CHM 130 Final Exam Study Guide

Chapter 2
- Length, mass, volume
- Significant figures (or Significant Digits)
  - Rounding
  - In measurements, reflect uncertainty
  - For adding, subtracting: Count decimal places
  - When multiplying/dividing: Count sig figs
- Scientific notation
- Problem solving by unit analysis method
  - Solve problems using unit factors
- Percentages
  - Given amount, calculate percentage
  - Be able to use percentage given in calculations

Chapter 3
- Metric System
  - Know prefixes and values from milli to kilo
  - Perform metric-metric conversions
  - Given conversions, carry out metric-English conversions
  - Know $1 \text{ cm}^3 \equiv 1 \text{ mL}$ (exact)
- Volume by calculation: $V = l \times w \times t$
- Volume by displacement
- Density = $\dfrac{\text{mass}}{\text{volume}}$
  - Solve for density, mass or volume given two of the variables.
- Temperature: Convert °C to/from Kelvin
  - Know melting & boiling point of H_2O in °C and °F

Chapter 4
- Physical states of matter: solid, liquid, gas
  - Recognize how atoms/molecules exist and move at molecular level for each state (Section 4.9)
- Know terms for changes of state (p.74 Fig. 4.1)
- Identify matter as element, compound, mixture
- Given molecular-level images, determine which represent elements/compounds/mixtures and which are solids/liquids/gases
- Know names and symbols of most commonly used elements (Table 4.3 p 79)
- Classify physical & chemical properties & changes
- Know definitions for kinetic and potential energy

Chapter 5
- Subatomic particles
  - Proton: +1 charge, inside nucleus
  - Electron: -1 charge, outside nucleus
  - Neutron: no charge, inside nucleus
- Atomic notation:
  mass number = $\substack{A \\ Z}$E = element symbol
  atomic number =
  - Be able to give atomic notation for any element given element name and mass number
  - Identify unknown given two of following: mass number, atomic number, element symbol
- Recognize an element can be identified by its name, sumbol, or atomic number
- Determine number of protons, neutrons, electrons given element and mass number or atomic notation
- Recognize isotopes have same atomic number but differing numbers of neutrons
- Be able to write electron configuration for atoms of elements #1-20 using full notation and core notation (Noble gas abbreviation)

Chapter 6
- Periodic Table
  - column = called "group" or "family"
  - row = called "period" or "series"
  - Representative Elements
    - Recognize columns for alkali-metals, alkaline earth metals, halogens, noble gases
  - Transition Metals or Elements
- Know Periodic Trends
  - For atomic radius, metallic character, ionization energy, valence electrons
- valence electrons: outermost electrons responsible for chemical bonds and reactions
  - For Representative elements, group number gives number of valence electrons
- Give electron dot formula for any atom or ion
- Determine ionic charges for Rep. elements
- isoelectronic: has same number of electrons as
- Be able to write electron configuration for ions using full notation and core notation (Noble gas abbreviation)

Chapter 7
- Naming cations
  - Group IA, IIA, IIIA, Ag, Zn, Cd: element name + ion
  - All other metals use Stock system: element name (charge in Roman numerals) + ion
- Naming anions: nonmetal stem name + "ide" + ion
- Be able to use names and formulas for polyatomic ions included on CHM130 Periodic Table
- Distinguish between ionic and molecular compounds
- Be able to name ionic compounds given the formula, or given name, determine the formula
- Be able to name binary molecular compounds given formula, or given name, determine the formula
- Be able to name acids given the formula, or given name, determine the formula

Chapter 8
- Write chemical equations, including physical states—(s), (l), (g), (aq)—of reactants, products
- Balance chemical equations
  - Distinguish between reactants and products
- Identify chemical reactions as one of the following: combination, decomposition, single-replacement, double-replacement/precipitation, acid-base neutralization, combustion
- Given reactants, predict products for following:
  - Single-replacement: Use Activity Series, list of Active metals, and Solubility Rules
  - Neutralization: Acid + Base $\rightarrow$ H_2O + salt
  - Combustion: Products always $H_2O(g)$ and $CO_2(g)$
- **Activity Series, list of Active metals, and Solubility Rules will be provided**

Chapter 9
- Avogadro's Number: 6.02×10^{23} anything = 1 mole
- Determine Molar Mass for atoms and compounds
- Recognize Standard Temperature & Pressure (STP) is defined as T=0°C and P=1 atm
- Molar Volume: 1 mole of gas occupies 22.4L at STP
- Mole calculations
  - Use Avogadro's number, molar mass, and/or molar volume to solve for number of moles, number of atoms/molecules, mass, or volume
- Calculate the percent composition by mass of an element in a compound given the formula of the compound

Chapter 10
- Recognize chemical equations given mole-to-mole ratio of reactants and products to each other.
- Solve various types of Stoichiometry Problems:
  - Mass-mass or mass-volume (at STP)
- Limiting Reactant produces smallest amount of product, gets completely used up
  - Determines theoretical yield that can be made
  - Given moles of reactants present, solve Limiting Reactant problems to get amount of product formed and identify the limiting reactant and reactant(s) in excess
- Percent Yield= $\dfrac{\text{Actual yield}}{\text{Theoretical yield}} \times 100\%$

Chapter 11
- Recognize properties of gases
- Know 1 atm $\equiv$ 760 torr $\equiv$ 760 mmHg
- How changes in volume, temperature, and number of moles of gas affect gas pressure
- Solve for problems using Combined Gas Law and variations on it
- Know how the motion of gas particles changes with temperature

Chapter 12
- Ionic bond: electrostatic attraction between ions
- Covalent bond: sharing of electrons between nonmetal atoms
- Ionic radii (size): cation < neutral atom < anion
- Distinguish between formula unit and molecule
- Recognize the trends for Electronegativity
- Use Electronegativity differences to identify
  - a bond as polar covalent or nonpolar covalent
  - a diatomic molecule as polar or nonpolar
- Draw Electron Dot Formulas of Molecules and Polyatomic Ions given formula and central atom
  - Know the octet rule
  - Know when double and triple bonds are needed for all atoms to get an octet
- Determine a molecule's molecular geometry (shape) and bond angles using its Electron Dot Formula and the Table of Molecular Shapes and Bond Angles
- Given the shape of a molecule, determine if it is polar or nonpolar

Chapter 13

- Recognize properties of liquids and solids
- Intermolecular Forces
  - Identify the type of intermolecular force for a molecule as dispersion/London forces, dipole-dipole forces, or hydrogen bonding
  - Know how intermolecular forces affect physical properties, such as vapor pressure, boiling point, molar heat of vaporization, viscosity, and surface tension
  - Relate physical properties to intermolecular forces (e.g. Recognize why H_2O has a higher boiling point than CH_4 or H_2S in terms of intermolecular forces.)
- Given a bond or intermolecular force, identify it a polar covalent, nonpolar covalent, ionic, metallic, dispersion, dipole-dipole forces, or hydrogen bonding
- Recognize properties of water: density of ice versus liquid, bond angle, melting & boiling points
- Given formula or description, identify a solid as ionic, molecular, or metallic

Chapter 14

- solution: a solute dissolved in solvent
- Know how temperature and pressure affect solubility of gases in solution
- Know effect of temperature on solubility of solid in solution
- Use "Like dissolves like" Rule and Solubility Rules to predict what substances are soluble in/miscible with water or other solvents
- Recognize what occurs at the molecular level when a solute dissolves in water
- Recognize what can be done to increase the Rate of Dissolving: heating solution, stirring solution, grinding solute into smaller particles
- Mass perc. conc. $(M/M\%) = \dfrac{\text{mass of solute}}{\text{mass of solution}} \times 100\%$

  $\text{Molarity} = \dfrac{\text{moles of solute}}{\text{liters (L) of solution}}$
- Solve problems involving molarity and mass percent concentration using unit analysis

Chapter 15

- pH scale: Given the pH of a solution, determine if it's, strong acidic, weakly acidic, neutral strongly basic, or weakly basic
- Know definitions for acid-base titration, indicator, endpoint, and buffer
- Know Arrhenius and Bronsted-Lowry definitions for acids and bases
- Given a chemical equation, classify each reactant as an Arrhenius acid or base or Bronsted-Lowry acid or base
- Know definitions for strong, weak, and nonelectrolytes, that electrolytes contain ions in solution to conduct electricity
- Recognize that some compounds may dissolve in water but are still nonelectrolytes (e.g. sugar)
- Given an ionic compound, use the Solubility Rules to classify it as a strong or weak electrolyte

Chapter 16

- Know definitions for activation energy (E_{act}), heat of reaction (ΔH), catalyst
- Endothermic and Exothermic Reactions
  - Know energy of reactants and products relative to each other, if energy released or absorbed
- At **equilibrium**, rate of forward and reverse reactions are equal, and concentrations of reactants and products are constant

Chapter 17

- Determine oxidation number for metals and nonmetals in the free state and for monoatomic ions in binary compounds
- Given an oxidation-reduction reaction, determine what is oxidized (reducing agent) and what is reduced (oxidizing agent)

Chapter 18

- Know atomic notation for alpha, beta, gamma emissions, proton, neutron, and electron
- Write and balance nuclear equations
- Know term: parent and daughter nuclide
- Solve problems involving half-life (Section 18.4)

**Solve problems using the CHM130 Periodic Table
and the Table of Molecular Shapes and Bond Angles.**