



Centripetal Force Lab

PSI Physics

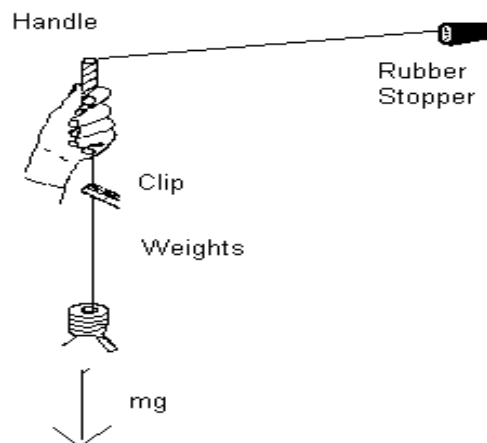
Name _____

Objectives:

- You will verify that the centripetal force is proportional to the v^2
- Apply Newton's 2nd law to find the mass of the rotating object

Materials:

- Plastic Tube 10 cm to 20 cm long, 1 cm outside diameter (polished at both ends)
- Nylon Cord about 1.0 m long
- Scale
- Stopper (Unknown mass)
- Washers (all the same size) or hooked masses
- Tape
- Stopwatch
- Safety Goggles



Background:

Centripetal force is a net force that always points toward the center of the circle while an object moves in circular motion. In this lab, you will be using centripetal force to verify that centripetal force is directly proportional to velocity squared, and then find the mass of the stopper.

Note: enter all data and calculation results in the table at the end of this handout!

Preparation:

1. Pass the free end of the nylon cord through the plastic tube and adjust it so that the radius of the circular path of the stopper will be about 40 – 60 cm. Record this radius = _____ meters in (table column 2). Attach the tape (rather than a clip as shown in the diagram) a little below the end of the tube
2. Tie the rubber stopper to one end of the nylon cord and hang a weight on the other end. If the weights are washers:
 - a. Weigh all the washers you are going to use
 - b. Tie a partially unfolded paperclip to the end of string
 - c. Slide the washers over the paperclip onto the string
 - d. As an alternative to a paperclip, you can tie an eye bolt to the string. You can then slide washers on and off, securing them with the accompanying bolt.
3. Practice whirling the stopper in a circular horizontal path above your head. Make sure that you spin the rubber stopper with a correct velocity. If the tape stays just a little below the plastic tube, then you are spinning it with a good velocity. If the tape moves up against the tube, you are whirling the stopper too rapidly. If the tape starts to descend, you are whirling the stopper too slowly.

Measurement Procedure:

For each of 4 different weights hanging on the end of string:

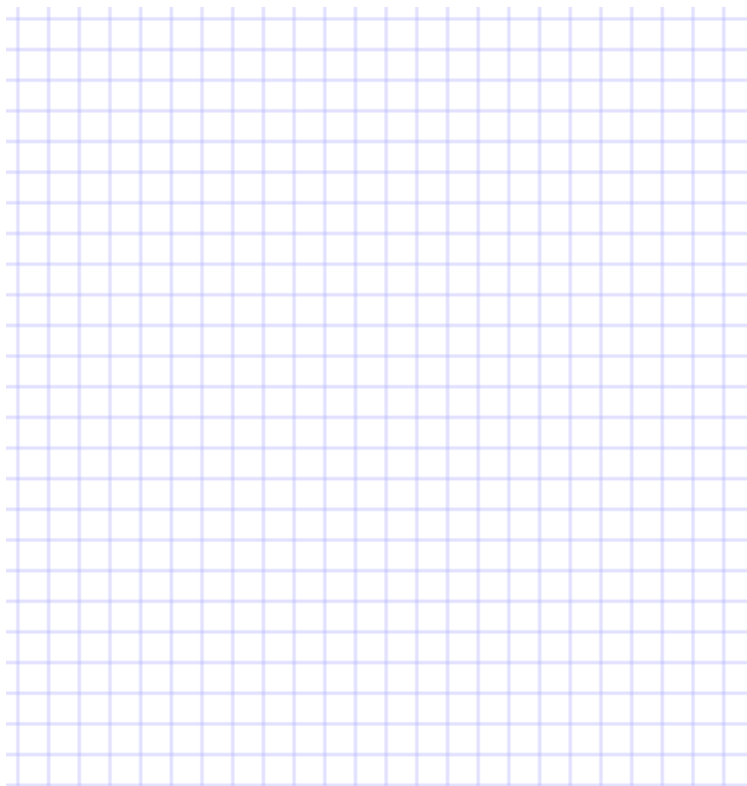
1. Record the weight in newtons (table column 1).
2. Make sure that the radius of your circle is the same as it was when you set it up.
3. When the stopper is moving with the desired rotational speed, have one of the members in your group use the stopwatch to measure the time it takes the stopper to complete 20 revolutions and record this (table column 3)

Data Analysis:

1. In your data table:
 - Calculate the time for one revolution $T = t / 20$. (table column 4)
 - Calculate the circumference, $2\pi r$ ($\pi=3.14$). (table column 5)
 - Calculate the speed of the stopper $v = 2\pi r / T$. (table column 6)
 - Calculate v^2 . (table column 7)
 - Calculate the centripetal acceleration, v^2 / r . (table column 8)
2. Plot the Centripetal Force, F_C vs. Radial acceleration v^2 / r on the grid to the right.
 - Include the origin (0,0) as a point on your line.
 - Draw a best-fit line through the origin.

a) What is the slope of this line?

b) What are the units for the slope?



Applications:

1. The same experiment is performed. This time the stoppers mass is known $m = 0.05 \text{ kg}$, the radius of the string is 0.4 m and the period is 0.25 s . What is the weight of the hanging mass?
2. When a car moves around in a circle, the force that allows the car to keep moving in a circle is static friction. If 1000 kg car moves at 45 m/s around a loop with a radius of 60 m , what static friction force does it experience?

Centripetal Force Lab Data and Analysis Table

Trial	(1) Weight of hanging masses (N) F_c	(2) Radius (m) (same for all) r	(3) Time for 20 revolutions (s) t	(4) Period (s) $T=t/20$	(5) Circumference (m) (same for all) $2\pi r$	(6) Speed (m/s) $v=2\pi r/T$	(7) Speed ² (m/s) ² v^2	(8) Centripetal Acceleration (m/s ²) v^2/r
1								
2								
3								
4								