m_3 \bar{v}_{rel}}{m_1 + m_2}$$



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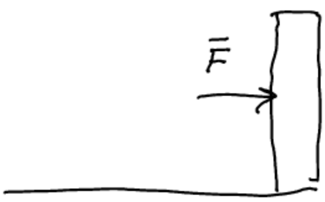
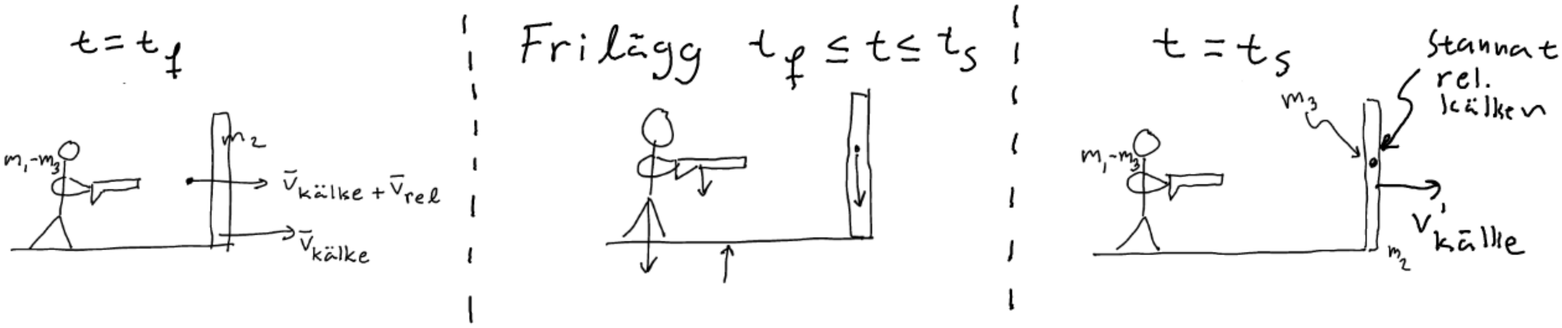
b)

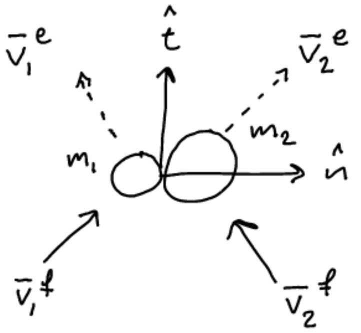




$$\rightarrow: \quad 0 = (m_1 - m_3)\bar{v}'_{kälke} + m_2 \bar{v}'_{kälke} + m_3 \bar{v}'_{kälke} - \underbrace{*}_{0} \iff$$

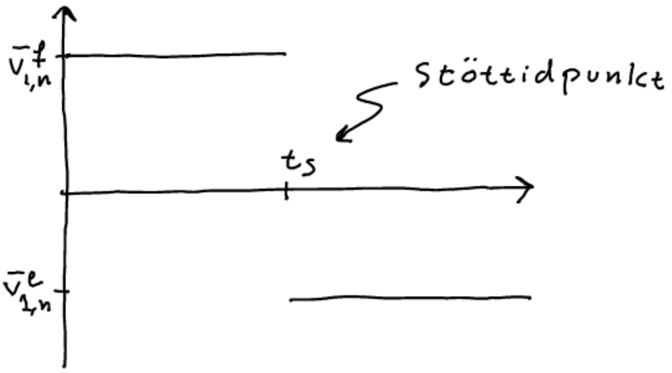
$$\bar{v}'_{kälke} = 0.$$

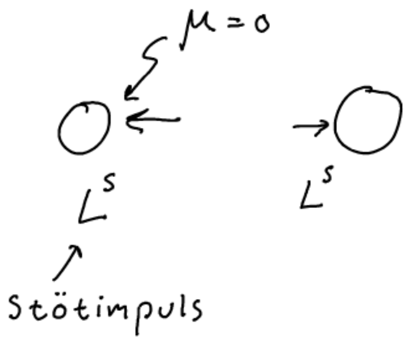
Momentan stöt



efter stöten.

före stöten





Impuls av $mg, F_{fi}, F_{dämpare} = 0$!

$$\int_{t_s}^{t_s} mg\,dt = 0$$

Stöt-impulslagen

$$\boxed{\bar{L}^{s,ext} = \sum_{i=1}^{n} \bar{p}^{i,e} - \sum_{i=1}^{n} \bar{p}^{i,f}} \quad (1)$$

($n=1$ eller 2, i våra fall)

Stöttalet e

$$\boxed{e = \frac{V_{2,n}^{e} - V_{1,n}^{e}}{V_{1,n}^{f} - V_{2,n}^{f}}} \quad (2)$$

OBS ordningen.

$0 \leq e \leq 1$

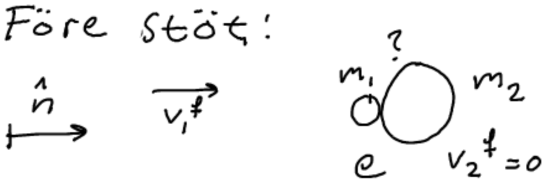
$e=0$: Helt plastisk stöt, $V_{2,n}^{e} = V_{1,n}^{e}$

$e=1$: Helt elastisk stöt, ingen energiförlust vid stöten.

e fås ur tabelle

<u>Ex</u>:

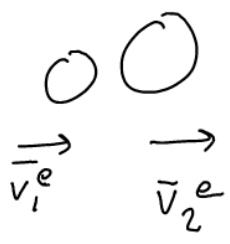
Före stöt:



m_1 så att $v_1^e \to$?

vid stöt:

efter stöt



(1) för $\overset{\text{kula}}{\downarrow}$ 1+2

$$\hat{n}:\ 0 = m_1 v_1^e + m_2 v_2^e - (m_1 v_1^f + \underbrace{m_2 v_2^f}_{0}) \qquad (3)$$

(2) $\Rightarrow$

$$e = \frac{v_2^e - v_1^e}{v_1^f - 0} \qquad (4)$$

$$(3),(4) \Rightarrow v_1^e = \frac{v_1^f\left(\frac{m_2}{m_1} - e\right)}{1 + \frac{m_1}{m_2}} > 0$$

$\therefore \quad m_1 > e m_2$

$\blacksquare$

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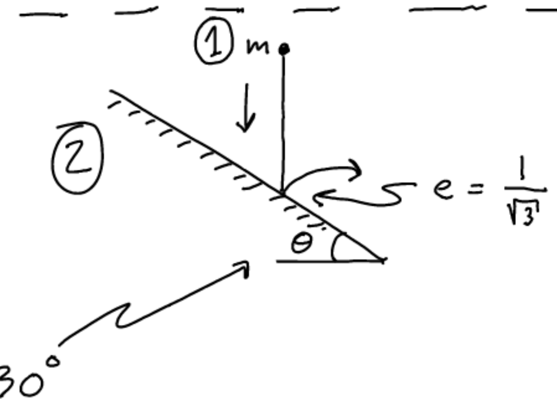
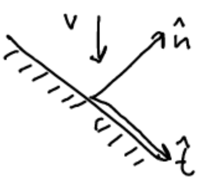
74)



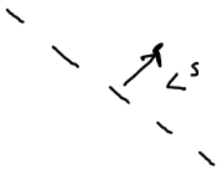
Givet: $e = \frac{1}{\sqrt{3}}$

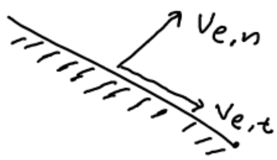
Sökt: V_e

Före:

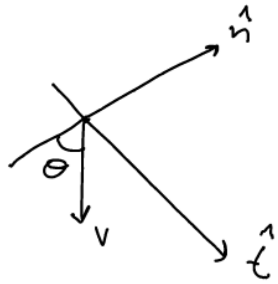


Vid





(1) för 1



$$\hat{t}: \; 0 = m_e v_{e,t} - mv\underbrace{\sin\theta}_{\frac{1}{2}}$$

$$\Leftrightarrow v_{e,t} = \frac{v}{2}$$

$$(2) \Rightarrow e = \frac{0 - v_{e,n}}{-v\cos\theta - 0} \Leftrightarrow v_{e,n} = \underbrace{e}_{\frac{1}{\sqrt{3}}} v \underbrace{\cos\theta}_{\frac{\sqrt{3}}{2}} = \frac{v}{2}$$

$$|v_e| = \sqrt{v_{e,n}^2 + v_{e,t}^2} = \frac{v}{\sqrt{2}}$$

$$T_f = \frac{mv^2}{2}$$

$$T_e = \frac{mv_e^2}{2} = \frac{mv^2}{4}$$

$\therefore$ 50% förlust av T