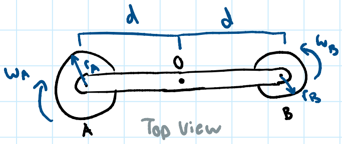
20-R-IM-DK-13

July 9, 2020 11:40 AM

Beginner Conservation of Momentum

Inspiration : 19-35 Hibbeler



Consider the a mechanism in the horizontal plane which consists of a ***5 kg*** rod and two disks. Disk A has a mass of ***m_A = 6 kg*** and has a radius ***r_A = 0.2 m***, while disk B has a mass of ***m_B = 5 kg*** and a radius ***r_B = 0.15 m***. Both are located at an equal distance ***d = 0.5 m*** away from the pin O. If disk A is given a clockwise angular velocity ***omega_A = 6 rad/s*** and disk B is given a counter clockwise angular velocity ***omega_B = 4 rad/s***, determine the angular velocity of the rod after both disks have stopped spinning relative to the rod. The pins at A and B have friction, but pin O is frictionless. Motion is in the horizontal plane.

$$\Sigma(H_O)_{1\,sys} = \Sigma(H_O)_{2\,sys}$$

$$\vec{H}_{O_1\,Disk A} + \vec{H}_{O_1\,Disk B} + \vec{H}_{O_1\,Rod} = \vec{H}_{O_2\,Disk A} + \vec{H}_{O_2\,Disk B} + \vec{H}_{O_2\,Rod}$$

$$\vec{H}_{O_1\,Disk A} = \vec{H}_{A\,Disk A} + \vec{r}_{A/O} \times m\vec{v}_A = \vec{H}_{A\,Disk A} \quad \text{as } \vec{v}_A = 0 \quad \text{Likewise for disk B}$$

$$\tfrac{1}{2}(6)(0.2)^2(-6) + \tfrac{1}{2}(5)(0.15)^2(4) + 0 = \left(\tfrac{1}{2}(6)(0.2)^2 + (6)(0.5)^2\right)\omega_2 + \left(\tfrac{1}{2}(5)(0.15)^2 + (5)(0.5)^2\right)\omega_2 + \tfrac{1}{12}(5)(0.5+0.5)^2\omega_2$$

$$-0.495 = \frac{8023}{2400}\omega_2 \qquad \boxed{\omega_2 = -1.148 \text{ rad/s}}$$