Chem 103, Spring 2006
Prof. Sevian
Study Guide for Exam 3

The third exam will be given in the same two locations as the first and second exams, according the first letter of your last name:

Last names beginning A – H: McCormack 1st floor, room 207 (M/1/207)

Last names beginning I – Z: Small Science Auditorium S/1/006 (where class is held)

Please show up directly to the correct location, so as to have the maximum time available on the exam.

The exam will take place during regular class time, 10:00-11:15 a.m., on Thursday, April 27. You will have the entire class period to complete the exam, but you will need to work efficiently to complete it. All exams must be turned in by 11:20. If you arrive late to the exam, you will not be given extra time. If you arrive after the first exam has been turned in, you will not be allowed to take the exam. I urge you to leave home earlier than usual to allow for surprise commuting problems.

All the rules and general information about the exam is the same as for exams 1 and 2.

As announced in class, the exam will cover lecture material through Thursday, April 20 (and possibly also a group problem that might be done on Tuesday, April 25), and Homework 8-11. These correspond to all sections of chapter 6, 7, and 8 in the text except the any sections explicitly mentioned in class as not being tested. A sample exam, and key, from last year's course will be posted on the course website, to assist you in gauging the level of difficulty of questions and scope of the exam. The format of the exam and style of questioning in this course may differ from the sample exam. In addition, specific problems from the ACS study guide are provided here to help you focus your studying. Again, specifying these problems is intended to provide you a guide as to the style of questioning and level of difficulty of the questions. It in no way limits the content of the exam to these questions.

You will be provided with the following information on the exam, so there is no need to memorize it:

<u>Constants of nature</u>

Speed of light, $c = 2.998 \times 10^{8}$ m/s

Planck's constant, $h = 6.626 \times 10^{-34}$ J·s

$hcR_H = 2.18 \times 10^{-18}$ J/atom = 1312 kJ/mol

<u>Conversions/Metric Prefixes</u>

1 nm = 10^{-9} m

1 Hz = 1 s^{-1}

<u>Equations</u>

$c = \lambda\nu$

$E = h\nu$

$$E_n = -\frac{hcR_H}{n^2}$$

from which can be derived that

$$\Delta E = -hcR_H\left(\frac{1}{n_{final}^2} - \frac{1}{n_{initial}^2}\right)$$

ACS Study Guide questions that may help you to prepare:

Chapter	Study Questions	Practice Questions
Atomic Structure	2, 4, 6-10	5, 6, 7, 9, 10, 13, 17-30
Molecular Structure & Bonding	1, 5, 6	11, 18, 19, 22-26, 30
Energetics	3	6, 8, 9
Descriptive Chem/Periodicity	6-10	13-30
Laboratory Chemistry	1-5, 9, 10	1-6, 12, 16-20

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Exam 3 will consist of the following parts, worth 100 points total:

Multiple choice and short response: worth approximately 60 points of the total
Problems: worth approximately 30 points of the total
Laboratory: worth 10 points

For all problems involving calculations, be careful to provide correct significant figures in your answers.

<u>Multiple-choice/Short response</u>: You should study and make sure you are able to answer each of the following kinds of questions:

- Electromagnetic radiation
  - Wavelength, frequency, energy conversions
  - Wavelength or frequency comparison of different forms/colors of radiation
  - Particle vs. wave behavior – when does which model work and when not?
- Hydrogen emission spectrum
  - Explain how it is produced
  - Use Rydberg equation to predict energy of a particular hydrogen spectral transition
- Emission spectra of elements other than hydrogen: how and why are they different from hydrogen's?
- Shapes of *s*-, *p*- and *d*-orbitals, and assignment of quantum numbers to specific orbitals
- Valid and invalid sets of quantum numbers
- Use hydrogen atom quantum mechanical model to predict electronic ground state structure of other elements, and write shorthand notation ($1s^2\ 2s^2\ldots$)
- Derive valence numbers from electronic structure, state similarities and differences among elements that have the same valence number, and distinguish groups (*e.g.*, alkali metals, halogens) and explain some of their observed properties on the basis of valence number
- Periodic trends in ionization energy, atomic and ionic radius, metallic character, and electron affinity, and logical arguments to explain the origins of the trends
- How to explain relative lattice energy comparisons among ionic crystals
- Compare covalent bond polarity using electronegativity differences
- Predict enthalpy of reaction using bond enthalpies
- Lewis structures
  - Molecules/ions with atoms that follow octet rule vs. exceptions
  - Resonance structures and predict bond order
  - Formal charges and using them to predict stability of structures
  - Identify isoelectronic structures

<u>Problems</u>: The problems will involve:

1. Drawing Lewis structures of molecules and/or ions
2. Explaining periodic trends
3. Predicting the enthalpy of reaction using bond enthalpies

One of the problems will be very similar to one of the in-class group problems.

<u>Laboratory question</u>:
A question based on laboratory techniques and theory behind it in one of the labs you have done.

7. *Five unlabeled bottles*
   Relevant concepts: determining net ionic reactions based on observations in the laboratory, identifying an unknown aqueous ionic solution based on reactions with known solutions
8. *Atomic spectra*
   Relevant concepts: using emission spectra to tell apart two different compounds in the laboratory, explaining how emission spectra work (at the particle level)
9. *Volumetric iron analysis*
   Relevant concepts: titration