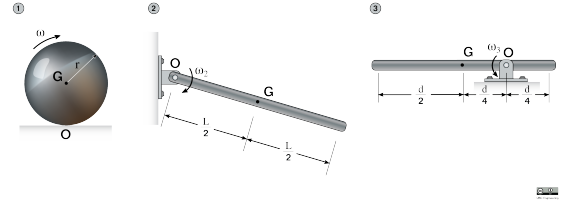


## 22-R-IM-JL-32

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.

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

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

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

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

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

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

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

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