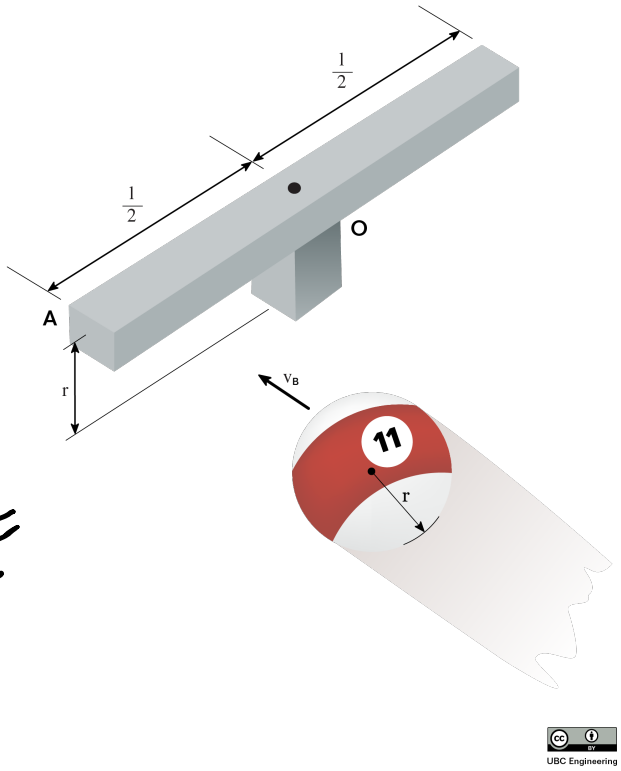
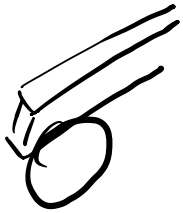
A Rube Goldberg machine utilizes a pool ball and a slender 2 m long rod. If the pool ball has a mass $m_{ball} = 0.16\ kg$ while the rod has mass $m_{rod} = 1\ kg$, determine the angular velocity of the rod when the pool ball strikes it at $v = 3\ m/s$. The pool ball has radius $r = 0.025\ m$ and the coefficient of restitution is $e = 0.8$. The rod hits the pool ball at the same height as the ball's center of gravity.



① 

② 

$$\sum (H_o)_1 = \sum (H_o)_2$$

$$(H_o)_1 = m_b v_{b1} \frac{\ell}{2}$$

$$(H_o)_2 = m_b v_{b2} \frac{\ell}{2} + I_{rod}\, \omega_2$$

$$m_b v_{b1} \frac{\ell}{2} = m_b v_{b2} \frac{\ell}{2} + \frac{1}{12} m \ell^2 \omega_2$$

$$e = \frac{v_{A2} - v_{b2}}{v_{b1} - v_{A1}} \quad (v_{A1} = 0) \quad \Rightarrow 0.8 = \frac{w_2 \frac{\ell}{2} - v_{b2}}{v_{b1}}$$

$$v_{b2} = -0.8(3\,m/s) + w_2 \frac{\ell}{2}$$

$$m_b v_{b1} \frac{\ell}{2} = m_b \left(-0.8(3\,m/s) + w_2 \frac{\ell}{2}\right) \frac{\ell}{2} + \frac{1}{12} m_A \ell^2 w_2$$

$$(0.16\,kg)(3\,m/s)\left(\frac{2m}{2}\right) = (0.16\,kg)\left(-0.8(3\,m/s) + w_2\left(\frac{2m}{2}\right)\right)\left(\frac{2m}{2}\right) + \ldots$$

$$\ldots + \frac{1}{12}(1\,kg)(2m)^2 w_2$$

$$\therefore \boxed{w_2 = 1.75\ rad/s}$$