

Chem 104 - Section I
Spring, 2006
Study Guide for Final Exam

The final examination will be given from 11:30 a.m. to 2:30 p.m. on Tuesday, May 16, in the Large Lecture Hall (Lipke Auditorium). As with previous tests, please take alternate seating. Bring your calculator (with extra batteries, if needed), several sharp pencils (or a mechanical pencil with extra leads), and erasers. Do not use colored pencil or pen. *Nothing else is permitted during the test.* Please be prepared to write your UMB Student Number on the cover of the test. **Do not cheat!**

The final exam is comprehensive, including all topics covered in the course. Nearly half of the points are concerned with material covered since the cut-off point for Test 3 (Electrochemistry and Thermodynamics). The final exam is worth 200 points and consists of ten (10) pages, including the cover sheet. You will also be given a separate handout containing a periodic table, a table of conjugate acid-base pairs with K_a 's, and a table of oxidizing and reducing agents with E° values. The following additional information appears on the cover of the test packet:

$$R = 0.08206 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol} = 8.314 \text{ J}\cdot\text{K}\cdot\text{mol}$$

$$\mathcal{F} = 9.65 \times 10^4 \text{ C}$$

$$\text{molar volume at STP} = 22.4 \text{ L}$$

$$\Delta G = \Delta H - T\Delta S = \Delta G^\circ + RT \ln Q$$

$$E = E^\circ - \frac{0.0592}{n} \log Q \text{ at } 25^\circ \text{C}$$

$$\text{K} = ^\circ\text{C} + 273.15$$

$$K_w = 1.00 \times 10^{-14} \text{ at } 25^\circ \text{C}$$

$$t_{1/2} = 0.693/k$$

$$\Delta G^\circ = -RT \ln K$$

The test consists of the following eight (8) sections:

1. (100 points; 4 points each) Circle the correct answers.

Multiple choice questions covering the entire range of topics in the course. Most questions have five choices (some have fewer), but only one choice is correct for each question.

2. (20 points) Given two couples and their corresponding standard reduction potentials, fill in the blanks regarding a certain galvanic cell under standard conditions. There are ten questions worth 2 points each.

Do not assume that the cell is shown in the proper order (i.e., anode and cathode placed on the correct sides). You must determine whether or not it is properly shown.

3. (10 points) Given a balanced redox reaction equation and its E°_{cell} value, calculate E_{cell} under certain non-standard concentration conditions.

4. (14 points) Balance a given skeletal redox equation in either acidic or basic medium (as specified) using the ion-electron (half-reaction) method. In answering this question, you must show the following:
 - (a) A balanced half-reaction for the reduction couple (5 points);
 - (b) A balanced half-reaction for the oxidation couple (5 points);
 - (c) The balanced overall redox reaction, with lowest whole-number coefficients (4 points).

Don't bother writing the state designations (*aq*), (*g*), (*l*), or (*s*), **but be sure that charges on all species are properly shown.**

5. (10 points) A straightforward calculation using Faraday's Law with electrolysis, similar to examples given in class and assigned for homework
6. (12 points) A straightforward gas-phase equilibrium problem, asking you to calculate equilibrium concentrations, given initial concentrations of reactants and/or products.
7. (18 points) Given a certain thermochemical reaction and its associated standard enthalpy, ΔH° , and also ΔG_f° and S° data for the reactants and products, determine ΔG° and ΔS° for the reaction, and calculate the estimated ΔG at a non-standard temperature. There are also three short questions regarding the relationship between the calculated values and spontaneity.
8. (16 points) Three calculations regarding the pH of a weak acid solution, a certain buffer prepared from the acid and its conjugate base, and the effect on the buffer's pH from adding a given amount of strong acid or base.