ANALYSIS OF THE PERIOD OF A ROTATING OBJECT

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:

Attach a soon to be swinging mass to the string, which passes through a glass tube. Hang weights from the other end of the string. The swinging mass should now be whirled in a nearly horizontal circle with the hanging weights providing the centripetal force. One can now measure the period of the motion, the time for one revolution, by determining the time for a number of revolutions. Note that for motion around a circle, the speed is simply 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, vary the hanging mass that provides the force, collecting data for a different force but with a constant radius.

Analysis:

You should first do a theoretical analysis of the situation (i.e., free-body diagrams, Newton's 2^{nd} Law, centripetal acceleration) giving an expression for the period, 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. When graphing your data it is useful to design you graph so that if your data matches the theory, a straight line would be expected. You can accomplish this by being cleaver about what you choose for your axes. Compare your results to theory, by a comparing your best fit line to your theoretical prediction of the slope and intercept. Remember to include uncertainties.

Use your 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.