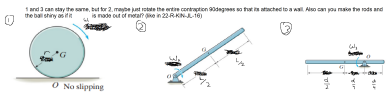
22-R-IM-JL-32



In each of the following scenarios find the angular momentum of the rod or disc about their center of gravity G and about point O.

Solution

Angular momentum is given by $I_P\,\omega$, where P is the point about which we are finding the angular momentum.

Scenario 1: The disc has radius $r = 45$ cm, mass $m = 600$ g and rolls with angular velocity $\omega = -3.6\ \hat{k}$ rad/s.

$\vec{H}_G = I_G\,\vec{\omega} = \frac{1}{2}\,m\,r^2\,\omega = -0.2187\ \hat{k}$ [kg·m^2/s]

$\vec{H}_O = I_O\,\vec{\omega} = \left(\frac{1}{2}\,m\,r^2 + m\,r^2\right)\omega = -0.6561\ \hat{k}$ [kg·m^2/s]

Scenario 2: rod has length $L = 90$ cm, mass $m = 350$ g and rolls with angular velocity $\omega = -4.4\ \hat{k}$ rad/s.

$\vec{H}_G = I_G\,\vec{\omega} = \frac{1}{12}\,m\,L^2\,\omega = -0.1040\ \hat{k}$ [kg·m^2/s]

$\vec{H}_O = I_O\,\vec{\omega} = \frac{1}{3}\,m\,L^2\,\omega = -0.4158\ \hat{k}$ [kg·m^2/s]

Scenario 3: rod has length $d = 67$ cm, mass $m = 630$ g and rolls with angular velocity $\omega = 2.9\ \hat{k}$ rad/s.

$\vec{H}_G = I_G\,\vec{\omega} = \frac{1}{12}\,m\,d^2\,\omega = 0.0683\ \hat{k}$ [kg·m^2/s]

$\vec{H}_O = I_O\,\vec{\omega} = \left(\frac{1}{12}\,m\,d^2 + m\,(\frac{d}{4})^2\right)\omega = 0.1196\ \hat{k}$ [kg·m^2/s]