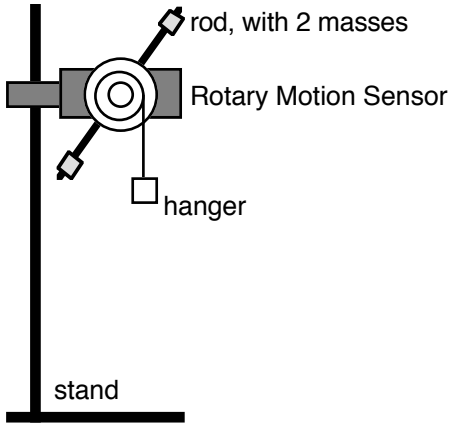
Lab 10-2: **Newton's Second Law**

Purpose: 1. To determine an equation that describes the relationship between torque and angular acceleration for an object of constant rotational inertia.

Procedure:



1. Set up the rotary motion sensor as shown in the diagram. Make sure the point masses are balanced on the rod. Attach the hanger to a string, and wrap the string around one of the pulleys on the sensor (use the biggest pulley). Record the position and mass of the 2 point masses on the rod.
2. Use the set-up file that is written on the board to get LoggerPro to take the right data.
3. Wind up the hanger, turn on the sensor, and let go of the hanger.
4. Record the angular acceleration of the pulley/rod by measuring the slope of the velocity vs time graph. Ignore the signs.
5. Repeat the above, but each time adding 50 grams to the hanger. Record your results in the data table. Do this for a total of 7 trials.

Data:

Mass of each brass mass: 0.0753 kg. Mass of rod: 0.027 kg.

Total length of rod: 0.38 m. Distance of each brass mass to center of rod: _____ m.

Largest Radius (r_3) of pulley: 0.025 m.

Hanger Mass (kg)	*Radius of Pulley (m)*	*Angular Acceleration (rad/s²)*	*Tangential Acceleration (m/s²)*	*Tension in String (N)*	*Torque on Pulley (Nm)*
0.050	0.025				
0.100	0.025				
0.150	0.025				
0.200	0.025				
0.250	0.025				
0.300	0.025				
0.350	0.025				

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Calculations:

1. Calculate the tangential acceleration of the string on the pulley. Show the calculations for the first trial here, and record all the results in the table.

2. Derive an expression to calculate the tension in the string.

3. Calculate the tension in the string for each trial and record the results in the table.

4. Calculate the torque on the pulley for each trial. Show the calculations for the first trial here, and record all the results in the table.

5. Make a graph of Torque verses Angular Acceleration. Make sure you label everything and include the best fit line.

6. Calculate the moment of inertia for the rod with the masses attached.

Questions:

1. What is the equation for the relationship between torque and angular acceleration for your data?

2. What is the physical significance of the slope of the τ vs. α graph?

3. What is the general relationship between torque and rotational acceleration?