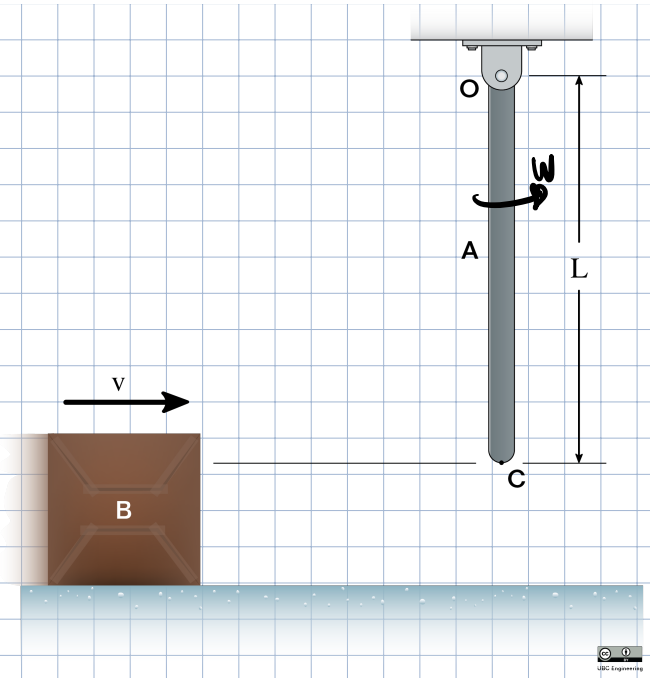
A block of mass $m_B = 6$ kg is sliding along a slippery, icy surface with no friction. It hits a slender bar of mass $m_A = 4$kg and length L = 5m at a speed of v =14 m/s at point C. If the angular velocity or the bar just after the impact is 2.85 rad/s, find the coefficient of restitution between the slender bar and the block.



$\vec{v} = \vec{\omega} \times \vec{r}$

$(\vec{H}_o)_1 = (\vec{H}_o)_2$

$(\vec{H}_o)_1 = m_B (\vec{r}_{C/O} \times \vec{v}_{B_1})$

$(\vec{H}_o)_2 = m_B (\vec{r}_{C/O} \times \vec{v}_{B_2}) + I_o (\vec{\omega}_{A_2}) \frac{v_{C_2}}{L} \hat{k}$

$I_o \frac{1}{3} m L^2 = \frac{1}{3} m_A L^2$

$m_B (\vec{r}_{C/O} \times \vec{v}_{B_1}) = m_B (\vec{r}_{C/O} \times \vec{v}_{B_2}) + \frac{1}{3} (m_A L^2) \left(\frac{v_{C_2}}{L}\right) \hat{k}$

$\vec{r}_{C/O} = -L\hat{j}$ $\quad \hat{v} = \hat{i}$

$m_B (L v_{B_1}) = m_B (L v_{B_2}) + \frac{1}{3} m_A L v_{C_2} [\hat{k}]$ $\quad v_{C_1} = 0$

Coeff of restitution:

$e = \frac{v_{C_2} - v_{B_2}}{v_{B_1} - v_{C_1}} \rightarrow v_{B_2} = v_{C_2} - v_{B_1} e$

$$m_B L v_{B1} = m_B \left(L(v_{C2} - v_{B1} e)\right) + \frac{L}{3} m_A v_{C2}$$

$$v_{B1} m_B (e+1) = v_{C2} \left(m_B + \frac{m_A}{3}\right)$$

$$v_{C2} = \omega_{A2} L = (2.85 \text{ rad/s})(5 \text{ m}) = 14.28 \text{ m/s}$$

$$(6\text{kg})(5\text{m})(14\text{m/s}) = (4\text{kg})\left((5\text{m})(14.28\text{m/s} - 14\text{m/s}\, e)\right) + \frac{5\text{m}}{3}(14\text{kg})(14.28\text{m/s})$$

$$e = 0.7$$