Chemistry CP

Name:

Lab: Molecular Models of Covalent Compounds Section:

Up to this point, we have focused on drawing Lewis structures of molecules, which are two-dimensional models of the actual molecules. While Lewis structures are useful for showing bonding, they are limited when it comes to three-dimensional geometries of molecules. Lewis structures do not necessarily represent the geometry of the molecule! In this lab, we will explore how atoms are arranged in molecules by building simple ball-and-stick models of various covalent compounds. We will use VSEPR theory, a system for predicting molecular shape based on the principle that pairs of electrons orient themselves as far apart as possible.

Problem

Can we predict the three-dimensional geometries of molecules?

Objectives

- To understand how atoms are arranged in molecules
- To assist in visualizing the three-dimensional nature of molecules

Materials

Molecular model kit protractor

Roles: Assign the roles of project manager, quality control manager, and materials manager.

Make a chart in your lab book with 6 columns. Label the columns as follows:

- formula
- Lewis structure
- Sketch of model (label the bond angles)
- Structural formula (when you fill in this column, label the bond angles as much as possible)
- Shape of the molecule (geometry around central atom, or around the C atoms)
- Does the molecule have polar bonds? (Which ones?)
- Does the molecule have a molecular dipole?

For each of the following compounds, first write in the Lewis structure for that compound. Then assemble the molecule and fill in the chart for that compound.

Compounds

1. Cl_2
2. CH_4
3. CH_3Cl
4. CH_2Cl_2
5. C_2H_6
6. C_2H_5OH
7. H_2O
8. NH_3
9. O_2
10. C_2H_4 (double bond)
11. C_2H_2
12. $C_2H_2Cl_2$ (how many isomers can you find?)
13. N_2
14. C_3H_8
15. CO_2
16. HCN
17. C_6H_6

Analyze and Apply Questions

1. Explain how the presence of lone pairs affects the observed geometry of molecules.
2. Why does VSEPR theory predict molecular shapes with the largest possible bond angles?
3. Explain how a molecule, such as CCl_4, can have an electronegativity difference ≥ 0.3 and still be considered to be non-polar (i.e., have no molecular dipole).
4. Sketch models of the following geometries: triatomic linear; octahedral; bent; tetrahedral; trigonal planar; trigonal bipyramidal; pyramidal.