A bicycle wheel and tire are supported so that they are free to rotate about their centroidal axis through the hub of the wheel. A small weight \( W \) is taped to the tire as shown in the accompanying figure at a distance \( R \) from the axis of rotation. When this weight is displaced slightly from the vertical axis shown, the wheel is observed to oscillate 3 times every 10 s. If \( R = 0.28 \) m, and \( W = 3.34 \) N, determine the centroidal mass moment of inertia \( I \) of the wheel and tire.

\[ I = 0.237 \text{ Nm}^2 \]

We will treat the weight \( W \) as a small particle and assume small oscillations.

\[ I = \frac{WR}{\omega^2} \]

\[ \omega^2 = \frac{WR}{I + WR^2} \]

Assume small angles.

\[ \tau = \frac{\omega^2}{\theta} \]

From experimental data:

\[ \tau = \frac{10}{3} \text{ sec} \]

Finally:

\[ \tau = \left( \frac{10}{3} \right)^2 \left( \frac{1}{2} \right)^2 (3.34)(0.28)^2 = \frac{(3.34)(0.28)^2}{9.8} \]

\[ \tau = 0.237 \text{ Nm}^2 \]