Rotational Mechanics
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Mechanics of Rotation:
Arc Length: \( S = R\theta \)
Tangential Speed: \( V = r\omega \)
Tangential Acceleration: \( A = Ra \)

\[ \omega = \frac{d\theta}{dt} = \frac{\Delta \theta}{\Delta t} \]
\[ D\omega/dt = a = \frac{\Delta \omega}{\Delta t} \]

For Constant Acceleration, Kinematics equations remain the same
\[ \theta = \theta_0 + \omega_0 t + 0.5at^2 \]
\[ \omega = \omega_0 + at \]
\[ \omega^2 - \omega_0^2 = 2a\Delta\omega \]

Moment of Inertia Equation:
\[ K = 0.5I\omega^2 \]
Where \( I = mR \)

A wheel is initially at rest and made to turn with a constant acceleration. After 4 seconds, it has made 4 complete rotations. How many revolutions has it made after 8 seconds?
\[ \theta = \theta_0 + \omega_0 t + 0.5at^2 \]
\[ \Delta\theta = 0.5at^2 \]

Moment of Inertia:
“Rotational Sluggishness”
\[ I = \sum m_i r^2 \]
\[ I = \int r^2 \, dm \]
R is measured from the axis of rotation

Moment of Inertia for:
Solid Cylinder: \( 0.5MR^2 \)
Cylindrical Shell: \( MR^2 \)
Solid Sphere: \( 2/5 \, MR^2 \)
Spherical Shell: \( 2/3 \, MR^2 \)
Linear Density = $\frac{M}{L}$
Surface Area Density: $\frac{M}{A}$
Volume Density: $\frac{M}{V}$