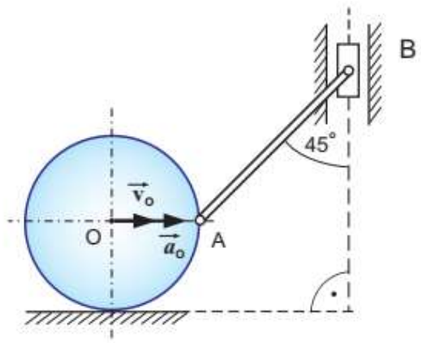
Zadatak 1.31

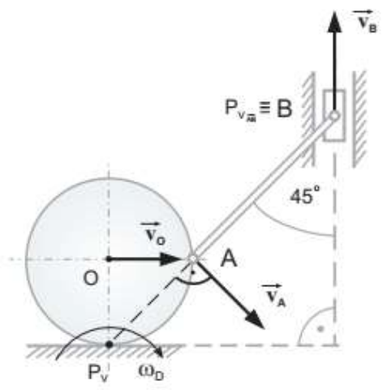
Štap AB dužine ℓ zglobno je vezan za obod diska poluprečnika R koji se kotrlja bez klizanja po pravom delu puta. Ako, u prikazanom položaju, središte diska ima brzinu v_0 i ubrzanje a_0, odrediti brzinu i ubrzanje klizača B.



Slika 1.42: uz zadatak zad:z-28.

■ **Rešenje 1.31** Brzine:

$$v_0 = R\omega_D \quad \Rightarrow \quad \omega_D = \frac{v_0}{R}, \quad v_A = \overline{AP}_v \cdot \omega_D = R\sqrt{2}\omega_D \quad \Rightarrow \quad v_A = v_0\sqrt{2}.$$



Slika 1.43: Brzine.

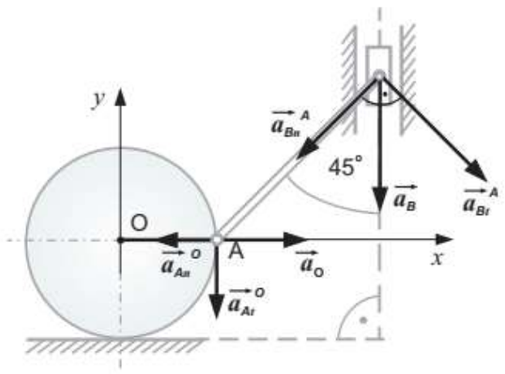
Primenom teoreme o projekcijama brzina, dobija se:

$$v_A \cos 90° = v_B \cos 45° \quad \Rightarrow \quad \boxed{v_B = 0},$$

$$v_A = \overline{AP}_v \omega_{AB} \Rightarrow \omega_{AB} = \frac{v_A}{\overline{AP}_v} = \frac{v_0\sqrt{2}}{\ell}.$$

Ubrzanja:

$$\mathbf{a}_A = \mathbf{a}_O + \mathbf{a}^O_{An} + \mathbf{a}^O_{At}. \qquad \text{(a)}$$



Slika 1.44: Ubrzanje.

$$\varepsilon_D = \frac{\mathrm{d}\omega_D}{\mathrm{d}t} = \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{v_0}{R}\right) = \frac{1}{R}\frac{\mathrm{d}}{\mathrm{d}t}(v_0) = \frac{a_0}{R},$$

$$a^O_{At} = \varepsilon_D \cdot \overline{OA} = \frac{a_0}{R}R = a_0,$$

$$a^O_{An} = \overline{OA}\,\omega^2_D = \frac{v_0^2}{R}.$$

Projektovanjem jednačine (a) na x i y, respektivno, dobija se:

$$x: \quad a_{Ax} = a_0 - a^0_{An} \quad \Rightarrow \quad a_{Ax} = a_0 - \frac{v_0^2}{R}$$

$$y: \quad a_{Ay} = -a^0_{An} = -a_0.$$

$$\mathbf{a}_B = \mathbf{a}_A + \mathbf{a}^A_{Bn} + \mathbf{a}^A_{Bt},$$

$$a^A_{Bn} = \overline{AB}\omega^2_{AB} = \frac{2v_0^2}{\ell}.$$

Projektovanjem ove vektorske jednačine dobija se:

$$\text{na } x: \quad 0 = a_0 - \frac{v_0^2}{R} - a^A_{Bn}\cos 45° + a^A_{Bt}\cos 45°,$$

$$a^A_{Bt}\frac{\sqrt{2}}{2} = \frac{2v_0^2}{\ell}\frac{\sqrt{2}}{2} + \frac{v_0^2}{R} - a_0\frac{\sqrt{2}}{2} \Rightarrow a^A_{Bt} = \frac{2v_0^2}{\ell} + \frac{v_0^2\sqrt{2}}{R} - a_0\sqrt{2},$$

$$\text{na } y: \quad -a_B = -a_0 - a^A_{Bn}\sin 45° - a^A_{Bt}\sin 45°$$

$$-a_B = -a_0 - \frac{2v_0^2}{\ell}\frac{\sqrt{2}}{2} - \frac{2v_0^2}{\ell}\frac{\sqrt{2}}{2} - \frac{v_0^2\sqrt{2}}{R}\frac{\sqrt{2}}{2} + a_0\sqrt{2}\frac{\sqrt{2}}{2} \quad \Rightarrow$$

$$\boxed{a_B = \frac{v_0^2}{\ell}\left(2\sqrt{2} + \frac{\ell}{R}\right)}.$$