

Ch 8 Covalent Bonding

Before You Read

Review Vocabulary

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_2S _____

KMnO_4 _____

Al_2O_3 _____

Covalent Bonding

Section 8.1 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 reaction

exothermic reaction

Academic Vocabulary

Define the following term.

overlap

Section 8.1 The Covalent Bond (continued)

Main Idea

Why do atoms bond?*Use with page 240.***What is a covalent bond?***Use with page 241.***Single Covalent Bonds
Lewis Structure
of a Molecule***Use with Example Problem 8.1, page 244.*

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 8.1 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.

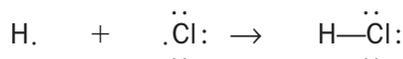
Known: H., $\begin{array}{c} \cdot\cdot \\ \cdot\text{Cl} \\ \cdot\cdot \end{array}$:

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.



Section 8.1 The Covalent Bond (continued)

Main Idea

Details

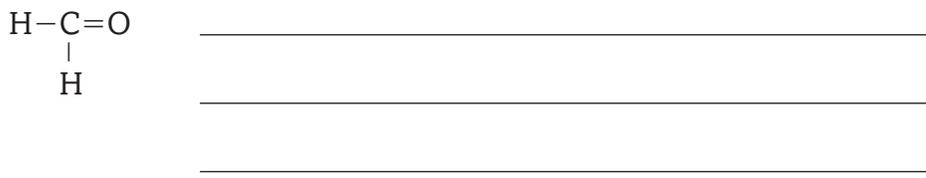
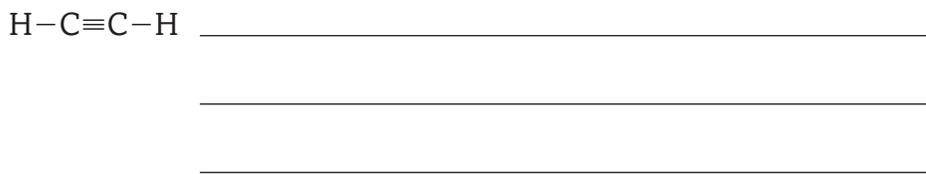
Multiple Covalent Bonds

Use with pages 245–246.

3. Evaluate the Answer

Each atom in the molecule has achieved a _____ configuration and thus is _____.

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).



The 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 8.2 Naming Molecules

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.
- 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

Use your text to define the following term.

oxyacid

Section 8.2 Naming Molecules (continued)

Main Idea

Naming Binary Molecular Compounds

Use with Example Problem 8.2, page 249.

Details

Identify the prefixes for these three binary molecular compounds.

Ge_3N_2 _____-germanium _____-nitride

C_2Cl_4 _____-carbon _____-chloride

B_6Si _____-boron silicide

Solve Read Example Problem 8.2 in your text.

You Try It

Problem

Name the compound N_2O_3 .

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, N_2O_3 .

Section 8.2 Naming Molecules (continued)

Main Idea

Details

Naming Acids*Use with page 250.***Writing Formulas from Names***Use with pages 251–252.***Match** the chemical formulas listed below with the correct acids.

HF	sulfurous acid
HIO ₄	hydrofluoric acid
H ₂ SO ₃	phosphoric acid
H ₃ PO ₄	hypochlorous acid
HC ₂ H ₃ O ₂	periodic acid
H ₂ CO ₃	permanganic acid
HClO	acetic acid
HMnO ₄	carbonic acid

Write the chemical formula for the molecular compound names given below. Use the flow chart in Figure 8.12 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 8.3 Molecular Structures

Main Idea _____

Details _____

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. _____

New Vocabulary

Use your text to define each term.

structural formula

resonance

coordinate covalent bond

Section 8.3 Molecular Structures (continued)

Main Idea

Structural Formulas*Use with pages 253–254.***Lewis Structure for a Covalent Compound with Multiple Bonds***Use with Example Problem 8.4, page 256.*

Details

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

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

Solve Read Example Problem 8.4 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.

$$\begin{aligned} & \square \text{ valence electrons/C atom} + \square \text{ valence electrons/F atom} \\ & + 1 \text{ valence electron/H atom} + \square \text{ valence electrons/O atom} \\ & = \square \text{ valence electrons} \end{aligned}$$

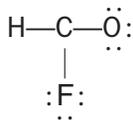
$$\begin{aligned} & \square \text{ available valence electrons}/(2 \text{ electrons/pair}) = \square \\ & \text{available pairs} \end{aligned}$$

Section 8.3 Molecular Structures (continued)

Main Idea

Details

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.

3. Evaluate the Answer

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

Lewis Structure for a Polyatomic Ion

Use with Example Problem 8.5, page 257.

Solve Read Example Problem 8.5 in your text.

You Try It

Problem

Draw the Lewis structure for the permanganate ion (MnO_4^-).

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 \times (valence electrons/Mn atom) + O atoms
 \times (6 valence electrons/O atom + electron(s) from the
 negative charge = valence electrons

Section 8.3 Molecular Structures (continued)

Main Idea

Details

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:

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 258.

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.

Exceptions to the Octet Rule

Use with pages 258–259.

List three reasons for exceptions to the octet rule.

1. _____

2. _____

3. _____

Covalent Bonding

Section 8.4 Molecular Shapes

Main Idea

Details

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

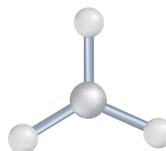
Section 8.4 Molecular Shapes (continued)

Main Idea

Details

VSEPR Model*Use with pages 261–263.***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 pages 262–263.***Label** the hybrid orbitals in the figures below as sp , sp^2 , sp^3 , sp^3d , or sp^3d_2 .

Section 8.4 Molecular Shapes (continued)

Main Idea

Details

Find the Shape of a Molecule

Use with Example Problem 8.7, page 264.

Solve Read Example Problem 8.7 in your text.

You Try It**Problem**

What is the shape of a SbI_5 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.

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

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

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

Lewis structure

Molecular shape

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.

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 8.5 Electronegativity and Polarity

Main Idea

Details

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 electrognegativity.

1. _____
2. _____
3. _____

New Vocabulary

Use your text to define the following term.

polar covalent bond

Section 8.5 Electronegativity and Polarity (continued)

Main Idea

**Electron Affinity,
Electronegativity,
and Bond
Character***Use with pages 265–266.***Polar Covalent
Bonds***Use with pages 267–268.*

Details

Sequence *the following elements from the least electronegative to the most electronegative. Use Figure 8.20 for reference.*

___ Au

___ Y

___ Ba

___ P

___ H

___ Te

___ O

___ I

___ Co

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 _____

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.
