PhyzLab: Angular Mass

an investigation of rotational inertia

PERIOD	1.		
	2.		
GROUP	3.		
	4.		

• Discussion •

In our study of rotation, we have learned that there are many parallels or *analogs* between the familiar concepts of translational (or linear) motion and rotational (or angular) motion. Thus far, we have only explored rotational kinematics (mathematical description of motion). We must now investigate rotational dynamics (physical explanation of motion).

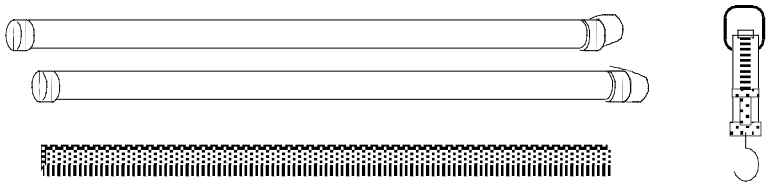
We already know the rotational analogs of position, speed, and acceleration. We now seek the rotational analogs of mass and force. We will eventually expand this investigation to find the rotational analogs for momentum, work, and kinetic energy.

• Purpose •

To investigate the difference between "linear mass" and "angular mass."

• Apparatus •

___ mystery rod labeled "A"
___ mystery rod labeled "B"
___ meterstick
___ spring scale



• Procedure •

1. MEASURE

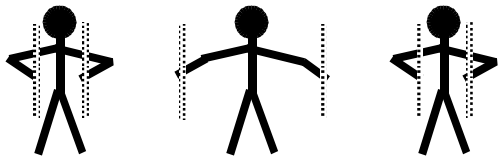
LENGTH: Rod A: L_A = _____ Rod B: L_B = _____

MASS: Rod A: m_A = _____ Rod B: m_B = _____

Due to the nature of this lab, each member of the lab team must carry out the procedures below for him/herself. The procedure is quick and simple, so this should not pose any problem.

2. COMPARE LINEAR MASSES

a. Move to an open space—make sure there are no people, desks, or walls within 1m of you in any direction.
b. Hold the bars—one in each hand—out to your sides and in front of you as shown to the right.
c. Wave the bars back and forth **as fast as possible**. (Keep your elbows fixed; swing your forearms back and forth.)

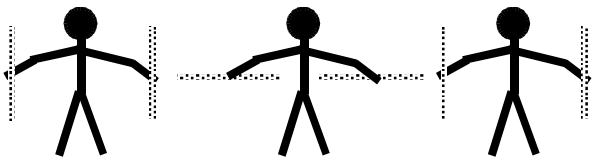


Which bar—A or B—is more difficult to wave (or is it a tie)? If there is a difference, it will be significant! If there is no significant difference, you must conclude that it is a tie.

Oh, wait! How can you be sure you're not just testing the relative strength of your right arm versus your left arm?

3. COMPARE ANGULAR MASSES

a. Hold the bars—one in each hand—out to your sides and in front of you as shown to the right.
b. Rotate both bars through 90° (a quarter turn) back and forth **as fast as humanly possible!**



Which bar—A or B—is more difficult to turn (or is it a tie)?
Oh, wait! How can you be sure you're not just testing the relative strength of your right arm versus your left arm?

• Analysis •

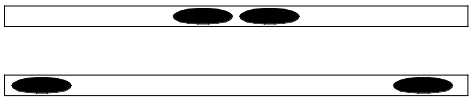
Answer questions 1-5 in complete sentences.

1. Did one rod have significantly (10% or more) more mass than the other? If so, which one was more massive, and by what percent? [$\%diff = \{ |m_{HEAVY} - m_{LIGHT}| / (m_{HEAVY} + m_{LIGHT}) \} \times 200$]

2. Was one rod significantly longer than the other? If so, which one and by what percent?

3. Did one rod feel significantly harder to rotate than the other? If so, which one?

4. If the rods were cut in half along their lengths, the distribution of mass within each could be seen. Based on your observations and intuition, which diagram represents rod A and which represents rod B? (Label the diagrams.)



5. What factors determine the "angular mass" or resistance to rotation of an object?

6. Rank the dumbbells shown from highest to lowest angular mass. The mass is indicated by the size of the circles at the ends of each bar. Use your best judgment and anything you learned in this activity.