**Phys 375 – Homework #1**

1) ( 6 pts.) Make a sketch of a histogram for the following set of data:

5.3, 5.1, 6.1, 5.6, 5.5, 5.9, 5.8, 5.5, 5.4, 5.3, 5.6, 4.9, 5.8, 5.7, 5.1, 5.6, 5.5

Calculate by hand (using a calculator rather than a computer) the mean, median, standard deviation, and standard deviation of the mean. Please show your work. What would you report as the measured value for this quantity?

2) (6 pts.) You are trying to determine the acceleration due to gravity (g) using the following relationship between the period (T) of a pendulum and its length (L):

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

You measure T = 2.01 ± 0.09 seconds and L = 93.5 ± 0.4 cm. By propagation of errors, determine the best value and uncertainty for g. If you could repeat your measurement to make it more accurate, should you try to improve your measurement of T or L?

3) (6 pts.) Prove that for multiplicative formulas, the fractional error on the calculated value is equal to the fractional error for each factor added together in quadrature. For example, if f = abc, and a, b, and c have errors Δa, Δb, and Δc, the fractional error on f is given by

$$\left(\frac{\Delta f}{f}\right)^2 = \left(\frac{\Delta a}{a}\right)^2 + \left(\frac{\Delta b}{b}\right)^2 + \left(\frac{\Delta c}{c}\right)^2$$

4) (5 pts.) Prove the following identities for complex numbers:

a) Re(z) = (z +z*)/2
b) Im(z) = (z - z*)/2i
c) cos(θ) = [exp(iθ) + exp(-iθ)]/2
d) sin(θ) = [exp(iθ) - exp(-iθ)]/2i

5) (5 pts.) Show that a wave function, expressed in complex form, is shifted in phase by π/2 when multiplied by i, and shifted in phase by π when multiplied by -1.

6) (5 pts) Prove the laws of addition of sines and cosines

$$\sin(\theta + \varphi) = \sin\theta\cos\varphi + \cos\theta\sin\varphi$$
$$\cos(\theta + \varphi) = \cos\theta\cos\varphi - \sin\theta\sin\varphi$$

using Euler's formula ( $\exp(i\theta) = \cos\theta + i\sin\theta$ ) and exponential notation. Hint: work out $\exp(i(\theta + \varphi))$, and then take the real and imaginary parts.