ERHS PHYSICS
LAB: **The Simple Pendulum**

name ___________________

Purpose: To become familiar with the simple pendulum and its motion, and to study simple harmonic motion (SMH) as it applies to the pendulum. There is nothing to turn in on this lab, but you will see information from it on your chapter test, and you are expected to learn all the associated principles demonstrated herein.

Hypothesis: the physical pendulum is a useful tool in determining the value of acceleration of the gravity of a particular massive body, such as the Earth. The motion of a pendulum, under certain ideal conditions whereby its arc moves through only one geometric plane, demonstrates Simple Hharmonic Motion. For this reason, we can use it to study certain aspects of SHM, such as period (T) and frequency (f).

Background information:
The physical pendulum can be described as a mass suspended from a pivot point. For most considerations, the masses is not significant, except that it must be large with respect to the weight of the line suspending it. This, in itself, should become an interesting concept to you since you already know that gravity will accelerate all masses, and that the resulting gravitational force on the object will be different for all masses.

We find, however, that for those pendulums which swing such that the vertical displacement is slight with respect to the length of the suspension line (those cases where the motion approximates simple harmonic motion) the period of oscillation is independent of the mass! This is not so in the case of a mass suspended from a spring. In fact, experiments you will perform today will show that the period and the frequency (frequency is the inverse of the period, or the number of cycles per unit of time) depend solely upon the length of the line of the pendulum when the strength of the gravitational field is constant!

Procedure: Conduct the following experiments to verify the above statements:

Materials:
a metal stand with a cross bar from which to suspend a pendulum
a piece of string about 1 meter in length
an assortment of slotted masses
a metal support to hold the masses to create a “bob” for the pendulum
a stopwatch or other timing device.

Method:

A. Construct a physical pendulum with a mass of approximately 50 grams suspended on a line of approximately 70 cm. The line length is measured from the pivot point just below the cross bar to the end of the mass hanger. Hang the pendulum so that the mass is no more than 1 cm from your table top at the bottom of the arc through which it will swing. Allow the pendulum to come to a complete rest and place a light, but visible pencil mark (which YOU will later ERASE!) on the table directly below the mass. Pull the mass back about 10 cm and release it. Watch it swing, and devise a method by which you will accurately time 10 complete oscillations. A complete oscillation is equal to a full swing from the maximum height, to the opposite side, and back. Determine the average period, or time to complete one full oscillation.

Find the formula for the period of a pendulum in the text book. Using information you have gathered in this experiment, solve the pendulum formula for the acceleration of gravity. How close to the accepted value for acceleration of gravity are your results? What is the frequency of this pendulum? (f = 1/T)

Record all data on the back of this page.

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DATA: mass ________________
length of line ________________
period ________________

Results: calculated value of gravity: ________________
frequency of the pendulum ________________

B. Repeat the above experiment with a greater mass, and report the same data and results as in part A

DATA: mass ________________
length of line ________________
period ________________

Results: calculated value of gravity: ________________
frequency of the pendulum ________________

C. Study the PERIOD formula. Exactly how is the period mathematically related to the length of the line? (directly proportional to some function of the length of the line, inversely, or what....?) Be SPECIFIC.
Write your answer here:

Make a new pendulum with the same mass as in B above, but with a line of half the length, hang the line so that it is close to the support stand, and use the stand to gauge the period, rather than the pencil mark on your desk. BEFORE you measure the period, calculate it according to the formula. How does the value compare to the value you obtained in part B? (more..less, about the same, about double, about half, or what)

Write your answer here:

Now, swing the pendulum and observe the period as in part A. How close to your calculated value is the observed value? How do you account for any deviation?
Write your answer here:

Disassemble your apparatus (including removing any knots from the string) and leave your desk top neater than you found it. Stop and reset and turn in your stopwatches and return to your seats.

Generalizations and Conclusions:

The greater the line length, the _______________ the period.
The greater the line length, the _______________ the frequency

How is mass related to the period of a pendulum?