Beginner   Conservation of Momentum
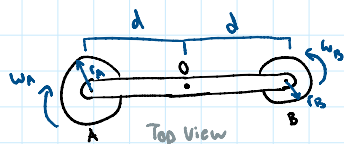
Inspiration : 19-35 Hibbeler

Top View

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.

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

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

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

$$\tfrac{1}{2}(6)(0.2)^2(-6) + \tfrac{1}{2}(5)(0.15)^2(4) + 0 = \left(\tfrac{1}{2}(6)(0.2)^2 + (6)(0.5)^2\right)W_2 + \left(\tfrac{1}{2}(5)(0.15)^2 + (5)(0.5)^2\right)W_2 + \tfrac{1}{12}(5)(0.5+0.5)^2 W_2$$

$$-0.495 = \frac{8023}{2400}\ W_2 \qquad \boxed{W_2 = -1.144\ rad/s}$$