Study Guide for Final Exam (Ch. 1-14)

Chem20, Elementary Chemistry

MEMORIZE

- The Metric prefixes (handout)
- 1 in. = 2.54 cm ; 1 mL = 1 cm^3
- density= $\frac{\text{mass}}{\text{volume}}$
- $q = mC_s\Delta T$
- Mass Number (A) = # of protons + # of neutrons
- Atomic Mass = (natural abundance of isotope A)(mass of isotope A) + (natural abundance of isotope B)(mass of isotope B) + (natural abundance of isotope C)(mass of isotope C) +…
- Charges on Group 1A/2A/6A/7A elements
- Nomenclature (handout)
- 1 mole = 6.022×10^{23} units
- mass percent = $\frac{\text{mass of sample}}{\text{total mass of mixture}} \times 100\%$
- Acid-Base Neutralization: acid + base → water + salt
- Combustion Reaction: (C+H) or (C+H+O) + oxygen → carbon dioxide + water
- percent yield = $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$
- Speed of Light = wavelength x frequency ($c = \lambda \times \nu$)
- Energy of Radiation = Planck's constant x frequency ($E = h \times \nu$)
- Electronic Configuration: 1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s 4f 5d 6p 7s 5f 6d 7p
- VSEPR Geometries; Types of Bonds (handout)
- 1 atm = 760 mmHg = 760 torr
- Gas Laws (Boyle's $P_1V_1 = P_2V_2$, Charles' $V_1/T_1 = V_2/T_2$, Avogadro's $V_1/n_1 = V_2/n_2$, Ideal PV = nRT, Dalton's $P_T = P_1 + P_2 + P_3...$ OR $P_1 = X_1 \cdot P_T$)
- Universal Gas Constant (R): 0.08206 $L \cdot atm \cdot mol^{-1} \cdot K^{-1}$
- mole fraction (X) = $\frac{\text{mols of A}}{\text{total mols of mixture}}$
- mass percent = $\frac{\text{mass solute}}{\text{mass solution}} \times 100\%$
- molarity (M) = $\frac{\text{mols solute}}{\text{L solution}}$
- molality (m)= $\frac{\text{mols solute}}{\text{kg solvent}}$
- $M_1V_1 = M_2V_2$
- $\Delta T_f = m \times K_f$

- $\Delta T_b = m \times K_b$
- $pH + pOH = 14.00$
- $K_w = [H_3O+][OH-] = 1.00 \times 10^{-14}$

Chapter 2: Measurement and Problem Solving

I. Scientific Notation, Significant Figures (2.1-4): Know how to convert numbers in and out of correct scientific notation. Know how to use correct significant figures in multistep calculations.

II. Measurement, Dimensional Analysis (2.5-8): Know the ten metrix prefixes and how to convert between them. Know how to use the process of dimensional analysis to solve conversion and/or stoichiometry problems.

Chapter 3: Matter and Energy

I. Classifying Matter (3.4): Know how to classify matter as a pure element, pure compound, homogeneous mixture, or heterogeneous mixture.

II. Heat Capacity and Temperature Changes (3.11-3.12): Know how to calculate heat, mass, specific heat capacity, or change in temperature when given the other three.

Chapter 4: Atoms and Elements

I. The Periodic Table, Atomic Notation (4.5-4.8): Given an element, be able to determine its group and period, whether it is a metal, non-metal, or metalloid, and whether it is a main group element or transition metal. Know how to write correct atomic notation for any element or its ions and/or isotopes. Be able to use an element's atomic notation to determine the number of protons, electrons, and neutrons present. Be able to calculate the atomic number (Z) and mass number (A).

II. Atomic Mass (4.9): Know how to use the natural abundances and masses of the isotopes of an element to calculate the atomic mass, or to use the atomic mass to solve for any other variable in the equation.

Chapter 5: Molecules and Compounds

I. Nomenclature (5.5-5.9): Know how to name any ionic type I, ionic type II, molecular, or acid compound, including polyatomic ions. Be equally comfortable going from chemical formula to word name or word name to chemical formula, including balancing charges for ionic formulas.

Chapter 6: Chemical Composition

I. Conversions for Elements and Compounds (6.3-6.5): Know how to convert between grams $\leftrightarrow$ mols $\leftrightarrow$ atoms for any element or compound, using Avogadro's number and the molecular weight.

II. Mass Percent (6.6-6.7): Know how to calculate the mass percent of a compound in a mixture.

III. Empirical and Molecular Formulas (6.8-6.9): Know how to calculate the empirical formula for a compound from masses resulting from decomposition or mass percent. Know how to convert empirical formulas into molecular formulas using the molecular weight.

Chapter 7: Chemical Reactions

I. Balancing Chemical Equations (7.3-7.4): Know how to balance any chemical equation. Know how to classify reactions by either product or movement of atoms.

II. Precipitation Reactions (7.6-7.7): Know how to use solubility guidelines to predict whether a precipitation reaction will occur. Know how to write the molecular, total ionic, and net ionic equations for any double displacement reaction.

III. Neutralizations and Combustions (7.8-7.9): Know how to identify and predict the products for an acid-base neutralization or combustion reaction.

Chapter 8: Quantities in Chemical Reactions

I. Stoichiometry, Limiting Reactant and Percent Yield (8.3-8.6): Know how to use balanced chemical reactions to convert between masses of reactant to product, product to reactant, or reactant to reactant.Know how to identify the limiting reactant when given finite amounts of two or more reactants. Know how to calculate the theoretical yield of product. Be able to calculate the actual, theoretical, or percent yield when given the other two.

II. Enthalpy (8.7): Know how to use the sign of the enthalpy of a reaction to classify it as endothermic or exothermic. Know how to use ΔH_{rxn} to calculate the heat gained or released in a chemical reaction.

Chapter 9: Electrons in Atoms and the Periodic Table

I. Nature of Light (9.2-9.3): Know how to convert between energy, wavelength, and frequency for any electromagnetic radiation.

II. Electron Configuration (9.6-9.7): Know how to write the electronic configuration for any element on the periodic table. Know how to distinguish between core and valence electrons.

Chapter 10: Chemical Bonding

I. Lewis Structures (10.3-10.6): Know how to write the appropriate Lewis structures for both ionic and molecular compounds, including possible exceptions to the Duet or Octet Rule. Also know when and how to include possible resonance structures.

II. VSEPR Theory, Polarity (10.7-8): Know how to determine the electronic and molecular geometry for any molecule form the Lewis structure. Know how to identify perfect covalent, polar covalent, or ionic bonds when given electronegativity values. Know how to determine if a molecule is polar or nonpolar from the VSEPR geometries.

Chapter 11: Gases

I. Pressure (11.3): Know how to convert in between units of pressure.

II. The Gas Laws (11.4-11.5, 11.7-11.8, 11.10): Know how to use Boyle's Law, Charles' Law, Avogadro's Law, and the Ideal Gas law in gas problems, including stoichiometry.

III. Dalton's Law of Partial Pressures (11.9): Know how to use both versions of Dalton's Law of Partial Pressures to calculate partial pressure, total pressure, or mole fraction for a mixture of gases. Know how to account for the vapor pressure due to water when reaction gases are collected over water.

Chapter 12: Liquids, Solids, and Intermolecular Forces

I. Phase Changes (12.4-12.5): Know how to use the heat of fusion or heat of vaporization to calculate the energy needed to change phases of matter. Know how to sum the total heat required when changing the temperature of a sample over a wide range.

II. Intermolecular forces (12.6): Given the structure of a compound, know how to determine what intermolecular forces will be present and how they will affect the rate of vaporization and boiling point, or the rate of melting and melting point, viscosity, or surface tension.

Chapter 13: Solutions

I. Concentration (13.5-13.6, 13.8): Know how to calculate the concentration of any solution in units of mass percent or molarity. Or, given the concentration of a solution, be able to use it in stoichiometry problems.

II. Dilutions (13.7): Know how to calculate dilution values of concentration or volume using $M_1V_1 = M_2V_2$.

III. Colligative Properties (13.9): Know how to use the freezing point depression and boiling point elevation equations in calculations.

Chapter 14: Acids and Bases

I. Acids and Bases (14.5): Know how to use acid-base neutralization and solution data to calculate stoichiometry in reactions.

II. Amphoteric Water (14.8): Know how to use the ion product constant expression for water to calculate $[H_3O^+]$ or $[OH^-]$. Know how to determine whether a solution is acidic or basic from either.

III. pH and pOH Scales (14.9): Know how to use pH, pOH, $[H_3O^+]$, and $[OH^-]$ to convert between any of the four.