

Chapter 3 Elements and Compounds

Advanced Chemistry

3.1 Elements

Learning Objective	
Define an element and write the chemical symbol for an element when given its name.	<ul style="list-style-type: none">• About elements:<ul style="list-style-type: none">○ All matter consists of about 100 elements.○ An element is a fundamental chemical substance.○ The smallest particle of an element is an atom.○ Elements cannot be broken down by chemical means to a simpler substance.○ Most elements are found in nature combined with other elements.○ Elements that are found in uncombined form in nature include gold, silver, copper, and platinum, as well as the noble gases.○ Chemical elements are not distributed equally in nature.○ Hydrogen is the most abundant element in the universe.○ Oxygen is the most abundant element on Earth and in the human body.• Naming elements:<ul style="list-style-type: none">○ Names for the chemical elements come from a variety of sources, including Latin, location of discovery, and famous scientists.○ Rules for writing symbols for the elements are:<ul style="list-style-type: none">▪ One or two letters▪ If one letter, use a capital▪ If two letters, only the first is a capital

Key Terms	
Element	A basic building block of matter that cannot be broken down into simpler substances by ordinary chemical changes.
Atom	The smallest particle of an element that can enter into chemical reaction.
Symbol	In chemistry, an abbreviation for the name of an element.

3.2 Introduction to the Periodic Table

Learning Objective	
Explain the arrangement of the elements on the periodic table and classify elements as metal, nonmetal, or metalloid.	<ul style="list-style-type: none">• The periodic table was designed by Dmitri Mendeleev and arranges the elements according to their atomic numbers and in groups by their chemical properties.• Elements can be classified as metals, nonmetals, or metalloids.<ul style="list-style-type: none">○ Most elements are metals.○ Metals have the following properties:<ul style="list-style-type: none">▪ High luster▪ Good conductors of heat and electricity▪ Malleable○ Nonmetals have the following properties:<ul style="list-style-type: none">▪ Not lustrous▪ Poor conductors of heat and electricity
Key Terms	
Group or Family (of elements)	Vertical groups of elements in the periodic table (1A, 2A, and so on). Families of elements that have similar outer-orbital electron structures.
Noble gases	A family of elements in the periodic table—helium, neon, argon, krypton, xenon, and radon—that contains a particularly stable electron structure.
Alkali metal	An element (except H) from Group 1A of the periodic table.
Alkaline earth metal	An element from Group 2A of the periodic table.

Halogens	Group 7A of the periodic table; consists of the elements fluorine, chlorine, bromine, iodine, and astatine.
Represented element	An element in one of the A groups in the periodic table.
Transition element	The metallic elements characterized by increasing numbers of <i>d</i> and <i>f</i> electrons. These elements are located in Groups 1B-8B of the periodic table.
Metal	An element that is solid at room temperature (except Hg) and whose general properties include luster, ductility, malleability, and good conductivity of heat and electricity; metals tend to lose their valence electrons and become positive ions.
Nonmetal	An element that has properties the opposite of metals: lack of luster, relatively low melting point and density, and generally poor conduction of heat and electricity. Nonmetals may or may not be solid at room temperature; many are gases. They are located mainly in the upper right-hand corner of the periodic table.
Metalloid	An element having properties that are intermediate between those of metals and nonmetals; these elements are useful in electronics.
Diatomic molecules	The molecules of elements that always contain two atoms (alike or different). Seven elements exist as diatomic molecules: H ₂ , N ₂ , O ₂ , F ₂ , Cl ₂ , Br ₂ , and I ₂ .

3.3 Compounds and Formulas

Learning Objective	
Distinguish between molecular and ionic compounds and write chemical formulas for compounds.	<ul style="list-style-type: none"> • There are two general types of compounds: <ul style="list-style-type: none"> ○ Molecular—formed of individual molecules composed of atoms ○ Ionic—formed from ions that are either positive or negative <ul style="list-style-type: none"> ▪ Cation—positively charged ion ▪ Anion—negatively charged ion

	<ul style="list-style-type: none"> • Characteristics of a chemical formula include: <ul style="list-style-type: none"> ○ It contains symbols of all elements in the compound. ○ The symbol represents one atom of the element. ○ If more than one atom of an element is present, the number of atoms is indicated by a subscript. ○ Parentheses are used to show multiple groups of atoms occurring as a unit in the compound. ○ A formula does not show the arrangement of the atoms in the compound.
Key Term	
Compound	A distinct substance composed of two or more elements combined in a definite proportion by mass.
Molecule	The smallest unchanged individual unit of a compound formed by the union of two or more atoms.
Ion	A positively or negatively charged atoms or group of atoms.
Cation	A positively charged ion.
Anion	A negatively charged ion.
Chemical formula	A shorthand method for showing the composition of a compound, using symbols of the elements.
Subscript	Number that appears partially below the line and to the right of a symbol of an element.
Natural law	A statement summarizing general observations regarding nature.
Law of definite composition	A compound always contains two or more elements in definite proportion by mass.
Law of multiple proportions	Atoms of two or more elements may combine in different ratios to produce more than one compound.