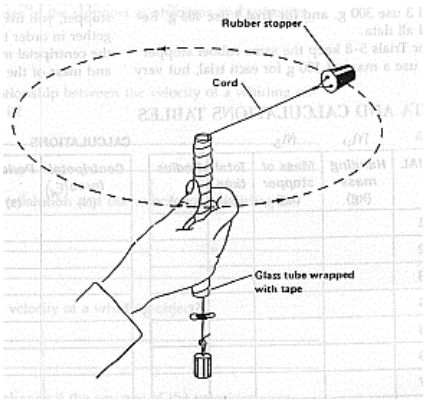
Names: _____ Date: _____

Whirligig Force Lab

Objective

To investigate the relationship between the linear speed of an orbiting rubber stopper and the mass of an object its orbit suspends.



Apparatus

- Nylon Cord
- Rubber Stopper
- Masking Tape
- Meterstick
- Tube (Glass, PVC, Plastic)
- Set of Masses
- Stopwatch

Procedure

1. Cut a length of cord approximately 1.5-1.75 m long. Fasten one end of the nylon cord securely to the rubber stopper, passing the other end through the tube and fasten a 100 g mass to it. Adjust the cord so that there is approximately 1.0m of cord between the top of the tube and the stopper. Attach a piece of masking tape to the cord just below the bottom of the tube to act as a reference to ensure that the hanging mass remains level.

2. Support the 100 g mass with one hand and the tube with the other. Whirl the stopper by moving the tube in a circular motion. Slowly release the 100 g mass and adjust the speed of the stopper so that the tape remains just below the bottom of the tube. **Do not let the tape go up into the tube. You should not be holding onto the hanging mass – it should remain suspended as a result of the circular motion of the rubber stopper.** Perform several trial runs before recording any actual data.

3. Now that you have successfully been able to keep the speed of the stopper and the vertical position of the tape relatively constant, have your partner record the time required for 25 revolutions. After the trial, measure the distance from the center of the tube to the rubber stopper – that is, record the radius of the stopper's circular motion. Also record the mass of the rubber stopper.

4. Repeat step 3, changing the suspended mass so that you perform six trials in total.

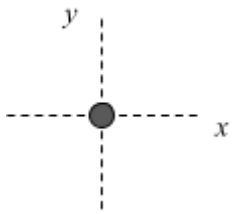
Data

Radius of circular path (m): _____ Mass of rubber stopper (kg): _____

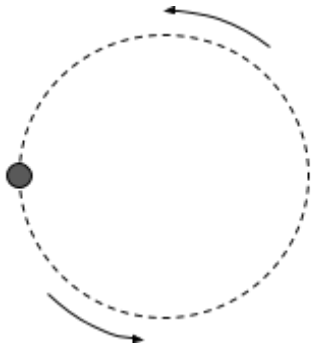
Trial	Mass of Suspended Object, M (kg)	Total Radial Force F_r (N)	Time for 25 Revolutions, Δt (s)	Average Period, T (s)	Average Linear Speed, v (m/s)	(Avg Linear Speed)^2, v (m^2/s^2)
1						
2						
3						
4						
5						
6						

Questions and Example Calculations

1. Draw a free-body diagram for the hanging mass.



2. Draw a free-body diagram for the rubber stopper when it is in the following position (as seen from above).



3. Which of the forces that we've discussed throughout the year is responsible for the stopper's acceleration that makes uniform circular motion possible?

4. Provide sample calculations for each of the following quantities. Use your data from Trial 1 to do so.

(a) Determine the period of revolution, T, of the rubber stopper in Trial 1 – that is, determine the time it takes the rubber stopper to complete a single revolution.

(b) Determine the average linear speed, v, of the rubber stopper in Trial 1.

(c) Refer to the answer from question 3. Determine the magnitude of the centripetal force in Trial 1.