

Chapter 7 Chemical Reactions

Section 7.5 Equilibrium

(pages 216–219)

This section explains physical and chemical equilibria, and describes the factors that affect chemical equilibrium.

Reading Strategy (page 216)

Outlining As you read, make an outline of the most important ideas from this section. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

I. Equilibrium

A. Types of equilibria

1. Physical equilibrium
2. Chemical equilibrium

B. Factors affecting chemical equilibrium

1. Temperature
2. Pressure
3. Concentration

Types of Equilibria (pages 216–217)

1. Equilibrium is a state in which the forward and reverse paths of a change take place at the same rate.
2. Circle the letter of the correct answer. In the system described by the equation $\text{H}_2\text{O}(l) \rightleftharpoons \text{H}_2\text{O}(g)$, at room temperature, which of the following two physical changes are in equilibrium?
 - a. sublimation and condensation
 - b. evaporation and melting
 - c. evaporation and condensation
3. Circle the letter of the correct answer. What does the single arrow imply about the reaction described in the following equation?
$$\text{CH}_4(g) + 2\text{O}_2(g) \longrightarrow \text{CO}_2(g) + 2\text{H}_2\text{O}(g)$$
 - a. The forward reaction goes to equilibrium.
 - b. The reaction is in equilibrium.
 - c. The reverse reaction goes to completion.

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4. Circle the letter of the correct answer. In the system described by the equation $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$, what two reaction types are in equilibrium?
- a. synthesis and decomposition
 - b. synthesis and double replacement
 - c. synthesis and combustion

Factors Affecting Chemical Equilibrium (pages 218–219)

5. Is the following sentence true or false? A change in reaction conditions does not affect a chemical equilibrium. false
6. Circle the letter of each correct answer. The synthesis of ammonia is described by the equation $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}) + \text{heat}$. Which reaction is favored when the temperature is lowered?
- a. the forward reaction
 - b. the reaction that removes heat from the system
 - c. the reaction that adds heat to the system
7. Circle the letter of each correct answer. During the synthesis of ammonia, which reaction is favored when hydrogen is added to the system?
- a. the forward reaction
 - b. the reverse reaction
 - c. the reaction that removes hydrogen from the system
8. Use the equation $\text{C}(\text{s}) + \text{H}_2\text{O}(\text{g}) + \text{heat} \rightleftharpoons \text{CO}(\text{g}) + \text{H}_2(\text{g})$ to complete the table below.

An Example of Le Châtelier's Principle		
An increase in	Shifts the equilibrium so as to	Favoring the
Temperature, concentration of C, or concentration of H ₂ O	Remove heat	Forward reaction
Pressure	Produce fewer gas molecules	Reverse reaction
Concentration of H ₂	Remove H ₂ , produce fewer gas molecules, or add heat	Reverse reaction