Chem 310
1st Homework Set
Due Date: Jan. 27, 2004

Note: for the discussion questions, write your answer in your own words; do not copy the Required Notes or the text. This is an opportunity for you to get the concepts organized in your mind.

1. Sketch a calibration curve and show on the plot the data, the linear regression line, the linear dynamic range and the sensitivity.

2. A graphite furnace AA spectrometer was used to determine the copper (Cu) concentrations in drinking water. A large set of blank samples yielded a blank standard deviation of 0.015. The following data were obtained for a calibration curve.

[Cu] (ppm)	1.0	2.0	3.0	4.0	5.0
Absorbance	0.151	0.282	0.463	0.564	0.654

Using a spreadsheet, create a graph of the data using symbols only for the data points. Use your judgement to determine the dynamic range. Fit the data in the dynamic range to a linear regression line. See Harris (pp. 83-85) for the functions to use in Excel, or contact your instructor if you don't know how create a linear regression line fitted to selected data. Note: don't use the linear regression option in the Chart part of Excel; it automatically fits all of the points. Plot the line on the same graph and give the linear regression slope and intercept. If possible, give the standard deviations of the slope and intercept; these are also available from the spreadsheet (LINEST function). Make sure that the axes are labeled and that the data are plotted as symbols and the linear regression line is a solid line. Print the graph and attach it to your HW set.

Answer the following questions.

(a) What is the dynamic range of the method? Hint: it is NOT the entire concentration range.
(b) What is the sensitivity of the method?
(c) Calculate the LOD and LOQ for Cu.
(d) A sample of water yielded an absorbance of 0.366. What is the concentration of Cu in the water? There are two ways to calculate the answer. Explain which way gives the more accurate answer.

3. A commercial analytical lab. received a vegetation standard from the National Institute of Standards & Technology and performed an analysis of a pesticide. They found a concentration of 8.4 ± 1.2 ppb. The NIST data sheet with vegetation standard stated that the concentration of the pesticide was 11. ± 1 ppb. The ±1.2 ppb is due to _____ error and the difference between the measured conc. of 8.4 ppb and the true conc. of 11 ppb is due to _____ error. Which type of error is correctable?

4. A fish was caught in the Monongahela River just below the sewer treatment plant in Star City. The flesh was homogenized and analyzed for mercury. The following values were obtained: 51, 66, 63, 61 ppb. Calculate the mean, sample standard deviation, and RSD.

5. Convert 1 ppb Hg to the molar concentration of Hg. FYI, ppb = part per billion.

6. List 5 techniques for reducing matrix effects. Briefly describe each technique.

7. Iron was determined by the method of standard addition using flame atomic absorption spectroscopy. A Fe sample and a Fe standard of 10.0 ppm were used to prepare the following solutions; each solution was diluted to a final volume of 100.0 mL. What is the concentration of Fe in the sample?

Sample (mL)	Standard (mL)	Absorbance
20.00	0.00	0.331
20.00	10.00	0.557

8. The lead (Pb) levels in Finklea's home brew were determined by anodic stripping voltammetry. 30.0 mL of home brew was placed in the cell and analyzed. The signal (peak height of the stripping voltammogram) of 0.351 cm. Then 5.00 mL of a Pb standard containing 10.0 ppb Pb was added to the cell and mixed. The new signal was 0.583 cm. Calculate the Pb concentration in the home brew. State the assumption needed to do the calculations.

10. A 16-bit ADC is used to convert a signal between +2 V and 0 V to binary numbers. What is the resolution of the signal? What is the minimum RSD of the signal?

11. Problem 20-26 (Chapter 20, problem # 26) in Harris.

12. Problem 20-28 (Chapter 20, problem # 28) in Harris.

13. List the strategies for enhancing signal-to-noise in an instrumental method.

14. S/N for a FT-IR spectrum can be improved by ensemble averaging. How is this done?

15. In some sensitive spectrometers, the light detector is cooled well below room temperature. Why is this done?