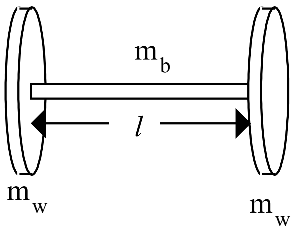
Chapter 11 Problem 35 †



Given
$m_w = 25\ kg$
$m_b = 15\ kg$
$l = 1.6\ m$
$\omega = \frac{10\ rev}{min}\left(\frac{2\pi\ rad}{1\ rev}\right)\left(\frac{1\ min}{60\ s}\right) = 1.05\ rad/s$

Solution
Find the angular momentum of the spinning barbell.

Each of the weights on the barbell are a distance of $l/2$ from the pivot point. Each of the weights have a moment of inertia of

$$I_w = m_w r^2 = m_w (l/2)^2 = m_w l^2/4$$

The bar of the barbell is spun about its center. From table 10.2 of the textbook the bar has a moment of inertia of

$$I_b = (l/12) m_b r^2$$

The total moment of inertia of the barbell is

$$I = 2(m_w l^2/4) + m_b r^2/12$$

The angular momentum is then

$$L = I \cdot \omega = (2 m_w l^2/4 + m_b r^2/12)\omega$$

$$L = \left[2(25\ kg)(1.6\ m)^2/4 + (15\ kg)(1.6\ m)^2/12\right](1.05\ rad/s)$$
$$L = 37.0\ kg \cdot m^2/s$$

† Problem from Essential University Physics, Wolfson