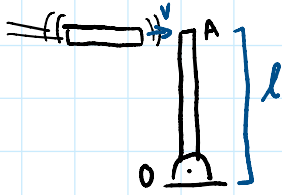


Beginner Eccentric Impact

Inspiration: None



There is a popular party game which involves throwing a frisbee to knock off cups resting on a stick. For simplicity, assume the frisbee can be modelled as a disk, the stick can be modelled as a rod connected to a pin joint which is held stationary until impact, and neglect any frictional effects. If the frisbee, with mass $m_{\text{frisbee}} = 0.2 \text{ kg}$ and radius $r = 0.135 \text{ m}$, strikes the very top of the stick with length $l = 1.3 \text{ m}$ at a velocity $v = 6 \text{ m/s}$, determine the velocity of the frisbee immediately after collision. The stick has mass $m_{\text{stick}} = 0.5 \text{ kg}$ and the coefficient of restitution is $e = 0.8$.

$$I_0 = \frac{1}{3} m l^2 = \frac{1}{3} (0.5)(1.3)^2 = \frac{169}{600} \quad \omega = \frac{v_A}{l} = \frac{v_A}{1.3}$$

$$\sum (H_0)_1 = \sum (H_0)_2$$

$$m_d v_{d1} l = I_0 \omega_2 + m_d v_{d2} l$$

$$(0.2)(6)(1.3) = \frac{169}{600} \omega_2 + (0.2) v_{d2} (1.3)$$

$$1.56 = \frac{169}{600} \left(\frac{v_{A2}}{1.3} \right) + 0.26 v_{d2}$$

$$e = \frac{v_{A2} - v_{d2}}{v_{d1} - v_{A1}} \quad 0.8 = \frac{v_{A2} - v_{d2}}{6 - 0}$$

$$v_{d2} = v_{A2} - 4.8$$

$$1.56 = \frac{13}{60} v_{A2} + 0.26 v_{A2} - 1.248$$

$$v_{A2} = 5.8909 \text{ m/s}$$

$$v_{d2} = \frac{12}{11} \text{ m/s}$$