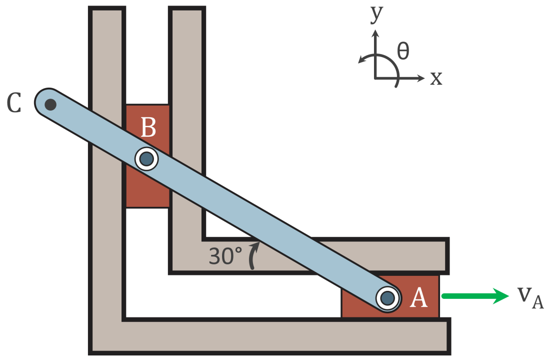
Linked Bodies



A bar is moving in paths A and B as shown in the figure. If the length of AC is 1 m and the length of CB is 0.25 m, with $v_A = 3$ m/s. Determine the angular velocity ω of the bar.

Using known expressions:

$$\boldsymbol{v_{B/A}} = \boldsymbol{v_A} + \boldsymbol{\omega} \times \boldsymbol{r_{B/A}} \tag{1}$$

Given:
Distance between A and C: $L_{AC} = 1$ m
Distance between B and C: $L_{BC} = 0.25$ m
Angle of the blue bar: $\theta = 30°$
Velocity of A: $v_A = 3$ m/s

From this follows that the distance between A and B is $L_{AB} = 0.75$ m. Furthermore, point B can only move up and down, thus is has only a velocity term in the y-direction. Point A can only move left and right, thus it has only a velocity term in the x-direction. Inserting this in Equation 1 gives.

$$\boldsymbol{v_{B/A}} = \boldsymbol{v_A} + \boldsymbol{\omega} \times \boldsymbol{r_{B/A}} \quad \Rightarrow \quad \begin{pmatrix} 0 \\ v_B \\ 0 \end{pmatrix} = \begin{pmatrix} v_A \\ 0 \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ \omega \end{pmatrix} \times \begin{pmatrix} -\cos 30 \\ \sin 30 \\ 0 \end{pmatrix} L_{AB} \tag{2}$$

$$\begin{pmatrix} 0 \\ v_B \\ 0 \end{pmatrix} = \begin{pmatrix} v_A \\ 0 \\ 0 \end{pmatrix} + \begin{pmatrix} -\sin 30 \\ -\cos 30 \\ 0 \end{pmatrix} L_{AB} \cdot \omega$$

From this follows that:

$$0 = v_A - \sin 30 \cdot L_{AB} \cdot \omega \quad \Rightarrow \quad \omega = \frac{v_A}{\sin 30 \cdot L_{AB}} = \frac{3}{\frac{1}{2} \cdot \frac{3}{4}} = 8 \text{ rad/s} \tag{3}$$