ANALYSIS OF THE PERIOD OF A ROTATING OBJECT

Each person will prepare a Formal Report for the lab, which will be due Monday, October 20 at high noon. The penalty for late reports is 10% per day late. See the *Guidelines For Formal (Written) Reports* for information on preparing the report.

Goal of the lab:

Using a simple apparatus you will carefully investigate how the period of an object in circular motion depends on the radius of its circular path and on the force acting on the rotating mass.

Apparatus and measurement:

A mass is attached to a string, which then passes through a glass tube. Weights are hung from the string. The mass can be whirled in a nearly horizontal circle with the hanging weights providing the centripetal force. The period of the motion, the time for one revolution, is measured by determining the time for a number of revolutions. Note that for motion around a circle, the speed would simply be the distance traveled, the circumference of the circle, divided by the time for one revolution, the period.

The investigation:

Your group will investigate the dependence of the period on two variables: the radius of the circular path and the force on the moving mass. Clearly, you should keep one variable fixed while you vary the other. When varying the radius, use a 100 g hanging mass to provide the fixed force. Make sure that you choose enough different values of the radius and make enough trials to make a good estimate of the uncertainties. Then for one of the radii used in the first part, typically one of your larger ones, use 200 g for the hanging mass to provide the force, giving data for a different force but with the same radius.

Analysis:

You should first have done a theoretical analysis of the situation (think free-body diagrams, Newton's 2^{nd} Law, centripetal acceleration) giving an expression for the period squared, T^2, as the dependent variable equal to a function that has the radius r and the force acting on the rotating mass, F. When F is held constant, then the independent variable is r.

Use graphical analysis to determine whether your data matches this theoretical relationship of period to the radius. Do a graph of your experimental T^2 versus your experimental r. If your data matches the theory, a straight line would be expected. Compare your results to theory, including a comparison to the expected, theoretical slope. Remember to include uncertainties.

You have data for two different forces acting on the rotating mass while keeping the radius of the motion fixed. Compare the ratio of the two experimentally measured periods to the ratio expected using your theoretical expression.