Chapter 7
Quantitative Composition of Compounds
Advanced Chemistry

7.1 The Mole

Learning Objective	
Apply the concepts of the mole, molar mass, and Avogadro's number to solve chemistry problems.	• We count atoms by weighing them since they are so tiny. • 1 mole = 6.022 x 10^{23} items. • Avogadro's number is 6.022 x 10^{23}.
Key Terms	
Avogadro's number	6.022 x 10^{23}; the number of formula units in 1 mole.
Mole	The amount of a substance containing the same number of formula units (6.022 x 10^{23}) as there are in exactly 12 g of ^{12}C. One mole is equal to the molar mass in grams of any substance.
Molar mass	The mass of Avogadro's number of atoms or molecules. The sum of the atomic masses of all the atoms in an element, compound, or ion. The mass of a mole of any formula unit. It is also known as the molecular weight.

7.2 Molar Mass of Compounds

Learning Objective	
Calculate the molar mass of a compound.	• One mole of a compound contains Avogadro's number of formula units of that compound. • The mass (grams) of one mole of a compound is the molar mass. • Molar mass is determined by adding the molar masses of all the atoms in a formula. • Molar masses are given to four significant figures in this text.

7.3 Percent Composition of Compounds

Learning Objective	
Calculate the percent composition of a compound from its chemical formula and from experimental data.	• To determine the percentage composition from a formula: ○ Calculate the molar mass. ○ For each element in the formula $$\frac{total\ mass\ of\ the\ element}{molar\ mass\ of\ the\ compound} \times 100 = percent\ of\ the\ element$$ • To determine percent composition from experimental data: ○ Calculate the mass of the compound formed. ○ For each element in the formula $$\frac{mass\ of\ the\ element}{mass\ of\ the\ compound\ formed} \times 100 = percent\ of\ the\ element$$
Key Terms	
Percentage composition of a compound	The mass percent represented by each element in a compound.

7.4 Calculating Empirical Formulas

Learning Objective	

Determine the empirical formula for a compound from its percent composition.	• The empirical formula is the simplest formula giving the smallest whole-number ratio of atoms present in a compound.
	• To determine the empirical formula for a compound you need to know:
	  ○ The elements that are combined
	  ○ Their atomic masses
	  ○ The ratio of masses or percentage in which they are combined
	• Empirical formulas are represented in the form A_xB_y. To determine the empirical formula of this compound:
	  ○ Assume a started quantity (100.0 g is a good choice).
	  ○ Convert mass (g) to moles for each element.
	  ○ Divide each element's moles by the smallest number of moles.
	  ○ If the ratios are whole numbers, use them as subscripts and write the empirical formula.
	  ○ If the ratios are not whole numbers, multiply them all by the smallest number, which will convert them to whole numbers.
	  ○ Use the whole numbers to write the empirical formula.

Key Terms	
Empirical formula	A chemical formula that gives the smallest whole-number ratio of atoms in an compound—that is, the relative number of atoms of each element in the compound; also known as the simplest formula.

7.5 Calculating the Molecular Formula From the Empirical Formula

Learning Objective	
Compare an empirical formula to a molecular formula and calculate a molecular formula from the empirical formula of the compound and its molar mass.	• The molecular formula is the true formula representing the total number of atoms of each element present in one molecule of the compound. • Two or more substances may have the same empirical formulas but different molecular formulas. • The molecular formula is calculated from the empirical formula when the molar mass is known: $$n = \frac{molar\ mass}{mass\ of\ empirical\ formula}$$ n = number of empirical formula units • The molecular formula is $(A_xB_y)_n$.
Key Terms	
Molecular formula	The total number of atoms of each element present in one molecule of a compound; also known as the true formula.