Moment of Inertia

Equipment

- Rotary Motion Sensor
- Rotation stage with ring and disk
- Assorted masses
- Pendulum apparatus

Objective

Data collection

- Quantitative analysis of rotational motion

Data analysis

- Determine angular position, velocity and acceleration
- Fit appropriate functions to data

Physics Concepts

- Torque, Moment of Inertia, Angular Kinematics

Conceptual (C-Level)

Draw a schematic and force diagram for a cart being pulled down a horizontal track by a mass hung over a pulley.

- Find an expression for the acceleration of the cart.
- What happens to the acceleration of the cart if mass is added to the cart?
- Does it matter where the mass is added to the cart? (i.e. in the back or in the front)

Now draw a schematic and force diagram for an object that is free to spin by means of a string wrapped around its rotation axis and pulled by a mass hung over a pulley.

- Is the instantaneous velocity constant for every point on the spinning object?
- Describe angular velocity and angular acceleration.
- You spin both a disk and a ring that have the same mass with the same setup. How would the resulting rotations compare?

Basic Lab (B-level)

Setup a rotation stage to be spun by a string connected to a mass hung over the pulley of a rotary motion sensor. You are investigating whether mass distribution is important for objects in motion.

- Compare the angular acceleration for a disk and for a ring.
- How does the angular acceleration of an object change when the mass spinning it varies?

Investigate the swinging rod attached to a rotary motion sensor.

- Determine the oscillation frequency.
- Qualitatively determine how the oscillation frequency changes as the mass attached to the rod is moved.

Advanced/Extended Lab Ideas (A-level)

- Determine an expression for the angular acceleration of the spinning object above.
- Compare an oscillating pendulum and an oscillating rod.
- Determine how the oscillation frequency varies with mass distribution for a rod.
- Compare theoretical and experimental moment of inertia of an object.
- What might you be curious to investigate?