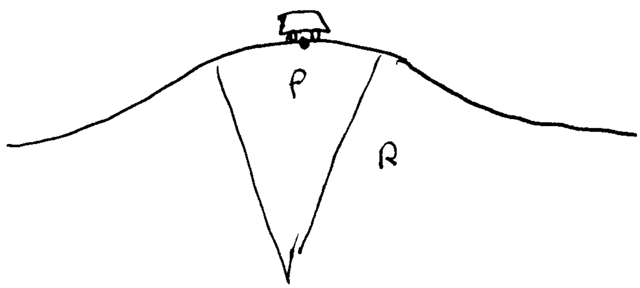
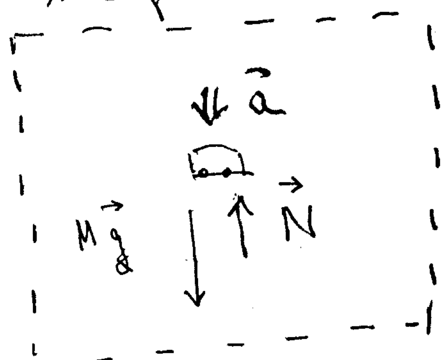
L1

a) Frilegeme-diagram
Bilen tenkes isolert fra omgivelsene som erstattes med krefter



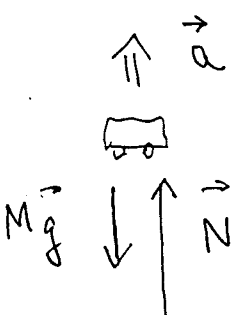


$$Mg - N = Ma = M\frac{V_0^2}{R}$$

$$\underline{N = Mg\left(1 - \frac{V_0^2}{gR}\right)}$$

Når $V_0 \to \sqrt{gR}$ vil $N \to 0$
For $V > V_0$ vil bilen lette fra bakken.

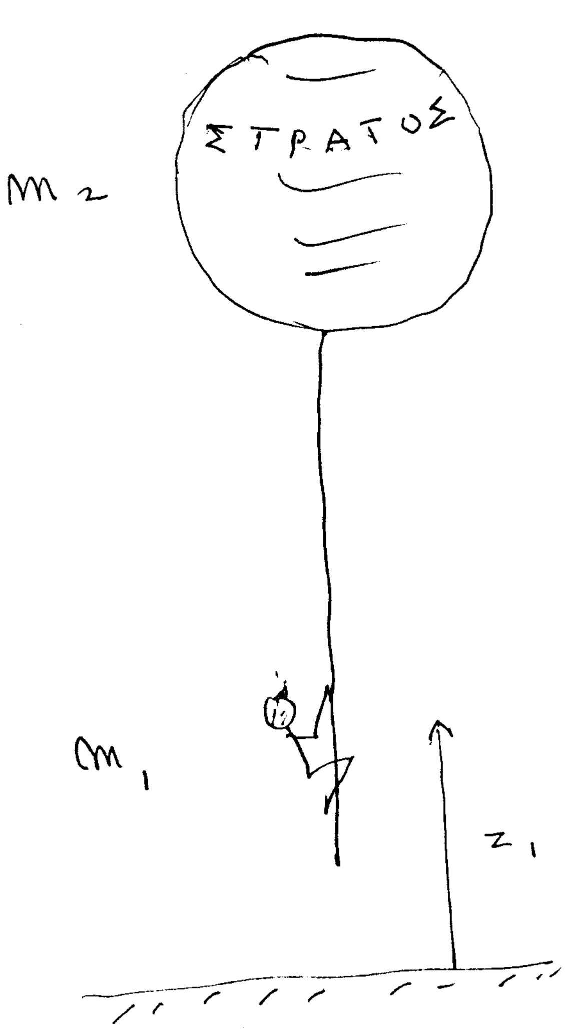
b)



$$N - Mg = Ma = M\frac{V_0^2}{R}$$

$$\underline{N = Mg\left(1 + \frac{V_0^2}{R}\right) > Mg}$$

L2



Ingen netto ytre kraft.
Massesenterets posisjon endres ikke.

$$Z_{før} = \frac{1}{m_1+m_2}\left[m_1 Z_1 + m_2 Z_2\right]$$

$$Z_{etter} = \frac{1}{m_1+m_2}\left[m_1(Z_1+\Delta_1) + m_2(Z_2+\Delta_2)\right]$$

mannens forskyvn. — ballongens forskyvn.

$$Z_{før} = Z_{etter} \Rightarrow$$

$$m_1 Z_1 + m_2 Z_2 = m_1(Z_1+\Delta_1) + m_2(Z_2+\Delta_2) \Rightarrow$$

$$m_1\Delta_1 + m_2\Delta_2 = 0 \qquad \Delta_2 = -\frac{m_1}{m_2}\Delta_1 .$$

Ballongen senkes

$\Delta_2 << \Delta_1$ for $m_2 >> m_1$

Rimelig.

L3

$$MA = F \Rightarrow M \frac{dV}{dt} = -rV^2$$

(dropper komponentindex da bevegelsen bare kan gå i opprinnelig bev. retn.)

Separasjon:

$$\frac{dV}{V^2} = -\frac{r}{M}\,dt$$

Integrasjon

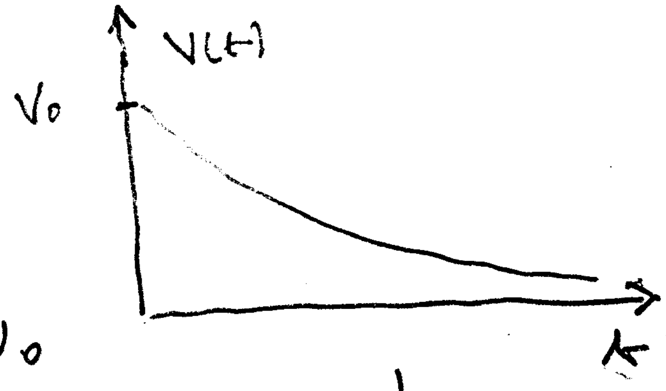
$$\int \frac{dV}{V^2} = -\frac{r}{M}\int dt$$

$$-\frac{1}{V} = -\frac{r}{M}t + \underbrace{K}_{\text{Int. konst}}$$

Randbetingelse bestemmer K

$$-\frac{1}{V_0} = -\frac{r}{M}\cdot 0 + K \qquad K = -\frac{1}{V_0} \Rightarrow$$

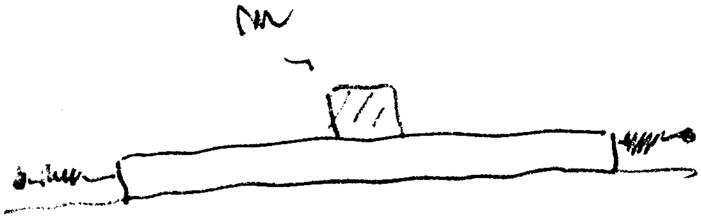
$$\frac{1}{V} = \frac{1}{V_0} + \frac{r}{M}t = \frac{1}{V_0}\left(1 + \frac{rV_0}{M}t\right)$$



$$\underline{V(t) = \frac{V_0}{1 + \frac{rV_0}{M}t}}$$

Kontroll: $t = 0 \quad V(0) = V_0$

$t \to \infty \quad V(t) \to 0$ Rimelig!



Harmonisk svingning

$$x(t) = A\cos\omega t = A\cos\left(\frac{2\pi}{T}t\right)$$

Akselerasjon

$$a(t) = \frac{d^2x}{dt^2} = -\left(\frac{2\pi}{T}\right)^2 A\cos\left(\frac{2\pi}{T}t\right).$$

Største akselerasjon i bevegelsens ytterpunkter

$$|a_{max}| = \left(\frac{2\pi}{T}\right)^2 A$$

Når pakken følger plattformen, har den samme akselerasjon!

Max. kraft på pakken

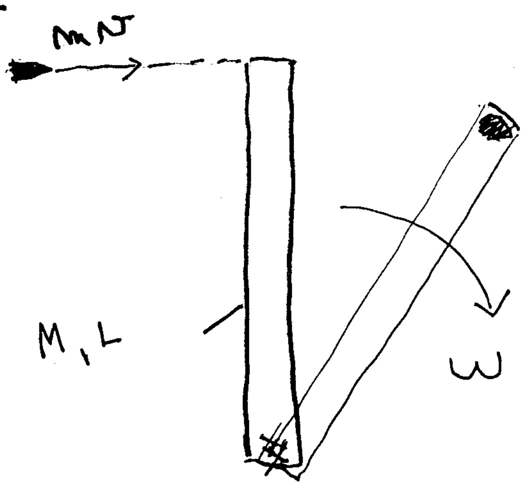
$$F_{max} = m\left(\frac{2\pi}{T}\right)^2 A$$

Kraften på pakken overføres via friksjon

$$f_{max} = F_{max} = m\left(\frac{2\pi}{T}\right)^2 A \leq \mu m g$$

$$m\left(\frac{2\pi}{T}\right)^2 A_0 = \mu m g \Rightarrow A_0 = \left(\frac{T}{2\pi}\right)^2 \mu g$$

L5.



a) Ikke ytre kraft-moment om aksen på system stav + kule ⇒ totale spinn om A bevart.

$$\underbrace{mvL}_{\text{før}} = \underbrace{I_{tot}\,\omega}_{\text{etter}}$$

$$I_{tot} = \left(\frac{M}{3} + m\right)L^2$$

$$\omega = \frac{mvL}{I_{tot}} \Rightarrow$$

$$\omega = \frac{mv}{(M/3+m)L}$$

$[\omega] = s^{-1}$ OK.

b) $$K_r = \frac{1}{2} I_{tot}\,\omega^2 = \frac{1}{2} I_{tot}\left(\frac{mvL}{I_{tot}}\right)^2 \Rightarrow$$

$$K_r = \frac{m^2v^3}{2(M/3+m)} = K_0\,\frac{3m}{M+3m}$$

c) $$\frac{K_r}{K_0} = \frac{3m}{M+3m}$$
→ $\frac{3m}{M} \ll 1$ for $m \ll M$
→ 1 for $m \gg M$

$m \ll M$: Hele (nesten) all kin. energi går tapt til varme. Sml. uel. støt med vegg.

$m \gg M$: Ingen (nesten) energi tapes.