Experiment 2

Simple Harmonic Motion of a Mass Suspended from a Spring

In this experiment you investigate the behavior of a simple physical system consisting of a mass hanging on the end of a spring. How do you suppose the frequency of oscillation depends on the mass, the spring stiffness, and the amplitude of the oscillations? What does the theory tell us? But the theory is based on a perfect spring, obeying Hooke's Law. You'll have to verify if it really does. In the end, you'll find the spring constant by both stretching the spring and by oscillating the spring!

Preliminaries.

Part A. Static Determination of Spring Constant.

Find out the spring constant by graphing the force you put on it against its extension. What should the graph look like? What should the slope be? . How could you determine the spring constant from this graph?

Part B. Dynamic Determination of Spring Constant.

How does the period of oscillation depend on the mass you hang off the spring? What does the theory say? Can you find this relationship? What would you graph in order to make a straight-line graph? What should be the value of the slope? How might we extract the dynamic spring constant from this graph? What is the meaning of the y- and/or x-intercept? What should it be? What *should* be the period of oscillation with no mass on the spring? What isn't this the case?

Part C. How does amplitude affect the period?

What does theory tell us about how the amplitude might affect the frequency? How might you test this?

Procedure.

• The spring should hang with its narrower end on top so that, as it stretches, the coil spacing is uniform in width.

Make certain not to damage the spring by stretching it beyond its elastic limit. This means both – don't put too much mass on it, and also don't oscillate it at too high an amplitude!

Questions (Answer clearly and completely).

1. Does your spring obey Hooke's Law? How do you know?

2. Does your spring behave according to theory in the dynamic test? How do you know?

3. What value do you determine for the spring constant statically? What value do you determine for the spring constant dynamically? These are supposed to be the same. What is the percent difference between these values? Is this within the expected uncertainty of your measurements and the plotted data?

4. What does your oscillation data imply about the effective mass of the spring? What is the *real* mass of the spring? Do you *think* these values should be the same? Why or why not? What is the ratio of the two values?

6. How would your dynamic data look different if the spring was stiffer?

7. How would your dynamic data look if the spring were more massive?