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.

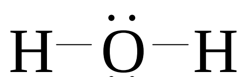
Download your own list of molecules/ions from the Post-Lab Questions link of our Web Site as soon as you get to lab. You will not be working with a partner on this lab. Also bring your textbook (and any supplemental materials that are available from the course).

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 a total of 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. Download your own list of molecules/ions from the Post-Lab Questions link of our Web Site when you get to lab. **You will not be working with a partner.**

2. Obtain a model kit and report sheet from Lab Services.

3. Transfer the formulas for the molecules/ions that have been assigned to you, in order, to the report sheet. When you turn in your report sheet, be sure this list is attached.

4. Take your time. Learning this now, while you have the model kit, handout, and three hours of dedicated time will make life much easier for you when you are studying for the next exam.

5. Determine the number of valence electrons on the molecule/ion.

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

7. Build the model. Have your TA initial that you have built the model. This (that you built a model) is the only thing your TA will be checking. Your TA is not responsible for making sure that you built the correct model.

8. Determine the electron geometry and molecular geometry of the molecule/ion. Use the appropriate terms to describe each.

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

10. Determine the polarity of the molecule/ion.

11. 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/ion correspond with the model's shape. See how the shape helps you decide on the polarity of the molecule/ion.

12. Repeat for each assigned molecule/ion.

13. Review the names for all molecular geometries, including those for structures you were not assigned.

14. After you have completed all ten of the assigned molecules/ions and reviewed all molecular geometries: turn in your report sheet, put all your materials away, return your model kit to Lab Services, and pick up a quiz. Go directly to the center lab bench in your laboratory and, using only your brain and a pencil (no handouts, models, or human help), complete and turn in your quiz.