

# Chemistry: 11, 12

## Properties and Classification of Matter CHEM.A.1

### 1 Identify and describe how observable and measurable properties can be used to classify and describe matter and energy. CHEM.A.1.1

- 1 Classify physical or chemical changes within a system in terms of matter and/or energy. CHEM.A.1.1.1
- 2 Classify observations as qualitative and/or quantitative. CHEM.A.1.1.2
- 3 Utilize significant figures to communicate the uncertainty in a quantitative observation. CHEM.A.1.1.3
- 4 Relate the physical properties of matter to its atomic or molecular structure CHEM.A.1.1.4
- 5 Apply a systematic set of rules (IUPAC) for naming compounds and writing chemical formulas (e.g., binary covalent, binary ionic, ionic compounds containing polyatomic ions). CHEM.A.1.1.5

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### 2 Compare the properties of mixtures. CHEM.A.1.2

- 1 Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving, dissociating). CHEM.A.1.2.1
- 2 Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated). CHEM.A.1.2.2
- 3 Describe how factors (e.g., temperature, concentration, surface area) can affect solubility. CHEM.A.1.2.3
- 4 Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume). CHEM.A.1.2.4
- 5 Describe how chemical bonding can affect whether a substance dissolves in a given liquid. CHEM.A.1.2.5

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## Atomic Structure and the Periodic Table CHEM.A.2

### 1 Explain how atomic theory serves as the basis for the study of matter. CHEM.A.2.1

- 1 Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr. CHEM.A.2.1.1
- 2 Differentiate between the mass number of an isotope and the average atomic mass of an element CHEM.A.2.1.2

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**2 Describe the behavior of electrons in atoms.** CHEM.A.2.2

- 1 Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion. CHEM.A.2.2.1
  - 2 Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity). CHEM.A.2.2.2
  - 3 Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals). CHEM.A.2.2.3
  - 4 Relate the existence of quantized energy levels to atomic emission spectra. CHEM.A.2.2.4
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**3 Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.** CHEM.A.2.3

- 1 Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
  - 2 Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.
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**The Mole and Chemical Bonding** CHEM.B.1**1 Explain how the mole is a fundamental unit of chemistry.** CHEM.B.1.1

- 1 Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
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**2 Apply the mole concept to the composition of matter.** CHEM.B.1.2

- 1 Determine the empirical and molecular formulas of compounds CHEM.B.1.2.1
  - 2 Apply the law of definite proportions to the classification of elements and compounds as pure substances. CHEM.B.1.2.2
  - 3 Relate the percent composition and mass of each element present in a compound. CHEM.B.1.2.3
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**3 Explain how atoms form chemical bonds.** CHEM.B.1.3

- 1 Explain how atoms combine to form compounds through ionic and covalent bonding CHEM.B.1.3.1
- 2 Classify a bond as being polar covalent, non-polar covalent, or ionic CHEM.B.1.3.2
- 3 Use illustrations to predict the polarity of a molecule. CHEM.B.1.3.3

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#### 4 Explain how models can be used to represent bonding. CHEM.B.1.4

- 1 Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball-and-stick models, graphical models, solid-sphere models, structural formulas, skeletal formulas, Lewis dot structures). CHEM.B.1.4.1
  - 2 Utilize Lewis dot structures to predict the structure and bonding in simple compounds. CHEM.B.1.4.2
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### Chemical Relationships and Reactions CHEM.B.2

#### 1 Predict what happens during a chemical reaction. CHEM.B.2.1

- 1 Describe the roles of limiting and excess reactants in chemical reactions. CHEM.B.2.1.1
  - 2 Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction. CHEM.B.2.1.2
  - 3 Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion. CHEM.B.2.1.3
  - 4 Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion). CHEM.B.2.1.4
  - 5 Balance chemical equations by applying the Law of Conservation of Matter. CHEM.B.2.1.5
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#### 2 Explain how the kinetic molecular theory relates to the behavior of gases. CHEM.B.2.2

- 1 Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law). CHEM.B.2.2.1
- 2 Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP. CHEM.B.2.2.2