

## Chemistry

### Proficient Performance Level Descriptors

A student who is **Proficient** in Chemistry **consistently** exhibits competency in the scientific method, the scientific process, quantitative analysis, and science content, including abilities to do the following:

#### Scientific Thinking

- Identifies and applies the steps of the scientific method
- Distinguishes between dependent and independent variables including graphical data
- Reports the results of measurements and calculations to the correct number of significant figures
- Correctly expresses numbers in scientific notation and standard form
- Calculates molar mass from a given chemical formula
- Distinguishes between accuracy and precision
- Makes observations about uncertainty in measurement
- Calculates percent composition from the formula of a compound or the mass data
- Uses Avogadro's number and molar mass to convert among moles, mass, and number of particles

#### Structure of Matter

- Identifies subatomic particles, their charges, relative masses, and locations in the atom
- Identifies and interprets electron configurations
- Correctly writes an orbital filling diagram and identifies elements from orbital filling diagrams or electron configurations
- States the VSEPR theory
- Correctly predicts the charges of the representative element ions
- Distinguishes between anions and cations
- Classifies compounds as ionic or covalent, based on the chemical formula
- Defines, compares, and contrasts ionic and covalent bonding
- Relates the numbers of the subatomic particles to the atomic number, mass number, and charge
- Relates states of matter to the arrangement of particles and their freedom of motion (entropy changes)
- Identifies periodic trends including ionization energy, electronegativity, and atomic radii

#### Chemical Reactions

- Balances chemical equations
- Classifies chemical reactions
- Predicts the products of chemical reactions
- Relates the name to the formula of a compound and vice versa
- Performs stoichiometric calculations including mole to mole and mass to mass conversions (and volume to volume for gases at STP)
- Makes qualitative predictions based on Le Chatlier's Principle
- Understands factors that affect the rates of reaction

#### Energy

- Knows how temperature and kinetic energy are related
- Distinguishes between kinetic and potential energy

- Describes energy transformations (potential to kinetic, etc.)
- Classifies chemical reactions as endothermic or exothermic by observation
- Identifies energy and temperature changes that a substance undergoes on heating or cooling curves

### **Properties of Matter**

- Understands the properties of metals, nonmetals, and metalloids
- Compares and contrasts the properties of ionic and covalent (molecular) compounds
- Classifies matter as elements, compounds, or mixtures
- Manipulates and solves for any of the variables in the density equation
- Calculates partial pressures of a gas using Dalton's Law
- Determines and ranks bond polarity based on electronegativity
- Calculates the molarity of a solution
- Calculates using gas laws
- Predicts the solubility of compounds in water
- Classifies compounds as acids or bases (using Arrhenius and Bronsted-Lowry definitions)

A student who is **Borderline Proficient** in Chemistry **periodically** exhibits competency in the scientific method, the scientific process, quantitative analysis, and science content, including abilities to do the following:

#### Scientific Thinking

- Identifies the steps of the scientific method
- Distinguishes between dependent and independent variables including graphical data
- Reports the results of measurements and calculations
- Expresses numbers in scientific notation and standard form
- Calculates molar mass from a given chemical formula
- Calculates percent composition
- Uses molar mass to convert between moles and mass

#### Structure of Matter

- Identifies subatomic particles, their charges, relative masses, and locations in the atom
- Correctly predicts the charges of the representative element ions
- Distinguishes between anions and cations
- Classifies compounds as ionic or covalent based on the chemical formula
- Defines ionic and covalent bonding
- Relates the numbers of the subatomic particles to the atomic number, mass number, and charge
- Recognizes periodic trends
- Identifies elements from orbital filling diagrams or electron configurations

#### Chemical Reactions

- Balances chemical equations
- Classifies chemical reactions
- Relates the name to the formula of a compound and vice versa
- Performs stoichiometric calculations including mole to mole
- Understands factors that affect the rates of reaction

#### Energy

- Knows how temperature and kinetic energy are related
- Distinguishes between kinetic and potential energy
- Recognizes energy transformations (potential to kinetic, etc.)
- Classifies chemical reactions as endothermic or exothermic

#### Properties of Matter

- Understands the properties of metals, nonmetals, and metalloids
- Lists the properties of ionic and covalent (molecular) compounds
- Classifies matter as elements, compounds, or mixtures
- Recognizes the formula for density