**Homework 4**

Phys 1140, Fall 2012 Prof. Markus B. Raschke
Due: Tuesday, **October 9**, 4 pm, in your TA's hw box in G2B66

This is your last homework assignment!

1) (7 points) We want to revisit a problem on error propagation similar to one we had on an earlier hw, but analyze it in a little more depth. We want to calculate $z=x*\cos^2(\Theta)$, and understand for which values of $\Theta$ we are more or less sensitive to the uncertainty of $\Theta$.

a) Take x = 1.203 +/- 0.002 meters, $\Theta$ = (45.5 +/- 0.5) degrees. Calculate $z \pm \delta z$.
b) Repeat the calculation with x = 1.203 +/- 0.002 meters, $\Theta$ = (5.5 +/- 0.5) degrees.
c) Discuss why $\delta z$ is different for both cases, despite identical uncertainties in x and $\Theta$? Use a suitable graph to illustrate your explanation.

2) (7 points) The period of a pendulum is measured by six students, and they report their values as 2.51, 2.48, 2.51, 2.52, 2.45, and 2.53 seconds, respectively.

a) What is the average value for the period, T, and the statistical uncertainty (standard error on the mean) for T? State your final answer for $T_{avg} \pm \delta T$ with proper sig figs.
b) The students want a statistical uncertainty that is half of what is calculated above. How many total number of measurements will they need to make (including the 6 above), assuming that the spread in their measurements (s) remains the same? State your reasoning in words.

3) (6 points) You measure a velocity of some particles many thousands of times, and find that the average is 90.7 m/s, and that the standard deviation on an individual measurement is 2 m/s. Now, you take an additional 20 measurements, and take the average just of those 20 measurements. What is the probability that you find that average to be either greater than 91.6 m/s, or less than 89.8 m/s?