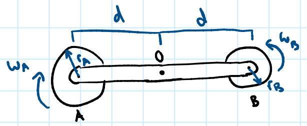
20-R-IM-DK-13

July 9, 2020 11:40 AM

Beginner Conservation of Momentum

Inspiration: 19-35 Hibbeler



Top view

A mechanism 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 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 counterclockwise angular velocity $\omega_B = 4$ rad/s, determine the angular velocity of the rod after both disks have stopped spinning relative to the rod. Motion is in the horizontal plane and neglect the friction at pin O.

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

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

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

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

$$-0.495 = \frac{8023}{2400}\omega_2 \qquad \boxed{\omega_2 = -1.144 \text{ rad/s}}$$