Name:

Partner:

Physics 12
M. Lam

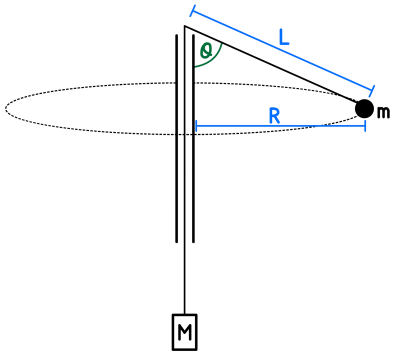
Circular Motion Lab

Block:

Objective
Determine the relationship between the period and length of string for the uniform circular motion of a mass revolving at the end of a string

Equipment
central mass *M* (9 washers)
orbiting mass *m* (3 washers)
glass tube
thread
meter stick
stopwatch

Apparatus



Introduction
In this lab, a central mass *M* is joined to a smaller mass *m* which is placed in a circular orbit around a glass tube. As the smaller mass is in orbit, the tension in the string will keep the central mass stationary.

1. Draw a free body diagram for the central mass *M*. What must the tension in the string be to keep it stationary?

2. Draw a free body diagram for the orbiting mass *m*. Using the 3:1 ratio of *M* to *m*, determine the theoretical angle θ between the thread and the vertical glass tube.

3. What is the centripetal force on the orbiting mass in terms of *m*, *g* and $\sin\theta$?

4. What is the radius of orbit *R* in terms *L* and $\sin\theta$?

Experimental Method

1. Prepare the apparatus using 3 identical washers for the orbiting mass and 9 washers for the central mass.

2. In this lab, you will vary *L* and measure the period of revolution *T* for each length *L*. Measure from the centre of gravity of the mass *m* along the string and mark off every 10 cm (or 5 cm) up to at least 100 cm. You may find it helpful to use alternating colours for the markings.

3. Hold the glass tube vertically in your hand and swing mass *m* until it achieves a stable orbit such that length *L* is 20 cm. **The length should be kept constant by swinging alone; you are not to hold the thread in place with your hand or any other instrument.** While you keep the orbiting mass revolving, have your partner make a measurement of the period.

   Human reaction time is one of the main sources of uncertainty in this experiment. Consider ways in which this uncertainty can be minimized.

4. Repeat step 3 for a minimum of five lengths.

Analysis and Discussion

Establish the relationship between *T* and *L*, calculate the slope and write the equation. Your report should include two graphs: 1) *T* vs. *L* and 2) a linearized plot.

Compare the experimental value for the slope with the theoretical value. Determine the percent error. *To find the theoretical value of the slope, start with the equation for centripetal force F_c. Solve for T and make the substitutions using the equations from introduction questions 3 and 4.*

Discuss the sources of error.

Component	**Criterion**	**Weight**	**Mark**
Introduction	*Objective and introductory questions*	1	
Experimental Method	*Apparatus diagram and an experimental method which implements a method to reduce uncertainty due to human reaction time*	1	
Data	*Data quality and presentation*	2	
Analysis and Discussion	*Plot of the original data*	1	
	Linearized plot and a statement about the relationship between the variables	1	
	Slope of the linearized plot with correct units	1	
	Theoretical slope of the linearized plot and percent error	1	
	At least two <u>significant</u> sources of error	1	
Conclusion	*Summary of the experiment and final results*	1	
TOTAL		10	