BLOCK 02 TOPICS (CH 3-6)



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 3b: ENERGY

Energy:

- Define energy, work, and heat.
- Differentiate between and provide examples of kinetic, potential, thermal, and chemical energy.
- Express and apply the law of conservation of energy.
- Convert between energy in joules, standard calories, and Calories (also called nutritional calories).
- Provide the conversion factor between joules and calories.
- Define the energy value of a substance.
- Relate the mass and energy value to the energy content in a sample of matter.

Temperature:

- Define temperature.
- Convert between temperature measures in Celsius, Kelvin, and Fahrenheit.
- Relate the initial and final states of a system to the delta (change) of that property.

Heating Matter:

- Define heat, heat capacity, and specific heat capacity.
- Relate changes in temperature to heat transferred, using heat capacity.
- State both forms of the heat capacity equation.

State Changes:

- Define heat of vaporization and heat of fusion.
- Relate heats of fusion (melting), freezing, vaporization, condensation, deposition and sublimation.
- Relate heat transferred to quantities of matter changing state, at their critical temperatures.
- Relate the mass of a sample and either heat of fusion or vaporization to the energy required to change state.
- Determine the total heat transfer required for a given net change in both temperature and state.

CH 4a: ATOMIC THEORY

Greek Atomos:

- Know the contributions of Democritus, Empedocles, and Aristotle to atomic theory.
- Describe and differentiate between atomic and elemental theory.

Alchemy:

- Distinguish between substances that are elements and compounds.
- Describe how early chemists identified pure substances and identified the first elements.
- Give the classical and modern names of the first two modern elements identified.

Laws of Stoichiometry:

- State the law of conservation of mass and give an illustrative example.
- State the law of definite composition and reconcile it with atomic theory.
- State the law of multiple proportions and reconcile it with atomic theory.

Give John Dalton's four postulates that formed a basis for atomic theory.

Electrical Revolution:

- Describe the properties of electric charge.
- Describe why Michael Faraday named the particles he discovered ions, cations, and anions.
- Understand J.J. Thomson's contribution to the discovery of sub atomic particles.
- Describe Millikan's oil drop experiment and show what two things it demonstrated.
- Describe Thomson's Plum-Pudding model of the atom and explain the reasoning behind it.
- Explain the existence of ions using the Plum-Pudding model.
- Nuclear Atom:
 - Understand the differences in charge and mass of alpha, beta, and gamma radiation.
 - Describe Rutherford's gold foil experiment and state it's three most important observations.
 - Understand the nuclear model of the atom and explain its basis in Rutherfords observations.
 - Name the three basic sub atomic particles and differentiate them by charge and mass.

Electronic Structure:

- Define and understand atomic spectroscopy and emission spectrum.
- Understand how the Bohr model explains emission spectrum.

CH 4b: FLAVORS OF THE ATOM

Elements & Symbols:

- Convert between the name and symbol of the first 18 elements.
- Explain why the periodic table is organized in periods (rows).
- Periodic Table:
 - Identify periods and families (or groups) in the periodic table.
 - Predict an ion's charge by the position of it's element on the periodic table.
 - Identify elements as metals, non-metals or metalloids.
 - Identify elements as representative, transition, or inner transition elements.
 - Predict properties of an element based on it's location in the periodic table.
- Isotopes & Atomic Mass:
 - Name the three basic sub atomic particles and differentiate them by charge and mass.
 - Describe the physical significance of atomic number and mass number.
 - Write and interpret isotopic notation of different atoms, isotopes, and ions.
 - Understand what natural abundance of isotopes means.
- Periodic Trends:
 - C Know cations are smaller in radius than the neutral atom from which they are formed.
 - C Know anions are larger in radius than the neutral atom from which they are formed.
 - C Know and predict trends in first ionization energy down a group (smaller going down).
 - C Know and predict trends in first ionization energy going across a period (larger to the right).
 - Use the ideas of screening and effective nuclear charge to explain the trends for ionization energy.
 - Define and understand the trend for electron affinity: less exothermic down and more exothermic to the right.
 - C Know the periodic trends in metallic character: increases going down, decreases to the right.
- Know the names, periodic trends, and representative chemical reactions of the elements of groups 1A, 2A, 7A, and 8A. Energy Levels & Valence:
 - Understand electrons exist around an atom in shells (layers).
 - Use the periodic table to determine the total number of electrons in a neutral atom or ion.
 - Identify the number of electrons in each shell of a neutral atom or ion using the periodic table.
 - Differentiate between valence and core electrons
 - Draw the Lewis dot symbol for a neutral atom using a periodic table.

CH 6a: COMPOUNDS

Bonding Atoms:

- Understand the differences between a mixture and a compound.
- T Know the difference between ionic, covalent, and metallic bonds.
- Describe the structural differences between ionic and molecular compounds.
- Recognize monatomic, diatomic, and a polyatomic particles (molecule, atom, or ion).
- Identify the seven diatomic elements and the two polyatomic elements (P4 and S8)
- Identify a compound as ionic or molecular.

Chemical Formula:

- Interpret a chemical formula to give the ratio of atoms of each element.
- Write chemical formulas of ionic compounds given the component ions.
- Define the terms binary compound, monatomic, diatomic, and polyatomic.
- Define a formula unit.
- Elements & Monatomic Ions:
 - Give the chemical formula for an element, including sulfur, phosphorus and the seven diatomic elements.
 - Use the periodic table to predict the formula and charge for ions of representative elements.
 - Translate between the name and formula of ions formed from representative elements.
 - Know the possible charges on the ions of the metals Co, Cr, Fe, Cu, Hg, Mn, Pb, and Sn.
- Use classical and stock systems for naming metals you know may have more than one possible charge. Binary Compounds:
 - Translate between the name and formula of binary compounds composed of a metal and non-metal.
 - Translate between the name and formula of binary compounds composed of two non-metals.
- Oxy-ions:
 - Translate between the name and formula of the primary oxy-ions of C, N, P, S, Br, Cl, and I.
 - Understand the use of the prefix per- and hypo- to describe other oxy-ions of Br, Cl, and I.
 - Translate between the name and formula of ammonium, cyanide, hydroxy, and acetate ions.
 - Translate between the name, common name, and formulas of hydrogen oxy ions of P, S, and C.
 - Translate between the name and formula of compounds formed from oxy-ions and hydrogen oxy-ions.

Naming Acids:

- Define the terms acid and base.
- Recognize halogen ions, oxy-ions, and hydrogen oxy-ions are bases.
- Translate between the name and formula of binary acids of F, Br, Cl, and I.
- Translate between the name and formula of acids of oxy-ions of C, N, P, S, Br, Cl, and I.