Student Learning Outcomes & Enabling Objectives

1. Use the principles of scientific investigation within the context of a physical or natural science.
    a. Identify the steps of the scientific process.
    b. Differentiate between hypothesis, theory, and law.
2. Describe chemical and physical properties using the metric system.
    a. Calculate density, mass, and volume.
    b. Convert units of measurement using correct significant figures.
3. Explain the structure of atoms.
    a. Identify the mass number and atomic number when given the standard isotopic notation.
    b. Determine the number and properties of protons, neutrons, and electrons in an atom.
    c. Classify the major groups of elements.
    d. Describe the quantum model of the atom using the four quantum numbers.
    e. Apply the Pauli Exclusion Principle and the Heisenberg Uncertainty Principle.
    f. Predict trends for atomic radius, ionization potential, electron affinity, and electronegativity.
4. Describe chemical reactions.
    a. Explain the laws of Conservation of Mass and Energy.
    b. Explain the laws of Definite Proportions and Multiple Proportions.
    c. Explain the mole and its importance to understanding chemical reactions.
    d. Calculate the concentrations of solutions in percent mass-volume, molarity, and molality, and calculate how these change upon dilution.
    e. Construct the molecular equation, complete ionic equation, and net ionic equation for chemical reactions.
5. Identify the structure of ionic and covalent compounds.
    a. Classify molecular geometry using the five basic shapes of linear, trigonal planar, tetrahedral, trigonal bipyramidal, and octahedral (with the variant molecular shapes derived from the five basics).
    b. Explain valence bond theory.
    c. Write the Lewis electron-dot structures of compounds and ions with emphasis upon resonance, incomplete octets, expanded octets, and the concept of formal charge.
6. Evaluate the physical states of matter.

a. Assess the properties that distinguish gases, liquids, and solids from one another.
b. Describe phase changes.
c. Differentiate between physical and chemical properties.
d. State the gas laws and perform calculations illustrating them.
e. Assess the solubility of gases and solids.
f. Describe how the presence of dissolved substances influences the freezing and boiling points of water.

7. Evaluate chemical formulas.
   a. Classify chemical bonds as covalent, polar covalent, or ionic when provided with the electronegativities of the bonded atoms.
   b. Identify the names and formulas of ionic and covalent compounds.
   c. Determine the empirical formula, molecular formula, and molar mass of a compound.
   d. Classify chemical reactions.
   e. Relate electron configuration to the properties of elements.
   f. Construct chemical equations from word equations.
   g. Explain the molecular equation, complete ionic equation, and net ionic equation

8. Perform problems related to stoichiometry.
   a. Practice concepts of limiting reagents percent yield, theoretical yield, and actual yield.
   b. Perform stoichiometric problems involving molarity.

9. Apply thermochemistry to chemical systems.
   a. Describe the first law of thermodynamics.
      i. Quantify heat and work.
      ii. Describe enthalpy and how it applies to chemical systems.

10. Apply the principles of chemical kinetics.
    a. Describe the laws that determine the rate of reactions.
       i. The effect of concentration.
       ii. Dependence of concentration on time.
       iii. Effect of temperature.
       iv. The role of catalysis.

11. Solve chemical equilibrium problems.
    a. Explain dynamic equilibrium.
    b. Explain chemical equilibrium constants.
    c. Explain Le Chatelier's Principle.

12. Interpret properties of acids, bases, and buffers.
    a. Identify the characteristics of acids and bases according to both the Bronsted-Lowry and Arrhenius definitions.
    b. Convert between the pH or pOH of a solution and its hydrogen-ion or hydroxide-ion concentration.
    c. Perform problems dealing with the Ionization Constant of a weak acid (Ka) and/or weak base (Kb), and also, the solubility product constant (Ksp).

13. Interpret redox reactions.

    a. Define oxidation and reduction.
    b. Identify oxidation states.
    c. Balance redox equations.
    d. Evaluate redox reactions and their practical applications.
        i. Combustion
        ii. Batteries
        iii. Electrolysis
        iv. Corrosion

14. Laboratory Student Learning Outcomes and Enabling Objectives
    a. Conduct experimental laboratories applying concepts from lecture:
    b. Collect experimental data by observing lab safety and proper procedures.
    c. Analyze data, perform calculations, and interpret the results of the experiments.
    d. Create well-formatted and -labelled graphs and diagrams.

These SLOs are not approved for experiential credit.

Effective: Fall 2017