5.13)

$m = 210\,kg$

$\vec{v}(t) = 310\,km/h = 310 \cdot \frac{1}{3,6}\,m/s = 86,1\,\vec{i}$

$d = 81\,cm = 0,81\,m$

a) $a(t) = ?$ $a = const.$

b) $F = ?$

c) $t_F = ?$

(0,0), u točki udara

F_M
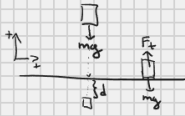
a)

$m\vec{a} = \vec{F_t} + m\vec{g} \;/\vec{j}$

$ma = F_t - mg$

$\ddot{j} = a$

$\frac{d\dot{j}}{dt} = a \quad d\dot{j} = a\,dt /\int$

$\dot{j} = at + C_1 \;(t=0)$

$C_1 = v(t)$

$\dot{j} = at + v(t)$

$\frac{dy}{dt} = at + v(t)$

$dy = (at + v(t))\,dt /\int$

$\dot{x} = at + v(t)$

$y = \frac{1}{2}at^2 + v(t)\,t$

$\dot{y} = at + v(t)$

$at = \ddot{x} - v(t)$

$t = \frac{\ddot{x} - v(t)}{a}$

$y = \frac{1}{2}a\frac{v(t)^2}{a^2} + v(t) \cdot \frac{-v(t)}{a}$

$y = \frac{v(t)^2}{2a} - \frac{v(t)^2}{a} \;\Big|\cdot a$

$a = \frac{v(t)^2}{2y} - \frac{v(t)^2 \cdot 2}{y}$

$a = \frac{v(t)^2 - 2\,v(t)^2}{2y}$

$a = -4576,05\,m/s$

$\boxed{a = -466\,g}$

b) $ma = F_t - mg$

$F_t = ma + mg$

$\boxed{F_t = 9,62 \cdot 10^5\,N}$

c) $t_F = ?$

$y = \frac{1}{2}at^2 + v(t)\cdot 0 \cdot t$

$t^2 = \frac{2y}{a} \quad t = \sqrt{\frac{2y}{a}}$

$\boxed{t = 0,01883\,s}$

5.28) BANANA ♡

$\vec{F_B} = 40N = m\vec{g}$

$\mu_s = 0,40$

$\mu_d = 0,20$

a) $F_{tr_1} = ?$ $F_M = 0$

b) $F_{tr_2} = ?$ $F_M = 6N$ $v(0) = 0$

c) $F_M' = ?$

d) $F_M'' = ?$ $v = const$

e) $F_M''' = 18N$ $F_{tr_3} = ?$ $a = ?$

a) $F_{tr_1} = ?$ $F_M = 0$

$F_{tr_1} = 0$

– ne postoji F_{tr} pošto kutija miruje

b) $F_{tr_2} = ?$ $F_M = 6N$

$m\vec{a} = \vec{F_{tr}} + \vec{F_M} + m\vec{g} + \vec{N}\;(\vec{i})(\vec{j})$

$ma = -F_{tr} + F_M$

$ma = -mg + N$

$1' = F_B \cdot 0,4 = 16N$

$F_M < F_M' \Rightarrow \boxed{F_{tr} = F_M = 6N}$

C) $F_M' = 16N$

d) $F_M'' = ?$ $v = const.$

$F_M'' = \mu_d \cdot F_M'$

$\boxed{F_M'' = 8N}$

e) $F_M''' = 18N$

$F_M''' > F_M' \Rightarrow F_{tr_3} = 40 \cdot 0,2$

$\boxed{F_{tr_3} = 8N}$

$ma = -F_{tr} + F_M$

$a = \frac{-F_{tr} + F_M}{m}$

$\boxed{a = 2,457\,m/s}$

$m = ?$

$40N = mg$

$m = \frac{40}{g} = 4,07\,kg$
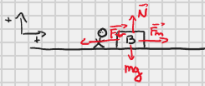
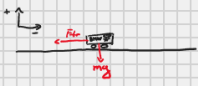## 5.33)

$\mu_d = 0,80$

$v(0) = 28,7\,m/s$

a) $x_{min} = ?$ b) $\mu_d \le 0,25$

$x_{min} = x_{min}$

$v' = ?$

$m\vec{a} = \vec{F_{tr}} + m\vec{g} \;/\vec{i}$

$m\ddot{x} = F_{tr}$

$\ddot{x} = \frac{F_{tr}}{m} = a$

$\frac{d\dot{x}}{dt} = a \quad d\dot{x} = a\,dt /\int$

$\dot{x} = at + C_1 \;(C_1 = v(0))$

$F_{tr} = -mg\cdot\mu_d$

$m\cancel{a} = -\cancel{m}g\mu_d$

$a = -g\mu_d = -7,848$

$\dot{x} = at + v(0)$

$\frac{dx}{dt} = at + v(0)$

$dx = dt(at + v(0)) /\int$

$x = \frac{1}{2}at^2 + v(0)t$

$t = \frac{\dot{x}}{a}$

$x = \frac{1}{2}a\frac{\dot{x}^2}{a^2} + v(0)\frac{\dot{x}}{a}$

$at = -v(0)$

$g\mu_d t = v(0)$

$t = \frac{v(0)}{g\mu_d}$

$\frac{dx}{dt} = at + v(0)$

$\boxed{t = 3,65\,s}$

$x = \frac{1}{2}at^2 + v(0)t$

$\boxed{x = 52,47\,m}$

b) $\mu_d' \le 0,25$

$x' = 52,47\,m$

$v' = ?$

$a' = -g\mu_d' = -2,45\,m/s$

$\ddot{x} = a$

$\frac{d\dot{x}}{dt} = a \quad d\dot{x} = a\,dt$

$\dot{x} = at + C_1 \quad (t=0) \Rightarrow (C_1 = 0)$

$\dot{x} = at \longrightarrow \boxed{\dot{x} = 16,02\,m/s}$

$\frac{dx}{dt} = at$

$t = \sqrt{\frac{2x}{a}}$

$dx =$

$x = \frac{1}{2}at^2$

$\boxed{t = 6,54\,s}$

→ da li možemo da uzmemo
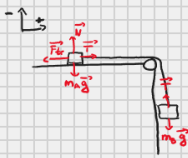da krećemo iz mirovanja

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5.37)

$m_A = 2,25\,kg$

$m_B = 1,30\,kg$

$\mu_d = 0,45$

$v(0) = 0$

a) $v_A = ?$, $v_B = ?$

$x = 3\,cm = 0,03\,m = y$

b) $T = ?$

a)

$m_A\vec{a} = \vec{F_{tr}} + m_A\vec{g} + \vec{T} + \vec{N}\;(\vec{i})$

$m_A\ddot{x} = T - F_{tr}$

$F_{tr} = mg\cdot\mu_d$

$m_B\vec{a} = \vec{T} + m_B\vec{g}\;(\vec{j})$

$m_B\ddot{y} = m_Bg - T$

$\ddot{x} = a$

$\frac{dx}{dt} = a \quad d\dot{x} = a\,dt\;|\int$

$\dot{x} = at + C_1 \;(C_1 = 0)$

$\frac{dx}{dt} = at \quad dx = at\,dt$

$\boxed{x = \frac{1}{2}at^2} \Rightarrow \boxed{y = \frac{1}{2}at^2}$

$m_A\ddot{x} + m_B\ddot{y} = T - F_{tr} - T + m_Bg$

$\ddot{x}(m_A + m_B) = m_Bg - F_{tr}$

$\ddot{x} = \frac{m_Bg - F_{tr}}{m_A + m_B} = \frac{m_Bg - m_Ag\mu_d}{m_A + m_B}$

$\boxed{\ddot{x} = 0,7\,g\,m/s}$

$t^2 = \frac{2x}{a} \quad t = \sqrt{\frac{2x}{a}}$

$\boxed{t = 0,27\,s}$

$\dot{x} = \dot{y} = at$

$\boxed{\dot{x} = \dot{y} = 0,213\,m/s}$

b) $m_A\ddot{x} = T - F_{tr}$

$T = m_A\ddot{x} + F_{tr}$

$T = m_A\ddot{x} + m_A\mu_d g$

$\boxed{T = 11,71\,N}$

5.44)

$r = 220\,m$

$v = 25\,m/s$

a) $\mu_d' = ?$

b) $v_{max} = ?$

a) $\boxed{a(n) = \frac{v^2}{r}}$

$m\vec{a} = \vec{F_{tr}} + m\vec{g}\;(\vec{i})$

$ma = F_{tr}$

$\vec{F_{tr}} = mg\mu_d$

$ma = mg\mu_d$

$m\frac{v^2}{r} = mg\mu_d$
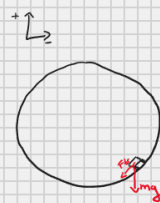
$\frac{v^2}{r} = g\mu_d$

$\mu_d = \frac{v^2}{rg}$

$\boxed{\mu_d = 0,289}$

b) $\mu_d' = \frac{\mu_d}{3}$

$Rg = const = \frac{v^2}{\mu_d}$

$\frac{v^2}{\mu_d} = \frac{v_{max}^2}{\mu_d'}$

$v_{max}^2 = \frac{\mu_d' v^2}{\mu_d}$

$v_{max} = \sqrt{\frac{\mu_d' v^2}{\mu_d}} = \sqrt{\frac{\mu_d}{3}}\,v \cdot \frac{1}{\mu_d}\,v$

$v_{max} = \sqrt{\frac{\mu_d}{3\mu_d}}\,v = \sqrt{\frac{1}{3}}\,v$

$\boxed{v_{max} = 14,43\,m/s}$

5.46)

$l_n = 3\,m$

$l_2 = 5\,m$

Modul 5 - Zadaci

5,46)

$\ell_x = 3m$

$\ell_e = 5m$

a) $t_k = ? \Rightarrow \boxed{T = ?}$

$\alpha = 30°$

$\sin 30 = \dfrac{\ell'}{5}$ $\ell' = 5\sin 30° = 5 \cdot \dfrac{1}{2} = 2,5m$
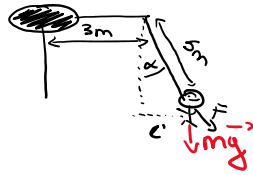
$R = 3m + 2,5m$

$\boxed{R = 5,5m}$

$\vec{F_y} = m\vec{a} = m\vec{g} \; /\vec{j}$

$F_y = ma_k = mg$

$\cos\alpha = \dfrac{mg}{F}$ $\boxed{F = \dfrac{mg}{\cos\alpha}}$

$\dfrac{m\upsilon^2}{R\sin\alpha} = \dfrac{mg}{\cos\alpha}$

$\upsilon^2 = \dfrac{Rg\sin\alpha}{\cos\alpha} = Rg\,tg\alpha$

$\upsilon = \sqrt{Rg\,tg\alpha}$

$\boxed{\upsilon = 5.58 \, m/s}$ $\upsilon = \dfrac{2\pi R}{T}$

$\boxed{T = 6,19s}$ $\boxed{T = \dfrac{2\pi R}{\upsilon}}$
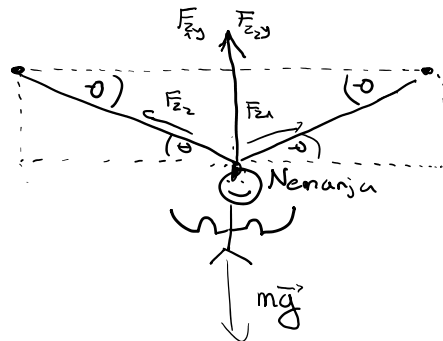
$\sin\alpha = \dfrac{ma_k}{F}$ $F\sin\alpha = ma_k$

$F\sin\alpha = m\dfrac{\upsilon^2}{R} \Rightarrow F = \dfrac{m\upsilon^2}{R\sin\alpha}$

5.56) $m_h = 90kg$

$F_{max} = 2,5 \cdot 10^4 N$

a) $\theta = 10°$

$F_z = ?$ $F_z = F_{z_2} = F_{z_1}$

→ zaustavio se ⇒ zbir svih sila je jednak 0
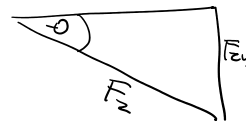
$\vec{F_{zy}} = \sin\theta \cdot F_z$ $\vec{F} = m\vec{a} = m\vec{g} + \sin\alpha F_{z_1} + \sin\alpha F_{z_2} \; /\vec{j}$

$F = -mg + \sin\alpha (F_{z_1} + F_{z_2})$

$-mg + 2F_z \sin\alpha = 0$

$2F_z \sin\alpha = mg$

$F_z = \dfrac{mg}{2\sin\alpha}$ $\boxed{F_z = 2542N}$

b) $F_z = 2,5 \cdot 10^4$ $\theta = ?$

$2,5 \cdot 10^4 = \dfrac{mg}{2\sin\theta}$

$\sin\theta = \dfrac{mg}{5 \cdot 10^4}$ $\theta = \arcsin\left(\dfrac{mg}{5 \cdot 10^4}\right)$

$\boxed{\theta = 1,01°}$

5.59) $m = 45 kg$

$2R = 32 cm$

$\boxed{R = 16 cm}$
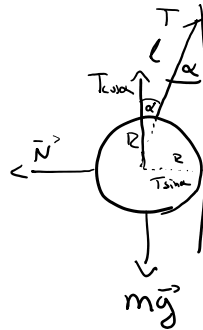
$\ell = 30 cm$

$\sin \alpha = \dfrac{R}{R+\ell} = \dfrac{16}{46}$

$\alpha = \arcsin\left(\dfrac{16}{46}\right)$ $\boxed{\alpha = 20{,}35°}$

$\vec{F_y} = 0$ $F = m\vec{a} = m\vec{g} + \vec{N} + \vec{F_{zy}} + \vec{F_{zx}} \; / \vec{j} \; / \vec{i}$

$F_{zy} = T\cos\alpha$ $F_y = -mg + F_{zy}$

$0 = -mg + T\cos\alpha$ $T\cos\alpha = mg$ $T = \dfrac{mg}{\cos\alpha}$ $\boxed{T = 470 N}$

b) $\vec{F_x} = 0$

$F_{zx} = T\sin\alpha$
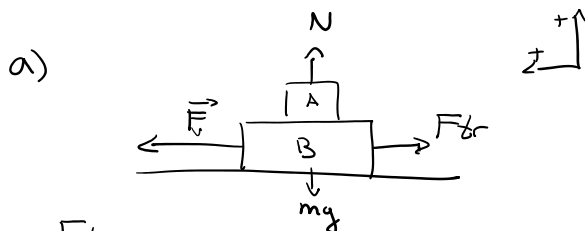
$F_x = -N + F_{zx}$

$N = F_{zx} = T\sin\alpha$

$\boxed{N = 163 N}$

$\Rightarrow$ tražena sila pritiskanja je usmerena udesno

5.73) $Q_A = 2{,}4 N$ $Q_A = m_A g$

$Q_B = 3{,}6 N$ $\boxed{m_x = \dfrac{Q_x}{g}}$

$\mu_d = 0{,}3$

a)
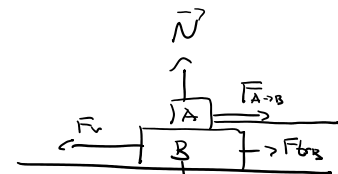

$F_{tr} = \mu m g$ $a = 0$ $(v = const.)$

$\vec{F} = m\vec{a} = m\vec{g} + \vec{N} + \vec{F_{tr}} + \vec{F_v} \; / \vec{i}$

$m\overset{0}{\cancel{a}} = -F_{tr} + F_v$

$F_v = F_{tr}$ $F_v = F_{tr} = \mu g (m_A + m_B) = \mu g \left(\dfrac{Q_A}{g} + \dfrac{Q_b}{g}\right) = \dfrac{\mu g}{g}(Q_A + Q_B) = \mu (Q_A + Q_B)$

$\boxed{F_v = 1{,}8 N}$

b)

$\vec{F} = m\vec{a} = m_B \vec{g} + \vec{N} + \vec{F_v} + \vec{F_{A \to B}} + \vec{F_{trB}} \; / \vec{i}$

$m_B \vec{a} = F_v - F_{A \to B} - F_{trB}$

$F_{trB} = m_B g \mu$

$F_{A \to B} = m_A g \mu = \dfrac{Q_A}{g} g \mu = Q_A \mu$

$F_{A \to B} = 0{,}72$

$F_v = F_{A \to B} + F_{trB}$ $\boxed{F_v = 2{,}52 N}$

5.80) $\alpha = 67°$

$\vec{F} = m\vec{a} = \vec{F_z} \; / \vec{j}$
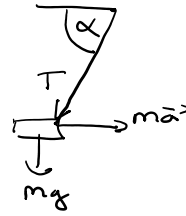

$F_z \cos\alpha = ma$ $F_z \sin\alpha = mg$

$$F_z \cos\alpha = ma \qquad F_z \sin\alpha = mg$$

$$F_z = \frac{ma}{\cos\alpha} \qquad F_z = \frac{mg}{\sin\alpha}$$

$$\frac{ma}{\cos\alpha} = \frac{mg}{\sin\alpha} \qquad a = \frac{g\cos\alpha}{\sin\alpha} = g \cdot tg\alpha$$

$$\boxed{a = 4,16 \, m/s^2}$$

5.106)

$$v_o = \frac{3mg}{k} \qquad\qquad \frac{dv}{dt} = g - kv$$

$$F_{vtr} = kv \qquad\qquad dv = \left(g - \frac{k\,v}{m}\right)dt + \int$$

$$v(t) = ? \qquad\qquad v(t) =$$

$$m\frac{dv}{dt} = mg - kv$$

5.120)

$$m = 1,6 \, kg$$
$$v = 12 \, m/s$$
$$R = 5m$$

a)
$$\vec{F_y} = m\vec{g} + m\vec{a_k} \ / \vec{j}$$
$$N = mg + ma_k$$
$$N = mg + m\frac{v^2}{R}$$
$$\boxed{N = 61,776 N}$$

b)

$$F_y = N = mg - m a_k$$
$$\boxed{N = -30,38 N}$$