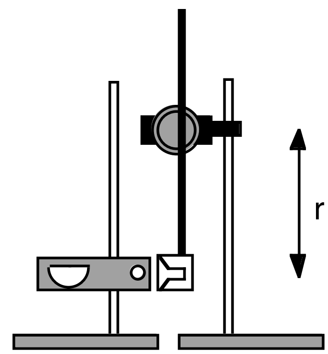
Lab 11-4: **Ballistic Pendulum**

Purpose: 1. To determine the moment of inertia of a ballistic pendulum using conservation of angular momentum.
2. To predict the final angular velocity of a ballistic pendulum.
3. To determine if kinetic energy is conserved in an inelastic collision.

Materials: 1 Rotary Motion Sensor 1 Ballistic Pendulum 1 Mini-Projectile Launcher
1 or 2 stands, depending on model of Mini-Projectile Launcher

Procedure:

1. **For the one click only:** Determine the launch speed of the ball bearing from the Launcher. There are a few different ways to do this – it is up to you to figure out a method and take data. Record any data below under "Additional Data for Determining Initial Speed of Projectile," and show your calculations in #1 below.
2. Set up ballistic pendulum and projectile launcher so that the launcher will fire a projectile into the pendulum and the ball bearing sticks in the pendulum. Make sure the launcher is firing only horizontally and that the ball bearing does in fact get lodged in the pendulum when fired. (See diagram at right.)



3. Open up "Logger Pro." If it starts with a graph of "y" vs. "x" then you need to set up the Rotary Motion Sensor as follows: Under "Experiment" choose "Set Up Sensors / Lab Pro 1:" Click on the Digital 1, and choose "Rotary Motion Sensor."
4. Increase the sampling as follows: under "Experiment" choose "Data Collection" and increase the sampling to at least 100 samples per second and change the experiment length to 5 seconds.
5. Start collecting data and then fire the ball bearing. (Use only one click.)
6. Find the maximum angular speed of the pendulum and record in the data table. (Don't worry about positives or negatives.) Repeat a few times to make sure it is reproducible.
7. Repeat the above, but using two clicks in the projectile launcher.
8. Do your calculations below. Finally test your prediction of the angular speed after adding the 100 gram mass to the bottom of the pendulum by doing it.

Data:

Mass of ball bearing: _______ kg Radius of Pendulum (r): _______ m

Angular Velocity After Impact	*Trial 1*	*Trial 2*	*Trial 3*	*Average*
1 click				
2 clicks				

Additional Data for Determining Initial Speed of Projectile:

Calculations:

1. Calculate the initial speed of the projectile. Make sure you are clear in what you a doing; a diagram may help to label your variables.

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2. What is the moment of inertia of the ball bearing as it enters the pendulum?

3. For the “1-Click” shot, what is the angular momentum of the projectile just *before* it crashes into the pendulum.

4. Based on the conservation of angular momentum, what is the angular inertia of the pendulum alone? (Base your answer on the average of your results. for the “1-Click” shot.)

5. For the “1-Click” shot, what was the kinetic energy of the ball bearing just before impact?

6. For the “1-Click” shot, what was the kinetic energy of the ball bearing and pendulum just after impact?

7. Was kinetic energy conserved in the collision? Explain.

8. How fast did the launcher fire the ball bearing when using two clicks? (Hint: you will need your answer to #4 above.)

Prediction:

9. Attach the 100 gram mass to the bottom of the pendulum. If the ball bearing is fired (using 1 click) into the pendulum, what will be the angular velocity of the pendulum immediately after impact?

10. Fire the ball bearing into the pendulum and experimentally determine the angular velocity right after impact. What was the actual angular velocity? How close was your prediction?