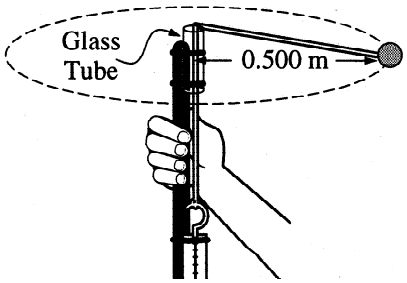
Lab 5-1: Circular Motion



An object moving in a circle is accelerating constantly, as the direction of its velocity vector is constantly changing. In this experiment, you will attempt to "mass" a rubber stopper by whirling it in (hopefully) uniform circles and using Newton's 2nd law applied to an object in uniform circular motion. * Note: In the calculations, you will have to assume that the tension in the string is constant throughout, i.e. that the tension exerted on the rubber stopper is the same as that exerted on the hanging mass.

Instructions:

1. Attach your string to a hanging weight of known mass. If it isn't already done, thread the string through the piece of glass tubing, then tie the other end to the rubber stopper.

2. Now, giving yourself plenty of space, begin to spin the rubber stopper on the string by holding the glass tube in your hand and moving it in small circles. Practice until you are able to keep the stopper spinning in a constant, level circle. You've got it down when *the hanging mass stays in place as you spin the stopper*, not moving up or down relative to the glass tube.

3. Spin the rubber stopper in a circle and determine its period of motion using a stopwatch. Also measure the length of string between the glass tube and the stopper (you have to clamp your thumb down on the string as soon as you stop timing).

4. Mass the rubber stopper on a digital scale (to be used ONLY for % error purposes).

DATA**:**

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1. Draw free-body diagrams showing the forces which act on both the hanging mass and the rubber stopper. NOTE: the string is not perfectly horizontal.

2. Apply Newton's 2nd law to the hanging mass and determine the tension in the string.

3. Write Newton's 2nd law equations for the rubber stopper along the X and along the Y axes:

   X:

   Y:

4. Draw a diagram showing the relationship between the radius of the circle made by the rubber stopper, the length of the string that you measured, and the angle in the cable.

5. Use your Newton's 2nd law equations to solve for
   i. The mass of your stopper. (NOTE: the angle in the cable will cancel out if you do this properly)

   ii. The angle in the cable.

6. Calculate the % error between your calculated mass and the actual mass of the stopper.

7. Comment on sources of error which might explain the (often sizeable) discrepancy between your calculated mass and the actual mass of the rubber stopper. Consider both errors of measurement and errors of assumption.