

F1 $m = 150 \text{ g}$

$v = 20 \text{ m/s}$

$\Delta t = 0,01 \text{ s}$

$F_{\text{max}} = 300 \text{ N}$

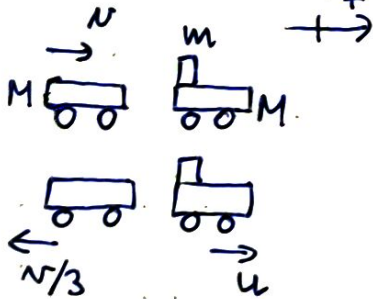
Az ütközéskor fellejövő átlagos erő.

$$\bar{F} = \frac{m \cdot \Delta v}{\Delta t} = \frac{mv}{\Delta t} = 300 \text{ N}$$

Ennél nagyobb erő is fellejövő ütközések, ezért biztos, hogy betörik.

F2

$m = 0,1 \text{ kg}$



Impulzus:

$$Mv = -M\frac{v}{3} + (M+m)u \quad (1)$$

energia:

$$\frac{1}{2}Mv^2 = \frac{1}{2}M\left(\frac{v}{3}\right)^2 + \frac{1}{2}(M+m)u^2 \quad (2)$$

(1): $u = \frac{4M}{3(m+M)}v$

(2)-be írva:

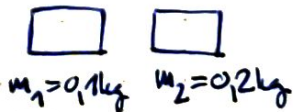
$$Mv^2 = \frac{Mv^2}{9} + (m+M) \cdot \frac{16M^2v^2}{9(m+M)^2}$$

$$\frac{8}{9}M = \frac{16M^2}{9(m+M)}$$

$$M(m+M) = 2M \rightarrow mM = M^2 \rightarrow M = m ; u = \frac{2v}{3}$$

$v_0 = 2,1 \text{ m/s}$

F3

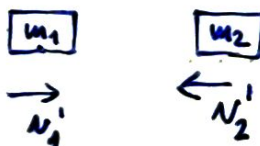


$v_1 = 0,5 \text{ m/s}$



$$v_{TK} = \frac{m_1 v_0 + 0}{m_1 + m_2} = 0,7 \frac{\text{m}}{\text{s}} \quad (\text{jobbára mutat})$$

TK-ban ülvé:



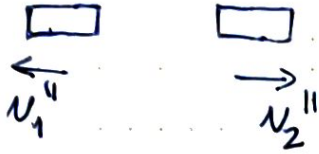
$$v_1' = v_0 - v_{TK} = 1,4 \text{ m/s}$$

$$v_2' = v_{TK} = 0,7 \text{ m/s}$$

ütközés után:

$$v_{TK} = \frac{-m_1 v_1 + m_2 v_2}{m_1 + m_2} \rightarrow v_2 = 1,13 \text{ m/s}$$

TK-hoz képest:



$$v_1'' = v_1 + v_{TK} = 1,2 \text{ m/s}$$

$$v_2'' = v_2 - v_{TK} = 0,6 \text{ m/s}$$

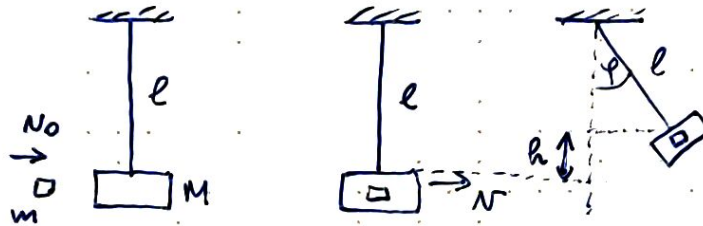
F4

$$M = 5 \text{ kg}$$

$$l = 1 \text{ m}$$

$$m = 0,2 \text{ kg}$$

$$v_0 = 50 \text{ m/s}$$



ütközés pillanatában: $mv_0 = (m+M)v \rightarrow v = \frac{m}{m+M} v_0 = 1,923 \frac{\text{m}}{\text{s}}$

Kilendülésre már érvényes az energiamegmaradás:

$$\frac{1}{2}(m+M)v^2 = (m+M)gh$$

$$h = \frac{v^2}{2g} = l(1 - \cos\varphi)$$

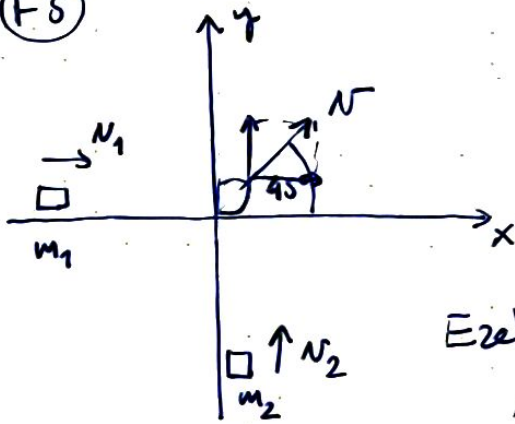
$$\cos\varphi = 1 - \frac{v^2}{2gl} = 1 - \frac{m^2 v_0^2}{2gl(m+M)^2} \rightarrow \varphi \approx 35^\circ$$

$$E_1 = \frac{1}{2} m v_0^2$$

$$E_2 = \frac{1}{2} (m+M) v^2 = \frac{1}{2} \frac{m^2 v_0^2}{m+M}$$

$$\eta = \frac{E_2 - E_1}{E_1} = 1 - \frac{E_2}{E_1} = 1 - \frac{m}{m+M} = 0,96 \text{ (96\%)}$$

FS



$$x: m_1 v_1 = (m_1 + m_2) v \cdot \cos 45^\circ$$

$$y: m_2 v_2 = (m_1 + m_2) v \cdot \sin 45^\circ$$

Ergebnis:

$$v_1 = \frac{m_1 + m_2}{m_1} v \cdot \cos 45^\circ = 106 \frac{\text{km}}{\text{h}} \approx 100 \frac{\text{km}}{\text{h}}$$

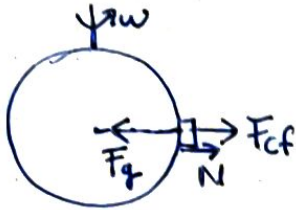
$$v_2 = \frac{m_1 + m_2}{m_2} v \cdot \sin 45^\circ = 53 \frac{\text{km}}{\text{h}} \approx 50 \frac{\text{km}}{\text{h}}$$

F1

$$M = 6,0 \cdot 10^{24} \text{ kg}$$

$$R = 6,4 \cdot 10^3 \text{ km}$$

$$m = 3,0 \text{ kg}$$



A vonzóerő: (a gömbszimmetria miatt használható)

$$F_g = \frac{\gamma m M}{R^2} = 29,33 \text{ N} \approx 29 \text{ N}$$

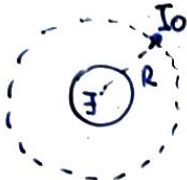
Föld rendszere:

$$F_g = F_{cf} + N$$

$$N = F_g - F_{cf} = F_g - m\omega^2 R = 29,23 \text{ N} \approx 29 \text{ N}$$

$$\frac{N}{F_g} = 99,7\%$$

F2



$$R = 4,22 \cdot 10^5 \text{ km}$$

$$T = 1,77 \text{ nap}$$

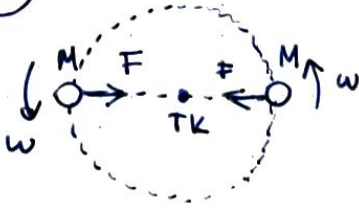
$$m\omega^2 R = \gamma \frac{mM}{R^2}$$

$$\frac{4\pi^2}{T^2} R = \frac{\gamma M}{R^2}$$

$$\frac{R^3}{T^2} = \frac{\gamma M}{4\pi^2} = \text{const.}$$

$$M = \frac{4\pi^2 R^3}{\gamma T^2} = 1,9 \cdot 10^{27} \text{ kg}$$

F3



$$d = 5 \cdot 10^4 \text{ km}$$

$$T = 5 \text{ nap}$$

a) $\frac{\gamma M^2}{d^2} = M\omega^2 \frac{d}{2}$

$$M = \frac{\omega^2 d^3}{2\gamma} = \frac{2\pi^2 d^3}{\gamma T^2} = 2 \cdot 10^{23} \text{ kg}$$

b) $T = \sqrt{\frac{2\pi^2 d^3}{\gamma M}} \Rightarrow T' = \sqrt{\frac{2\pi^2 \cdot 8d^3}{\gamma M}} = 2\sqrt{2} \cdot T \approx 14 \text{ nap}$

F4

Első kozmikus sebesség: a bolygó felhíne felett körpályán keringő test sebessége

$$\frac{\gamma_{\text{MM}}}{R^2} = m \frac{v^2}{R}$$

$$v_{\text{I}} = \sqrt{\frac{\gamma_{\text{M}}}{R}}$$

Energiamegmaradás:

$$-\frac{\gamma_{\text{MM}}}{R} + \frac{1}{2} m v_{\text{I}}^2 = -\frac{\gamma_{\text{MM}}}{h} + 0$$

$$-\frac{\gamma_{\text{M}}}{R} + \frac{1}{2} \cdot \frac{\gamma_{\text{M}}}{R} = -\frac{\gamma_{\text{M}}}{h} \Rightarrow h = 2R \text{ (földfelszínétől méve R)}$$

Második kozmikus sebesség: elhagyjuk a bolygó vonzását

$$-\frac{\gamma_{\text{MM}}}{R} + \frac{1}{2} m v_{\text{II}}^2 = 0 \Rightarrow v_{\text{II}} = \sqrt{\frac{2\gamma_{\text{M}}}{R}} = \sqrt{2} \cdot v_{\text{I}}$$