**EXAM 3**

Name: ___________________________  Student ID #: ___________________________

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**Physics 2010**  
**Fall 2002**  
**Sid Rudolph**

B. A yo-yo is released from rest and falls with constant acceleration so that after dropping 1.00 m the downward velocity of the center of mass (CM) of the yo-yo is 0.750 m/s. The inner and outer radii are \( r = 2.00 \) cm and \( R = 4.00 \) cm.

1. [8 pts.] What are the tangential speed of the edge of the inner radius hub and the angular speed of the yo-yo about the axis through the yo-yo's center of mass after the yo-yo falls 1.00 m?

\[
\begin{align*}
\omega_T &= 0.750 \text{ m/s} \\
\omega &= \frac{\omega_T}{R} = \frac{0.750 \text{ m/s}}{0.02 \text{ m}} = 37.5 \text{ rad/s}
\end{align*}
\]

2. [8 pts.] What are the tangential acceleration of the inner radius hub and the angular acceleration of the entire yo-yo about the axis through the yo-yo's center of mass?

\[
\begin{align*}
\omega_T &= \sqrt{\omega_T^2 + \alpha_T (x - x_0)} \\
\alpha &= \frac{\alpha_T}{r} = \frac{0.38 \text{ m/s}^2}{0.02 \text{ m}} = 19.1 \text{ rad/s}^2
\end{align*}
\]

3. [7 pts.] Though how many rotations has the yo-yo rotated during the 1.00 fall?

\[
\begin{align*}
\theta &= \theta_0 + \omega_{AV} t \\
\Delta \theta &= \frac{\omega_T^2 - \omega_i^2}{2\alpha} = \frac{(3.5 \text{ rad/s})^2}{2 \cdot 0.38 \text{ rad/s}^2} = 3.125 \text{ rad} \\
\Delta \theta &= 50.0 \text{ rad} \\
\Delta \theta &= 7.96 \text{ rad}
\end{align*}
\]