

## Key Understandings

### 2.1 Amounts in Chemistry: Mass, Moles, and Molar Mass

- Define the terms “mole” and “Avogadro’s constant ( $N_A$ )” and discuss how they relate to each other.
- Interpret the coefficients in a chemical equation as individual entities or groups of entities.

### 2.2 Calculations Involving the Mole

- State the difference between molecular elements and compounds.
- Use the periodic table to calculate the relative atomic mass and the molar mass ( $M$ ) of an entity.
- Count a large number of entities using the mass of a small group of the same entities.

### 2.3 Determining Chemical Formulas

- State the law of constant composition.
- Explain the function of a mass spectrometer and a combustion analyzer.
- Define the percentage composition of a compound.
- State the difference between the empirical formula and the molecular formula of a compound.

### 2.4 Investigation: Percentage Composition by Mass of Magnesium Oxide

- Collect experimental evidence to determine the composition, by mass, of magnesium oxide, and calculate the percentage composition.
- Use results to test the validity of the law of constant composition.
- Research information about the career of a gemologist.

### 2.5 Quantitative Analysis: Concentrations of Solutions

- State the difference between % V/V and % W/V concentrations of a solution.
- Discuss when to use ppm, ppb, and ppt to describe concentration.
- Define the term “molar concentration.”

### 2.6 Tech Connect: The Spectrophotometer

- Explain how a spectrophotometer works and how results can be used to determine the concentration of a sample.

- Research information about the career of a chemical laboratory technician.

### 2.7 Activity: Determining the Concentration of a Solution

- Collect experimental evidence to determine the molar concentration of a copper(II) sulfate solution.

### 2.8 Explore an Issue: Drug Testing

- List the types of substances that are banned by the International Olympic Committee, and understand why they are banned.
- Describe ways in which drug tests can produce false positives.

### 2.9 The Mole and Chemical Equations: Stoichiometry

- Determine mole ratios from balanced chemical equations.
- Solve stoichiometric problems.

### 2.10 Limiting and Excess Reagents

- Discuss the roles of the limiting reagent and excess reagent in a chemical reaction.
- Describe how the process of analysis by precipitation works.
- Identify the limiting reagent and excess reagent in a chemical reaction, and perform calculations based on this information.

### 2.11 Investigation: The Limiting Reagent in a Chemical Reaction

- Design and conduct an experiment to determine the excess reagent.
- Organize qualitative and quantitative observations.
- Evaluate the stoichiometric method, as used in the prediction of masses of reactants and products.

### 2.12 Percentage Yield

- Distinguish between the terms “theoretical yield” and “actual yield.”
- Understand the advantages of obtaining maximum percentage yield, particularly as it relates to industry.

### 2.13 Investigation: The Percentage Yield of a Chemical Reaction

- Collect experimental evidence to determine and evaluate the actual yield, theoretical yield, and percentage yield of copper(II) chloride dihydrate and aluminum metal.

- Identify sources of experimental error.

### 2.14 Case Study: The Haber Process

- Understand the Haber process, as well as the factors that affect the Haber process.

## Key Terms

### 2.1

isotopic abundance  
unified atomic mass unit (u)  
atomic mass  
molecular mass  
formula unit mass  
macroscopic  
mole  
Avogadro's constant ( $N_A$ )  
molar mass

### 2.2

molecular element  
compound

### 2.3

law of constant composition  
mass spectrometer  
combustion analyzer  
percentage composition  
empirical formula  
molecular formula

### 2.5

quantitative analysis  
concentration  
molar concentration  
parts per million  
dilution

### 2.9

mole ratio  
stoichiometry

### 2.10

excess reagent  
limiting reagent

### 2.12

yield  
actual yield  
theoretical yield  
percentage yield

## Problems You Can Solve

### 2.1

- Use mass and molar mass to calculate the number of entities.
- Use the periodic table to calculate atomic mass and molecular mass.

### 2.2

- Use mass, amount in moles, molar mass, and number of entities to calculate an unknown value.

### 2.3

- Calculate the empirical formula of a compound.
- Calculate the molecular formula of a compound.
- Calculate the percentage composition by mass of a compound.

### 2.5

- Use the percentage concentration formula to calculate % V/V and % W/V of a solution.
- Use the molar concentration formula to solve for the unknown value.
- Use the dilution concentration formula to solve for the unknown value.

### 2.9

- Use a balanced chemical equation to calculate the masses of the reactants.
- Use a balanced chemical equation to calculate the numbers of entities and the masses of the reactants.

### 2.10

- Use a balanced equation to determine the limiting reagent in a reaction and calculate the mass of a product formed.

### 2.12

- Use actual yield and theoretical yield to calculate percentage yield.

### ▶ MAKE a summary

In this unit, you learned how to calculate a number of different quantities related to compounds and chemical reactions. To summarize your learning, construct two master flow charts on separate sheets of paper. In one flow chart, summarize the calculations related to individual compounds (sections 2.1 to 2.5). In the other flow chart, summarize the calculations based on a balanced chemical equation (sections 2.9 to 2.12).