

# Moment of Inertia Lab

Diagram of the components:



**Part Mass (g) Length (cm) OD (cm) ID (cm)**

A	133.08	55.5	2.15	1.5
B	72.79	30.5	2.15	1.5
C	12.77	2.5	2.81	2.15
D	33.37	7.2	2.81	2.15

**1. Calculate the moment of inertia of the apparatus using measurements of the length and mass of each component. Show and label each step of the calculation.**

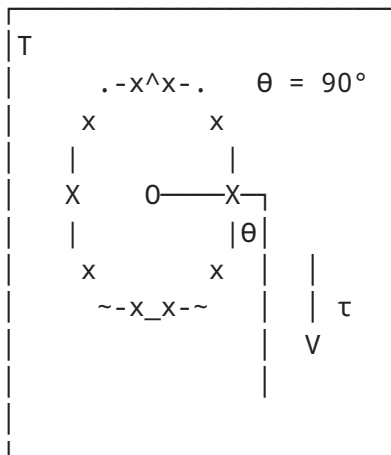
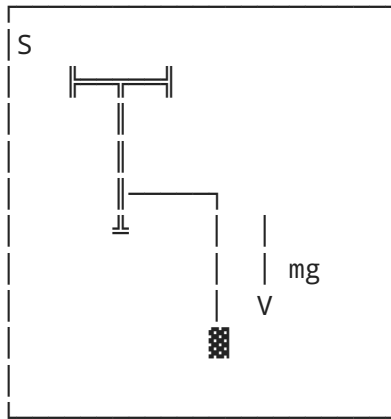
$$\frac{1}{12} * (2(0.1277 \text{ kg} + 0.7279 \text{ kg}) + 0.3337 \text{ kg}) * (2(0.025 \text{ m} + 0.305 \text{ m}) + 0.072 \text{ m})^2$$
$$0.09129 \text{ kg m}^2$$

**2. Perform two experiments using different hanging masses, record  $\Theta$ , t, m,  $\Delta y$ , and r in a data table format.**

**mass (g) time (s)**

200.	8.92
500.	5.20

**3. Draw a free body diagram showing and labeling all forces and torques.**



**4. Write the two Newton's second law equations derived from the free body diagram.**

$$F = mg$$

$$F = 0.200 \text{ kg} * 9.8 \text{ m/s}^2$$

$$F = 1.96 \text{ N}$$

$$\tau = r \perp F$$

$$\tau = 0.0215 \text{ m} * 1.96 \text{ N}$$

$$\tau = 0.04124 \text{ m}^*\text{N}$$

$$F = 0.500 \text{ kg} * 9.8 \text{ m/s}^2$$

$$F = 4.9 \text{ N}$$

$$\tau = r \perp F$$

$$\tau = 0.0215 \text{ m} * 4.9 \text{ N}$$

$$\tau = 0.10535 \text{ m}^*\text{N}$$

**5. Use the experimental data to calculate I for the apparatus. Show each mathematical step. Provide a caption describing the purpose of each step.**

The angular acceleration was first found by multiplying the tangential acceleration by the radius

$$\begin{aligned}\alpha &= a_{\text{tan}} / r \\ \alpha &= 8.92 \text{ rad/s}^2 * 0.0215 \text{ m} \\ \alpha &= 0.192 \text{ rad/s}^2\end{aligned}$$

And the inertia was found by solving the following equation

$$\Sigma \tau = I\alpha$$

$$\begin{aligned}0.04124 \text{ m}\cdot\text{N} &= I * 0.192 \text{ rad/s}^2 \\ I &= 0.04124 \text{ m}\cdot\text{N} / 0.192 \text{ rad/s}^2 \\ I &= 0.215\end{aligned}$$

**6. Compare the calculated I with the experimentally determined I. Analyze sources of error associated with each method used to determine I.**

The calculated I was far smaller than the experimentally found I, which was almost certainly due to errors in the experimental calculations.