Accelerated Rotation Lab
AP Physics 1

Name: _____
1 2 3 4 5 6 7 8

Goal: to theoretically and experimentally determine the moment of inertia of a spinning meter stick.

Preliminary Questions:
A bucket is hanging on a 0.5 m wide (diameter) pulley with a mass of 4 kg and is dropped into a well. It accelerates downward at 8 m/s^2.

1. What is the moment of inertia of the pulley? (assume that the string has no mass and that the pulley can be modeled as a solid disc.)

2. What is the angular acceleration of the pulley?

3. What is the magnitude of the torque that the rope/bucket exert on the pulley?

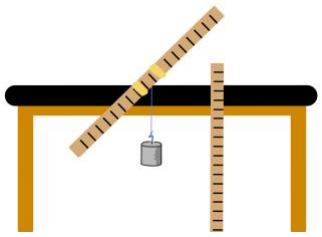
Materials:

- Meter stick
- Meter stick attached to a circular motion apparatus
- 3 masses
- Ipad with Technique

Procedure:

1. Go to the scale at the front of the room and find the mass of your meter stick/circular motion apparatus. Record it here: _____ kg

2. Using a meter stick, find the radius of the spool (where the string goes) on the circular motion apparatus and record it here: _____ m



3. Attach a small mass to the string tied to the circular motion apparatus and wind the string around the spool on the plastic part of the apparatus.

4. Set up a second meter stick as shown and hang the mass over the table.

5. Open up Technique on an iPad and position it so the view matches the picture above.

6. Start recording and let the mass fall, causing the circular motion apparatus/meter stick to spin

7. Repeat steps 3-6 for each of your three masses

Part 1: Calculating Angular Velocity

1. Look back at your first video collected on Technique. Find the final velocity of the mass as it falls by measuring the distance that it falls in the last 0.03 seconds before it hits the ground.

2. Using your video, find the total time that it takes for your mass to fall. Knowing this and the fact that the initial velocity of your mass was 0 m/s, find the linear acceleration of the mass as it fell.

3. Using your answer to part 2 and the radius of the spool, find the angular acceleration of the circular motion apparatus.

4. For your second video, find the final angular velocity of the circular motion apparatus by measuring its angular displacement over the 0.03 seconds right before the mass hits the ground.

5. Using your video, find the total time that it takes for this mass to fall (note that it might be a different time than that in your first video!). Knowing this and the fact that the initial angular velocity of your circular motion apparatus was 0 rad/s, find the angular acceleration of the mass as it fell.

6. Using one of the processes described above, find the angular acceleration of the circular motion apparatus in the third video.

Part 2: Finding Torpe

1. Draw a diagram of the spool, string and mass in the space below. Using your diagram, find the net torque on the spool for each of the masses.

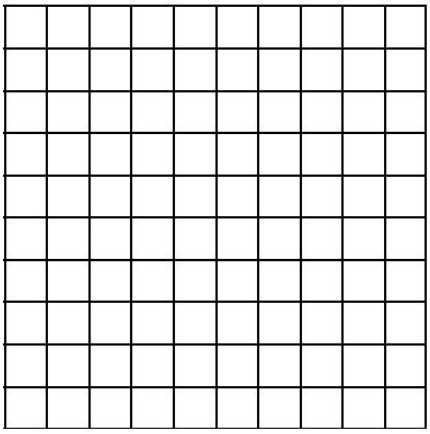
Torque 1: _____

Torque 2: _____

Torque 3: _____

Part 3: Graph and Analysis

1. On the grid below, graph the torque (y – axis) vs the angular acceleration (x- axis) for each of the three trials.



2. Calculate the slope of the line. This should represent the moment of inertia for your circular motion apparatus!!

3. Treating your meter stick as a rod that rotates around its center, find the theoretical value of its moment of inertia.

4. Calculate the percent error between the measured and the theoretical value of the moment of inertia.

5. How could you improve this experiment to make your experimental value of the rods moment of inertia closer to the theoretical value?