

Rotations, Torque, and Rotational Inertia

This lab more or less follows Activity 13 from the regular Physics I sections. You'll have a "rigid body" with an adjustable value of rotational inertia I . I would like you to experiment with the apparatus, and try to confirm some of the equations we've developed for rotational motion. This will be a little different from previous labs; instead of comparing "measurement" to "prediction" you should try to carry out a more free form investigation, and see what you learn.

The "rigid body" for this experiment is just two masses, whose positions can be adjusted relative to the an axis, located at the center of a straight rod. Two configurations, looking sideways (i.e. rotation in a plane perpendicular to the page) are as follows:



How would you write the rotational inertia of this object, assuming that the two masses each have mass M and that they are both a distance R from the rotation axis? You might want to include a term I_{rod} for the rotational inertia of the rod.

Set the object spinning and measure its angular acceleration with LOGGERPRO. You can assume that it is slowing down due to the constant torque τ applied by friction at the bearing holding the object to the axle. To get a good measurement of the angular acceleration α , you should probably take enough data to let the object slow down to about half of its initial rotation speed. Repeat this measurement for various values of R .

Now analyze your data. You might try making a plot of α as a function of R . Can you see evidence for a non-zero value of I_{rod} ? (What would a non-zero value of I_{rod} do to this curve?) Perhaps you could determine a value of I_{rod} with an uncertainty, and then try to estimate it independently. Does your estimate agree with your measurement, within uncertainties?

What about the torque? This analysis assumes that the torque is independent of the configuration of the two masses M . Is that a good assumption? Try determining a value of this torque from your data. Do you suppose you could estimate what you might expect, using other assumptions?

How else could you modify and/or use this apparatus to make other measurements?