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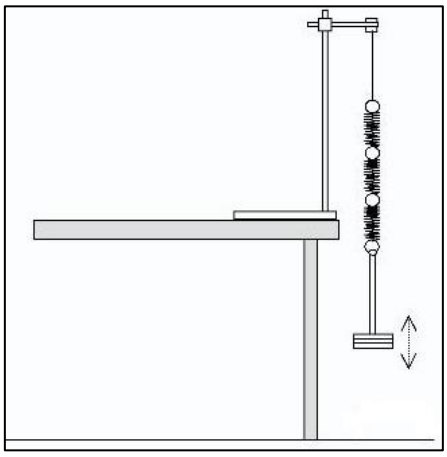
AP Physics I
Lab – Spring and Pendulum Oscillations

Part 1 - Springs

Purpose

The purpose of this lab is to discover what can affect the period, the time it takes to return to its original position) of an oscillating spring when a mass is suspended from it. We will be testing a variety of variables which are up to you as a group. What do you think can affect it? Think scientifically and refer to terms such as mass, displacement, force, and other proper variables.



Procedure

We will be changing variables as detailed below.

Remember: Proper scientific experimentation tests a single variable at a time. This means if you decide to change one thing, other variables must remain constant.

1. Each of the two tables below will have a different spring constant. Please hang a mass off of your spring and record the k value using the equation $F_g = F_{spring}$. Recall that $F_{spring} = k\Delta x$ where Δx is the stretched length from the spring's natural state.

$$k_{spring} = 37.7 \text{ N/m}$$

2. Fill in the table below in which only the mass hanging from the spring is changing. Pull the spring from its equilibrium position, allowing it to oscillate, and record the period of oscillation. To reduce error, record the time of 10 oscillations, then divide that time by 10 to get the period of a single oscillation.

WARNING: Be careful with the springs. Do NOT allow them to be overstretched. Try not to hang any more than 0.1 kg on it during any oscillation.

Variable(s) which remains constant: spring constant

Variable to be tested: mass

x-variable	y-variable
Mass (kg)	**Period (s)**
0.01kg	0.37ss
0.02kg	0.44s
0.03kg	0.47s
0.04kg	0.526s
0.05kg	0.56s

Did this variable have a significant impact on the period? **Yes, the larger the mass was the larger the period of the oscillations became.**

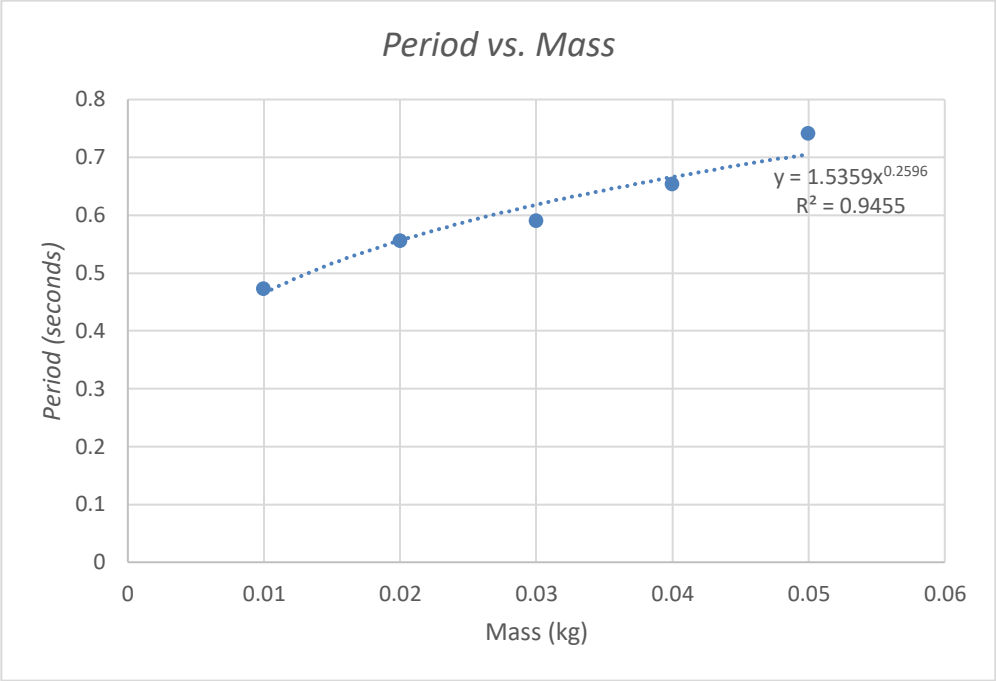
3. Create a table below for the second spring that you have. Pull the spring from its equilibrium position, allowing it to oscillate, and record the period of oscillation. To reduce error, record the time of 10 oscillations, then divide that time by 10 to get the period of a single oscillation. Use the SAME five mass values as from your first spring.

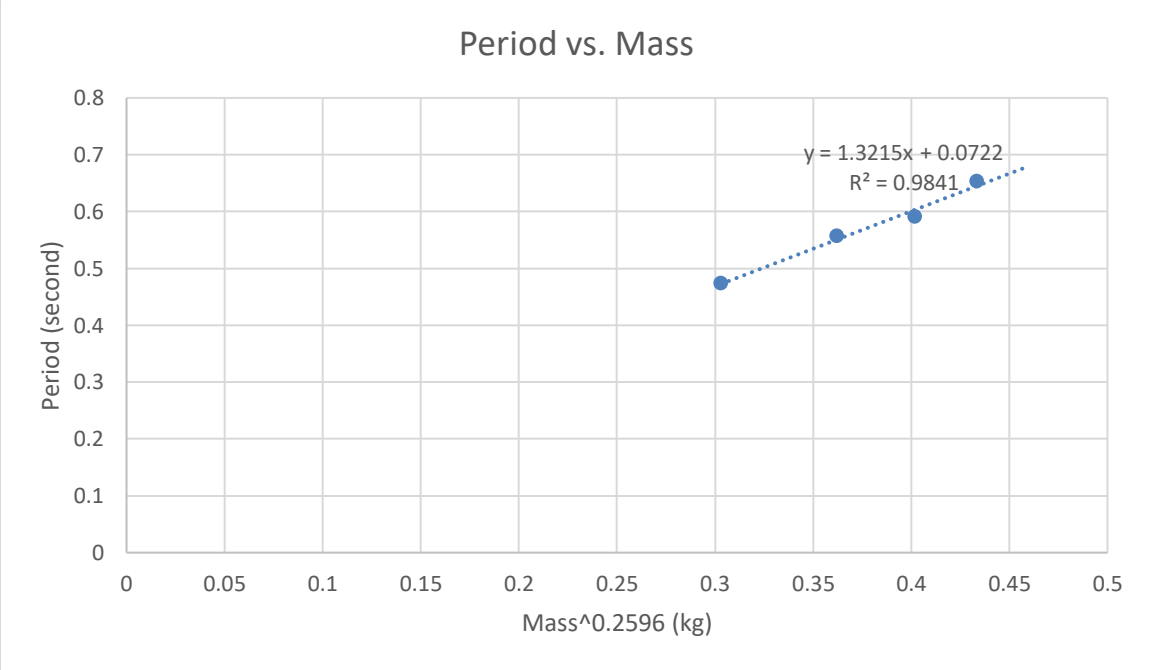
$$For\ second\ spring: k_{spring} = 22.27\ n/m$$

x-variable	y-variable
Mass (kg)	**Period (s)**
0.01kg	0.473s
0.02kg	0.556s
0.03kg	0.590s
0.04kg	0.653s
0.05kg	0.741s

How did changing the spring constant change the period for any given mass (take a ratio)? **Approximately 0.785**

4. Now, with the variable which had a significant impact on the period of oscillation, plot the x and y variables in a graphing calculator and sketch the relationship below. Just do this for one spring.





5. What kind of relationship is this (square, root, exponential, inverse, etc.)? **Power graph**

$$T \propto \underline{\text{mass}}$$

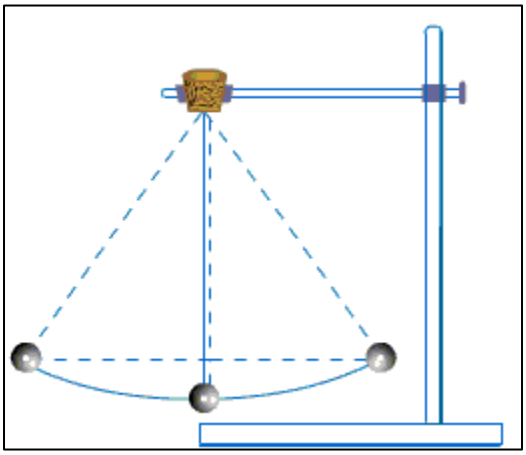
6. Now linearize the data, regress it, and record your equation on the line below in terms of Period (T) and mass along with spring constant.

Period: $\underline{T = 1.3215m + 0.0722}$

7. Keep in mind, this was just the result for your particular spring with its particular spring constant. Other tables throughout the room will be testing different spring constants to see if the stiffness might affect the oscillation period. Do you believe it will? Also keep in mind that this experiment was done on Earth, do you believe it might have yielded different results on another planet like Mars or Jupiter? Why or why not?

   I believe that the stiffness of a spring would affect the oscillation period of a string because the tighter a spring is the less time it takes for one period to be completed. The tighter a spring, overall, the higher a spring constant would be. These results would not change if the lab was to take place on a different because the effect of gravity is to act only as a restoring force hence indicating that there would be no difference in the oscillation periods and only in the restoring force.

Purpose



The purpose of this lab is to discover what can affect the period, the time it takes to return to its original position) of an oscillating pendulum when a mass is suspended from it. We will be testing a variety of variables which are up to you as a group. What do you think can affect it? Think scientifically and refer to terms such as mass, displacement, force, and other proper variables.

Procedure

We will be affecting any variables you can imagine, *except* for the elevation of the pendulum. **Every release must be done with a SMALL angle of 5°**. We can change the length or the mass of the pendulum.

Remember: Proper scientific experimentation tests a single variable at a time. This means if you decide to change one thing, other variables must remain constant.

8. Create a table below in which only one variable from above is changing and record the period of oscillation. To reduce error, record the time of 10 oscillations, then divide that time by 10 to get the period of a single oscillation.

Variable(s) which remains constant: **String Length**

Variable to be tested: **Mass**

x-variable	y-variable
Mass(kg)	**Period (s)**
0.01kg	1.378s
0.05kg	1.333s
0.1kg	1.406s
0.2kg	1.470s
0.5kg	1.458s

Did this variable have a significant impact on the period? **No. the mass didn't have a significant effect on the period of the "pendulum"**

9. Create another table below in which the other variable is changing and record the period of oscillation. To reduce error, record the time of 10 oscillations, then divide that time by 10 to get the period of a single oscillation.

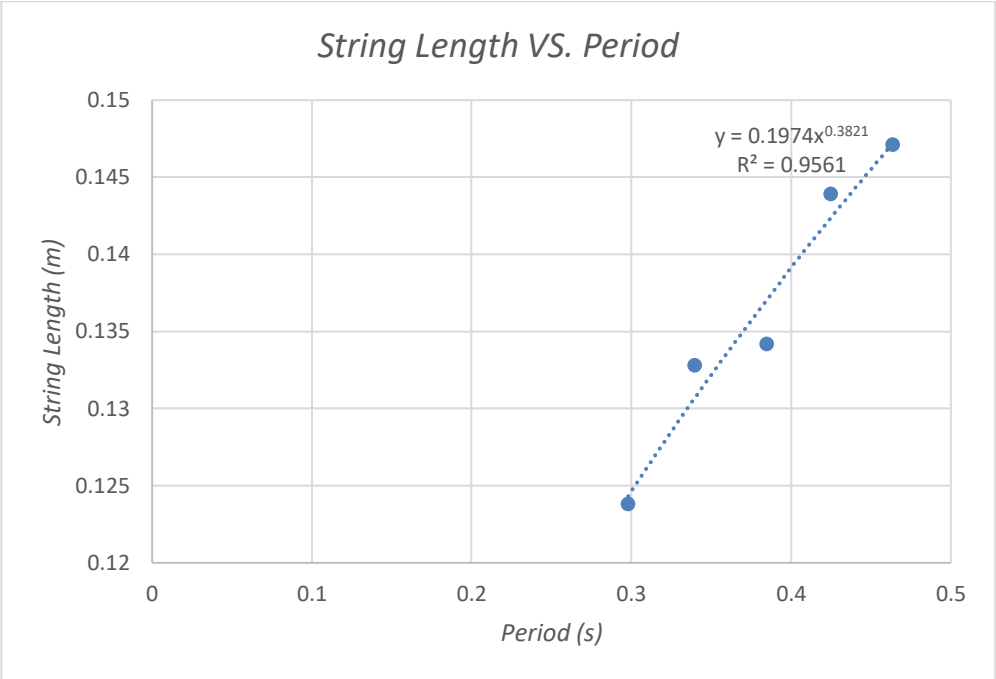
Variable(s) which remains constant: **Mass**

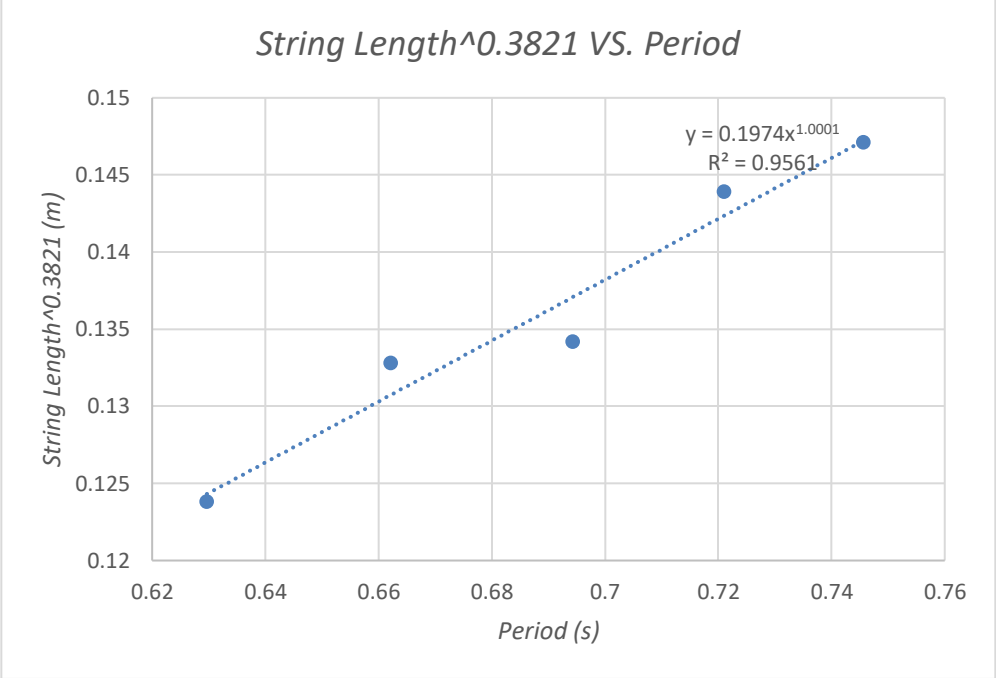
Variable to be tested: **String Length**

x-variable	y-variable
String Length	**Period (s)**
0.464m	0.1471s
0.425m	0.1439s
0.385m	0.1342s
0.34m	0.1328s
0.298m	0.1238s

Did this variable have a significant impact on the period? **No**

10. Now, with the variable which had a significant impact on the period of oscillation, plot the x and y variables in a graph and use a best fit curve (power relation) to identify the relationship below. Be sure to label the axes!





11. What kind of relationship is this (square, root, exponential, inverse, etc.)?
    Root

12. Now linearize the data, regress it, and record your equation on the line below in terms of Period (T) and your other variable (not it terms of x and y!)

$$\text{Period: } T = \frac{length}{0.1974}$$

13. Keep in mind, all of these experiments were done here on Earth. Do you believe performing the same experiment on Mars or Jupiter would yield different results? Why or why not? Also keep in mind that you were limited to dropping the pendulum from a certain small elevation. Do you believe changing this elevation height might have changed the period of oscillation? Why or why not?

    If you were to consider this experiment to be taking place on a different planet such as Mars or Jupiter where there is a different gravitational force there would be different results due to the fact that the pendulum's length, and acceleration due to gravity are the factors that are considered when considering the period of a pendulum so if you were to go to a different planet with a different gravitational acceleration this period would change.