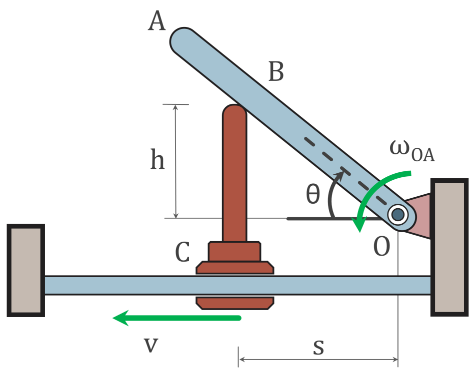
Collar induces Angular Velocity



The collar C moves to the left on a fixed guide with speed v. Determine the magnitude of the angular velocity ω_{OA} as a function of v, the collar position s, and the height h.

Using known expressions:

$$\boldsymbol{v_{B/O}} = \boldsymbol{v_O} + \boldsymbol{\omega} \times \boldsymbol{r_{B/O}} \tag{1}$$

Given:
Speed collar C: v
Displacement collar C: s
Height of contact point B: h

Figure 1 shows the kinematic diagram of the situation, including geometric relations. The angular velocity can be determined using the relative velocity $v_{B/O}$ and the distance L_{OB} with the relation from Equation 1. Since $v_O = 0$, this results in:

$$\left|v_{B/O}\right| = |\omega| \cdot \left|r_{B/O}\right| \tag{2}$$

Where $\left|r_{B/O}\right| = \sqrt{h^2 + s^2}$.
For the time instant that $\theta = 90°$, this results in a horizontal velocity that must be equal to $v_B = v$.

$$v_B = \omega \cdot h = v \tag{3}$$

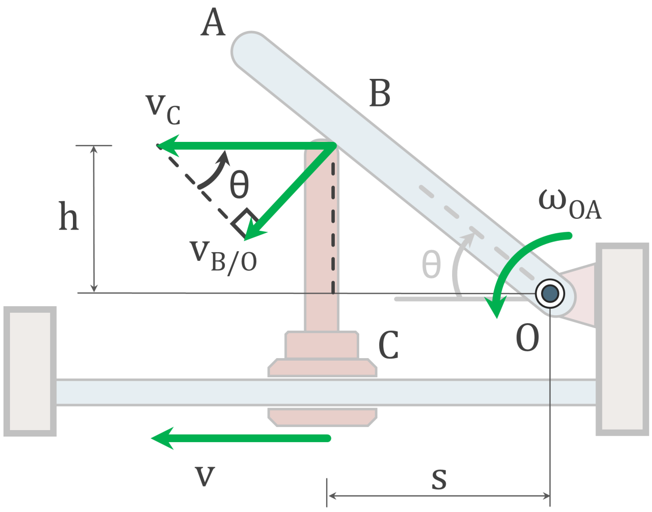


Figure 1: Kinematic diagram of the collar C and rotating bar AO.

These two equations can be manipulated to get an equation for ω. To do that first a relation to write $v_{B/O}$ in terms of v_C must be found. From the geometry of Figure 1 it follows:

$$v_C = \frac{\sqrt{h^2 + s^2}}{h} \cdot v_{B/O} \tag{4}$$

Inserting Equation 3 into Equation 4 gives:

$$v_C = \frac{\sqrt{h^2 + s^2}}{h} \cdot v_{B/O} = \frac{\sqrt{h^2 + s^2}}{h} \cdot \sqrt{h^2 + s^2} \cdot \omega = \frac{h^2 + s^2}{h} \cdot \omega = v \tag{5}$$

Rewriting give the following relation for ω:

$$\omega = \frac{v \cdot h}{h^2 + s^2} \tag{6}$$