Experiment 1

Molecular Models & Molecular Structure

During this experiment, you will draw Lewis Dot Structures for a number of molecules, including some organic molecules, as well as some ions. Drawing Lewis Dot Structures is the first step in understanding how many molecules are put together, the types of bonds that they contain, their overall molecular shape, and if the molecule is polar.

VSEPR is an abbreviation for **V**alence **S**hell **E**lectron **P**air **R**epulsion. VSEPR uses your Lewis Dot Structures, so it is important that you draw correct structures. You can also predict the molecular shape (molecule geometry) of a molecule using VSEPR. Also, based on the arrangement of atoms around a center atom, you can predict polarity. For VSEPR, please remember that an electron domain (often referred to as electron pairs) is any electron-rich region, and can be either (i) a single electron that involved in bonding, (ii) a pair of electrons (either as a lone unbonded pair or as a bonded pair of electrons), or (iii) multiple pairs of electrons (such as double and triple bonds). The best way to understand VSEPR is to do exercises, and that is the purpose of this experiment.

View information on *VSEPR Theory of Molecular Geometry Pages* online. These suppplemental pages describe what VSEPR is, and how to use VSEPR to make molecular models, how to predict molecular shapes (molecule geometry), and how to predict molecule polaity, based on the number of electron domains and their arrangement around the center atom. Please note, that an electron domain is a single electron region, a pair of electrons (either lone pairs or bonded pairs), multiple pairs of electrons (such as double and triple bonds).

In order to get correct VSEPR results, you *must* draw Lewis Dot structures. Follow the procedures below to draw correct Lewis structures:

1. Count the total number of valence electrons for each atom, or group of atoms, in a molecule (e.g., $CHCl_3$ has 26 electrons). For ions, add electrons corresponding to the total negative charge (-), or deduct electrons for each positive (+) charge (e.g., SO_4^{2-} has 32 electrons) to the number of valence electrons.
2. Identify the center atom (usually the atom present in smallest quantity, or usually the least electronegative), and attach the other atoms to this center atom. Remember, that "H" can never be a center atom, and *must* be attached to one of the outlying "O" atoms for acids, although the "H" is attached to the center atom if the molecule or ion is *not* an acid.
3. Add back all the electrons (count the electrons in bonds first, and then add the remainder electrons), adding eight (8) electrons to all outlying atoms ("H" can have only a 2-electron

bond) before adding any electrons to the center atom. If you do not have enough electrons to provide the center atom with eight (8) electrons, share a pair of electrons from an outlying atom with the center atom to form a double-bond (outlying halogens *never* form a double bond). Usually, all atoms will have eight (8) electrons (octet), except for "H" which wants *only* two (duet).

4. Any extra electrons, beyond what is necessary to achieve the octet rule for outlying and center atoms *must* be placed on the center atom *only*. The center atom can have more than eight (8) electrons.

5. Based on correct Lewis Dot structures, use the table described below to determine its number of VSEPR electron domains, predicted shape, and polarity.

You should print a table using VSEPR to predict molecule geometry (shape), polarity, and electron domain arrangments for molecules having *Three to Six Electron Domains*. This table is more complete than the table found in your experimental protocols.

You *must* print the worksheets, which are available ➡ *online* to record your results.

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