Chem 101- Midterm #2 is on Monday, Feb. 25 2008. Test #2 will focus on Chapters 4, 5(not including redox balancing) and 6 (be well versed with laboratory exercises – especially how to solve the questions similar to the questions at the end of the Solution Calorimetry Experiment , Experiment #20.

Part of the experiment will be multiple choice but expect more of it to be problem solving. Expect it to be more challenging than the first test.

Use this test to practice "time management" during the actual examination.

It is important to review earlier chapters like nomenclature, .density, empirical formula determination. It is particularly useful to be very good at writing ionic compound formulas. That means that you already know the polyatomic ions and their charges, right?? If you are still slow in that, be prepared to bealso slow during the test. Which means be prepared to be rushed and make silly mistakes at a time when you will be graded! Might as well throw away those valuable points. Unless of course you are really interested in learning some chemistry.

Remember that you are expected to still know chapters 1-3 very well. If needed, an activity table will be supplied. No table of solubilities will be supplied. (It is assumed that you know the table of solubilities!). Bring your own scantron. Know your assigned seating.

It is suggested you consult with your study group outside of class time to go over this test AFTER you have tried it alone by yourself. That way, you can explore different approaches to problem-solving. It is important to learn how to approach questions like the ones below rather than memorizing solutions to specific problems. Remember that the actual test will probably differ significantly from the questions given below.

It should be clear to all students that it is not enough to be able to do the homework problems. Try the exercises within the chapter . The midterm will check if you know a lot more BEYOND the basic concepts.

Some comments on the chapters:

Chapter 4 - 5: Stoichiometry

1) Be able to recognize and name the various types of reactions. Balance equations including redox reactions. Review step by step how you balance a complete redox reaction.

2) Be prepared for stoichiometric calculations involving conversions from grams of reactants to grams of product. Know how to determine % yield and how to determine limiting reactants. Know when to use Avogadro's number. (Don't be one of those who keep using it without thinking! To avoid needless calculations, do a"concept map" when you do calculations. After a while you won't need to do it.)

3) Know the solubility rules in your textbook. Be able to predict if a precipitation reaction will occur. Be able to write both the full and the net ionic equations. Be very familiar with concentrations and solutions. Know molarity. Know other forms of expressing concentration: g/mL, g/L and ppm.

4) Acid-Base: Be able to do calculations involving acid-base <u>titrations</u>. What is an "equivalent"? How many equivalents of H_2SO_4 are in 2.5 moles of H_2SO_4? Practice with monoprotic, diprotic and triprotic acids. Determine [analyte] given the equivalence point, [titrant] and the volume of the analyte. Be able to determine [analyte] when specific volumes of titrant are added to the analyte. (before and after the equivalence point). Be sure you can do all this. For those of you who like to cram, a word of advice. Who are you kidding???? You will use these calculations many times over. This is the time to learn it right from day 1. Resist bad habits and sloppy thinking. If you can do titration calculation titrations correctly, future calculations will be much more interesting and rewarding. Of course, some of you people already find it awesome!

5) We'll skip this: Redox: Be able to determine oxidation numbers, recognize redox reactions, balance redox reactions, and determine whether a redox reaction will occur or not based on the activity table (like table 4-3, page 176). But instead of the arrows, reduction potentials will be given (like the examples in the lecture). Know the terminology: oxidant, reductant, oxidation, reduction, etc.

Chapter 6: Thermochemistry

1) Be able to state and to apply the first law of thermodynamics.
2) Calculate enthalpy and energy using constant pressure and constant volume calorimetry.
3) Do calculations using Hess'Law and $\Delta H_f°$'s on problems resembling the questions at the end of the experiments on calorimetry (see lab manual for these questions). KNOW these VERY WELL.
4) Calculate heat changes for a substance undergoing heating both with and without phase.
5) Calculate enthalpy changes given the molecular structural formula of the reactants and products as well as the bond enthalpies of the relevant bonds.

Sample problems:

1) How many grams of sodium carbonate are needed to make a 250. mL solution which contains .14 M of sodium ions. (Use atomic wts: Na = 23.0; C= 12.0, O = 16.0; Note that atomic wt of Na^+ = same as that of Na)

2) Indicate which of the following aqueous solutions are expected to react. Write down the chemical equations explicitly to show the reaction. If there is a gas forming by some secondary reaction, make sure you indicate that. If they do react, write down the chemical formula of the expected products:
a) sodium sulfate & barium chloride. React? ___(yes/no) If so, product(s): __ , _____.
b) silver chloride & potassium nitrate. React? __ (yes/no) If so, product(s): ____ , ___.
c) Lead acetate & ammonium iodide. React? ___ (yes/no) If so, product(s): __ , ___________.
d) sulfuric acid and sodium hydrogen carbonate? _______ (yes/no) If so, product(s): __ , ___________.

3) SKIP THIS: Which of the following are redox reactions? Acid base reactions? **Balance** them anyway.
a) $Cu^{2+}(aq) + Ag(s) \text{-->} Cu(s) + Ag^+(aq)$ Redox? _______ (yes/no)
b) metathesis reactions in general. Redox? _______ (yes/no)
c) VO_2 (s) + HNO_3(aq) --> $V(NO_3)_5$(aq) + NO_2(g) Redox? _______ (yes/no)
d) $CH_4 + O_2 \text{-->} CO + H_2O$ Redox? _______ (yes/no)
e) H_2CO_3 + NaCl--> Na_2CO_3 + HCl Redox? ____ (yes/no)
f) $H_2CO_3 \rightarrow H_2O + CO_2$? Redox? _______ (yes/no)

4) Write balanced equations for the following reactions:
a) phosphoric acid with sodium bicarbonate: (exchange reacion)
b) ammonium sulfate with barium nitrate: (exchange reacion)
c) SKIP THIS: sodium oxalate reacts with potassium permanganate ($KMnO_4$) to form CO_2 and Mn^{2+} (among other things). Write in the missing elements. Write the half reactions, balance them and then add them together to form the full net ionic equation.

5) Titration of a 25.0 mL NaOH solution requires 15.0 mLs of 0.25 M sulfuric acid to reach equivalence.
a) What is the concentration of the original NaOH solution?

b) What would be the concentration of NaOH be after the first 10.0 mLs of the sulfuric acid were added?

6) 18 M sulfuric acid solution has a solution density of 1.48 g/mL. Suppose that a diluted acid solution was prepared by adding 25.0 grams of the above concentrated acid to enough water to make a total of 500.0mLs of diluted acid.

a) What is the molarity of the diluted H_2SO_4 solution?

(b) How many mLs of a 5% (mass%) NaOH is required to titrate 50.0 mLs of this diluted acid to the equivalence point? (Note that the density of the NaOH solution is 1.10 g/mL) Use atomic wts (in g/mol): Na=23.0, O=16.0, H=1.0.

7) 6.0 moles of N_2 are mixed with 12.0 moles of H_2 according to the following equation: N_2 (g) + 3 H_2 (g) --> 2 NH_3 (g)

a) Which chemical is in excess and by how many grams?
b)What is the theoretical yield of NH_3 is produced?
c) If the percent yield of NH_3 is 80%, how many moles of NH_3 are actually produced?
d) How many grams of ammonia (NH_3) will be produced at 80% yield?
e) How many molecules of ammonia (NH_3) will be produced at 80% yield?
f) What volume of ammonia will be produced at 80% yield if its gas density is 0.76 g/L?

8) Copper metal can react completely with nitric acid to form a blue solution containing the products: copper(II) nitrate, a brown gas known to be nitrogen dioxide and liquid water. If 0.15 cm^3 of copper metal are reacted with excess nitric acid, how many liters of the brown gas do you expect to produce if the actual yield is 70%? (Note density, ρ:Cu = 8.95 g/cm^3; NO_2 gas = 2.05 g/L)
The balanced equation is: $Cu + 4\ HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

9) If the titration of 16.0 mLs of $H_2C_2O_4$ requires 20.0 mLs of 0.400M KOH to reach the endpoint, what is $[H_2C_2O_4]$ initially?
What is $[H_2C_2O_4]$ in the resulting solution after only 10.0 mLs of KOH have been added?
What is [KOH] after a total of 25.0 mL of KOH has been added to the acid?

10) How much heat is needed to convert 12.0 g of water at 0°C to 12.0 g of steam at 100°C? (C_p = 4.18 J/gK for water, H_f = 333 J/g and H_v = 2260 J/g)

11) Given the following ΔH°_{rxn} 's below, determine ΔH for: $6FeO + O_2 \rightarrow 2\ Fe_3O_4$:
a) $3\ Fe(s) + 2\ O_2(g) \rightarrow Fe_3O_4(s)$ ΔH°_f = -1118.4 kJ/mol
b) $Fe(s) + 1/2\ O_2(g) \rightarrow FeO(s)$ ΔH°_f = -272.0 kJ/mol