

The center of mass of a pitched baseball (3.80-cm radius) moves at 38.0 m/s. The ball spins about an axis through its center of mass with an angular speed of 125 rad/s. Calculate the ratio of the rotational energy to the translational kinetic energy. Treat the ball as a uniform sphere.

Translational kinetic energy:

$$W_{tr} = \frac{mv^2}{2}$$

Rotational kinetic energy:

$$W_r = \frac{I\omega^2}{2} = \frac{\frac{2}{5}mr^2\omega^2}{2} = \frac{1}{5}mr^2\omega^2$$

The ratio of the rotational energy to the translational kinetic energy:

$$\frac{W_r}{W_{tr}} = \frac{\frac{1}{5}mr^2\omega^2}{\frac{mv^2}{2}} = \frac{2r^2\omega^2}{5v^2}$$

$$\frac{W_r}{W_{tr}} = \frac{2(0.038m)^2(125rad/s)^2}{5(38m/s)^2} = 6.25 * 10^{-3}$$

Answer: $\frac{W_r}{W_{tr}} = 6.25 * 10^{-3}$