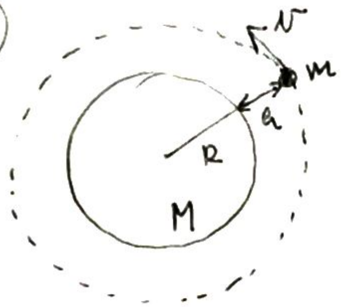
4. Gyakorlat

F1.



$$\frac{\gamma m M}{(R+h)^2} = m \cdot \frac{v^2}{R+h}$$

$$\frac{\gamma M}{R+h} = v^2$$

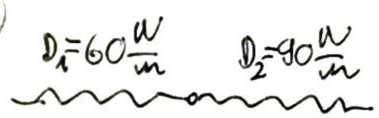
$$v = \frac{2(R+h)\pi}{T}$$, ahol $T = 24\,h$

$$\frac{\gamma M}{R+h} = \frac{4(R+h)^2\pi^2}{T^2} \rightarrow (R+h)^3 = \frac{\gamma M T^2}{4\pi^2}$$

$$h = \sqrt[3]{\frac{\gamma M T^2}{4\pi^2}} - R = 35800\,km$$

F2.

a,



Mindkét rugóban azonos erő ébred:

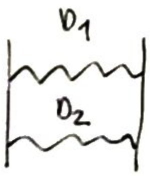
$$F = D_1 \cdot \Delta l_1 = D_2 \cdot \Delta l_2$$

A teljes megnyúlás: $\Delta l = \Delta l_1 + \Delta l_2$. A helyettesítő rugóra:

$$F = D \cdot \Delta l \rightarrow D = \frac{F}{\Delta l_1 + \Delta l_2} = \frac{F}{\frac{F}{D_1} + \frac{F}{D_2}} = \frac{1}{\frac{1}{D_1} + \frac{1}{D_2}} =$$

$$= \frac{D_1 D_2}{D_1 + D_2} = 36\,N/m$$

b,



Mindkét rugó megnyúlása azonos:

$$F_1 = D_1 \cdot \Delta l$$

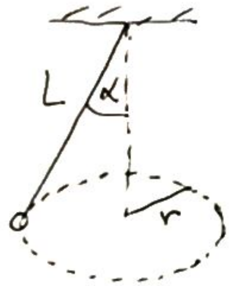
$$F_2 = D_2 \cdot \Delta l$$

A teljes erő: $F = F_1 + F_2$. A helyettesítő rugóra:

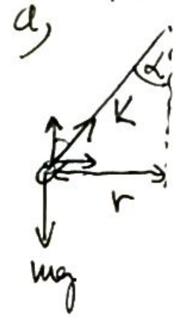
$$F = D \cdot \Delta l \;\rightarrow\; D = \frac{F_1+F_2}{\Delta l} = \frac{D_1 \cdot \Delta l + D_2 \Delta l}{\Delta l} =$$

$$= D_1 + D_2 = 150 \text{ N/m}$$

F3.



a)



$$mg = K \cdot \cos\alpha \rightarrow K = \frac{mg}{\cos\alpha}$$

$$K \cdot \sin\alpha = m \frac{v^2}{r}$$

$$\cancel{m}g \cdot \mathrm{tg}\alpha = \cancel{m}\frac{v^2}{r}$$

$$g \cdot \mathrm{tg}\alpha = \frac{v^2}{r} \quad (2)$$

$L = 50$ cm
$T = 1$ s
$m = 0{,}3$ kg

$$v = \frac{2r\pi}{T} \quad (1)$$

(1) és (2):

$$g \cdot \mathrm{tg}\alpha = \frac{1}{\cancel{r}} \cdot \frac{4r^{\cancel{2}}\pi^2}{T^2} \qquad (r = L \cdot \sin\alpha)$$

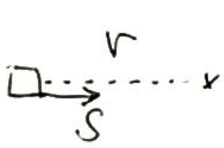
$$g \cdot \mathrm{tg}\alpha = \frac{4\pi^2}{T^2} \cdot L \cdot \sin\alpha$$

$$g \cdot \frac{\cancel{\sin\alpha}}{\cos\alpha} = \frac{4\pi^2}{T^2} L \cancel{\sin\alpha} \rightarrow \cos\alpha = \frac{gT^2}{L \cdot 4\pi^2} \rightarrow \alpha \approx 60°$$

b)

$$K = \frac{mg}{\cos\alpha} = \frac{m\cancel{g}L \cdot 4\pi^2}{\cancel{g}T^2} = 4\pi^2 \frac{mL}{T^2} \simeq 6 \text{ N}$$

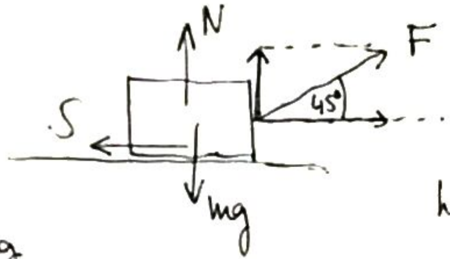
F4.



határesetben: $S = \mu \cdot mg = m \frac{v^2}{r}$

$$v_{max} = \sqrt{\mu g r} = 14 \text{ m/s}$$

F5.



a, $F\cdot\cos 45° = S$ (1)

$mg = N + F\sin 45°$ (2)

határesetben: $S = \mu_0 N$ (3)

$m = 3\,kg$
$\mu_0 = 0{,}5$
$\mu = 0{,}4$

(2): $N = mg - F\sin 45°$

(1) és (3): $F\cdot\cos 45° = \mu_0\cdot N = \mu_0 mg - \mu_0 F\cdot\sin 45°$

$$F = \frac{\mu_0 mg}{\cos 45° + \mu_0 \sin 45°} = 14{,}1\,N$$

b, (1) módosul: $F\cdot\cos 45° - S = ma$ (1')

$mg = N + F\sin 45°$ (2') $\rightarrow N = mg - F\sin 45°$

$S = \mu N$ (3')

(1') és (3'): $F\cdot\cos 45° - \mu(mg - F\sin 45°) = ma$

$F\cdot\cos 45° + \mu F\sin 45° - \mu mg = ma$

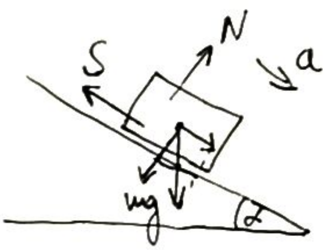
$$a = \frac{F}{m}(\cos 45° + \mu\sin 45°) - \mu g =$$

$$= \frac{\mu_0 g}{\cos 45° + \mu_0 \sin 45°}\cdot(\cos 45° + \mu\sin 45°) - \mu g = \frac{g}{15} = 0{,}07g$$

F6.

$s = 6\,m$
$\alpha = 30°$
$\mu = 0{,}3$

a,



$mg\sin\alpha - \mu mg\cos\alpha = ma$

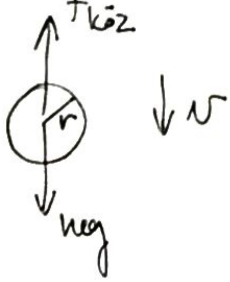
$a = g(\sin\alpha - \mu\cos\alpha) = 0{,}2g$

$$\left.\begin{array}{l} N = \mu mg\cos\alpha \\ S = \mu N \end{array}\right\} S = \mu mg\cos\alpha$$

b) $mg\sin\alpha = \mu_0 mg\cdot\cos\alpha \Rightarrow \mu_0 = tg\alpha \Rightarrow \alpha_{max} = 16^\circ$

F7.

$r = 1mm$



$mg = F_{köz}$

$\varrho\cdot\frac{4}{3}r^{\cancel{3}}\cancel{\pi}g = C\cdot\varrho_{lev}\cdot\cancel{r^2}\cancel{\pi}v^2$

$v = \sqrt{\frac{4\varrho r g}{3C\varrho_{lev}}} = 3{,}3\ m/s$