BLOCK 03 TOPICS (CH 6-8)

The following is a list of important topics for students taking Chemistry 30A. Exams and assignments will focus on helping students achieve these goals. Additional topics may be added during the semester and not all will be tested for on any given exam or assignment. Students are encouraged to use this outline as a baseline for reviewing readings, preparing for exams, and determining if Chemistry 30A meets the student's personal objectives in studying chemistry.

CH 6b: MOLECULES

Bonding:

- ☐ Know that Lewis structures are simple predictors of how atoms form compounds and molecules.
- ☐ Know chemical bonds form because they are a more stable arrangement of atoms.
- ☐ Understand how ionic bond, covalent bond, and metallic bonding occur.
- ☐ Know that most nonmetal atoms prefer an octet of valence electrons (hydrogen requires only two).
- ☐ Atoms achieve an octet by forming covalent bonds, a pair of electrons, one from each of two atoms.
- ☐ Know why forming covalent bonds is exothermic.
- ☐ Atoms can also share two pairs of electrons (a double bond) or three pairs of electrons (triple bond).
- ☐ Identify and draw covalent compounds with single, double, and triple bonds.

Lewis Symbols & Structures:

- ☐ Know that valence electrons can be represented with dots around an element symbol.
- ☐ Identify and draw atoms with their valence electrons represented as dots (Lewis symbols).
- ☐ Define and know the octet rule.
- ☐ Draw Lewis structures of ions and ionic compounds containing main-group elements.
- ☐ Understand that the formation of an ionic compound from neutral atoms is exothermic.
- ☐ Understand the role of lattice energy he amount of energy released is largely due to lattice energy.
- ☐ Know that lattice energy decreases for larger ions and increases with increasing charge.
- ☐ Understand why and when ionic solids, solutions, and liquids are electrical conductors.

Electronegativity & Bond Dipoles:

- ☐ Know that a pair of electrons in a covalent bond may be shared unequally, a polar covalent bond.
- ☐ Define electronegativity and know its periodic trends.
- ☐ Know the electronegativity values of F, Li, all 2nd period elements between them, H, and Cs.
- ☐ Predict whether a bond is pure covalent bond, polar covalent bond or ionic by electronegativity.
- ☐ Define dipole moment and percent ionic character.
- ☐ Draw Lewis structures for molecular compounds and polyatomic ions.
- ☐ Define resonance structures and understand how Lewis structures represent hybrid structures.
- ☐ Define formal charge and understand how to calculate it for the atoms in a Lewis structure.

Exceptions to the Octet Rule:

- ☐ Draw Lewis structures for odd-electron species.
- ☐ Draw Lewis structures for molecules containing atoms with incomplete octets.
- ☐ Draw Lewis structures for molecules containing atoms with expanded octets.
- ☐ Understand why the second-period elements cannot have expanded octets.

Molecular Shape

- ☐ Describe the five optimal electronic structures that each result from 2, 3, 4, 5, and 6 electronic domains.
- ☐ Describe why atoms in a molecule form bonds of a fixed distance.
- ☐ Show the angles in each electronic structure.
- ☐ Within each domain, predict the possible molecular structures that result from different combinations of bonding and non-bonding electron pairs.
- ☐ For a given molecular formula, use Lewis dot structures to predict the electronic and molecular shape of a molecule.
- ☐ Given a Lewis structure predict the approximate bond angles in the structure, based on it's electronic shape.
- ☐ Draw bond dipoles on a molecular shape and determine if that shape is polar or non-polar.

CH 7: STOICHIOMETRY

Molar Mass:

- ☐ Explain how an AMU is defined.
- ☐ Given the natural abundance and mass of isotopes of an element, calculate the average atomic mass.
- ☐ Determine the atomic mass and molar mass of an atom of any element from a periodic table.
- ☐ Convert between a count of single atoms and mass in AMUs, using atomic mass.
- ☐ Convert between a count of mols of atoms and mass in grams, using molar mass.
- ☐ Show Avogadro's number is the relationship between an AMU (in grams) and a gram.
- ☐ Give Avogadro's number with 4 significant figures.
- ☐ Use Avogadro's number to convert between a count of particles as singles and in mols.

- ☐ Using atomic mass, molar mass, and Avogadro's number convert between quantities in grams, AMUs, singles, or mols.

Chemical Equations:

- ☐ Understand the symbols for reactants, products, yield, state, and reaction conditions used in a chemical equation.
- ☐ Translate a description of a chemical reaction into a chemical equation.
- ☐ Interpret a chemical equation to describe a chemical reaction.
- ☐ State the five steps to balancing a chemical equation.
- ☐ Demonstrate that a chemical equation is balanced.
- ☐ Balance a chemical equation.
- ☐ Distinguish between a chemical change and a physical change.
- ☐ Represent a chemical change with a chemical equation.
- ☐ Recognize single displacement, double displacement, combination, and decomposition reactions.
- ☐ Recognize single combustion, gas evolution, and precipitation reactions.
- ☐ Balance a chemical equation.

Stoichiometry Calculations:

- ☐ Identify a mol ratio between two components in a chemical reaction from a balanced equation.
- ☐ Use a mol ratio to determine the quantity in moles of one component from the moles of another.
- ☐ Determine the mass of one component of a chemical reaction from the mass of another.
- ☐ Identify the limiting reactant and excess reactants in a given reaction.
- ☐ Calculate the theoretical yield of a reaction, using the concept of limiting reactants.
- ☐ Calculate the percent yield of a reaction, from the theoretical and experimental yield.
- ☐ Determine the quantities produced or consumed in a limiting reagent problem.

CH 8: GAS STATE

Dimensions & Measurement:

- ☐ Describe how gases differ qualitatively from other states by compressibility, energy (per volume), and density.
- ☐ Describe how measurements of volume (V), temperature (T), and moles (n) per volume quantify these properties.
- ☐ Define pressure (P).
- ☐ Describe how a barometer and manometer are used to measure pressure.
- ☐ Convert between units of atm, torr, and mmHg.
- ☐ Define STP (standard temperature and pressure).

Simple Gas Laws:

- ☐ Qualitatively relate changes in volume to changes in pressure, if T and n do not change.
- ☐ State Boyle's law and use it to quantitatively solve before and after PV problems.
- ☐ Describe how J.A.C. Charles observations lead to the Kelvin temperature scale.
- ☐ Convert between units of Celcius and Kelvin.
- ☐ Qualitatively relate changes in temperature to changes in volume, if P and n do not change.
- ☐ State Charles' law and use it to quantitatively solve before and after TV problems.
- ☐ Qualitatively relate changes in temperature to changes in pressure, if V and n do not change.
- ☐ State Gay-Lussac's law and use it to quantitatively solve before and after PT problems.

Combined Gas Law:

- ☐ Derive the combined gas law from Boyle's law, Charles' law, and Gay-Lussac's law.
- ☐ State the combined gas law and use it to quantitatively solve before and after PVT problems.

Ideal Gas Theory:

- ☐ Describe how atomic theory explains the observations of the simple gas laws.
- ☐ State Avogadro's law, use it to compare the moles of different volumes of gas, at constant T and P.
- ☐ Derive the ideal gas law from Avogadro's law and Gay-Lussac's law.
- ☐ State the ideal gas constant (R) and describe why it is unique from the constants in the simple gas laws.
- ☐ State the ideal gas law and given three of T, P, V and n, determine the fourth.

Mixtures of Gases:

- ☐ Describe the procedure for capturing gases over water.
- ☐ Define a vapor, vapor pressure and partial pressure.
- ☐ Determine the partial pressure of a gas over water from observed pressure and a vapor pressure table.