Lab: Data Analysis, and Periodic Motion- Hooke's Law

AP Physics

Background

Hooke's Law, $\mathbf{F} = -k\mathbf{x}$, describes the relationship between the distance a spring has been stretched, **x**, and the force that the spring pulls back with, **F**. The value *k* is, mathematically speaking, a *constant of proportionality* that represents, in this case, a *spring constant*. In Hooke's Law, *k* varies depending on the "springiness" of the spring being measured.

Objectives

Part A. To determine the spring constant for a spring. To practice simple graphing, data collection, and data analysis.

Part B. To compare calculated and measured periods of mass-spring periodic motion.

Equipment

(To be determined, and carefully described, by you.)

Procedure

Part A. Determining a Spring Constant

Using a procedure that you develop and describe, collect a series of at least 5 measurements that will allow you to graph **F** vs. **x** for a specific spring. Be sure to include:

- a labeled diagram of your equipment set-up
- a step-by-step procedure detailed enough that another physics student can recreate your experiment

Please note that *x* refers to the distance the spring has been stretched, and *not* its length!)

Part B. Comparing calculated and measured Periods of mass-spring periodic motion.

1. Using the formula for the period of a mass-spring system, calculate a theoretical period for your mass-spring system.
2. Set the mass-spring system in motion and take measurements to calculate the system's actual period.

Questions

1. Draw a *best-fit* line on your graph[1]. What is the meaning of the slope and *y*-intercept for the line that fits most of your data?
2. If you have a stiffer spring, will the value for *k* be larger or smaller?[2]
3. Real springs only follow Hooke's Law for a limited range of values. How would you go about trying to find out the range of values that are appropriate for your particular spring?
4. If you were to take the spring you used and cut it in half, what would be the spring constant k' for each half of the spring? Would the spring constant for each half be the same? Double of the original value? Half of the original value? Why?

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[1] A *best-fit* line, in this case, is a straight line that takes into account most of the points, with most of the points very close to the line if not right on it. If there are any data points that don't fall on this line (and their usually are), there should be an even number of points above and below the line.

[2] Note that you need to give complete sentence answer here, with an explanation. Why? Because we *always* want complete sentence answers, with explanations!