Chemistry 161-06 **Unit 3** **Fall '17**

Please note that there are two major collaborative assignments that require work out-of-class. These are the Acetic Acid Lab and the Atmospheric Chemistry Presentations (done collaboratively). The Presentations are 12/12 & 12/14. There are due dates for components of these throughout Unit 3, below, and general information is on the last page.

11/15 Laboratory: Sodium Hydroxide Solutions
Prelaboratory Assignment (p.70) due at start of lab. Report due 11/21.

11/16 Outcomes:

1. To view matter through a new set of principles that are grounded in theory and proven by experiment, where atomic and electron behavior are governed by quantum theory, and for which we have no personal experience.
2. To describe and compare properties of electromagnetic radiation through wavelength, frequency, and speed.
3. For visible light, to memorize the relationship between the "red" and "blue" ends of the visible spectrum as long vs. short wavelengths, and relate these to lower and higher energy.
4. To know that atoms in elements and compounds may emit or absorb light of a specific, discrete wavelength or energy.
5. To know how absorption and emission spectra differ for an atom, and differ among atoms.
6. To describe how Planck's model of emission of light from heated solids and Einstein's description of the Photoelectric Effect led to advances in understanding the quantization of energy and the wave-particle duality.
7. To view and describe how Rydberg and Balmer's equations successfully fitted the hydrogen spectrum.
8. To describe Bohr's model of electron transitions between energy levels, and how they correspond to frequency and color. To interpret and use an energy level diagram for this purpose.
9. To understand that Bohr's model correctly related energy levels to quantum numbers, which explained the absorption and emission of energy by electrons in a Hydrogen atom.
10. To know how Bohr's theory was incorrect in describing position and radii of electron orbits.

Read §7.1 through 7.4. Reading quiz on these sections.
Recommended exercises: From the above sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.

11/21 Outcomes:

1. To describe the contrast of our view of particles and waves in the "macroscopic" world, to the wave-particle duality in the realm of atoms and subatomic particles.
2. To grasp how the deBroglie relation expresses the wave properties of particles.
3. How does an electron microscope make use of these properties?
4. To view the behavior of electrons in atoms as particles with wave properties, which must obey certain principles of "standing waves."
5. How does the Uncertainty Principle imply that locating an electron is an issue of probability?
6. To know that wavefunctions are sets of related functions specified by integers, and that the mathematics of wave mechanics gives specific energies and location probabilities for electrons.
7. To describe what an orbital is and that wavefunctions exist for specific types of orbitals, corresponding to quantum numbers.
8. To understand quantum numbers (and their allowed values) that describe electrons in orbitals, and how they relate to the energies and kinds of orbitals in atoms.
9. To describe how quantum theory corrected problems with Bohr's theory, to contrast orbit and orbital, and a radial "shell" vs. an energy "shell."
10. To use the traditional notations for quantum numbers (n, l, m_l) to lead to a count of orbitals in a subshell.
11. To memorize the descriptive letters for orbital types: s, p, d, f, and the number and general shape of each type.
12. To view electron spin as a fundamental property of an electron in an orbital.
13. To apply the Pauli principle to justify that only two electrons may be in any one orbital.
14. To apply the spin property of nuclei to know the information nmr / mri provides.
15. To describe the emission of light from a laser as a transition between specific energy levels.

Read §7.5, 7.6. Reading quiz on these sections.
Recommended exercises: From the above sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.
Sodium Hydroxide Solutions lab report due (pp. 68 – 69)

11/22 No Lab Session: Work on Chemical Resources Lab. Overview p.48, is on Canvas, but the assignment to be turned in, due 11/28, is hard-copy only.

11/23 Holiday

11/28 Outcomes:

1. To view mathematical properties of simplified wavefunctions, and describe how they predict regions of high, low, and zero probability (not in book).
2. To describe a region of low probability as a "node" and what "tunneling" describes.
3. To describe the functioning of a scanning tunneling microscope.
4. To describe how mathematical properties of the wavefunctions generally predict their diverse shapes (not in book); to memorize that s orbitals are spherical, p orbitals have lobes along one axis, and d and f orbitals have complex shapes.
5. To know the source of orbital energy level differences in multielectron atoms, and interpret energy level diagrams. Given an energy level diagram for an atom, obtain its electron configuration.
6. To use several styles of communicating electron configurations, and identify areas that may be misleading.
7. To describe how the shape of the Periodic Table is related to energy level diagrams of atoms, and to use the Periodic Table to obtain configurations of all main group elements, plus the first row Transition Metals.
8. To contrast "core" and "valence" electrons and how to identify each from configurations or the Periodic Table.
9. To use the term "valence electrons" differently in the contexts of configurations and of reactivity.

Read §7.7, 7.8. (Note 7.9 has been moved to 12/5.) Reading quiz on these sections.

Recommended exercises: From the above sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.

Chemical Resource Lab due (see Canvas)

Presentation Rough Outline (2 points): Short listing of topics and subtopics in outline form with minimal detail.

11/29 Laboratory: Absorption and Emission Spectra

Prelaboratory Assignment (p.91) due at start of lab. Report due 12/5.

11/30 Laboratory planning session. Outcomes:

1. To know that mass percent can (and often does) pertain to a solute in a solution.
2. To use mass percent to obtain the moles of a solute, and the reverse.
3. To plan a practical titration procedure that will determine the acetic acid content of vinegar. This is an important session where pre-selected groups will plan the experimental procedure your group will follow on 12/6. There is a rough guide in the lab manual, but you must devise a practical procedure.

Assignments:

Review from various sources the definition of mass percent and the process and calculations for titration.

Reading Quiz: <u>All</u> content from the top of page 92 of the lab manual.

12/5 Outcomes:

1. To be able to write the electron configuration of any main-group element ion.
2. To know and use how differences in 3d vs. 4s orbital energies in ions (compared to atoms) give rise to the configurations of first-row transition metals having no 4s electrons.
3. To use the terms "penetration," "shielding," and "effective nuclear charge" to describe the influences electrons in various orbitals have on each other.
4. To know and explain the tendencies in atomic size across groups and down rows of the Periodic Table.
5. To define ionization energy, and relate it to energy levels, size, location in the Periodic Table, and metallic character.
6. To use second and subsequent ionization energies to explain why we have the types of ions typical of metals.
7. To define Electronic Affinity; to use it to justify which ions form monatomic anions.

Read §7.9, 7.10, 7.11, 7.12. Reading quiz on these sections. (Note 7.9 was been moved from 11/28.)

Recommended exercises: From the above sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.

Absorption and Emission Lab Report due (pp. 87 – 90)

Graded Homework due: 7.12, 7.14, 7.16, 7.62, 7.80 (two each), 7.84, 7.90 (if not, explain), 7.94, 7.102, 7.120

Presentation Detailed Outline (5 points), Outcomes and Assessment questions (3 points) due.

The detailed outline should also include the style that is planned (projected, or poster, or other, if approved) and a list of references in any clear format.

12/6 Laboratory: Acetic Acid Content of Vinegar (Group Design of Procedure)

Your group's procedure (which is the Prelab, one per group; 6 points) must be approved before you start work. Report (one from each student) due 12/12. Lab notebooks will be due for grading on 12/12.

12/7 Outcomes:

1. Group Sheet 3
2. Hour exam! Covers above outcomes and pertinent topics from lab.
3. Overview and logistics for Atmospheric Chemistry presentations.

12/12, 12/14: Atmospheric Chemistry Presentations (See information on next page.)

Percent contribution estimate forms due after your group's presentation.
A 25% deduction will be made if you do not participate in assessment of all presentations on both dates.
Lab notebooks due for grading 12/12.
Group sheet 4 on 12/14 (see below).
Acetic Acid lab report due 12/12, individually from each student.

General Information about Atmospheric Chemistry Presentations

General Format:

EITHER: Projected presentation (20-25 min)
OR: Poster Presentation (discussed by members during a "round-robin" session)

General Content

Required:

Brief information on the gaseous molecule (or molecules)
Normal atmospheric chemistry
Content on subtopic of title

Flexible content depending on the topic, subtopic and your interest

Industrial / commercial applications
Environmental Chemistry

General Expectations

State outcomes
Present the essential content at a level of your audience

Some content from the text (use the Index)
Content from several other references expected

Documentation of references in <u>any</u> format

Topics and subtopics

Oxygen and Ozone / The ozone layer
Noble gases / Radon exposure
Methane /Global warming
Carbon dioxide / Global warming
Carbon dioxide / Ocean acidification
Hydrogen / Fuel cells and the Hydrogen economy
Sulfur oxides / "SO_x" pollution and acid rain
Nitrogen and compounds / "NO_x" air pollution

Assessment

Rough outline, one per group (2 points); due 11/28. Shows general topics with minimal detail.

Detailed outline, one per group (5 points); due 12/5. Shows enough detail that any group member could use it to give an acceptable presentation in the absence of another.

<u>Includes list of references in any clear format</u>.
Statement of format (Projected or Poster)

Learning Outcomes and two questions (3 points) due 12/5.

Outcomes: a short statement of what you want the class to learn.
Two questions submitted by group for the class to answer.

Presentation

Presentation content (evaluated by instructor, 15 points)
Presentation effectiveness (evaluated by peers, 15 points)
Group contribution assessment (what % did each member contribute?)

Adjusts the above score up or down for each individual

The above total 40 points. A 25% deduction will be made if you do not participate in assessment of all presentations.

Answers to group-authored questions (**Group Sheet 4**: 8 points, due in class 12/14)