Molecular Models

Pre-lab

Make a table with the following headings:
Species Lewis structure 3-D drawing Molecular shape Polarity

Copy the formula for the first of the following species into your table. Then combine Lewis symbols to write the Lewis electron dot structure. You may need to move electrons to form multiple bonds, or add or remove electrons for charged species, or divide electron pairs on the Lewis symbols to make expanded octets. Continue with the next species, again only filling in the first two columns in your table at this point.
(a) CH_4, $SiCl_4$, NH_3, H_2O, HCN, CO_2, F_2, O_2, N_2, HCl, PCl_3, PCl_5, SF_4, SF_6, BF_3, ClF_3, IF_5, XeF_2, XeF_4, O_3, SO_2, SO_3, N_2O, C_2H_2
(b) C_2H_4, C_2H_6, $CH_3CH_2CH_3$, CH_3F, CH_2Cl_2, CH_3OH, H_2CO, H_2NNH_2 (hydrazine), CH_3COOH, HNO_3, $POCl_3$, SF_3CN
(c) NH_4^+, ICl_2^-, IF_4^-, CO_3^{2-}, NO_2^-, NO_3^-, SO_3^{2-}, SO_4^{2-}, ClO_2^-, ClO_4^-, PF_6^-, OCN^-, I_3^-, NO_2^+
(d) HCO_3^-, CH_3O^-
Show all resonance structures where applicable.

Procedure

Use molecular model kits to make the species listed in the pre-lab, omitting SO_2 and SO_4^{2-}. (The models may mislead you for SO_2 and SO_4^{2-}.) Use stiff connectors for single bonds and flexible connectors for multiple bonds.

Use the models as an aid when you fill in the vacant columns of your table. When making the 3-D drawing (using wedges and dashed lines) for a species with a double or triple bond, just draw 2 or 3 parallel lines rather than curved lines. In 3-D drawings you must show lone pairs of electrons on the central atom.

Omit the molecular shape for group (b) since they have more than one central atom or the atoms attached to the central atom are different.

Since electrostatic forces involving ions are much stronger than forces involving dipoles, omit the polarity for all ionic species in group (c).

Omit both the molecular shape and the polarity for group (d).

Post-lab

Make a summary table with the following headings:
different directions for e^- pairs, Electron-pair Geometry, # lone pairs, Molecular shape, Examples

Start your table with "Number of different directions for electron pairs on the central atom" = 2. (A double bond or a triple bond only counts once.) Then go to "# different directions for e^- pairs" = 3, first with "number of lone pairs" = 0, then with "number of lone pairs" = 1. Continue this pattern.

Under "Electron-pair Geometry" put both a 3-D drawing (using pairs of dots for electron pairs) and the name for the shape. This shape refers to the geometry of the electron pairs, not necessarily the molecular shape.

Try to find two examples and show them as 3-D drawings.