**Honors Chemistry**

**Semester #2 Learning Targets**

**Thermodynamics I**

(7.01) Explain the difference between kinetic and potential energy

(7.02) Define heat and work and explain the sign of ‘q’ and ‘w’ with respect to the system.

(7.03) State and interpret the First Law of Thermodynamics.

(7.04) Interpret a potential energy diagram to determine energy change for a reaction and classify it as endothermic or exothermic.

(7.05) Describe the energy transfer between a system and its surrounding during a phase or temperature change as endothermic or exothermic.

(7.06) Calculate the quantity of energy transferred, mass of substance involved, or temperature change for a system that has undergone a temperature change.

(7.07) State the physical meaning of heat of fusion, heat of vaporization, and specific heat capacity.

(7.08) Identify phases present and the various phase change temperatures for substances from a heating/cooling curve.

(7.09) Recognize that energy can be stored in an object or system as thermal energy or phase energy.

(7.10) Calculate the quantity of energy transferred, mass of substance involved, or temperature change for a system that has undergone a phase change.

**Thermodynamics II**

(8.01) Define enthalpy, ∆H.

(8.02) Calculate the enthalpy for a given chemical reaction using heats of formation.

(8.03) Calculate the enthalpy for a given chemical reaction using Hess’s Law.

(8.04) Explain what is meant by ‘spontaneous reaction”

(8.05) Define entropy, ∆S.

(8.06) Relate changes in entropy to changes in state, temperature, number of gas particles and characteristics of molecules.

(8.07) Calculate change in entropy, using a reference table.

(8.08) State the two driving forces for spontaneous reactions as enthalpy and entropy.

(8.09) Define free energy.

(8.10) Calculate free energy from a reference table of from values of enthalpy and entropy.

(8.11) Use enthalpy, entropy and free energy to predict if a reaction will occur spontaneously.

(8.12) State what values of enthalpy, entropy and free energy are favorable for a spontaneous reaction.

**Kinetics**

(9.01) Calculate the speed of a reaction based on experimental data.

(9.02) Relate the rate of formation of products and the rate of disappearance of reactants given the balanced chemical equation for the reactions.

(9.03) Identify factors that will affect reaction rate and how they influence rate.

(9.04) Define activation energy and explain how it relates to reaction rate.

(9.05) Label a potential energy diagram for reactants, products, activation energy and ∆H.

(9.06) Explain what a catalyst is, how it affects reaction rate and predict its effect on a potential energy diagram.

(9.07) State the Molecular Collision Theory and use it to describe how changes in temperature and concentration affect rates of chemical reactions.

(9.08) Describe what a reaction mechanism is and from it, identify intermediates and the rate determining step.

(9.09) Understand the form and meaning of a rate law including the ideas of reaction order and rate constant.

(9.10) Determine the rate law and rate constant for a reaction from experimental data.

**Equilibrium**

(10.01) Define chemical equilibrium and dynamic equilibrium.

(10.02) Describe the quantitative relationship between the concentrations of reactants and products in a system which exists in a state of equilibrium.

(10.03) Define the equilibrium constant, Keq, and relate its magnitude to relative amounts of product and reactant.

(10.04) Write equilibrium expressions for both homogeneous and heterogeneous reactions given the chemical equation.

(10.05) Calculate the equilibrium constant when given the equilibrium concentrations.

(10.06) Calculate equilibrium concentrations using the value of the equilibrium constant, Keq.

(10.07) Calculate the reaction quotient, Q, at any point in a reaction.

(10.08) Predict the direction of a reaction, sing the reaction quotient, Q, and the equilibrium constant, Keq.

(10.09) State LeChatelier’s principle and apply it to predict the shift in a reaction when conditions of concentration, pressure or temperature are changed.

(10.10) Describe the common-ion effect and what spectator ions are.

**Quantum Theory**

(11.01) Define electromagnetic radiation and describe the electromagnetic spectrum.

(11.02) Perform calculations relating the wavelength, frequency, and photon energy of light base on the equations: C=λν and E=hν

(11.03) Draw the model of the atom proposed by Bohr and describe how it explains the hydrogen emission spectrum.

(11.04) Explain the significance of the deBroglie equation and perform calculations using it: λ = h/mν

(11.05) Describe wave-particle duality of matter and light.

(11.06) Describe the Heisenberg Uncertainty Principle and its implications for atomic structure.

(11.07) State the contribution of Schroedinger to quantum theory.

(11.08) Describe electrons within an atom based on the Quantum Mechanical Model of the atom.

(11.09) Identify the four quantum numbers as relating to energy levels, sublevels, orbitals and spin

(11.10) Write complete and condensed electron configurations of atoms and ions.

(11.11) Explain the electron configuration of atoms and ions using the Period Table.

(11.12) Write orbital diagrams of atoms by applying Aufbau’s Principle, Hund’s Rule and the Pauli Exclusion Principle.

**Periodic Table and Bonding**

(12.01) Define the following quantities, describe their periodic trends, and use them to predict the relative magnitudes of elements: atomic radii, ionic radii, electronegativity, ionization energy, electron affinity.

(12.02) Describe lattice energy and make comparisons between ionic compounds using lattice energy.

(12.03) Compare and contrast the distinctive properties of ionic and molecular compounds.

(12.04) Identify bond type based on the atoms present and on electronegativity differences. (ionic, polar, nonpolar)

(12.05) Define the octet rule, apply it to Lewis structures and explain its exceptions.

(12.06) Illustrate bond formation by constructing Lewis structures for simple molecular compounds and polyatomic ions.

(12.07) Explain multiple bonding in molecular compounds and the difference in strength between single, double and triple bonds.

(12.08) Explain resonance and draw valid resonance structures using Lewis Structures.

(12.09) Explain the valence-shell-electron-pair repulsion model (VSEPR) and use it to predict the molecular geometry of simple molecular compounds.

(12.10) Predict whether a simple molecular compound is polar or non-polar based on its molecular geometry.

**Gases and Gas Laws**

(13.01) Define gas pressure and know the units for its measurement.

(13.02) Convert between different units of pressure, volume, temperature and amount of gas.

(13.03) State the following Gas Laws and apply them in calculations:

a) Boyle’s: P1V1 = P2V2

b) Charles’: V1/T1 = V2/T2

c) Gay-Lussac’s’: P1/T1 = P2/T2

d) Combined: P1V1/T1 = P2V2/T2

e) Ideal: PV = nRT

(13.04) Define STP as “standard temperature and pressure” and know its values.

(13.05) Discuss Kinetic Molecular Theory and how it relates to the behavior of gases.

(13.06) Differentiate between an ideal and a real gas.

(13.07) Solve stoichiometric problems that involve gas volumes.