Chapter 10 Problem 36 †

Given
$m = 150\ g = 0.150\ kg$
$v = 33\ m/s$
$\omega = 42\ rad/s$
$r = 3.7\ cm = 0.037\ m$

Solution
Find the fraction of kinetic energy that is rotational.

Since the baseball is solid, its moment of inertia is

$$I = \frac{2}{5}mr^2 = \frac{2}{5}(0.150\ kg)(0.037\ m)^2 = 8.21 \times 10^{-5}\ kg \cdot m^2$$

The rotational kinetic energy of the baseball is then

$$K_{rot} = \frac{1}{2}I\omega^2 = \frac{1}{2}(8.21 \times 10^{-5}\ kg \cdot m^2)(42\ rad/s)^2 = 0.0724\ J$$

The translational kinetic energy of the baseball is

$$K_{tran} = \frac{1}{2}mv^2 = \frac{1}{2}(0.150\ kg)(33\ m/s)^2 = 81.68\ J$$

The fraction of kinetic energy in rotation is

$$fraction = \frac{K_{rot}}{K_{tran} + K_{rot}} = \frac{0.0724\ J}{81.68\ J + 0.0724\ J} = 8.86 \times 10^{-4}$$

†Problem from Essential University Physics, Wolfson