Definitions

Angular displacement θ indicates the angle through which an object has rotated. It is measured in radians.

Average angular velocity ω is angular displacement divided by the time interval over which that angular displacement occurred. It is measured in rad/s.

Instantaneous angular velocity is how fast an object is rotating at a specific moment in time.

Angular Acceleration α tells how much an object's angular speed changes in one second. It is measured in rad/s per second.

Angular acceleration and centripetal acceleration are independent. Angular acceleration changes an object's rotational speed, while centripetal acceleration changes an object's direction of motion.

Relationship between angular and linear motion

The linear displacement of a rotating object is given by $r\theta$, where r is the distance from the rotational axis.

The linear speed of a rotating object is given by $v = r\omega$

The linear acceleration of a rotating object is given by $a = r\alpha$.

Torque

The torque provided by a force is given by $\tau = Fd_{\perp}$, where $d_{\perp}$ refers to the "lever arm." (see pp. 126-127 of the 5-steps book for a more detailed summary of lever arm.) It is also denoted as $\tau = Fd\sin\theta$.

Rotational Inertia

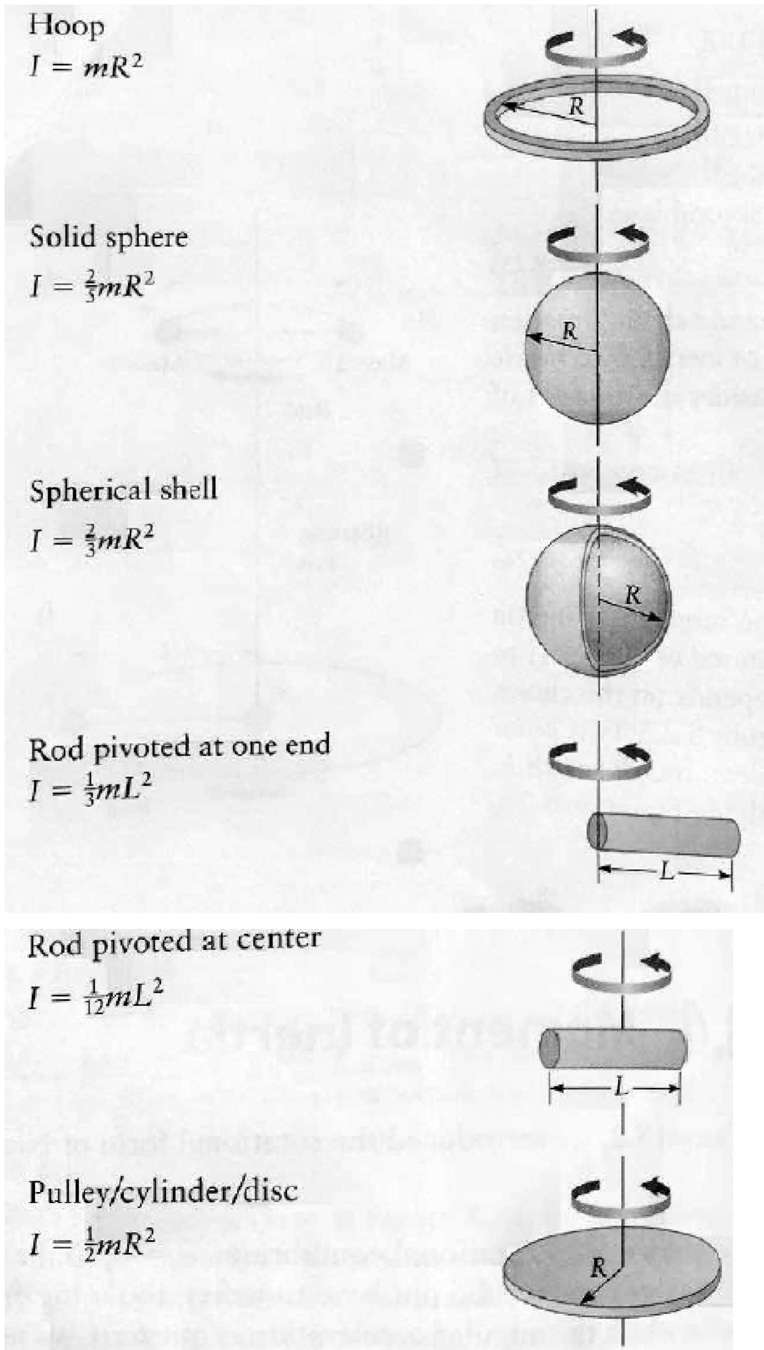
Rotational inertia I represents an object's resistance to angular acceleration.

For a point particle, rotational inertia is MR^2, where M is the particle's mass, and R is the distance from the axis of rotation.

For a series of point particles, the rotational inertia is calculated by finding the sum of the individual moments of inertia - $I = \Sigma mR^2$. For a continuous object we use the integral formula $I = \int R^2 dm$

For a complicated object, its rotational inertia may be given by an equation relating its mass and radius. The chart on the next page from Giordano's text should not be memorized, but used as a guide. These equations will be given as needed.

Rotational inertia of multiple objects add together algebraically.



Newton's Second Law for Rotation

An angular acceleration is caused by a net torque: $\alpha = \dfrac{\tau_{net}}{I}$