Spring Constants: Hooke's Law & Periods

Part I – Determine the Spring Constant via Hooke's Law

Hang a total of 15 grams on the spring. The spring should stretch slightly. This will be considered the zero equilibrium point. Total displacements will be measured from this point. The initial 15 grams that was utilized to establish the zero equilibrium point does not attribute to the total displacements.

Using the meterstick and the masses at the station, collect multiple data pairs such that the data can be plotted in Excel to determine the spring constant. The Excel Plot should be printed and attached to the Data Sheet.

Hints:

1. A paper clip can be bent and fabricated into a pointer.
2. Do not hang more than a total of 45 g on the spring.
3. The mass hanger has a mass of 5 grams.
4. Collect at least six data pairs.
5. Consider using 0,0 as an additional data pair.

Part II – The Relationship between Period and Displacement

Hang a total of 35 grams on the spring, displace the mass by approximately 2 centimeters and release the mass. Observe the oscillation for approximately 10 seconds. Now, displace the mass by approximately 5 centimeters and release the mass. Observe this oscillation for approximately 10 seconds. Answer the first question of Part II on the Data Sheet.

Using the stopwatch at the station, time 10 cycles for a displacement of approximately 2 cm and 5 cm. Then divide these times by 10 to determine the period, and answer the second question on Part II of the Data Sheet.

Part III - Using Oscillating Masses to Determine the Spring Constant

By varying the mass placed on the spring, the period of oscillation can be changed. When multiple data sets are collected and plotted, the spring constant can be determined. How the data is plotted can make a difference on how to interpret the fit of the plotted points.

Plotting parameters such that a plot results in a linear relationship is of great value in science. This can be accomplished even if the equation does not appear to be linear. Linear plots are typically easier to interpret for most individuals, and information from the linear fit is typically more readily interpreted. This can be especially true if the plots are being plotted by hand on graph paper.

Using the spring and stopwatch located at the workstation, determine the period for different masses. Begin with 25 grams, and limit the oscillations to amplitudes of 2 - 3 centimeters. After collecting multiple data sets, assign parameters to the x and y axes based on

$$T = 2\pi\sqrt{\frac{m}{k}}$$

such that the plot will result in a linear relationship. Since the mass is the parameter that is being varied, the mass is the independent variable, and it should be associated with the x axis.

Before plotting your parameters in Excel, create a quick sketch of a plot with labeled axes on the Data Sheet so the TA can determine if the plot will result in a linear relationship.

After the TA approves the sketch, use Excel to create a plot and fit the data. Determine the spring constant k from the plot. The Excel Plot should be printed and attached to the Data Sheet.

Part IV – Compare the Spring Constants that were found using the two different experimental methods.

Name: ______________________________ Banner ID: ______________________________

Lab Group ID: _______________________ Number of Lab Partners: _________________

Data Sheet
Spring Constants: Hooke's Law & Periods

Part I - Determine the Spring Constant via Hooke's Law
(Attach Excel Plot and Relevant Data) [25 points]

Value of the Spring Constant (A)	
Units of the Spring Constant	

Part II – The Relationship between Period and Displacement [15 points]

Which oscillation does the group believe has the greatest period?

Displacement	Total Time of Ten Cycles	Period
~ 2 cm		
~ 5 cm		

Is the period dependent on displacement? Justify your answer mathematically.

Part III - Using Oscillating Masses to Determine the Spring Constant (Attach Excel Plot and Relevant Data) [40 points]

Sketch of Plot

Value of the Spring Constant (B)	
Units of the Spring Constant	

Part IV: Compare the Experimental Values of the Spring Constant [20 points]

Percent Difference $= \dfrac{|A - B|}{(A + B)/2} \times 100\%$ = ____________________

Circle the group's score

Percent Difference	<=8%	<=9%	<=11%	<15%	<=20%	>20%
Points	20	18	16	14	10	5