Chemistry 236 -- Quiz 1

September 15, 2010 — Statistics and KaleidaGraph Basics

1. (4) State each of the following numbers with unambiguous precision and with the minimal number of digits needed to achieve 1% precision: (a) 1.234 (b) 876500

   (a) 1.23 (b) 8.8×10^5

2. (3) A pressure is measured to be 456.250 Torr and is estimated to be uncertain by 0.45 %. Using the 10% rule for uncertainties, state this pressure and its uncertainty.

   456.2 ± 2.1 Torr

3. (3) Using KaleidaGraph, you carry out an unweighted least-squares fit of 15 data points to a quadratic polynomial containing the adjustable parameters *a*, *b*, and *c*. The fit results box gives a value of 849.3322 for Chisq. Give numerical values for the estimated variance and standard deviation in y. (Use extra precision here, *i.e.*, <u>not</u> the 10% rule.)

   s_y^2 = Chisq/ν = 70.7777 s_y = 8.4129

4. (3) What, if anything, is "wrong" with the following stated results? Fix to the extent that you can.

   a. 789.1234 ± 3 b. 789.1234(7)

   (a) 3 is insufficiently precise, by the 10% rule; best we can do is 789 ± 3 (b) O.K.

5. (4) Use error propagation to obtain expressions for σ_z in terms of σ_x and σ_y, in each of the following cases: (No other quantities are uncertain.)

   a. $z = \exp(ay^2)$ b. $z = ax^2 - by$

   (a) $\sigma_z = |\, 2ay \exp(ay^2) \,|\, \sigma_y$ (b) $\sigma_z = [(2ax)^2 \sigma_x^2 + b^2 \sigma_y^2]^{1/2}$

6. (4) You have recorded a boatload of data in the P Chem lab and now seek to plot and analyze them using KaleidaGraph. When you "Open" the file, you see:

   Precisely what do you select or enter in order to ensure that the resulting KG data sheet will contain all your data, in numerical format, <u>with</u> column headings?

   Delimiter: ____<u>tab</u>_____ Number: _<u>1 or >=1</u>_____ Lines Skipped: ____<u>2</u>_____

   Options: (Check or don't check?) Check

7. (4) You have data that should follow the equation, $y = a\,x - b\,x^3$, with x being error-free.

   (a) How should you define X_i and Y_i in terms of x_i and y_i, in order to fit these data to the relation, $Y = a + bX$?

   $Y_i = y_i/x_i$ $X_i = -\,x_i^2$

   (b) If the original data have constant uncertainty, $\sigma_y = 1$, the latter fit should be a weighted one. What quantities should you enter in the σ_Y column to carry out this weighted fit?

   $\sigma_{Yi} = \sigma_{yi}/x_i = 1/x_i$

8. (2) In a KG data sheet, you have three columns (c0−c2 = A − C) containing 100 numbers each. You wish to compute the corresponding 100 values of $(A + 1/B^3)/C^2$ and put them in the 4th column (D). Write the expression you must enter in the Formula Entry window to carry out this operation.

   (c0 + 1/c1^3)/c2^2