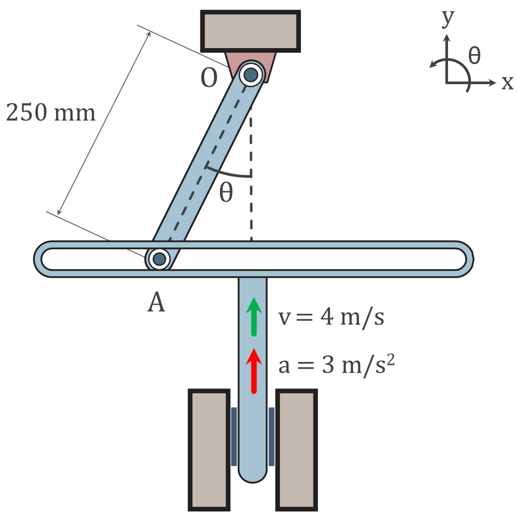
Link Motion



A link rotates clockwise shown in the picture. Give the correct expression for the velocity of the roller inside slotted guide, v_A.

Using known expressions:

$$\boldsymbol{v_{A/O}} = \boldsymbol{\omega} \times \boldsymbol{r_{A/O}} \tag{1}$$

Given:
Vertical velocity of the slotted guide: $v = 4$ m/s
Distance between O and A: $L_{OA} = 0.25$ m

First a kinematic diagram is made in Figure 1 which shows all velocities acting on roller A. From this it can be seen that v_A can be calculated using v and $v_{A/O}$. Using Equation 1 $v_{A/O}$ becomes:

$$\boldsymbol{v_{A/O}} = \boldsymbol{\omega} \times \boldsymbol{r_{A/O}} = \begin{pmatrix} 0 \\ 0 \\ \omega \end{pmatrix} \times \begin{pmatrix} -0.25 \sin\theta \\ -0.25 \cos\theta \\ 0 \end{pmatrix} = \begin{pmatrix} -0.25\omega \cos\theta \\ 0.25\omega \sin\theta \\ 0 \end{pmatrix} \tag{2}$$

Where $\omega = \dot{\theta}$.

From Figure 1 follows:

$$\boldsymbol{v_{A/O}} = \boldsymbol{v_A} + \boldsymbol{v} \quad \Rightarrow \quad \begin{pmatrix} -0.25\omega\cos\theta \\ 0.25\omega\sin\theta \\ 0 \end{pmatrix} = \begin{pmatrix} -v_A \\ 0 \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ v \\ 0 \end{pmatrix} \tag{3}$$

This results in that $v_A = 0.25\omega\cos\theta = 0.25\dot{\theta}\cos\theta$. Since we have drawn v_A in Figure 1 in the negative x-direction. The velocity of the roller in the positive x-direction becomes: $v_A = -0.25 \cdot \dot{\theta} \cdot \cos\theta$.

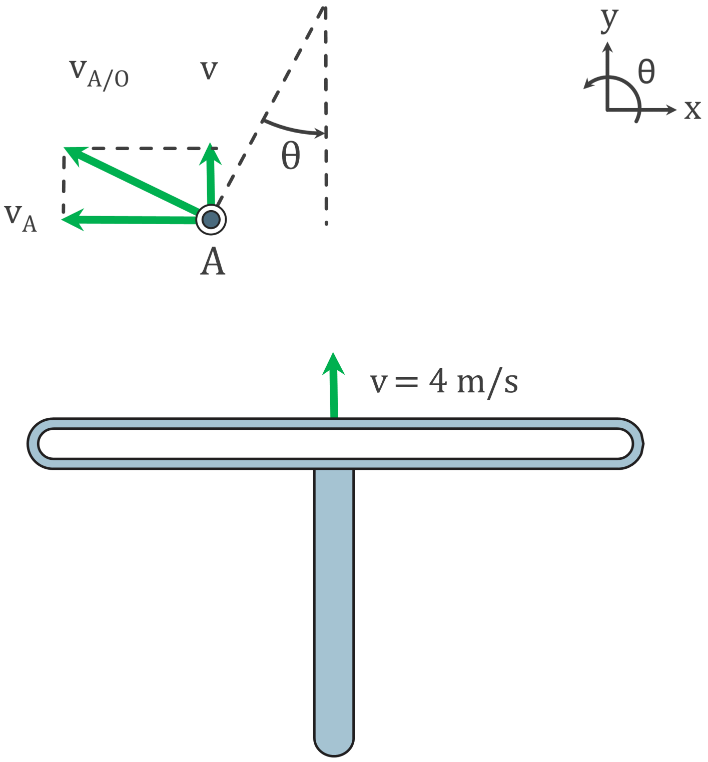


Figure 1: Kinematic diagram of the roller and the slotted guide.