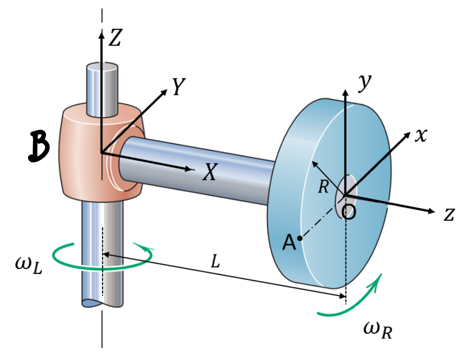
Problem

(**10 min**) Disk O with radius R is attached to a rotating arm with length L. The disk is rotating with a constant angular speed of ω_R and the arm is rotating with a constant angular speed of ω_L with directions as shown in the figure. A moving reference frame is attached to the disk at center O. At the given moment, point A is located in the $-x$ direction from O with the figure showing the relationship between the fixed and moving reference frame axis.



The following equation is used to calculate the acceleration of A:

$$\vec{a}_A = \vec{a}_O + (\vec{a}_{A/O})_{rel} + \vec{\alpha} \times \vec{r}_{A/O} + 2\vec{\omega} \times (\vec{v}_{A/O})_{rel} + \vec{\omega} \times [\vec{\omega} \times \vec{r}_{A/O}]$$

Complete the expression for the following terms in the acceleration equation for the instant shown using the **Moving Reference Frame** unit vectors.: (Treat R, L, ω_R, and ω_L as given values)

$\hat{I} = \hat{k}$, $\hat{J} = \hat{i}$, $\hat{K} = \hat{j}$ @ instant shown

I. $\vec{\omega} =$ $\omega_L \hat{K} + \omega_R \hat{k} = \boxed{\omega_L \hat{j} + \omega_R \hat{k}}$

II. $\vec{\alpha} =$ $\cancel{\dot{\omega}_L} \hat{K} + \cancel{\omega_L} \dot{\hat{K}} + \cancel{\dot{\omega}_R} \hat{k} + \omega_R \dot{\hat{k}}$

$\omega_R [\vec{\omega}_{TOT} \times \hat{k}] = \omega_R [(\omega_L \hat{j} + \omega_R \hat{k}) \times \hat{k}] \boxed{= \omega_R \omega_L \hat{i}}$

III. $\vec{a}_O =$ $\cancel{a_B} + \cancel{\vec{\alpha}} \times \vec{r}_{O/A} - \vec{\omega}_{BO}^2 \vec{r}_{O/A} = -\omega_L^2 (L \hat{k})$

$\boxed{= -\omega_L^2 L \hat{k}}$

IV. $\vec{r}_{A/O} =$ $\boxed{-R \hat{i}}$

V. $(\vec{v}_{A/O})_{rel} =$ $\boxed{0}$

VI. $(\vec{a}_{A/O})_{rel} =$ $\boxed{0}$