Chem 30A: Exam 2 Topics to Review (Tro Chpts 7-10, 16.2-16.3)

Chpt 7. Chemical Reactions and Chpt 16.2-16.3. Oxidation and Reduction

1. Balance reaction equations.
2. Identify a reaction as precipitation, acid-base (neutralization), or redox reactions, given equation.
3. Precipitation Reactions
    a) Predict solubility of ionic compounds in water, given solubility rules table (See Solubility Rules and Oxidation Number Assignment Rules Handout).
    b) Write balanced molecular, total ionic, and net ionic equations for precipitation reactions, given two aqueous solutions that are mixed.
4. Acid-Base (Neutralization) Reactions
    a) Know the definitions of acids and bases: Acids are substances that produce H^+ ions (protons) in water, or proton donors. Bases are substances that produce OH^- ions (hydroxide) in water, or proton acceptors.
    b) Recognize that acid + strong base (metal hydroxide) form water + salt.
    c) Recognize that acid + carbonate base form water and CO_2 gas.
    d) Write balanced molecular, total ionic, and net ionic equations for acid-base reactions.
5. Redox Reactions
    a) Assign oxidation numbers (oxidation states) to atoms in elements, polyatomic ions, and compounds (See Solubility Rules and Oxidation Number Assignment Rules Handout).
    b) Identify the oxidized element, reduced element, oxidizing agent, and reducing agent, given equation of a redox reaction.
6. Classify chemical reactions as combination (synthesis), decomposition single-displacement, or double displacement, given reaction equations.

Memorize

- Common strong acids, strong bases, weak acids, and weak base.
- Rules for assigning oxidation numbers (excluding exceptions).

Chpt 8. Quantities in Chemical Reactions

1. Stoichiometry Problems: Mole-to-Mole, Mole-to-Mass, and Mass-to-Mass Conversions
    a) Recognize that the coefficients in a chemical equation tell the relative moles of the substances in the reaction.
    b) Use the mole-to-mole ratio between two substances in the reaction to convert the amount (mole or mass) of one substance to amount (mole or mass) of another substance in the reaction.
2. Stoichiometry Problems: Limiting Reactant Problems
    a) Given the amounts of both reactants in a reaction, find the theoretical yield (max amount of product possible). (Recognize that you must first determine the limiting reactant to find the theoretical yield. The limiting reactant is the reactant whose amount gives the smaller amount of product.)
3. Stoichiometry Problems: % Yield Problems
    a) % yield = (mass of actual yield/mass of theoretical yield) x 100
    b) You will need to calculate the theoretical yield first before you can determine % yield.

Chpt 9. Electrons in Atoms and the Periodic Table

1. Electromagnetic spectrum
    a) Be familiar with the electromagnetic spectrum.
    b) Know the inverse relationship between wavelength λ and frequency ν according to $c = \lambda\nu$.
    c) Know that energy is directly proportional to the frequency (higher frequency → higher energy)
2. Quantum mechanical model of atoms
    a) Know why discrete line spectra (rather than continuous spectra) are seen for atoms (quantized energy levels).
    b) Know definition of orbit: probability map that shows the probability of finding an electron in a certain space around the nucleus.
    c) Understand definitions of shells, subshells, orbitals, and electrons, and how they are organized and related.
    d) Understand that bigger the shell number → higher the energy and bigger the size of shell.
    e) Be familiar with general shapes of s, p, and d orbitals.
    f) Know the number of orbitals in each type of subshell: s-1, p-3, d-5.
    g) Know that a maximum of two electrons can be in each orbital.
3. Electron configurations and orbital diagrams:
    a) Know how to write both full and condensed electron configurations for atoms of main group elements and some transition metal elements, using the periodic table as a guide.
    b) Know how to draw orbital diagrams for atoms.
    c) State the number of valence electrons (electrons involved in bonding, electrons in highest shell number for main group elements). For main group elements, group number = # of valence electrons.
    d) From orbital diagram, determine number of unpaired electrons.
4. Know periodic table trends and predict relative ordering of elements in:
    a) Ionization energy
    b) Metallic character
    c) Atomic size (radii)

Memorize
$c = \lambda\nu$

Chpt 10. Chemical Bonding

1. Know the difference between molecular (covalent) and ionic compounds, and covalent and ionic bonds.
2. Understand octet rule (duet rule for hydrogen).
3. Draw Lewis symbols (electron dot diagrams) for atoms.
4. Draw Lewis structures for ionic compounds.
5. Draw Lewis structures for molecular compounds, given chemical formula.
6. Predict molecular geometry (shape) of a molecule using the VSEPR model, given chemical formula. (Know the difference between electron domain geometry and molecular geometry. See Predicting Molecular Geometry Handout.)
7. Know definition of electronegativity, and recognize electronegativity trends on the periodic table.

a) Electronegativity increases going across the period to the right; it decreases going down the column.
b) Of the elements, N, O, F, and Cl have the highest electronegativity values.
c) H and C have electronegativity values that are similar to each other, and that are significantly lower than those of N, O, F, or Cl. Thus C-H bonds are nonpolar; C or H bonded to N, O, F, or Cl is polar.

8. Determine bond polarity, using electronegativity values of atoms in the bond. (Specific electronegativity values for atoms may be given, or must be estimated from positions on periodic table.)
9. Determine whether a molecule is polar or nonpolar (Remember: Molecular polarity depends on both bond polarity and molecular geometry).

Memorize
Molecular geometries and bond angles, according to the VSEPR model.