About the Consultant

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Covalent Bonding

Before You Read

Define the following terms.

ionic bond
octet rule
sigma bond
pi bond
endothermic
exothermic
stable

Describe the structure of an atom.

An atom has a dense central nucleus consisting of neutrons and positively charged protons, which is surrounded by a cloud of fast-moving, negatively charged electrons.

Explain the following concepts: periodic trends and periodic properties of elements.

Periodic trends are the tendencies of the properties of elements to change in a predictable way as you move across a period or down a group. The periodic properties of elements are the chemical or physical characteristics of elements in the periodic table.

Identify the ions, along with their charges, in the following ionic compounds.

Li₂S
KMnO₄
Al₂O₃

Note taking tools based on the Cornell Note-Taking System.

Before You Read helps you review concepts that you will need to know in order to understand the information that will be presented in the chapter.

Vocabulary helps you understand information better.

New Vocabulary

covalent bond
molecule
Lewis structure
sigma bond
pi bond
endothermic
exothermic
stable

Academic Vocabulary

Define the following term.

stable
Writing activities help you understand the information being presented and make connections between the concepts and the real-world.

You Try It problems help you work a problem similar to the Example Problem presented in the text.

The Chapter Wrap-Up helps you assess what you have learned in the chapter and prepare for chapter tests.
Note-Taking Tips

Your notes are a reminder of what you learned in class. Taking good notes can help you succeed in science. The following tips will help you take better classroom notes.

• Before class, ask what your teacher will be discussing in class. Review mentally what you already know about the concept.

• Be an active listener. Focus on what your teacher is saying. Listen for important concepts. Pay attention to words, examples, and/or diagrams you teacher emphasizes.

• Write your notes as clear and concise as possible. The following symbols and abbreviations may be helpful in your note-taking.

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Symbol or Abbreviation</th>
<th>Word or Phrase</th>
<th>Symbol or Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>for example</td>
<td>e.g.</td>
<td>and</td>
<td>+</td>
</tr>
<tr>
<td>such as</td>
<td>i.e.</td>
<td>approximately</td>
<td>≈</td>
</tr>
<tr>
<td>with</td>
<td>w/</td>
<td>therefore</td>
<td>:</td>
</tr>
<tr>
<td>without</td>
<td>w/o</td>
<td>versus</td>
<td>vs</td>
</tr>
</tbody>
</table>

• Use a symbol such as a star (★) or an asterisk (*) to emphasis important concepts. Place a question mark (?) next to anything that you do not understand.

• Ask questions and participate in class discussion.

• Draw and label pictures or diagrams to help clarify a concept.

• When working out an example, write what you are doing to solve the problem next to each step. Be sure to use your own words.

• Review you notes as soon as possible after class. During this time, organize and summarize new concepts and clarify misunderstandings.

Note-Taking Don’ts

• **Don’t** write every word. Concentrate on the main ideas and concepts.

• **Don’t** use someone else’s notes as they may not make sense.

• **Don’t** doodle. It distracts you from listening actively.

• **Don’t** lose focus or you will become lost in your note-taking.
Before you read the chapter, write down four facts you know about chemistry.

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________

Write three questions about scientific methods and research.

1. ____________________________
2. ____________________________
3. ____________________________

Define the following term.

______________________________
Introduction to Chemistry
Section 1.1 The Stories of Two Chemicals

Scan Section 1 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 pictures and read the captions.
• Think about what you already know about ozone and chlorofluorocarbons (CFCs).

Write four facts you discovered about ozone and chlorofluorocarbons (CFCs).
1. ____________________________________________
2. ____________________________________________
3. ____________________________________________
4. ____________________________________________

New Vocabulary

Use your text to define each term.
ozone

chlorofluorocarbon

ozone hole

Academic Vocabulary

Define the following term.
chemical
The Ozone Layer

Use with pages 3–5.

Explain the ozone by completing the following paragraph.

Overexposure to _____________ causes sunburn, is harmful to _____________, lowers _____________, and disrupts _____________. When _____________ is exposed to ultraviolet radiation in the upper regions of the _____________, a chemical called _____________ is formed. About _____________ of Earth’s ozone is spread out in a layer that surrounds and _____________ our planet. Ozone forms over the _____________ and flows toward the _____________.

Sequence the steps necessary for the formation of ozone.

1. __________________________________________________________________________

2. __________________________________________________________________________

3. __________________________________________________________________________

Illustrate the balance between oxygen gas and ozone levels in the stratosphere, using Figure 1-3 in your text as a model. Give it a title and label the parts of your model.
Section 1.1 The Stories of Two Chemicals (continued)

**Main Idea**

### Chlorofluorocarbons

*Use with pages 5–6.*

**Details**

**Analogy** Consider the two pictures in Figure 1-4. Explain in your own words how (a) helps illustrate what is happening in (b).

---

**Analyze** chlorofluorocarbons by completing the following table.

<table>
<thead>
<tr>
<th>CFCs Were First Developed Because:</th>
<th>Facts about CFCs</th>
<th>Uses of CFCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Real-World Connection**

Infer from your reading the potential connection between CFCs and the ozone layer. Use Figure 1-5 and the table in the Section 1.1 Assessment to draw your conclusions.

---

4  *The Stories of Two Chemicals*
Introduction to Chemistry
Section 1.2 Chemistry and Matter

**Main Idea**

**Details**

**Skim** Section 2 of your text. Write four facts that come to mind from reading the headings, boldfaced words, and the illustration captions.

1. 
2. 
3. 
4. 

**New Vocabulary**

*Use your text to define each term.*

- **chemistry**
- **matter**
- **mass**
- **weight**

**Academic Vocabulary**

*Define the following term.*

- **structure**
Section 1.2 Chemistry and Matter (continued)

**Main Idea**

Chemistry: The Central Science
*Use with page 7.*

**Details**

Identify *six substances mentioned in the book that are important in everyday life and are made of chemicals.*

1. 
2. 
3. 
4. 
5. 
6.

Matter and its Characteristics
*Use with pages 8–9.*

**Details**

Compare and contrast *mass and weight using the Venn diagram below.*

- does not reflect gravitational pull on matter
- a measure of the effect of gravitational pull on matter
- a measurement that reflects the amount of matter in an object

![Venn diagram](image-url)
Organize the following terms by arranging them from largest to smallest.
macroscopic, submicroscopic, microscopic

Explain a chemical model by completing the following sentences.
The ________, composition, and ________ of all matter can be explained on a ____________ level. All that we observe depends on _______ and the _______ they undergo. ________ seeks to explain the submicroscopic events that lead to _____________________.
One way to do this is by making a chemical model, a ____________________ of a _____________________.

REAL-WORLD CONNECTION
Analyze the importance of chemistry in our society using the branches of chemistry as examples.
**Skim** Section 2 of your text. Write three questions that come to mind from reading the headings, boldface terms, and illustration captions.

1. 

2. 

3. 

**Use your text to define each term.**

- **scientific method**

- **hypothesis**

- **experiment**

- **control**

- **conclusion**

- **model**

- **theory**

- **scientific law**

**Compare** the terms qualitative data and quantitative data.

New Vocabulary
Section 1.3 Scientific Methods (continued)

**Main Idea**

**Details**

**Compare** the terms independent variable and dependent variable.

**Analyze** whether the characteristics listed below represent qualitative data, quantitative data, or both.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Type of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>the rate at which a candle burns</td>
<td></td>
</tr>
<tr>
<td>a blanket with varying degrees of softness</td>
<td></td>
</tr>
<tr>
<td>sand with a reddish-brown color</td>
<td></td>
</tr>
</tbody>
</table>

**Sequence** the steps of the scientific method.

1. Plan and set up one or more experiments to test one variable at a time.
2. Gather information using both qualitative data and quantitative data.
3. Observe, record, and analyze experimental data.
4. Develop a hypothesis, or tentative explanation based on observations.
5. Develop a theory or a scientific law.
6. Compare findings to the hypothesis, and form a conclusion.
Section 1.3 Scientific Methods (continued)

Main Idea

Analyze Figure 1-13 and the caption information on Molina and Rowland’s model. Explain in words what the model visually predicts about the effect of ultraviolet radiation on CFCs.

Details

Use with page 13.

SYNTHESIZE

Design a simple experiment using the scientific method. Give your experiment a descriptive title. Limit the number of variables you test. Write the steps of the experiment based on the scientific method, including but not limited to hypothesis, analysis, and conclusions. Draw a simple sketch of your experiment, if appropriate, and label the independent, dependent, and control variables.

Title: ____________________________

Steps:

Independent variable(s):

Dependent variable(s):

Control variable(s):
Introduction to Chemistry
Section 1.4 Scientific Research

Skim Section 4 of your text. Write three questions that come to mind from reading the headings, boldfaced terms, and illustration captions.

1. 
2. 
3. 

Use your text to define each term.

pure research

applied research

technology

Define the following terms.

analyze

investigate
Describe scientific investigations by completing the following sentences.

Pure research becomes _____________ when scientists develop a hypothesis based on the data and try to solve a specific problem. _____________ have been made when a scientist reaches a conclusion far different than anticipated. Some wonderful scientific discoveries have been made _____________.

Review Table 1-2 in your text. Write an A if you agree with the statement. Write a D if you disagree with the statement.

___ Return unused chemicals to the stock bottle.
___ It is not safe to wear contact lenses in the lab.
___ Only a major accident, injury, incorrect procedure, or damage to equipment needs to be reported.
___ Graduated cylinders, burettes, or pipettes should be heated with a laboratory burner.

Analyze laboratory safety by responding to the following situations.

1. Explain in your own words why safety goggles and a laboratory apron must be worn whenever you are in the lab.

________________________________________________________________________
________________________________________________________________________

2. State why bare feet or sandals are not permitted in the lab.

________________________________________________________________________
________________________________________________________________________
Section 1.4 Scientific Research (continued)

3. Describe how you would explain to another student why you should not return unused chemicals to the stock bottle.

4. Explain why it is important to keep the balance area clean.

SYNTHESIZE

Some students are conducting an experiment that involves combining sodium and water. Too much sodium is added, which causes a fire. A student reacts by throwing water on the fire, but this only causes the fire to spread. The teacher finally puts the fire out. Based on what you now know about chemistry and lab safety, explain how this could have been avoided.
Now that you have read the chapter, review what you have learned. Fill in the blanks below with the correct word or phrase.

Chemistry is the study of ________________________________.

Matter is anything that has _______ and takes up _______. Mass is ____________________________ and differs from weight in that it does not measure the effect of __________________ on matter.

The steps of the scientific process include:

________________________________________

________________________________________

Two types of scientific investigation are:

________________________________________

**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**

Explain three ways you use chemistry in daily life.

1. __________________________
2. __________________________
3. __________________________
## Data Analysis

### Before You Read

**Review Vocabulary**

Define the following terms.

**qualitative data**

**quantitative data**

**variable**

**analysis**

---

### Chapter 1

You and a friend are making sweetened iced tea. You both have different opinions about how much sugar to add and at what temperature is best to add the sugar. Design an experiment to find out how much sugar will dissolve at three different temperatures. In your experiment, identify the following:

- Qualitative data
- Quantitative data
- Independent variable
- Dependent variable
Data Analysis
Section 2.1 Units of Measurement

Main Idea

Skim Section 1 of your text. Write a question you have about each of the three types of units discussed in this section.

1. 

2. 

3. 

New Vocabulary

base unit

Use your text to define each term.

 density

Match the SI base units below with their functions.

 second distance

 meter temperature

 kilogram time

 liter mass

 kelvin volume

Academic Vocabulary

ratio

Define the following term.


16 Units of Measurement
Section 2.1 Units of Measurement (continued)

**Main Idea**

**SI Units**

**Base Units**
Use with page 26.

**Derived Units**
Use with pages 27–28.

**Details**

**Identify** five items around your home that use SI units of measurement.

1. 

2. 

3. 

4. 

5. 

**Organize** these prefixes from smallest to largest.

- pico
- micro
- deci
- kilo
- mega
- giga
- nano
- milli
- centi

**Explain** density by completing the following statement and equation.

Density is a ______ that ______ the _____ of an object to its ______.

density = ______
Using Density and Volume to Find Mass

Use with Example Problem 2-1, page 29.

**Main Idea**

**Details**

Solve Read Example Problem 2-1 in your text.

You Try It

**Problem**

Determine the mass of an object that, when placed in a 25-mL graduated cylinder containing 14 mL of water, causes the level of the water to rise to 19 mL. The object has a density of 3.2 g/mL.

1. **Analyze the Problem**
   Known:
   Unknown:
   You know the density and the volume of an object and must determine its mass; therefore, you will calculate the answer using the density equation.

2. **Solve for the Unknown**
   Write the density equation.

   \[ \text{mass} = \frac{\text{density} \times \text{volume}}{\text{density}} \]

   Rearrange the density equation to solve for mass.

   \[ \text{density} = \frac{\text{mass} \times \text{density}}{\text{volume}} \]

   Substitute the known values for density and volume into the equation.

   \[ \text{Density} = \frac{16 \text{ g}}{5.0 \text{ mL}} = 3.2 \text{ g/mL} \]

   Multiply the values and units. The mL units will cancel out.

   mass = ______ × ______ = ___

3. **Evaluate the Answer**
   The two sides of the equation should be equal.
   density = ____________
   If you divide 16 g by 5.0 mL, you get ______

**Temperature**

Use with page 30.

**Compare and contrast** the kelvin scale and the Celsius scale.
**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 pictures and read the captions.
- Think about what you already know about this subject.

*Write three facts you discovered about scientific notation and dimensional analysis.*

1. 
2. 
3. 

**New Vocabulary**

*Use your text to define each term.*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>scientific notation</td>
<td></td>
</tr>
<tr>
<td>conversion factor</td>
<td></td>
</tr>
<tr>
<td>dimensional analysis</td>
<td></td>
</tr>
</tbody>
</table>

**Academic Vocabulary**

*Define the following term.*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>convert</td>
<td></td>
</tr>
</tbody>
</table>
Solve Read Example Problem 2-2 in your text.

You Try It

Problem

Change the following data into scientific notation:

a. The distance between Pluto and the Sun is 5,913,000 km.

b. The density of nitrogen gas, a major component of Pluto’s atmosphere, is .001,250,6 g/cm³.

1. Analyze the Problem

Known:  

Unknown:  

You are given two measurements. In both cases, the answers will be factors between 1 and 10 that are multiplied by a power of ten.

2. Solve for the Unknown

Move the decimal point to produce a factor between 1 and 10. Count the number of places the decimal point moved and the direction.

The decimal point moved __ places to the __.

Remove the extra zeros at the end or beginning of the factor. Multiply the result by $10^n$ where $n$ equals the _______

When the decimal point moves to the left, $n$ is a ______ number. When the decimal point moves to the right, $n$ is a ______ number. Remember to add units to the answers.

a. __________

b. __________

3. Evaluate the Answer

The answers have ___ factors. The first factor is a number between __ and __. In answer a, because the distance to Pluto is a large number, $10$ has a __________. In answer b, because the density of nitrogen gas is a very small number, the exponent is ______.
Using Multiple
Conversion Factors

Use with Example
Problem 24, page 35.

Solve Read Example Problem 2-4 in your text.

You Try It

Problem

The Cassini probe heading toward Saturn will reach speeds of 5.2 kilometers per second. How many meters per minute would it travel at this speed?

1. Analyze the Problem
   Known: 
   Unknown:
   You need conversion factors that relate kilometers to meters and seconds to minutes. A conversion factor is a _____ of ___________ used to express ____________ in ____________.

2. Solve for the Unknown
   First convert kilometers to meters. Set up the conversion factor so that the kilometer units will cancel out.
   \[
   \frac{5.2 \text{ km}}{s} \times \frac{1000 \text{ m}}{1 \text{ km}} = \frac{m}{s}
   \]
   Next convert seconds to minutes. Set up the conversion factor so that the seconds will cancel out.
   \[
   \frac{5200 \text{ m}}{s} \times \frac{60 \text{ s}}{1 \text{ min}} = \frac{m}{\text{min}}
   \]

3. Evaluate the Answer
   To check your answer, you can do the steps in reverse order.
   \[
   \frac{5.2 \text{ km}}{s} \times \frac{60 \text{ s}}{1 \text{ min}} = \frac{312 \text{ km}}{\text{min}} \times \frac{1000 \text{ m}}{\text{min}} = \frac{\text{km}}{\text{min}}
   \]
Data Analysis
Section 2.3 How reliable are measurements?

Skim Section 3 of your text. Focus on the headings, subheadings, boldfaced words, and main ideas. Summarize the main ideas of this section.

Main Idea

Details

New Vocabulary

Use your text to define each term.

accuracy

precision

percent error

significant figure

Academic Vocabulary

Define the following term.

device
Section 2.3 How reliable are measurements? (continued)

Main Idea

Percent Error
Use with page 37.

Calculating Percent Error
Use with Example Problem 2-5, page 38.

Details

Explain percent error by completing the statement and equation below.
Percent error is the _____ of an _____ to an _____________.

Percent error = ______ \times \_

Solve Read Example Problem 2-5 in your text.

You Try It

Problem

Calculate the percent errors. Report your answers to two places after the decimal point. The table below summarizes Student B’s data.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Density (g/cm³)</th>
<th>Error (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.4</td>
<td>-.19</td>
</tr>
<tr>
<td>2</td>
<td>1.68</td>
<td>.09</td>
</tr>
<tr>
<td>3</td>
<td>1.45</td>
<td>-.14</td>
</tr>
</tbody>
</table>

1. Analyze the Problem

Known:

Unknown:

Use the accepted value for density and the errors to calculate percent error.

2. Solve for the Unknown

Substitute each error into the percent error equation.

\[
\text{percent error} = \frac{\text{error}}{\text{accepted value}} \times 100
\]

\[
\text{percent error} = \frac{.19}{1.59 \text{ g/cm}^3} \times 100 = \_
\]

\[
\text{percent error} = \frac{.09}{1.59 \text{ g/cm}^3} \times 100 = \_
\]

\[
\text{percent error} = \frac{.14}{1.59 \text{ g/cm}^3} \times 100 = \_
\]

3. Evaluate the Answer

The percent error is greatest for trial __ which had the largest error, and smallest for trial __ which was closest to the accepted value.
Identify the significant numbers below by drawing a circle around them. Use the five rules for recognizing significant digits on page 39 for reference.

0.00

Explain the rules for rounding numbers by completing the following sentences. Then complete the example of each rule for rounding numbers.

1. If the digit to the immediate right of the last significant figure is less than five, _________________
   3.751 _____

2. If the digit to the immediate right of the last significant figure is greater than five, _________________
   4.127 _____

3. If the digit to the immediate right of the last significant figure is equal to five and is followed by a nonzero digit, _________________
   8.3253 _____

4. If the digit to the immediate right of the last significant figure is equal to five and is not followed by a nonzero digit, look at the last significant figure. _________________

   1.4750 = ___; 1.4650 = ___
Data Analysis
Section 2.4 Representing Data

Scan Section 4 of your text. Use the checklist below as a guide.

- Read all section titles.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about data analysis.

Write facts you learned about representing data as you scanned the section.

1. 
2. 
3. 

New Vocabulary

Use your text to define the following term.

graph

Academic Vocabulary

Define the following terms.

identify

interpret

data
Graphing

Use with page 43.

Draw and label (a) a circle graph and (b) a bar graph using the information in the table below.

<table>
<thead>
<tr>
<th>Student Budget</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget items</td>
<td>Percent</td>
</tr>
<tr>
<td>Car insurance</td>
<td>45</td>
</tr>
<tr>
<td>Movies</td>
<td>6</td>
</tr>
<tr>
<td>Books</td>
<td>5</td>
</tr>
<tr>
<td>Clothing</td>
<td>30</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>4</td>
</tr>
<tr>
<td>Gas</td>
<td>10</td>
</tr>
</tbody>
</table>

The _____________ best displays the data in the Student Budget table because ________________________________________________________________________________.
Section 2.4 Representing Data (continued)

**Main Idea**

**Line Graphs**

*Use with pages 44–45.*

**Details**

**Identify** each of the following slopes.

_____ slope  

_____ slope

**Analyze** whether the following sequences will likely plot as linear or nonlinear relationships.

**Sequence A:**  
Result 1: 2  
Result 2: 4  
Result 3: 7  
Result 4: 10  
Answer: _____

**Sequence B:**  
Result A: 31  
Result B: 27  
Result C: 49  
Result D: 45  
Answer: _____

**Interpreting Graphs**

*Use with page 45.*

**Organize** information about interpreting graphs by completing the sentences below.

Information on a graph typically consists of ____ types of variables: _________ variables and _________ variables.

The relationship between the variables may reflect either a _________ or a _________ slope.

When reading the graph, you use either interpolation for _________  
__________ or _________ for estimated values beyond the plotted points.
Data Analysis  Chapter Wrap-Up

Now that you have read the chapter, review what you have learned. Write out the key equations and relationships.

density =

percent error = \times 100

slope =

Conversion between temperature scales:

°C + ___ = ___

K - ___ = ___

Review

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.
☐ Study the definitions of vocabulary words.
☐ 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.

SUMMARIZE

If you were a scientist, what precautionary guidelines would you use to ensure the accuracy of your data and to provide a clear representation of that data?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Matter—Properties and Changes

Before You Read

Define the following terms.

**matter**

**significant figure**

**Chapter 2**

Measure the height and arm length for five friends or family members. In the space below, create an appropriate graph to represent the data you collected.

Compare and contrast circle, bar and line graphs.
Skim Section 1 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. __________________________________________
2. __________________________________________
3. __________________________________________

Use your text to define each term.

substance __________________________________________

physical property __________________________________________

extensive property __________________________________________

intensive property __________________________________________

chemical property __________________________________________

states of matter __________________________________________

describe vapor __________________________________________

Match each of the following states of matter with its physical description

solid flows and fills the entire volume of its container
liquid has definite shape and volume
gas flows and has a constant volume

Define the following term.

unique __________________________________________
### Main Idea

<table>
<thead>
<tr>
<th>Physical and Chemical Properties of Matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use with pages 56–57.</td>
</tr>
</tbody>
</table>

### Details

<table>
<thead>
<tr>
<th>Contrast intensive and extensive physical properties.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Describe how the person in Figure 3-1 uses the physical property of density to separate gold from pyrite (fool’s gold).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List several physical properties and explain why they are used more than chemical properties in the identification of objects.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compare the properties of water at room temperature with water that has a temperature greater than 100 °C.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Observed Properties of Matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use with pages 57–58.</td>
</tr>
</tbody>
</table>
Section 3.1 Properties of Matter (continued)

Main Idea

States of Matter
Use with pages 58–59.

Compare the way the three common states of matter fill a container.

Details

Meteorologists (scientists who study weather) refer to water in the gaseous state in the atmosphere as water vapor. Explain why this term is used.
Matter—Properties and Changes
Section 3.2 Changes in Matter

Main Idea

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 pictures and read the captions.
- Think about what you already know about this subject.

Write three facts you discovered about changes in matter.
1. 
2. 
3. 

New Vocabulary

Use your text to define each term.
physical change

chemical change

law of conservation of mass

Academic Vocabulary

Define the following term.
constant
Physical and Chemical Changes

Use with pages 61–62.

Determine which type of change each statement represents. Use P for physical change and C for chemical change. Explain your answers.

silver spoon tarnishes __
   Explanation: ____________________________

crushing an aluminum can __
   Explanation: ____________________________

freezing water __
   Explanation: ____________________________

burning wood __
   Explanation: ____________________________

copper turns a greenish color __
   Explanation: ____________________________

grind coffee beans __
   Explanation: ____________________________

Describe how iron turns into a brownish-red powder. Name the reactants and product that are involved

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
Section 3.2 Changes in Matter (continued)

### Main Idea

**Conservation of Mass**

Use with Example Problem 3-1, page 64.

### Details

**Summarize** Fill in the blanks to help you take notes while you read Example Problem 3-1.

**Problem**

The total _____ of the products must _____ the total mass of the _________. This shows the law of ____________________.

1. **Analyze the Problem**
   - Known:
   - Unknown:

2. **Solve for the Unknown**
   - Write an equation showing conservation of mass of reactants and products.
   - Mass of ______ = mass of ______ + mass of ______
   - Write an equation to solve for the mass of oxygen.
   - Mass of ______ = mass of _______ − mass of ______
   - Substitute known values and solve.
   - Mass of oxygen = ______ g − ______ g
   - Mass oxygen = ______ g

3. **Evaluate the Answer**
   - Write an equation that shows mass of the two products equals the mass of the reactant.
   - _____ g mercury + _____ g oxygen = _____ g mercury(II) oxide
### Matter—Properties and Changes

**Section 3.3 Mixtures of Matter**

#### Main Idea

**Scan** Section 3 of your text. Use the checklist below as a guide.
- Read all section titles.
- Read all boldfaced words.
- Read all charts and graphs.
- Look at all pictures and read the captions.

**List** three facts you have learned about mixtures.
1. 
2. 
3. 

#### Details

**New Vocabulary**

*Use your text to find the correct term for each definition.*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>mixture</td>
<td></td>
</tr>
<tr>
<td>heterogeneous mixture</td>
<td></td>
</tr>
<tr>
<td>homogeneous mixture</td>
<td></td>
</tr>
<tr>
<td>solution</td>
<td></td>
</tr>
<tr>
<td>filtration</td>
<td></td>
</tr>
<tr>
<td>distillation</td>
<td></td>
</tr>
<tr>
<td>crystallization</td>
<td></td>
</tr>
<tr>
<td>chromatography</td>
<td></td>
</tr>
</tbody>
</table>

**Academic Vocabulary**

*Define the following term.*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>component</td>
<td></td>
</tr>
</tbody>
</table>
Section 3.3 Mixtures of Matter (continued)

<table>
<thead>
<tr>
<th>Main Idea</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mixtures</strong></td>
<td><strong>Describe</strong> how mixtures relate to substances.</td>
</tr>
<tr>
<td>Use with page 66.</td>
<td></td>
</tr>
<tr>
<td><strong>Contrast</strong> heterogeneous and homogeneous mixtures.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Separating Mixtures</strong></td>
<td><strong>Describe</strong> what an alloy is and why alloys are used.</td>
</tr>
<tr>
<td>Use with pages 68–69.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Identify</strong> four techniques that take advantage of different physical properties in order to separate mixtures and describe how each is done.</td>
<td></td>
</tr>
<tr>
<td>Technique 1:</td>
<td>How it is done:</td>
</tr>
<tr>
<td>Technique 2:</td>
<td>How it is done:</td>
</tr>
<tr>
<td>Technique 3:</td>
<td>How it is done:</td>
</tr>
</tbody>
</table>
Main Idea

Technique 4: __________
How it is done: ____________________________
______________________________

Sequence the steps of separating a mixture of sand, salt, and iron filings. Identify which physical property you were using in each step.

1. Mix the sand and salt mixture with water.
   Physical property used: ____________________________
   ________________________________

2. Boil the salt and water mixture, leaving the salt behind.
   Physical property used:
   ________________________________

3. Separate the iron filings from the sand and salt by using a magnet.
   Physical property used: ____________________________
   ________________________________

4. Use filtration to separate the sand from the salt and water.
   Physical property used: ____________________________
   ________________________________

Real-World Connection

Crude oil (petroleum) is a mixture of several materials, including gasoline, kerosene, diesel fuel, and heating oil. Describe whether you think distillation or filtration would be a better method to separate the products of crude oil. Hint: each of the products listed has a different boiling point.
Scan Section 4 of your text. Review the periodic table of elements in Figure 3-18. Record some observations about how the table is organized and what information you can determine just by looking at the table.

New Vocabulary

*element*

*periodic table*

*compound*

*law of definite proportions*

*percent by mass*

*law of multiple proportions*

Academic Vocabulary

*stable*

Use your text to define each term.

**element**

**periodic table**

**compound**

**law of definite proportions**

**percent by mass**

**law of multiple proportions**

Define the following term.

**stable**
Discuss elements and compounds by completing the following paragraph.

There are ___ naturally occurring elements. Seventy-five percent of the universe is _______. The Earth's crust and the human body are made of different elements. But _______ is an element that is abundant in both. Most objects are made of ________ with approximately ten million known and over ______ being developed and discovered every _____.

Analyze the concept map for matter in Figure 3-17. Write a brief description of the information the concept map is conveying.

Describe how the periodic table organizes elements.

Explain how Figure 3-20 illustrates the fact that the properties of a compound are different from the properties of its component elements.
Section 3.4 Elements and Compounds (continued)

Main Idea

Law of Definite Proportions
Use with page 75.

**Describe** how to do percent by mass by completing the following paragraph.
The _____ of a compound is _____ to the _____ of the masses of the ________ that make up the compound. This demonstrates the law of _____________________.

Analyze the law of definite proportions by indicating whether the following examples are for identical or different compounds.

<table>
<thead>
<tr>
<th>Description</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound 1 consists of 24g of Na, and 36g of Cl. Compound 2 has 36g of Na and 54g of Cl.</td>
<td></td>
</tr>
<tr>
<td>Compound 3 has 10.00g of lead and 1.55g of sulfur. Compound 4 has 10.00g of lead, 1.55g of sulfur, and 1.55g of carbon.</td>
<td></td>
</tr>
</tbody>
</table>

Main Idea

Law of Multiple Proportions
Use with pages 76–77.

**Describe** the law of multiple proportions by completing the following statement.
When different _________ are formed by combining the same ________, different masses of one element combine with the same ________ of the other element in a ratio of _________________.

SYNTHEZISE
Carbon combines with oxygen to form two compounds, carbon monoxide and carbon dioxide. Based on the law of multiple proportions, describe how the proportions of oxygen in the two compounds relate to each other.
Chapter Wrap-Up

Matter—Properties and Changes

After reading this chapter, list three things you have learned about the properties and changes in matter.

1. ______________________________________________________________
2. ______________________________________________________________
3. ______________________________________________________________

Review

Use this checklist to help you study.

☐ Use this Science Notebook to study 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

Explain how understanding the physical and chemical properties of matter can help find alternatives to the burning of fossil fuels, thus reducing the amount of harmful greenhouse gases released into the atmosphere.

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

42 Chapter Wrap-Up
The Structure of the Atom

Before You Read

Review Vocabulary

Define the following terms.

scientific law


theory


element


law of definite proportions


law of multiple proportions


Describe three things that you already know about the atom.

1. 

2. 

3. 
The Structure of the Atom

Section 4.1 Early Theories of Matter

Scan Section 1 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 pictures and read the captions.
- Think about what you already know about this subject.

List three things you expect to learn about while reading the section.

1. ________________________________________________
2. ________________________________________________
3. ________________________________________________

Use your text to define each term.

Dalton’s atomic theory

atom

Define the following term.

accurate

conclude

reveal
The Philosophers
Use with pages 87–89.

Summarize the effect that Aristotle had on the atomic theory proposed by Democritus.

List the main points of Dalton’s atomic theory.
1. 
2. 
3. 
4. 
5. 

Discuss Dalton’s ideas by completing the following paragraph.
After years of studying _____________, Dalton was able to accurately determine the __________ of the elements involved in the reactions. His conclusions resulted in the ____________, which helped to explain that ________ in chemical reactions separate, ________, or __________, but are not created, __________, or __________.
**Main Idea**

Compare and contrast the atomic theories of Democritus and Dalton. Mark an X under each name if a statement in the table applies to that person's theory.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Democritus</th>
<th>Dalton</th>
</tr>
</thead>
<tbody>
<tr>
<td>All matter is made of tiny pieces.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Matter is made of empty space through which atoms move.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atoms cannot be divided.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Atoms cannot be created.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atoms cannot be destroyed.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Different atoms combine in whole-number ratios to form compounds.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The properties of atoms vary based on shape, size, and movement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Different kinds of atoms come in different sizes and shapes.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Details**

**Defining the Atom**

*Use with pages 90–91.*

**Real-World Connection**

The experiments of the alchemists revealed the properties of some metals and provided the foundation for the science of chemistry. Although not successful, alchemy proved beneficial to science. Explain how this example can be applied to modern research.

---

**Explain an atom by completing the following statements.**

The atom is the ____________________________________________

_________________________________________________________________

When a group of atoms ________________ and act as a ____________, the result is known as a ____________.
The Structure of the Atom

Section 4.2 Subatomic Particles and the Nuclear Atom

**Main Idea**

**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 pictures and read the captions.
- Think about what you already know about this subject.

**Write** three facts you discovered about subatomic particles.

1. ________________________________
2. ________________________________
3. ________________________________

**New Vocabulary**

*Use your text to define each term.*

- cathode ray
- electron
- nucleus
- proton
- neutron

**Academic Vocabulary**

*Define the following term.*

- concentrate
Discovering the Electron
Use with pages 92–94.

Main Idea

Summarize the information you learned from cathode ray experiments. Use Figure 4-8 for reference.

Details

Identify the major discoveries about subatomic particles made by the 19th century.

1. 
2. 
3. 

Cathode Ray Experiment

Altering the gas in the tube and the material used for the cathode have no effect.

Cathode ray is deflected toward the positively charged plate by an electric field.

Proves:

Cathode ray is deflected in a magnetic field.

Indicates:

Proves:
Describe Rutherford’s model of the atom by completing the following statements.

1. Most of an atom consists of __________ moving __________ through ____________.
2. The electrons are ________ within the atom by their _________ to the positively charged ____________.
3. The volume of __________ through which the electrons move is many times ________ than the volume of the ________.

Organize the properties of subatomic particles by completing the table below. Use Table 4-1 for reference.

<table>
<thead>
<tr>
<th></th>
<th>Electron</th>
<th>Proton</th>
<th>Neutron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td>____________</td>
</tr>
<tr>
<td>Relative electrical charge</td>
<td></td>
<td>1+</td>
<td></td>
</tr>
</tbody>
</table>
**Main Idea**

**Details**

**Skim** Section 3 of your text. Focus on the headings, boldfaced words, and main ideas. Then summarize the main ideas of this section.

1. 

2. 

3. 

**New Vocabulary**

In the left margin, write the term defined below.

- the number of protons in an atom
- atoms with the same number of protons but different numbers of neutrons
- the sum of the number of protons and neutrons in the nucleus
- 1/12 the mass of a carbon-12 atom; the standard unit of measurement for the mass of atoms
- the weighted average mass of the isotopes of an element

**Academic Vocabulary**

Define the following term.

**percent**
Section 4.3 How Atoms Differ (continued)

Main Idea

Atomic Number
Use with page 98.

Details

Explain how to use an atomic number to identify an element by completing the paragraph below.

Each _______ of an element has a unique number of _________. Since the overall charge of an atom is _________ the number of ________ equals the number of _________. Atomic number = number of _________ = number of _________. If you know how many one of the three an atom contains, you also know the other _________. Once you know the _____________, the __________ can be used to find the name of the _________.

Solve Read Example Problem 4-1 in your text.

You Try It

Problem

Given the following information about atoms, determine the name of each atom’s element and its atomic number.

a. Atom 1 has 11 protons  b. Atom 2 has 20 electrons

1. Analyze the Problem
Apply the relationship among atomic number, number of protons, and number of electrons to determine the name and atomic number of each element.

2. Solve for the Unknown

a. Atom 1
Atomic number = number of protons = number of electrons
Atomic number = ______ = number of electrons
An element with an atomic number of 11 is ____________.

b. Atom 2
Atomic number = number of protons = number of electrons
Atomic number = number of protons = ______
An element with an atomic number of _____ is ____________.

3. Evaluate the Answer
The answers agree with ________________ and element _______________ given in the periodic table.
Isotopes and Mass Number

Use with page 100.

Review your understanding of isotopes and mass number by completing the following paragraph.

Isotopes are elements with ______________ but with ______________. The number of neutrons can be determined by ______________ the atomic number from the ______________. The mass number is ______________.

Solve Read Example Problem 4-2 in your text.

You Try It

Problem

You are given two samples of carbon. The first sample, carbon-12, has a mass number of 12, the second sample, carbon-13, has a mass number of 13. Both samples have an atomic number of 6. Determine the number of protons, electrons, and neutrons in each sample.

1. Analyze the Problem

Known:

<table>
<thead>
<tr>
<th>Carbon-12</th>
<th>Carbon-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass number is</td>
<td>Mass number is</td>
</tr>
<tr>
<td>Atomic number is</td>
<td>Atomic number is</td>
</tr>
</tbody>
</table>

Unknown:

The number of protons, electrons, and neutrons in each sample.

2. Solve for the Unknown

Number of protons = number of electrons = atomic number = __

Number of neutrons = mass number – atomic number

The number of neutrons for carbon-12 = 12 – 6 = __

The number of neutrons for carbon-13 = 13 – 6 = __

3. Evaluate the Answer

The number of neutrons does equal the ______________ minus the ______________, or the number of protons.
**Main Idea**

**Mass of Individual Atoms**
*Use with page 102.*

**Calculating Atomic Mass**
*Use with Example Problem 4-3, page 103.*

---

**Details**

**Explain** why the mass number for chlorine is more than 35. Use Figure 4-17 for reference.

Elements can have several isotopes. Each isotope has a different number of neutrons. Therefore each isotope has a different mass. The atomic mass of an element is a weighted average mass of all the isotopes of that element.

**Summarize** Fill in the blanks to help you take notes while you read Example Problem 4-3.

**Problem**

Given the ______ in the table in the left margin, ________ the ______ of unknown element X. Then, ________ the unknown ______, which is used ________ to treat some ________.

1. **Analyze the problem**
   Known: Unknown:
   For isotope $^6X$: mass = ________ of $X = ?$ amu
   abundance = ________
   For isotope $^7X$:
   mass = ________
   abundance = ________

2. **Solve for the unknown**
   Mass contribution = (________)(________)
   For $^6X$: Mass contribution = ________ = ________
   For $^7X$: Mass contribution = ________ = ________
   Sum the mass contributions to find the atomic mass.
   ________ of $X = ________ = ________
   Use the __________ to identify the element.
   The element with an atomic mass of 6.941 amu is ________.

3. **Evaluate the answer**
   The number of neutrons does equal the ________ minus the ________, or number of ________.

---

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Mass (amu)</th>
<th>Percent abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^6X$</td>
<td>6.015</td>
<td>7.5%</td>
</tr>
<tr>
<td>$^7X$</td>
<td>7.016</td>
<td>92.5%</td>
</tr>
</tbody>
</table>
**The Structure of the Atom**

**Section 4.4 Unstable Nuclei and Radioactive Decay**

### Main Idea

**Skim** Section 4 of your text. Write two questions that come to mind from reading the headings, and the captions.

1. ____________________________
2. ____________________________

### New Vocabulary

**Use your text to define each term.**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>nuclear reaction</td>
<td></td>
</tr>
<tr>
<td>radioactivity</td>
<td></td>
</tr>
<tr>
<td>radiation</td>
<td></td>
</tr>
<tr>
<td>radioactive decay</td>
<td></td>
</tr>
<tr>
<td>alpha radiation</td>
<td></td>
</tr>
<tr>
<td>alpha particle</td>
<td></td>
</tr>
<tr>
<td>nuclear equation</td>
<td></td>
</tr>
<tr>
<td>beta radiation</td>
<td></td>
</tr>
<tr>
<td>beta particle</td>
<td></td>
</tr>
<tr>
<td>gamma ray</td>
<td></td>
</tr>
</tbody>
</table>
Radioactivity

Use with pages 105–106.

Explain radioactivity by completing the paragraph below.

In chemical reactions, atoms may be __________ , but their __________ do not change. The rearrangement __________ only the __________ of the atoms, not the __________ . __________ are different. In nuclear reactions, __________ gain stability by emitting __________ . As a result of __________ in the nuclei, the atoms’ __________ change. __________ will continue emitting __________ , in a process called __________ , until stable nuclei, often of a __________ , are formed.

Sequence the steps of a nuclear reaction.

___ A stable, nonradioactive atom is formed.
___ Radiation is emitted.
___ The process of radioactive decay continues until the nucleus is stable.
___ An atom has an unstable nucleus.

Distinguish between alpha, beta, and gamma radiation by completing the table below.

<table>
<thead>
<tr>
<th>Radiation Type</th>
<th>Alpha</th>
<th>Beta</th>
<th>Gamma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
<td>$\frac{1}{2}$ He</td>
<td>1/1840</td>
<td>0</td>
</tr>
<tr>
<td>Mass (amu)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discuss why some elements are radioactive while most elements are not.
The Structure of an Atom  Chapter Wrap-Up

Now that you have read the chapter, review what you have learned. List three important things you learned about the structure of an atom.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Review

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.

☐ Study the definitions of vocabulary words.

☐ 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

Radioactive materials are used in power plants and for medical uses. Some people object to the widespread use of nuclear reactors and radioactive materials. Discuss how what you’ve learned in this chapter affects your view on the use of radioactive materials.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
Electrons in Atoms

Before You Read

**Chapter 4**

Review the structure of the atom by completing the following table.

<table>
<thead>
<tr>
<th>Part of the Atom</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>proton</td>
<td>centrally located part of the atom that contains protons and neutrons</td>
</tr>
<tr>
<td>electron</td>
<td>subatomic particle with no charge found in the _________</td>
</tr>
</tbody>
</table>

Draw a typical atom and label the structures.

Identify three facts about electrons.

Example: Electrons are a part of the structure of an atom.

1. ____________________________________

2. ____________________________________

3. ____________________________________
Light and Quantized Energy

Electrons in Atoms
Section 5.1 Light and Quantized Energy

Main Idea

Scan Section 1 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 pictures and read the captions.

Write three facts you discovered about light.
1. 
2. 
3. 

Details

New Vocabulary

Use your text to define each term.

- electromagnetic radiation
- wavelength
- frequency
- amplitude
- electromagnetic spectrum
- quantum
- Planck’s constant
- photoelectric effect
- photon
- atomic emission spectrum
List the three reasons scientists found Rutherford’s nuclear atomic model to be fundamentally incomplete.

1. 

2. 

3. 

Explain the relationship shown by the figure below. Use the following terms: wavelength, frequency, amplitude, and speed.
Main Idea

Calculating Wavelength of an EM Wave

Use with Example Problem 5-1, page 121.

Details

Solve Read Example Problem 5-1 in your text.

You Try It

Problem

Radio waves are used to transmit information on various channels. What is the wavelength of a radio wave having the frequency of $5.40 \times 10^{10}$ Hz?

1. Analyze the Problem

Known: $\nu =$ ______ and $c =$ ______

Unknown: $\lambda =$ ______

You know that because radio waves are part of the electromagnetic spectrum, their speed, frequency, and wavelength are related by the formula $c = \lambda \nu$.

2. Solve for the Unknown

Solve the equation relating the speed, frequency, and wavelength of an electromagnetic wave for wavelength ($\lambda$).

If $c = \lambda \nu$, then $\lambda =$ _____

Substitute $c$ and the frequency of the radio wave, $\nu$, into the equation. Note that hertz is equivalent to $1/s$ or $s^{-1}$.

$\lambda =$

Divide the values to determine wavelength, $\lambda$, and cancel units as required.

$\lambda =$

3. Evaluate the Answer

The answer is correctly expressed in a unit of ____________ .

Both of the known values in the problem are expressed with ____ significant figures, so the answer must have ____ significant figures.
Particle Nature of Light

Use with page 122.

Identify two facts the wave model of light failed to explain.
1. ____________________________
   ____________________________
2. ____________________________
   ____________________________

Describe Planck’s quantum concept by completing the following statement.
The quantum concept concludes that matter can gain or lose _______ only in small, specific amounts called _______.
A quantum is the minimum amount of energy that can be _______ or _______ by an atom.

Compare and contrast Einstein’s equation with Planck’s equation by completing the following sentence.
Planck’s equation, ________, demonstrates mathematically that the energy of a quantum is related to the _______ of the emitted radiation. Einstein went further by explaining that, in addition to its wavelike characteristics, a beam of light can be thought of as a stream of _______ called ________.

Contrast the continuous electromagnetic spectra and the atomic emission spectra.
Electrons in Atoms
Section 5.2 Quantum Theory and the Atom

Main Idea

Skim Section 2 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 
2. 
3. 

New Vocabulary

Use your text to define each term.

ground state

de Broglie equation

Heisenberg uncertainty principle

quantum mechanical model of the atom

atom orbital

principal quantum number

principal energy level

energy sublevel

Academic Vocabulary

Define the following term.

interact
Section 5.2 Quantum Theory and the Atom (continued)

**Main Idea**

**Bohr Model of the Atom**
Use with page 127.

**Details**

Classify the characteristics of each series in hydrogen’s line spectrum. Include the following information.

1. Beginning orbit(s)/ending orbit
2. Description of the spectral lines

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Balmer</td>
<td>Paschen</td>
<td>Lyman</td>
</tr>
<tr>
<td>1.</td>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
<td>2.</td>
</tr>
</tbody>
</table>

**Sequence**
de Broglie’s process in developing his equation by completing the flow chart below.

Whole ______ of ______ are allowed in a circular orbit of fixed ______.

Light has both ______ and ______ characteristics.

Can particles of matter, including electrons, behave like ______?

If an electron has ______ and is restricted to circular orbits of fixed radius, the ______ is allowed only certain possible wavelengths, ______, and ______.
Section 5.2 Quantum Theory and the Atom (continued)

Main Idea
The Heisenberg Uncertainty Principle
Use with page 131.

Details
Discuss how Heisenberg’s principle influenced Schrödinger to develop his wave equation.

Hydrogen’s Atomic Orbitals
Use with page 133.

Identify four facts about atomic orbitals by completing the following statements.
1. ____________________________ indicate the relative sizes and energies of atomic orbitals.
2. The atom’s major energy levels are called ____________________________.
3. Principal energy levels contain ____________.
4. The number of ______________ in a principal energy level ______________ as n increases.

Summarize
Compare and contrast the Bohr and quantum mechanical models of the atom.
**Main Idea**

*Skim* Section 3 of your text. Focus on the headings, subheadings, boldfaced words, and figure captions. Summarize the main ideas of this section.

<table>
<thead>
<tr>
<th>New Vocabulary</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>electron configuration</strong></td>
<td>Use your text to define each term.</td>
</tr>
<tr>
<td><strong>aufbau principle</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Pauli exclusion principle</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Hund’s rule</strong></td>
<td></td>
</tr>
<tr>
<td><strong>valence electron</strong></td>
<td></td>
</tr>
<tr>
<td><strong>electron-dot structure</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Academic Vocabulary**

Define the following term.

**nuclear**
Ground-State Electronic Configurations
*Use with page 135.*

Orbital Diagrams and Electron Configuration Notations
*Use with pages 136–139.*

Valence Electrons
*Use with page 140.*

**Main Idea**

**Details**

**Organize** information about electron configurations by completing the following outline.

Electron configuration is _____________________________.

I. Ground–state electron configurations

A. Three rules define how electrons can be arranged in an atom’s orbitals:

1. _____________________________.
2. _____________________________.
3. _____________________________.

B. The _________ methods for representing an atom’s electron configuration

1. Orbital diagrams
   a. An empty box represents an _________________.
   b. A box containing a single up arrow represents an orbital with _________________.
   c. A box containing both up and down arrows represents a _________________.
   d. Each box is labeled with the _________________.

2. _____________________________.

   a. This method designates the _________________.
   b. _________________ associated with each of the atom’s orbitals, and includes a _________________.

C. Only Valence electrons _____________________________.

1. Electron-dot structures consist of the _________________.
   which represents the _________________.
   _________________, surrounded by dots representing the _________________.

Section 5.3 Electron Configurations (continued)
Section 5.3 Electron Configurations (continued)

**Main Idea**

Writing Electron-Dot Configurations

*Use with Example Problem 5-3, page 139.*

**Details**

Solve Read Example Problem 5-3 in your text.

You Try It

**Problem**

Ruthenium (Ru) is commonly used in the manufacture of platinum alloys. What is the ground-state electron configuration for an atom of ruthenium?

1. **Analyze the Problem**
   
   **Known:**
   
   **Unknown:**
   
   Determine the number of additional electrons a ruthenium atom has compared to the nearest preceding noble gas, and then write out ruthenium’s electron configuration.

2. **Solve for the Unknown**

   From the periodic table, ruthenium’s atomic number is determined to be ____. Thus a ruthenium atom contains ____ electrons. The noble gas preceding ruthenium is krypton (Kr), which has an atomic number of 36. Represent ruthenium’s first 36 electrons using the chemical symbol for krypton written inside brackets.

   The first 36 electrons have filled out the 1s, 2s, 2p, 3s, 3p, 4s, 3d and 4p sublevels. The remaining ____ electrons of ruthenium’s configuration need to be written out. Thus, the remaining ____ electrons fill the _________ orbitals.

   Using the maximum number of electrons that can fill each orbital, write out the electron configuration. _________

3. **Evaluate the Answer**

   All ____ electrons in a ruthenium atom have been accounted for. The correct preceding noble gas _________ has been used in the notation, and the order of orbital filling for the _________ is correct.
Electrons in Atoms  Chapter Wrap-Up

Now that you have read the chapter, review what you have learned. Write out the key equations and relationships.

Review

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.

☐ Study the definitions for vocabulary words.

☐ 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

Explain how advances in our understanding of the atom influence our daily lives.
The Periodic Table and Periodic Law

Before You Read

Define the following terms.

atom

electron configuration

valence electrons

electron-dot structure

Distinguish between the subatomic particles in terms of relative charge.

<table>
<thead>
<tr>
<th>Subatomic Particle</th>
<th>Electrical Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Describe how the subatomic particles are arranged.

[Blank line]
The Periodic Table and Periodic Law

Section 6.1 Development of the Modern Periodic Table

Main Idea

Skim Section 1 of your text. Look at the headings, boldfaced words, figures and captions. Write two facts you discovered about the periodic table.

1. 

2. 

New Vocabulary

Use your text to define each term.

periodic law

group

period

representative element

transition element

metal

alkali metal

alkaline earth metal

transition metal

inner transition metal

nonmetal

halogen

noble gas

metalloid
Section 6.1 Development of the Modern Periodic Table (continued)

**Main Idea**

History of the Periodic Table’s Development

Use with pages 151–154.

**Details**

**Sequence** the events that helped develop the periodic table.

1. In the 1790’s, _____________________________.
2. In 1864, _____________________________. He left blank spaces and saw the properties of elements _____________________________.
3. In 1869, _____________________________. He arranged elements by _____________________________.
4. In 1913, _____________________________.

**Determine** where you can find each of the following groups of elements on the periodic table below:

- alkali metals
- nonmetals
- alkaline earth metals
- transition elements
- halogens
- inner transition metals
- noble gases
- representative elements
- transition metals

**Hint:** colored pencils might be helpful. Be sure to include a legend.

The Modern Periodic Table

Use with pages 154–158.

- alkali metals
- nonmetals
- alkaline earth metals
- transition elements
- halogens
- inner transition metals
- noble gases
- representative elements
- transition metals

**Hint:** colored pencils might be helpful. Be sure to include a legend.

The number in parentheses is the mass number of the longest lived isotope for that element.

*Status not officially assigned. Discovery of elements 114, 115, and 116 not yet reported. Further information not yet available.
Organize information about the periodic table by completing the concept map below.

The periodic table has ____ rows called periods.
The table has ____ columns called ____ or families

Groups ____
are called representative elements
which possess

1A 
all metals except
more reactive than 2A

7A 
alkaline halogens

8A 
unreactive

Groups 1B to 8B
are called divided into
inner transition metals
transition metals earth metals
the and actinide series
located at
Identify the information that is given on a typical box from the periodic table.

1. 
2. 
3. 
4. 
5. 

Match the box color on the periodic table in Figure 6-4 with the class of element the box describes.

- blue: nonmetal
- green: recently discovered
- yellow: metalloid
- gray: metal

Describe how knowledge of the periodic table would be important in three different careers, based on what you’ve read.
Scan Section 2 of your text. Use the checklist below as a guide.
• Read all section titles.
• Read all boldfaced words.
• Read all tables.
• Look at all pictures and read the captions.
• Think about what you already know about the shapes and arrangements of atoms in covalent compounds.

Write three facts that you discovered about the relationship between electrons and an element’s location on the periodic table.

1. ____________________________

2. ____________________________

3. ____________________________

Academic Vocabulary

Define the following terms.

- corresponding
- significant
- transit
- sphere
Section 6.2 Classification of the Elements (continued)

Organizing the Elements by Electron Configuration

Use with page 159.

Organize information about electron configurations by completing the outline below.

I. Electrons
   A. Valence electrons
      1. electrons in ________________
      2. atoms in the ___________ have ________________

   B. Valence electrons and period
      1. The __________ of an element’s valence electrons indicates ________________.
         a. Elements with valence electrons in energy level 2 are found in ________________.
         b. Elements with ________________ are found in the fourth period.

   C. Valence electrons and group number
      1. For representative elements, group number matches the ________________.
         a. All elements in group 1A have ________________.
         b. All elements in group 2A have ________________.
      2. Helium, in group 8A, is an ________________.

Describe the relationship between the number of valence electrons and the chemical properties of atoms.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
Section 6.2 Classification of the Elements (continued)

Main Idea

The s-, p-, d-, and f-Block Elements
Use with pages 160–161.

Details

Distinguish between s-, p-, d-, and f-block elements by completing the table below.

<table>
<thead>
<tr>
<th>Orbital</th>
<th>Type of Occupied Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-block</td>
<td>p</td>
</tr>
<tr>
<td>d-block</td>
<td>3B to 2B</td>
</tr>
<tr>
<td>f-block</td>
<td></td>
</tr>
</tbody>
</table>

Summarize Fill in the blanks to help you take notes while you read Example Problem 6-1.

Problem Without using the periodic table, determine the group, period, and block in which strontium is located on the periodic table.

1. Analyze the problem

   Known: Unknown:

   ________________________________

   Use the electron configuration of strontium to determine its place.

2. Solve for the unknown

   Group: Strontium has a valence configuration of ____. All group ___ elements have the ____ configuration.

   Period: The ___ in 5s^2 indicates that strontium is in _______.

   Block: The ___ indicates that strontium’s valence electrons

   ____________________________. Therefore, strontium is in the ________.

3. Evaluate the answer

   The relationships among ____________________ and ____________________ have been correctly applied.
The Periodic Table and Periodic Law
Section 6.3 Periodic Trends

Scan Section 3 of your text. Use the checklist below as a guide.
• Read all section titles.
• Read all boldfaced words.
• Read all tables.
• Look at all pictures and read the captions.

Write three facts that you discovered about periodic trends.
1. __________________________
2. __________________________
3. __________________________

Use your text to define each term.

ion

ionization energy

octet rule

electronegativity

Define the following term.
trend
Section 6.3 Periodic Trends (continued)

Main Idea

Atomic Radius
Use with pages 163–164.

Details

Describe how atomic size is defined.

Analyze any trends that you observe in Figure 6-11 and how the trends relate to atomic mass.

Interpreting Trends in Atomic Radii
Use with Example Problem 6-2, page 165.

Summarize Fill in the blanks to help you take notes while you read Example Problem 6-2.

Problem
Which has the largest atomic radius: carbon (C), fluorine (F), beryllium (Be), or lithium (Li)? Explain your answer in terms of trends in atomic radii.

1. Analyze the problem
   Known: periodic table information for four elements
   Unknown: which of the four has the ________________

2. Solve for the unknown
   Use the ________________ to determine if the elements are in the same group or period. All four elements are in ________________.
   Order the elements from ________________ across the period.
   ________________
   Determine the largest based on trends of ________________.
   ________________

3. Evaluate the answer
   The ________________ in atomic radii have been correctly applied.
Section 6.3 Periodic Trends (continued)

Main Idea

Ionic Radius
Use with pages 165–166.

**Describe** atomic size and ionic change by completing the table below.

<table>
<thead>
<tr>
<th>Ionic Change</th>
<th>Ion Charge</th>
<th>Size of Atom</th>
</tr>
</thead>
<tbody>
<tr>
<td>atom loses electrons</td>
<td>becomes positive</td>
<td></td>
</tr>
<tr>
<td>atom gains electrons</td>
<td>becomes</td>
<td>increases</td>
</tr>
</tbody>
</table>

**Identify** two reasons why the relative size of an atom becomes smaller due to the loss of electrons:

1. 
2. 

**Explain** why atoms increase in size when the atom gains electrons.

________________________________________________________________________

Details

Ionization Energy
Use with pages 167–168.

**Describe** ionization energy trends on the periodic table by completing the paragraphs below.

Ionization energies generally ________ as you move left-to-right across a ____. Increased nuclear charge leads to an ___________ on valance electrons. Ionization energy generally ________ when you move down a ____. Less energy is required to remove ____________ because they are ______ from the nucleus.

The octet rule states that atoms tend to gain, lose, or share ________ in order to acquire a full set of ________________. First period elements are the ________ to this rule.

Electronegativity
Use with pages 168–169.

**Predict** what part of the periodic table has the greatest electronegativity. Use Figure 6-18 for reference.
Chapter Wrap-Up

The Periodic Table and Periodic Law

Now that you have read the chapter, review what you have learned. List three facts about the periodic table and periodic law.

Review

Use this check list to help you study.

☐ Study your Science Notebook for this chapter.
☐ Study the definitions and vocabulary words.
☐ 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

Explain how an understanding of the periodic table can help you gain confidence in studying chemistry.
The Elements

Before You Read

<table>
<thead>
<tr>
<th>Chapter 5</th>
<th>Write the electron configurations for the following elements.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strontium:</td>
</tr>
<tr>
<td></td>
<td>Selenium:</td>
</tr>
<tr>
<td></td>
<td>Cesium:</td>
</tr>
<tr>
<td></td>
<td>Cobalt:</td>
</tr>
<tr>
<td></td>
<td>Antimony:</td>
</tr>
<tr>
<td></td>
<td>Cadmium:</td>
</tr>
<tr>
<td></td>
<td>Krypton:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 6</th>
<th>List the general properties of metals.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                      | List the general properties of nonmetals.                   |
|                      |                                                             |
|                      |                                                             |
|                      |                                                             |

|                      | List the general properties of metalloids.                   |
|                      |                                                             |


The Elements
Section 7.1 Properties of s-Block Elements

Main Idea

Skim Section 1 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 
2. 
3. 

Details

Use your text to define the following term.

diagonal relationship

Academic Vocabulary

Define the following terms.

Physical (property)

chemical (property)

element

react
Section 7.1 Properties of s-Block Elements (continued)

**Main Idea**

**Representative Elements**
*Use with pages 179–180.*

Describe the properties of elements by completing the following statements.

The properties of elements within a group are similar, but not _______ because the elements share the same number of valence electrons, but a different number of _________________________.

Often, the lightest element in a Period 2 group has more in common with the ____________ in the next group than with the _________ element in its own group. These close relationships between elements in ________________ are called ________ _________.

**Hydrogen**
*Use with page 180.*

Analyze hydrogen by completing the following statements.

The mass of the universe contains ______________ hydrogen by mass. Hydrogen exists naturally as the following three isotopes:

1. _______—___ proton; no neutrons; _____% of hydrogen
2. deuterium—___ proton(s); ___ neutron(s); _____% of hydrogen
3. _______—___ proton(s); two neutron(s), and is _________

**Group 1A Alkali Metals**
*Use with pages 181–182.*

Identify the atomic, physical, and chemical characteristics of Group 1A elements.

Atomic: ____________________________________

__________________________________________

Physical: __________________________________

Chemical: __________________________________

Write the symbols for Group 1A elements in the order of most reactive to least reactive.

Section 7.1 Properties of s-Block Elements (continued)

**Main Idea**

**Group 2A: Alkaline Earth Metals**

*Use with pages 183–185.*

**Identify** the atomic, physical, and chemical characteristics of Group 2A elements.

Atomic: ________________

Physical: ________________

Chemical: ________________

**Write** the symbols for Group 2A elements in the order of most reactive to least reactive.

**Compare** the properties of lithium and magnesium that account for their diagonal relationship.

<table>
<thead>
<tr>
<th>Lithium</th>
<th>Property</th>
<th>Magnesium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>atomic radius</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ionic radius</td>
<td></td>
</tr>
<tr>
<td></td>
<td>reaction with water</td>
<td></td>
</tr>
</tbody>
</table>

**Real-World Connection**

Several s-block elements are important in making products we use every day. Describe a product or a use you are familiar with for the elements listed below. Use pages 181–185 as a guide.

sodium: __________________
calcium: __________________
potassium: __________________
magnesium: __________________
strontium: __________________
barium: __________________
Main Idea

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 pictures and read the captions.
- Think about what you already know about this subject.

Write four facts that you discovered about p-block elements as you scanned the section.

1. 
2. 
3. 
4. 

New Vocabulary

Use your text to define each term.

mineral

ore

allotropes

Academic Vocabulary

Define the following term.

compound
Section 7.2 Properties of p-Block Elements (continued)

**Main Idea**

**Group 3A: The Boron Group**

*Use with pages 186–187.*

**Details**

**Compare the properties of Group 3A elements based on whether a property applies to all, some, or one of the elements in the group.**

- always found combined with other elements in nature
- lose three valence electrons to form ions with a 3+ charge
- can form ions with a 1+ charge
- abundant in Earth’s crust
- remains liquid in a wide temperature range

<table>
<thead>
<tr>
<th>Element</th>
<th>Property</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>can take both hard and soft forms in a solid state</td>
</tr>
<tr>
<td></td>
<td>similar except for toxicity</td>
</tr>
<tr>
<td></td>
<td>occurs most often combined with oxygen</td>
</tr>
<tr>
<td></td>
<td>found in most organic compounds</td>
</tr>
</tbody>
</table>
Section 7.2 Properties of p-Block Elements (continued)

**Main Idea**

**Group 5A: The Nitrogen Group**

*Use with Pages 189–191.*

**Details**

*Consider Group 5A. Complete the following outline on the nitrogen group.*

I. Nitrogen
   A. Role in biology
      1. component in proteins and ________________
      ________________________________
      2. bacteria in soil convert molecular nitrogen into ____________
         ________________________________
   B. Uses
      1. ammonia: ________________________________
      2. nitric acid: ________________________________

II. Phosphorus
   A. Reactivity with oxygen
      1. white phosphorus: ________________________________
      2. red phosphorus: ________________________________
   B. Uses
      1. phosphate compounds found in ________________________________
         ________________________________
      2. a common ingredient in ________________________________

III. Arsenic, antimony, and bismuth
   A. Properties
      1. less abundant ________________________________
      2. among the oldest ________________________________
   B. Uses
      1. antimony and sulfur was used ________________________________
      2. an alloy of tin and antimony forms ________________________________
      3. bismuth is used in a popular remedy for ________________________________

*The Elements* 87
Section 7.2 Properties of p-Block Elements (continued)

**Main Idea**

**Group 6A: The Oxygen Group**
*Use with pages 192–194.*

**Details**

Describe properties of the oxygen group by completing the following statements.

1. Group 6A elements are mostly ________ and tend to gain ___ electrons to form ions with a ____ charge.

2. An allotrope of oxygen, ____, makes up about 21% of the _________________.

3. Oxygen is important in _________________ for plants and animals.

4. Sulfur has ___ allotropes.

5. Sulfur dioxide, in the atmosphere, contributes to ________.

6. Selenium is used in dietary ________________.

**Group 7A: The Halogens**
*Use with pages 194–195.*

**Details**

Match the halogen listed on the left with its characteristics on the right.

- Fluorine used for bleaching, rust removal, and manufacturing plastics
- Iodine used to prevent tooth decay and to coat non-stick cookware
- Chlorine used as a nutrient added to salt

**Group 8A: Noble Gases**
*Use with page 196.*

**Details**

Analyze why helium is the most abundant element in the universe yet is rare on Earth.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Section 7.3 Properties of d-Block and f-Block Elements

**Main Idea**

*Skim* Section 1 of your text. Use the following checklist as a guide.
- Read all section titles.
- Read all boldfaced words.
- Read all charts and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about the subject.

**Details**

*Write* three facts you discovered about environmental chemistry.
1. 
2. 
3. 

**New Vocabulary**

*Use your text to define each term.*

- **lanthanide series**
- **actinide series**
- **ferromagnetism**
- **metallurgy**

**Academic Vocabulary**

*Define the following term.*

- **structural**
Section 7.3 Properties of d-Block and f-Block Elements (continued)

**Main Idea**

**Transition Metals**

*Use with pages 197–200.*

**Details**

**Identify** three atomic properties of transition metals that are shared across a given period.

1. 

2. 

3. 

**List** four physical properties of transition metals that vary with the number of unpaired electrons.

1. 

2. 

3. 

4. 

**Explain** how the number of unpaired electrons relates to the number of ions the metal can form and the variety of colors that compounds of those ions can have.

**Real-World Connection**

List the two countries in which the greatest number of transition (d-block) elements are located and list those elements. Use Figure 7-26 on page 200 and other figures in the chapter for reference.
Identify the transition metal that is found in the greatest number of countries and list the countries in which it is found.

Describe some of the uses for the following d-block and f-block elements.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td></td>
</tr>
<tr>
<td>Neodymium</td>
<td></td>
</tr>
<tr>
<td>Europium</td>
<td></td>
</tr>
<tr>
<td>Cerium</td>
<td></td>
</tr>
<tr>
<td>Uranium</td>
<td></td>
</tr>
<tr>
<td>Plutonium</td>
<td></td>
</tr>
<tr>
<td>Americium</td>
<td></td>
</tr>
</tbody>
</table>
The Elements  Chapter Wrap-Up

Now that you have read the chapter, review what you have learned. List three facts about the elements.

1. 

2. 

3. 

Review

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.

☐ Study the definitions of vocabulary words.

☐ 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.

SUMMARIZE

Explain how the number of electrons in the s-block, p-block, and d-block affects the behavior of an element.
# Ionic Compounds

## Before You Read

### Review Vocabulary

**Define the following terms.**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ion</td>
<td></td>
</tr>
<tr>
<td>ionization energy</td>
<td></td>
</tr>
<tr>
<td>noble gas</td>
<td></td>
</tr>
<tr>
<td>valance electron</td>
<td></td>
</tr>
</tbody>
</table>

### Chapter 5

**Create** electron-dot diagrams for the following elements.

- aluminum: 
- calcium: 
- arsenic: 
- tellurium: 
- xenon: 

---

*Ionic Compounds*  93
Ionic Compounds
Section 8.1 Forming Chemical Bonds

Main Idea

Skim Section 1 of your text. Read the title and subheads. List three concepts that you think will be discussed in this section.

1. ________________________________
2. ________________________________
3. ________________________________

New Vocabulary

Use your text to define each term.

chemical bond

cation

anion

Academic Vocabulary

Define the following term.

element
Section 8.1 Forming Chemical Bonds (continued)

Chemical Bonds
Use with pages 211–214.

Main Idea

Details

Organize information about forming chemical bonds by completing the concept map below.

As the number of

in an atom increases,

,

or

the atom’s ability to attract electrons,

reactivity

Electron affinity is smallest for

which in general have eight

in their outermost s and p orbitals.

Write the electron configuration of the most likely ion and the charge that is lost or gained by each of the following atoms. Indicate what the overall charge of the ion is, and whether it is a cation or an anion.

Cs:  [Xe]6s\(^1\)

O:  [He]2s\(^2\)2p\(^4\)

Ga:  [Ar]4s\(^2\)3d\(^{10}\)4p\(^1\)

Br:  [Ar]4s\(^2\)3d\(^{10}\)4p\(^5\)

Ag:  [Kr]5s\(^1\)4d\(^{10}\)

Sc:  [Ar]4s\(^2\)3d\(^1\)
Sequence the first group of elements in order of increasing ionization energy. Sequence the second group of elements in order of increasing electron affinity.

<table>
<thead>
<tr>
<th>First Group</th>
<th>Second Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>K → K⁺</td>
<td>P → P³⁻</td>
</tr>
<tr>
<td>Ne → Ne⁺</td>
<td>O → O²⁻</td>
</tr>
<tr>
<td>P → P⁵⁺</td>
<td>Xe → Xe⁻</td>
</tr>
<tr>
<td>Fe → Fe²⁺</td>
<td>S → S²⁻</td>
</tr>
<tr>
<td>Rb → Rb⁺</td>
<td>I → I⁻</td>
</tr>
<tr>
<td>Mg → Mg²⁺</td>
<td>F → F⁻</td>
</tr>
</tbody>
</table>

Identify the following ions.

Ag⁺
Li⁺
Br⁻
Ca²⁺
S²⁻
B³⁺
As³⁻
H⁻
Cd²⁺
Se²⁻
Ionic Compounds
Section 8.2 The Formation and Nature of Ionic Bonds

Main Idea

Skim Section 2 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. ________________________________
2. ________________________________
3. ________________________________

New Vocabulary

Use your text to define each term.

ionic bond

---

electrolyte

---

lattice energy

---

Academic Vocabulary

Define the following term.

conduct

---
Section 8.2 Formation and Nature of Ionic Bonds

Main Idea

Formation of an Ionic Compound
Use with Example Problem 8-1, page 217.

Solve Read Example Problem 8-1 in your text.

You Try It

Problem
Describe the formation of an ionic compound from the elements boron and selenium.

1. Analyze the Problem
Known: the electron configurations of the given elements

Unknown: the number of valence electrons for each neutral atom

2. Solve for the Unknown
Determine how many electrons need to be removed from boron and how many electrons need to be added to selenium to form noble gas configurations.

Determine how many boron atoms and how many selenium atoms must be present for the total number of electrons exchanged between the two elements to be equal.

3. Evaluate the Answer
The overall charge on one unit of this compound is zero.

boron ions (3+/boron ion) + selenide ions (3+/selenide ion) = (3+) + ( ) = 0
Properties of Ionic Compounds
Use with pages 217–220.

Main Idea

Analyze the relationship between the lattice energy of an ionic compound and the force of attraction.

Describe the relationship between the size of the ions in a compound and the compound’s lattice energy.

Explain the relationship between lattice energy and the charge of the ion.

Organize the following ionic compounds from those with the least negative lattice energy to those with the most negative lattice energy.

LiCl
BeS
LiBr
BeO
BeCl₂
RbBr
CsI
SrCl₂
CsBr
Ionic Compounds
Section 8.3 Names and Formulas for Ionic Compounds

Scan Section 3 of your text. Use the checklist below as a guide.
• Read all section titles.
• Read all boldfaced words.
• Read all tables and diagrams.
• Look at all figures and read the captions.
• Study the example problems and note what they are intended to solve.
• Think about what you already know about the formation, formulas, and naming of ions and ionic compounds.

Write three facts that you discovered about the names and formulas of ionic compounds.
1. 
2. 
3.

New Vocabulary
Use your text to define each term.

formula unit

monatomic ion

oxidation number

polyatomic ion

oxyanion
Formulas for Ionic Compounds

Determining the Formula for an Ionic Compound

Use with Example Problem 8-3, page 223.

**Solve** Read Example Problem 8-3 in your text.

You Try It

**Problem**

Calcium can form a cation with a $2^+$ charge. Write the formula for the ionic compound formed from calcium ion and Chlorine.

1. **Analyze the Problem**
   
   Known: the ionic forms of the component elements
   
   and
   
   Unknown:

2. **Solve for the Unknown**

   The smallest number that is divisible by both ionic charges is ____, so the compound contains ____ calcium ion(s) and ____ sulfide ion(s). The formula for the ionic compound formed is _____.

3. **Evaluate the Answer**

   The overall charge on one formula unit of this compound is zero.

   $\square$ Ca ion(s) $(2+/Ca\ ion) + \square$ Cl ions $(1-/Cl\ ion) = 0$

**Solve** Read Example Problem 8-4 in your text.

You Try It

**Problem**

Write the formula for the ionic compound formed from the calcium ion and the bromate ion.

1. **Analyze the Problem**

   Known: the ionic forms of the component elements _____ and _______

   Unknown: ___________________________
Section 8.3 Names and Formulas for Ionic Compounds (continued)

**Main Idea**

2. Solve for the Unknown
   The smallest number that is divisible by both ionic charges is _____, so ____ bromate ions combine with ____ calcium ion. The formula for the ionic compound formed is to form ________.

3. Evaluate the Answer
   The overall charge on one formula unit of this compound is zero.
   \[ \text{1 Ca ion (2+/Ca ion)} + \Box \text{BrO}_3 \text{ ions (1-/BrO}_3 \text{ ion)} = 0 \]

**Details**

**Naming Ions and Ionic Compounds**

*Use with pages 225–227.*

**Classify** the ions listed below as monatomic or polyatomic cations or anions. If the ion is a polyatomic anion, indicate whether it is an oxyanion.

- CN
- MnO$_4^-$
- Ba$^{2+}$
- Fe(CN)$_6^{4-}$
- NH$_4^+$
- N$^3-$
- Hg$_2^{2+}$
- S$_2$O$_3^{2-}$
- O$^{2-}$

**Identify** the ionic compounds listed below.

- CaO
- KMnO$_4$
- Sr(IO$_3)_2$
- NH$_4$OH
- Fe$_2$S$_3$
- Sn(NO$_3)_4$
- Pb$_3$(PO$_4)_2$
- Hg$_2$SO$_4$
- PtCl$_4$
Ionic Compounds

Section 8.4 Metallic Bonds and Properties of Metals

Main Idea

Details

Skim Section 4 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 
2. 
3. 

New Vocabulary

Use your text to define each term.

electron sea model

delocalized electrons

metallic bond

alloy

Academic Vocabulary

Define the following term.

interact
Section 8.4 Metallic Bonds and Properties of Metals (continued)

**Main Idea**

**Metallic Bonds**

*Use with pages 228–229.*

**Details**

**Summarize** how the electron sea model accounts for the malleability, high thermal conductivity, and high electrical conductivity of metals.

**Explain** the properties of metals by completing the following sentences.

The ________________ of transition metals increases as the number of delocalized electrons ___________.

Because the ____________ in metals are strongly attracted to the delocalized electrons in the metal, they are not easily ____________ from the metal, causing the metal to be very ____________.

Alkali metals are _______ than transition metals because they have only __________________ per atom.

The ________________ of metals vary greatly. The melting points are not as extreme as the ______________. It does not take an extreme amount of energy for ____________ to be able to move past each other. However, during ________, atoms must be separated from a group of __________________, which requires a lot of ________.

Light absorbed and released by the ________________ in a metal accounts for the _______ of the metal.
### Metal Alloys

*Use with pages 230–231.*

MATCH the alloy composition given in the first column with the common name of the alloy in the second column and the alloy’s uses in the third column. Draw lines between the appropriate items. Use Table 8-8 as a reference.

<table>
<thead>
<tr>
<th>Composition</th>
<th>Alloy</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>45% Cu, 15% Ag, 42% Au</td>
<td>cast iron</td>
<td>tableware, jewelry</td>
</tr>
<tr>
<td>75% Fe, 17% Cr, 8% Ni</td>
<td>10-carat gold</td>
<td>dental fillings</td>
</tr>
<tr>
<td>97% Fe, 3% C</td>
<td>sterling silver</td>
<td>casting</td>
</tr>
<tr>
<td>92.5% Ag, 7.5% Cu</td>
<td>dental amalgam</td>
<td>medals, bells</td>
</tr>
<tr>
<td>80% Cu, 15% Zn, 5% Sn</td>
<td>brass</td>
<td>instruments, sinks</td>
</tr>
<tr>
<td>85% Cu, 15% Zn</td>
<td>bronze</td>
<td>jewelry</td>
</tr>
<tr>
<td>50% Hg, 35% Ag, 15% Sn</td>
<td>stainless steel</td>
<td>hardware, lighting</td>
</tr>
</tbody>
</table>

**Contrast** a substitutional alloy with an interstitial alloy. Give an example of each.

1. Substitutional alloy: 
2. Interstitial alloy: 
3. Substitutional alloy: 
4. Interstitial alloy: 
5. Substitutional alloy: 
6. Interstitial alloy: 
7. Substitutional alloy: 
8. Interstitial alloy: 
9. Substitutional alloy: 
10. Interstitial alloy: 
11. Substitutional alloy: 
12. Interstitial alloy:
**Ionic Compounds Chapter Wrap-Up**

Now that you have read the chapter, review what you have learned. List three important facts about ionic compounds.

1. 
2. 
3. 

Use this checklist to help you study.

- Study your Science Notebook for this chapter.
- Study the definitions of vocabulary words.
- 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.

Explain how the atomic properties of an element determine what sort of ion it will form, and what properties a resulting ionic compound will have.
Covalent Bonding

Before You Read

**Define** the following terms.

- **ionic bond**: 
- **octet rule**: 

**Chapter 4**

**Describe** the structure of an atom.

**Chapter 6**

**Explain** the following concepts: periodic trends and periodic properties of elements.

**Chapter 8**

**Identify** the ions, along with their charges, in the following ionic compounds.

- Li$_2$S
- KMnO$_4$
- Al$_2$O$_3$
## Covalent Bonding
### Section 9.1 The Covalent Bond

**Main Idea**

**Details**

**Skim** Section 1 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. ____________________________
2. ____________________________
3. ____________________________

### New Vocabulary

Use your text to define each term.

- **covalent bond**
- **molecule**
- **Lewis structure**
- **sigma bond**
- **pi bond**
- **endothermic**
- **exothermic**

### Academic Vocabulary

Define the following term.

- **stable**
Section 9.1 The Covalent Bond (continued)

Main Idea

Why do atoms bond?
Use with page 241.

What is a covalent bond?
Use with page 242.

Details

Explain the octet rule by completing the following sentences.
The _____ rule states that ____________________________
__________________________. Although exceptions exist, the rule provides a useful frame-
work for understanding ________________.

Complete the following sentences using words or phrases from your text.
The force between two atoms is the result of ________________
repulsion, nucleus-nucleus ________, and nucleus-electron _________. At the point of ________________, the ________
forces balance the ________ forces. The most stable arrangement
of atoms exists at the point of ________________, when the
atoms bond covalently and a ________ forms.

Solve Read Example Problem 9-1 in your text.

You Try It

Problem
Draw the Lewis structure for hydrochloric acid, HCl.

1. Analyze the Problem
Write the electron-dot structures of each of the two component
atoms.
Known: H, .Cl:

Unknown: _______________ of HCl

Hydrogen, H, has only one valence electron. Chlorine, Cl, has
seven valence electrons. Cl needs one electron to complete its
octet.

2. Solve for the Unknown
Draw the electron-dot structure for each of the component atoms.
Then show the sharing of the pairs of electrons.

H. + .Cl: → H—Cl:

_________ _______ ____________
______ _______ ________
Section 9.1 The Covalent Bond (continued)

**Main Idea**

**Details**

3. Evaluate the Answer
   - Each atom in the molecule has achieved a configuration and thus is .

**Multiple Covalent Bonds**

*Use with pages 245–246.*

Identify each bond between the component atoms as sigma bonds (single bonds), one sigma bond and one pi bond (double bonds), or one sigma bond and two pi bonds (triple bonds).

- \( \text{H–C≡C–H} \)
- \( \text{H–C=O} \)

**Strength of Covalent Bonds**

*Use with pages 246–247.*

Explain the factors that control the strength of covalent bonds.

Define bond dissociation energy.

**Real-World Connection**

Explain how understanding covalent bonding and the chemistry of compounds might help scientists increase food supplies.
The Covalent Bond
Section 9.2 Naming Molecules

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.
- Read all formulas.
- Look at all figures and read the captions.
- Think about what you already know about the naming of molecules.

Write three facts you discovered about the names and formulas of covalent molecules.

1. 
2. 
3. 

New Vocabulary
oxyacid

Academic Vocabulary
formula

Use your text to define the following term.

Define the following term.
Section 9.2 Naming Molecules (continued)

**Main Idea**

Naming Binary Molecular Compounds

Use with Example Problem pages 248–249.

**Details**

Identify the prefixes for these three binary molecular compounds.

Ge₃N₂  _____-germanium  _____-nitride

C₂Cl₄  _____-carbon  _____-chloride

B₆Si  _____-boron  silicide

Solve Read Example Problem 9-2 in your text.

You Try It

Problem

Name the compound N₂O₃.

1. Analyze the Problem
   
   Known:  
   
   Unknown:  
   
   The formula reveals the elements present and the number of atoms for each element. Only two elements are present, and both are nonmetals, so the compound can be named according to the rules for binary molecular compounds.

2. Solve for the Unknown
   
   The first element present in the compound is ____, _______. The second element is ____, _______. The root of this name is ____, so the second part of the name is ____. From the formula, two _____ atoms and three _____ atoms make up a molecule of the compound. The prefix for two is ____ and prefix for three is ____. The complete name for the compound is __________.

3. Evaluate the Answer
   
   The name ______________ shows that a molecule of the compound contains _________ atoms and __________ atoms, which agrees with the chemical formula for the compound, N₂O₃.
Section 9.2 Naming Molecules (continued)

**Main Idea**

**Naming Acids**  
*Use with page 250.*

**Details**

Match the chemical formulas listed below with the correct acids.

- HF  
  sulfurous acid
- HIO₄  
  hydrofluoric acid
- H₂SO₃  
  phosphoric acid
- H₃PO₄  
  hypochlorous acid
- HC₂H₃O₂  
  periodic acid
- H₂CO₃  
  permanganic acid
- HClO  
  acetic acid
- HMnO₄  
  carbonic acid

**Writing Formulas from Names**  
*Use with pages 250–251.*

Write the chemical formula for the molecular compound names given below. Use the flow chart in Figure 9-9 to help you determine the correct formulas.

- _____ dicarbon tetrabromide  
- _____ tetrasulfur tetranitride
- _____ arsenic pentafluoride  
- _____ arsenic acid
- _____ perchloric acid  
- _____ hydrocyanic acid

**SYNTHESIZE**

Create questions and answers about naming molecules for your own original quiz game. Include topics such as: prefixes and number of atoms; formulas, common names, and molecular names for covalent binary compounds; and formulas, common names, and molecular names for binary acids and oxyacids.
Covalent Bonding
Section 9.3 Molecular Structures

Main Idea

Skim Section 3 of your text. Write three questions that come to mind from reading the headings, illustration captions, and topics for the example problems.

1. 
2. 
3. 

Details

Use your text to define each term.

- structural formula
- resonance
- coordinate covalent bond

Academic Vocabulary

Define the following term.

- bond
Section 9.3 Molecular Structures (continued)

**Main Idea**

**Structural Formulas**

*Use with page 252.*

**Details**

List the steps that should be used to determine Lewis structures.

1. 
2. 
3. 
4. 

Solve Read Example Problem 9-4 in your text.

You Try It

**Problem**

Draw the Lewis structure for FCHO.

1. **Analyze the Problem**
   
   **Known:** the compound formula: 
   
   **Unknown:**
   
   Carbon has less attraction for shared electrons, so it is the central atom.

2. **Solve for the Unknown**
   
   Find the total number of valence electrons and the number of bonding pairs.
   
   $\square$ valence electrons/C atom + $\square$ valence electrons/F atom
   $\square$ valence electrons/H atom + $\square$ valence electrons/O atom
   
   $= \square$ valence electrons
   
   $\square$ available valence electrons/(2 electrons/pair) = $\square$ available pairs
Section 9.3 Molecular Structures (continued)

Main Idea

Draw single bonds, which represent ____________ each, from the carbon atom to each terminal atom, and place electron pairs around the _______ and _______ atoms to give them stable _______.

____ available pairs – ____ pairs used = 0

Carbon does not have an octet, so one of the lone pairs on the _______ atom must be used to form a _______ bond.

Details

3. Evaluate the Answer

Both carbon and _______ now have an octet, which satisfies the octet rule.

Lewis Structure: Polyatomic Ion

Use with Example Problem 9-5, page 255.

Solve Read Example Problem 9-5 in your text.

You Try It

Problem

Draw the Lewis structure for the permanganate ion (MnO₄⁻).

1. Analyze the Problem

Known: the compound formula: ____________

Unknown: ___________________________________________________________________

Manganese has less attraction for shared electrons, so it is the central atom.

2. Solve for the Unknown

Find the total number of valence electrons and the number of bonding pairs.

1 Mn atom × (□ valence electrons/Mn atom) + □ O atoms
× (6 valence electrons/O atom + □ electron(s) from the negative charge = □ valence electrons
Section 9.3 Molecular Structures (continued)

**Main Idea**

- available valence electrons/(2 electrons/pair) = __________
- available pairs + 1 electron
  - Draw single bonds, which represent an __________, from the Mn atom to each O atom, and place electron pairs around the O atoms to give them stable __________.

- available pairs – __________ pairs used = 0
  - No electron pairs remain available for the Mn atom, so the Lewis structure for the permanganate ion is: 

**Details**

3. **Evaluate the Answer**

All atoms now have an octet, and the group of atoms has a net charge of __________.

**Resonance Structures**

Use with page 256.

**Exceptions to the Octet Rule**

Use with pages 256–257.

**Explain** resonance structures by completing the following sentences.

Each actual molecule or ion that undergoes __________ behaves as if it has only __________ structure. Experimentally measured bond lengths show that the bonds are __________ to each other.

**List** three reasons for exceptions to the octet rule.

1. __________

2. __________

3. __________

---

Covalent Bonding 117
Covalent Bonding
Section 9.4 Molecular Shape

Scan Section 4 of your text. Use the checklist below as a guide.
• Read all section titles.
• Read all boldfaced words.
• Read all tables.
• Look at all pictures and read the captions.
• Think about what you already know about the shapes and arrangements of atoms in covalent compounds.

Write three facts you discovered about the shapes covalent compounds take.
1. ____________________________
2. ____________________________
3. ____________________________

New Vocabulary
Use your text to define each term.

VSEPR model

hybridization
Section 9.4 Molecular Shape (continued)

**Main Idea**

**VSEPR Model**

*Use with pages 259–260.*

**Details**

Match the molecular shapes listed below with their corresponding bond angles.

- trigonal planar 180°
- trigonal pyramidal 120°
- bent 109.5°
- linear 107.3°
- octahedral 104.5°
- tetrahedral 90° (out of plane); 120° (in plane)
- trigonal bipyramidal 90°

**Hybridization**

*Use with page 261.*

Label the hybrid orbitals in the figures below as $sp$, $sp^2$, $sp^3$, $sp^3d$, or $sp^3d_2$. 
Finding the Shape of a Molecule

Use with Example Problem 9-7, page 262.

Solve Read Example Problem 9-7 in your text.

You Try It

Problem

What is the shape of a SbI₅ molecule? Determine the bond angles, and identify the type of hybrid orbitals that form the molecule’s bonds.

1. Analyze the Problem

Known: the compound formula: 

Unknown:

The molecule contains one central antimony atom bonded to _____ iodine atoms.

2. Solve for the Unknown

Find the number of valence electrons and the number of electron pairs.

1 Sb atom \times (\square \text{valence electrons/Sb atom}) + \square \text{I atoms} \times (\square \text{valence electrons/I atom}) = \square \text{valence electrons}

Three electron pairs exist on each iodine atom. This leaves \square available valence electrons for bonding. \square available valence electrons/(2 \text{electrons/pair}) = \square \text{available pairs}

Draw the molecule’s Lewis structure. From this Lewis structure, determine the molecular shape.

<table>
<thead>
<tr>
<th>Lewis structure</th>
<th>Molecular shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>The molecule’s shape is ________________, with a bond angle of ____ in the horizontal plane, and a bond angle of ____ between the vertical and horizontal bonds. The bonds are made up of ______ hybrid orbitals.</td>
<td></td>
</tr>
</tbody>
</table>

3. Evaluate the Answer

Each iodine atom has an octet. The antimony atom has ____ electrons, which is allowed when a d orbital is hybridized.
Covalent Bonding
Section 9.5 Electronegativity and Polarity

Scan Section 5 of your text. Use the checklist below as a guide.
- Read all section titles.
- Read all boldfaced words.
- Read all tables and charts.
- Look at all pictures and read the captions.
- Think about what you already know about the strengths and distribution of charge in covalent bonds.

Write three facts you discovered about electronegativity.
1. 
2. 
3. 

Use your text to define the following term.

polar covalent

Define the following term.

network
Section 9.5 Electronegativity and Polarity (continued)

**Main Idea**

**Electronegativity Difference and Bond Character**

*Use with page 263.*

**Details**

**Sequence** the following elements from the least electronegative to the most electronegative. Use Table 9-15 for reference.

___ Au
___ Y
___ Ba
___ P
___ H
___ Te
___ O
___ I
___ Co

**Polar Covalent Bonds**

*Use with pages 264–265.*

**Draw** the Lewis structure for each of the molecular compounds listed below. Analyze the symmetry of the structure to determine whether or not the compound is polar covalent or nonpolar covalent.

N₂

CO₂

CH₃Cl
**Section 9.5 Electronegativity and Polarity** (continued)

**Main Idea**

**Properties of Covalent Compounds**

*Use with page 266.*

**Details**

**Determine** whether each of the properties listed below is characteristic of ionic compounds, covalent compounds, nonpolar covalent compounds, or polar covalent compounds.

- low melting point
- very soft solid
- high boiling point
- weak interaction between formula units
- solubility in oil
- very hard solid
- high melting point
- solubility in water
- easily vaporized
- strong interaction between formula units

**Covalent Network Solids**

*Use with page 267.*

**Describe** what the network solid for quartz (SiO₂) molecules is like, and how it has a tetrahedral structure similar to diamond structure.
Covalent Bonding  Chapter Wrap-Up

After reading this chapter, list three key facts about covalent bonding.

1. 

2. 

3. 

Review  Use this checklist to help you study.

☐ Use this Science Notebook to study 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  Explain how covalent bonds in carbon account for the vast number of carbon compounds, including those responsible for living organisms.
Chemical Reactions

Before You Read

**Review Vocabulary**

Define the following terms.

- **Ionic compound**
  - __________________________
  - __________________________
  - __________________________

- **Molecular compound**
  - __________________________
  - __________________________
  - __________________________

**Chapter 8**

Explain how to write formulas for ionic compounds.

[Space for answer]

Write the formula for the following ionic compound.

- Aluminum carbonate
  - __________________________

**Chapter 9**

Explain how to write formulas for molecular compounds.

[Space for answer]

Write the formula for the following molecular compound.

- Sulfuric acid
  - __________________________
Chemical Reactions
Section 10.1 Reactions and Equations

Scan Section 1 of your text. Use the checklist below as a guide.
• Read all section titles.
• Read all boldfaced words.
• Read all charts and graphs.
• Look at all pictures and read the captions.

Write three facts about chemical reactions.

1. _____________________________________________________________
2. _____________________________________________________________
3. _____________________________________________________________

In the left column, write the terms defined below.

a rearrangement of the atoms in one or more substances to form different substances

the starting substances of a chemical reaction

the substances formed during a chemical reaction

a statement that uses chemical formulas to show the identities and relative amounts of the substances involved in a chemical reaction

number written in front of a reactant or product that is used to balance chemical equations
Section 10.1 Reactions and Equations (continued)

Main Idea

Evidence of Chemical Reactions
Use with page 277.

Identify three examples of chemical reactions you have seen, heard, or smelled in the last 24 hours. Think about activities at home, at school, or outside. Include any evidence you had that a chemical reaction was occurring.

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>

Representing Chemical Reactions
Use with pages 278–280.

Organize types of equations that can express a chemical reaction. In the second column, list the elements (words, coefficients, etc.) that are used to create each equation. In the third column, rank each equation from 1 to 3, giving a 3 to the equation that provides the most information, and a 1 to the equation that provides the least information.

<table>
<thead>
<tr>
<th>Type</th>
<th>Elements</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word equations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical equations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skeleton equations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Label the chemical state each symbol below identifies in a chemical equation.

(s) __________________________

(g) __________________________

(aq) _________________________

(l) __________________________
Section 10.1 Reactions and Equations (continued)

**Main Idea**

Balancing Chemical Equations

*Use with pages 280–283.*

**Details**

**Solve** Read Example Problem 10-1 in your text.

**You Try It**

**Problem**

Balance the chemical equation for the reaction in which fluorine reacts with water to produce hydrofluoric acid and oxygen.

1. **Analyze the problem**
   
   **Known:**
   
   **Unknown:**

2. **Solve for the Unknown**

   Use the space below to write the skeleton equation:

   

   Count the atoms of each element in the reactants.
   
   ___ F, ___ H, ___ O

   Count the atoms of each element in the products.
   
   ___ F, ___ H, ___ O

   Insert the coefficient ___ in front of ___ to balance the oxygen atoms.

   Insert the coefficient ___ in front of ___ to balance the ____________.

   Insert the coefficient ___ in front of ___ to balance the ____________.

   Write the equation after adding the coefficients.

   

   Check that the coefficients are at their lowest possible ratio.
   
   The ratio of the coefficients is ______.

   Write the number of atoms in the balanced equation below:
   
   **Reactants:** ____________________________
   
   **Products:** ____________________________

3. **Evaluate the Answer**

   The ____________ of each element is ____ on both sides of the equation. The __________ are written to the _____ ratio.
Chemical Reactions

Section 10.2 Classifying Chemical Reactions

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

• Read all section titles.
• Read all boldfaced words.
• Read all charts and graphs.
• Look at all pictures and read the captions.
• Think about what you already know about chemical reactions.

Write three facts you discovered about classifying chemical reactions.

1. ____________________________________________________________
2. ____________________________________________________________
3. ____________________________________________________________

New Vocabulary

Use your text to define each term.

synthesis reaction

combustion reaction

decomposition reaction

single-replacement reaction

double-replacement reaction

precipitate

Chemical Reactions
Section 10.2 Classifying Chemical Reactions (continued)

**Main Idea**

Complete the following diagrams illustrating each classification of chemical reaction. The first one has been completed for you.

**Synthesis Reactions**

Use with page 284.

**Combustion Reactions**

Use with page 285.

**Decomposition Reactions**

Use with page 286.

**Replacement Reactions**

Use with pages 287–291.
Section 10.2 Classifying Chemical Reactions (continued)

Organize types of chemical reactions. The first column in the chart below lists some possible products in a chemical reaction. In the second column, write the type of chemical reaction that is likely to generate each product.

<table>
<thead>
<tr>
<th>Products</th>
<th>Possible Chemical Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>two different compounds one of which is often a solid, a gas, or water</td>
<td></td>
</tr>
<tr>
<td>oxide of the metal or a nonmetal or two or more oxides</td>
<td></td>
</tr>
<tr>
<td>two or more elements or compounds</td>
<td></td>
</tr>
<tr>
<td>a new compound and a replaced metal or nonmetal</td>
<td></td>
</tr>
<tr>
<td>one compound</td>
<td></td>
</tr>
</tbody>
</table>

**Analogy**

Consider the list of metals and halogens and their relative reactivity in Figure 10-10. Using your own experiences, identify people or things that could be ranked according to how they react in a certain situation.

1. (Example) Rank baseball bats by how likely they are to break.
2. 
3. 
4. 
Chemical Reactions
Section 10.3 Reactions in Aqueous Solutions

Main Idea

Consider the title and first paragraph in Section 3. Based on what you read, what do you expect to learn in this chapter?

Details

In the left column, write the terms defined below.

- the most plentiful substance in a solution
- substances dissolved in a solution
- equations that include only particles that participate in a reaction
- ion that does not participate in a reaction
- ionic equation that shows all the particles in a solution as they realistically exist
- a solution in which the most plentiful substance is water

Academic Vocabulary

Define the following terms.

- react
- detect
- obvious
Connect English words to their Latin roots. The term *aqueous* comes from the Latin word for water, *aqua*. Use a dictionary to find three words that also come from *aqua*, and list them in the box below together with a brief definition that explains their connection to water.

<table>
<thead>
<tr>
<th>Word</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Compare a complete ionic equation and a chemical equation.

Draw a circle around the spectator ions in the following equation.

$$2A^+(aq) + 2B^-(aq) + C^+(aq) + 2D^-(aq) \rightarrow 2A^+(aq) + 2D^-(aq) + 2BC$$

Identify whether each of the equations below is a complete ionic equation or a net ionic equation.

$$A^+(aq) + B^-(aq) + C^+(aq) + D^-(aq) \rightarrow AD + B^-(aq) + C^+(aq)$$

$$E^+(aq) + F^-(aq) \rightarrow EF$$

$$G^+(aq) + HI^-(aq) \rightarrow GI + H(g)$$
Section 10.3 Reactions in Aqueous Solutions (continued)

**Main Idea**

**Reactions That Form Water**

*Use with page 295.*

**Details**

**Compare** reactions in aqueous solution that form a precipitate and reactions that form water. Put each of the following characteristics in the corresponding category.

- can be described with ionic equations
- generates a solid product
- double-replacement reaction
- has no observable evidence

**Reactions That Form Gases**

*Use with page 299.*

**Identify** three commonly produced gases in reactions in aqueous solutions.

---

**State** the evidence that would indicate that carbon dioxide gas is escaping from the solution containing sodium hydrogen carbonate shown in Figure 10-13.

---

**List** the two reactions that occur when any acidic solution is mixed with sodium hydrogen carbonate.
Tie-It-All-Together

**Sequence the steps in writing an overall equation.**

1. 

2. 

3. 

4. 

**What if** ten years from now, you are a chemist working for a government agency that investigates chemical reactions. Read each of the case studies below, and in the space provided, list the type of chemical reaction that you think is involved and any products or effects that you would expect to discover during or after the chemical reaction.

1. Owners of an industrial plant plan to mix oxygen with existing chemical substances in order to create a new product.

<table>
<thead>
<tr>
<th>Type of Reaction</th>
<th>Product or Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Two vats of chemicals have spilled into a river and created a gelatinous ooze.

<table>
<thead>
<tr>
<th>Type of Reaction</th>
<th>Product or Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Now that you have read the chapter, review what you have learned. List three facts you have learned about chemical reactions and the equations that describe them.

Use this checklist to help you study.

- Study your Science Notebook for this chapter.
- Study the definitions of vocabulary words.
- Review daily homework assignments.
- Reread the chapter, and review the charts, 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.

Imagine you were asked to give an expert opinion on a magazine article before it is published. The article is on how to make your own household cleansers. You can tell that the author got the ingredients right, and she has amounts in the correct proportion. However, it looks to you like the author mixed up the order in which ingredients should be combined. How would you explain to the author why that matters?
The Mole

Before You Read

Review
Vocabulary

Define the following terms.

atomic mass

atomic mass unit (amu)

Chapter 2

Write the following in scientific notation

0.005 82
24 367
400

Circle the significant figures in the numbers below.

75 600 000
0.000 33
3.140
The Mole
Section 11.1 Measuring Matter

Main Idea

Scan Section 1, using the checklist below to preview your text.
• Read all section titles.
• Read all boldfaced words.
• Read all tables and graphs.
• Look at all pictures and read the captions.
• Think about what you already know about this subject.

Write three questions that come to mind from your reading.
1. __________________________________________________________________________
2. __________________________________________________________________________
3. __________________________________________________________________________

Details

Use your text to define each term.

Mole

Avogadro’s number

Counting Particles

Use with page 309.

List three common counting units and their values.
1. __________________________________________________________________________
2. __________________________________________________________________________
3. __________________________________________________________________________
Section 11.1 Measuring Matter (continued)

Main Idea

Use with page 310.

Details

Describe why chemists needed to invent a new counting unit.

List three forms of substances that can be measured using moles.

1. 

2. 

3. 

Analyze the usefulness of a conversion factor.

Write the equation for finding the number of representative particles in a number of moles.

Explain how you would find the number of moles that are represented by a certain number of representative particles.

Converting Moles to Particles and Particles to Moles

Use with page 311.
Section 11.1 Measuring Matter (continued)

Main Idea

Converting Number of Representative Particles to Moles

Use with Example Problem 11–1, page 312.

Details

Summarize Fill in the blanks to help you take notes as you read Example Problem 11–1.

Problem

Convert $4.50 \times 10^{24}$ atoms of Zn to find the number of mol of Zn.

1. Analyze the Problem

   Known: number of atoms = ________________
   
   $1 \text{ mole Zn} = \underline{\quad} \text{ atoms of Zn}$
   
   Unknown: mole Zn = \underline{\quad}

2. Solve for the Unknown

   the number of atoms $\times$ conversion factor = number of moles
   
   ________ atoms Zn $\times$
   
   $= \text{ number of moles}$
   
   $= \underline{\quad}$

3. Evaluate the Answer

   The answer has ____ significant digits and is less than ________.

Real-World Connection

Suppose you were given each of the following tasks. Analyze which task(s) the mole would be an effective unit for counting. Explain your answer.

A. Counting the atoms in a single grain of salt.

B. Counting the grains of salt in a very large mine.

C. Counting the grains of salt in the world.
The Mole
Section 11.2 Mass and the Mole

Scan Section 2, using the checklist below as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about this subject.

List four things you expect to learn from the chapter.

1. ______________________________________________

2. ______________________________________________

3. ______________________________________________

4. ______________________________________________

Use your text to define this term.

Molar mass

__________________________________________
Section 11.2  Mass and the Mole (continued)

Main Idea

The Mass of a Mole

Use with pages 313–314.

Analyze  molar mass by completing the following statements.

The mass of one mole of carbon-12 atoms is ____ grams.
The mass of one mole of hydrogen is ____ gram and is _____ the mass of one mole of ________.
The mass of one mole of helium-4 is _____ the mass of one mole of ______ and is equal to ____ grams.
One mole of manganese is equal to _________ atoms of Mn.

Using Molar Mass

Use with pages 314–317.

Organize the following equations by drawing a line from type of conversion to the correct equation.

- mole to mass: \[
\text{mass} \times \frac{1 \text{ mole}}{\text{number of grams}}
\]
- mass to mole: \[
\text{mass} \times \frac{1 \text{ mole}}{\text{number of grams}}, \quad \text{moles} \times \frac{6.02 \times 10^{23}}{1 \text{ mole}}
\]
- mass to atoms: \[
\text{number of moles} \times \frac{\text{number of grams}}{1 \text{ mole}}
\]
- atoms to mass: \[
\text{atoms} \times \frac{1 \text{ mole}}{6.02 \times 10^{23}}, \quad \text{moles} \times \frac{\text{number of grams}}{1 \text{ mole}}
\]
Using Molar Mass
Mass to Atoms
Conversion

Use with Example
Problem 11-4, page 317.

Main Idea

Details

Solve Read Example Problem 11-4.

You Try It.

Problem

Determine how many atoms are in 10 g of pure copper (Cu).

1. Analyze the Problem

   Known: mass = ________
   Unknown: molar mass
              number of atoms

2. Solve for the Unknown

   Use the periodic table to find the atomic mass of copper and convert it to g/mol.

   Complete the conversion equations.
   mass Cu x conversion factor = moles Cu
   _______ × _____________ g Cu = ____ moles Cu
   moles Cu x conversion factor = atoms Cu
   ____ mol Cu × ____________________________
   atoms Cu

3. Evaluate the Answer

   Restate the answer with correct significant digits.
The Mole
Section 11.3 Moles of Compounds

Main Idea

Skim Section 3 of your text. Write three questions that come to mind from your reading.

1. 
2. 
3. 

Describe the relationship between the mole information of a substance and its chemical formula.

Summarize Fill in the blanks to help you take notes as you read Problem 11-6.

Problem
Determine the number of moles of Al$^{3+}$ ions in 1.25 moles of Al$_2$O$_3$.

1. Analyze the Problem
   Known: number of moles of alumina =
   Unknown: number of moles =

2. Solve for the Unknown
   Write the conversion factor: mol Al$^{3+}$ ions/mol Al$_2$O$_3$
   Multiply the known number of moles by the conversion factor.
   mol Al$_2$O$_3$ × mol Al$^{3+}$ ions/mol Al$_2$O$_3$
   = mol Al$^{3+}$ ions

3. Evaluate the Answer
   Restate the answer with correct significant digits:
Section 11.3 Moles of Compounds (continued)

**Main Idea**

The Molar Mass of Compounds

*Use with page 322.*

**Details**

Describe the molar mass of a compound.

Investigate the process of finding molar mass by completing the table below.

<table>
<thead>
<tr>
<th>Number of Moles</th>
<th>Molar Mass</th>
<th>=</th>
<th>Number of Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>mol K</td>
<td>g K/1 mol K</td>
<td>=</td>
<td>g</td>
</tr>
<tr>
<td>mol Cr</td>
<td>g Cr/1 mol Cr</td>
<td>=</td>
<td>g</td>
</tr>
<tr>
<td>mol O</td>
<td>g O/1 mol O</td>
<td>=</td>
<td>g</td>
</tr>
<tr>
<td>molar mass of K₂CrO₄</td>
<td></td>
<td>=</td>
<td>g</td>
</tr>
</tbody>
</table>

Analyze the process of converting moles of a compound to molar mass by completing the table below. Refer to Example Problem 11-7.

<table>
<thead>
<tr>
<th>Number of Moles</th>
<th>Molar Mass</th>
<th>=</th>
<th>Number of Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 \times 3 mol C</td>
<td>g C/1 mol C</td>
<td>=</td>
<td>g</td>
</tr>
<tr>
<td>2 \times 5 mol H</td>
<td>g H/1 mol H</td>
<td>=</td>
<td>g</td>
</tr>
<tr>
<td>1 mol S</td>
<td>g S/1 mol S</td>
<td>=</td>
<td>g</td>
</tr>
<tr>
<td>molar mass of (C₃H₅)₂S</td>
<td></td>
<td>=</td>
<td>g</td>
</tr>
</tbody>
</table>
Investigate the process of converting the mass of a compound to moles by completing the following.

<table>
<thead>
<tr>
<th>Number of Moles</th>
<th>Molar Mass</th>
<th>=</th>
<th>Number of Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mol Ca</td>
<td>g Ca/1 mol Ca</td>
<td>=</td>
<td>g</td>
</tr>
<tr>
<td>2 \times 1 mol O</td>
<td>g O/1 mol O</td>
<td>=</td>
<td>g</td>
</tr>
<tr>
<td>2 \times 1 mol H</td>
<td>g H/1 mol H</td>
<td>=</td>
<td>g</td>
</tr>
<tr>
<td>molar mass of Ca(OH)(_2)</td>
<td>=</td>
<td>g</td>
<td></td>
</tr>
</tbody>
</table>

Conversion factor: \( \text{g of Ca(OH)}\(_2\)/\text{1 mol Ca(OH)}\(_2\) \)

\( \text{g Ca(OH)}\(_2\) \times \text{conversion factor} = \text{mol Ca(OH)}\(_2\) \)

\( \text{mol Ca(OH)}\(_2\) \times \text{________} / \text{________} = \text{____ mol Ca(OH)}\(_2\) \)

Explain the steps in converting the mass of a compound to number of particles.

1. Determine the ________.
2. Multiply by the _______ of the molar mass to convert to _______.
3. Multiply by _____________ to calculate the number of _________.
4. Use the ratios from the _____________ to calculate the number of _______.
5. Calculate the _____ per formula unit.
**Main Idea**

**Details**

**Skim** Section 4 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 

2. 

3. 

**New Vocabulary**

*Use your text to define each term.*

*percent composition*  

*empirical formula*  

*molecular formula*  

**Academic Vocabulary**

*Define the following terms.*

*stable*  

*environment*
Write the equation for determining the percent by mass for any element in a compound.

Describe the general equation for calculating the percent by mass of any element in a compound.

Explain empirical formula by completing the following statements.

To determine the empirical ______ for a compound, you must first determine the smallest __________ of the moles of the elements in the compound. This ratio provides the ______ in the empirical formula. If the empirical formula differs from the molecular formula, the molecular formula will be a ______ multiple of the empirical formula. The data used to determine the chemical formula may be in the form of __________ or it may be the actual masses. When the percent composition is given, you can assume that the total mass of the compound is 100.0 g to simplify calculations. The ______ of elements in a compound must be ________ to whole numbers to be used as ________ in the chemical formula.
Section 11.4  Empirical and Molecular Formulas (continued)

Molecular Formula

Use with pages 333–335.

Main Idea

Details

**Explain** how a molecular formula distinguishes two distinct substances sharing the same empirical formula.

Investigate molecular formulas by completing the steps below. Refer to Example Problem 11-12 in your text.

empirical formula = \(C_2H_3O_2\)

molar mass = 118.1 g/mol

**Identify the molar mass of the compound.**

<table>
<thead>
<tr>
<th>Moles of Element</th>
<th>Mass of Element/ 1 Mol of Element</th>
<th>=</th>
<th>Mass of Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 mol C</td>
<td>(g \text{ C/mol C})</td>
<td>=</td>
<td>(g \text{ C})</td>
</tr>
<tr>
<td>3 mol H</td>
<td>(g \text{ H/mol H})</td>
<td>=</td>
<td>(g \text{ H})</td>
</tr>
<tr>
<td>2 mol O</td>
<td>(g \text{ O/mol O})</td>
<td>=</td>
<td>(g \text{ O})</td>
</tr>
</tbody>
</table>

empirical molar mass of \(C_2H_3O_2\) = \(g\)

**Divide the molar mass of the substance by the molar mass of the compound to determine \(n\).**

\[
n = \frac{\text{molar mass of substance}}{\text{molar mass of compound}} = \frac{\text{mass of substance}}{\text{mass of compound}} = \boxed{\text{ }}
\]

Multiply the subscripts in the empirical formula by \(n\). Write the molecular formula.
Examine the flow chart below. Write the steps in determining empirical and molecular formulas from percent composition or mass data next to the relevant boxes in the flow chart.
The Mole
Section 11.5 The Formula for a Hydrate

Main Idea

Details

Skim Section 5 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 

2. 

3. 

New Vocabulary

Use your text to define the following term.

hydrate

Naming Hydrates

Use with page 338.

Explain how hydrates are named by completing the table below.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Molecules of Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>mono-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
<tr>
<td>nona-</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>
Section 11.5 The Formula for a Hydrate (continued)

Main Idea

Analyzing a Hydrate

Use with page 339.

Determining the Formula for a Hydrate

Use with Example Problem 11-14, page 340.

Details

Describe an anyhydrate.

Solve Read Example Problem 11-14 in your text.

You Try It

Problem

A 5.00 g sample of barium chloride hydrate was heated in a crucible. After the experiment, the mass of the solid weighed 4.26 g. Determine the number of moles of water that must be attached to BaCl₂.

1. Analyze the Problem

Known: mass of hydrated compound = ____ g BaCl₂ • x H₂O

mass of anhydrous compound = ____ g BaCl₂

molar mass of H₂O = ____ g/mol

molar mass of BaCl₂ = 208.23 g/mol

Unknown: formula for hydrate

name of hydrate
2. **Solve for the Unknown**

   Subtract the mass of the anhydrous compound from the hydrated compound.

   Calculate the number of moles of \( \text{H}_2\text{O} \) and anhydrous \( \text{BaCl}_2 \) using the conversion factor that relates moles and mass based on the molar mass.

   \[
   4.26 \text{ g BaCl}_2 \times \frac{\text{moles \text{BaCl}_2}}{\text{4.26 g BaCl}_2} = \text{moles \text{BaCl}_2}
   \]

   \[
   0.84 \text{ g H}_2\text{O} \times \frac{\text{moles \text{H}_2\text{O}}}{\text{0.84 g H}_2\text{O}} = \text{moles \text{H}_2\text{O}}
   \]

   Determine the value of \( x \).

   \[
   x = \frac{\text{moles \text{H}_2\text{O}}}{\text{moles \text{BaCl}_2}} = \text{_____}
   \]

3. **Evaluate the Answer**

   The ratio of \( \text{H}_2\text{O} \) to \( \text{BaCl}_2 \) is ____ so the formula for the hydrate is ______________, and the name of the hydrate is ______ _________.

---

**REAL-WORLD CONNECTION**

Explain why hydrates are useful in storage and shipping.
Now that you have read the chapter, review what you have learned and list three things you have learned about moles.

1. __________________________________________

2. __________________________________________

3. __________________________________________

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.

☐ Study the definitions of vocabulary words.

☐ 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.

Summarize the important conversions you have learned in this chapter.

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________
Stoichiometry

Before You Read

**Review Vocabulary**

*Define the following terms.*

- **mole**
- **molar mass**
- **conversion factor**
- **dimensional analysis**
- **law of conservation of mass**

**Chapter 10**

*Balance the following equation.*

\[ \square \text{Mg} \, (s) + \square \text{AlCl}_3 \, (aq) \rightarrow \square \text{Al} \, (s) + \square \text{MgCl}_2 \, (aq) \]

**Chapter 11**

*Use the periodic table in the back of your text to complete the chart.*

<table>
<thead>
<tr>
<th>Pure Substance</th>
<th>Molar Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>12.011</td>
</tr>
<tr>
<td>Sodium carbonate</td>
<td>22.990</td>
</tr>
<tr>
<td>Sodium carbonate</td>
<td>15.999</td>
</tr>
</tbody>
</table>
Stoichiometry

Section 12.1 What is Stoichiometry?

Main Idea

**Skim** Section 1 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 

2. 

3. 

New Vocabulary

Use your text to define each term.

**stoichiometry**

**mole ratio**

Academic Vocabulary

Define the following term.

**qualitative**

Mole-Mass Relationships in Chemical Reactions

Use with page 354.

Explain the importance of the law of conservation of mass in chemical reactions.
Section 12.1 What is Stoichiometry? (continued)

Interpreting Chemical Equations

Use with Example Problem 12-1, page 354.

Summarize Fill in the blanks to help you take notes while you read Example Problem 12-1.

Problem
Interpret the equation in terms of , and . Show that the law of conservation of mass is .

1. Analyze the Problem
   Known:
   Unknown:

2. Solve for the Unknown
   The coefficients indicate the number of .
   The coefficients indicate the number of .
   Use the space below to calculate the mass of each reactant and each product. Multiply the number of moles by the conversion factor, molar mass.
   \[
   \text{moles of reactant} \times \frac{\text{grams of reactant}}{1 \text{ mole of reactant}} = \text{grams of reactant}
   \]
   \[
   \text{moles of product} \times \frac{\text{grams of reactant}}{1 \text{ mole of reactant}} = \text{grams of product}
   \]
   Add the masses of the reactants.
   \[\square \text{ g C}_3\text{H}_8 + \square \text{ g O}_2 = \square \text{ g reactants}\]
   Add the masses of the products.
   \[\square \text{ g CO}_2 + \square \text{ g H}_2\text{O} = \square \text{ g products}\]
   Determine if the is observed. Does the mass of the reactants equal the mass of the products? .

3. Evaluate the Answer
   Each product or reactant has significant figures. Your answer must have significant figures.
Section 12.1 What is Stoichiometry? (continued)

**Main Idea**

Mole ratios

*Use with page 356.*

**Details**

Examine Relationships between coefficients can be used to write conversion factors called __________.

**Example**

Given the equation \( 2\text{KClO}_3(\text{s}) \rightarrow 2\text{KCl}(\text{s}) + 3\text{O}_2(\text{g}) \)

Each substance forms a ________ with the other substances in the reaction.

Write the mole ratios that define the mole relationships in this equation. *(Hint: Relate each reactant and each product to each of the other substances.)*

---

**You Try It**

Draw arrows with colored pencils that show the relationships of the substances in this equation.

\( \text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) \)

Write the mole ratios for the above equation.
Stoichiometry
Section 12.2 Stoichiometric Calculations

Main Idea

Scan Section 2, using the checklist below to preview your text.
- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about this subject.

Write three facts you discovered about stoichiometric calculations.
1. ________________________________________
2. ________________________________________
3. ________________________________________

Define the following terms.
convert
________________________________________
process
________________________________________
significant
________________________________________

Identify the tools needed for stoichiometric calculations.
All stoichiometric calculations start with __________ based on a ______________. Finally, ______________ are required.

Using Stoichiometry
Use with page 358.
Section 12.2 Stoichiometric Calculations (continued)

**Main Idea**

Stoichiometric Mole-to-Mole Conversion

*Use with Example Problem 12-2, page 359.*

**Details**

**Solve** Read Example Problem 12-2 in your text.

**You Try It**

**Problem**

How many moles of aluminum oxide (Al₂O₃) are produced when 4.0 moles of aluminum (Al) are combined with oxygen gas (O₂)?

1. **Analyze the Problem**

   **Known:**
   
   **Unknown:**
   
   Both the known and the unknown are in moles, therefore, you will do a mole-to-mole conversion.

2. **Solve for the Unknown**

   Write the balanced chemical equation. Label the known and unknown.

   \[
   \text{Al(s)} + \text{O}_2(g) = \text{Al}_2\text{O}_3(s)
   \]

   List the mole ratios for this equation. (Hint: Draw arrows that show the relationships of the substances in this equation.)

   Circle the mole ratio that relates mol Al to mol of Al₂O₃.

   Multiply the known number of moles Al by the mole ratio to find the moles of unknown Al₂O₃.

   \[
   \frac{\text{moles of Al}}{\text{moles of Al}_2\text{O}_3} = \frac{\text{moles of Al}_2\text{O}_3}{\text{moles of Al}}
   \]

3. **Evaluate the Answer**

   The given number of moles has **significant figures. Therefore, the answer must have **significant figures.
Section 12.2 Stoichiometric Calculations (continued)

Main Idea

Stoichiometric Mole-to-Mass Conversion

Use with Example Problem 12-3, page 360.

Details

Solve Read Example Problem 12-3 in your text.

You Try It

Problem

How many grams of solid iron (III) chloride (FeCl\textsubscript{3}) are produced when 2.00 moles of solid iron (Fe) are combined with chlorine gas (Cl\textsubscript{2})?

1. Analyze the Problem

Known: 

Unknown:

You are given the moles of the reactant, Fe, and must determine the mass of the product, FeCl\textsubscript{3}, therefore, you will do a mole to mass conversion.

2. Solve for the Unknown

Write the balanced chemical equation. Identify the known and unknown substances.

\[
\text{Fe(s)} + \text{Cl}_2(g) \rightarrow \text{FeCl}_3(s)
\]

List the mole ratios for this equation. (Hint: Draw arrows that show the relationships of the substances in this equation.)

Circle the mole ratio that relates moles of Fe to FeCl\textsubscript{3}.

Multiply the number of moles of Fe by the mole ratio.

\[
\text{mol Fe} \times \frac{\text{mol FeCl}_3}{\text{mol Fe}} = \text{mol FeCl}_3
\]

Multiply the moles of FeCl\textsubscript{3} by the molar mass of FeCl\textsubscript{3}.

\[
\text{mol FeCl}_3 \times \frac{\text{g FeCl}_3}{1 \text{ mol FeCl}_3} = \text{g FeCl}_3
\]

3. Evaluate the Answer

The given number of moles has \underline{ } digits, so the mass of FeCl\textsubscript{3} must have \underline{ } digits.
Stoichiometric Calculations (continued)

**Main Idea**

Stoichiometric Mass-to-Mass Conversion
Use with Example Problem 124, page 361.

**Details**

Solve Read Example Problem 12-4 in your text.

You Try It

**Problem**

Determine the mass of ammonia (NH₃) produced when 3.75 g of nitrogen gas (N₂) react with hydrogen gas (H₂).

1. **Analyze the Problem**

   Known: 
   Unknown: 

   You are given the mass of the reactant, N₂, and must determine the mass of the product NH₃. Do a mass-to-mass conversion.

2. **Solve for the Unknown**

   Write the balanced chemical equation for the reaction.
   \[ \text{N}_2(g) + \text{H}_2(g) = \text{NH}_3(g) \]

   Convert grams of N₂(g) to moles of N₂(g) using the inverse of molar mass as the conversion factor.
   \[ \text{g N}_2 \times \frac{1 \text{ mol N}_2}{\text{g N}_2} = \text{mol N}_2 \]

   List the mole ratios for this equation.

   Multiply moles of N₂ by the mole ratio that relates N₂ to NH₃.
   \[ \text{mol N}_2 \times \frac{\text{mol NH}_3}{\text{mol N}_2} = \text{mol NH}_3 \]

   Multiply moles of NH₃ by the molar mass.
   \[ \text{mol NH}_3 \times \frac{\text{g NH}_3}{1 \text{ mol NH}_3} = \text{g NH}_3 \]

3. **Evaluate the Answer**

   The given mass has \[ \quad \text{significant figures, so the mass of NH}_3 \text{ must have \[ \quad \text{significant figures.} \]}}

162  Stoichiometric Calculations
Sequence the steps needed to convert from the balanced equation to the mass of the unknown.

Identify the steps in stoichiometric calculations by completing the summary below.

1. Interpret the equation in terms of _____.
2. Use the _______ as the conversion factor.
3. Use the appropriate mole ratio from the _______ as the conversion factor.
4. Use _______ as the conversion factor.
Stoichiometry
Section 12.3 Limiting Reactants

Main Idea

Scan Section 3 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 pictures and read the captions.
• Think about what you already know about limiting reactants.

Write three facts you discovered about limiting reactants.

1. __________________________________________

2. __________________________________________

3. __________________________________________

New Vocabulary

limiting reactant

Use your text to define each term.

excess reactant

Academic Vocabulary

reassemble

Define the following term.
Section 12.3 Limiting Reactants (continued)

Main Idea

Why do reactions stop?
Use with page 364.

Calculating the Product When a Reactant is Limited

What if you have six slices of bread, three tomato slices, and two cheese slices. How many tomato-cheese sandwiches can you make? Which ingredient(s) limit the number of sandwiches you can make?

Organize information about limiting reactants.

I. ______________________________________________________________________
   A. Limiting reactant
      1. _____________________________________________________________________
      2. _____________________________________________________________________
   B. _____________________________________________________________________

II. Calculating the product when a reactant is limited
   A. _____________________________________________________________________
      1. convert the masses to moles
      2. multiply each mass by the inverse of the molar mass
   B. _____________________________________________________________________
   C. _____________________________________________________________________
   D. Determine the amount of product that can be made with the moles of the limiting reactant.

Solve Read Example Problem 12-5 in your text.

You Try It

Problem If 100.0g of sulfur reacts with 50.0g of chlorine, what mass of disulfur dichloride is produced?

1. Analyze the Problem
   Known: ___________________________________________________________________
   Unknown: __________________________________________________________________

2. Solve for the Unknown
   Write the balanced chemical equation.
List the mole ratios for this equation.

Multiply each mass by the inverse of molar mass.

Calculate the actual ratio of available moles.

Determine the limiting reactant.

Multiply the number of moles of the limiting reactant by the mole ratio of the product to the limiting reactant.

Multiply moles of the product by the molar mass.

Multiply moles of the excess reactant by the molar mass.

Subtract the mass of the excess reactant needed from the mass available.

3. Evaluate the Answer

The given mass has ____ significant figures, so the mass of the unknown must have ____ significant figures.
Stoichiometry
Section 12.4 Percent Yield

Main Idea

Skim Section 4 of your text. Focus on the headings, subheadings, and boldfaced words. Summarize the main ideas of this section.

New Vocabulary

In the left margin, write the terms defined below.

the ratio of actual yield to theoretical yield (from stoichiometric calculations) expressed as a percent

in a chemical reaction, the maximum amount of product that can be produced from a given amount of reactant

the amount of product actually produced when a chemical reaction is carried out in an experiment

Define the following term.

maximize

How much product?

Write the formula for percent yield.

Use with page 370.
Section 12.4 Percent Yield (continued)

Main Idea

Calculating Percent Yield
Use with page 371.

Details

Solve Read Example Problem 12-6 in your text.

You Try It

Problem
When 100.0 kg sand (SiO₂) are processed with carbon, CO and 51.4 kg SiC are recovered. What is the percent yield of SiC?

1. Analyze the Problem

Known: ________________________________

Unknown: ________________________________

2. Solve for the Unknown

Write the balanced chemical equation.

Determine the mole ratio that relates ____ to ____.

Convert kg to g.

100 kg SiO₂ = _________ g, 51.4 kg SiC = _________ g

Convert mass to moles using the inverse of molar mass.

Use the appropriate mole ratio to convert mol SiO₂ to mol SiC.

Calculate the theoretical yield. Multiply mol SiC by the molar mass.

Divide the actual yield by the theoretical yield and multiply by 100.

3. Evaluate the Answer

The quantities have _____ significant figures, so the percent yield must have _____ significant figures.
Stoichiometry and the Stock Market

In the left margin, write the stoichiometry concepts that parallel the daily activities of a Wall Street professional.

1. A stock analyst keeps a close eye on the earnings of corporations. She has determined how much each company should accomplish.

2. The same analyst tracks whether companies meet expectations or fall short.

3. A grain trader wants to be sure to have 100,000 bushels in reserve for the winter selling season. He places an order for 120,000 bushels because he knows spoilage may damage a percentage of the crop.

4. A livestock futures trader knows that one cattle car holds 10 steers averaging 1200 lbs. each. He wants to bid on an identical car full of sheep, which average about 200 lbs. each. He needs to know how many sheep are on the car.

5. A stockbroker learns that a medical supply company has acquired several tons of a rare silver compound that will allow it to make superior dental equipment. The question is whether the company will have enough of the product to meet the demands of the marketplace.
Now that you have read the chapter, review what you have learned. Write the key equations and relationships.

Use this checklist to help you study.

☐ Use this Science Notebook to study this chapter.
☐ Study the vocabulary words and scientific definitions.
☐ Review daily homework assignments.
☐ Reread the chapter, reviewing 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.

Explain how stoichiometry is important to air bags and your safety.
States of Matter

Before You Read

**Review Vocabulary**

Define the following terms.

- **gas**

- **physical property**

**Chapter 2**

Calculate the density of a sample with a mass of 22.5 g and a volume of 5.0 cm$^3$. Use the equation: density = mass/volume.

**Chapter 3**

Describe the two essential characteristics that determine the chemical and physical properties of matter.

Compare and contrast the chemical and physical properties of gases.
States of Matter
Section 13.1  Gases

Scan Section 1, using the checklist below as a guide.
• Read all section titles.
• Read all boldfaced words.
• Read all tables and graphs.
• Look at all pictures and read the captions.
• Think about what you already know about this subject.

New Vocabulary

kinetic-molecular theory

elastic collision

temperature

diffusion

Graham’s law of effusion

pressure

barometer

pascal

atmosphere

Dalton’s law of partial pressures

Use your text to define each term.
Section 13.1 Gases (continued)

Main Idea

The Kinetic-Molecular Theory

Use with pages 385–386.

Details

Distinguish between the three main physical properties of gas particles by completing the passages below.

1. Size is very _____ . It is assumed that there are ____ significant _______ or _______ forces among gas particles.

2. Motion is _______ moving in a _______ pattern. It is assumed that gas particles move in a _______ path until they ________.

3. Energy is ________ . It is assumed that ____ and ______ impact the _____ level of a gas ______.

Describe kinetic energy in equation form by completing the table below.

<table>
<thead>
<tr>
<th>KE = 1/2mv^2</th>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>KE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>v</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Describe the following concepts as they relate to the behaviors of gases by completing the passages below.

low density—Gases have low density (_____ per _________) in comparison to ______. The difference in density is partly due to the mass of the _________ and also because there is a great deal of ______ between gas particles.

compression and expansion—The large amount of ________ between gas particles allows them to be _________, or pushed, into a ______ volume. Once the pressure is ______, the particles _______ to the original ______.

diffusion and effusion—Because there are no ________ forces of _______ between gas particles, gases ________ past one another. This ______ motion allows gases to mix until they are _______________. The movement of _________ past one another is called ________. The process of allowing a gas to escape from a more concentrated container is called ________.
Gases

Use with pages 388–392.

Main Idea

Write Graham’s law of effusion as a proportional statement.

Write the proportional statement based on Graham’s law of effusion that allows you to compare the diffusion rate of two different gases.

Details

Describe pressure as it relates to the behaviors of gases.

Distinguish between a barometer and a manometer.

Explore the relationship between different units of pressure by filling in the table below.

<table>
<thead>
<tr>
<th>Unit Name (unit symbol)</th>
<th>Conversion Ratio: 1 atm = ________</th>
<th>Conversion Ratio: 1 kPa = ________</th>
</tr>
</thead>
<tbody>
<tr>
<td>kilopascal (kPa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>millimeters of mercury (mmHg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>torr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pounds per square inch (psia)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>atmosphere (atm)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**States of Matter**

Section 13.2 Forces of Attraction

**Main Idea**

**Details**

*Skim Section 2 of your text. Write three questions that come to mind from reading the headings and the illustration captions.*

1. __________________________________________
2. __________________________________________
3. __________________________________________

**New Vocabulary**

*Use your text to define each term.*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>dispersion forces</td>
<td></td>
</tr>
<tr>
<td>dipole-dipole force</td>
<td></td>
</tr>
<tr>
<td>hydrogen bond</td>
<td></td>
</tr>
</tbody>
</table>

**Academic Vocabulary**

*Define the following term.*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>distribute</td>
<td></td>
</tr>
</tbody>
</table>
Intermolecular Forces

Use with pages 393–395.

**Main Idea**

**Details**

Describe the difference between an intramolecular and an intermolecular force.

**Compare and contrast** intramolecular forces by completing the table below.

<table>
<thead>
<tr>
<th>Force</th>
<th>Basis of Attraction</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ionic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metallic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Compare** intermolecular forces by completing the table below.

<table>
<thead>
<tr>
<th>Force</th>
<th>Basis of Attraction</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispersion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dipole-dipole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen bond</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Scan Section 3, using the checklist below as a guide.
- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about this subject.

Use your text to define each term.

New Vocabulary

- viscosity
- surface tension
- surfactant
- crystalline solid
- unit cell
- amorphous solid

Academic Vocabulary

Define the following term.

- predict
Liquids

Use with pages 396–398.

**Main Idea**

Compare and contrast the following paired concepts as they relate to the properties of liquids by completing the following statements.

**Details**

**Density and compression:** A liquid can take the _______ ________, but its volume is ______. The density of a liquid is ______ than the density of the same substance as a _______.

Liquids cannot usually be ________ except under ________ pressure.

**Fluidity and viscosity:** Fluidity is the ability to ______. Liquids flow through each other but at a _______ than ______ do. Viscosity is the measure of the _______ of a liquid to _______. The stronger _______ slow down the ability to flow, which _______ resistance (viscosity).

**Viscosity and temperature:** Temperature affects the _______ of a _______. Viscosity _______ with temperature.

**Analyze** the relationship between viscosity, temperature, and change in kinetic energy by completing the table.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Δ KE</th>
<th>Viscosity</th>
<th>Effect in Liquid</th>
</tr>
</thead>
<tbody>
<tr>
<td>increases</td>
<td></td>
<td></td>
<td>flows faster</td>
</tr>
<tr>
<td>decreases</td>
<td></td>
<td>increases</td>
<td></td>
</tr>
<tr>
<td>stays the same</td>
<td>no change</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section 13.3 Liquids and Solids (continued)

Main Idea

Explain surface tension by completing the web diagram below.

Details

Describe the following concepts as they relate to the properties of liquids by completing the following passages.

Capillary action is__________________________________________________________

Cohesion is_______________________________________________________________

Adhesion is_______________________________________________________________
Section 13.3 Liquids and Solids (continued)

Solids
Use with pages 399–400.

Contrast the density of solids and liquids by completing the following paragraph.
In general, the ________ in a solid are more ________—that is, more dense—than those in a ______. When liquid and solid states of the same substance exist at the same time, the ______ usually ______ in the ______. One familiar exception is ______.
When water is in its solid state as ice, it ______, such as ______ or a(n) ______. This is because there is _____ space between the ______ in ice than in liquid water.

Compare the different types of crystalline solids by completing the following table.

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit Particles</th>
<th>Characteristics</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molecular</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covalent network</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ionic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metallic</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Main Idea

**Skim** Section 4 of your text. Write a brief summary of the main topics covered.


### New Vocabulary

**Use your text to define each term.**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>sublimation</td>
<td></td>
</tr>
<tr>
<td>condensation</td>
<td></td>
</tr>
<tr>
<td>deposition</td>
<td></td>
</tr>
<tr>
<td>phase diagram</td>
<td></td>
</tr>
<tr>
<td>melting point, freezing point, and triple point</td>
<td></td>
</tr>
<tr>
<td>vaporization and evaporation</td>
<td></td>
</tr>
</tbody>
</table>

### Compare and contrast

**the following terms using your text as a guide.**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>melting point</td>
<td></td>
</tr>
<tr>
<td>freezing point</td>
<td></td>
</tr>
<tr>
<td>triple point</td>
<td></td>
</tr>
<tr>
<td>vaporization</td>
<td></td>
</tr>
<tr>
<td>evaporation</td>
<td></td>
</tr>
</tbody>
</table>
Section 13.4 Phase Changes (continued)

**Main Idea**

Phase Changes That Require Energy

Use with page 404.

**Details**

Classify the types of phase changes by completing the table below. Use Figure 13–22 in your text for reference.

<table>
<thead>
<tr>
<th>Phase Transition</th>
<th>Type of Transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>gas to solid</td>
<td></td>
</tr>
<tr>
<td>solid to liquid</td>
<td></td>
</tr>
<tr>
<td>liquid to gas</td>
<td></td>
</tr>
<tr>
<td>liquid to solid</td>
<td>condensation</td>
</tr>
<tr>
<td>solid to gas</td>
<td></td>
</tr>
</tbody>
</table>

Describe the phase changes that require energy by completing the following outline.

I. Melting
   A. Heat energy disrupts ____________________________
   B. The amount of energy required depends on ________________
   C. The melting point is the temperature at which ________________
   D. The melting point of ________________ may be unspecified.

II. Vaporization
   A. In liquid water, some particles have more ________________
   B. Particles that escape from liquid enter the ________________
   C. When vaporization occurs only at a surface it is called ________________
   D. The pressure exerted by a vapor over liquid is called ________________
   E. The temperature at which vapor pressure equals atmospheric pressure is called the ________________.

III. Sublimation
   A. Many solids can become gases without ________________
   B. Some solids sublime at ________________
   C. The process of ________________ is an example of sublimation.
Section 13.4 Phase Changes (continued)

**Main Idea**

**Phase Changes That Release Energy**

*Use with pages 407–408.*

**Details**

Organize the phase changes that release energy. Identify the phase, describe the process, and identify the reverse process by completing the table below.

<table>
<thead>
<tr>
<th>Phase Change</th>
<th>Process Description</th>
<th>Reverse Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>condensation</td>
<td>process in which a liquid becomes a solid</td>
<td>vaporization</td>
</tr>
<tr>
<td>deposition</td>
<td></td>
<td>sublimation</td>
</tr>
</tbody>
</table>

**Phase Diagrams**

*Use with pages 408–409.*

Explain how the critical point affects water.

Identify normal freezing point, normal boiling point, critical point, and triple point in the phase diagram for H₂O below. Use Figure 13–28 in your text for reference.
States of Matter  Chapter Wrap-Up

After reading this chapter, list three key equations and relationships.

1. ________________________________
2. ________________________________
3. ________________________________

Review

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.
☐ Study the definitions of vocabulary words.
☐ 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

You see examples of phase changes every day. Use your text to identify which phase change each of the following transitions demonstrates. The first one has been done for you.

frost forms on a windowpane  deposition
ice becomes water
steam rises from a cup of coffee
a water pipe bursts on a very cold day
drops of water cover the mirror after a shower
snow melts without leaving a puddle
Gases

Before You Read

**Review Vocabulary**

Define the following terms.

- **density**
- **stoichiometry**
- **kinetic-molecular theory**

**Chapter 10**

Balance the following equation.

\[ \_\text{Fe} + \_\text{H}_2\text{SO}_4 \rightarrow \text{Fe}_2(\text{SO}_4)_3 + \_\text{H}_2 \]

**Chapter 12**

Show the mole ratios for the following reaction.

\[ \text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3 \]

a. mole ratio of \( \text{N} \) to \( \text{H}_2 \)

b. mole ratio of \( \text{NH}_3 \) to \( \text{H}_2 \)

**Chapter 13**

Explain how gas particles exert pressure.

________________________________________________________________________

________________________________________________________________________
Gases
Section 14.1 The Gas Laws

Main Idea

Scan Section 1 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 pictures and read the captions.
• Think about what you already know about this subject.

Write three facts you discovered about the gas laws.
1. ____________________________________________________________
2. ____________________________________________________________
3. ____________________________________________________________

New Vocabulary

Use your text to define each term.

Boyle’s law

_________________________________________________________________
_________________________________________________________________

Charles’s law

_________________________________________________________________
_________________________________________________________________

Gay-Lussac’s law

_________________________________________________________________
_________________________________________________________________

Academic Vocabulary

Define the following term.

theory

_________________________________________________________________
Section 14.1 The Gas Laws (continued)

Main Idea

Kinetic Theory
Use with pages 419–420.

Details

List the five assumptions the kinetic theory makes about gases.

1. ____________________________

2. ____________________________

3. ____________________________

4. ____________________________

5. ____________________________

Boyle’s Law
Use with Example Problem 14-1, page 422.

Summarize Fill in the blanks to help you take notes while you read Example Problem 14-1.

Problem Helium gas in a balloon is compressed from 4.0 L to 2.5 L at constant temperature. The gas’s pressure at 4.0 L is 210 kPa. Determine the pressure at 2.5 L.

1. Analyze the Problem
   Known:
   \[ V_1 = \quad \quad \quad \quad \quad \quad P_2 \quad \quad \quad \quad \]
   \[ V_2 = \quad \quad \quad \quad \quad \quad P_1 \quad \quad \quad \quad \]
   Use the equation for Boyle’s law to solve for \( P_2 \).

2. Solve for the Unknown
   Write the equation for Boyle’s law: \[
   P_1 V_1 = P_2 V_2
   \]
   To solve for \( P_2 \), divide both sides by \( V_2 \).
   \[ P_2 = \]
   Substitute the known values.
   \[ P_2 = \]
   Solve for \( P_2 \).
   \[ P_2 = \]

3. Evaluate the Answer
   When the volume is _____, the pressure is _____.
   The answer is in ____, a unit of pressure.
Section 14.1 The Gas Laws (continued)

Charles’s Law
Use with Example Problem 14–2, page 425.

Summarize Fill in the blanks to help you take notes while you read Example Problem 14–2.

Problem
A gas sample at 40.0°C occupies a volume of 2.32 L. Assuming the pressure is constant, if the temperature is raised to 75.0°C, what will the volume be?

1. Analyze the Problem
Known: Unknown:

\( T_1 = \)______  
\( V_1 = \)______  
\( T_2 = \)______  

\( V_2 = \)______

Use Charles’s law and the known values for \( T_1, V_1, \) and \( T_2 \) to solve for \( V_2 \).

2. Solve for the Unknown
Convert the \( T_1 \) and \( T_2 \) Celsius temperatures to kelvin:

\( T_1 = 273 + 40.0^\circ C = \) ____ K  
\( T_2 = 273 + 75.0^\circ C = \) ____ K

Write the equation for Charles’s law:

\[
\frac{V_1}{T_1} = \frac{V_2}{T_2}
\]

To solve for \( V_2 \), multiply both sides by \( T_2 \):

\[
V_2 =
\]

Substitute known values:

\[
V_2 =
\]

Solve for \( V_2 \).

\[
V_2 = \)______

3. Evaluate the Answer
When temperature in kelvin increases by a small amount, the volume ______ by a small amount. The answer is in ____ , a unit for volume.
Gay-Lussac’s Law

Use with Example Problem 14-3, page 426.

Solve Read Example Problem 14-3 in your text.

You Try It

Problem

The pressure of a gas stored in a refrigerated container is 4.0 atm at 22.0°C. Determine the gas pressure in the tank if the temperature is lowered to 0.0°C.

1. Analyze the Problem

Known: Unknown:

\[ P_1 = 4.0 \, \text{atm} \quad P_2 = \ ? \]

\[ T_1 = \quad \] \[ T_2 = \quad \]

Use Gay-Lussac’s law and the known values for \( T_1 \), \( V_1 \), and \( T_2 \) to solve for \( V_2 \).

2. Solve for the Unknown

Convert the \( T_1 \) and \( T_2 \) Celsius figures to kelvin.

\[ T_1 = \quad + 22.0^\circ \text{C} = \quad \text{K} \]

\[ T_2 = 273 + \quad ^\circ \text{C} = \quad \text{K} \]

Write the equation for Gay-Lussac’s law.

To solve for \( P_2 \), multiply both sides by \( T_2 \).

\[ P_2 = \]

Substitute known values.

\[ P_2 = \]

Solve for \( P_2 \).

\[ P_2 = 3.7 \, \text{atm} \]

3. Evaluate the Answer

The temperature _________ and the pressure _________.
Gases
Section 14.2 The Combined Gas Law and Avogadro’s Principle

Main Idea

Skim Section 2 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 
2. 
3. 

New Vocabulary

Use your text to define each term.

combined gas law

Avogadro’s principle

molar volume

Academic Vocabulary

Define the following term.

convert
**Main Idea**

**The Combined Gas Law**

*Use with page 428.*

**Details**

**Describe** the combined gas law.

**Write** the combined gas law equation.

\[
\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}
\]

Pressure is inversely proportional to \(T\) and directly proportional to \(V\). Volume also is proportional to temperature.

**Solve** Read Example Problem 14-4 in your text.

**You Try It**

**Problem**

A gas at 100.0 kPa and 30.0°C has an initial volume of 1.00 L. Determine the temperature that could support the gas at 200.0 kPa and a volume of 0.50 L.

1. **Analyze the Problem**
   
   **Known:**
   
   \(P_1 = \) \_
   
   \(T_1 = \) \_
   
   **Unknown:**
   
   \(T_2 = ? \) °C
   
   \(P_2 = \) \_
   
   \(T_1 = \) \_
   
   \(V_1 = \) \_
   
   \(V_2 = \) \_
   
   Remember that volume increases as temperature increases, and volume is inversely proportional to pressure.

2. **Solve for the Unknown**

   Convert the \(T_1\) Celsius temperature to kelvin.
   
   \(T_1 = \) \_
   
   \(+ 30.0°C = \) \_ K
Section 14.2 The Combined Gas Law and Avogadro’s Principle (continued)

Main Idea

Write the combined gas law equation.

To solve for \( T_2 \), multiply both sides of the equation by \( T_2 \).

\[
\frac{T_1}{T_1} = P_2 \, V_2
\]

Multiply both sides of the equation by \( T_1 \).

\[
T_2 \, P_1 \, V_1 = \text{______}
\]

Divide both sides of the equation by \( P_1 \, V_1 \).

\[
T_2 = \text{______}
\]

Substitute known values.

\[
T_2 = \frac{100.0 \, \text{kPa} \times 1.00 \, \text{L}}{\text{______}}
\]

Solve for \( T_2 \).

\[
T_2 = 303K - 273K = 30.0^\circ \text{C}
\]

Details

3. Evaluate the Answer

As pressure _______ and volume _______ in proportional amounts, the temperature remained constant.

Avogadro’s Principle

Use with pages 430–431.

Explain Avogadro’s principle by completing the paragraph below.

Avogadro’s principle states that ________________ ________________ ________________.

The _____ volume for a gas is the volume that one mole occupies at ______ of pressure and a temperature of ______.
Gases

Section 14.3 The Ideal Gas Law

Scan Section 3 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 pictures and read the captions.
- Think about what you already know about this subject.

Write three facts you discovered about the ideal gas law.

1. 

2. 

3. 

Use your text to define each term.

New Vocabulary

ideal gas constant (R)

Define the following term.

Academic Vocabulary

volume
The Ideal Gas Law

Use with pages 434–435.

Analyze the ideal gas law.
The equation is written \( P = \frac{Vn}{R} \).

- \( P \) represents ________
- \( V \) represents ________
- \( n \) represents the number of ________ of gas present
- \( R \) represents the ________________

\( \) represents temperature

The ideal gas law states that _________________. The value of \( R \) depends on the units used for ________.

Describe the properties of an ideal gas.

______________________________

______________________________

Describe the properties of a real gas.

______________________________

______________________________
Section 14.3 The Ideal Gas Law (continued)

**Main Idea**

**The Ideal Gas Law—Using Moles**

*Use with Example Problem 14-7, pages 436–437.*

**Details**

**Summarize** Fill in the blanks to help you take notes while you read Example Problem 14-7.

**Problem**

Calculate the number of moles of a gas contained in a 3.0-L vessel at $3.00 \times 10^2$ K with a pressure of 1.50 atm.

1. **Analyze the Problem**
   Known:  
   
   $V =$ ________  
   
   $T =$ ________  
   
   $P =$ ________  
   
   $R =$ ________  
   
   Use the known values to find the value of $n$.

2. **Solve for the Unknown**
   Write the ideal gas law equation.
   
   $\frac{n}{R} T$  
   
   To solve for $n$, divide both sides by $RT$.
   
   $n =$ ________  
   
   Substitute known values into the equation.
   
   $n =$ ________  
   
   Solve for $n$.
   
   $n =$ ________  
   
   $n =$ ________

3. **Evaluate the Answer**
   The answer agrees with the prediction that the number of moles will be ________ one mole. The unit in the answer is the ________.
Gases
Section 14.4 Gas Stoichiometry

Main Idea

Scan Section 4 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 pictures and read the captions.
• Think about what you already know about this subject.

Write three facts you discovered about gas stoichiometry.

1. 

2. 

3. 

Academic Vocabulary

Define the following terms.

react

involve

affect

proportion
Section 14.4 Gas Stoichiometry (continued)

Main Idea

Calculations Involving Only Volume

Use with page 440.

Volume-Volume Problems

Use with Example Problem 14-9, page 441.

Details

Indicate the moles and volume for the reaction below. Use Figure 14-12 as a reference.

\[ 2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g) \]

\[ \text{moles moles moles moles} \]

\[ \text{moles moles moles moles} \]

\[ \text{moles moles moles moles} \]

\[ \text{volume volumes volumes volumes} \]

\[ \text{volume volumes volumes volumes} \]

\[ \text{volume volumes volumes volumes} \]

The coefficients in the balanced equation represent _____ amounts and relative ______.

Summarize Fill in the blanks to help you take notes while you read Example Problem 14-9.

Problem

Determine the volume of oxygen gas needed for the complete combustion of 4.00 L of propane gas (C_3H_8).

1. Analyze the Problem

   Known: Unknown:
   
   \[ V \text{ of } C_3H_8 = \text{ ? L} \]
   
   Use the known volume of 4.00 L to find the volume needed for the combustion.

2. Solve for the Unknown

   Write the balanced equation for the combustion of C_3H_8.

   ________________________________

   Write the volume ratio.

   Multiply the known volume of propane by the volume ratio to find the volume of O_2.

3. Evaluate the Answer

   The coefficients of the reactants show that the quantity of _____ consumed is greater than the amount of propane. The unit of the answer is the _____, a unit of volume.
Gases  Chapter Wrap-Up

After reading the chapter, review what you have learned. Match each of the gas laws with its equation.

1. Ideal gas law
   \[ \frac{V_1}{T_1} = \frac{V_2}{T_2} \]

2. Gay-Lussac’s law
   \[ P_1 V_1 = P_2 V_2 \]

3. Charles’s law
   \[ \frac{P_1}{T_1} = \frac{P_2}{T_2} \]

4. Combined gas law
   \[ PV = nRT \]

5. Boyle’s law
   \[ \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \]

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

Explain why the volume of a balloon increases as you blow into it instead of bursting immediately from the added pressure.
# Solutions

## Before You Read

### Review Vocabulary

**Define the following terms.**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>alloy</td>
<td></td>
</tr>
<tr>
<td>solution</td>
<td></td>
</tr>
</tbody>
</table>

### Chapter 3

**Compare and contrast** a homogeneous mixture with a heterogeneous mixture.

### Chapter 9

**Explain** why water is a polar molecule. Include a labeled drawing of a water molecule in your answer.

### Chapter 11

**Describe** the relationship between moles and molar mass.
Solutions
Section 15.1 What are solutions?

Main Idea

Skim Section 1 of your text. List three main ideas of the section.

1. 

2. 

3. 

New Vocabulary

Use your text to define each term.

solvation

heat of solution

solubility

supersaturated solution

Henry's law

Compare and contrast soluble and insoluble substances.

Compare and contrast miscible and immiscible liquids.

Compare and contrast saturated solutions and unsaturated solutions.
**Main Idea**

**Characteristics of Solutions**

*Use with pages 453–454.*

Describe solutions by completing the following statements.

A solution may exist in gas, solid, or liquid form, depending on the state of its ______. Some combinations of substances easily form ______ and others do not. A substance that does not ______ in a solvent is ______ in that solvent. When two liquids are not soluble in each other, they are said to be ______. Liquids that will dissolve in each other are said to be ______.

Write the general rule to determine if solvation will occur.

List three factors that must be known about component substances to determine if solvation will occur.

1. ______________________________________
2. ______________________________________
3. ______________________________________

Sequence the steps required for a sodium chloride crystal to dissolve in water.

___ The charged ends of water molecules attract the positive Na ions and the negative Cl ions.
___ The ions from the crystal break away from the surface.
___ Water molecules collide with the surface of the crystal.
___ NaCl crystals are placed in water.
___ Solvation continues until the entire crystal has dissolved.
___ The attraction between the dipoles and the ions are stronger than the attractions among the ions in the crystal.
Section 15.1 What are solutions? (continued)

**Main Idea**

Organize the following table on factors that can increase the rate of solvation by increasing the number of collisions.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Increase Collisions By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agitating the mixture</td>
<td></td>
</tr>
<tr>
<td>breaking particles into smaller pieces</td>
<td></td>
</tr>
<tr>
<td>increasing temperature of the solvent</td>
<td></td>
</tr>
</tbody>
</table>

**Details**

Explain how solubility is expressed in units of measurement.

Review Table 15-2 in your text to determine the solubility of the following compounds in water.

- **Ca(OH)₂ at 20°C**
- **KCl at 60°C**

Describe each of these solubility states.

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>continuing solvation</td>
<td></td>
</tr>
<tr>
<td>dynamic equilibrium</td>
<td></td>
</tr>
<tr>
<td>saturated solution</td>
<td></td>
</tr>
<tr>
<td>unsaturated solution</td>
<td></td>
</tr>
</tbody>
</table>
Section 15.1 What are solutions? (continued)

**Main Idea**

**Factors That Affect Solubility**
*Use with pages 458–461.*

**Details**

**Describe** how solubility changes with temperature for most substances.

**Explain** why some gases are less soluble as temperature increases.

**Describe** the relationship between solubility and pressure.

**Write** the equation for Henry’s law.

**Using Henry’s Law**
*Use with Example Problem 15-1, page 461.*

**Problem**

Fill in the blanks to help you take notes while you read Example Problem 15-1.

1. **Analyze the Problem**
   - List the knowns and unknowns.
   - Known:
     - \( S_1 \)
     - \( P_1 \)
   - Unknown:
     - \( S_2 \)
     - \( P_2 \)

2. **Solve for the Unknown**
   - Rearrange Henry’s Law to solve for \( S_2 \).
     - \( S_2 = \) __________
   - Substitute known values and solve.
     - \( S_2 = \) __________ \((1.0 \text{ atm})\) = __________

3. **Evaluate the Answer**
   - The solubility __________ as expected due to the __________ in pressure.
Scan Section 2 of your text, using the checklist below as a guide.
• Read all section titles.
• Read all boldfaced words.
• Read all tables and graphs.
• Look at all pictures and read the captions.
• Think about what you already know about this subject.

Write three facts you discovered about solutions.
1. ____________________________________________________________
2. ____________________________________________________________
3. ____________________________________________________________

Use your text to define these terms.

concentration

molarity

molality

mole fraction

Define the following term.

factor
Expressing Concentration
Use with page 462.

Using Percent to Describe Concentration
Use with page 463.

Calculating Percent by Mass
Use with Example Problem 15–2, page 463.

Analyze the similarities in all of the concentration ratios shown in Table 15-3 in your text.

Write the equation for determining percent by mass.
Percent by mass =

Summarize Fill in the blanks to help you take notes as you read Example Problem 15-2.

Problem Determine the percent by mass of 3.6 g NaCl in 100.0 g H₂O.

1. Analyze the Problem
List the knowns and unknowns.
Known: Unknown:
mass of solute = __________ percent by mass = ?
mass of solvent = __________

2. Solve for the Unknown
Find the mass of the solution.
mass of solution = grams of solute + grams of solvent
mass of solution = 3.6 g + ______ = ______
Substitute the known values into the percent by mass equation.
percent by mass =

3. Evaluate the Answer
The answer should be a small percent, to match the small quantity of ____. The mass of sodium chloride was given in two significant figures, therefore, the answer should have ____ significant figures.
Section 15.2 Solution Concentration (continued)

Main Idea

Molarity

Preparation Molar Solutions
Use with pages 466–467.

Details

Describe how to calculate the molarity of a solution by completing the following statements.

To calculate the ______ of a solution, you must know the amount of dissolved _____ and the volume of _______. The following equation is used: molarity \((M) = \) _____ of solute/liters of _______.

Explain why you may need less than one liter of water to prepare a molar solution of one liter:

_______________________________________________________________

Write the expression that describes the relationship between a stock solution and a dilute solution.

\[ M_1 = \frac{M_2 V_2}{V_1} \]

M_1 = __________________________

V_1 = __________________________

M_2 = __________________________

V_2 = __________________________
Section 15.2 Solution Concentration (continued)

**Main Idea**

Molality and Mole Fraction

*Use with pages 469–470.*

**Details**

Explain how the volume and mass of a solution change with temperature.

The volume may ______ when heated or ______ when cooled.

The mass of the solution ______ change.

Write the mole fraction equations for a solvent \( (X_A) \) and a solute \( (X_B) \) below.

\[
X_A = \quad X_B =
\]

Evaluate the mole fraction for the values given in problem 15-5 on page 469 of your text. The number of moles for 100 g \( H_2O \) is given.

\( n_A = 5.55 \text{ mol } H_2O \quad n_B = \text{______ mol } NaCl \)

\[
X_{H_2O} = \quad = \quad
\]

\[
X_{NaCl} = \quad = \quad
\]

\[
X_{H_2O} + X_{NaCl} = 1.000
\]

\[
\quad + \quad = 1.000
\]

**Real-World Connection**

Describe how the mole fractions for a solution are similar to the pieces of a pie.
Solutions
Section 15.3 Colligative Properties of Solutions

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

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

Write two questions that you would want answers to based on your reading.

1. ____________________________
2. ____________________________

Use your text to define each term.

**colligative property**

**vapor pressure lowering**

**boiling point elevation**

**freezing point depression**

**osmosis**

**osmotic pressure**
Section 15.3 Colligative Properties of Solutions (continued)

**Main Idea**

Electrolytes and Colligative Properties

Use with page 471.

Vapor Pressure Lowering

Use with page 472.

**Details**

**Compare and contrast electrolytes and nonelectrolytes.**

Substances like sodium chloride that _____ in water and conduct an ____________ are called ___________. Substances like sucrose that dissolve in water but do not _____ and do not conduct an electric current are called _____________.

**Summarize why vapor pressure lowering is a colligative property.**

Include an explanation of vapor pressure.

__________________________________________

__________________________________________

__________________________________________

__________________________________________

__________________________________________

Boiling Point Elevation

Use with page 472.

**Explain boiling point elevation by completing the following statements.**

A liquid boils when its ____________ equals _________________.

Adding a nonvolatile solute lowers the solvent’s _____ pressure.

More _____ energy must be added to reach the solvent’s _____________. The greater the number of _____ particles in the solution, the greater the _____________ elevation.
Section 15.3 Colligative Properties of Solutions (continued)

**Main Idea**

**Freezing Point Depression**
Use with pages 473–474.

**Details**

Describe why the freezing point changes when a solute is added to a solution.

---

**Osmosis and Osmotic Pressure**
Use with page 475.

Evaluate the diagram of a semipermeable membrane separating a sucrose-water solution on one side and water on the other side. Draw an arrow to show in which direction more water will flow and circle the side which has the greater osmotic pressure.
Solutions
Section 15.4 Heterogeneous Mixtures

Scan Section 4 of your text, using the checklist below as a guide.

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

Identify the unifying theme of this section.

New Vocabulary

Use your text to define each term.

- suspension

- colloid

Brownian motion

Tyndall effect

Academic Vocabulary

Define the following terms.

- abundant

- categorize
Section 15.4 Heterogeneous Mixtures (continued)

**Main Idea**

**Suspensions**
*Use with page 476.*

- List *three properties of a suspension.*
  1. 
  2. 
  3. 

- State *three examples of suspensions.*
  1. 
  2. 
  3. 

**Colloids**
*Use with pages 477–479.*

- Identify *four properties of a colloid.*
  1. 
  2. 
  3. 
  4.
Section 15.4 Heterogeneous Mixtures (continued)

Main Idea

**Explain** why particles in Brownian motion do not settle out.

Details

**Identify each of the following mixtures as a suspension, dilute colloid, or concentrated colloid. Base your answers on the property described.**

<table>
<thead>
<tr>
<th>Property</th>
<th>Type of Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>cloudy mixture with particles that move erratically</td>
<td></td>
</tr>
<tr>
<td>large particles with thixotropic behavior</td>
<td></td>
</tr>
<tr>
<td>clear mixture with particles that scatter light</td>
<td></td>
</tr>
</tbody>
</table>

Real-World Connection

Describe the properties of fog in terms of being a mixture and why those properties make driving through fog so dangerous.
Now that you have read the chapter, review what you have learned and write the key equations and relationships.

Use this checklist to help you study.

- Study your Science Notebook for this chapter.
- Study the definitions of vocabulary words.
- 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.

Identify four ways in which an understanding of the properties of solutions and heterogeneous mixtures can be applied to your own life.

1. 
2. 
3. 
4. 
Energy and Chemical Change

Before You Read

Define the following terms.

chemical equation

mole

Chapter 11

Describe the equation you would use to convert mass in grams to moles.

Chapter 13

Identify the three characteristics of particles about which the kinetic-molecular theory makes assumptions.

1. 

2. 

3. 

Write the equation that represents the kinetic energy of a particle.


Energy and Chemical Change

Section 16.1 Energy

**Main Idea**

**Details**

*Skim* Section 1 of your text. Write two facts you discovered about energy.

1. 

2. 

**New Vocabulary**

*Use your text to define each term.*

energy

law of conservation of energy

chemical potential energy

heat

calorie

joule

specific heat
Section 16.1 Energy (continued)

**Main Idea**

**The Nature of Energy**

Use with pages 489–491.

**Details**

Compare and contrast kinetic energy with potential energy.

On the curve below that represents the roller coaster on page 488, label the place of greatest kinetic energy A, least kinetic energy B, greatest potential energy C, and least potential energy D.

---

Describe the roller coaster ride above as a function of the law of conservation of energy.

---

Explain chemical potential energy.

Chemical ______ energy of a substance is a result of the arrangement of its _____ and the strength of the ____________ joining the atoms. During some ______ reactions, such as burning ___, much of the potential energy may be released as ___. Some of the energy may be converted to work, which is a form of _____ energy.

**Specific Heat**

Use with pages 492–493.

Identify each symbol in the equation for specific heat.

\[ q = c \times m \times \Delta T \]

____ represents heat absorbed or released

____ represents the specific heat of the substance

____ represents mass of a sample in grams

____ represents a change in temperature
Section 16.1 Energy (continued)

Calculating Specific Heat

Use with Example Problem 16–2, page 494.

**Summarize.** Fill in the blanks to help you take notes while you read Example Problem 16–2.

**Problem**
The temperature of a sample of iron with a mass of 10.0 g changed from 50.4°C to 25.0°C with the release of 114 J heat. Determine the specific heat of iron.

1. **Analyze the Problem**
   - **Known:**
     - energy released = _____
     - ΔT = ________________
     - mass of iron = _____
   - **Unknown:**
     - specific heat of iron = ?

2. **Solve for the Unknown**
   - Write the equation for heat absorption.
     \[ q = \text{mass 	imes specific heat 	imes ΔT} \]
   - Solve for \( c \).
     \[ q = \text{mass 	imes specific heat 	imes ΔT} \]
   - \( c = \)_____

3. **Evaluate the Answer**
   - If the values used in the calculations have _____ significant figures, the answer must also have _____ significant figures. The calculated value matches the value for iron in Table 16–2.

**Real-World Connection**

Describe two potential problems with the use of the Sun as a source of everyday energy.

1. ____________________________
2. ____________________________
**Main Idea**

**Details**

**Skim** Section 2 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. __________________________
   __________________________
   __________________________

2. __________________________

3. __________________________

**New Vocabulary**

Use your text to define each term.

- **calorimeter**

- **thermochemistry**

- **system**

- **surroundings**

- **universe**

- **enthalpy**

- **enthalpy (heat) of reaction**

**Academic Vocabulary**

Define the following term.

- **utilize**
Section 16.2 Heat in Chemical Reactions and Processes (continued)

**Main Idea**

Measuring Heat

Use with page 496.

**Details**

Describe *how a calorimeter measures heat.*

---

Using Data from Calorimetry


**Details**

*Summarize. Fill in the blanks to help you take notes while you read Example Problem 16–3.*

**Problem**

Determine the specific heat of a piece of metal with a mass of 4.68 g that _____ 256 J of heat when its temperature increases by 182°C, and explain if the metal could be an ____________.

1. **Analyze the problem**

   Known:  
   
   mass of metal = _____  
   
   quantity of heat absorbed = _____  
   
   _____ = 182°C  

   Unknown:  
   
   specific heat, c = ? J/(g · °C)  

2. **Solve for the Unknown**

   Write the equation for absorption of heat.
   
   \[ q = \text{_______} \]
   
   Solve for \( c \) by dividing both sides of the equation by \( m \times \Delta T \).
   
   \[ c = \]
Substitute the known values into the equation.

\[ c = \]  

Table 16–3 indicates the metal could be _______.

3. Evaluate the Answer

The quantities used in the calculation have _____ significant figures, and the answer is correctly stated with _____ significant figures. The calculation yielded the ________ unit, and the calculated _________ is the same as that for _________.

Chemical Energy and the Universe

*Use with pages 498–500.*

Compare and contrast *exothermic and endothermic reactions.*

Write the symbol for enthalpy (heat) chain of reaction.

Explain why chemists prefer to measure change in heat energy, rather than the total amount of heat energy present.
Energy and Chemical Change
Section 16.3 Thermochemical Equations

Main Idea

Skim Section 3. Focus on the subheadings, boldfaced words, and the main ideas. In the space below, summarize the main idea of this section.

New Vocabulary

thermochemical equation

Use your text to define each term.

enthalpy (heat) of combustion

molar enthalpy (heat) of vaporization

molar enthalpy (heat) of fusion

Academic Vocabulary

region

Define the following term.
Section 16.3 Thermochemical Equations (continued)

**Main Idea**

**Writing Thermochemical Equations**

*Use with page 501.*

**Details**

**Identify which of the reactions below is endothermic and explain how you know.**

1. \(4\text{Fe}(s) + 3\text{O}_2(g) \rightarrow 2\text{Fe}_2\text{O}_3(s)\) \[\Delta H = -1625 \text{ kJ}\]

2. \(\text{NH}_4\text{NO}_3(s) \rightarrow \text{NH}_4^+(aq) + \text{NO}_3^-(aq)\) \[\Delta H = 27 \text{ kJ}\]

**Changes of State**

*Use with page 502.*

**Name the common states of matter.**

---

Energy and Chemical Change  223
Section 16.3 Thermochemical Equations (continued)

Explain changes in physical states by completing the sentences below.

During vaporization, a _______ becomes a _______.
Energy must be _________ by the liquid.
During condensation, a _______ becomes a _______.
Energy is _________ by the gas.
During fusion of ice, a _______ becomes a _______.
Energy is _________ by the solid.

Identify what the following equations represent.

\[ \Delta H_{\text{vap}} = -\Delta H_{\text{cond}} \]

\[ \Delta H_{\text{fus}} = -\Delta H_{\text{solid}} \]

Real-World Connection

Explain why a farmer would spray his orange trees with water when he knows the overnight temperature will be below 32°C.
Energy and Chemical Change
Section 16.4 Calculating Enthalpy Change

Main Idea

Scan Section 4 of your text. Use the checklist below to preview the section.
• Read all section titles.
• Read all boldfaced words.
• Read all tables and graphs.
• Look at all pictures and read the captions.
• Think about what you already know about energy and chemical change.

Write three statements about calculating enthalpy change based on your reading.

1. 
2. 
3. 

Details

Use your text to define each term.

Hess’s law

standard enthalpy (heat) of formation

Define the following term.

random

New Vocabulary

Academic Vocabulary

Chemistry 7.e
**Main Idea**

**Hess’s Law**

Use with pages 506–508.

**Details**

Describe Hess’s law by completing the following statement.

_____ is used to determine the _____ of a system by imagining that each reaction is part of a __________, each of which has a known \( \Delta H \).

Examine Figure 16-13. Read the caption and follow the arrows. Then apply Hess’s law to fill in the blanks below.

\( \Delta H \) for reaction c _____

\( \Delta H \) for reaction d _____

sum of \( \Delta H \) for reactions c and d _____

In other words, the ______ for the conversion of S and O\(_2\) to SO\(_3\), is ______.

Explain standard enthalpy of elements and compounds by completing the following statements.

An element’s ______ is the normal ______ state at one ______ pressure and _____. For example, the standard state for iron is ____, for mercury is ____, and for oxygen is _____. Free elements such as these are assigned a \( \Delta H^0_f \), or ___________ _____________, of exactly ____. The \( \Delta H^0_f \) of many _______ has been measured ___________. For example, the standard enthalpies of formation for the following compounds are:

NO\(_2\)(g) _____

CCl\(_4\)(l) _____

Fe\(_2\)O\(_3\)(s) _____
Section 16.4 Calculating Enthalpy Change (continued)

**Main Idea**

**Details**

Enthalpy Change from Standard Enthalpies of Formation

Use with Example Problem 16–6, pages 511–512.

Write the formula that sums up the procedure for combining standard heats of formation equations to produce the desired equation and its $\Delta H_{rxn}^0$.

This equation says to ______ the ____ of heats of ________ of the ______ from the sum of the ____ of formation of the ______.

Summarize. Fill in the blanks to help you take notes as you work through Example Problem 16–6.

**Problem**

Calculate $\Delta H_{rxn}^0$ for the combustion of methane.

$\text{CH}_4(g) + 2\text{O}_2(g) \rightarrow \text{CO}_2(g) + 2\text{H}_2\text{O}(l)$

1. Analyze the Problem

   Use the formula $\Delta H_{rxn}^0 = \Sigma \Delta H_f^0 (\text{products}) - \Sigma \Delta H_f^0 (\text{reactants})$ with data from Table 16-7.

   **Known:**
   
   $\Delta H_f^0 (\text{CO}_2) = \underline{}$
   
   $\Delta H_f^0 (\text{H}_2\text{O}) = \underline{}$
   
   $\Delta H_f^0 (\text{CH}_4) = \underline{}$
   
   $\Delta H_f^0 (\text{O}_2) = \underline{}$

   **Unknown:**

   $\Delta H_{rxn}^0 = ? \text{ kJ}$
Section 16.4 Calculating Enthalpy Change (continued)

Main Idea

2. Solve for the Unknown
   Use the formula \( \Delta H_{rxn}^0 = \Sigma \Delta H_f^0 \text{(products)} - \Sigma \Delta H_f^0 \text{(reactants)} \)
   Substitute values in the formula
   \( \Delta H_{rxn}^0 = \frac{\sum \Delta H_f^0 \text{(products)} - \sum \Delta H_f^0 \text{(reactants)}}{\text{value} - \text{value} = \text{value}} \)

3. Evaluate the Answer
   All values are ________ to the stated place. The calculated value matches that in Table 16–5.

 real-world connection

Your family needs to choose a system to heat the new home you are building. From what you have learned so far, write down four questions you will use to evaluate the systems available.

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________
Scan Section 5, using the checklist below as a guide.
• Read all section titles.
• Read all boldfaced words.
• Read all tables and graphs.
• Look at all pictures and read the captions.
• Think about what you already know about energy and chemical change.

State the main concepts of this section.

Use your text to define each term.

spontaneous process

entropy

law of disorder

free energy

Define the following term.

intervention
Spontaneous Processes

Use with page 513.

Compare and contrast spontaneous processes and non-spontaneous processes.

Identify the parts of the entropy equation.

\[ \Delta S_{\text{system}} = S_{\text{products}} - S_{\text{reactants}} \]

\( \Delta S \) represents ______________________________.

\( S \) represents ________________________.

List five reactions or processes in which it is possible to predict change in entropy. For each process, indicate whether entropy will increase or decrease.

1. __________________________________________

2. __________________________________________

3. __________________________________________

4. __________________________________________

5. __________________________________________
Write the equation for the standard free energy change under standard conditions.

Predict whether entropy increases or decreases for the reaction below and explain your reasoning.
N₂(g) + 3H₂(g) → 2NH₃(g)

Describe free energy changes by writing the word positive or negative in the appropriate blank.
If the sign of the free energy change is _______, the reaction is spontaneous.
If the sign of the free energy system is _______, the reaction is non-spontaneous.

Explain how ΔH°_system and ΔS°_system affect reaction spontaneity by completing the following table.

<table>
<thead>
<tr>
<th>How ΔH°_system and ΔS°_system Affect Reaction Spontaneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔH°_system</td>
</tr>
<tr>
<td>+ΔS°_system</td>
</tr>
<tr>
<td>−ΔS°_system</td>
</tr>
</tbody>
</table>
Energy and Chemical Change  Chapter Wrap-Up

Now that you have read the chapter, review what you have learned and write three key equations or relationships.

1. 

2. 

3. 

Use this checklist to help you study.

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

Real-World Connection

Explain why the energy that comes from chemical reactions is critical for almost every phase of your daily life.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Reaction Rates

Before You Read

**Review Vocabulary**

*Define the following terms.*

_Boyle’s law_  

_**Charles’s law**_  

_**Gay-Lussac’s law**_  

_**Molarity**_  

**Chapter 10**

*Balance the following equation.*

\[ \square C_8H_{18}(l) + \square O_2(g) \rightarrow \square CO_2(g) + \square H_2O(l) \]
## Reaction Rates

### Section 17.1 A Model for Reaction Rates

**Main Idea**

**Skim** Section 1 of your text. Preview headings, photos, captions, boldfaced words, problems, and graphs. Write three questions that come to mind.

1. __________________________________________________________________________
2. __________________________________________________________________________
3. __________________________________________________________________________

**New Vocabulary**

*Use your text to define each term.*

- **reaction rate**
  - __________________________________________________________________________
- **collision theory**
  - __________________________________________________________________________
- **activated complex**
  - __________________________________________________________________________
- **transition state**
  - __________________________________________________________________________
- **activation energy**
  - __________________________________________________________________________

**Academic Vocabulary**

*Define the following term.*

- **consumption**
  - __________________________________________________________________________
Section 17.1 A Model for Reaction Rates (continued)

**Main Idea**

Expressing Reaction Rates

*Use with page 529.*

Calculating Average Reaction Rates

*Use with Example Problem 17-1, page 531.*

**Details**

**Identify** what each phrase or symbol represents in this equation.

Average rate = \( \frac{\Delta \text{quantity}}{\Delta t} \)

Average rate = the average is used because the rate changes over time

\( \Delta = \) ______________________

\( t = \) ______________________

**Summarize** Fill in the blanks to help you take notes while you read Example Problem 17-1.

**Problem**

Calculate the average reaction rate of the chemical reaction using the ________________ of butyl chloride in ________________.

1. **Analyze the Problem**

   Known: Unknown:

   ______________________ ______________________

   \([C_4H_9Cl]\) at \( t_1 = 0.220M \)

2. **Solve for the Unknown**

   Write the equation.
   
   Average reaction rate =
   
   Insert known quantities.

   Solve for the average rate = \( \frac{4.00 \text{ s} - 0.00 \text{ s}}{} \)

   = ______________________

   Average reaction rate = ______________________

3. **Evaluate the Answer**

   The answer is correctly expressed in _____ significant figures.
Section 17.1 A Model for Reaction Rates (continued)

Main Idea

The Collision Theory
Use with pages 532–533.

Describe how each of the items below affects a reaction.

collision theory

orientation and the activated complex

activation energy and reaction

Analyze Figure 17-3. Use colored pencils to draw similar molecules colliding. Be sure to include incorrect orientation, correct orientation, and correct orientation with insufficient energy. Develop a key for your drawings.

Explain activation energy by completing the following paragraph.

Some reactions have enough ______ to overcome the _______ _______ of the reaction in order to form products. These are called _________________. After the ________________ is formed, ______ is released. In other reactions the reactants must absorb energy to overcome the _______________ of the reaction. These reactions are called _________________.

Real-World Connection

Describe how the collision theory would apply to a demolition derby.
Reaction Rates
Section 17.2 Factors Affecting Reaction Rates

Scan Section 2, using the checklist below as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about this topic.

Write three facts you discovered about reaction rates.
1. 
2. 
3. 

New Vocabulary
Use your text to define each term.

catalyst

inhibitor

heterogeneous catalyst

homogeneous catalyst

Academic Vocabulary
Define the following term.

orientation

The Nature of Reactants
Use with page 536.

Explain how reactants influence the rate at which a chemical reaction occurs by completing the following statement.

As the reactant increases, the ________ increases.
### Section 17.2 Factors Affecting Reaction Rates (continued)

<table>
<thead>
<tr>
<th><strong>Main Idea</strong></th>
<th><strong>Details</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use with pages 536–539.</td>
<td>Explain the effect each of the following has on the rate of a reaction.</td>
</tr>
</tbody>
</table>

1. Reactivity of reactants
2. Concentration
3. Surface area
4. Temperature
5. Catalyst
6. Inhibitors

### Real-World Connection

Compare and contrast the rate at which a sugar cube in cold water and granulated sugar in warm water would dissolve. Include how surface area and the temperature of the water might affect the rate at which each dissolves. Create a statement about which would dissolve faster.
Reaction Rates

Section 17.3 Reaction Rate Laws

Main Idea

Details

Skim Section 3 of your text. Choose a photograph from this section. Write a question based on what you see and read.

New Vocabulary

Use your text to define each term.

rate law

specific rate constant

reaction order

method of initial rates

Academic Vocabulary

Define the following term.

interval
Reaction Rate Laws

Use with pages 542–543.

**Main Idea**

**Details**

Explain what each symbol represents in the following equation.

Rate = \( k[A] \)

\( k = \) ________________

\( \) ________________

\( [A] = \) ________________

**Analyze** the rate law reaction for the decomposition of hydrogen peroxide.

\( 2H_2O_2 \rightarrow 2H_2O + O_2 \)

Rate law equation: \( \) rate = \( k[A] \), where \( [A] = \) ________________

Insert the reactant: \( \) rate = ________________

**Express** the rate law reaction for this chemical reaction.

Chemical equation: \( 2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g) \)

Rate law equation: \( \) rate = ________________, where \( [A] \) represents the reactant ________________ and \( [B] \) represents the reactant ________________

Insert the reactants: \( \) rate = ________________
Determining Reaction Order

*Use with pages 544–545.*

**Main Idea**

**Details**

Relate how the reaction rate varies with:
- concentration
  - 
  - 
  - 
- the overall reaction order
  - 
  - 

Explain reaction order by completing the following sentences.

One of the means of determining reaction order is by comparing ______ of a reaction with varying _______.

This is known as the method of _______. This method requires experimentation with differing ______ of the reactants and comparing the ______ of the reaction at each quantity. While the rate law for a reaction can tell you the reaction rate, the rate constant \( k \), and the ____________, actual _______ and _____ of a complex reaction can be determined only through experimentation.

---

**REAL-WORLD CONNECTION**

Consider whether an average of a student’s grades on all chemistry tests is or is not a better way of determining a final grade as compared to using just one test score. Explain which is better and why.
Reaction Rates
Section 17.4 Instantaneous Reaction Rates and Reaction Mechanisms

Main Idea

Skim Section 4 of your text. Preview the headings, photos, captions, boldfaced words, problems, and graphs. Write three questions that come to mind.

1.____________________________________________________
2.____________________________________________________
3.____________________________________________________

New Vocabulary

Use your text to define each term.

instantaneous rate _______________________________________
complex reaction _______________________________________
reaction mechanism ______________________________________
intermediate ___________________________________________
rate-determining step ___________________________________
Section 17.4 Instantaneous Reaction Rates and Reaction Mechanisms (continued)

Main Idea

Calculating Instantaneous Reaction Rates

Use with Example Problem 17-2, page 547.

Details

Summarize Fill in the blanks to help you take notes while you read Example Problem 17-2.

Problem Calculate the instantaneous rate for this reaction, given the quantities for NO and H2.

\[ 2\text{NO}(g) + \text{H}_2(g) \rightarrow \text{N}_2\text{O}(g) + \text{H}_2\text{O}(g) \]

1. Analyze the Problem

Known: Unknown:

quantity of [NO] = 0.002 00 M rate = ? mol/(L \cdot s)

quantity of [H\text{\textsubscript{2}}] = 

k = 

2. Solve for the Unknown

Insert the known quantities into the rate law equation.

rate = 

rate = 

rate = 

3. Evaluate the Answer

Are your units correct? Is your magnitude reasonable?

Reaction Mechanisms

Use with pages 548–549.

Compare the reaction mechanism using the terms complex, intermediate, rate-determining step to the process of building a car. Show that you understand the vocabulary.
Now that you have read the chapter, list three facts you learned about reaction rates:

1. 
2. 
3. 

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.
☐ Study the definitions of vocabulary words.
☐ 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 Chapter Assessment at the end of the chapter.

REAL-WORLD CONNECTION

Suppose you obtain a part-time job working for a lawn care business. Your new boss wants you to help her choose the right fertilizer for most of the lawns you will see. Use the terms from this chapter to explain to your boss what she should look for in a fertilizer.
Define the following terms.

**Vocabulary**

*chemical equation*

*reaction rate*

*rate law*

Chapter 10

Balance the chemical equation below.

\[ \text{NO(g)} + \text{H}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O(g)} + \text{H}_2\text{O(g)} \]

Chapter 17

Write the rate law for the reaction below.

\[ \text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2 \text{HI(g)} \]

Rate = ______________
Chemical Equilibrium

Section 18.1 Equilibrium: A State of Dynamic Balance

Main Idea

**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**
  - Definition:

- **chemical equilibrium**
  - Definition:

- **law of chemical equilibrium**
  - Definition:

- **equilibrium constant**
  - Definition:

- **homogeneous equilibrium**
  - Definition:

- **heterogeneous equilibrium**
  - Definition:

---

Equilibrium: A State of Dynamic Balance
Section 18.1 Equilibrium: A State of Dynamic Balance (continued)

**Main Idea**

What is Equilibrium?

*Use with pages 559–563.*

**Details**

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.

\[ \text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \Rightarrow 2\text{NH}_3(\text{g}) \]

<table>
<thead>
<tr>
<th>Reactants</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward reaction</td>
<td></td>
</tr>
<tr>
<td>Reverse reaction</td>
<td></td>
</tr>
</tbody>
</table>

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.

Identify the parts of the equilibrium constant expression.

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

\[ K_{eq} = \] \[ [C][D] = \] \[ [A][B] = \] \[ a, b, c, \text{ and } d = \]
Write the equilibrium constant expression for the following balanced chemical equation.

\[ N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \]

\[ K_{eq} = \quad \]

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.

\[ I_2(s) \rightleftharpoons I_2(g) \]

Real-World Connection: Discuss why sodium hydrogen carbonate is valuable in baking.

...
Main Idea Calculating the Value of Equilibrium Constants

Details

Summarize Fill in the blanks to help you take notes while you read Example Problem 18-3.

Problem Calculate the value of $K_{eq}$ for the equilibrium constant expression.

$$K_{eq} = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

1. Analyze the Problem
   List the knowns and unknowns.
   Known: the equilibrium constant expression:

   Known: the concentration of each reactant and product:
   
   $[NH_3] = $ __________
   
   $[N_2] = $ __________
   
   $[H_2] = $ __________

   Unknown: the value of the equilibrium constant

2. Solve for the Unknown
   Substitute the ______________ into the equilibrium ______________ and calculate its value.

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

3. Evaluate the Answer
   The given concentrations have ____ significant figures, therefore the answer must have ____ significant figures.
Chemical Equilibrium
Section 18.2 Factors Affecting Chemical Equilibrium

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
Le Chatelier’s principle

Use your text to define the following term.

Academic Vocabulary
stress

Define the following terms.

volume
Section 18.2 Factors Affecting Chemical Equilibrium (continued)

**Main Idea**

Le Chatelier's Principle

*Use with pages 569–573.*

**Details**

**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 18.3 Using Equilibrium Constants**

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

**solubility product**

**constant**

**common ion**

**common ion effect**

Academic Vocabulary

**symbol**

Use your text to define each term.

Define the following term.
Section 18.3 Using Equilibrium Constants (continued)

**Main Idea**

Calculating Equilibrium Concentrations

*Use with Example Problem 18-4, page 576.*

**Details**

Summarize Fill in the blanks to help you take notes while you read example Problem 18-4.

**Problem**

At 1405 K, hydrogen sulfide _________ to form _________ and a diatomic _____ molecule, S₂. The _______________ for the

\[ 2\text{H}_2\text{S}(g) \rightleftharpoons 2\text{H}_2(g) + \text{S}_2(g) \]

reaction is \(2.27 \times 10^{-3}\).

What is the concentration of \(\text{H}_2(g)\) if \([\text{S}_2]\) = 0.0540 mol/L and \([\text{H}_2\text{S}]\) = 0.184 mol/L?

1. **Analyze the Problem**

   List the knowns and unknowns.

   - Known: \(K_{\text{eq}}\), \([\text{S}_2]\), \([\text{H}_2\text{S}]\)
   - Unknown: \([\text{H}_2]\)

2. **Solve for the Unknown**

   Write the equilibrium constant expression.

   \[ K_{\text{eq}} = \]  

   Substitute known quantities.

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 18.3 Using Equilibrium Constants (continued)

**Main Idea**

**Details**

**Solubility Equilibria**

*Use with pages 577–583.*

**Describe** solubility equilibrium.

*...

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

\[ \text{BaSO}_4(s) \rightleftharpoons \text{Ba}^{2+}(aq) + \text{SO}_4^{2-}(aq) \]

**Explain** solubility by completing the following statements.

\[ \text{is the amount of a substance that will } \]

\[ \text{in a given volume of } \]

\[ K_{sp} \text{ represents the } \]

\[ K_{sp} \text{ is the } \]

\[ K_{sp} \text{ depends only on the } \]

**Explain why it benefits both doctors and chefs to understand solubility.**

*...

**Calculating Molar Solubility from**

**Ksp**

*Use with Example Problem 18-5, page 579.*

**Problem** Calculate the solubility in mol/L of copper(II) carbonate (CuCO₃) at 298 K.

1. **Analyze the Problem**

   List the knowns and unknowns.

   Known: \( K_{sp} (\text{CuCO}_3) = \) \( \) \( \) Unknown: \( \) \( \) \( \) solubility (CuCO₃) = \( \) \( \)
Section 18.3 Using Equilibrium Constants (continued)

Main Idea

2. Solve for the Unknown
   Write the balanced chemical equation.

   \[ \text{Reactants} \rightleftharpoons \text{Products} \]

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

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

   Substitute \( s \) for \([Cu^{2+}]\) 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. ______________________

Common Ion Effect
Use with pages 583–585.

Solubility Equilibria in the Laboratory
Use with page 585.

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 ________________.

Explain which reactants you would add to a solution to determine if it contained ions of mercury (\( Hg^{2+} \)). Use Figure 18-18 as a guide.
Chapter Wrap-Up

Chemical Equilibrium

**Review**

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

**Describe** chemical equilibrium.

---

**Explain** Le Chatelier’s principle.

---

**Real-World Connection**

Describe several uses of solubility in your home.

---

**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.
Define the following term.

Write the equation for hydrogen chloride dissolving in water to form hydrogen ions and chloride ions.

Explain what type of compound hydrogen chloride is since it produces hydrogen ions in aqueous solution.

Identify five factors that influence reaction rate.

1. 
2. 
3. 
4. 
5. 
**Main Idea**  
**Details**

*Skim* Section 1 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 
2. 
3. 

**New Vocabulary**

Use your text to define each term.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>acidic solution</td>
<td></td>
</tr>
<tr>
<td>basic solution</td>
<td></td>
</tr>
<tr>
<td>Arrhenius model</td>
<td></td>
</tr>
<tr>
<td>Brønsted-Lowry model</td>
<td></td>
</tr>
<tr>
<td>conjugate acid</td>
<td></td>
</tr>
<tr>
<td>conjugate base</td>
<td></td>
</tr>
<tr>
<td>conjugate acid-base</td>
<td></td>
</tr>
<tr>
<td>conjugate acid-base</td>
<td></td>
</tr>
<tr>
<td>conjugate acid-base</td>
<td></td>
</tr>
<tr>
<td>amphoteric</td>
<td></td>
</tr>
</tbody>
</table>
Properties of Acids and Bases

Use with pages 595–599.

Comparing and contrasting the properties of an acid and a base by placing an X in the Acid column if the property applies to an acid and in the Base column if the property applies to a base.

<table>
<thead>
<tr>
<th>Acid</th>
<th>Properties</th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tastes sour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tastes bitter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>feels slippery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>affects color</td>
<td></td>
</tr>
<tr>
<td></td>
<td>reacts with metal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>conducts electricity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>has more hydrogen ions than hydroxide ions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>has more hydroxide ions than hydrogen ions</td>
<td></td>
</tr>
</tbody>
</table>

Write the chemical equation for the self-ionization of water.

\[
\text{H}_2\text{O}(l) \rightleftharpoons \text{H}^+\text{(aq)} + \text{OH}^-\text{(aq)}
\]

Analyze why the Arrhenius model of acids and bases does NOT include ammonia (NH\textsubscript{3}) in solution as a base.

Identify which of the following statements describes the Arrhenius model and which describes the Brønsted-Lowry model by filling in the blanks.

The ________ model is based on the dissociation of compounds, while the ________ model is based on the donation and acceptance of hydrogen ions. Conjugate acid-base pairs are a component of the ________ model and are NOT a component of the ________ model.
Describe what happens in the forward and reverse reactions when ammonia is dissolved in water. Identify the conjugate acid, the conjugate base, and the two conjugate acid-base pairs.

Monoprotic and Polyprotic Acids

Use with pages 600–601.

Monoprotic and Polyprotic Acids

Explain what a polyprotic acid is.

Sequence the following equations in the steps of the ionization of phosphoric acid in the correct order.

___ $\text{HPO}_4^{2-}(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{PO}_4^{3-}(aq)$

___ $\text{H}_3\text{PO}_4(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{H}_2\text{PO}_4^{2-}(aq)$

___ $\text{H}_2\text{PO}_4^-(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{HPO}_4^{2-}(aq)$

Define and give examples of an anhydride, distinguishing between those that produce an acid and those that produce a base.
Acids and Bases
Section 19.2 Strengths of Acids and Bases

Main Idea

Skim Section 2 of your text. Focus on the headings, subheadings, boldfaced words, and the main ideas. Write three questions about strengths of acids and bases based on what you have read.

1. 
2. 
3. 

New Vocabulary

Use your text to define each term.

strong acid

weak acid

acid ionization constant

strong base

weak base

base ionization constant

Academic Vocabulary

Define the following term.

significant
Section 19.2 Strengths of Acids and Bases (continued)

**Main Idea**

Strengths of Acids

*Use with pages 602–605.*

**Details**

Explain why all acids are not equal in strength.

Identify the acids in the following table as strong or weak.

<table>
<thead>
<tr>
<th>Acid</th>
<th>Strong or Weak</th>
<th>Acid</th>
<th>Strong or Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>acetic</td>
<td></td>
<td>hydroiodic</td>
<td></td>
</tr>
<tr>
<td>carbonic</td>
<td></td>
<td>hydrosulfuric</td>
<td></td>
</tr>
<tr>
<td>hydrobromic</td>
<td></td>
<td>hypochlorous</td>
<td></td>
</tr>
<tr>
<td>hydrochloric</td>
<td></td>
<td>nitric</td>
<td></td>
</tr>
<tr>
<td>hydrocyanic</td>
<td></td>
<td>perchloric</td>
<td></td>
</tr>
<tr>
<td>hydrofluoric</td>
<td></td>
<td>sulfuric</td>
<td></td>
</tr>
</tbody>
</table>

Describe the difference in conductivity between strong and weak acids.

Analyze equilibrium constant expressions by completing the following statements.

The concentration of liquid water in the denominator of an equilibrium constant expression is considered to be _______ in dilute aqueous solutions. Therefore, liquid water can be _______________ $K_{eq}$ to give a new equilibrium constant, $K_a$. For weak acids, the equilibrium _________ of the _______ in the numerator tends to be small compared to the equilibrium _________ of the _______ in the denominator. The weakest acids have the _______ $K_a$ values because their solutions have the highest concentrations of _______ acid molecules.
Section 19.2 Strengths of Acids and Bases (continued)

**Main Idea**

**Strength of Bases**
Use with pages 606 and 607.

**Details**

Compare and contrast the strengths of acids and bases by completing this concept map using the terms ionize, ionization constant, strong, stronger, weak, and weaker.

Describe the differences between the strength and the concentration of acids and bases by completing the following statements.

The number of the acid or base molecules dissolved is described by the terms _____ and ____________. The degree to which an acid or base separates into ions is described by the terms _____ and ___________.

A strong acid can be a _____ solution and a _____ acid can be a concentrated solution.
Acids and Bases
Section 19.3 What is pH?

Scan Section 3 of your text. Use the checklist below as a guide.
- Read all section titles.
- Read all boldfaced words.
- Read all formulas.
- Look at all figures and read the captions.
- Think about what you already know about alcohols, ethers, and amines.

Write three facts you discovered about pH as you scanned the section.

1. __________________________________________________________
2. __________________________________________________________
3. __________________________________________________________

Use your text to define the following terms.

ion product constant for water

pH

pOH
Section 19.3 What is pH? (continued)

**Main Idea**

Ion Product Constant for Water

Use with pages 608–609.

**Details**

Describe how the ion product constant for water is derived from the self-ionization equation.

\[
H_2O(l) \leftrightarrow [H^+][OH^-] \\
K_{eq} = \frac{[H^+][OH^-]}{[H_2O]} \\
K_{eq}[H_2O] = [H^+][OH^-] \\
K_w = [H^+][OH^-] = \text{constant} 
\]

**Summarize** Fill in the blanks to help you take notes while you read Example Problem 19–1.

**Problem**

Calculate \([OH^-]\) using \(K_w\) and the concentration of \(\text{_____}\), and determine if the solution is acidic, basic, or neutral.

**Step 1: Analyze the Problem**

Known: \(\text{_____}\)  \(\text{_____}\)

\([H^+] = \text{_____} \quad [OH^-] = \text{____}\) mol/L

\(K_w = \text{_____}\)

Write what you can predict about \([OH^-]\):

**Step 2: Solve for the Unknown**

Write the ion product constant expression

\(K_w = \text{_____}\)

Solve for \([OH^-]\) by \(\text{_____}\).

\([OH^-] = \text{_____}\)

\([OH^-] = \text{_____}\)

Since \([H^+] > [OH^-]\), \(\text{_____}\).
Step 3: Evaluate the Answer

The answer is correctly stated with ____ significant figures because [H⁺] and [OH⁻] each have two. The hydroxide ion concentration ______ the prediction.

Compare and contrast pH and pOH by completing the following table.

<table>
<thead>
<tr>
<th>Solution Type</th>
<th>Scale Measure</th>
<th>Relationship (Equation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>acid</td>
<td>pH</td>
<td></td>
</tr>
<tr>
<td>base</td>
<td></td>
<td></td>
</tr>
<tr>
<td>acid and base</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analyze the process of calculating pH and pOH from the hydroxide concentration.

Describe the process of calculating the hydrogen ion and hydroxide ion concentrations from pH.

Describe the process of calculating $K_a$ from pH for a 0.100M weak acid.
Skim Section 4 of your text. Focus on the headings, subheadings, boldfaced words, and the main ideas. Write three questions about strengths of acids and bases based on what you have read.

1. 

2. 

3. 

Define the following terms.

neutralization reaction

salt

titration

equivalence point

acid-base indicator

end point

salt hydrolysis

buffer

buffer capacity
Section 19.4 Neutralization (continued)

**Main Idea**

The Reaction Between Acids and Bases

*Use with pages 617–621.*

**Details**

Write the full equation of the neutralization reaction for magnesium hydroxide and hydrochloric acid.

Draw the titration curve for 50.0 mL 0.100M HCl titrated with 0.100M NaOH. Label the pH and volume vectors, as well as the equivalence point.

Describe the indicator that matches each of the following pH levels. *Use Figure 19–18 as a guide.*

<table>
<thead>
<tr>
<th>pH</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>1–12</td>
<td></td>
</tr>
</tbody>
</table>

Explain the process for calculating the molarity of an unknown HCOOH solution by completing the equations below.

Balanced equation:
HCOOH(aq) + NaOH(aq) $\rightarrow$ HCOONa(aq) + H$_2$O(l)

18.28 mL NaOH $\times$ ____________ = _______ L NaOH
0.01828 L NaOH $\times$ ____________

= ___________ mol NaOH
1.828 $\times$ 10$^{-3}$ mol NaOH $\times$ ____________

= ___________ mol HCOOH
1.828 $\times$ 10$^{-3}$ mol HCOOH / ____________

= ___________ $M$ HCOOH
Section 19.4 Neutralization (continued)

Main Idea

**Salt Hydrolysis**

*Use with pages 621–622.*

Describe *salt hydrolysis by completing the following statements.*

Some aqueous salt solutions are neutral, some are basic, and some are ___. The reason for this is a process known as __________.

In this process, the anions of the dissociated salt donate __________ to water. Salts that will hydrolyze have a weak acid and a __________ or a strong acid and a __________. A salt formed from a strong acid and a weak base will form an __________. A salt formed from a strong base and a weak acid will form a __________. Salts formed from weak acids and bases or from strong acids and bases will not hydrolyze and form __________.

Details

Explain *how a buffer works by completing the table below.*

<table>
<thead>
<tr>
<th>The equation at equilibrium</th>
<th>HF(aq) $\rightleftharpoons$ H$^+$ (aq) + F$^-$ (aq)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Δ Condition</strong></td>
<td><strong>Equilibrium Shift</strong></td>
</tr>
<tr>
<td>add acid</td>
<td>left</td>
</tr>
<tr>
<td>add base</td>
<td>right</td>
</tr>
</tbody>
</table>

A greater of the buffering molecules and ions in the solution leads to a of the solution.

A buffer has or a base with its of an acid and its
Acids and Bases  Chapter Wrap-Up

Now that you have read the chapter, review what you have learned; write out three key equations and relationships.

1. .................................................................

2. .................................................................

3. .................................................................

Review  Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.

☐ Study the definitions of vocabulary words.

☐ 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

Suppose you are on the bench for your school’s soccer team when one of the players comes out of the game with a cramp. A teammate suggests that she start breathing into a paper bag to recover sooner. Explain whether or not this is good advice.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Redox Reactions

Before You Read

**Review Vocabulary**

Define the following terms.

- **electronegativity**

- **chemical reactions**

**Chapter 8**

Compare and contrast *monatomic ions and polyatomic ions*.

- 
- 
- 
- 
- 

**Chapter 10**

List five types of chemical reactions.

1. 
2. 
3. 
4. 
5. 

Redox Reactions
Redox Reactions
Section 20.1 Oxidation and Reduction

Main Idea

Skim Section 1 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. ________________________________
2. ________________________________
3. ________________________________

New Vocabulary

Use your text to define each term.

oxidation-reduction reaction
redox reaction
oxidation
reduction
oxidizing agent
reducing agent

Details

Describe redox reactions by completing the statement below. Use Figure 20-1 in your text as reference.

A redox reaction consists of two complimentary processes.

Oxidation results in a _____________ and an increased _____________. Reduction results in a _____________ and a ____________ oxidation number.

Electron Transfer and Redox Reactions

Use with pages 635–637.
Section 20.1 Oxidation and Reduction (continued)

Main Idea

Oxidizing and Reducing Agents

Use with page 638.

Details

Compare and contrast an oxidizing agent and a reducing agent.

Summarize Fill in the blanks to help you take notes while you read Example Problem 20-1.

Problem

Write the equation for the redox reaction:

Identify what is _________ and what is _________ in the redox reaction of aluminum and iron. Identify the _____________ and the _____________.

1. Analyze the Problem
   Known: __________________________________________________________________________
   Unknown: _________________________________________________________________________

2. Solve for the Unknown
   Al becomes Al^{3+} and ____________ electrons.
   Fe^{3+} becomes Fe and gains ______ electrons.

3. Evaluate the Answer
   Aluminum ____________ electrons and is _____________.
   It is the ____________ agent. Iron ____________
   electrons and is _____________. It is the ____________ agent.
Describe the rules for determining oxidation numbers by completing these statements.
1. The oxidation number of an uncombined atom is ____________.
2. The oxidation number of a monatomic ion is equal to ____________.
3. The oxidation number of the more electronegative atom in a molecule or a complex ion is the same as ____________.
4. The oxidation number of fluorine, the most electronegative element, when it is bonded to another element is ____________.
5. The oxidation number of oxygen in compounds is ____________, except in peroxides where it is ____________. The oxidation number of oxygen when it bonds to fluorine is ____________.
6. The oxidation number of hydrogen in most of its compounds is ____________.
7. The oxidation numbers of the metal atom in the compounds formed by the metals of groups 1A and 2A and aluminum in group 3A are ____________, respectively. These oxidation numbers are equal to ____________.
8. The sum of the oxidation numbers in a neutral compound is ____________.
9. The sum of the oxidation numbers of the atoms in a polyatomic ion is equal to ____________.

Describe the redox reaction for the equation listed below. Use the example on page 643 of your text to complete the table, then label the oxidation numbers of the elements in the equation and indicate the change in each.

\[2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3\]

<table>
<thead>
<tr>
<th>Element</th>
<th>Oxidation Number</th>
<th>Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe in Fe₂O₃</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O in Fe₂O₃</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al in Al₂O₃</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O in Al₂O₃</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Redox Reactions
Section 20.2 Balancing Redox Equations

**Main Idea**

**Scan** Section 2 of your text, using the checklist below as a guide.
- Read all section titles.
- Read all boldfaced words.
- Read all formulas.
- Look at all figures and read the captions.
- Think about what you already know about redox reactions.

**Write** three facts you discovered about balancing redox reactions.

1. 

2. 

3. 

**Details**

**Use your text to define this term.**

**New Vocabulary**

oxidation-number method

**The Oxidation-Number Method**

*Use with page 644.*

**Sequence** the steps for balancing redox reactions by the oxidation-number method.

____ Identify the atoms that are oxidized and the atoms that are reduced.

____ Assign oxidation numbers to all atoms in the equation.

____ Make the change in oxidation numbers equal in magnitude by adjusting coefficients in the equation.

____ If necessary, use the conventional method to balance the remainder of the equation.

____ Determine the change in oxidation number for the atoms that are oxidized and for the atoms that are reduced.
Summarize Fill in the blanks to help you take notes while you read Example Problem 20-3.

Problem}
Balance the ______ equation for the ______ that produces _________.

\[ \text{Cu} + \text{HNO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{NO}_2 + \text{H}_2\text{O} \]

1. Analyze the Problem
Known:
The formulas for the reactants and _______; the rules for determining ________________; and the fact that the increase in the oxidation number of the _______________ must equal the ________________ of the reduced atoms.

Unknown:

2. Solve for the Unknown
Step 1 Assign oxidation numbers to all the atoms in the equation.

\[ \text{Cu} + \text{H} \text{N} \text{O}_3 \rightarrow \text{Cu(N}_3\text{O}_2) + \text{N}_2 + \text{H}_2\text{O} \]

Step 2 Identify which atoms are oxidized (using black arrows) and which are reduced (using red arrows).

\[ \text{Cu} + \text{H} \text{N} \text{O}_3 \rightarrow \text{Cu(N}_3\text{O}_2) + \text{N}_2 + \text{H}_2\text{O} \]

Step 3 Determine the change in oxidation number for the atoms that are oxidized and for the atoms that are reduced. Complete the following tables.

\[ \text{Cu} + \text{HNO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{NO}_2 + \text{H}_2\text{O} \]

Step 4 To make the net changes in oxidation number have the same magnitude, \text{HNO}_3 on the left and \text{NO}_2 on the right must be multiplied by _____.

Balancing a Redox Reaction
by the Oxidation-Number Method

Use with Example Problem 20-3, pages 645–646.
Section 20.2 Balancing Redox Equations (continued)

Main Idea

Step 5  Increase the coefficient of HNO₃ from 2 to ____ to balance the nitrogen atoms in the products. Add a coefficient of ____ to H₂O to balance the number of hydrogen atoms on the left.

3. Evaluate the Answer

The number of atoms of each element is _____ on both sides of the equation. No subscripts have been _________.

Details

Describe how the form of the balanced equation for the oxidation of copper by nitric acid, below:

\[ \text{Cu(s)} + 4\text{HNO}_3(\text{aq}) \rightarrow \text{Cu(NO}_3)_2(\text{aq}) + 2\text{NO}_2(\text{g}) + 2\text{H}_2\text{O(l)} \]

is changed when rewritten as:

\[ \text{Cu(s)} + 4\text{H}^+(\text{aq}) + 4\text{NO}_3^-(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{NO}_3^-(\text{aq}) + 2\text{NO}_2(\text{g}) + 2\text{H}_2\text{O(l)} \]

Solve Read Example Problem 20-4 in your text.

You Try It

Problem

Balance the net ionic redox equation for the reaction between the perchlorate ion and the iodide ion in acid solution.

\[ \text{ClO}_3^- (\text{aq}) + \text{I}^- (\text{aq}) \rightarrow \text{Cl}^- (\text{aq}) + \text{I}_2(\text{s}) \text{ (in acid solution)} \]

1. Analyze the Problem

Known:______________________________________________________

______________________________________________________

Unknown:______________________________________________________
2. Solve for the Unknown

Step 1 Assign oxidation numbers to all the atoms in the equation.

\[ \text{ClO}_3^- \text{(aq)} + I^- \text{(aq)} \rightarrow \text{Cl}^- \text{(aq)} + I_2 \text{(s)} \text{ (in acid solution)} \]

Step 2 Identify which atoms are oxidized (using black arrows) and which are reduced (using red arrows).

\[ \text{ClO}_3^- \text{(aq)} + I^- \text{(aq)} \rightarrow \text{Cl}^- \text{(aq)} + I_2 \text{(s)} \text{ (in acid solution)} \]

Step 3 Determine the change in oxidation number for the atoms that are oxidized and for the atoms that are reduced. Complete the following tables.

\[ \text{ClO}_3^- \text{(aq)} + 6I^- \text{(aq)} \rightarrow \text{Cl}^- \text{(aq)} + 3I_2 \text{(s)} \text{ (in acid solution)} \]

Step 4 To make the net changes in oxidation number have the same magnitude, place the appropriate coefficients in front of the formulas in the equation.

\[ \text{ClO}_3^- \text{(aq)} + 6I^- \text{(aq)} \rightarrow \text{Cl}^- \text{(aq)} + 3I_2 \text{(s)} \text{ (in acid solution)} \]

Step 5 Write an equation that adds enough hydrogen ions and water molecules to balance the oxygen atoms on both sides.

3. Evaluate the Answer

The number of atoms of each element is _____ on both sides of the equation. The net charge on the right _____ the net charge on the left. No subscripts have been _______.
Redox Reactions
Section 20.3 Half-Reactions

Main Idea

Skim Section 3 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 

2. 

3. 

Details

Use your text to define each term.

species 

half-reaction 

New Vocabulary

Identifying Half-Reactions

Use with pages 650–651.

Identify the number of species in each reaction. Then, show the oxidation half-reaction and the reduction half-reaction for each equation.

<table>
<thead>
<tr>
<th>Reaction</th>
<th>No. of Species</th>
<th>Half-Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Oxidation</td>
</tr>
<tr>
<td>4Fe + 3O₂ → 2Fe₂O₃</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4Fe + 3Cl₂ → 2Fe₂Cl₃</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Main Idea: Balancing Redox Equations by Half-Reactions

Use with page 651.

Details: Sequence the steps for balancing by half-reactions.

1. Adjust the coefficients so that the number of electrons lost in oxidation equals the number of electrons gained in reduction.
2. Write the net ionic equation for the reaction, omitting spectator ions.
3. Add the balanced half-reactions and return spectator ions.
4. Write the oxidation and reduction half-reactions for the net ionic equation.
5. Balance the atoms and charges in each half-reaction.

Summarize: Fill in the blanks to help you take notes while you read Example Problem 20-5.

Problem: Balance the redox equation for the reaction of permanganate and sulfur dioxide when sulfur dioxide is bubbled into an aqueous solution of permanganate.

KMnO₄(aq) + SO₂(g) → MnSO₄(aq) + K₂SO₄(aq)

1. Analyze the problem
   Known: ____________________________
   ____________________________
   Unknown: ____________________________
   ____________________________

2. Solve for the Unknown
   Step 1: Write the net ionic equation for the reaction:
   ____________________________

   Step 2: Using rule number 5, the oxidation number for Mn in MnO₄⁻ is ____. Using rule number 2, the oxidation number for Mn²⁺ is ____. The reduction half-reaction is ____________________________.
   Step 3(a): Balance the atoms and charges in the half-reaction.
   ____________________________

Section 20.3 Half-Reactions (continued)
Step 3(b): The ___ ions are readily available and can be used to balance the charge in half-reactions in acid solutions. The number of H+ ions added to the right side of the oxidation half-reaction is ____. The number of H+ ions added to the left side of the reduction half-reaction is ____. Write the oxidation half-reaction: __________________________. Write the reduction half-reaction: __________________________.

Step 4: The number of electrons lost in oxidation is ____. The number of electrons gained in reduction is ____. The least common multiple of these numbers is ____. To balance the half-reactions, the atoms in the oxidation half-reaction must be multiplied by ____ and the atoms in the reduction half-reaction must be multiplied by ____. The oxidation half-reaction is now __________________________

The reduction half-reaction is now __________________________

Step 5 After adding the balanced half-reactions, write the redox reaction equation:

___________________________

Cancel or reduce like terms on both sides of the equation, then write the simplified equation:

___________________________

Return spectator ions ____ and restore the state descriptions.

3. Evaluate the Answer
The number of _____ for each element is _____ on both sides of the equation and none of the subscripts have been changed.
Redox Reactions  Chapter Wrap-Up

After reading this chapter, summarize the processes that occur in a redox reaction.

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.
☐ Study the definitions of vocabulary words.
☐ 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

Photosynthesis is an example of a series of naturally occurring redox reactions. In this context, discuss the importance of redox reactions to life on Earth.
Electrochemistry

Before You Read

<table>
<thead>
<tr>
<th>Review Vocabulary</th>
<th>Define the following terms.</th>
</tr>
</thead>
<tbody>
<tr>
<td>energy</td>
<td></td>
</tr>
<tr>
<td>chemical potential energy</td>
<td></td>
</tr>
<tr>
<td>spontaneous process</td>
<td></td>
</tr>
<tr>
<td>oxidation</td>
<td></td>
</tr>
<tr>
<td>reduction</td>
<td></td>
</tr>
<tr>
<td>half-reaction</td>
<td></td>
</tr>
</tbody>
</table>

Chapter 10

Identify three types of reactions.

1. ____________________________
2. ____________________________
3. ____________________________

Organize the following elements from least active to most active.
Refer to the activity series in Figure 10-10.

aluminum, copper, calcium, gold, rubidium, iron, lead, potassium
Skim Section 1 of your text. Focus on the headings, subheadings, boldfaced words, and the main ideas. Summarize three main ideas of this section.

1. 
2. 
3. 

Use your text to define each term.

- **salt bridge**
- **electrochemical cell**
- **voltaic cell**
- **half-cell**
- **anode**
- **cathode**
- **reduction potential**
- **standard hydrogen electrode**
- **battery**

Define the following term.

- **involve**
**Section 21.1 Voltaic Cells** (continued)

**Main Idea**

Use with page 663.

**Details**

**Explain** the branch of chemistry called electrochemistry.


**Redox in Electrochemistry**

Use with pages 663–665.

**Chemistry of Voltaic Cells**

Use with page 665.

**Write** the half-reactions of copper and zinc.

<table>
<thead>
<tr>
<th>Reduction half-reaction: electrons</th>
<th>Oxidation half-reaction: electrons</th>
</tr>
</thead>
</table>

**Explain** how an electrochemical cell uses a redox reaction.


**Complete** each of the following statements.

1. The electrode where oxidation takes place is called the ______.
2. The electrode where reduction takes place is called the ______.
3. An object’s potential energy is ____________________________.
4. In electrochemistry, __________________________ is a measure of the amount of ______ that can be generated from a ______ to do work.

**Sequence** the steps of the electrochemical process that occur in a zinc-copper voltaic cell. The first one has been done for you.

1. To complete the circuit, both positive and negative ions move through the salt bridge. The two half-reactions can be summed to show the overall cell reaction.
2. The electrons flow from the zinc strip and pass through the external circuit to the copper strip.
3. Electrons are produced in the oxidation half-cell according to this half-reaction: \( \text{Zn}(s) \rightarrow \text{Zn}^{2+}(aq) + 2e^- \).
4. Electrons enter the reduction half-cell where the following half-reaction occurs: \( \text{Cu}^{2+} (aq) + 2e^- \rightarrow \text{Cu}(s) \).
Section 21.1 Voltaic Cells (continued)

Main Idea

Calculating Electrochemical Cell Potential
Use with page 666.

Describe reduction potential in relation to an electrode.

Analyze Table 21-1. Some of the $E^0$ (V)s are positive, some are negative. Explain the difference.

Write the abbreviated $E^0$ and half-reaction for each of the following:

<table>
<thead>
<tr>
<th>Element</th>
<th>Half-Reaction</th>
<th>$E^0$ (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Au</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PbSO₄</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summarize Fill the blanks to help you take notes while you read Example Problem 21-1.

Problem

Calculate the overall cell reaction and the standard potential for the half-cells of a voltaic cell.

$I_2(s) + 2e^- \rightarrow 2I^-(aq)$
$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$

1. Analyze the Problem.
   List the known and the unknown.
   Known: Standard reduction potentials for the half-cells
   Unknown: 

2. Solve for the unknown.

Find the standard reduction potentials for half-reactions.

\[ E_{I_2/I^-}^0 = \text{______________________________} \]
\[ E_{Fe^{2+}/Fe}^0 = \text{______________________________} \]

Rewrite the half-reactions in the correct direction.

reduction half-cell reaction: ________________

oxidation half-cell reaction: ________________

overall cell reaction: \[ I_2(s) + Fe(s) \rightarrow Fe^{2+}(aq) + 2I^-(aq) \]

Balance the reaction if necessary:

Calculate cell standard potential:

\[ E_{cell}^0 = E_{reduction}^0 - E_{oxidation}^0 \]
\[ E_{cell}^0 = +0.536 \text{ V} - \text{______________________________} \]
\[ E_{cell}^0 = + \text{______________________________} \]

Write the reaction using cell notation:

3. Evaluate the answer.

The answer seems reasonable given the ________________ of the ____________ that comprise it.

Using Standard Reduction Potentials

Use with page 671.
Electrochemistry
Section 21.2 Types of Batteries

Main Idea

**Skim** Section 2 of your text. Write three questions that come to mind after reading the headings and the illustration captions.

1. 

2. 

3. 

New Vocabulary

*Use your text to define each term.*

- **dry cell**

- **primary battery**

- **secondary battery**

- **fuel cell**

- **corrosion**

- **galvanizing**

Academic Vocabulary

*Define the following term.*

- **trend**

---

288  Types of Batteries
Section 21.2 Types of Batteries (continued)

**Main Idea**

**Dry Cells**
*Use with pages 673–675.*

**Details**

Write the oxidation half-reaction for the dry cell of the most commonly used voltaic cell.

List the paste and cathode type for each of the following batteries. So-called dry cell batteries contain different moist pastes in which the cathode half-reaction takes place.

Zinc-carbon battery
- Paste: ______________
- Cathode type: ______________

Alkaline battery
- Paste: ______________
- Cathode type: ______________

Mercury battery
- Paste: ______________
- Cathode type: ______________

Compare and contrast primary and secondary batteries.

Explain how NiCad batteries, often found in cordless tools and phones, are recharged.
Section 21.2 Types of Batteries (continued)

**Main Idea** —

**Details** —

**Lead-Acid Storage Battery**
*Use with pages 675–676.*

**Lithium Batteries**
*Use with pages 676–677.*

**Fuel Cells**
*Use with pages 678–679.*

**Lead-Acid Storage Battery**

Explain how the following overall reaction of lead-acid batteries is different from traditional redox reactions.

\[ \text{Pb(s)} + \text{PbO}_2(s) + 4\text{H}^+(aq) + 2\text{SO}_4^{2-}(aq) \rightarrow 2\text{PbSO}_4(s) + 2\text{H}_2\text{O}(l) \]

List two reasons that scientists and engineers have focused a lot of attention on the element lithium to make batteries.

1. 
2. 

Describe two applications of lightweight lithium batteries.

**Fuel Cells**

Explain the makeup of a fuel cell by completing the following paragraph and accompanying reactions.

In a fuel cell, each electrode that allows contact between the ______. The walls of the chamber also contain ______, such as powdered platinum or palladium, which ______. 

oxidation half-reaction: 

reduction half-reaction: 

overall cell reaction: 

The overall cell reaction is the same as the equation for the ______.

List three reasons why PEMs are used instead of a liquid electrode.

1. 
2. 
3. 
**Corrosion**

*Use with pages 679–682.*

**Main Idea**

**Details**

**Compare** rusting of metal to redox reactions in voltaic cells.

**Draw** and label the parts of the corrosion reaction in Figure 21-14. Be sure to identify the anode and cathode.

**Explain** why rusting is a slow process. List a way that it might be sped up in certain areas.

**Explain** the two ways galvanizing helps prevent corrosion.

1. 

2. 
Scan Section 3 of your text. Use the checklist below as a guide.
- Read all section titles.
- Read all boldfaced words.
- Read all formulas.
- Look at all figures and read the captions.
- Think about what you already know about electrolysis.

Write three facts you discovered about electrolysis as you scanned the section.

1. 
2. 
3. 

New Vocabulary

Use your text to define each term.

- electrolysis

- electrolytic cell

Academic Vocabulary

Define the following term.

- conduct
Section 21.3 Electrolysis (continued)

**Main Idea**

**Reversing Redox Reactions**

*Use with page 683.*

**Applications of Electrolysis**

*Use with pages 684–687.*

**Details**

**Describe** how it is possible to reverse a spontaneous redox reaction in an electrochemical cell.

**Compare** the reactions involved in sodium chloride to those in the electrolysis of brine.

**Explain** the importance of electrolysis in the purification of metals.
Electrochemistry  Chapter Wrap-Up

After reading this chapter, list three important facts you have learned about electrochemistry.

1. ______________________________________

2. ______________________________________

3. ______________________________________

Review

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.

☐ Study the definitions of vocabulary words.

☐ 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 how electrochemistry is involved in producing energy in batteries.

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

294  Chapter Wrap-Up
Hydrocarbons

Before You Read

Review Vocabulary

Define each term.

covalent bond

Lewis structure

Chapter 7

Write the electron configuration of a carbon atom.

Chapter 9

Draw the Lewis structure for NH₃.

Chapter 13

Compare and contrast melting and boiling.
Scan Section 1 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 pictures and read the captions
- Think about what you already know about this subject.

Write three facts you discovered about alkanes.

1. ____________________________________________________________

2. ____________________________________________________________

3. ____________________________________________________________

Use your text to define each term.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>organic compound</td>
<td></td>
</tr>
<tr>
<td>hydrocarbon</td>
<td></td>
</tr>
<tr>
<td>alkane</td>
<td></td>
</tr>
<tr>
<td>homologous series</td>
<td></td>
</tr>
<tr>
<td>parent chain</td>
<td></td>
</tr>
<tr>
<td>substituent group</td>
<td></td>
</tr>
</tbody>
</table>
Organic Chemistry

Use with page 697.

Main Idea

**Organic Chemistry**

Use with page 697.

**Main Idea**

Explain the evolution of the contemporary understanding of the term organic compound.

In the early nineteenth century, chemists referred to the variety of carbon compounds produced by living things as organic compounds.

Today the term organic compound is applied to all carbon-containing compounds with the primary exceptions of carbon oxides, carbides, and carbonates, which are considered inorganic.

Details

Explain why many compounds contain carbon by completing the following statements.

Carbon’s __________ allows it to make four covalent bonds.

In organic compounds, carbon atoms bond to ___________ or other elements near carbon on the periodic table. Carbon atoms also bond to ___________ and can form long _____.

Hydrocarbons

Use with pages 698–699.

**Hydrocarbons**

Use with pages 698–699.

Label the web below with the correct name for each model of methane.

1. \( \text{CH}_4 \)

2. \( \text{H} - \text{C} - \text{H} \)

3. [Model image]

4. [Model image]
Straight-Chain Alkanes

Use with pages 699–700.

Compare and contrast the models in the table below.

<table>
<thead>
<tr>
<th>Type of Model</th>
<th>Description of Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Molecular formula</td>
<td></td>
</tr>
<tr>
<td>2. Structural formula</td>
<td></td>
</tr>
<tr>
<td>3. Space-filling model</td>
<td></td>
</tr>
<tr>
<td>4. Ball-and-stick model</td>
<td></td>
</tr>
</tbody>
</table>

Describe straight-chain alkanes by completing the following sentences.

The first four compounds in the straight-chain series of alkanes are _________________. The names of all alkanes end in ___. Because the first four alkanes were named before there was a complete understanding of alkane structures, their names do not have ________________ as do the alkanes with ________________ in a chain. Chemists use ________________ to save space.

Explain the structural formula of the following hydrocarbons. The first has been done for you.

1. Methane is formed from one atom of carbon and four atoms of hydrogen.
2. Butane is formed ___________________________.
3. Octane is formed ___________________________ ___________________________.
4. Decane is formed ___________________________ ___________________________.

Analyze how the function of a homologous series is evidenced in the condensed structural formula of nonane.
Section 22.1 Alkanes (continued)

Main Idea

Branched-Chain Alkanes

Use with page 701.

Details

Compare three characteristics of butane and isobutane.

Describe naming branched-chain alkanes.

A straight-chain and a branched-chain alkane can have the same molecular formula.

Therefore, the name of an organic compound also must describe

NAMING PROCESS

Branched-chain alkanes are viewed as consisting of a

NAMING, PART 1

The longest continuous chain of carbon atoms is called .

NAMING, PART 2

All side branches are called because they appear to substitute for a hydrogen atom in the straight chain.

NAMING, PART 3

Each alkane-based substituent group branching from the parent chain is named
Hydrocarbons
Section 22.2 Cyclic Alkanes and Alkane Properties

Main Idea

Skim Section 2 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. ______________________________________

2. ______________________________________

3. ______________________________________

New Vocabulary

Use your text to define each term.

cyclic hydrocarbon

cycloalkane

saturated hydrocarbon

unsaturated hydrocarbon

Academic Vocabulary

Define the following terms.

infer
Section 22.2 Cyclic Alkanes and Alkane Properties (continued)

Main Idea

Cycloalkanes

Use with page 706.

Organize the concept web below.

Properties of Alkanes

Use with pages 708–709.

Classify the properties of alkanes into categories.

<table>
<thead>
<tr>
<th>General Properties (3)</th>
<th>Physical Properties (4)</th>
<th>Chemical Properties (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Main Idea

Multiple Carbon-Carbon Bonds

Use with page 710.

Details

Organize the outline below.

I. Ways that carbon atoms bond to each other
   A. ________________________________
      1. share ____________________________
      2. also called _______________________
   B. ________________________________
      1. share ____________________________
      2. also called _______________________
   C. ________________________________
      1. share ____________________________
      2. also called _______________________

Draw models of each carbon-carbon bond and label them appropriately. Use the illustrations on page 710 of your text as a guide.

<table>
<thead>
<tr>
<th>Single Covalent Bond</th>
<th>Double Covalent Bond</th>
<th>Triple Covalent Bond</th>
</tr>
</thead>
</table>

Real-World Connection

Explain the process of cleaning an oil spill in the ocean using what you have learned about the immiscibility of alkanes. Why are oil spills dangerous for birds like ducks?
Hydrocarbons
Section 22.3 Alkenes and Alkynes

Scan Section 3 of your text. Focus on the headings, subheadings, boldfaced words, and the main ideas. Set the book aside and, in the space below, summarize the main ideas of this section.

New Vocabulary

Use your text to define each term.

alkene

alkyne

Academic Vocabulary

Define the following term.

formula
Section 22.3 Alkenes and Alkynes (continued)

Main Idea

Alkenes

Use with page 711.

Details

Identify five facts about alkenes as discussed in your text.

1. 

2. 

3. 

4. 

5. 

Sequence the factors involved in naming an alkene with four or more carbons in the chain using the web below and number the steps.

1. Change the –ane ending of the corresponding alkane to

2. Specify the location of the

3. Number the carbons in the parent chain starting

4. Use only that number

Summarize Use the following to help you take notes as you read Example Problem 22–3 in your text.

Problem Name the following alkene.
Section 22.3 Alkenes and Alkynes (continued)

Main Idea

1. Analyze the Problem
   You are given a branch-chained alkene that contains one double bond and two alkyl groups. Follow the IUPAC rules to name the organic compound.

2. Solve for the Unknown
   a. The longest continuous carbon chain that includes the double bond contains _____ carbons. The _______ alkane is heptane, but the name is changed to _______ because a double bond is present.
   b. and c. Number the chain to give the lowest number to the double bond and name each substituent.
   d. Determine how many of each substituent is present, and assign the correct prefix to represent that number. Then, include the position numbers to get the complete prefix.
   e. The names of substituents ________________________________ ________________________________.
   f. Apply the complete prefix to the name of the parent alkene chain. Use commas to separate numbers and hyphens between numbers and words. Write the name ____________________.

3. Evaluate the Answer
   The longest carbon chain includes the ____________, and the position of the double bond has the ________________.
   Correct prefixes and alkyl-group names ____________________.

Details

Alkynes
Use with page 714.

Compare and contrast alkenes and alkynes.
Hydrocarbons
Section 22.4 Isomers

Main Idea

Skim Section 4 of your text. Write two questions that come to mind from reading the headings and the illustration captions.

1. 
2. 

New Vocabulary

Use your text to define each term.

- isomer
- structural isomer
- stereoisomer
- geometric isomer
- chirality
- asymmetric carbon
- optical isomer
- polarized light
- optical rotation

Details
Section 22.4 Isomers (continued)

**Main Idea**

**Structural Isomers**
*Use with pages 717–718.*

**Details**

Organize the outline below.

I. **Isomers**: Two or more compounds that have the same molecular formula but different molecular structures.

A. Two types of isomers

1. Structural isomers
   a. __________________________
   b. __________________________
      i. Examples include __________________________

2. Stereoisomers
   a. __________________________
      i. __________________________
      ii. __________________________
   b. __________________________
      i. Result from different arrangements of groups around a double bond
      1. Possible __________________________ with *trans*-fatty acids.
      2. The __________________________ seem not to be as harmful.

**Stereoisomers**
*Use with pages 718–719.*

**Chirality**
*Use with page 719.*

Describe chirality by completing the flow chart below.

- **Chirality occurs whenever**
- a compound contains an
  - which has
    - or
      - attached to it.

- These isomers are called
- The molecules are
- The four groups can be
Section 22.4 Isomers (continued)

Optical Isomers

Use with page 719.

Main Idea

Details

Identify the types of isomers shown below. Which pair are optical isomers?

<table>
<thead>
<tr>
<th>D-glyceraldehyde</th>
<th>L-glyceraldehyde</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHO</td>
<td>CHO</td>
</tr>
<tr>
<td>HO C OH</td>
<td>HO C H</td>
</tr>
<tr>
<td>CH₂OH</td>
<td>CH₂OH</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ethanol</th>
<th>Methoxymethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>H H H</td>
<td>H H H</td>
</tr>
<tr>
<td>H C C O H</td>
<td>H C O C H</td>
</tr>
<tr>
<td>H H H</td>
<td>H H H</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trans-1,2-dichloroethene</th>
<th>cis-1,2-dichloroethene</th>
</tr>
</thead>
<tbody>
<tr>
<td>H C Cl</td>
<td>H C Cl</td>
</tr>
<tr>
<td>Cl C H</td>
<td>Cl C Cl</td>
</tr>
</tbody>
</table>

Compare

Explain what a pair of shoes and crystals of the organic compound tartaric acid have in common.
Hydrocarbons
Section 22.5 Aromatic Hydrocarbons and Petroleum

Main Idea

Skim Section 5 of your text. Focus on the headings, subheadings, boldfaced words, and the main ideas. Summarize the main ideas of this section.

Details

Use your text to define each term.

aromatic compound

aliphatic compound

Match the names of these two processes with their definitions.

1. fractional distillation
2. cracking

___________ is done to break the larger molecules of petroleum components into smaller molecules.

__________________ separates petroleum into simpler components.

Define the following term.

isolate

New Vocabulary

Academic Vocabulary
Section 22.5 Aromatic Hydrocarbons and Petroleum (continued)

**Main Idea**

**Aromatic Compounds**

Use with pages 723–724.

**Details**

Classify the properties of aromatic and aliphatic compounds.

<table>
<thead>
<tr>
<th></th>
<th>Structural Characteristics</th>
<th>Reactivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aromatic Compounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aliphatic Compounds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model Draw a model of a fused ring system.

Explain how substituted benzene rings are numbered.

Number the substituted benzene ring in the structure below, then name the structure.

![Fused ring system diagram]
Section 22.5 Aromatic Hydrocarbons and Petroleum (continued)

Main Idea

Natural Sources of Hydrocarbons
Use with pages 725–726.

Use natural sources of hydrocarbons by completing the following statements.

The main natural source of hydrocarbons is ________, a complex mixture containing more than a thousand _________________. Petroleum is more useful to humans when ________________, called _______. Separation is carried out by ________________, a process called fractional distillation.

Details

Sequence the process of fractional distillation.

___ Vapors travel up through the column.
___ Temperature is controlled to remain near 400° at the bottom of the fractionating tower.
___ Hydrocarbons with fewer carbon atoms remain in the vapor phase until they reach regions of cooler temperatures farther up the column.
___ Hydrocarbons with more carbon atoms condense closer to the bottom or the tower and are drawn off.
___ Petroleum boils and gradually moves toward the top.

Rating Gasolines
Use with pages 726–727.

Explain why branched-chain alkanes make better gasolines than straight-chain hydrocarbons.

REAL-WORLD CONNECTION

Describe how changing the grade of gasoline you use could help engine knocking.

Hydrocarbons
Now that you have read the chapter, review what you have learned; list the types of models used to represent chemical compounds and name the different categories of hydrocarbons.

### Hydrocarbons:

- **Alkanes**
- **Alkenes**
- **Alkynes**
- **Isomers**
- **Aromatic**

### Models:

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

### Isomers:

- [ ]
- [ ]
- [ ]

### Aromatic:  

- Aliphatic: 

---

**Review**

Use this checklist to help you study.

- [ ] Study your Science Notebook for this chapter.
- [ ] Study the definitions of vocabulary words.
- [ ] 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.

---

**Summarize**

Explain how hydrocarbons have contributed to space exploration.

---

312  Chapter Wrap-Up
### Substituted Hydrocarbons and Their Reactions

#### Before You Read

**Review Vocabulary**

Define the following terms.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>periodic table</td>
<td></td>
</tr>
<tr>
<td>compound</td>
<td></td>
</tr>
<tr>
<td>halogens</td>
<td></td>
</tr>
<tr>
<td>chemical bond</td>
<td></td>
</tr>
<tr>
<td>catalyst</td>
<td></td>
</tr>
</tbody>
</table>

**Chapter 7**

Explain organic chemistry.

**Chapter 22**

Compare and contrast stereoisomers with structural isomers.
## Substituted Hydrocarbons and Their Reactions

### Section 23.1 Functional Groups

### Main Idea

**Skim** Section 1 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 
2. 
3. 

### New Vocabulary

Use your text to define each term.

- **functional group**

- **halocarbon**

- **alkyl halide**

- **aryl halide**

- **substitution reaction**

- **halogenation**

### Academic Vocabulary

Define the following term.

- **structure**

---

314  Functional Groups
Section 23.1 Functional Groups (continued)

Functional Groups
Use with pages 737–738.

**Main Idea**

Describe how a functional group can be helpful in determining how a molecule reacts.

**Details**

Identify the meaning of each of the following symbols for functional groups.

* represents ________________

R and R’ represents ________________

Organize information about organic compounds and their functional groups by completing the table below.

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>General Formula</th>
<th>Functional Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halocarbon</td>
<td>R-OH</td>
<td>Halogen</td>
</tr>
<tr>
<td></td>
<td>R-NH2</td>
<td>Ether</td>
</tr>
<tr>
<td>Aldehyde</td>
<td></td>
<td>Carbonyl</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carbonyl</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ester</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amido</td>
</tr>
</tbody>
</table>
Compare and contrast alkyl halides and aryl halides.

Describe how to name halocarbons by completing the following paragraph.

Organic molecules containing functional groups are given IUPAC names based on their ________________. For the alkyl halides, a prefix indicates which ______ is present. The prefixes are formed by ________________________.

Examine Table 23-2 on page 740. Write three observations you make regarding the compounds listed in the table.

1. __________________________
2. __________________________
3. __________________________

Sequence the steps needed to add Cl₂ to ethane to create chloroethane. Use the reaction from the bottom of page 741 in your text as a reference.

1. __________________________
2. __________________________
3. __________________________
4. __________________________

Create another substitution reaction using Br₂ and methane. Label molecules in each part of the reaction.

__________________________
## Substituted Hydrocarbons and Their Reactions

### Section 23.2 Alcohols, Ethers, and Amines

**Main Idea**

**Scan** Section 2 of your text. Use the checklist below as a guide.
- Read all section titles.
- Read all boldfaced words.
- Read all formulas.
- Look at all figures and read the captions.
- Think about what you already know about alcohols, ethers, and amines.

**Write** three facts you discovered about alcohols as you scanned the section.

1. 
2. 
3. 

### Details

**New Vocabulary**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>hydroxyl group</td>
<td></td>
</tr>
<tr>
<td>alcohol</td>
<td></td>
</tr>
<tr>
<td>denatured alcohol</td>
<td></td>
</tr>
</tbody>
</table>

**Define the following terms and write the general formula for each term.**

<table>
<thead>
<tr>
<th>Term</th>
<th>General Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>ether</td>
<td></td>
</tr>
<tr>
<td>amine</td>
<td></td>
</tr>
</tbody>
</table>

**Academic Vocabulary**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>compound</td>
<td></td>
</tr>
</tbody>
</table>
Section 23.2 Alcohols, Ethers, and Amines (continued)

**Main Idea**

**Alcohols**
*Use with pages 743–744.*

Describe alcohol by completing the following sentence.

Because they readily form hydrogen bonds, alcohols have _____ boiling points and _____ water solubility than other organic compounds.

Write the general formula for alcohol:

**Details**

Draw structures for the following molecules.

1-butanol

2-butanol

**Ethers**
*Use with page 745.*

Describe ethers by completing the following sentence.

Ethers are similar to _____ as they are compounds in which oxygen is bonded to ____. Ethers are different from alcohols because the oxygen atom bonds with ___ carbon atoms. Ethers are much less _____ in water than alcohol because they have no ______ to donate to a hydrogen bond.
Substituted Hydrocarbons and Their Reactions

Section 23.2 Alcohols, Ethers, and Amines (continued)

**Main Idea**

**Details**

**Write** the general formula for ethers:

__________________________________________

**Draw** a structure for the following molecule.

ethyl ether

---

**Amines**

*Use with pages 745–746.*

**Complete the following sentence.**

Amines contain _______ atoms bonded to carbon atoms in _______ chains or _______ rings. Amines are responsible for many of the ______ associated with decay.

**Write** the general formula for amines:

__________________________________________

**Draw** a structure for the following molecule.

ethylamine
Substituted Hydrocarbons and Their Reactions

Section 23.3 Carbonyl Compounds

Main Idea

Organic Compounds Containing the Carbonyl Group

New Vocabulary

ketone

carboxylic acid

carboxyl group

ester

amide

Use your text to define each term.

Define the following terms and write the general formula of each.

carbonyl group

aldehyde

condensation reaction

Define the following term.

process

Skim Section 3 of your text. Write two questions that come to mind from reading the headings and the illustration captions.

1. 

2. 

Use your text to define each term.
Section 23.3 Carbonyl Compounds (continued)

**Main Idea**

Organic Compounds Containing the Carbonyl Group

Use with pages 747–752.

**Details**

Identify five important classes of organic compounds containing or made from carbonyl compounds:

a. ____________________________

b. ____________________________

c. ____________________________

d. ____________________________

e. ____________________________

Describe the common structure of aldehydes and ketones.

______________________________

g. ____________________________

g. ____________________________

Carboxylic Acids

Use with page 749.

Draw a molecule of a carboxylic acid.

![Ethanoic acid (acetic acid)]

Describe organic compounds that are derived from carboxylic acids by completing the following paragraph.

Several classes of organic compound have structures in which the _________________________ of a carboxylic acid is replaced by ____________ or ____________. The two most common types are ________________________.
Section 23.3 Carbonyl Compounds (continued)

**Main Idea**

Condensation Reactions

*Use with pages 752–753.*

**Details**

Sequence the steps for a condensation reaction.

- A small molecule, such as water, is lost.
- Two organic molecules combine.
- A more complex molecule is formed.

Complete the following condensation reaction.

RCOOH + R’OH → ____________________

**Summarize**

Identify the functional group that corresponds to each of the following:

- **a.** -ine at the end of each halogen name to -o
- **b.** adding -amine as the suffix
- **c.** -ane of the parent alkane to -ol
- **d.** replacing -e ending with -amide
- **e.** -e at the end of the name to -al
- **f.** -ane of the parent alkane to -anolic acid
- **g.** -ic acid ending replaced by -ate
- **h.** -e end of the alkane replaced by -one
Substituted Hydrocarbons and Their Reactions

Section 23.4 Other Reactions of Organic Compounds

Scan Section 4 of your text. Use the checklist below as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all formulas.
- Look at all figures and read the captions.

Write three facts you discovered about organic reactions.

1. 
2. 
3. 

Use your text to define each term.

**elimination reaction**

**dehydrogenation reaction**

**dehydration reaction**

**addition reaction**

**hydration reaction**

**hydrogenation reaction**

Define the following term.

**convert**
Section 23.4 Other Reactions of Organic Compounds (continued)

Main Idea

Reactions of Organic Substances
Use with page 754.

Classifying Organic Reactions
Use with pages 754–756.

Details

List what needs to happen for chemical reactions of organic substances to occur. Include when and why a catalyst might be needed.
1. 
2. 
3. 

Review the section and give an example formula for each of the following reaction types.
addition reaction 

hydration reaction 

dehydrogenation reaction 

dehydration reaction 

hydrogenation reaction 

elimination reaction
Predicting Products of Organic Reactions

Use with Pages 759–760.

**Main Idea**

Describe oxidation-reduction reactions by completing the following statements.

Many ______ compounds can be converted to other compounds by _______ and _______ reactions. _______ is the loss of _______. A substance is oxidized when it gains _______ or loses _______. Reduction is the _____ of electrons. A substance is reduced when it loses _______ or gains _______.

Write the generic equation representing an addition reaction between an alkene and an alkyl halide.

Substitute the structure for cyclopentene and the formula for hydrogen bromide. From the equation, you can see that:

A _______ and a _______ add across the _______ to form an _______.

Draw the formula for the likely product.
Substituted Hydrocarbons and Their Reactions

Section 23.5 Polymers

Scan Section 5 of your text. Use the checklist below as a guide.

• Read all section titles.
• Read all boldfaced words.
• Read all tables and formulas.
• Look at all figures and read the captions.

Write three facts you discovered about polymers.

1. __________________________

2. __________________________

3. __________________________

New Vocabulary

polymer

monomer

polymerization reaction

addition polymerization

condensation polymerization

plastic

thermoplastic

thermosetting

Academic Vocabulary

bond

Use your text to define each term.

Define the following term.

bond
Section 23.5 Polymers (continued)

The Age of Polymers
Use with page 761.

Reactions Used to Make Polymers
Use with page 762–764.

**Main Idea**

**Details**

Identify three common polymers described in the text. Include their uses.

1. ____________________________
2. ____________________________
3. ____________________________

Identify the monomers or polymers.

<table>
<thead>
<tr>
<th>Monomer (s)</th>
<th>Polymer (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethylene</td>
<td>Polyethylene terephthalate</td>
</tr>
<tr>
<td>Urethane</td>
<td></td>
</tr>
</tbody>
</table>

Compare and contrast condensation polymerization with addition polymerization by placing the terms below into the Venn diagram.

- all atoms present in final product
- small by-product, usually water
- involves the bonding of monomers
Section 23.5 Polymers (continued)

Materials Made from Polymers: Uses and Recycling

Use with page 764.

### Main Idea

Identify the common polymer. Use Table 23-4 in your text as a reference.

<table>
<thead>
<tr>
<th>Use</th>
<th>Polymers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foam furniture cushions</td>
<td></td>
</tr>
<tr>
<td>A planter</td>
<td></td>
</tr>
<tr>
<td>Nonstick cookware</td>
<td></td>
</tr>
<tr>
<td>Food wrap</td>
<td></td>
</tr>
<tr>
<td>Windows</td>
<td></td>
</tr>
<tr>
<td>Clothing</td>
<td></td>
</tr>
<tr>
<td>Carpet</td>
<td></td>
</tr>
<tr>
<td>Water pipes</td>
<td></td>
</tr>
<tr>
<td>Beverage containers</td>
<td></td>
</tr>
</tbody>
</table>

### Details

Identify four reasons that many different polymers are widely used in manufacturing.

1. 
2. 
3. 
4. 

Describe the melting characteristics of thermoplastic polymers and thermosetting polymers.

Thermoplastic polymers ..................................................................................

Thermosetting polymers ..................................................................................

Polymers
Discuss recycling by completing the following paragraph.

Americans are not efficient at recycling their plastics. Currently, only ____ of plastic waste is recycled. This contrasts with the ____ of paper waste and ____ of aluminum waste that are recycled. This low rate of ______________ is due in part to the ______________. Plastics must be ____ according to ______________, which is ______________ and ______________. The plastic industry has ______________ that indicate the ______________ of each plastic product to make the process easier on individuals.

Describe what the code of recycling polymers does. Give an example of the code from the textbook.

__________________________
__________________________
__________________________

Real-World Connection

Describe some common polymers that you use every day.

__________________________
__________________________
__________________________
__________________________
__________________________
__________________________
After reading this chapter, list three things you have learned about substituted hydrocarbons and their reactions.

1. 

2. 

3. 

Review

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.

☐ Study the definitions of vocabulary words.

☐ 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

Examine the picture of spooled threads on page 736. Explain how monomers might be a part of the process that produces these spooled polymer threads.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
The Chemistry of Life

Before You Read

**Review Vocabulary**  Define the following terms.

<table>
<thead>
<tr>
<th>hydrogean bond</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>isomers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>functional group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>polymers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Chapter 13  **Illustrate** the hydrogen bonding between water molecules.

Chapter 23  **Illustrate** the molecules for flouroethane and 1,2 difluoropronane.
Skim Section 1 of your text. Focus on the headings, subheadings, boldfaced words, and the main ideas. Summarize three main ideas of this section.

1. 

2. 

3. 

New Vocabulary

Use your text to define each term.

protein

amino acid

peptide bond

peptide

denaturation

enzyme

substrate

active site
Section 24.1 Proteins (continued)

Main Idea

Protein Structure

Use with pages 775–777.

Details

Draw and label a general amino acid with a variable side chain, an amino group, and a carboxyl group.

Describe the structure of a dipeptide and its functional units.

Rewrite each of the following statements, making each true.

To function properly, each protein must be flat.

A dipeptide consists of an amino acid with two side chains.

Complete the following paragraph statements about peptide bonds.

When a peptide bond is formed, _____ is released in the process.

This type of reaction is known as a ______ reaction.
Section 24.1 Proteins (continued)

Main Idea

Details

Identify the peptide bond between the following amino acids.

\[
\begin{array}{c}
\text{H} & R_1 & \text{H} & R_2 \\
\downarrow & \uparrow & \uparrow & \uparrow \\
\text{N} & \text{C} & \text{C} & \text{N} & \text{C} & \text{C} & \text{OH} \\
\uparrow & \uparrow & \uparrow & \uparrow & \uparrow & \uparrow & \uparrow \\
\text{H} & \text{H} & \text{O} & \text{H} & \text{O} \\
\end{array}
\]

Explain why Gly-Phe is a different molecule than the Phe-Gly.

Describe three changes in environment that will uncoil or otherwise denature a protein.

1. 

2. 

3. 

Draw an enzyme/substrate complex with the enzyme and substrates labeled.

Use with page 778.

The Many Functions of Proteins

Use with page 779.
Describe how the following functions affect living organisms by giving an example from your text.

Enzymes: 

Transport proteins: 

Structural proteins: 

Hormones: 

Review the statements below and revise to make them correct.

1. Substrates bind to an enzyme site.

2. An active site changes shape a great deal to accommodate the substrate.

3. An enzyme-substrate complex changes the enzyme, and it becomes part of the new molecule.
Scan Section 2 of your text. Use the checklist below as a guide.

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

Write three facts you discovered about carbohydrates as you scanned the section.

1. ________________________________
2. ________________________________
3. ________________________________

Use your text to define each term.

**Carbohydrate**

**Monosaccharide**

**Disaccharide**

**Polysaccharide**

Define the following term.

**Complex**
Section 24.2 Carbohydrates (continued)

Main Idea

Kinds of Carbohydrates

Use with page 781.

Details

Draw the cyclic and open-chain structures of the monosaccharide glucose.

Explain how the monosaccharides glucose and galactose differ. Discuss why they would not react the same way in nature.

Describe the structure and composition of the following types of carbohydrates by completing this table.

<table>
<thead>
<tr>
<th>Carbohydrate</th>
<th>Example</th>
<th>Structure and composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>starch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cellulose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>glycogen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>glucose</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Chemistry of Life

Section 24.3 Lipids

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

• Read all section titles.
• Read all boldfaced words.
• Look at all figures and read the captions.
• Think about what you already know about lipids.

Write three facts you discovered about lipids as you scanned the section.

1. 

2. 

3. 

New Vocabulary

Use your text to define each term.

lipid

fatty acid

triglyceride

saponification

phospholipid

wax

steroid
## Section 24.3 Lipids (continued)

### Main Idea

**What is a lipid?**

*Use with pages 784–787.*

### Details

**Describe** how a lipid differs from a protein or carbohydrate.

- [ ]

**Compare and contrast** saturated and unsaturated fatty acids.  
*Give an example of each.*

- [ ]

**Explain** the reactions that form triglycerides.  *Give the type of reaction as well as the substrates.*

- [ ]
Describe how waxes are made and what their specific properties include.

Describe a lipid that is not composed of fatty acid chains. Give an example.

**SYNTHESIZE**

List the important functions for each of the following types of lipids.

- triglyceride
- phospholipid
- waxes
- steroids
The Chemistry of Life
Section 24.4 Nucleic Acids

Main Idea

Details

Skim Section 4 of your text. Write three questions that come to mind from reading the headings and the illustration captions.
1. 
   
   
2. 
   
3. 
   

New Vocabulary

nucleic acid

Use your text to define each term.

nucleotide


Academic Vocabulary

Define the following term.

sequence
Section 24.4 Nucleic Acids (continued)

**Main Idea**

Structure of Nucleic Acids
*Use with page 788.*

**Details**

**DNA: The Double Helix**
*Use with pages 789–790.*

**Draw** a diagram of a nucleotide. Label all of the parts: sugar, phosphate group, and nitrogen-containing base.

![Diagram of a nucleotide]

**Write** a statement that differentiates between nucleotides and nucleic acids.

**Sequence** the events of DNA replication. The first one has been done for you.

- Hydrogen bonds form between new nitrogen bases and the existing strand.
- Two nucleotide strands unzip.
- Nitrogen bases pair adenine with thymine, cytosine with guanine.
- **1** An enzyme breaks the hydrogen bonds between the nitrogen bases.
- The nucleotide strands separate to expose the nitrogen bases.
- Free nucleotides are delivered by enzymes from the surrounding environment.

**Predict** the complimentary base pairing given the following strand of nucleotides.

A T C T A T C G G A T A T C T G
Section 24.4 Nucleic Acids (continued)

**Main Idea**

**Details**

**RNA**

*Use with page 791.*

**Identify differences in DNA and RNA.**

<table>
<thead>
<tr>
<th></th>
<th>DNA</th>
<th>RNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen Bases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Form of strand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**State whether you would find each of the following in DNA, RNA, both, or neither. Explain your answer.**

<table>
<thead>
<tr>
<th>Nucleotide</th>
<th>DNA</th>
<th>RNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G-A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-U</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U-A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**REAL-WORLD CONNECTION**

Suppose you are an assistant to a forensic scientist who has found an unknown sample of DNA at a crime scene. Upon analysis, he finds it contains 22% thymine molecules. A DNA sample that contains 40% guanine is obtained from a suspect who is brought in. You ask for the suspect’s release. Explain your reasoning based on the bonding patterns of DNA nucleotides.
Skim Section 5 of your text. Focus on the headings, subheadings, boldfaced words, and the main ideas. List three main ideas of this section.

1. _____________________________________________________________________
2. _____________________________________________________________________
3. _____________________________________________________________________

New Vocabulary

Use your text to define each term.

metabolism
_____________________________________________________________________

ketabolism
_____________________________________________________________________

anabolism
_____________________________________________________________________

ATP
_____________________________________________________________________

photosynthesis
_____________________________________________________________________

cellular respiration
_____________________________________________________________________

fermentation
_____________________________________________________________________
Section 24.5 Metabolism (continued)

Main Idea

Anabolism and Catabolism

Use with pages 792–793.

Details

Explain the relationship between metabolism, catabolism, and anabolism.

Explain how ATP is able to store and release energy in the cells of organisms.

Photosynthesis

Use with page 793.

Write the reaction of photosynthesis. Label the individual molecules.

Identify the redox process that occurs during photosynthesis.
Section 24.5 Metabolism (continued)

**Main Idea**

**Cellular Respiration**

*Use with page 794.*

**Details**

Write the reaction of cellular respiration. Be sure to label the individual molecules.

Identify the redox process that occurs during cellular respiration.

Summarize the relationship between photosynthesis and cellular respiration.
Section 24.5 Metabolism (continued)

**Main Idea**

**Fermentation**

*Use with pages 794–795.*

**Details**

*Compare and contrast* alcoholic fermentation and lactic acid fermentation.

**Real-World Connection**

Explain why the redox processes that occur during photosynthesis are vital to life.
Now that you have read the chapter, review what you have learned. Write out the major concepts from the chapter.

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.
☐ Study the definitions of vocabulary words.
☐ 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

Explain why someone with a liver disorder might be advised to avoid overexertion.
Nuclear Chemistry

Before You Read

Review Vocabulary

Define the following terms.

- isotopes
- nuclear reaction
- electron

Chapter 4

Use your text to review the following concepts which will help you understand this chapter.

List the three kinds of subatomic particles discussed in Chapter 4.

1. 
2. 
3. 

Draw and label a nuclear model of the atom. Use Figure 4-13 as a reference.

Identify the primary factor in determining an atom’s stability.
Nuclear Chemistry

Section 25.1 Nuclear Radiation

Main Idea

Details

Skim Section 1 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 

2. 

3. 

New Vocabulary

Academic Vocabulary

Use your text to define each term.

radioisotope

X ray

attain

extract

process

Define the following terms.
Section 25.1 Nuclear Radiation (continued)

The Discovery of Radioactivity
Use with page 806.

Contrast chemical and nuclear reactions.

<table>
<thead>
<tr>
<th>Chemical Reactions</th>
<th>Nuclear Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>bonds are and formed</td>
<td>nuclei emit</td>
</tr>
<tr>
<td>atoms are</td>
<td>are converted into atoms of another element</td>
</tr>
<tr>
<td>though they may be rearranged</td>
<td></td>
</tr>
<tr>
<td>reaction rate</td>
<td>reaction rate by pressure, temperature, concentration, or catalyst</td>
</tr>
<tr>
<td>by pressure, temperature, concentration, and catalyst</td>
<td></td>
</tr>
<tr>
<td>involve only valence</td>
<td>may involve protons,</td>
</tr>
<tr>
<td>energy changes</td>
<td>energy changes</td>
</tr>
</tbody>
</table>

Summarize the discovery of radioactivity. Review the dates on the timeline below. Use your text to fill in the important achievements in radioactive research on those dates.

1895 Roentgen

1895 Becquerel

1898 The Curies

1903 The Curies and Becquerel

1911 Marie Curie
Section 25.1 Nuclear Radiation (continued)

**Main Idea**

**Types of Radiation**
*Use with pages 806–809.*

**Details**

Identify the common type of radiation signified by each symbol.

- $\alpha$
- $\beta$
- $\gamma$

Differentiate between each of the subatomic radiation particles mentioned in the chapter.

<table>
<thead>
<tr>
<th>Radiation Type</th>
<th>Charge</th>
<th>Mass</th>
<th>Relative Penetrating Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gamma</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Describe what happens when a radioactive nucleus emits an alpha particle.

Describe beta particles by completing the following statements.

A beta particle is a very fast-moving ______. To represent its insignificant mass, beta particles have a superscript of ______. A subscript of $-1$ denotes the ______ charge of beta particles. Beta particles have greater ______ than alpha particles.

Describe what the subscript and superscript of zero tell you about gamma particles.
Main Idea

Scan Section 2, using the checklist below as a guide.
- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about radioactive decay.

Write three facts you discovered about transmutation.

1. 
2. 
3. 

New Vocabulary

Use your text to define each term.

-nucleon

-strong nuclear force

-band of stability

-positron emission

-positron

-electron capture

-radioactive decay series
Contrast the properties of isotopes by imagining two eggs as models. One isotope would be created using hard-boiled eggs as building blocks, the other using raw eggs as building blocks. Explain which model would be more stable, and which would be more typical of known isotopes.

Summarize how the strong nuclear force helps to keep protons in a nucleus.

Describe the neutron-to-proton (n/p) ratio in nuclear stability.

The number of protons compared to the number of _______ in a ratio identifies the nuclear ratio. To some degree, the _______ of a nucleus can be correlated with its _______ ratio. As atomic number _______, more _______ are needed to balance the ________ forces. Plotting the number of neutrons versus the number of _______ for all stable nuclei illustrates the _______.

Analyze the relative stability of radioisotopes. Use Figure 25-8 as a guide.

1. a radioisotope with too many neutrons relative to its protons
2. a radioactive isotope
3. a nucleus with more than 83 protons
4. a nucleus with a high atomic number and a neutron-to-proton ratio of 1:5:1.
Writing and Balancing Nuclear Equations

Use with page 813.

Compare positron emission with electron capture.
Positron emission is ____________ that involves the emission of a _______ (particle with the same mass as an electron but opposite charge) from a nucleus. During this process, a _______ in the nucleus is converted into a neutron and a positron, and then the _______ is emitted.

Electron capture is ____________ that decreases the number of _______ in unstable nuclei lying below the _____________. This occurs when the nucleus of an atom draws in a surrounding _______, usually from the lowest energy level. The captured electron combines with a _______ to form a _______.

Contrast balanced chemical equations with balanced nuclear equations.
Balanced chemical equations conserve _______________
______.
Balanced nuclear equations conserve _______________
______.

Solve Read Example Problem 12-5 in your text.

You Try It

Problem
Write a balanced nuclear equation for the alpha decay of uranium-238 \((^{238\,92}_{\text{U}})\).

1. Analyze the Problem
   Known: ___________________________________________
   decay type: _______________________________________
   Unknown: ________________________________________

Balancing a Nuclear Equation

Use with Example Problem 25-1, page 813.
2. Solve for the Unknown
Using each particle’s mass number, make sure the mass number is conserved on each side of the reaction arrow.

Mass number: \(238 = X + ____ \quad X = 238 - 4\)
Mass number of \(X = ____\)

Using each particle’s atomic number, make sure the atomic number is conserved on each side of the reaction arrow.

Atomic number: \(92 = ____ \quad X = 92 - ____\)
Atomic number of \(X = ____\)

Use the periodic table to identify the unknown element.

______________

Write the balanced nuclear equation.

______________

Describe a radioactive decay series by completing the following paragraph.

A radioactive decay series is a series of ______________ that begins with a(n) ______ nucleus and ends in the formation of a stable ______. Both alpha decay and ________ are involved in the process.

Real-World Connection
Suppose you want to join an after-school club. Two clubs interest you. In the photography club, there are a lot of members, but only a few who are truly interested (proactive) about the topic. Most members just seem to have joined to be involved in an activity (or are neutral). The chemistry club, on the other hand, has fewer members, but there seems to be an equal number of truly interested (proactive) students as there are students without a lot of interest (neutrals). If human interactions followed the same laws as radioisotopes, explain which group would be more stable over the school year.
Scan Section 3, using the checklist below as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about transmutation of one element into another.

Write three facts you discovered about transmutation.

1. ____________________________________________
2. ____________________________________________
3. ____________________________________________

New Vocabulary

transmutation ____________________________________________

induced transmutation ____________________________________________

transuranium elements ____________________________________________

half-life ____________________________________________

radiochemical dating ____________________________________________

Define the following term.

react ____________________________________________
Section 25.3 Transmutation (continued)

**Main Idea**

**Induced Transmutation**

*Use with pages 815–816.*

**Details**

*Sequence the steps in Rutherford’s induced transformation of nitrogen-14 into oxygen.*

\[ ^4_2 \text{He} \text{ bombarding alpha particle} \rightarrow ^{17}_{10} \text{O} \text{ Oxygen atom} \]

\[ \text{and} \rightarrow p^+ \text{ proton} \]

**Radioactive Decay Rates**

*Use with page 817.*

**Describe** how Ernest Rutherford’s early experiments in inducing nuclear reactions led to modern particle accelerators.

Rutherford discovered that particles must move at extremely _____ to overcome electrostatic _____ and affect a target nucleus. Scientists have built on this to develop methods to accelerate particles to extreme speed using ______ and ______ fields. Particle accelerators use conventional and __________ magnets to force particles to move at high speeds.

**Explain** why some naturally occurring radioactive substances still remain on Earth.
Section 25.3 Transmutation (continued)

Main Idea
Calculating Amount of Remaining Isotope

Use with Example Problem 25-3, page 818.

You Try It

Problem
Determine the amount of an original sample of 2.0 grams of thorium-234 after 49 days. The half-life of thorium-234 is 24.5 days.

1. Analyze the Problem

Known:
Initial amount = 
Elapsed time (t) = 
Half-life (T) = 

Unknown:
Amount remaining = ? g

2. Solve for the Unknown

Number of half-lives (n) = Elapsed time/Half-life

\[ n = \frac{49}{24.5} = \] 

Amount remaining = 
Amount remaining = 
Amount remaining = 
Amount remaining = 

3. Evaluate the Answer

After 49 days, ____ half-lives of thorium-234 have elapsed. The number of half-lives is equivalent to \( \frac{1}{2} \times \frac{1}{2} \) or ____. The answer, ____ is equal to ____ the original quantity.

Radiochemical Dating

Use with page 820.

Solve Read Example Problem 25–3 in your text.

Write the balanced nuclear equation for carbon dating.
Nuclear Chemistry
Section 25.4 Fission and Fusion of Atomic Nuclei

Main Idea

Skim Section 4 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. 
2. 
3. 

New Vocabulary

Use your text to define each term.

mass defect

nuclear fission

critical mass

breeder reactor

nuclear fusion

thermonuclear reaction
Section 25.4 Fission and Fusion of Atomic Nuclei (continued)

**Main Idea**

Nuclear Reactions and Energy

*Use with pages 821–822.*

**Details**

Write Einstein's equation. Be sure to include the measurement units.

Identify the three things you need to know to calculate mass defects.

a. 

b. 

c. 

Organize the steps in a nuclear fission reaction involving uranium.

1. A neutron 

2. The uranium 

3. The nucleus 

   Organize the steps in a nuclear fission reaction involving uranium.

   1. A neutron 

   2. The uranium 

   3. The nucleus 

   **Explain** why a fissionable material must have sufficient mass before a sustained reaction can take place.

   **Explain** why a fissionable material must not have an excess of mass.

---

Nuclear Chemistry 361
**Main Idea**

**Nuclear Reactors**

Use with pages 824–825.

*Describe how a nuclear reactor creates energy. Include how the environment is protected from nuclear waste.*

Nuclear fission produces _____________________________.

A common fuel is _____________________________. A neutron-emitting source ____________________________ and control rods absorb virtually all of the __________ produced in the reaction. Heat from a reaction is used to power ____________________________ which produce electrical power.

---

**Nuclear Fusion**

Use with page 826.

*Describe nuclear fusion by completing the following paragraph.*

Nuclear fusion is the combining of atomic ______. Nuclear fusion reactions are capable of _____________________________.

The most common fusion reaction is the ______. Because of the energy requirements, fusion reactions are also known as _____________________________.

*Explain why fusion reaction is not yet a practical source of everyday energy.*

---

**REAL-WORLD CONNECTION**

Create a metaphor from everyday life that will show the difference between nuclear fission and nuclear fusion.

Nuclear fusion requires _____________________________.

Nuclear fusion requires _____________________________.

Fusion is like: _____________________________.

Fusion is like: _____________________________.
Scan Section 5, using the checklist below as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about radioactive decay.

Write three questions you have about nuclear radiation.

1. ____________________________________________________________
2. ____________________________________________________________
3. ____________________________________________________________

Use your text to define each term.

ionizing radiation
____________________________________________________________

radiotracer
____________________________________________________________

Define the following term.

detect
____________________________________________________________
Section 25.5 Applications and Effects of Nuclear Reactions (continued)

Main Idea

Detecting Radioactivity

Use with page 827.

List and describe three methods of detecting radiation.

1. ____________________________

2. ____________________________

3. ____________________________

Describe how a radiotracer works.

A radiotracer is a _______ that emits _______________ and is used to signal the presence of _______ or specific substance. The fact that all of an element’s isotopes have the same _______ makes the use of radioisotopes possible.

Discuss a common radiotracer that is used in medicine.

Iodine-131 is commonly used to detect _______ associated with the _______. A doctor will give the patient a drink containing a small amount of iodine-131. The iodine-containing _______ is then used to monitor the function of the thyroid gland.
Identify three factors that affect the possible damage to the body caused by ionizing radiation discussed in the textbook.

1. 

2. 

3. 

Discuss genetic and somatic damage caused by ionizing radiation.

Somatic damage affects ______________________

______________________________

Genetic damage can affect ______________________

______________________________

______________________________

Create a warning label that will identify the dangers of a radioactive material to users.
Nuclear Chemistry  Chapter Wrap-Up

After reading this chapter, list three important facts you have learned about nuclear chemistry.

1. _____________________________________________
2. _____________________________________________
3. _____________________________________________

Review

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.
☐ Study the definitions of vocabulary words.
☐ 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

Imagine you are watching a program on radiation with a friend. Your friend is afraid of all radiation. Explain to your friend some of the common useful applications of radiation.

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
Chemistry in the Environment

Before You Read

Review the following concepts.

Explain the difference between a mixture and a solution.

Explain the difference between solutes and a solvent.

Explain the difference between solutions and aqueous solutions.

Explain the difference between an acidic solution and a basic solution.

Review Vocabulary

Define the following terms.

combined gas law

chemical equilibrium

acid-base indicator

pH
Chemistry in the Environment
Section 26.1 Earth’s Atmosphere

Main Idea

Scan Section 1, using the checklist below as a guide.
• Read all section titles.
• Read all boldfaced words.
• Read all tables and graphs.
• Look at all pictures and read the captions.
• Think about what you already know about Earth’s atmosphere.

Write three facts you discovered about environmental chemistry.
1. ______________________________________________________________________
2. ______________________________________________________________________
3. ______________________________________________________________________

New Vocabulary
Use your text to define each term.

atmosphere
________________________________________________________________________
________________________________________________________________________

stratosphere
________________________________________________________________________
________________________________________________________________________

A Balanced Atmosphere
Use with page 840.

Observe the picture on page 840 of your text. Describe one example of a chemical process shown in the photo.
________________________________________________________________________
Section 26.1 Earth’s Atmosphere (continued)

Structure of Earth’s Atmosphere
Use with page 842.

Label each atmospheric layer in the diagram below, and indicate whether temperatures increase or decrease at each of the bottom four layers.

Composition of Earth’s Atmosphere
Use with pages 842–843.

Organize the table below to include three solids, the three most common gases other than nitrogen or oxygen, and a liquid found in the atmosphere.

<table>
<thead>
<tr>
<th>Solids</th>
<th>Gases</th>
<th>Liquid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Describe the troposphere by completing the following paragraph.
Roughly ____ of the mass of all atmospheric gases is found in the _____________. The main two gases are __________________. They make up a total of ____ of the molecules in this layer.
Chemistry in the Outer Atmosphere
Use with pages 843–844.

Chemistry in the Stratosphere
Use with pages 844–846.

Describe the processes of photodissociation and photoionization.

Describe how ozone is produced.

Sequence the steps in the thinning of the ozone layer.

___ CFCs become unstable due to high-energy radiation and break down, forming ClO and O₂.

___ Cl atoms speed up the depletion of ozone.

___ Chlorine monoxide combines with free oxygen atoms to regenerate free chlorine atoms and oxygen molecules.

___ CFCs diffuse into the stratosphere.
Chemistry in the Troposphere

Use with pages 846–849.

Main Idea

Details

Explain how CFCs can cause damage to the atmosphere. Include the precautions to help slow the damage.

Explain how acid rain is formed.

1. Power plants release _______.

2. Sulfur dioxide combines with _______ to form _______.
   then _______ forms when _______ reacts with moisture in the air.

3. Acid rain can also form when car exhaust combines with _______ to form _______.

4. Acidic moisture _______.

Describe the problems caused by acid in the atmosphere.

______________________________

______________________________

______________________________

______________________________

______________________________
Chemistry in the Environment
Section 26.2 Earth’s Water

Main Idea

Skim Section 2 of your text. Focus on the headings, subheadings, boldfaced words, and the main ideas. Summarize the main ideas of this section.

Details

Use your text to define each term.

New Vocabulary

- hydrosphere
- salinity
- desalination

Academic Vocabulary

- specific
- specify

The Hydrosphere

Use with page 850.

Create a circle graph that identifies each of the areas of water on the planet.

The Water Cycle

Use with page 850.

Identify the three main activities of the water cycle.
Earth's Oceans
Use with pages 851–852.

Trace a drop of rain through the water cycle. Use Figure 26-2 in your text as a guide.

Explain how the salinity of ocean water remains fairly constant over millions of years.

Ocean water contains dissolved _____, which give the water a salty taste. The salts come from calcium, magnesium and sodium that are dissolved from ____________. Rivers transport the dissolved elements to the oceans. Sulfur and chlorine may be added from erupting ________. As rivers, volcanoes, and atmospheric processes add new substances to ________, elements are removed from oceans by biological processes and ____________.

Sequence the process within a desalination tube.

____ A desalination cylinder holds more than three million fibers.
____ Desalinated water flows through the inside of the fibers and is collected.
____ The water molecules pass inward through the walls of the fibers, and the salts are held back.
____ Seawater is forced under pressure into cylinders containing hollow, semi-permeable fibers.

Earth’s Freshwater
Use with page 852.

Identify how much water is used by an average person in the United States for each of the following.

cooking and drinking _____
bathing, laundering, and housecleaning _____
flushing toilets _____
watering lawns _____
Section 26.2 Earth’s Water (continued)

Main Idea

Human Impact on the Hydrosphere

Use with page 853.

Municipal Water and Sewage Treatment

Use with pages 853–854.

Details

Explain why everyday use of cleaners and detergents leads to water pollution and the death of aquatic life.

Describe the steps in water treatment by completing the table below.

<table>
<thead>
<tr>
<th>Step in Water Treatment</th>
<th>Result of Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>coarse filtration</td>
<td></td>
</tr>
<tr>
<td>sedimentation</td>
<td></td>
</tr>
<tr>
<td>water is passed through a bed of sand</td>
<td></td>
</tr>
<tr>
<td>aeration</td>
<td></td>
</tr>
<tr>
<td>water is treated with substances that kill bacteria</td>
<td></td>
</tr>
</tbody>
</table>

Analyze the differences between the treatment of bacteria in freshwater treatment and sewage treatment.

In freshwater treatment, _______ are _______ from the water to purify the water. In sewage treatment, ____________ are increased to promote the growth of ___________ to biodegrade ___________.
Chemistry in the Environment
Section 26.3 Earth’s Crust

Scan Section 3, using the checklist below as a guide.
• Read all section titles.
• Read all boldfaced words.
• Read all tables and graphs.
• Look at all pictures and read the captions.
• Think about what you already know about this subject.

Write three facts you discovered about the crust of Earth.
1. __________________________________________
2. __________________________________________
3. __________________________________________

Use your text to define the following term.

Classify the eight most abundant components of the lithosphere found in Table 26-3 as metals, metalloids, or nonmetals. Use the periodic table for help.
Metals: _______________________________________
Metalloids: ___________________________________
Nonmetals: ___________________________________

List Earth’s major regions from the surface to the center of the planet.
1. __________________________________________
2. __________________________________________
3. __________________________________________
4. __________________________________________
Section 26.3 Earth's Crust (continued)

**Main Idea**

**Classify** each of the mineral compounds below as oxide, sulfide, or carbonate.

<table>
<thead>
<tr>
<th>Mineral Compound</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SrCO₃</td>
<td></td>
</tr>
<tr>
<td>MnO₂</td>
<td></td>
</tr>
<tr>
<td>MgCO₃</td>
<td></td>
</tr>
<tr>
<td>FeS₂</td>
<td></td>
</tr>
<tr>
<td>SnO₂</td>
<td></td>
</tr>
<tr>
<td>Al₂O₃</td>
<td></td>
</tr>
<tr>
<td>BaCO₃</td>
<td></td>
</tr>
<tr>
<td>PbS</td>
<td></td>
</tr>
</tbody>
</table>

**Synthesize**

Explain why periodic properties govern the state of combination in which elements are found in nature.
### Main Idea

**Skim** Section 4 of your text. Write three questions that come to mind from reading the headings, boldfaced terms, and the illustration captions.

1. 
2. 
3. 

### Details

**New Vocabulary**

*Use your text to define each term.*

- **greenhouse effect**
  - 
  - 
  - 

- **global warming**
  - 
  - 
  - 

- **nitrogen fixation**
  - 
  - 
  - 

**Academic Vocabulary**

*Define these terms.*

- **component**
  - 

- **maintain**
  - 

**Main Idea**

**The Carbon Cycle**

*Use with pages 858–860.*

**Details**

Trace the pathway of carbon through the environment. Use Figure 26-18 as a guide.

**Compare and contrast the greenhouse effect and global warming.**

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Section 26.4  Cycles in the Environment  (continued)

Main Idea  

**The Nitrogen Cycle**  
*Use with pages 860–861.*

Details

**Describe how lightning forms a route for nitrogen fixation.**


After reading this chapter, list the main concepts below.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Review

Use this checklist to help you study.

☐ Study your Science Notebook for this chapter.

☐ Study the definitions of vocabulary words.

☐ 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

Some people might argue that problems identified by scientists are just cycles of chemicals in nature and are not caused by humans. Explain whether you agree or disagree, based on what you have learned in the chapter.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________