

CH 221 LEARNING OUTCOMES

1. CHEMICAL FOUNDATIONS: MATTER AND MEASUREMENT

Upon completion of this topic, the student should be able to:

1. Identify the principle operations and limitations of the scientific method.
2. Apply the rules of significant figures to calculations based upon experimental measurements.
3. Convert between Fahrenheit, Celsius and Kelvin temperatures using the relations $T(^{\circ}\text{F}) = 1.8(T(^{\circ}\text{C})) + 32$ and $T(\text{K}) = T(^{\circ}\text{C}) + 273.15$.
4. Apply the factor label method to convert lengths, volumes, masses or other quantities from one unit to another.
5. Use the relation: density = mass/volume to calculate one of these three quantities, given (or having calculated) the other two quantities.
6. Differentiate between an element and a compound and also between a solution and a heterogeneous mixture.

2. ATOMS, MOLECULES, AND IONS

Upon completion of this topic, the student should be able to:

1. Apply the Laws of Conservation of Mass, Constant Composition, and Multiple Proportions to atomic theory.
2. Identify the three types of atomic particles and give the relative charges and masses of these particles.
3. Relate a nuclear symbol to the number of protons and neutrons in the nucleus.
4. Calculate the atomic mass of an element given the masses and abundances of the element.
5. Demonstrate how to name compounds given their formulas and to write formulas given their name.

3. STOICHIOMETRY, CHEMICAL FORMULAS AND EQUATIONS

Upon completion of this topic, the student should be able to:

1. Calculate the number of atoms or the mass in grams of an element given the other quantity.
2. Calculate the molar mass of a compound given the molecular formula (and a table of atomic masses.)
3. Relate the number of moles of a species of known formula to the number of grams or the number of particles.
4. Calculate the molarity of a solution given the number of moles and solution volume.
5. Calculate the mass percent of a compound given the molecular formula.
6. Determine the simplest (empirical) formula of a compound given the mass percents of the elements.
7. Relate the empirical formula of a compound and its molar mass to the molecular formula.
8. Express the correct name for ionic compounds and binary molecular compounds.
9. Construct a simple balanced chemical equation.
10. Compare stoichiometric ratios to relate the number of moles (or grams) of reactants to products and products to reactants.
11. Determine the limiting reactant and the theoretical yield of product given the number of grams for each reactant.
12. Relate the actual yield of product to the theoretical yield in order to calculate the percent yield.

4. TYPES OF CHEMICAL REACTIONS AND SOLUTION STOICHIOMETRY

Upon completion of this topic, the student should be able to:

1. Predict whether a precipitate will form when two electrolyte solutions are mixed using the solubility rules.
2. Express the net ionic equation for any reaction that occurs.
3. Distinguish between strong and weak acids and identify the common strong acids.
4. Distinguish between strong and weak bases and identify the common strong bases.
5. Determine the percent abundance of a species in a sample using stoichiometric data for solution reactions.

5. THERMOCHEMISTRY

Upon completion of this topic, the student should be able to:

1. Determine the value of q , specific heat, m and ΔT when three of the four quantities are known.
2. Determine the heat flow for a reaction using calorimetric data (temperature change, mass of water, specific heat of water, calorimeter constant, etc.)
3. Calculate ΔH for a specified amount of reactant or product given the appropriate thermochemical equation.
4. Employ Hess' Law to calculate ΔH for stepwise reactions if the value of ΔH is known for each step.
5. Use the general relation $\Delta H = \Delta H(\text{products}) - \Delta H(\text{reactants})$ to calculate ΔH for a reaction or for a specific species, knowing the heats of formation for all other species.

6. ATOMIC STRUCTURE AND PERIODICITY

Upon completion of this topic, the student should be able to:

1. Describe λ , ν and c for electromagnetic radiation.
2. Determine the energy of an electron in a given principle energy level of the hydrogen atom using Bohr's theory of the atom.
3. Express the electron configuration of an atom using the atomic number.
4. Describe the four quantum numbers for any electron in any atom.
5. Determine the electron configuration for an ion.
6. Recognize trends in the Periodic Table with respect to atomic radius, ionic radius, ionization energy, and electron affinity.