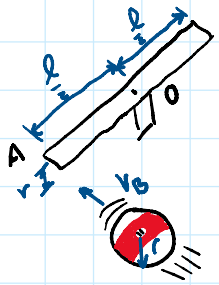
20-R-IM-DK-15

July 9, 2020 2:23 PM

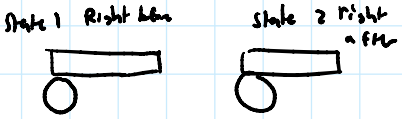
Beginner Impact Video

Inspiration: 19-43 Hibbeler



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 = 3m/s***. The pool ball has radius r = 0.025m 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.

View is from an angle



$I_{rod} = \frac{1}{12} m l^2 = \frac{1}{12}(1)(2)^2 = \frac{1}{3}$ Pinned at O $\therefore \omega_2 = \frac{v_{A_2}}{\frac{l}{2}} = \frac{v_{A_2}}{1}$

$\Sigma (H_O)_1 = \Sigma (H_O)_2$ $H_O = H_G + r_{G/O} m v$

$0 + m_b v_{b_1} \frac{l}{2} + 0 = I_{rod} \omega_2 + m_b v_{b_2} \frac{l}{2}$

$(0.16)(3)(1) = \frac{1}{3}\omega_2 + (0.16) v_{b_2} (1)$

$e = \frac{v_{A_2} - v_{B_2}}{v_{B_1} - v_{A_1}}$ $0.8 = \frac{v_{A_2} - v_{B_2}}{3 - 0}$ $2.4 = v_{A_2} - v_{B_2}$

$0.48 = \frac{1}{3} v_{A_2} + 0.16 v_{B_2}$ $0.48 = \frac{1}{3}(2.4 + v_{B_2}) + 0.16 v_{B_2}$

$v_{B_2} = -0.6486$ m/s

$v_{A_2} = 1.751351$

$\omega_2 = 1.751351$ rad/s