Lab 9-1: Centripetal Force

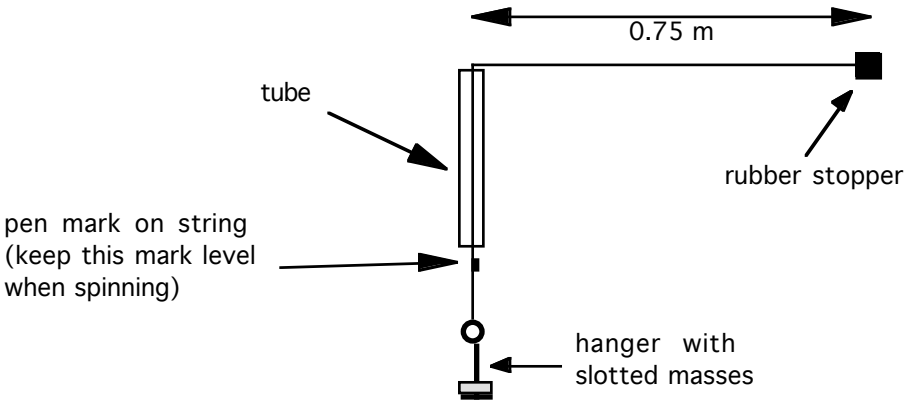
Purpose: Whenever an object moves in a circle with constant speed and radius, the net force on the object is always directed to the *center* of the circle. The net force in this situation is given the special name, *centripetal force*, which simply means "center-seeking" force.

Centripetal forces depend on an object's mass, speed, and radius of the circular path. In this lab, you will determine how centripetal forces depend on the speed of an object.

Materials: 1 hanger 1 glass tube 1 rubber stopper
1 string (~1 m) 1 stop watch
slotted masses: one 50 gm, one 100 gm, one 200 gm

Procedure:

1. Find the mass of the rubber stopper, record it in the data table, and then set up your apparatus as shown in the diagram below.



2. Adjust the length of the string so that there is 0.75m from the glass tube to the middle of the stopper. Using a pen or marker, make a small mark on the string just where it comes out the tube. (*This will give you a reference point to keep the radius constant at 0.75 m while spinning the stopper.*)
3. Without any additional masses on the hanger, practice spinning the stopper. You need to be able to spin the stopper in a horizontal circle over your head and keep the piece of tape at the same distance below the glass tube. **Be careful not to hit any passersby while you are spinning the stopper!**
4. Without any additional masses on the hanger, spin the stopper. When you are ready, time how long it takes for the stopper to make 20 revolutions. The person timing should NOT be the person spinning the stopper. Record your results.
5. Add 50 grams to the hanger, and repeat step #5. Fill out the data table, each time adding an additional 50 grams to the hanger.

Calculations:

1. Calculate the circumference of the circle that the stopper always traveled in. Record in the data table.

2. Calculate the speed of the stopper for each trial and record in the data table. Show your first calculation here:

3. Calculate the square of the speed of the stopper for each trial and record in the data table. Show your first calculation here:

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Data:

Mass of rubber stopper = _____ kg Radius of circular path = 0.75 m

Note: While doing the lab, the only data you need to take is the third column of the data table (Time for 20 revolutions). The rest of the table is calculated.

Mass hanging (kg)	Weight hanging F_c (N)	Time for 20 revolutions (s)	Period of 1 revolution (s)	Circumference of circle (m)	Speed of stopper (m/s)	v^2 $(m/s)^2$
.050						
.100						
.150						
.200						
.250						
.300						

Graph:

Make a graph of F_c vs. speed^2. Make sure you can see the origin in the graphs. Make sure the graph has a title, labels, units and the regression line. Check with your teacher and if it is ok, print the graph.

Conclusion:

1. What is the equation that relates centripetal force and speed for your experimental setup?

2. Show that the units of the slope of the straight line reduces to kg/m. (Hint: what is a N?)

3. Divide the mass of your stopper by the radius of the circle.

4. What is the physical significance of the slope of this equation?

5. Define the following terms:
   a. Revolution

   b. Period

   c. Net Force

   d. Centripetal Force