SHAPES OF COVALENT MOLECULES AND POLARITY

22

The most common chemical bond between two atoms is a covalent bond. The covalent bond consists of a pair of shared electrons, one from each atom. If this pair of electrons is shared between two atoms of equal electronegativities, the bond would be called a nonpolar covalent bond. However, in most cases, the pair of electrons is shared by two atoms of different electronegativities. Thus, the pair of electrons is shifted toward the more electronegative element. A partial negative charge results on one side of the bond and a partial positive charge on the other. This type of covalent bond is called polar covalent.

Molecules composed of covalently bonded atoms may also be polar or nonpolar. For the molecule to be polar, it must, of course, have polar bonds. But the key factor for determining the polarity of a molecule is its shape. If the polar bonds (dipoles) are symmetrical around the central atom, they offset each other and the resulting molecule is nonpolar. However, if the dipoles are not symmetrical around the central atom, the electrons will be pulled to one end of the molecule and the resulting molecule is polar.

Ball and stick models are often used to demonstrate molecular shape. In this exercise you will build several covalent molecules and predict each molecule's polarity on the basis of its molecular shape.

Objectives

In this experiment, you will

- **build models of some simple molecules;**
- **predict each molecule's shape using your knowledge of hybridization; and,**
- **predict each molecule's polarity on the basis of its shape.**

EQUIPMENT

student set of ball and stick models

PROCEDURE

1. Prepare a data table according to the directions in the Analysis.
2. Build models of the following molecules (when in doubt, have your teacher check your model). Remember that some atoms, such as carbon and oxygen, can form multiple bonds.

H_2	CH_4
HBr	HClO
H_2O	O_2
NH_3	AlH_3
CH_3NH_2	CH_3Cl
CO_2	HCOOH
H_2CO	C_6H_6
C_2H_2	C_6H_6O (two structures)

ANALYSIS

Prepare a table for recording data on each molecule. Include in your table the formula, the Lewis dot structure, a diagram of the ball and stick model, the shape of the molecule (linear, angular, tetrahedral, and so on), and the molecular polarity (polar or nonpolar) for each molecule. Use Table 22-1 as a guide.

Table 22-1

Formula	Electron Dot Structure (Lewis)	Ball & Stick Models	Shape of Molecule	Molecular Polarity
HCl	H:$\ddot{\text{Cl}}$:	H—Cl	Linear	Polar

★ CONCLUSIONS Complete #1 & 2

1. Explain how you were able to determine molecular polarity on the basis of molecular shape. Cite examples from your results.
2. Discuss the advantages and disadvantages of using ball and stick models as learning aids. Recommend an alternative to the ball and stick models.

★ FURTHER INVESTIGATIONS Complete #2

1. On the basis of this experiment and your classwork, predict the (a) type of bonding,

(b) molecular shape, and (c) molecular polarity for the following.

a. HBr
b. SCl_2
c. $BaCl_2$
d. NH_3
e. CI_4
f. AlH_3

2. Calculate the electronegativity difference and indicate the type of bond for the following attractions.

a. Na—Cl
b. C—H
c. Se—O
d. N—N
e. Mg—Cl
f. Cu—Br

3. What does the term "isomer" mean? Which one of the molecular substances in this experiment forms isomers?

Name: _____ Pd: ___ Date: _____

Molecular Structure Lab: Complete the following table.

FORMULA	Lewis Dot Diagram	Ball and Stick Model	Shape of Molecule	Molecular Polarity
H_2				
HBr				
H_2O				
NH_3				
CH_3NH_2				
CO_2				
H_2CO				

FORMULA	Lewis Dot Diagram	Ball and Stick Models	Shape of Molecule	Molecular Polarity
C_2H_2				
CH_4				
HClO				
O_2				
AlH_3				
CH_3Cl				
HCOOH				