Name _____ Date _____ Class _____

8 COVALENT BONDING

SECTION 8.1 MOLECULAR COMPOUNDS (pages 213–216)

This section explains how to distinguish between ionic and molecular compounds.

▶ Molecules and Molecular Compounds (pages 213–214)

1. What is a covalent bond?

_____

2. Most elements found in nature, with the exception of the _____ , exist as molecules.

3. What is a molecule?

_____

_____

4. Compounds that are formed when two or more atoms combine to form molecules are called _____ .

5. Circle the letter of the substances that do NOT exist as molecules in nature.

a. oxygen

b. water

c. neon

d. ozone

e. helium

6. List two properties of molecular compounds.

a. _____

b. _____

CHAPTER 8, Covalent Bonding *(continued)*

▶ Molecular Formulas (pages 215–216)

7. What is a molecular formula?

_____

_____

Match each compound with its molecular formula.

_____ **8.** carbon dioxide **a.** C_2H_6

_____ **9.** ethane **b.** CO_2

_____ **10.** ammonia **c.** NH_3

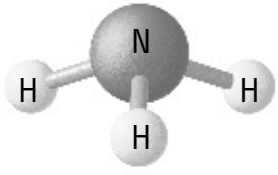
11. Is the following sentence true or false? A molecular formula shows the arrangement of the atoms in a molecule. _____

In the diagram, match the type of model or formula with its representation.

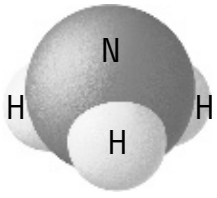
a. ball-and-stick model
b. molecular formula
c. perspective drawing
d. space-filling molecular model
e. structural formula

$NH_3(g)$

12. _____

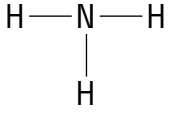


13. _____



14. _____

15. _____



16. _____

17. What is the arrangement of atoms within a molecule called?

_____

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SECTION 8.2 THE NATURE OF COVALENT BONDING (pages 217–220)

This section uses electron dot structures to show the formation of single, double, and triple covalent bonds. It also describes and gives examples of coordinate covalent bonding, resonance structures, and exceptions to the octet rule.

▶ The Octet Rule in Covalent Bonding (page 217)

1. How does electron sharing occur in forming covalent bonds?

_____

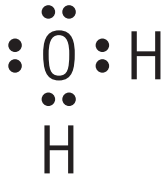
_____

▶ Single Covalent Bonds (pages 217–220)

2. Is the following sentence true or false? A shared pair of electrons is represented by a double dash. _____

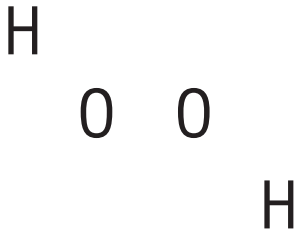
3. Structural formulas show the arrangement of _____ in molecules.

4. Use the electron dot diagram below. Circle each unshared pair of electrons in a water molecule.

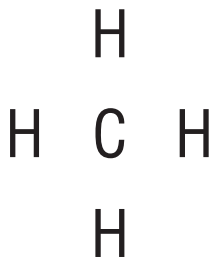


5. Complete the electron dot structure for each molecule. Each molecule contains only single covalent bonds.

a. NH_3



b. H_2O_2



c. CH_4

▶ Double and Triple Covalent Bonds (pages 221–222)

6. A chemical bond formed when atoms share two pairs of electrons is called a(n) _____ .

7. How many covalent bonds are in the nitrogen molecule?

_____

8. Is the following sentence true or false? All diatomic molecules contain double bonds. _____

▶ Coordinate Covalent Bonds (pages 223–225)

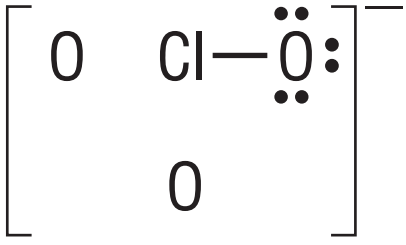
9. What is a coordinate covalent bond?

_____

10. Look at Table 8.2 on page 224. Which two nitrogen compounds contain coordinate covalent bonds?

_____

11. Complete the electron dot formula of the chlorate ion (ClO_3^-) by filling in the bonds and unpaired electrons.



▶ Bond Dissociation Energies (page 226)

12. What is bond dissociation energy?

_____

_____

13. Is the following sentence true or false? Molecules with high bond dissociation energies are relatively unreactive. _____

14. What is the bond energy for covalent bond C — O?

_____

Name _____ Date _____ Class _____

▶ Resonance (pages 227–228)

15. The actual bonding in ozone is a _____ of the extremes represented by its _____ .

16. What are resonance structures?

_____

_____

▶ Exceptions to the Octet Rule (pages 228–229)

17. Why does NO_2 not follow the octet rule?

_____

SECTION 8.3 BONDING THEORIES (pages 230–236)

This section describes the molecular orbital theory of covalent bonding, including orbital hybridization. It also explains the use of VSEPR theory to predict the shapes of some molecules.

▶ Molecular Orbitals (pages 230–231)

1. What is a molecular orbital?

_____

_____

2. Is the following sentence true or false? Electrons fill the antibonding molecular orbital first to produce a stable covalent bond. _____

3. When two *s* atomic orbitals combine, the molecular orbital formed is called a(n) _____ bond.

4. Circle the letter of each type of covalent bond that can be formed when *p* atomic orbitals overlap.

a. pi **b.** beta **c.** sigma **d.** alpha

▶ VSEPR Theory (pages 232–233)

5. What is VSEPR theory?

_____

_____

6. When the central atom of a molecule has unshared electrons, the bond angles will be _____ than when all the central atom's electrons are shared.

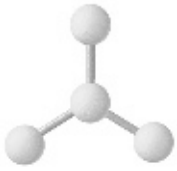
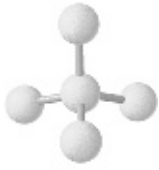
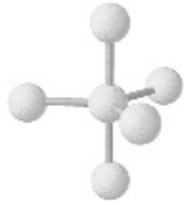
7. What is the bond angle in carbon dioxide? Why?

_____

8. What are the names of these common molecular shapes?



_____

_____

▶ Hybrid Orbitals (pages 234–236)

9. Is the following sentence true or false? Orbital hybridization theory can describe both the shape and bonding of molecules. _____

10. What is orbital hybridization?

_____

_____

Match the hybrid orbitals formed by carbon with the carbon compound in which they are found.

_____ **11.** sp^3 **a.** ethyne

_____ **12.** sp^2 **b.** ethene

_____ **13.** *sp* **c.** methane

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Reading Skill Practice

You can increase your understanding of what you have read by making comparisons. A compare/contrast table can help you do this. On a separate sheet of paper, draw a table to compare the three types of hybrid orbitals as explained on pages 235 and 236. The three heads for the rows should be sp, sp^2, and sp^3. Then list the characteristics that will form the basis of your comparison above each column. The column heads should be *Number of Hybrid Orbitals, Component Orbitals, Number of Bonds,* and *Bond Angle.*

SECTION 8.4 POLAR BONDS AND MOLECULES (pages 237–244)

This section explains the use of electronegativity values to classify a bond as nonpolar covalent, polar covalent, or ionic. It also names and describes the weak attractive forces that hold groups of molecules together.

▶ Bond Polarity (pages 237–238)

1. Is the following statement true or false? Covalent bonds differ in the way electrons are shared by the bonded atoms, depending on the kind and number of atoms joined together. _____

2. Describe how electrons are shared in each type of bond. Write *equally* or *unequally*.

a. Nonpolar bond _____ **b.** Polar bond _____

3. Why does the chlorine atom in hydrogen chloride acquire a slightly negative charge? _____

_____

4. What symbols are used to represent the charges on atoms in a polar covalent bond? The polarity of the bond? _____

Match the electronegativity difference range with the most probable type of bond that will form.

_____ **5.** 0.0–0.4	**a.** ionic
_____ **6.** 0.4–1.0	**b.** nonpolar covalent
_____ **7.** 1.0–2.0	**c.** very polar covalent
_____ **8.** > 2.0	**d.** moderately polar covalent

▶ Polar Molecules (pages 239–240)

9. Circle the letter of each sentence that is true about polar molecules.

a. Some regions of a polar molecule are slightly negative and some are slightly positive.

b. A molecule containing a polar bond is always polar.

c. A molecule that has two poles is called a dipolar molecule.

d. When polar molecules are placed in an electric field, they all line up with the same orientation in relation to the charged plates.

10. Are the following molecules polar or nonpolar?

a. H_2O _____ **c.** NH_3 _____

b. CO_2 _____ **d.** HCl _____

▶ Attractions Between Molecules (pages 240–241)

11. What causes dispersion?

_____

_____

12. Is the following sentence true or false? Dispersion forces generally increase in strength as the number of electrons in a molecule increases. _____

13. The strongest of the intermolecular forces are _____ .

▶ Intermolecular Attractions and Molecular Properties (pages 243–244)

14. What determines the physical properties of a compound?

_____

15. Use Table 8.4 on page 244. Complete the following table comparing ionic and covalent compounds.

Characteristic	Ionic Compound	Covalent Compound
Representative unit		
Physical state		
Melting point		
Solubility in water		

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GUIDED PRACTICE PROBLEM

GUIDED PRACTICE PROBLEM 19 (page 239)

19. Identify the bonds between atoms of each pair of elements as nonpolar covalent, moderately polar covalent, very polar covalent, or ionic.

a. H and Br **b.** K and Cl **c.** C and O **d.** Br and Br

Analyze

Step 1. What is the most probable type of bond for each electronegativity difference range?

Electronegativity Difference Range	Most Probable Type of Bond
0.0–0.4	_____
0.4–1.0	_____
1.0–2.0	_____
$\geq$ 2.0	_____

Calculate

Step 2. From Table 6.2 on page 177, determine the electronegativity values and differences for each pair of elements.

a. H = 2.1, Br = [ ]; difference = [ ]

b. K = [ ], Cl = 3.0; difference = [ ]

c. C = [ ], O = 3.5; difference = [ ]

d. Br = 2.8, Br = [ ]; difference = [ ]

Step 3. Refer to Table 8.3 on page 238 to determine the most probable type of bond for each compound.

a. _____

b. _____

c. _____

d. _____

Evaluate

Step 4. How do you know that your answers are correct?

_____

_____