Name: _____ Date: _____

Data Analysis Worksheet Answers

1. Create separate scatter plots in Excel of the spring deflection data you collected for each spring. Plot force (y-axis) vs. deflection (x-axis).

   Check that students plotted data on separate graphs, each with force on y-axis and deflection on x-axis

2. Fit a curve to each plot in #1. Display the equation for the curve and its respective plot. What is the stiffness of each spring? (include units in your answer)

   These plots should have linear trend lines (straight lines) running through them, equations displayed next to each trend line (in the form of y = m*x + b), and the stiffnesses of the springs (spring constants) written beside the graphs. The stiffness should be equal to the slope of the line (m in the equation above; that is, the number being multiplied by x in the equation displayed on the graph). It should have units of N/m or N/cm (if displacement was measured in cm).

3. Create a scatter plot in Excel of the spring deflection data you collected for all springs. Plot force (y-axis) vs. deflection (x-axis). Note: All lines should be on the same graph.

   Check that students plotted all sets of data to form multiple lines on one graph.

4. Answer the following questions about your graphs and data:

   a. Do the fitted curves (in #2) match the data well? Why or why not?

      Yes, because the spring follows Hooke's law, which is a linear relationship between force and displacement.

      No, because of measurement error or they did not fit their curve with a linear trend line, which should not match their data.

   b. Why is the curve linear in #2?

      Because it follows Hooke's law for springs, $F = k\,x$, which is a linear equation.

   c. Describe the relationship between the lines in #3. Are they the same line? Do they differ? If so, how are they different? If they are different, then explain why.

      They are different due to their different spring constants. Spring "x" has a larger spring constant than spring "y," which means that spring "x" is stiffer (and so on for each spring). Check students' analyses by looking at the equations of the lines; the larger the value of slope, the stiffer the spring.

   d. List the springs in order from stiffest to most compliant using the spring constant values calculated in #2. Were your predictions before and after the activity correct? If not, explain what was incorrect.

      Check that students listed the springs in order from largest to smallest spring constant. Answers should describe whether their predictions were correct or not. If predictions were incorrect, expect them to explain which springs they listed out of order.