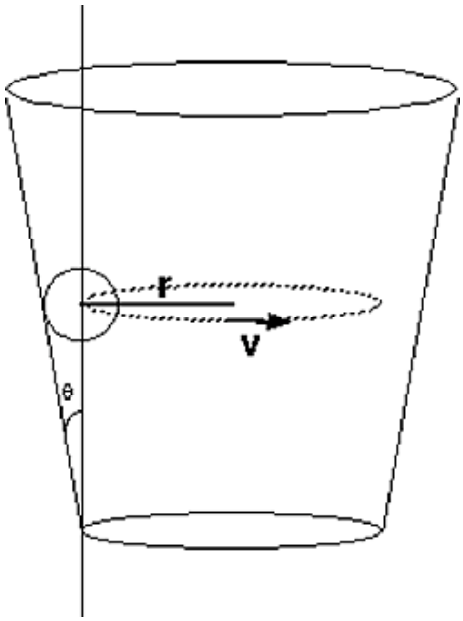
Levitating Marble
Uniform Circular Motion

Purpose: To describe, mathematically, the forces involved when a bottomless Styrofoam cup is used to pick up a marble.

Materials:
- Styrofoam cup
- craft knife
- marble
- Vernier calipers
- metric ruler

Procedure:

1. Remove the bottom from a Styrofoam cup and put the bottom opening over the marble.
2. Spin the cup until the marble is about halfway up.
3. Determine a method for finding the radius (**r**) of its orbit, and the slope of the cup (θ). Describe your method below and record your data in the data section. The period (T) is probably too short to measure, so just observe and make an estimate.



Data:

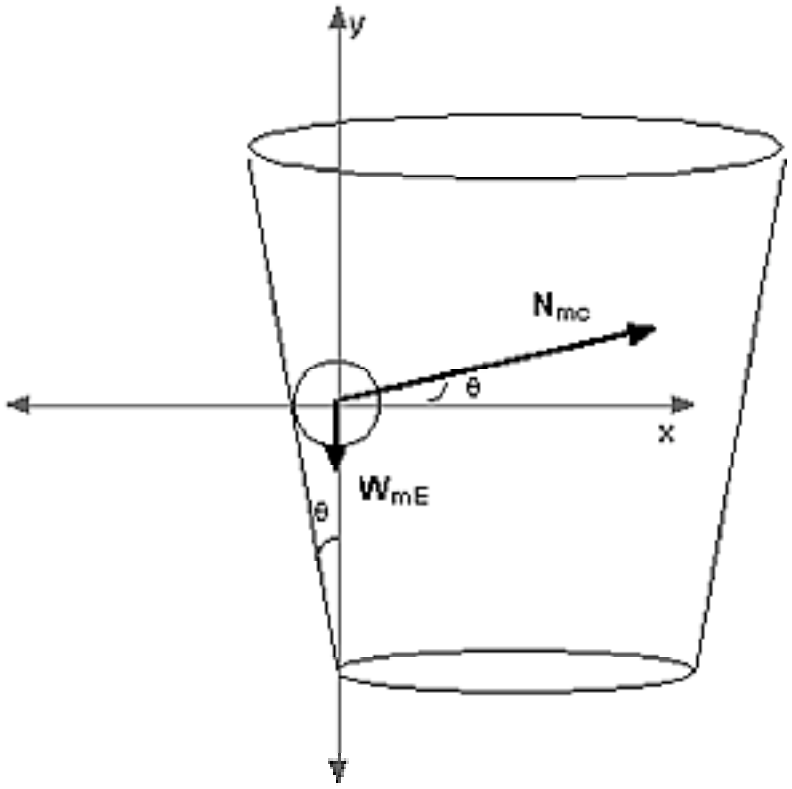
r = _____ m

estimate of period = _____ s

Measurements used for and calculation of the slope of the cup:

Data Analysis:

The force diagram is as follows (assume friction is negligible).



Write an equation for the net force in the x- direction and the net force in the y-direction.

$F_{net\ x} =$

$F_{net\ y} =$

What provides the centripetal force to keep the marble moving in a circle?

Derive an equation for the period (**T**) as a function of the radius (**r**) and the slope of the cup (**θ**) and your equation (use the force diagram and equations for centripetal force). Calculate **T** for your data.

Conclusions:

1. How does your calculated (theoretical) period compare to your estimate of the period?

2. What are the sources of experimental error in this experiment?

3. If you stop spinning the cup, what happens to the number of revolutions per second? (Try this experimentally).

4. Explain your observation in #3 using the equation you derived for period.