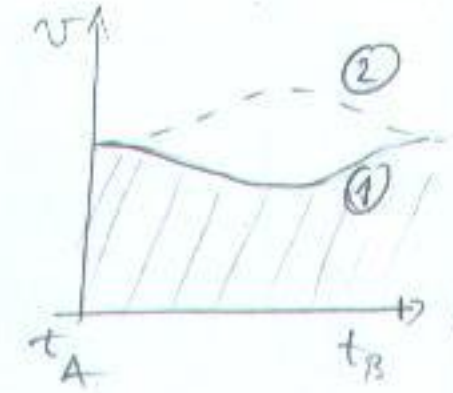
(1) (A) v_x/t graf

KAD BI BILA ISTA VREMENA ($t_A = t_B$)



→ očito bi 2. tijelo došlo dalje jer je put (POVRŠINA!) veći

$\Rightarrow t_2 < t_1$

(ILI)

tj. $s_{AB} = \int_0^{t_1} v_{x1}(t)\,dt = \overline{v_{x1}}\,\Delta t_1$

$ds = v\,dt$ ↗

$s_{AB} = \int_0^{t_2} v_{x2}(t)\,dt = \overline{v_{x2}}\,\Delta t_2$

↑

SREDNJA BRZINA U x-SMJERU

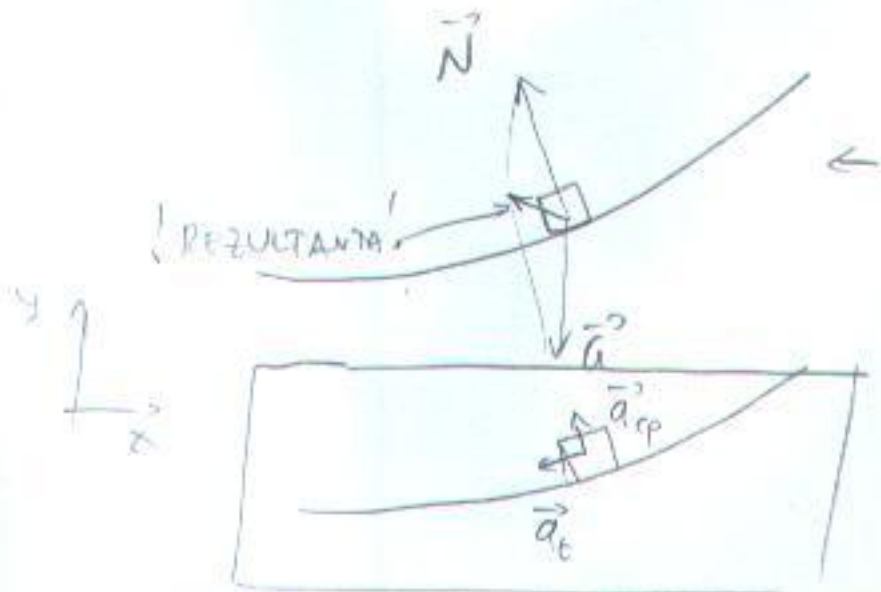
no $\overline{v_{x1}} < \overline{v_{x2}}$ jer ① usporava, a ② ubrzava u x-smjeru

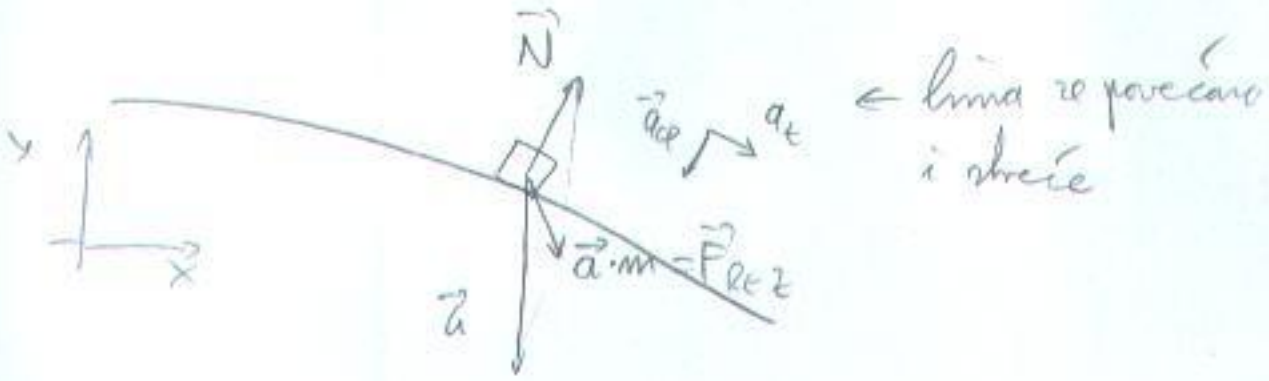
$\Rightarrow \overline{v_{x1}}\,\Delta t_1 = \overline{v_{x2}}\,\Delta t_2$

$\frac{\Delta t_2}{\Delta t_1} = \frac{\overline{v_{x1}}}{\overline{v_{x2}}} < 1$

NAPOMENA: zašto ① usporava, a ② ubrzava

→ dva dijela pitanja





$\Rightarrow a_{tx} > 0$

SKRETANJE NIJE BITNO JER "LIJEVO" SKRETANJE PONIŠTI "DESNO" PA BRZINA OSTAJE U x-SMJERU

OČITO JE $a_{x1} < 0$

I $a_{x2} > 0$ (CRTEŽ)

$\Rightarrow v_{x2}(t) \geq v_{x1}(t)$

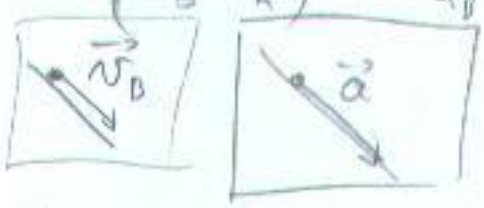
(JEDNAKOST NA RAVNIM DIJELOVIMA)

(4) BODA NA "UBRZAVANJE"

(4) BODA NA OBJAŠNJENJE UBRZANJA

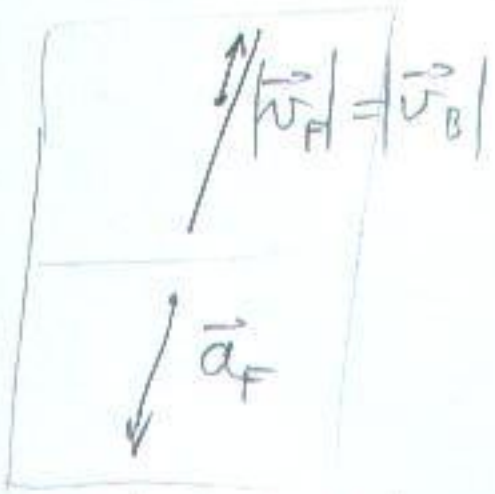
1B

$(v_B > v_A)$ $\vec{a}_B = \vec{a}_A$ (ISTI NAGIB, ISTA AKC.)



ISTA BRZINA !

$\vec{v}_C = \vec{v}_E$ $\vec{v}_C = \vec{v}_E$

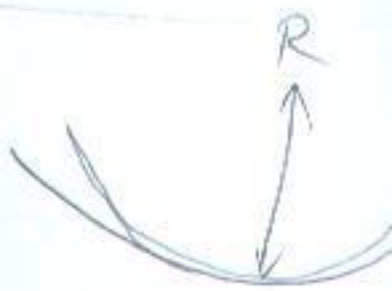


$|\vec{a}_F| > |\vec{a}_A| = |\vec{a}_D|$

VEĆE, JER JE NAGIB VEĆI!

($|\vec{a}| = mg \sin\alpha$ / NIJE TREBALO)

JOŠ CENTRIPETALNE AKCELERACIJE



→ C) i D) imaju iste (tj. podjednake) polumjere zakrivljenosti, no $v_D < v_C$ jer je na većoj visini pa je smanjilo od C) do D)

→ C) i E) imaju iste brzine ali E) ima manji radijus zakrivljenosti (SLIKA) jer je zakrivljenost veća

$\Rightarrow$ $\frac{v_C^2}{R_C} > \frac{v_D^2}{R_D}$ (imamo $R_C = R_D$, ali $v_C > v_D$

$\frac{v_C^2}{R_C} < \frac{v_E^2}{R_E}$ (imamo $v_C = v_E$, ali $R_C > R_E$

→

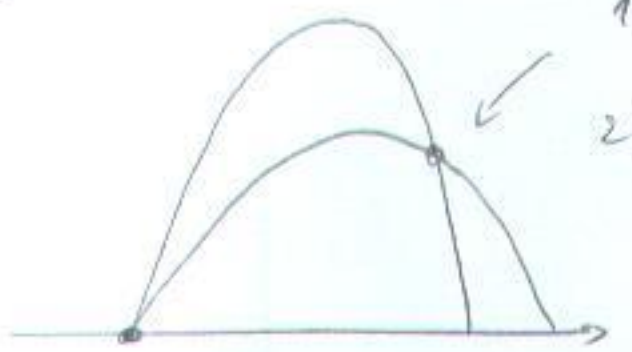
$\Rightarrow$ $v_A < v_B = v_F < v_D < v_C = v_E$

$a_A = a_B < a_F$

$a_E > a_C > a_D$

+ rezultantne sile $\vec{F}_R \sim \vec{a}$ + SKICA

(2) SKICA PUTANJA:



1) POSTOJI TOČKA PRESJEKA (nije trebalo provjeravati)

2) NE POČINJU OBA GIBANJA U ISTOM TRENUTKU

-> ista jedn. gibanja (nije trebalo izvoditi)

$x(t) = v_0 \cos(\varphi)\, t$ (za oba tijela)

$y(t) = v_0 \sin(\varphi)\, t - \frac{g}{2} t^2$ (za oba tijela)

no ishodište vremena je 0 za 1. i τ za drugo

$$\Rightarrow \quad x_1(t) = v_0 \cos(\varphi_1)\, t \qquad \| \qquad x_2(t) = v_0 \cos(\varphi_2)\,(t-\tau)$$

$$y_1(t) = v_0 \sin(\varphi_1)\, t - \frac{g}{2} t^2 \qquad \| \qquad y_2(t) = v_0 \sin(\varphi_2)\,(t-\tau) - \frac{g}{2}(t-\tau)^2$$

da skratim, nazvat ću $t = t_1$ i $t - \tau = t_2$

=> SUDAR SE DOGODI AKO I SAMO AKO

$$x_1 = x_2 \longrightarrow v_0 \cos\varphi_1\, t_1 = v_0 \cos\varphi_2\, t_2$$

$$y_1 = y_2 \longleftarrow \Rightarrow \frac{t_2}{t_1} = \frac{\cos\varphi_1}{\cos\varphi_2} = \eta \Rightarrow t_2 = \eta\, t_1$$

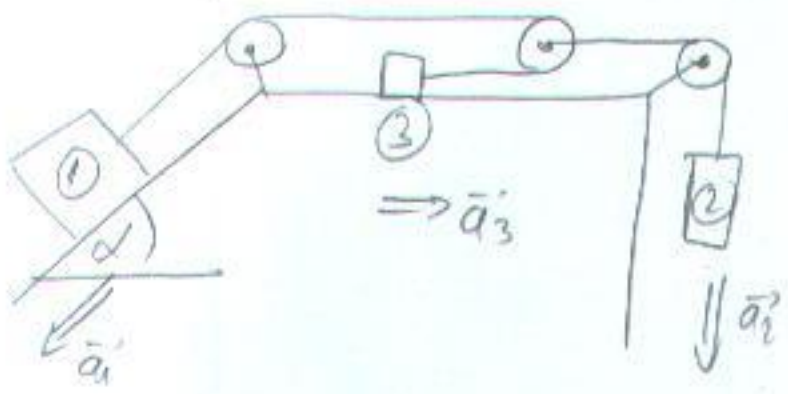
$$v_0 \sin\varphi_1\, t_1 - \frac{g}{2} t_1^2 = v_0 \sin\varphi_2\, \eta\, t_1 - \frac{g}{2} \eta^2 t_1^2$$

=> rješenje kvadratne jednadžbe dvije

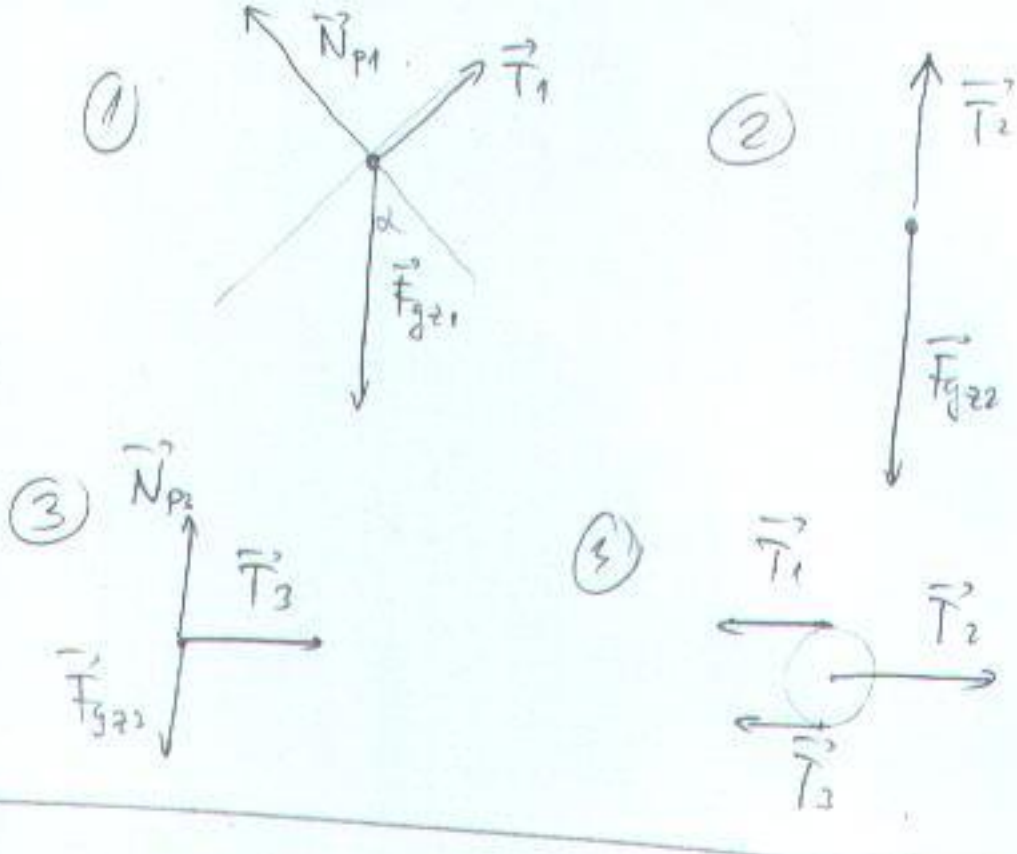
$$t_1 \; ; \quad t_2 = \eta\, t_1$$

$$\Delta t = t_1 - t_2 \,(= \tau) = 27{,}2 \text{ sekunde}$$

(5)



(MOŽE I DRUGA PRETPOSTAVKA O AKCELERACIJAMA)



2. N. Z.

$$\begin{cases} m_1 a_1 = m_1 g \sin\alpha - T_1 \\ m_2 a_2 = m_2 g - T_2 \\ m_3 a_3 = T_3 \end{cases}$$

(+)

$$\begin{cases} T_1 + T_3 = T_2 \\ T_1 = T_3 = T \end{cases} \qquad T_2 = 2T$$

(JER KOLOTURE NEMAJU MASU I TRENJE SA OSOVINOM)

(+) NERASTEZLJIVOST KONOPA ("ZAKON OČUVANJA KONOPA")

- nekaje (1) pomakne za Δx, a (2) za Δy
- tada je $l_1 + l_2 + l_3 = l_{TOT} = \text{konst}$

l_1 = položaj (1) u odn. na koloturu (A)

l_2 = položaj koloture (B) u odn. na (A)

l_3 = položaj (3) u odn. na (B)

l_4 = l_2 + dugi konop ((B) i (2) su kroz zajedno)

$\frac{d}{dt}$ na $l_1 + l_2 + l_3$

$$\frac{dl_1}{dt} + \frac{dl_2}{dt} + \frac{dl_3}{dt} = 0$$

podl. $v_1 \quad v_2 \quad -v_3$

jer je $v_3 > 0$ (x-smjer)

a $\frac{dl_3}{dt} < 0$

$$\Rightarrow v_3 = v_1 + v_2$$

$$\Rightarrow a_3 = a_1 + a_2$$

} u odnosu na koloturu (B)

AKC. SUSTAVA

$\Rightarrow$ ukupno $a_{3,TOT} = a_3 + a_2$

$$\Rightarrow a_{3,rot} = a_1 + 2a_2$$

$$\Rightarrow \quad m_1 a_1 = m_1 g \sin\alpha - T$$

$$m_2 a_2 = m_2 g - 2T$$

$$m_3(a_1 + 2a_2) = T$$

(...) LOL

rješenje sustava:

$$a_1 = \frac{m_1(m_2 + 4m_3)\sin\alpha - 2m_2 m_3}{m_1 m_2 + m_2 m_3 + 4m_1 m_3} g$$

$$a_2 = \frac{m_2(m_1 + m_3) - 2m_1 m_3 \sin\alpha}{m_1 m_2 + m_2 m_3 + 4m_1 m_3} g$$

$$a_3 = \frac{m_1 m_2 (2 + \sin\alpha)}{m_1 m_2 + m_2 m_3 + 4m_1 m_3} g$$

$\Rightarrow$ a_3 **može** mirovati samo ako ne pustiš nekog od preostalih tijela, jer tada bar 1 konop nije napet, pa ga nemo što vući