Atomic Structure

(5) Science concepts. The student understands the historical development of the periodic table and can apply its predictive power. The student is expected to:

(A) explain the use of chemical and physical properties in the historical development of the periodic table;
(B) identify and explain the properties of chemical families, including alkali metals, alkaline earth metals, halogens, noble gases, and transition metals, using the Periodic Table; and
(C) interpret periodic trends, including atomic radius, electronegativity, and ionization energy, using the Periodic Table

Chemical Bonds

(7) Science concepts. The student knows how atoms form ionic, covalent, and metallic bonds. The student is expected to:

(A) name ionic compounds containing main group or transition metals, covalent compounds, acids, and bases using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules;
(B) write the chemical formulas of ionic compounds containing representative elements, transition metals and common polyatomic ions, covalent compounds, and acids and bases;
(C) construct electron dot formulas to illustrate ionic and covalent bonds;
(D) describe metallic bonding and explain metallic properties such as thermal and electrical conductivity, malleability, and ductility; and
(E) classify molecular structure for molecules with linear, trigonal planar, and tetrahedral electron pair geometries as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory.

Chemical Reactions

(8) Science concepts. The student can quantify the changes that occur during chemical reactions. The student is expected to:

(A) define and use the concept of a mole;
(B) calculate the number of atoms or molecules in a sample of material using Avogadro's number;
(C) calculate percent composition of compounds;
(D) differentiate between empirical and molecular formulas;
(E) write and balance chemical equations using the law of conservation of mass;
(F) differentiate among double replacement reactions, including acid-base reactions and precipitation reactions, and oxidation-reduction reactions such as synthesis, decomposition, single replacement, and combustion reactions;
(G) perform stoichiometric calculations, including determination of mass and gas volume relationships between reactants and products and percent yield; and
(H) describe the concept of limiting reactants in a balanced chemical equation.

Stoichiometry

(8) Science concepts. The student can quantify the changes that occur during chemical reactions. The student is expected to:

(A) define and use the concept of a mole;
(B) calculate the number of atoms or molecules in a sample of material using Avogadro's number;
(C) calculate percent composition of compounds;
(D) differentiate between empirical and molecular formulas;
(E) write and balance chemical equations using the law of conservation of mass;
(F) differentiate among double replacement reactions, including acid-base reactions and precipitation reactions, and oxidation-reduction reactions such as synthesis, decomposition, single replacement, and combustion reactions;
(G) perform stoichiometric calculations, including determination of mass and gas volume relationships between reactants and products and percent yield; and
(H) describe the concept of limiting reactants in a balanced chemical equation.

Kinetics

(4) Science concepts. The student knows the characteristics of matter and can analyze the relationships between chemical and physical changes and properties. The student is expected to:

(A) differentiate between physical and chemical changes and properties;
(B) identify extensive properties such as mass and volume and intensive properties such as density and melting point;
(C) compare solids, liquids, and gases in terms of compressibility, structure, shape, and volume; and
(D) classify matter as pure substances or mixtures through investigation of their properties.

Chemical Equilibrium

(10) Science concepts. The student understands and can apply the factors that influence the behavior of solutions. The student is expected to:

(A) describe the unique role of water in solutions in terms of polarity;
(B) apply the general rules regarding solubility through investigations with aqueous solutions;
(C) calculate the concentration of solutions in units of molarity;
(D) calculate the dilutions of solutions using molarity;
(E) distinguish among types of solutions such as electrolytes and nonelectrolytes; unsaturated, saturated, and supersaturated solutions; and strong and weak acids and bases;
(F) investigate factors that influence solid and gas solubilities and rates of dissolution such as temperature, agitation, and surface area;
(G) define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions and predict products in acid-base reactions that form water; and
(H) define pH and calculate the pH of a solution using the hydrogen ion concentration.

Acids and Bases

(10) Science concepts. The student understands and can apply the factors that influence the behavior of solutions. The student is expected to:

(A) describe the unique role of water in solutions in terms of polarity;
(B) apply the general rules regarding solubility through investigations with aqueous solutions;
(C) calculate the concentration of solutions in units of molarity;
(D) calculate the dilutions of solutions using molarity;
(E) distinguish among types of solutions such as electrolytes and nonelectrolytes; unsaturated, saturated, and supersaturated solutions; and strong and weak acids and bases;
(F) investigate factors that influence solid and gas solubilities and rates of dissolution such as temperature, agitation, and surface area;
(G) define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions and predict products in acid-base reactions that form water; and
(H) define pH and calculate the pH of a solution using the hydrogen ion concentration.

Thermodynamics

(11) Science concepts. The student understands the energy changes that occur in chemical reactions. The student is expected to:

(A) describe energy and its forms, including kinetic, potential, chemical, and thermal energies;
(B) describe the law of conservation of energy and the processes of heat transfer in terms of calorimetry;
(C) classify reactions as exothermic or endothermic and represent energy changes that occur in chemical reactions using thermochemical equations or graphical analysis; and
(D) perform calculations involving heat, mass, temperature change, and specific heat.

Intermolecular Forces

(10) Science concepts. The student understands and can apply the factors that influence the behavior of solutions. The student is expected to:

(A) describe the unique role of water in solutions in terms of polarity;
(B) apply the general rules regarding solubility through investigations with aqueous solutions;
(C) calculate the concentration of solutions in units of molarity;
(D) calculate the dilutions of solutions using molarity;
(E) distinguish among types of solutions such as electrolytes and nonelectrolytes; unsaturated, saturated, and supersaturated solutions; and strong and weak acids and bases;
(F) investigate factors that influence solid and gas solubilities and rates of dissolution such as temperature, agitation, and surface area;
(G) define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions and predict products in acid-base reactions that form water; and
(H) define pH and calculate the pH of a solution using the hydrogen ion concentration

Electrochemistry

(5) Science concepts. The student understands the historical development of the periodic table and can apply its predictive power. The student is expected to:

(A) explain the use of chemical and physical properties in the historical development of the periodic table;
(B) identify and explain the properties of chemical families, including alkali metals, alkaline earth metals, halogens, noble gases, and transition metals, using the Periodic Table; and
(C) interpret periodic trends, including atomic radius, electronegativity, and ionization energy, using the Periodic Table