Pendulum Measurements

Table #: _______ Name:_____________________ Partners: ____

Measurements on a simple pendulum consisting of a length of string (or in our case a chain of paper clips) and a weight. Different weights, lengths, and starting angles might be tried, but we will keep it simple by using one weight and small swing angles. When small swing angles are used, the period of swinging is independent of weight and swing angle. Each trial will consist of the length and the average of 20 periods.

Mass: ________________ g Angle of Swing: 5 degrees (9 cm sideways for each 100 cm of length)

Trial #	**Approx Length (m)**	**Actual Length *l* (m)**	**Average Period T (s)**	**Average Period Squared T^2 (s^2)**	$\frac{l}{T^2}$ **m/s²**
1	2.6				
2	2.6				
3	1.3				
4	1.3				
5	0.65				
6	0.65				

Graph paper will be supplied in two forms with labeled coordinates. The first is for plotting the length vs. period and the second is for plotting length vs. the square of the period.

Theoretical calculations of pendulum motion indicate that when the motion is sufficiently small, the period of a pendulum T obeys the following equation:

$$T=2\pi\sqrt{\frac{l}{g}}$$

where l is the distance between the suspension point and the center-of-mass of the weight and $g \approx 9.81\ \mathrm{m/s^2}$ is the local acceleration of gravity. Squaring both sides of this equation, solving for l vs T^2, and using the values for π and g, we get

$$T^2=\frac{4\pi^2 l}{g}=(4.024\,\mathrm{s^2/m})\,l \qquad l=\left(\frac{g}{4\pi^2}\right)T^2=(0.2485\,\mathrm{m/s^2})\,T^2 \qquad \frac{l}{T^2}=\frac{g}{4\pi^2}=0.2485\,\mathrm{m/s^2} \quad .$$

A graph of l vs T^2 should be a straight line with a slope of 0.2485 m/s² or a graph of T^2 vs l should be a straight line with a slope of 4.024 s²/m. What will you get? Remember, that (0,0) is a valid point. Estimate your slope from the graph and then calculate it using the program that is the **bottom link** at

http://yosemitefoothills.com/Calculator/

Your data needs to be entered as (x,y) pairs, specifically $T_1^2,\ l_1;\ T_2^2,\ l_2;\ T_3^2,\ l_3;\ T_4^2,\ l_4;\ T_5^2,\ l_5;\ 1_6^2,\ l_6$, etc. and the program will give you a slope and standard deviation which you will write below with 4 digits of precision (e.g. 0.2485). Different parts of the earth will have slightly different values because the earth is not a perfect sphere of uniform density. Maybe we can get a better value for Clovis than 9.81 m/s² .

slope: _______________ ± _____________ m/s² **4π² x slope = *g* = _______________ m/s²**