MOLECULAR GEOMETRY

Molecular geometry describes the three-dimensional shape of a molecule or polyatomic ion. In turn, this shape determines whether the molecule or ion is polar or nonpolar. Molecular geometry and polarity play important roles in determining how molecules and ions interact with one another.

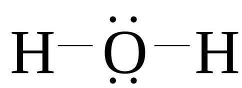
Having your textbook available may prove to be beneficial.

BRIEF REVIEW

Consider H_2O, the water molecule.

The oxygen atom contributes six electrons to the valence electrons for the molecule and each hydrogen atom contributes one electron to the valence electrons for the molecule giving the molecule eight valence electrons.

The following shows the Lewis structure for water. Lines are used for shared pairs of electrons and dots for unshared electrons.



The electron geometry is based on where electron regions are located around the central atom. Four electron regions (two bonding regions + two lone pair regions) around the central oxygen atom lead to a **tetrahedral** electron geometry for the water molecule.

The molecular geometry is based on the locations of atoms around the central atom. The possible locations for the atoms arise from the electron geometry of the molecule. A water molecule has a **bent** molecular geometry.

A molecule is polar if the molecule has a center of positive charge and a center of negative charge which do not coincide. The bent shape of the water molecule causes this to occur, making the molecule **polar**.

In valence bond theory, an orbital of one atom is said to overlap with an orbital on another atom with the total number of electrons in both orbitals no more than two. Often these orbitals are obtained by taking combinations of atomic orbitals of the isolated atoms and are called hybrid orbitals. Table 10.2 in your textbook lists the hybrid orbitals that lead to the various electron geometry arrangements.

The central oxygen atom in water requires a tetrahedral electron geometry, so according to valence bond theory, it uses **sp^3** hybrid orbitals.

PROCEDURE

1. You will need to purchase a box of Dots candy and some toothpicks**.**

2. Here is a list of the molecules that you will need to construct using your Dots gumdrops and toothpicks.
    a. XeF_2
    b. PI_3
    c. CCl_4
    d. ICl_5
    e. OCl_2
    f. KrF_4

3. Take your time. Learning this now and three hours of dedicated time will make life much easier for you when you are studying for the next exam.

4. Determine the number of valence electrons on the molecule.

5. Draw the Lewis structure for the molecule using **lines** for shared pairs of electrons and **dots** for unshared electrons.

6. Build the model using the gumdrops and toothpicks. Use a different color for each element in a molecule.

7. Determine the electron geometry and molecular geometry of the molecule. Use the appropriate terms to describe each.

8. Determine the hybrid orbitals used by the central atom according to valence bond theory.

9. Determine the polarity of the molecule.

10. Again, take your time. Examine the shape of the model and see how the terms used to describe the electron geometry, hybrid orbitals, and molecular geometry of the molecule correspond with the model's shape. See how the shape helps you decide on the polarity of the molecule.

11. Before disassembling your gumdrop model of the molecule, take a selfie with it. You will need to submit this with your lab report.

12. Repeat for each of the six molecules.