Lab 11-4: **Ballistic Pendulum**

Purpose: 1. To determine the moment of inertia of a ballistic pendulum using conservation of angular momentum.
2. To determine the velocity of a projectile using 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

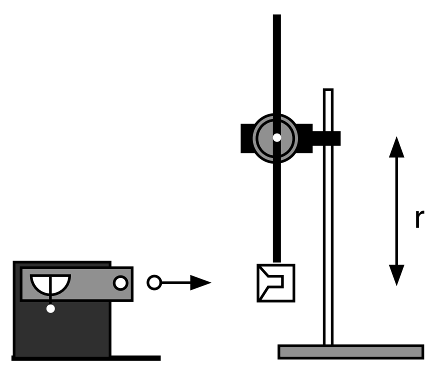
Procedure:

Part 1: Determine the launch speed of your Projectile Launcher for a "1-click" shot.

1. Figure out a way to measure how fast your Mini-Projectile Launcher fires its projectile when loaded with just 1 click. In the space below, sketch what you measured, give your data and show your calculations:

Speed of Projectile: __________ m/s

Part 2: Determine the moment of inertia of your ballistic pendulum.



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. Record the mass of the ball bearing and the distance (r) from the center of the rotary motion sensor to the middle of the projectile-catching styrofoam on the ballistic pendulum.
4. 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 box next to the image of the Lab Pro, and choose "Rotary Motion Sensor."
5. 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 at most 5 seconds.
6. Make sure the pendulum is not moving. Start collecting data and then fire the ball bearing so that it lodges into the ballistic pendulum. (Use only one click.)
7. Find the maximum angular speed of the pendulum and record in the data table. (Don't worry about positives or negatives.) Repeat three times and calculate the average value.

Part 3: Determine the speed of the launcher for a 2-click shot using the ballistic pendulum,

8. Repeat steps 6 and 7 above, but using two clicks in the projectile launcher.

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Data:

Mass of ball bearing: _______ kg Distance from rotation point to ball bearing: (r): _______ m

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

Calculations:

Part 2

1. What is the angular momentum of the ball bearing just *before* it strikes the ballistic pendulum?

2. What is the moment of inertia of the ball bearing as it enters the pendulum? (Consider it a point particle.)

3. What must be the angular momentum of the ballistic pendulum / ball bearing immediately *after* the collision?

4. What is the angular inertia of the pendulum alone?

5. What was the kinetic energy of the ball bearing just *before* impact?

6. What was the kinetic energy of the ball bearing and pendulum just *after* impact?

7. Was kinetic energy conserved in the collision? Explain why your calculations (hopefully) make sense.

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Part 3

8. Now that you know the moment of inertia of the ballistic pendulum and the maximum angular speed after the collision for the 2-click shot, calculate the speed of the launcher for the 2-click shot. Clearly show your work and explain what you are doing.

9. If you have time, determine the speed of the 2-click projectile using your method from Part 1. Show the data and calculations here.

10. Did physics work?

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