Uniform Circular Motion – Procedure

EQUIPMENT

Metal tube

String

Rubber stopper

Slotted masses and hanger

Protractor

PROCEDURE

Please print the worksheet for this lab. You will need this sheet to record your data.

Part 1: Experimental Determination of Mass

Most of the data collection from the lab will involve the following method.

1 Cut a long piece of string and run it through the steel tube so it sticks out both sides.

2 Tie the rubber stopper to the end of the string on the side of the tube with the white plug. (*This is a Teflon® plug designed to reduce friction.*)

3 Tie a loop at the other end of the string. You will hang the mass hanger from this end.

4 To achieve uniform circular motion, hold the tube vertically with the mass hanger at the bottom and spin the stopper around in a circular motion (*see Figure 2*).

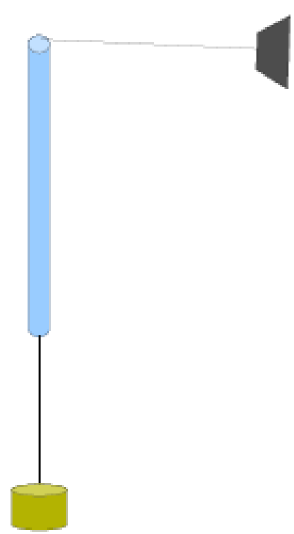

Figure 2: Experimental set-up

5 To give you an idea of what this should look like, here is a YouTube video demonstrating this type of lab: Physics Circular Motion Lab 1[1].

> **CAUTION:**
>
> Don't hit any computers or people while spinning the stopper!

6 Make the measurements for five trials. In general, you can use whatever values of m_h and L you want. Use different values for m_h to get a variety of data.

- **a** Use a timing device to measure the time for 10 full oscillations, and then divide by 10 to determine the period of rotation, T. (Measuring for 10 oscillations is done to minimize the effect of measurement uncertainty.)
- **b** Use the meterstick to determine the length, L, of the string from the edge of the tube to the stopper (this will be the radius of rotation). *When you're ready to stop spinning, make sure to grab the string so you can measure the length without it sliding.*
- **c** Use the slotted masses to set the hanging mass, m_h.

> Note that $m_\mathrm{h}g$ provides the tension in the cord (because the hanging mass is approximately motionless and thus in equilibrium), so if the stopper is swinging in an approximately horizontal circle, the tension value ($m_\mathrm{h}g$) will be the centripetal force, F_c. You can use the values of F_c and a_c to determine the mass of the stopper.

7 Calculate a_c and $m_\mathrm{h}g$ for each of the trials.

8 Plot $m_\mathrm{h}g$ versus a_c and find the slope of the graph.

9 Use the slope of the graph of $m_\mathrm{h}g$ versus a_c to determine the experimental value of M_s, the mass of the stopper. (See Linear Regression [2] if you need help with this calculation and the lab manual if you're unsure of which equation is relevant.)

Part 2: An Alternate Method

1 Perform one more trial, making sure that you have a way of determining the angle, θ.

Record the period, radius, mass of the hanger and the angle.

2 Based on this angle, what is the mass of the stopper?

Analysis

1 Find the percent difference between the two values of M_s.

[1] http://www.youtube.com/watch?v=_L2IhBD8Vyc

[2] ../regression/manual.html

2 What factors may contribute to the difference in these two values?

3 Based on the assumptions made and possible sources of error, as well as the accuracy of the data collection methods, which value do you feel is likely to be more accurate? Why?