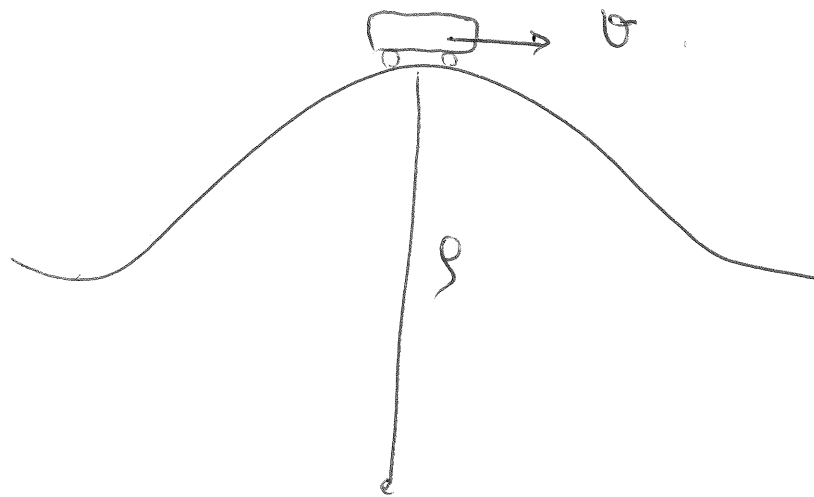
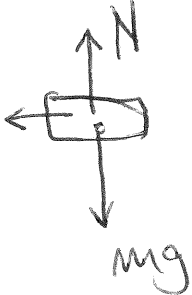


EXEMPEL

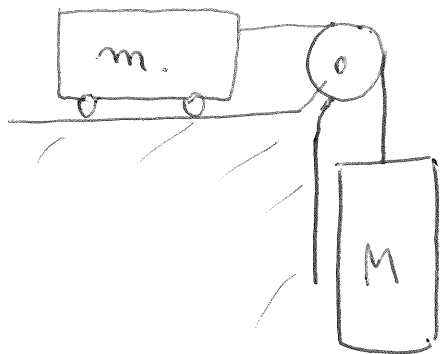


FRILÄGG:  $mg - N = m \frac{v^2}{\rho}$

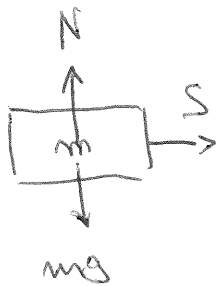
The free-body diagram shows a rectangular car with four forces acting on it: a normal force N pointing upwards, a gravitational force mg pointing downwards, and a friction force F_r pointing to the left.

Bilen tappar kontakt med marken
när $N = 0 \Rightarrow v = \sqrt{g\rho}$

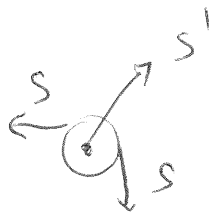
EXEMPEL.



ingen friktion
masslös rep och trissa.



$$S = ma$$



$$Mg - S = Ma \quad (\text{OBS!})$$

VARNING FÖR
JÄMVRTSTÄNKANDE!

$$\begin{cases} S = ma \\ Mg - S = Ma \end{cases}$$

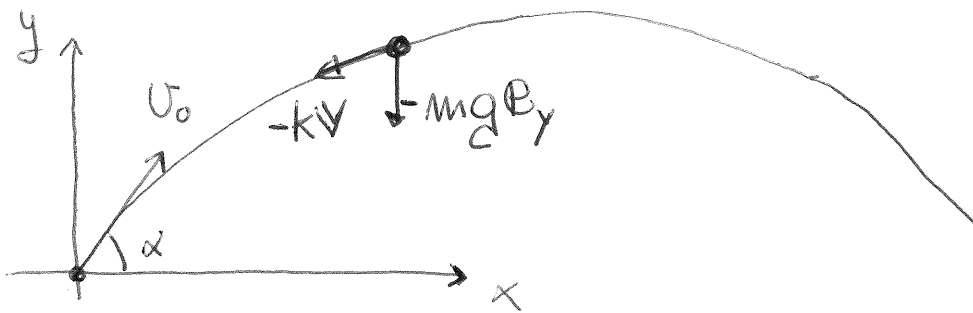
$$\Downarrow$$

$$a = \frac{M}{m+M} g$$

$$S = \frac{mM}{m+M} g$$

(Rimligt? låt $m \ll M$
eller $m \gg M$)

KASTRÖRELSE (PROJECTILE MOTION)



$$X(t_0=0) = Y(t_0=0) = 0$$

UTAN LUFTMOTSTÅND:
($k=0$)

$$\begin{cases} m\ddot{x} = 0 \\ m\ddot{y} = -mg \end{cases}$$

$$\Rightarrow \begin{cases} x = v_{0x} t = v_0 \cos \alpha \cdot t \\ y = v_{0y} t - \frac{1}{2} g t^2 = v_0 \sin \alpha t - \frac{1}{2} g t^2 \end{cases}$$

$$\Rightarrow y = -\frac{g}{2v_0^2 \cos^2 \alpha} x^2 + \tan \alpha x \quad (\text{Parabel})$$

MED LUFTMOTSTÅND:
(AIR RESISTANCE)

$$\begin{cases} m\ddot{x} = -k\dot{x} & [1] \\ m\ddot{y} = -k\dot{y} - mg & [2] \end{cases}$$

$$[k] = \text{kg/s}$$

$$[1]: \dot{v}_x = -\frac{k}{m} v_x \Rightarrow \frac{dv_x}{v_x} = -\frac{k}{m} dt$$

$$\Rightarrow \int_{v_{x0}}^{v_x} \frac{dv_x'}{v_x'} = -\frac{k}{m} t \Rightarrow \log \frac{v_x}{v_{x0}} = -\frac{kt}{m}$$

$$\Rightarrow v_x = v_{x0} e^{-kt/m} = v_0 \cos \alpha e^{-kt/m}$$

$$\Rightarrow X(t) = \frac{mv_0 \cos \alpha}{k} (1 - e^{-kt/m})$$

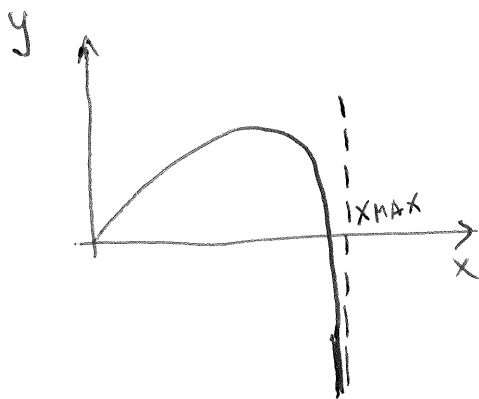
$$[2] \quad \dot{v}_y = -\frac{k}{m} v_y - g \Rightarrow \frac{dv_y}{v_y + \frac{mg}{k}} = -\frac{k}{m} dt$$

$$\Rightarrow \log \frac{v_y + \frac{mg}{k}}{v_{y0} + \frac{mg}{k}} = -\frac{k}{m} t$$

$$\Rightarrow v_y + \frac{mg}{k} = \left(v_{y0} + \frac{mg}{k}\right) e^{-\frac{kt}{m}}$$

$$\Rightarrow v_y = -\frac{mg}{k} + \left(v_0 \sin \alpha + \frac{mg}{k}\right) e^{-\frac{kt}{m}}$$

$$\Rightarrow y = -\frac{mg}{k} t + \left(v_0 \sin \alpha + \frac{mg}{k}\right) \frac{m}{k} \left(1 - e^{-\frac{kt}{m}}\right)$$



$$\lim_{t \rightarrow \infty} v_x = 0$$

$$" \quad x = \frac{m v_0 \cos \alpha}{k}$$

$$" \quad v_y = -mg/k$$

$$" \quad y = -\infty$$

GRÄNSHASTIGHETEN : $v_g = mg/k \Rightarrow k = \frac{mg}{v_g}$
(LIMITING VELOCITY)

$$x_{\max} = \frac{m v_0 \cos \alpha}{k} = \frac{v_0 v_g \cos \alpha}{g}$$