

Name: _____

Student Study Guide

40S

Chemistry

Chemical Equilibrium

Chemical Equilibrium

Before You Read

Review Vocabulary

Define the following terms.

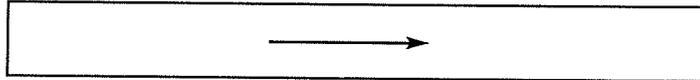
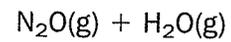
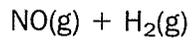
chemical equation

reaction rate

rate law

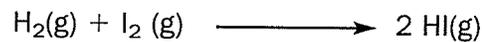
Chapter 9

Balance the chemical equation below.



Chapter 16

Write the rate law for the reaction below.



Rate = _____

Chemical Equilibrium

Section 17.1 A State of Dynamic Balance

Main Idea

Details

Skim Section 1 of your text. Write a statement that describes the nature of equilibrium from your reading of the headings, boldface terms, and illustration captions.

New Vocabulary

Use your text to define each term.

reversible reaction

chemical equilibrium

law of chemical equilibrium

equilibrium constant

homogeneous equilibrium

heterogeneous equilibrium

Section 17.1 A State of Dynamic Balance (continued)

Main Idea _____

Details _____

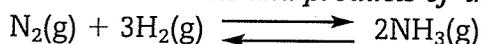
What is equilibrium?

Use with pages 594–598.

Explain reversible reactions by inserting the words left and right in the following statements.

The reactants for the forward reaction are on the _____. The products are on the _____. The reactants for the reverse reaction are on the _____. The products are on the _____.

List the reactants and products of the following reversible reaction.



	Reactants	Products
Forward reaction		
Reverse reaction		

Complete the following statement.

The state in which forward and reverse reactions balance each other because they take place at equal rates is called _____. Although a chemical reaction may be in equilibrium, the _____ and _____ may continually be _____ because chemical equilibrium is a dynamic process.

Equilibrium Expressions and Constants

Use with pages 599–604.

Identify the parts of the equilibrium constant expression.

$$K_{\text{eq}} = \frac{[\text{C}]^c[\text{D}]^d}{[\text{A}]^a[\text{B}]^b}$$

K_{eq} = _____

$[\text{C}][\text{D}]$ = _____

$[\text{A}][\text{B}]$ = _____

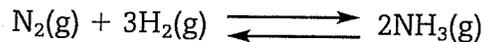
a, b, c, and d = _____

Section 17.1 A State of Dynamic Balance (continued)

Main Idea

Details

Write the equilibrium constant expression for the following balanced chemical equation.

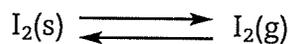


$K_{\text{eq}} =$ _____

Compare and contrast homogeneous equilibrium and heterogeneous equilibrium by completing the following sentences.

Homogeneous equilibrium occurs when _____ and _____ of a reaction are in the _____ physical state. Heterogeneous equilibrium occurs when _____ and _____ of a reaction are in more than _____ physical state. Equilibrium depends on the _____ in the system.

Write the equilibrium expression for this reaction.



REAL-WORLD CONNECTION

is valuable in baking.

Discuss why sodium hydrogen carbonate

Section 17.1 A State of Dynamic Balance (continued)

Main Idea

**The Value of
Equilibrium
Constants***Use with Example
Problem 17.3, page 605.*

Details

Summarize *Fill in the blanks to help you take notes while you read Example Problem 17.3.***Problem**Calculate the value of K_{eq} for the equilibrium constant expression.

$$K_{\text{eq}} = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

1. Analyze the Problem

List the knowns and unknowns.

Known: the equilibrium constant expression:

Known: the concentration of each reactant and product:

[NH₃] = _____[N₂] = _____[H₂] = _____

Unknown: the value of the equilibrium constant

2. Solve for the UnknownSubstitute the _____ into the equilibrium
_____ and calculate its value.

$$K_{\text{eq}} = \frac{\text{_____}}{[0.533]} = \text{_____}$$

3. Evaluate the AnswerThe given concentrations have ____ significant figures, therefore
the answer must have ____ significant figures.

Chemical Equilibrium

Section 17.2 Factors Affecting Chemical Equilibrium

Main Idea

Details

Scan Section 2 of your text. Use the checklist below as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all figures and read the captions.
- Think about what you already know about chemical equilibrium.

Write four facts you discovered about chemical equilibrium.

1. _____
2. _____
3. _____
4. _____

New
Vocabulary

Use your text to define the following term.

Le Châtelier's principle

Section 17.2 Factors Affecting Chemical Equilibrium (continued)

Main Idea

Details

**Applying Le
Châtelier's
Principle**

Use with pages 607–610.

Determine how each of the following changes affects a system in equilibrium. Write a sentence that includes the term(s) in parentheses.

changes in concentration (collisions)

changes in volume (pressure, products)

changes in temperature (endothermic, exothermic)

REAL-WORLD CONNECTION

Describe how your body would relieve the stress placed on it by climbing to a high altitude.

Chemical Equilibrium

Section 17.3 Using Equilibrium Constants

Main Idea

Details

Scan Section 3 of your text. Use the checklist below as a guide.

- Read all section heads.
- Read all boldfaced words.
- Read all the tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about equilibrium constants.

Write three facts you discovered about using equilibrium constants.

1. _____
2. _____
3. _____

New Vocabulary

Use your text to define each term.

solubility product constant

common ion

common ion effect

Section 17.3 Using Equilibrium Constants (continued)

Main Idea

**Calculating
Equilibrium
Concentrations**

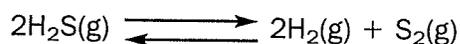
Use with Example
Problem 17.4, page 613.

Details

Summarize Fill in the blanks to help you take notes while you read example Problem 17.4.

Problem

At 1405 K, hydrogen sulfide _____ to form _____ and a diatomic _____ molecule, S₂. The _____ for the reaction is 2.27×10^{-3} .



What is the concentration of H₂(g) if
[S₂] = 0.0540 mol/L and [H₂S] = 0.184 mol/L?

1. Analyze the Problem

List the knowns and unknowns.

Known:

$K_{\text{eq}} =$ _____

[S₂] = _____

[H₂S] = _____

Unknown:

[H₂] = _____

2. Solve for the Unknown

Write the equilibrium constant expression.

$K_{\text{eq}} =$

Substitute known quantities.

Solve for the unknown.

3. Evaluate the Answer

The number of significant figures in the data is _____. Therefore, the number of significant figures in the answer must be _____.

Section 17.3 Using Equilibrium Constants (continued)

Main Idea _____

Details _____

The Solubility Product Constant

Use with pages 614–619.

Describe *solubility equilibrium.*

Identify *the part of the equation that shows equilibrium and circle it.*



Explain *solubility by completing the following statements.*

_____ is the amount of a substance that will _____ in a given volume of _____.

K_{sp} represents the _____.

K_{sp} is the _____ of the concentration _____ each raised to the power equal to the _____ of the ion in the _____.

K_{sp} depends only on the _____ of the _____ in a saturated _____.

Explain *why it benefits doctors to understand solubility.*

Calculating Molar Solubility

Use with Example Problem 17.5, page 616.

Summarize *Fill in the blanks to help you take notes while you read Example Problem 17.5.*

Problem _____

Calculate the solubility in mol/L of copper(II) carbonate (CuCO_3) at 298 K.

1. Analyze the Problem

List the knowns and unknowns.

Known:

Unknown:

$K_{\text{sp}}(\text{CuCO}_3) =$ _____ solubility (CuCO_3) = _____

Section 17.3 Using Equilibrium Constants (continued)

Main Idea

Details

2. Solve for the Unknown

Write the balanced chemical equation.



Write the solubility constant expression (remember only the ions are used).

$$s = [\text{Cu}^{2+}] =$$

Substitute s for $[\text{Cu}^{2+}]$ and

3. Evaluate the Answer

K_{sp} has ___ significant figures so the answer must be expressed with ___ significant figures.

Describe conditions in which precipitates are likely to form.

1. _____
2. _____
3. _____

The Common Ion Effect

Use with pages 620–621.

Discuss the common ion effect by completing the following paragraph.

An ion that is common to two or more ionic compounds is known as a _____. The lowering of the solubility of a substance by the presence of a common ion is called the _____.

Chemical Equilibrium Chapter Wrap-Up

Now that you have read the chapter, review what you have learned.

Describe chemical equilibrium.

Explain *Le Châtelier's principle*.

Review

Use this checklist to help you study.

- Study your Science Notebook for this chapter.
- Study the vocabulary words and scientific definitions.
- Review daily homework assignments.
- Reread the chapter and review the tables, graphs, and illustrations.
- Review the Section Assessment questions at the end of each section.
- Look over the Study Guide at the end of the chapter.

REAL-WORLD CONNECTION

Describe several uses of solubility in your home.

Describe several uses of solubility in your home.
