CHEM 305 Quantitative Analysis Fall 2007

Practice Problems for Final Exam.
Problem Set #10 (DUE Wednesday, December 5th)
(you may need to use Appendix F or Appendix G in the back of your book to answer some of these questions)

1. What would be the correct way to write the answer to following math problem using significant figures? 13.45 + 9.045 + 1.3

2. You find a 1 liter bottle of barium hydroxide, $Ba(NO_3)_2$, on a shelf with a concentration of 0.845 M.

a) How many milliliters of this base are required to prepare 250 mL of 0.150 M solution?

b) What is the normality of the original solution you found on the shelf?

3. You have prepared an ~0.1M solution of sodium hydroxide. You titrate 0.804g of KHP (204.22g/mol) with your base, using 20.24 mL. What is the concentration of the base based on this titration?

4. A quality control technician at a pharmaceutical company measures the mass of 5 pills randomly selected from the production line.

   3.245, 3.203, 3.185, 3.285, 3.350

   a. Decide if any of these values should be discarded.

   b. Calculate the mean and 95% confidence interval for the data, discarding a point *if* necessary. Show any intermediate results needed for this calculation.

5. A solution contains 0.008 M Ba^{+2} and 0.008 M Ag^{+}. Can 99.90% of Ba^{+2} be precipitated by chromate (CrO_4^{-2}) without precipitating the other metal ion?
   K_{SP} of $BaCrO_{4(s)} = 2.1 \times 10^{-10}$ K_{SP} of $Ag_2CrO_{4(s)} = 1.2 \times 10^{-12}$

6. Calculate the pH of:

a) 0.005 M HCl

b) 0.15M NaOH

c) 0.84M hydrofluoric acid ($K_a = 6.8 \times 10^{-4}$)

d) 0.95M ammonia (K_a of ammonium $= 5.7 \times 10^{-10}$)

7. A 40.00 mL solution containing 0.04642 M $Na_2C_2O_4$ was titrated with 0.028 M $Ca(NO_3)_2$ to precipitate calcium oxalate:

$$Ca^{+2} + C_2O_4^{-2} \rightarrow CaC_2O_{4(s)}$$

Find pCa^{+2} at the following volumes of $Ca(NO_3)_2$:

K_{SP} $CaC_2O_4 = 1.38 \times 10^{-8}$

a) V_e

b) $V_e + 5$ mL

c) $V_e - 5$ mL

8. Calculate the Voltage produced by the following cell at 25°C.
   $Al|Al^{3+}||Cu^{2+}|Cu$, where $[Al^{3+}] = .020M$, and $[Cu^{2+}] = .10M$

9. You have just built the classic Zn-Cu cell ($Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$, $E° = 1.101V$) You then realize that you can use your setup to find the concentration of a unlabeled copper solution that's been hanging around the lab for a while. You carefully dilute your Zn^{2+} solution to .00010M, and fill the copper half-cell with the unknown copper solution, and get a voltage of 1.219V. What was the concentration of Cu^{2+} in the unknown solution?

10. If you are extracting a substance from water into ether, is it more effective to do one extraction with 300 mL of ether or three extractions with 100 mL?

11. The partition coefficient for a solute in chromatography is $K = C_s / C_m$, where C_s is the concentration in the stationary phase and C_m is the concentration in the mobile phase. The larger the partition coefficient, the longer it takes a solute to be eluted. Explain why?

12. Nonpolar aromatic compounds were separated by HPLC on an octadecyl (C_{18}) bonded column. The eluent (mobile phase) was 65% methanol in water. How would the retention times be affected if 90% methanol were used instead?