Name: _____

Chem 2113 Test 1 September 23, 2002

Questions are worth 25 points each. OMIT ONE QUESTION by clearly writing OMIT in the space provided for your work. If you fail to mark OMIT on a question I will omit the last question of the test. Show your work and circle your answers for full credit.

1. Replicate measurements of the distance between two points were made using a new electromagnetic distance determination system (EDDS). The distances were 15.49 mi, 15.47 mi, 15.51 mi, and 15.72 mi.

   Can any of the points be rejected at the 90% confidence interval? If so, which one(s)?

   For all remaining points calculate the mean, the standard deviation, the relative standard deviation in ppt, and the confidence interval for μ at the 90% confidence interval.

   In development of the method the population standard deviation (σ) for this method was calculated. Assuming that σ is equal to 0.09 mi for this determination, calculate the 'new' confidence interval for μ at the 90% confidence interval.

2. A defendant is on trial for second degree burglary. In his possession were pieces of electronic equipment matching what was stolen from an apartment complex in Lawton; however, as the owners had not recorded any of the serial numbers there was not a definitive link to the crime. Lawton CSI did find shards of glass embedded in the defendant's jacket, which he claimed came from some broken glassware in the CU Freshman lab. Because laboratory glassware is a special borosilicate glass, determination of the boron content in the glass from his coat and from the broken glass at the crime scene was accomplished. The glass (using 5 measurements) from the defendant's coat had a boron content of 15.4 ppm, while glass from the crime scene (also using 5 replicates) had a boron content of 14.0 ppm. The population standard deviation for the test was found to be 0.7 ppm. Using the 99% confidence level, is there a significant difference in the two glass samples?

3. For the following calculations, determine the a) answer and b) the appropriate uncertainty for each result.

   $15.4(\pm 0.2) + 7.0(\pm 0.1)$

   $51.3(\pm 0.5) / 6.21(\pm 0.02) \times 10^{-3}$

   $[3.94(\pm 0.04) \times 10^{4}]^{3}$

   $-\log 5.1(\pm 0.3) \times 10^{-8}$

   $15.8(\pm 0.4) + 7.3(\pm 0.3) - 23.1 (\pm 0.7)$

4. A 100.0 mL sample of spring water was treated to convert any iron to Fe^{2+}. Addition of 25.00 mL of 0.002017 M $K_2Cr_2O_7$ resulted in the reaction:

$$6Fe^{2+} + Cr_2O_7^{2-} + 14H^+ \rightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O$$

The excess $K_2Cr_2O_7$ was back-titrated with 7.47 mL of a 0.00797 M Fe^{2+} solution. Calculate the parts per million of iron in the sample.

5. Consider the dissociation of lead chromate ($PbCrO_4$; $K_{sp} = 3.0 \times 10^{-13}$)

   a) Calculate the molar solubility of $PbCrO_4$ in water [HINT - assume $\gamma_i = 1$ for all ions **in this situation**]

   b) Calculate the concentration equilibrium constant for $PbCrO_4$ in 0.010 M NaCl.

   c) Calculate the molar solubility of $PbCrO_4$ in 0.010 M NaCl.

   d) Calculate the molar solubility of $PbCrO_4$ in a solution of 0.0333 M K_2CrO_4.

   e) Calculate the percent relative error associated with the facile assumption that the activity would equal the concentration for part (c) of this problem. [HINT: Isn't this the assumption that you used (properly) in part (a) of this problem?]