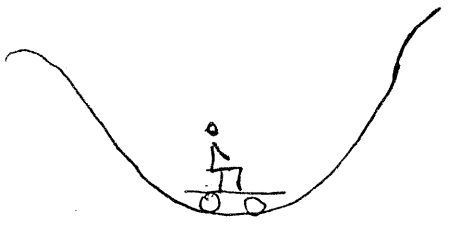
a)



↓ Tyngdekraft mg

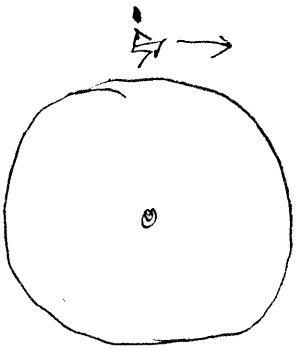
↑ Kraft fra sete F

$$F - mg = \frac{mv^2}{R} \Rightarrow$$

$$F = mg + \frac{mv^2}{R} = mg\left(1 + \frac{v^2}{gR}\right)$$

$$F/mg = 1 + \frac{v^2}{gR} = 1 + \frac{10^2}{10 \cdot 10} = 2$$

b)

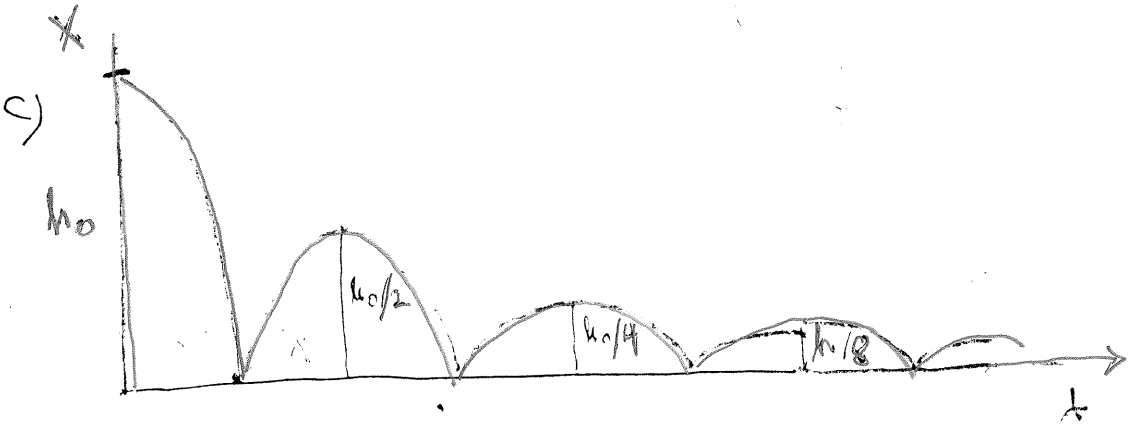


$$M = \frac{4\pi}{3} R^3 \rho$$

$$\frac{mMG}{R^2} = \frac{mv^2}{R} \Rightarrow$$

$$v = \left(\frac{MG}{R}\right)^{1/2} = \left(\frac{4\pi}{3}\rho G\right)^{1/2} R \approx 5\,\text{m/s}$$

c)



$$\frac{1}{2} m v_0^2 = mgh_0$$

$$\frac{1}{2} m v_1^2 = mgh_1$$

$$h_1/h_0 = \frac{v_1^2}{v_0^2} = \frac{1}{2}$$

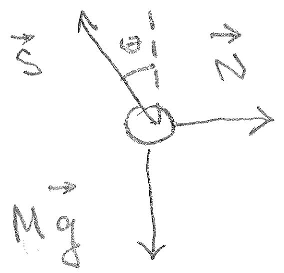
$$h_1 = h_0/2 \quad h_2 = h_0/4 \ \ldots$$

$$L = h_0 + 2h_1 + 2h_2 + \cdots = 2(h_0 + h_1 + h_2 + \cdots) - h_0$$

$$2h_0\left(1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \cdots\right) \quad 2h_0 \frac{1}{1 - 1/2} - h_0 = 3h_0$$

L 2:

a) Vertikal likevekt

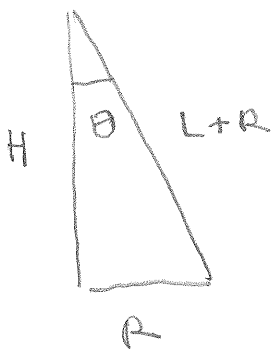


$$Mg = S\cos\theta \;\Rightarrow\; S = Mg/\cos\theta \qquad (1)$$

Horisontal likevekt

$$N = S\sin\theta = Mg\,tg\,\theta \qquad (2)$$

θ bestemt av:



$$H = [(L+R)^2 - R^2]^{1/2} = [L(L+2R)]^{1/2}$$

$$\cos\theta = \frac{H}{L+R}, \quad tg\,\theta = \frac{R}{H} \;\Rightarrow$$

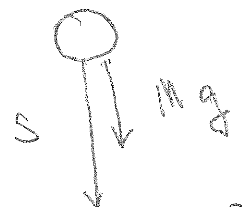
$$\underline{S = Mg\frac{L+R}{\sqrt{L^2+2LR}}} \qquad \underline{N = Mg\frac{R}{\sqrt{L^2+2LR}}}$$

Spm: $L \gg R \;\Rightarrow\; \underline{S \to Mg}\,;\; \underline{N \to Mg\frac{R}{L} \to 0}$

b) Energibevarelse

$$\frac{1}{2}Mv_0^2 = \frac{1}{2}Mv^2 + 2MgL \;\Rightarrow\; \underline{v = \sqrt{v_0^2 - 4gL}}$$

Topp-pkt.



$$S + Mg = \frac{Mv^2}{L} \;\Rightarrow$$

$$S = \frac{Mv_0^2}{L} - 4Mg - Mg = \underline{M\left[\frac{v_0^2}{L} - 5g\right]}$$

Sirkelbane krever

$$S \geq 0 \;\Rightarrow\; \underline{v_0 \geq \sqrt{5gL}}$$

L 2.

a) $v_x(t) = v_0 e^{-\frac{b}{m}t} \Rightarrow$

$$F_x = m a_x = m \frac{dv_x}{dt} = m\left(-\frac{b}{m}\right) v_0 e^{-\frac{b}{m}t}$$

$$F_x = -b v_0 e^{-\frac{b}{m}t} = \underline{-b v_x}.$$

b: mål for f. eks. luft/væskemotstand.

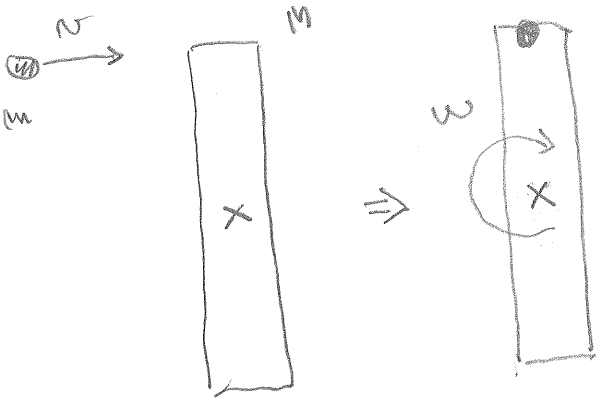
b) $$W = \int_{t=0}^{\infty} F_x \, dx = \int_0^{\infty} F_x v_x \, dt = -b \int_0^{\infty} v_x^2 \, dt$$

$$= -b v_0^2 \int_0^{\infty} e^{-\frac{2b}{m}t} \, dt = \frac{1}{2} m v_0^2 \left[e^{-\frac{2b}{m}t} \right]_0^{\infty}$$

$$\underline{W = -\frac{1}{2} m v_0^2 = -E_k}$$

Friksjonsarbeid i kalvedi lik kins. energi
Hele den opprinnelige energi går tapt.

L 3. a)



Spin-bevarelse om akselen:

$$mv \cdot \frac{L}{2} = I\omega$$

$$I = \underbrace{\frac{1}{12}ML^2}_{\text{stav}} + \underbrace{m\left(\frac{L}{2}\right)^2}_{\text{kule}}$$

$$= \frac{1}{12}[M + 3m]L^2$$

$$\omega = \frac{6mv}{[M+3m]L}$$

b) Spes: $m \ll M \Rightarrow \omega \approx \frac{6mv}{ML}$

$$E_{rot} = \frac{1}{2}I\omega^2 \approx \frac{1}{2} \cdot \frac{1}{12}ML^2 \cdot \left(\frac{6mv}{ML}\right)^2$$

$$= \frac{3}{2}\frac{m^2}{M}v^2 = 3\frac{m}{M} \cdot \frac{1}{2}mv^2 :$$

$$E_{rot} \approx 3\frac{m}{M}E_K \ll E_K$$

Diffusjon: strukturendring av E_K gir til deformasjon/energi / varme.