Experiment 7: Angular Momentum

Table and Group: _______ Participants: ________________________________
Each group will turn in one common report. ________________________________

In the following spaces, record your predictions done during the PRS questions:

1. For one washer (not spinning) dropped straight down onto one spinning washer, what will be the ratio of the final over the initial angular speed?

2. For one washer (not spinning) dropped straight down onto two spinning washers, what will be the ratio of the final over the initial angular speed?

3. For two washers (not spinning) dropped straight down onto one spinning washers, what will be the ratio of the final over the initial angular speed?

Part One: Collision
Fill in the table below with the values you found in your experiment. The last column is the ratio of the final over the initial angular speed calculates using your measured values.

<table>
<thead>
<tr>
<th>Num Spin</th>
<th>Num Drop</th>
<th>$\omega_1 \text{ (s}^{-1}\text{)}$</th>
<th>$\omega_2 \text{ (s}^{-1}\text{)}$</th>
<th>$\frac{\omega_2}{\omega_1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis

1. Do your data agree with your prediction?

Part Two: Stopping Torque
Suppose you have two theories for the stopping torque which causes the motor with one or more washers to slow down over time. Theory 1 predicts that the stopping torque is due to a friction-like force so the stopping torque is proportional to the number of washers on the
motor. Theory 2 predicts that the stopping torque is a constant, independent of the number of washers. Measure the acceleration with one, two, and three washers in place. Fill in the table below with the values you found in your experiment where the subscript denotes the number of washers on the apparatus.

<table>
<thead>
<tr>
<th>$\alpha_1 , (s^{-2})$</th>
<th>$\alpha_2 , (s^{-2})$</th>
<th>$\alpha_3 , (s^{-2})$</th>
</tr>
</thead>
</table>

1. Which theory does your data support? Explain your answer.

Additional fun ideas to play with if you have time

1. What do you think would happen if the dropped washer was spinning in the same direction as the lower one? Would the ratio of the final over the initial angular speed be smaller or larger? Predict and then measure.

2. What do you think would happen if the dropped washer was spinning in the opposite direction as the lower one? Would the ratio of the final over the initial angular speed be smaller or larger? Predict and then measure.

3. Will the curve of angular speed versus time look any different at all if the friction between the two washers is dramatically reduced? Try dropping a washer so the smooth side hits instead of the velcro side. Predict and then measure.