

## CH 104 LEARNING OUTCOMES

### 1. MATTER, ENERGY, AND LIFE

- discuss the properties of matter and describe the three states of matter.
- distinguish among mixtures, pure substances, chemical elements and chemical compounds.
- distinguish between chemical and physical changes.
- name and give the symbols of elements.
- describe in general terms the different types of energy.

### 2. MEASUREMENTS IN CHEMISTRY

- name the metric units of measure for mass, length, volume and temperature.
- interpret scientific notation and prefixes for units of measure and to convert numbers to and from scientific notation.
- interpret the number of significant figures in a physical quantity and round off numbers in calculations involving physical quantities.
- convert physical quantities from one unit to another by using conversion factors.
- apply the factor-label method, problem analysis and the ballpark solution technique to solving problems.
- define these quantities and use them in calculations.

### 3. ATOMS AND THE PERIODIC TABLE

- list the major assumptions of modern atomic theory.
- explain the composition of different atoms in terms of the number of protons, neutrons, and electrons.
- given the number of electrons in an atom, be able to explain how they are distributed in shells and subshells and to write the electron configuration of the atom.
- describe how elements are arranged in the periodic table, name the subdivisions of the periodic table, and relate the position of an element in the periodic table to its electron structure.

### 4. NUCLEAR CHEMISTRY

- define radioactivity and the terms used to describe it.
- list the characteristics of three common kinds of radiation - alpha, beta & gamma.
- describe alpha, beta and gamma decay and to write balanced equations for nuclear decay reactions.
- explain half-life and to calculate the quantity of a radioisotope remaining after a known number of half-lives.
- describe the properties of the different types of ionizing radiation, their potential for harm to living tissue, their detection, and protection from them.
- list and define the common units for measuring radiation.
- explain nuclear bombardment and balance equations for nuclear bombardment reactions.
- explain the differences between nuclear fission and nuclear fusion.

### 5. IONIC COMPOUNDS

- define an ionic bond and give the general properties of compounds that contain ionic bonds.
- state the octet rule and use it to predict the electron configurations of ions of main-group elements.
- predict what ions are likely to be formed by atoms of a given element.
- name the common ions and write their symbols or formulas.
- write formulas for ionic compounds, given the identities of the ions combined.
- name a compound from its formula or give the formula of a named compound.
- calculate the formula weight of any given ionic compound and explain what the formula weight represents.

### 6. MOLECULAR COMPOUNDS

After studying the chapter, the student should be able to:

- define the covalent bond and describe its formation.
- predict the numbers of covalent bonds usually formed by the more common main-group elements.
- interpret molecular formulas, structural formulas, and Lewis structures.
- recognize the occurrence of single, double, and triple covalent bonds.
- draw Lewis structures and use them to predict molecular geometry.
- use electronegativity and molecular geometry to predict bond and molecular polarity.
- compare the structures, compositions, and melting and boiling points of ionic and molecular compounds.
- describe ion formation by hydrogen loss or addition.

### 7. CHEMICAL REACTIONS: MASS RELATIONSHIPS AND CLASSIFICATION

- write a balanced chemical equation (or net ionic equation) and be able to interpret it.
- explain the meaning and uses of the mole and Avogadro's number.
- convert between molar and mass quantities of any element or compound.
- carry out mole-mole, mass-mole, and mass-mass calculations for quantities of reactants and products, & to calculate % yield.
- recognize combination, displacement, decomposition, exchange and redox reactions.
- given the reactants, predict whether an exchange reaction will occur and identify the products.
- explain the various ways of recognizing redox reactions and to identify the substances oxidized and reduced in a given reaction.

### 8. CHEMICAL REACTIONS: ENERGY AND RATE

- explain the factors that influence energy changes in chemical reactions.
- define heat of reaction and, given a heat of reaction and quantity of reactant or product, calculate the quantity of heat absorbed or released.
- define free energy change and entropy, and qualitatively interpret the equation that relates free energy change to heat of reaction, temperature and entropy.
- explain how collisions and activation energy determine reaction rate.