Study Guide for Exam #4, Ch. 9,11,13

Chem1A, General Chemistry I

MEMORIZE

- VSEPR Geometries (Electronic and Molecular) – handout
- nonpolar (perfect) covalent: 0.0-0.4, polar covalent: 0.5-2.0, ionic: 2.1+ (to tell polarity)
- Hybridization (sp, sp^2, sp^3, sp^3d, sp^3d^2)
- Molecular Orbital Diagrams up to period 2 diatomics (order of MOs, types of overlap)
- Intermolecular Forces (dispersion, dipole-dipole, ion-dipole, hydrogen bonding)
- $q = mC_s\Delta T$; $q = \Delta H \cdot \text{mols}$
- mass percent = $\frac{\text{g solute}}{\text{total g solution}} \times 100\%$
- parts per million (ppm) = $\frac{\text{g solute}}{\text{total g solution}} \times 10^6$
- mole fraction (X) = $\frac{\text{mols solute}}{\text{total mols mixture}}$
- Molarity (M) = $\frac{\text{mols solute}}{\text{L solution}}$
- Molality (m) = $\frac{\text{mols solute}}{\text{kg solvent}}$
- Raoult's Law: $P_A = X_A * P°_A$
- Boiling Point Elevation: $\Delta T_b = K_b m$; Freezing Point Depression: $\Delta T_f = K_f m$

Chapter 9: Molecular Geometries and Bonding Theories

I. VSEPR Theory (9.1-9.3): Know how to predict the electronic and molecular geometries for molecules given the Lewis structure. Know how to determine whether the molecule is overall polar or nonpolar given electronegativity values.
Examples: 9.23-26, 41-44

II. Hybridization (9.4-9.6): Know how to determine the hybridization around the central atom in a molecule from the electronic geometry. Know how to determine the type of orbital overlap (σ or π) composing the molecule's bonds.
Examples: 9.51-52, 56-62, 68, 90, 99

III. Molecular Orbital Theory (9.7-9.8): Know how to write and fill molecular orbital diagrams for any homonuclear diatomics up through period 2. Given the molecular orbital diagram structure, know how to fill the molecular orbitals for heteronuclear diatomics. Know how to calculate the bond order and determine whether a molecule is paramagnetic or diamagnetic.
Examples: 9.71-72, 77-78, 81-82

Chapter 11: Intermolecular Forces, Liquids, and Solids

I. Intermolecular Forces (11.2): Know how to determine the intermolecular forces present in a molecule given the structure and how it will relate to boiling and melting points and vapor pressure.
Examples: 11.17, 21-24, 26-28, 50-52

II. Heating Curves, Phase Changes (11.4-6): Know how to use the heating curves and ΔH values for phase changes (vaporization, fusion) to calculate the heat/temperature change for a substance. Know how to use heat associated with phase changes in system versus surroundings questions. Know how to analyze a phase diagram to predict the phase or phase changes occurring at particular pressures and temperatures.
Examples: 11.43-47, 61-62

Chapter 13: Properties of Solutions

I. Solubility (13.1-13.3): Know how to use a molecule's polarity to determine solubility in solvents. Know how to use Henry's Law to calculate the solubility of a gas in solution.
Examples: 13.27-34, 37-38, 93

II. Concentration (13.4): Know how to calculate a solution's concentration in mass percent, ppm, mole fraction, molarity, or molality, or to use these concentrations as conversion factors in dimensional analysis problems.
Examples: 13.39-52, 55-58, 96-98

III. Raoult's Law (13.5): Know how to use Raoult's Law and Dalton's Law in combination to calculate the vapor pressure of volatile liquids over a solution or the mole fraction composition of the vapor over a mixture.
Examples: 13.63, 65-68, 99-100

IV. Freezing Point and Boiling Point (13.5): Know how to use the freezing point depression and boiling point elevation equations to calculate the changes in freezing point/boiling point for mixtures. Know how to use the equations to solve for the molar mass of an unknown.
Examples: 13.71-76, 79-82, 103