

12.12. Model: The baton is a thin rod rotating about a perpendicular axis through its center of mass.

Solve: The moment of inertia of a thin rod rotating about its center is $I = \frac{1}{12}ML^2$. For the baton,

$$I = \frac{1}{12}(0.400 \text{ kg})(0.96 \text{ m})^2 = 0.031 \text{ kg m}^2$$

The rotational kinetic energy of the baton is

$$K_{\text{rot}} = \frac{1}{2}I\omega^2 = \frac{1}{2}(0.031 \text{ kg m}^2)\left((100 \text{ rev/min})\left(\frac{2\pi \text{ rad}}{\text{rev}}\right)\left(\frac{\text{min}}{60 \text{ s}}\right)\right)^2 = 1.68 \text{ J}$$