

Measuring g with the Physical Pendulum

In this activity we'll get some final practice with the concepts involved in the physical pendulum.

Warning: This lab has sharp things.

(1) Acquire Your Data

Support a ring from a knife edge and set it into small amplitude oscillations (why small?). Using the stopwatch, determine the period of oscillation by finding the time to complete something like 20 or more complete oscillations. The more data you have, the smaller your uncertainties will be. You'll have to gauge what a good number for each size ring is. (And be careful how you count, it's very common to make a ± 1 count error with this). Make something like 5 measurements of this time (partners... take turns) in order to find the mean period and the uncertainty in that quantity. Determine the inside and outside diameters of the ring and either use the formula for a solid ring, or come up with an average value in order to treat it as a thin ring. You decide which formula is good enough.

Repeat those measurements for a total of at least 6 rings of varying diameters. Just carry one at a time to your table to allow others to choose varying sizes too.

DATA TABLES:

(2) A Look at the Theoretical Underpinnings

Consider the problem of such a swinging thin ring. Starting with Newton's Second Law, determine the period as a function of radius. What do you want to plot in order to yield a straight line? What will be the slope and intercept of that line?

Make the plot that you just chose. Does it seem to produce a linear relationship? Determine the slope and intercept and compare the values to those you predicted previously. If the result is not a perfectly straight line, what might be causing any deviations?

From the graph of the data, determine the gravitational constant g , along with an uncertainty from the shiftiness in the graph.

Each group should submit one copy of their data tables, theoretical calculation, graph, and final experimental value of g (including uncertainty) determined from graph.

(3) If you finish early: (Brain-buster problem) Use your value of g to predict the period of oscillation of two meter sticks taped together to form an inverted 'T'. Try rigging this up using materials from the center table and see if your numerical prediction is correct.

