LAB 9, CENTRIPETAL FORCE

Name _____ Period_____

An object moving with changing speed in the same direction is undergoing acceleration. If an object moves with constant speed but in changing directions, it is also undergoing acceleration. Both types of acceleration require forces. A change in direction is called centripetal acceleration, and the force producing it is called centripetal force.

The equation relating centripetal force, mass, and velocity is

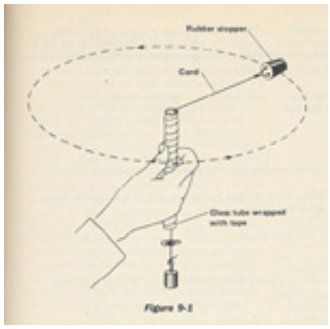
$$F = mv^2/r$$

where **F**, is the centripetal force, m is the mass of the moving object, v is its velocity, and **r** is the radius of the orbit of the object.

In this experiment each of the factors in this equation will be varied as an object is whirled on the end of a string. Centripetal force will be supplied by masses tied to a string that passes through a vertical tube. See Figure 9-1. The effect of gravity on the whirling object is offset by the resulting angle of the string with the horizontal.

OBJECTIVE:

After completing this experiment, you should be able to verify the relationship between centripetal force, mass, and velocity in a whirling object..



PROCEDURE:

SAFETY GOGGLES MUST BE WORN DURING THIS LAB!!

Fasten one end of the nylon cord securely to the rubber stopper. Pass the other end through the glass tube and fasten a 100-g mass to it.

Adjust the cord so that there is about 0.75 m of cord between the top of the tube and the stopper. Attach a paper clip to the cord just below the bottom of the tube. Support the 100-g mass with one hand and hold the glass tube in 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 paper clip stays just below the bottom of the tube. Make several trial runs before recording any data.

When you have learned how to keep the velocity of the stopper and the position of the paper clip relatively constant, have a classmate measure the time required for 20 revolutions. Record this time as Trial 1.

Stop the whirling of the stopper, place the apparatus on the top of the lab table with the cord extended the way it was during the experiment (as indicated by the position of the paper clip), and measure the distance from the center of the glass tube to the center of the rubber stopper. Record this distance in the data table as **r**. Record the mass of the stopper.

Repeat the procedure for Trials 2-4. Keep the radius the same as in Trial 1 and use the same rubber stopper, but increase the mass at the end of the cord. For Trial 2, use 200 g, for Trial 3 use 300 g, NOTE: 300g is a 200g mass with a 100g mass attached.

For Trials 4 & 5, keep the same rubber stopper and use a mass of 100 g for each trial, but vary the radius of revolution. The radius for the two trials should range from about 0.1 m to about 1.0 m.Record all data.

DATA AND CALCULATIONS TABLES

DATA

TRIAL	Hanging mass (kg)	Mass of stopper (kg)	Total time (s)	Radius (m)
1				
2				
3				
4				
5				

CALCULATIONS

Centripetal force (n)	Period (s)	Circumference (m)	Velocity (m/s)

CALCULATIONS to do on the back:

1. Calculate the weight of the hanging mass and enter it in the table as the centripetal force.
HINT: f = ma, so wt = mg. m is in kg, g = 9.8m/s^2. Weight is in newtons. Kg = g/1000g/kg. Show your work.

2. Find the **period of revolution**. by dividing the total time by the number of revolutions. Calculate the circumference of revolution from the radius. **HINT: C = 2πr. Show your work.**

3. Use the circumference and period to find the velocity. **HINT: v = d/t. Show your work.**

QUESTIONS to do on the back:

1. What is the relationship between the radius of revolution and the velocity of a whirling object?

2. What is the relationship between the mass and velocity of a whirling object?

CRITIQUE: