Saglabāšanās likumi

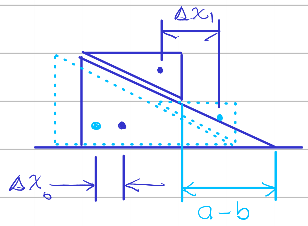
1

Sākumā: $H_{cm} = L + \frac{1}{4}L = \frac{5}{4}L$

Beigās: $H_{cm} = \frac{3}{4}L$

Laiks: $t = \sqrt{2\Delta H/g} = \sqrt{2\times\frac{1}{2}L/g} = \underline{\underline{\sqrt{L/g}}}$

2



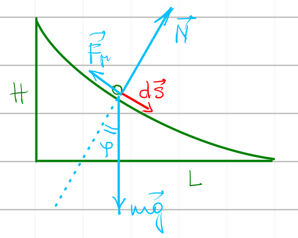
$m_0\Delta x_0 = m_1\Delta x_1$

$\Delta x_1 = a - b - \Delta x_0$

$m_0\Delta x_0 = m_1(a-b) - m_1\Delta x_0$

$$\underline{\underline{\Delta x_0 = (a-b)\frac{m_1}{m_0+m_1}}}$$

3



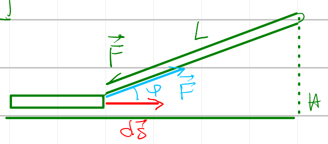
$F_\mu = \mu m g\cos\varphi$

$$A_\mu = -\int F_\mu\, ds = -\mu m g\int \overbrace{ds\cos\varphi}^{dx} = -\mu m g L$$

$$\Delta W_K = A_\mu - \Delta W_p = -\mu m g L + m g H$$
$$= mg(H - \mu L)$$

$W_K \sim v^2 \Rightarrow \underline{\underline{v_a = v_b = v_c}}$

4

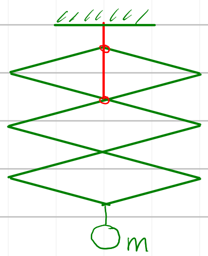


$$A_F = -\int F\, ds\cos\varphi = -F\int_{2L}^{2H} dl$$

$$\Delta W_K = A_F = F(2L - 2H)$$

$$v = \sqrt{\frac{2\Delta W_K}{m}} = \underline{\underline{2\sqrt{\frac{F(L-H)}{m}}}}$$

5

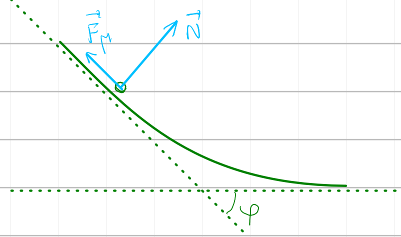


Virtuālie pārvietojumi (masa pārvietojas uz leju pa dh)

$\Delta W_p = -mg\,dh$, $\quad A_T = -T\frac{dh}{3}$.

$\Delta W_p = A_T \Rightarrow \underline{\underline{T = 3mg}}$

6



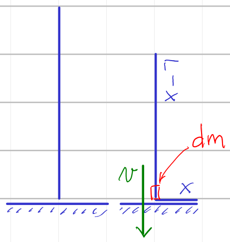
$$N = m v^2/r = 2W_k/r$$

$$dW_k = d'A_\mu = -\mu N\, ds = -2\mu W_k \overbrace{ds/r}^{d\varphi}$$

$$= -2\mu W_k\, d\varphi$$

$$\frac{dW_k}{W_k} = -2\mu\, d\varphi\, ; \qquad \underline{\underline{W_k = W_{k0}\, e^{-2\mu\varphi}}}$$

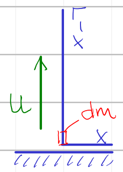
7



$$F = \frac{x}{L} mg + \frac{v\,dm}{dt} = \frac{x}{L} mg + \frac{v^2 dm}{dx} = \left[\begin{array}{l} v^2 = 2gx \\ \frac{dm}{dx} = \frac{m}{L} \end{array}\right] =$$

$$= \frac{x mg}{L} + \frac{2gx\,m}{L} = \underline{\underline{3mg\frac{x}{L}}}$$

8

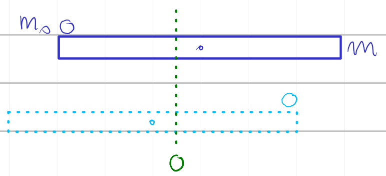


$$F = \frac{x}{L} mg + \frac{dm \cdot u}{dt} = \left[\begin{array}{l} dm = m\frac{dx}{L} \\ \frac{dx}{dt} = u \end{array}\right] = \frac{x}{L} mg + \frac{m\,dx \cdot u}{L\,dt} =$$

$$= \frac{x}{L} mg + \frac{m u^2}{L} = \frac{m}{L}\left(gx + u^2\right).$$

Pieņemot, ka kobra vēl tikai gatavojas, $x = L$ un $\underline{\underline{F = m/L\,(gL + u^2)}}$.

9 (a)

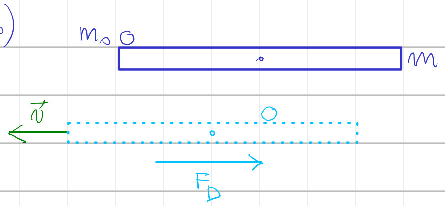


$$\begin{cases} m_0 x_0 = m x \\ x_0 + x = L/2 \end{cases} \longrightarrow \begin{array}{l} x_0 + \frac{m_0}{m} x_0 = \frac{L}{2} \\ x_0 = \frac{L}{2} / \left(1 + \frac{m_0}{m}\right) \end{array}$$

$$S_{0x} = 2x_0 = \underline{\underline{\frac{mL}{m + m_0}}}$$

$$S_x = -2x = 2x_0 - L = \underline{\underline{-\frac{m_0 L}{m + m_0}}}$$

(b)

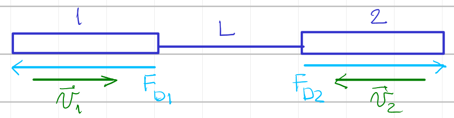


$$\Delta\vec{p} = \int_0^\infty \vec{F}_D\, dt = -\int_0^\infty \beta \underbrace{\vec{v}\, dt}_{d\vec{s}} = -\beta\vec{s}.$$

$$\vec{p}_i = \vec{p}_f = \vec{0} \Rightarrow \Delta\vec{p} = 0 \Rightarrow \underline{\underline{\vec{s} = \vec{0}}}$$

$$S_{0x} = S_x + L = \underline{\underline{L}}$$

10



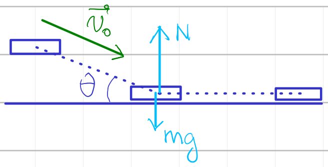
$$\vec{s}_1 = -\vec{s}_2 \Rightarrow \underline{\underline{s_1 = s_2 = \frac{L}{2}}}$$

$$\Delta\vec{p} = \int_0^\infty \left(\vec{F}_{D1} + \vec{F}_{D2}\right) dt =$$

$$= -\beta\int_0^\infty \left(\vec{v}_1\, dt + \vec{v}_2\, dt\right) =$$

$$= -\beta\left(\vec{s}_1 + \vec{s}_2\right) = \vec{0}$$

11



Sadursmes laikā

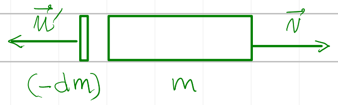
$$\begin{cases} m\,dv_x = -\mu N\,dt \\ m\,dv_y = (mg - N)\,dt \end{cases}$$

$$\cancel{m}\,dv_x = \mu\cancel{m}(dv_y - g\,dt) \rightsquigarrow \Delta v_x = \mu(\Delta v_y - g\tau)$$

$$\Delta v_x = -\mu\left(v_0\sin\theta + \cancel{g\tau}^{\,0}\right) = -\mu v_0\sin\theta$$

$$\underline{\underline{v_x(t) = v_0(\cos\theta - \mu\sin\theta) - \mu g t}}$$

12



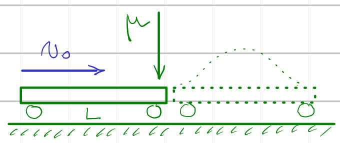
$$\vec F_{net} = \vec 0 \Rightarrow$$

$$m\vec v = (m+dm)(\vec v + d\vec v) + (\vec v + \vec u')(-dm)$$

$$\cancel{\vec v\,dm} + m\,d\vec v - (\cancel{\vec v} + \vec u')\,dm = \vec 0$$

$$\frac{dm}{m} = \frac{dv_x}{u'_x} \Rightarrow \ln\frac{m}{m_0} = \frac{v}{-u} \rightsquigarrow \underline{\underline{v = u\ln\frac{m_0}{m}}}$$

13



$$\vec F_{net} = \vec 0 \Rightarrow$$

$$mv_x = (m + \mu dt)(v_x + dv_x)$$

$$m\,dv_x + \mu v_x dt = 0$$

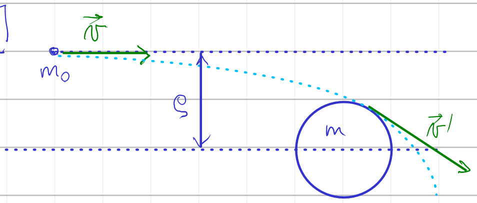
$$\frac{dv_x}{v_x} = -\frac{\mu dt}{m} = \left[m = m_0 + \mu t\right] =$$

$$= -\mu\frac{dt}{m_0+\mu t} \Rightarrow \ln\frac{v_x}{v_{0x}} = -\ln\frac{m_0+\mu t}{m_0}$$

$$v_x = v_{0x}\frac{m_0}{m_0+\mu t} \ ; \quad L = \int_0^\tau \frac{v_{0x}m_0}{m_0+\mu t}\,dt = \frac{v_{0x}m_0}{\mu}\ln\frac{m_0+\mu\tau}{m_0}$$

$$\underline{\underline{\mu\tau = m_0\left[\exp\left(\frac{\mu L}{m_0 v_0} - 1\right)\right]}}$$

14



$$\vec M_{net} = \vec 0 \Rightarrow \cancel{m_0}v\rho = \cancel{m_0}v'R$$

$$A_{nc} = 0 \Rightarrow \frac12\cancel{m_0}v^2 = \frac12\cancel{m_0}v'^2 - G\frac{m\cancel{m_0}}{R}$$

$$\rho = \frac{v'R}{v} = \frac{\sqrt{v^2 + 2Gm/R}}{v}R$$

$$\underline{\underline{= R\sqrt{1 + \frac{2Gm}{v^2R}}}}$$

15 $\vec M_{net} = \vec 0 \Rightarrow mr^2\omega = const$

$$dS = r^2\frac{d\varphi}{2} = r^2\omega\frac{dt}{2} \Rightarrow \underline{\underline{S = r_0^2\omega_0\frac{\tau}{2}}}$$