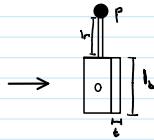


A 35 g dart is thrown at a swinging rectangular dart board with a painted bullseye. The dart hits the bullseye at a speed of 18 m/s. Find the angular velocity of the board around point P at the instant the dart hits the board. Assume the mass of the board is 0.35 kg, the mass of the connecting rod is $m_r = 0.15$ kg, the length of the rod is $l_r = 0.5$ m, the length of the board is $l_b = 0.25$ m, and the thickness of the board is $t = 0.1$ m. The dart sticks to the board after the collision.



$$\begin{aligned} m_d &= 0.35 \text{ kg} \\ m_r &= 0.15 \text{ kg} \\ l_r &= 0.5 \text{ m} \\ l_b &= 0.25 \text{ m} \\ t &= 0.1 \text{ m} \end{aligned}$$

$$(H_{sys})_1 = (H_{sys})_2$$

$$(m_d \cdot v_d) \cdot r_{Pd} = (I_P)_2 \omega_2$$

$$I_{P2} = I_{board} + I_{rod} + I_{dart}$$

$$I_{rod} = \frac{1}{3} m_r l_r^2 = \frac{1}{3} (0.15) (0.5^2) = 0.0125 \text{ kg} \cdot \text{m}^2$$

$$I_{board} = \frac{1}{12} m_b (l_b^2) + m_d l_{br}^2 = \frac{1}{12} (0.35) (0.25^2) + (0.35) (0.625)^2 = 0.1385 \text{ kg} \cdot \text{m}^2$$

$$I_{dart} = m_d l_{dp}^2 = (0.035) (0.625)^2 = 0.0137 \text{ kg} \cdot \text{m}^2 \quad I_{P2} = 0.152 \text{ kg} \cdot \text{m}^2$$

$$\omega_2 = \frac{m_d \cdot v_d \cdot r_{Pd}}{(I_P)_2}$$

$$\omega_2 = \frac{0.035 \cdot 18 \cdot 0.625}{0.152} = 2.586 \text{ rad/s}$$

$$\omega_2 = 2.59 \text{ rad/s}$$