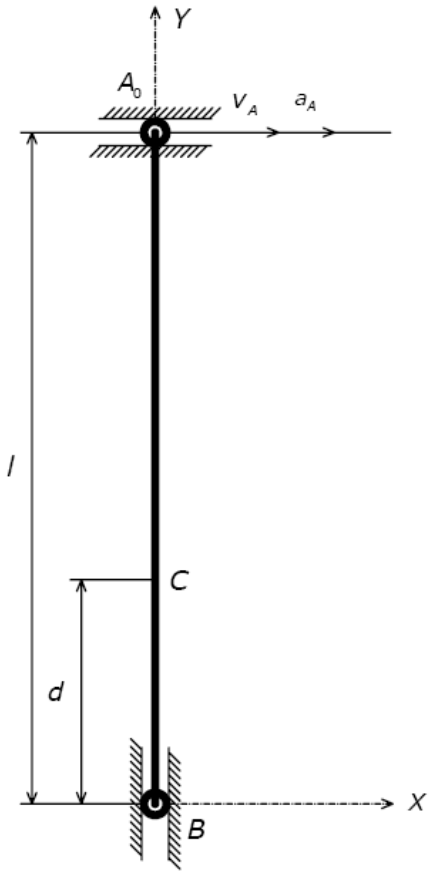
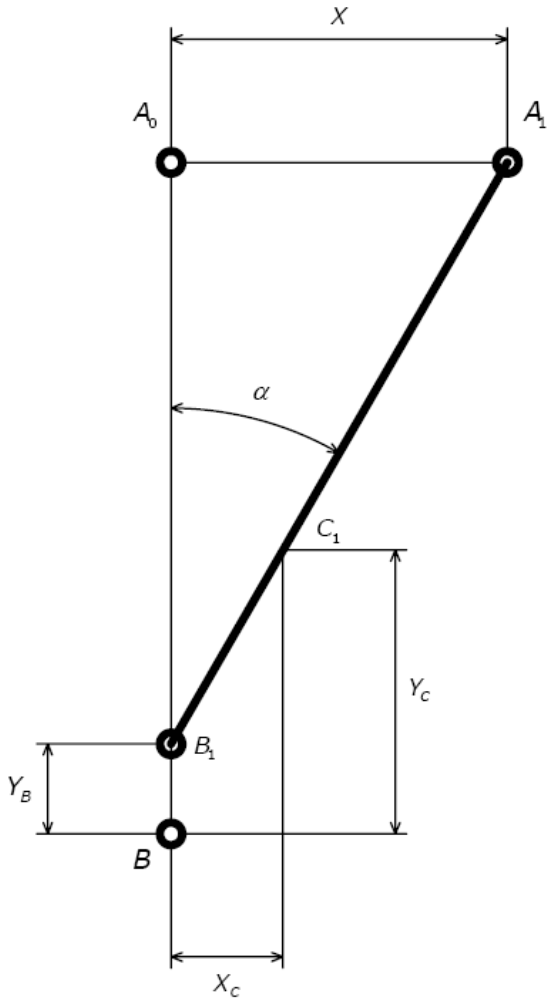
1.

Drog $\overline{AB}$ dolžine l = 30cm je voden v navpični smeri (točka B) in vodoravni smeri (točka A). Določite hitrost točke B in C po 0,5 s gibanja droga, če se je točka A začela gibati iz A_0 z začetno hitrostjo $v_0 = 20\ cm/s$ in pospeškom $a = 20\ cm/s^2$ ter če je razdalja d = 10 cm !





$l = 30cm$

$d = 10cm$

$t = 0,5s$

$v = 20\,cm/s$

$\underline{a = 20\,cm/s^2}$

$$X_A = v_0 t + \frac{at^2}{2}$$

$$Y_B = l - \sqrt{l^2 - X_A^2} = l - \sqrt{l^2 - \left(v_0 t + \frac{at^2}{2}\right)^2}$$

$$v_B = \dot{Y}_B = \frac{\left(v_0 t + \frac{at^2}{2}\right)\left(v_0 + at\right)}{\sqrt{l^2 - \left(v_0 t + \frac{at^2}{2}\right)^2}} = \underline{\underline{13,75\,\frac{cm}{s}}}$$

$$X_C = X_A \cdot \frac{d}{l} = \frac{d}{l} \cdot \left(v_0 t + \frac{at^2}{2}\right)$$

$$Y_C = Y_B + \sqrt{d^2 - X_C^2} = l - \sqrt{l^2 - X_A^2} + \sqrt{d^2 - \left(X_A \cdot \frac{d}{l}\right)^2} =$$

$$= l + \frac{d - l}{l}\sqrt{l^2 - \left(v_0 t + \frac{at^2}{2}\right)^2}$$

$$v_{X_C} = \dot{X}_C = \frac{d}{l} \cdot \left(v_0 + at\right) = \underline{\underline{10\,\frac{cm}{s}}}$$

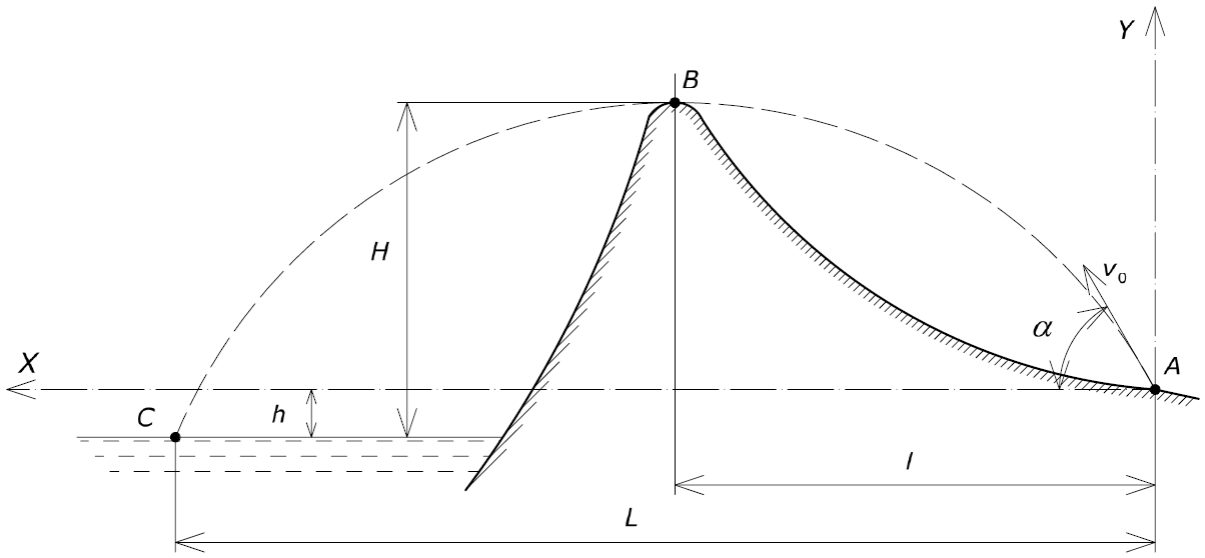
$$v_{Y_C} = \dot{Y}_C = \frac{l - d}{l}\; l\; \frac{\left(v_0 + at\right)\left(v_0 t + \frac{at^2}{2}\right)}{\sqrt{l^2 - \left(v_0 t + \frac{at^2}{2}\right)^2}} = \underline{\underline{9,17\,\frac{cm}{s}}}$$

$$v_C = \sqrt{v_{X_C}^2 + v_{Y_C}^2} = \underline{\underline{13,57\,\frac{cm}{s}}}$$

Hitrost točke B je $13,75\,\frac{cm}{s}$, točke C pa $13,57\,\frac{cm}{s}$.

2.

Iz topa, ki ima cev nagnjeno pod kotom $\alpha = 30°$, iztrelimo kroglo preko vrha hriba, oddaljenega 10 km. Na drugi strani hriba pade krogla v morje, katerega gladina je 500 m pod mestom iztrelitve. Določite začetno hitrost iztrelka, nadmorsko višino hriba in celotno dometno razdaljo !



$l = 10km$

$\alpha = 30°$

$\underline{h = 500m}$

$$Y = Xtg\alpha - \frac{gX^2}{2v_0^2 \cos^2 \alpha}$$

$$\frac{dy}{dx} = tg\alpha - \frac{gX}{2v_0^2 \cos^2 \alpha} = 0$$

$$v_0 = \sqrt{\frac{2gX}{\sin 2\alpha}} = \sqrt{\frac{2gl}{\sin 2\alpha}} = \underline{\underline{476 \frac{m}{s}}}$$

$$H = h + Y = h + ltg\alpha - \frac{gl^2}{2v_0^2 \cos^2 \alpha} = \underline{\underline{3383,4m}}$$

$$-h = Ltg\alpha - \frac{gL^2}{2v_0^2 \cos^2 \alpha}$$

$$gL^2 - 2Ltg\alpha v_0^2 \cos^2 \alpha - 2hv_0^2 \cos^2 \alpha = 0$$

$$gL^2 - 2Lv_0^2 \cos\alpha - 2hv_0^2 \cos^2 \alpha = 0$$

$$L_{1,2} = \frac{2v_0^2 \cos\alpha \pm \sqrt{\left(2v_0^2 \cos\alpha\right)^2 + 8ghv_0^2 \cos^2 \alpha}}{2g}$$

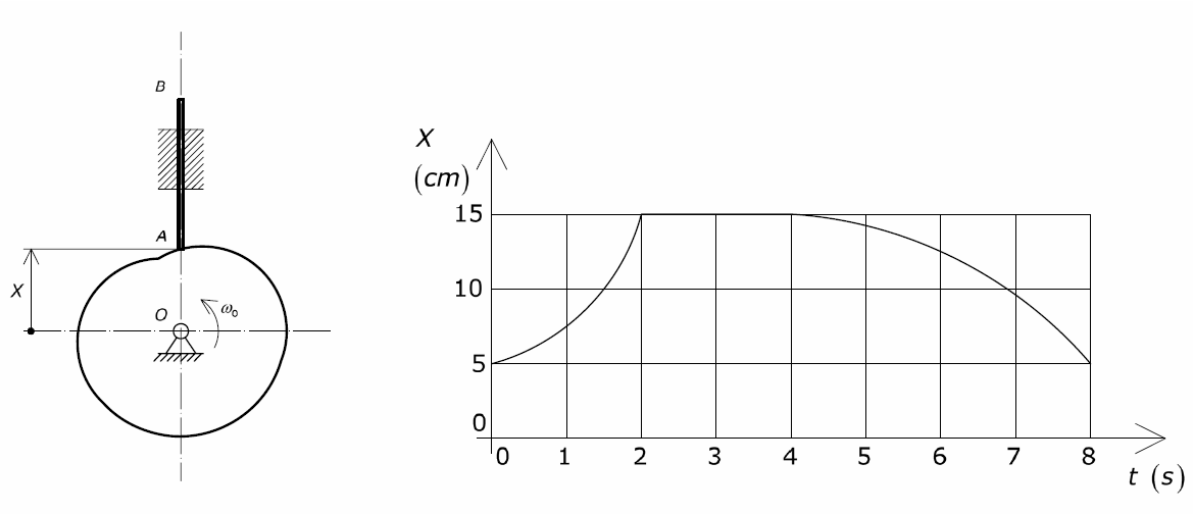
~~$L_1 = 830m$~~ *ni* realna *rešitev*

$L_2 = \underline{\underline{20797m}}$

Začetna hitrost iztrelka znaša $476 \frac{m}{s}$, nadmorska višina hriba je 3393,4m, celoten domet je pa 20797m.

3.

Določite obliko površine rotorja, ki odmika drog $\overline{AB}$, katerega odmik X je podan na sliki. Plošča kroži s konstantno kotno hitrostjo $\omega_0 = \frac{\pi}{4} s^{-1}$. Določite v-t in a-t diagram !



$\omega_0 = \frac{\pi}{4} s^{-1}$

$t_0 = 8s$

$a = \frac{2s}{t^2}$

$v = at$

$t_1 = 2s$

$\Delta s = 10cm$

$a_1 = 5 \frac{cm}{s^2}$

$v_1 = 10 \frac{cm}{s}$

$t_2 = 2s$

$\Delta s = 0cm$

$a_2 = 0 \frac{cm}{s^2}$

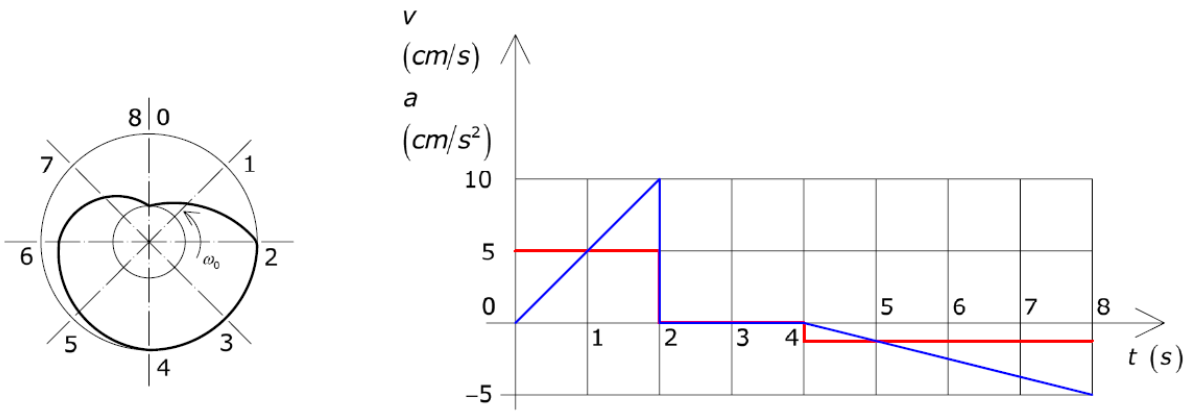
$v_2 = 0 \frac{cm}{s}$

$t_3 = 4s$

$\Delta s = -10cm$

$a_3 = -1,25 \frac{cm}{s^2}$

$v_3 = -5 \frac{cm}{s}$

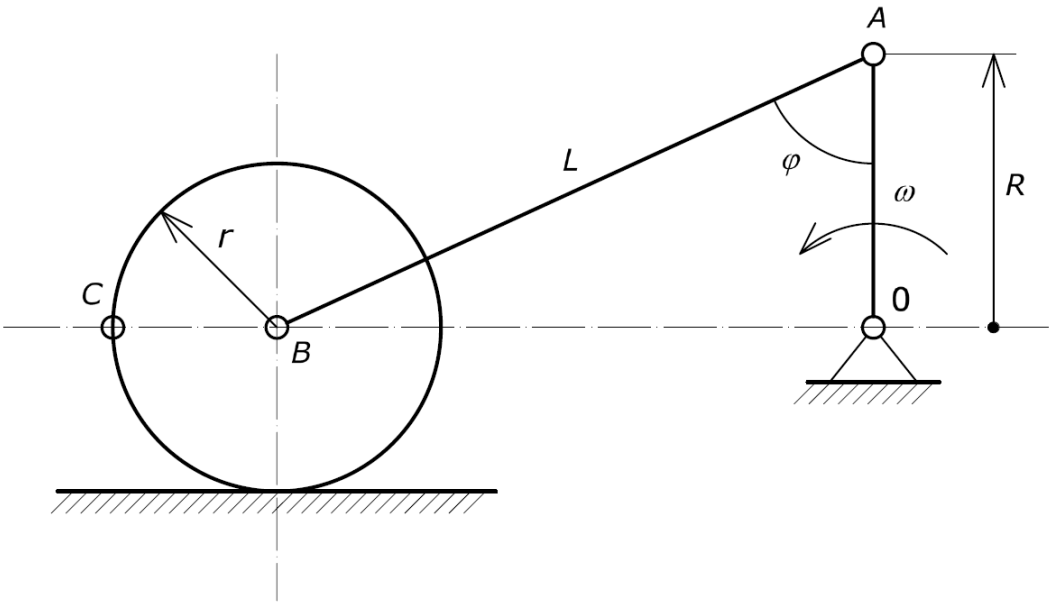


Levo: oblika rotorja

Desno: v-t diagram (modra črta) in a-t diagram (rdeča črta)

4.

Za mehanizem na sliki določite hitrost točk A, B, C in kotne hitrosti vseh elementov mehanizma, če je kotna hitrost ročice $\overline{0A}$ $\omega = 1,6\ s^{-1}$ in dimenzije R=25cm, r=15cm, L=60cm in $\varphi = 50°$!



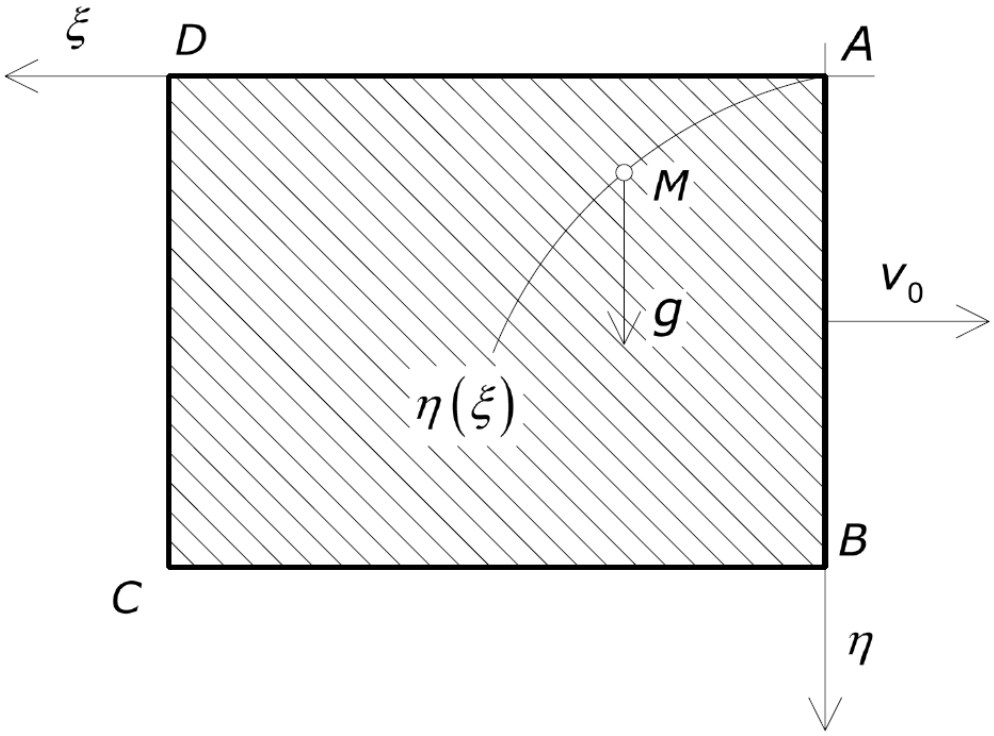
$\omega = 1,6 s^{-1}$
$R = 25cm$
$r = 15cm$
$L = 60cm$
$\varphi = 50°$
$v = \omega r$

$v_A = \omega R = \underline{\underline{40 \frac{cm}{s}}}$, $v_B = v_A = \underline{\underline{40 \frac{cm}{s}}}$, $v_C = \omega_{CB} r = \underline{\underline{40 \frac{cm}{s}}}$

$\omega_{BA} = 0$, $\omega_{CB} = \frac{v_B}{r} = \underline{\underline{2,67 s^{-1}}}$

5.

Pred ploščo ABCD, ki se giblje s konstantno hitrostjo v_0 prosto pada točka M brez začetne hirosti. Določite enačbo tirnice relativnega gibanja točke M glede na ploščo ABCD !



Točka M se giblje po paraboli.

$$\eta = \frac{g}{2v_0^2}\xi^2$$