ROLLING WITHOUT SLIPPING

Purpose:

To determine the moment of inertia of a hollow metal cylinder experimentally and theoretically.

Procedure:

1. Set up an inclined plane on your lab table using the boards and props provided. Mark a starting line near the top of the incline, and a finishing line near the bottom. Measure the distance between the lines and call it L. Also, calculate the angle theta that the incline makes with the horizontal by measuring the rise and run of the incline. Record this information as part of your data.

2. For the hollow cylinder, experimentally determine the moment of inertia (in $kg \cdot m^2$) as follows.
(a) Mass the cylinder using the heavy-duty balances inside the prep-room.
(b) Measure the disk **outside** diameter and calculate the corresponding radius. Call it R
(c) Release the cylinder from rest at the starting line on the inclined plane and time its travel to the finishing line. Since timing errors are the greatest source of error in this experiment, it is essential that you obtain accurate times. Therefore, one person releases the object and does the timing. The other lab partner stops the rolling cylinder. Each lab partner should do at least 5 trials. The lab partners should compare their times, and if they are consistent, calculate an average time. If the times are not consistent then figure out why and arrive at a mutually acceptable average time.

3. Substitute into the equation below to determine an "experimental" value of I.

$$I = MR^2\left[\frac{gt^2 \sin\theta}{2L} - 1\right]$$

Enter M in kilograms, R in meters, t in seconds, and L in meters.

4. Calculate a theoretical value of I using $I = MR^2$.

5. Calculate a percent error between the theoretical and experimental values. The percent error should be less than 30%.

6. Follow the lab manual standard format for reports and submit the report through Canvas.