Chem 101- Midterm #2 is on Friday, February 27, 2009. Test #2 will focus on Chapters 4, 5(but not including redox balancing i.e. sections 5.3, 5.4, 5.5) and Chapt 6
A review session is scheduled for **1-2 pm** in PS 607 on Thursday, Feb. 26, 2009

Use questions in this guide to practice "time management" during the actual examination. Don't expect the test questions to be the same as these questions. They are provided to you simply for practice and for assessing the depth of the questions to be expected.

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(i.e. know Table 3.4 and all of Table 3.7)**. 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 No table of solubilities will be supplied. (It is assumed that you know the table of solubilities!). 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: Stoichiometry

1) Be able to recognize and name the various types of reactions. Balance them. It is *assumed* in many problems that you understand the importance of writing balanced equations as you start solving these problems.

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. (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 (see Table 5.1 in your textbook. Usually knowing the "Usually Soluble" is enough for now). 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 concentration s and solutions.

4) Acid-Base: Be able to do calculations involving acid-base titrations. 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.

Sample problems: A very serious word of advice: the test may or may not look like these questions. It is an error on the student's part to memorize solutions since that doesn't help you think. You need to practice problem-solving not memorizing SOLUTIONS to problems

1) How many grams of sodium carbonate must be dissolved 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) (ans: 1.86g)

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) Balance (or complete) these reactions and then write the net ionic equations (whenever appropriate).
a) $Cu(s) + HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + H_2O(l) + NO_2(g)$
b) Combustion of ethane and also of ethanol.
c) $VO_2(s) + HNO_3(aq) \rightarrow V(NO_3)_5(aq) + NO_2(g)$
d) $KClO_3(s) \rightarrow KCl(s) + O_2(g)$
e) $Na_2CO_3(aq) + HCl(aq) \rightarrow$ (complete it!)
f) $H_3PO_4(aq) + CaMg(CO_3)_2 \rightarrow$ (complete it)
g) phosphoric acid with sodium bicarbonate: (exchange reacion)
h) ammonium sulfate with barium nitrate: (exchange reacion)

4) Titration of a 25.0 mL NaOH solution requires 15.0 mLs of 0.250 M sulfuric acid to reach equivalence.
a) What is the concentration of the original NaOH solution? (0.300M)

b) What would be the concentration of NaOH be after the first 10.0 mLs of the sulfuric acid were added? (ans:0.0714M)

c) What would be the resulting concentration of H_2SO_4 after overshooting the equivalence point by 6.00 mLs of the sulfuric acid? (ans:.0326M)

5) 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? (0.608M)

b) How many mLs of a 5% (mass%) NaOH is required to titrate 50.0 mLs of this diluted acid to the equivalence point?

6) 8.40 g of N_2 are mixed with 24.0 g of Cl_2 according to the following equation:
$N_2(g) + 3\ Cl_2(g) \rightarrow 2\ NCl_3(g)$
a) Which chemical is in excess and by how many grams? (ans: N_2,5.24g)

b)What is the theoretical yield of NH_3 is produced? (ans: 45.1g)

c) If the percent yield of NH_3 is 80%, how many grams of NCl_3 are actually produced? (ans:36.1g)

d) How many moles of NCl_3 will be produced at 80% yield? (ans:0.299g)

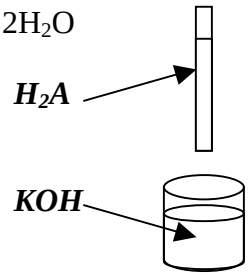
e) How many molecules of nitrogen trichloride will be produced at 80% yield? (ans:1.80×10^{23})

f) A separate problem: if the %yield is 85%, how many grams of Cl_2 are needed to form 50.0 g of NCl_3? (ans:52.0g)

7) Zinc metal can react completely with hydrochloric acid to form a colorless solution containing the products:$ZnCl_2$(aq), hydrogen gas and liquid water. If 0.15 cm^3 of zinc are reacted with excess HCl, how many mLs of the gas do you expect to produce if the actual yield is 70%? (Note densities, ρ : Zn =7.14 g/cm^3; H_2 gas = 0.900 g/L) (ans: 25.5)

The balanced equation for this reaction is : $Cu + 4\ HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

8) Suppose that 16.0 mLs of the diprotic weak acid, oxalic acid "H_2A", are needed to completely neutralize (i.e. titrate) 20.0 mLs of 0.400M KOH to the endpoint,



a) what is the net ionic equation for the titration reaction?

b) what is $[H_2C_2O_4]$ initially? (ans: .250M)

c) What is the resulting [KOH] after only 5.0 mLs of the acid are added. (ans:0.252M)

d) If a total of 0.36 g of oxalic acid were added at the equivalence point, what is the molecular weight of oxalic acid? (don't look up its formula. Just solve it from the given information. Ans: 90.0).

Chapter 6: Thermochemistry

a) Be able to state and to apply the first law of thermodynamics.
b) Calculate enthalpy and energy using constant pressure and constant volume calorimetry.
c) Do calculations using Hess'Law and 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.
d) calculate heat changes for a substance undergoing heating both with and without phase.

Some sample questions:

1.Determine the ΔH° for the reaction below. (here you have to have access to a ΔH_f° table.

$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$

(ΔH_f°'s (in kJ/mol): C_2H_5OH = -235 ; $CO_2(g)$=-394; $H_2O(l)$=-286; $H_2O(g)$ = -242) (ans:-1410)

2. Suppose that mixing 50 mLs of 1.0 M HCl solution with 50 mLs of 1.0M NaOH solution raises the mixture's temperature 5.00°C, Suppose further that mixing 50.0 mLs of 1.0 M Acetic acid (HCH_3CO_2) solution with 50mLs of 1.0 M NaOH solution raises the mixture's temperature 3.80°C.
a) Write the net ionic equations for these two reaction.

b) What is the ΔH° (in kJ/mole acid) for the two neutralization reactions just described? (As before, we assume that the solutions' mass and C_p (4.18J/g°C) are the same as the water in the solutions) (a:-41.8,-31.8)

c) What is the $\Delta H°$ (in kJ/mole acid) for following reaction? (hint write out the above 2 net equations and then use Hess' Law) (a:+10.0)

$$HCH_3CO_2(aq) \rightarrow H^+(aq) + CH_3CO_2^-(aq)$$

c) Does this reaction do any P-V work? Explain.

3) Which of the following is endothermic? a) condensing drops of water, b) freezing icecream, c) bubbling of soda pop, d) sublimation. How much energy does it take to convert 1 g of ice at 0°C to 1g of steam at 100°C? (assume you have the ΔH_{fusion} , ΔH_{vap} and $C_{p,H2O}$

4) Be able to solve (without looking at the solution) problem-solving exercise 6.12 (page 247), 6.14 (p. 251), 6.15(p.252)

5) A 55.0 g of Mg (C_p = 1.04 J/g°C) is dropped into a 100.0 g of water. The temperature of the water (C_p=4.18J/g°C) is observed to rise from 20.5°C to 26.4°C. What was the initial temperature of the Mg piece? (assume that all heat transfer is only between the water and the Mg). (69.5°C)

6) A 10.0g piece of 0°C is dropped into a 100. g of 20.0 °C water (H_{fus} 333 J/g). What is the final temperature of the water after all the ice is melted? (ans: +4.07°C)

7) The fuel value of food can be determined by measuring their heat of combustion in a bomb calorimeter. Suppose that 2.60 g of walnuts in a bomb calorimeter of a heat capacity of 2158 cal/°C caused a rise of temperature 6.82°C. Calculate the caloric value of 1.0 g of walnuts.(give final answer in **Cal**/g. Is the answer the same as the enthalpy of combustion? (note: Cal, nutritional calorie,=1kcal; ans=5.66Cal/g)