CHEM 122 Laboratory Final Exam Grading Rubric:

100 total points possible

_____Student's Name

Question Number	Possible Points	Points Earned
1	5	
2	10	
3	10	
4	4	
5	4	
6	4	
7	10	
8	5	
9	5	
10	10	
11 a	3	
11 b	3	
11 c	3	
11 d	3	
11 e	3	
11 f	3	
12	15	0 3 5 8 11 15
TOTAL Points Earned		

This rubric will be returned to you along with your other exams when you pick them up during final exam week in my office during office hours.

CHEM 122 Laboratory Final Examination

Directions

This is an exam. You may talk to no one except Dr. Carman about this exam as you are working it up.

The exam packet is to be printed in color on 8.5" x 11" white paper and one experimental page per piece of paper (i.e., one page per sheet), i.e., no front-to-back printing (you may need the back for calculations). The packet is to be stapled together with one staple in the upper left corner.

All work is to be shown on/in this packet: NO attached papers.

Legibility: If Dr. Carman can not read your work, it's wrong – write neatly for credit.

You may NOT use any web sources except for Dr. Carman's CHEM 121 and/or 122 lectures to complete this exam. If you need other sources, you are to use Chemistry textbooks in the WNC library, particularly King's spiral book (!) and cite them. Those of you who have King's 1959 textbook may use that, as well (cite it!).

Questions for Dr. Carman of a clarification manner are permitted. Questions to do the work for the student are not permitted.

This exam is due as you walk in to your ACS final exam. If you are late to the ACS exam (and, hence, not able to attend/participate in the ACVS final exam), your lab final exam will not be accepted late and a zero (0) will be entered for your lab final exam score.

No partial credit will be given: the answers to the individual questions will be graded as either "right" or "wrong". It would behoove you to highlight your answers for ease of finding.

The exams will not be returned to you after completion and scoring.

Good Luck! The content that you have studied this semester in CHEM 122 has well prepared you for this activity: you have the skills!

Student's Name: _____ Date: _____

1) A student, thinking the formula of mercurous chloride was HgCl, calculated its solubility product from the mass of the compound in a liter of solution. The student assumed the reaction occurring when the salt dissolved was $2\ HgCl \Leftrightarrow Hg_2^{2+} + 2\ Cl^-$.

The correct formula is Hg_2Cl_2 and the correct reaction is $Hg_2Cl_2 \Leftrightarrow Hg_2^{2+} + 2\ Cl^-$. Was the student's calculated value of the solubility product constant equal to, less than, or greater than the true value? Show your work.

2) Consider the possible reaction:

$$2\ HOAc + Mg(OH)_2 \rightarrow Mg^{2+} + 2\ OAc^- + 2\ H_2O$$

Using the K_a (HOAc), K_{sp} ($Mg(OH)_2$) and the K_W, derive the equilibrium constant (K_{eq}) for this reaction demonstrating the combination of these three constants to derive the K_{eq}. Based on your determination, is the reaction favored? Why or why not?

3) Zinc begins to precipitate at a pH of 1.15 at 25°C, 1 atm and 0.010 M $Zn(NO_3)_2$, saturated with hydrogen sulfide. What is the K_{sp} of ZnS? Show all of your work.

4) Balance the following reaction: $Sn(OH)_3^{-1} + Bi(OH)_3 \rightarrow Bi\ (s) + Sn(OH)_6^{2-}$.

5) Explain why a slight excess of HCl is used to precipitate Group 1. Why is a large excess to be avoided?

6) $NH_3 + Hg_2Cl_2 \rightarrow Hg(I) + HgNH_2Cl\ (s) + HCl$ is balanced, yet it is incorrect. Explain (and demonstrate) why 2 mol ammonia are required in this reaction (HINT: Chapter 7 in King's spiral book on reserve in the WNC library).

7) $2\ AgCl\ (s) + CrO_4^{2-} \rightarrow Ag_2CrO_4 + 2\ Cl^{-1}$. Use the K_{sp} of silver chloride and the K_{sp} of silver chromate to calculate the K_{eq}. Will any solid AgCl form if solid silver chromate is shaken with a solution 0.0010 M in chromate ion and 1.0 M in chloride ion? Show your work.

8) Silver solder is composed of silver, copper and zinc. Using your knowledge of qualitative analysis, your notes and King, devise the briefest possible method/procedure to separate the three ions from each other.

9) How many mg of sodium are required to give 50 mg of $NaZn(UO_2)_3(OAc)_9 \cdot 9H_2O$? Watch yourself: remember what “OAc” represents???

10) Plaster is made up of $CaSO_4$ and is still periodically used to construct casts to immobilize fractures as they heal. One weakness of plaster is that one must wrap them in plastic when showering – otherwise the cast will "dissolve". If the density of the plaster is 0.97 g/cm^3 and one showers with water flowing at a rate of 750 L/hour and the cast is 3 cm thick, how long (in minutes) will it take the water to make a hole 4 cm in diameter through the cast?

11) Design **<u>and illustrate in the space to the right of the reduction half reactions</u>** a battery using $Li \mid Li^+$ and air ($O_2 \mid OH^-$) that will work. The half reactions are as follow:

$Al^{3+} + 3\ e^- \rightarrow Al$ $\quad E° = -1.662\ V$

$O_2 + 2\ H^+ + 4\ e^- \rightarrow 2\ OH^-$ $\quad E° = 0.401\ V$

a) What is the E°cell?

b) What's the cathode?

c) What's the anode?

d) The density of Al is 2.701 g/cm^3. If a battery was designed to be 1.5 cm wide, 0.5 cm thick and 0.5 cm high, how much Al (in grams) would be needed to make this battery? Assume the volume will be filled 85% with Al.

e) The mass of the Al you calculated in d), above, is how many Coulombs?

f) If the battery is rated at 3 V and discharges in 4 hours, how much work in Joules will the battery do in that 4 hours?

12) You are working as a bench chemist for a water quality laboratory. You have received a water sample from a client. The client wants to know if the following ions are in the sample: Ag(I), Na(I), Fe(II), Ba(II) and/or Sb(III). You've not tested for these ions before and have only just completed CHEM 122. Using King (spiral or hard back version if you have it), devise a possible separation scheme **in flow chart format** to fit in the space below, neatly, that can be accomplished in about three hours (time is money, after all, in business!). Be sure to include brief comments about volumes, concentrations and techniques needed, as well: someone else in the lab may use this in the future!