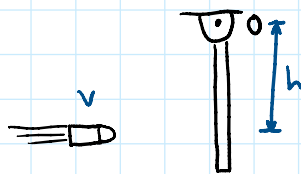


Beginner Conservation of Momentum

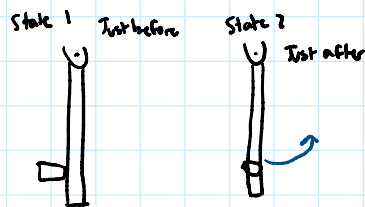
Inspiration: Hibbeler Example 19.7



A $1\text{ m} \times 1\text{ m}$ thin plate is used as target practice at a firing range where participants are shooting for sport. If the plate has a mass of $m = 20\text{ kg}$ and pinned at point O, determine the angular velocity of the plate just after a 5 g bullet, shot at a velocity of $v = 400\text{ m/s}$, is embedded in it. The bullet hits a vertical distance $h = 0.75\text{ m}$ away from point O.

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

$$m_{\text{bullet}} v_{\text{bullet},1} h = m_{\text{bullet}} v_{\text{bullet},2} h + m_{\text{plate}} v_{G,2} r_{G/O} + I_G \omega_2$$



$$(0.005)(400)(0.75) = (0.005)v_{B,2}(0.75) + (20)v_{G,2}(0.5) + \frac{1}{2}(20)(1)^2\omega_2$$

$$1.5 = 0.00375 v_{B,2} + 10 v_{G,2} + \frac{20}{12} \omega_2$$

Pinned at O: $v_{G,2} = 0.5 \omega_2$ $v_{B,2} = 0.75 \omega_2$

$$1.5 = 0.00375(0.75)\omega_2 + 10(0.5)\omega_2 + \frac{20}{12}\omega_2$$

$$\omega_2 = 0.2249 \text{ rad/s}$$