Simple Harmonic Motion

Purpose: Verifying Hook's law

Delicate Springs: Handle With Care! Please do not over-stretch springs by pulling too hard or hanging too much weight. *This will change the "k" values and ruin the springs.* ***Do not*** *leave masses hanging on the springs* ***longer*** *than it takes to collect data. Thank you.*

Static Method:

1. Make a table for one of your springs **(k_1)**. Make columns for mass (m), position (x), weight (w), and spring force (F_s).

Mass of a hanger(kg):		**Initial Position:**			
Mass(kg)	**Mass + Hanger Mass(kg)**	**Final Position(x_f):**	**Δx (m)**	**W(N)**	**F_s(N)**
0					
.050					
.100					
.150					
.200					

2. Hang a mass hanger from one of the springs and measure the displacement of the spring. Record this value in the table above. Calculate the force and record it, too. Repeat using the 4 other added mass values.

3. Make a plot of F_s vs. Δx in graphical analysis or excel, and sketch what you see in your lab report.

4. Find k_1 (the slope of the graph.) What is this value and unit?

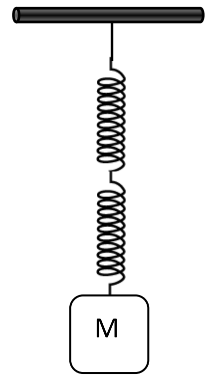
5. Switch to the other spring. Measure the displacement for the same mass. If it's the same, we can assume the two springs have the same spring constant.

Dynamic method:

1. Linearize the equation: $T = 2\pi\sqrt{\frac{M}{k_{eq}}}$ with T as the dependent variable and M as the independent variable. What is the slope in your linear equation?

You are going to set up your springs 2 different ways:

a) Series: $\frac{1}{k_{eq}} = \frac{1}{k_1} + \frac{1}{k_2}$



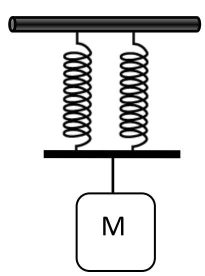
2. Use the table below to record your data for mass (m), period (T), and square of period (T^2) for 5 different masses. Record the values of masses. Open the Logger Pro® File named, "Pendulum Timer." Let the spring-Mass system break the beam of photogate twice to measure one period. Measure the *AVERAGE* T for each one (Beware: it runs for ~15 seconds and displays the latest T not the average.)

Mass of a hanger(kg):			
Mass(kg)	**Mass + Hanger Mass(kg)**	**T(S)**	**(T^2) (S^2)**
0			
.050			
.100			
.150			
.200			

3. Make a plot of m vs. T^2 in graphical analysis or excel. (m is Mass + Hanger Mass)

4. Find k_{eq} using the slope. (Refer to question 1)

b) Parallel: $k_{eq} = k_1 + k_2$



Mass of a hanger(kg):			
Mass(kg)	**Mass + Hanger Mass(kg)**	**T(S)**	**(T^2) (S^2)**
0			
.050			
.100			
.150			
.200			

- Repeat steps 2, 3, and 4 for this set-up.

Now you have 2 equations with 2 unknowns.

- Solve for k_{eq} for both series and parallel combination of two springs.
- Find % difference for k_{eq} using the k_1 and k_2 values, obtained using the static and the dynamic methods.

Please remove all masses from the springs. *Thank you.*