Review for the Summer Final

STUDY LIST

Chapter 1 – Matter and Measurement

- ☐ Define solid, liquid, and gas
- ☐ Know the Kinetic Molecular Theory and how particles behave in different states of matter
- ☐ Know qualitative, quantitative and inference observations
- ☐ Know the difference between homogeneous and heterogeneous mixtures
- ☐ Know the difference between elements and atoms
- ☐ Know the difference between ions and molecules
- ☐ Know how to distinguish physical properties
- ☐ Know the density formula and how to use it to calculate density, mass and volume
- ☐ Know the difference between Celsius and Kelvin; convert from one to the other
- ☐ Know how temperature affects physical properties such as density
- ☐ Know the difference between intensive and extensive properties
- ☐ Know your safety rules
- ☐ Know the difference between physical and chemical changes
- ☐ Know the SI units
- ☐ Know all the prefixes and their values
- ☐ Know how to do dimensional analysis
- ☐ Know how to do scientific notation
- ☐ Know the difference between precision and accuracy, and experimental error
- ☐ Know significant figures of measurements and in calculations
- ☐ Know how to do percents

Chapter 2 – Atoms and Elements

- ☐ Know the scientists, their theories, and what they did.
- ☐ Define law of conservation of matter, law of constant composition (definite proportions)
- ☐ Know the characteristics of protons, electrons, and neutrons.
- ☐ Know alpha (a), beta (ß), and gamma (?) rays.
- ☐ Review the cathode ray experiment (by Thomson), the oil drop experiment (by Millikan), and the gold foil experiment (by Rutherford).
- ☐ Know about how J.J. Thompson obtained the charge / mass ratio
- ☐ Know the structure of the atom.
- ☐ Know about the behavior of neutrons, protons, and canal rays
- ☐ Know the principle behind Rutherford's gold foil experiment and the discovery of the nucleus
- ☐ Define atomic number, atomic mass, atomic mass unit, and mass number.
- ☐ Be able to calculate the number of electrons, protons, and neutrons present in an atom given its mass number.
- ☐ Know isotopes and how to write them
- ☐ Know most elements have at least two stable (non-radioactive) isotopes
- ☐ Know how to find the number of protons and neutrons in an isotope
- ☐ Know the 3 isotopes of hydrogen
- ☐ Know how to calculate the average atomic mass from Isotopic Abundances (see ex 2.4)
- ☐ Know how to calculate Isotopic Abundances (see ex. 2.5)
- ☐ Know what a mass spectrometer is and what it measures
- ☐ Know the difference between a group (family) and a period on the periodic table
- ☐ Know where metals, non-metals, and metalloids are on the periodic table; know the properties of each
- ☐ Define the law of chemical periodicity
- ☐ Know who Mendeleev and Moseley are and what they did
- ☐ Define the Law of Chemical Periodicity
- ☐ Know the three elements that Mendeleev predicted
- ☐ Know the locations of Group 1A (Alkali Metals), Group 2A (Alkaline Earth Metals), Group 3A-Group 6A, Group 7A (Halogens) and Group 8A (Noble Gases/inert gases)
- ☐ Know location of Group B's (transition elements)
- ☐ Know location of Lanthanides and Actinides
- ☐ Be able to define an allotrope and what three allotropes are formed for Carbon
- ☐ Know the 7 diatomic elements

Chapter 3 – Molecules and Compounds

- ☐ Know the terms chemical formula, empirical formula, molecular formula, and structural formula
- ☐ Be able to write a molecular formula, a 3D molecular model on paper, and a molecular structure
- ☐ Know your ions (monatomic ions and polyatomic ions)
- ☐ Know how to name ions in the traditional (-ic, -ous) and Stock system (II, III)
- ☐ Know the terms cations and anions
- ☐ Write and name ionic compounds
- ☐ Write and name nonmetal (molecular) compounds (mono-, di-, tri-, etc.)
- ☐ Know common names of binary compounds
- ☐ Know definition of mole and Avogadro's Number (6.02×10^{23} molecules in one mole)
- ☐ Calculate the molar mass of a substance
- ☐ Know how to convert from moles to mass(g), molecules, volume(L) using conversion factor
- ☐ Know how to calculate % composition
- ☐ Know how to calculate empirical and molecular formulas from mass percent
- ☐ Define hydrated compounds
- ☐ Know how to determine the formula of a hydrated compound from experimental data

Chapter 4 – Chemical Equations and Stoichiometry

- ☐ Know that Antoine Lavoisier introduced the law of conservation of matter.
- ☐ Define combustion
- ☐ Know what products and reactants are
- ☐ Be able to write combustion equations
- ☐ Know when to label the substances solid (s) , gas (g), liquid (l), or aqueous (aq)
- ☐ Know how to balance equations
- ☐ Be able to find the molecular and empirical formulas and differentiate between the two
- ☐ Understand that subscripts in the formulas of reactants and products cannot be changed to balance equations.
- ☐ Know how to convert mass and moles (i.e. 1 mol = 22.4 L = 6.02×10^{23})
- ☐ Know Molar Mass (grams / mol or $g \cdot mol^{-1}$)
- ☐ Know how to use the stoichiometric factor (♥ of the problem) (i.e. 1 mol CO_2 = 1 mol C)
- ☐ Define limiting reactant and excess reactant
- ☐ Know how to determine the limiting reactant and excess reactant
- ☐ Solve problems involving Limiting Reactants
- ☐ Given the actual yield, know how to find the theoretical yield and the percent yield
- ☐ Know how to find the mass of each element of a compound
- ☐ Know how to find empirical and molecular formula using stoichiometry

Chapter 5 – Reactions in Aqueous Solution

Properties of Aqueous Solutions

- ☐ Define **solute**, **solvent**, and **solution**. Give examples
- ☐ Define **electrodes**. Give **operational** and **theoretical** definitions of **electrolytes**
- ☐ Know that soluble ionic compounds and strong acids are **strong electrolytes**. Ionic compounds of low solubility [e.g. $Mg(OH)_2$] and weak acids/bases are **weak electrolytes**.
- ☐ Know that molecular compounds (except acids) are **non-electrolytes**
- ☐ Know that **alcohols** (e.g. CH_3OH)are **not ionic hydroxides** (and are not bases). Bases are usually **metallic** hydroxides
- ☐ Know the **solubility rules**. State whether an ionic compound is soluble in water

Precipitation Reactions

- ☐ Know that ppt reactions are **double replacement** reactions that produce an insoluble product
- ☐ Given two ionic compounds in solution, correctly **determine the products**. (Know your ions)
- ☐ Determine which product(s) is/are **precipitates**. **Use (aq) and (s)** symbols
- ☐ Correctly write the **ions** in a soluble ionic compound. [e.g. $CaCl_2(aq)$ becomes $Ca^{2+} + 2Cl^-$]
- ☐ Identify **spectator ions**
- ☐ Write **molecular, detailed ionic, and net ionic** equations for a ppt reaction

Acids and Bases

- ☐ Give **operational** (cabbage juice) and **theoretical** definitions of acids and bases.
- ☐ Know that acids increase the **H^+ ion** concentration in an aqueous solution. (Theoretical definition)
- ☐ **Memorize** the 8 strong acids.

- ☐ Know that acids are **molecular compounds** that **form ions** when in aqueous solution.
- ☐ **Name acids** according to their anion.
  [**ide** → hydro__ic acid; **ate** → __ic acid;
  ite → __ous acid;
  sulfur: add "ur"; phosphorus: add "or"]
- ☐ Know that bases increase the **OH^- ion** concentration in an aqueous solution. (Theoretical definition)
- ☐ Memorize the eight **soluble hydroxides** (except NH_4OH) that are the **strong bases**.
- ☐ Understand that **ammonia(aq)**,
  $$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$
  forms a **weak basic** solution.
- ☐ Know that **acids react with bases** to form H_2O and a salt. (**Neutralization**)
- ☐ Write **equations** for acid-base reactions including **NH_3** (ex on page 199) as the base.
- ☐ Know that **strong acids** and **strong bases** are **written as ions** in the ionic equations.

Gas Forming Reactions

- ☐ Recognize the six products that turn into gases. Memorize the gases formed.

Organizing Reactions in Aqueous Solution

- ☐ Know the **three examples** of double replacement reactions and each driving force: Precipitate reactions form an insoluble product. Acid-Base reactions form water (a very weak electrolyte therefore, a very stable product). Gas-forming reactions form a gas.
- ☐ Know that a **driving force** is something that keeps the new combinations of ions from reforming the old combinations of ions.
- ☐ **Oxidation-Reduction** is a fourth type of reaction driven by the **transfer of electrons**.

Oxidation-Reduction Reactions

$$Fe_2O_3 + 3\ CO \rightarrow 2\ Fe(s) + 3\ CO_2$$

- ☐ Know that an important type of reaction gets its **name** from atoms that combine with **oxygen**. During the refining of iron, carbon monoxide combines with oxygen (from the iron ore), $CO \rightarrow CO_2$ and is **oxidized**. Large masses of iron ore (Fe_2O_3) are **reduced** to a smaller amount of iron metal.
- ☐ Understand that since CO helps the iron ore to be **reduced**, CO is called the **reducing agent**. Since Fe_2O_3 causes the C to be **oxidized**, iron ore is called the **oxidizing agent**. Whatever is **oxidized** acts as the **reducing agent**. Whatever is **reduced** acts as the **oxidizing agent**.
- ☐ Mnemonics to help: **GROL**; **LeO** the lion says **GeR**; and **OIL RIG**
- ☐ Be able to **assign oxidation numbers** to any atom in any substance. Rules on page 207.
- ☐ Recognize **redox** reactions because **oxidation numbers change**. (# ↑ = oxidation / # ↓ = reduction), electrons are gained or lost.
- ☐ Know several common oxidizing agents and reducing agents and what they turn into.

Measuring Concentrations of Solutions

- ☐ Know the definition of **molarity**, **M**, as one way to communicate **concentration** of solute.
- ☐ Know that the symbol **[X]** means the concentration of X in moles/Liter ($mol \cdot L^{-1}$).
- ☐ Be able to determine the concentration of **ions** in an ionic compound.
  For example, in 0.25 M $AlCl_3$
  $[AlCl_3] = 0.25$ M
  $[Al^{3+}] = 0.25$ M $[Cl^-] = 0.75$ M
- ☐ Use the molarity formula to calculate **moles**, **mass**, **volume**, or **molarity** of a solution.
- ☐ Know that **Volume x Molarity = moles** of solute. **Dilution** problems use $V_iM_i = V_fM_f$.
- ☐ Describe how to **make a solution** correctly. Know what a **volumetric flask** is.

Stoichiometry of Reactions in Aqueous Solution

- ☐ Use **molarity** as a **conversion factor**.
- ☐ Know that **titration** is a technique called ***quantitative* chemical analysis** because you are measuring. It is also called **volumetric analysis** (because you are measuring volumes).
- ☐ Understand the terms **indicator**, **equivalence point**, **standardization**, and **primary standard**.
- ☐ Know common indicators such as **phenolphthalein** for titrations with strong bases.
- ☐ Understand that a titration can be done with an **acid-base reaction** or a **redox reaction**. In each case, some sort of indicator must be used to tell when equivalent amounts of reactants have been mixed.