DETERMINATION OF MOLECULAR GEOMETRIES
VALENCE SHELL ELECTRON PAIR REPULSION THEORY

Introduction

Lewis structures can be used to predict molecular and ionic geometries, as well as polarity. Generally, atoms have eight electrons in their outer shell and is known as the octet rule. In addition, valence electrons around atoms (bonding pairs) or present in electron domains (lone pairs) can be used to predict the overall geometry of a molecule because electrons repel each other. This method is termed valence-shell electron-pair repulsion (VSEPR) theory. Each electron pair occupies as much space around the nucleus and inner electron shells of the atom as it can, and excludes other electrons from occupying the same space, a consequence of the Pauli Exclusion Principle.

In addition to VSEPR theory, orbital hybridization can be used to predict *overall geometry* (includes atoms and electron domains) as well as *molecular geometry*. As discussed in many chemistry books, blending of s, p, d, and f orbitals occurs based on electron wave functions first defined by Irwin Schödinger. Hybridization occurs when low energy electrons are promoted to higher energy levels, resulting in a blended orbital of the participating orbitals (i.e., sp, sp^2, sp^3, sp^3d, sp^3d^2).

Purpose

In this lab, you will construct molecules from Lewis structures, correlate molecular shapes with orbital hybridizations, and understand the VSEPR Model for molecular structures

Procedure

Procedure will be based on information from the teacher. Please look at each molecular geometry and build them with the balloons.

1. Linear Molecular Geometry will use 2 balloons.
2. Trigonal Planar Molecular Geometry will use 3 balloons.
3. Tetrahedral Molecular Geometry will use 4 balloons.
4. Trigonal Bipyramidal Molecular Geometry will use 5 balloons.
5. Octahedral Molecular Geometry will use 6 balloons.

Results/Conclusions

1. For each molecular geometry modeled in the lab, please draw the molecular geometry in the ball and stick format.
2. Give one example of a compound that follows each molecular geometry modeled in the lab from Question #2.
3. Draw the Lewis Structure for the compound that was used an example from Question #2.

Final Analysis

1. For the following molecular geometries, find the bond lengths, bond angles, electron pairs, unpaired electrons, and other key important information about the structure:

    a. linear
    b. trigonal planar
    c. tetrahedral
    d. trigonal pyramid
    e. trigonal bipyramid
    f. octahedral
    g. square planar