Name: ________________________________
1101 Section: __________
Date: _________________

Prelab for Graphing II, Simple Harmonic Oscillation

Complete these pages before the next lab session

Problem 2: Creating Linear Graphs from a Non-Linear Function

Now that the graphing and analyzing of linear relationships is fairly clear, we will extend the process to use graphs to analyze other experimental data that are NOT linear.

See the online document Graphing: Advanced for another version of these instructions.

The first part of the process is to look at the theoretical equation that the experiment is supposed to verify. From its structure, it may be possible to change the variables in the equation to TURN IT INTO A LINEAR EQUATION that would then be graphed as in Problem 1.

The period, T, of a mass, m, oscillating on a spring, depends on the spring constant, k. By measuring the period for different masses, the spring constant can be found.

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

In this equation, the period of oscillation can be measured for given/known masses. Plotting T *vs* m, though, would NOT give a straight line. In order to turn this equation into the linear form of $y = slope \bullet x + b$, we can keep T as the y variable, and

if we assign $x =$, the equation will become

The equation has now become linear! The slope of the linearized graph would now be

slope =

and thus

$k =$

The change of the x variable will require us to calculate all of the new x values, and the uncertainty of x, δx, will have to be calculated too.

Raw data: T (period), m (mass)	Desired quantity: k (spring constant)
Graphing data: x-axis: , y-axis:	Find the desired quantity from the slope of the graph:
Uncertainty for graphing data: $\delta x =$, $\delta y =$	Find the uncertainty of the desired quantity:

You may use the blank area below for scratch work:

Let's practice this change-of-variable process on a few more equations that aren't linear.

1. The mass, m, of a sphere depends on the density, ρ, of the material and the diameter, d. By measuring the mass and diameter of several spheres of the same material, the density of the material can be calculated.

$$m = \frac{\rho \pi d^3}{6}$$

Raw data:	Desired quantity:
Graphing data: x-axis: , y-axis:	Find the desired quantity from the slope of the graph:
Uncertainty for graphing data: $\delta x =$, $\delta y =$	Find the uncertainty of the desired quantity:

2. The intensity I of a point source of light depends on the distance, r, from the light source. By measuring the intensity at various distances, the power output, P, of the light source can be found.

$$I = \frac{P}{4\pi r^2}$$

Raw data:	Desired quantity:
Graphing data: x-axis: , y-axis:	Find the desired quantity from the slope of the graph:
Uncertainty for graphing data: $\delta x =$, $\delta y =$	Find the uncertainty of the desired quantity:

3. For a given length of string, L, a standing wave can be set up on the string. By measuring the frequencies of these standing waves, the velocity of the wave, v, can be found.

$$f_n = \frac{nv}{2L}$$

(Hint: The harmonic number n has no uncertainty. The string length L has an uncertainty δL.)

Raw data: Harmonic number: n (n=1, 2, 3…) Frequencies: f_n	Desired quantity:
Graphing data: x-axis: , y-axis:	Find the desired quantity from the slope of the graph:
Uncertainty for graphing data: $\delta x =$, $\delta y =$	Find the uncertainty of the desired quantity: