Discussion Worksheet #2

Bonding Theory

Skill 1: Given information, draw chemical representations

* Apply valence/octet rule to bonding
* Interconvert between Lewis structures, condensed formula, and bond-line
* Know functional groups
* Understand and apply terms such as cyclic, acyclic, saturated, unsaturated

Problem 1. Draw Lewis structures based on the given information



Problem 2. Draw bond line structures of six different molecules with the molecular formula C5H10O2. Label at least 7 different functional groups in these molecules.

Problem 2. Redraw the following molecules using other representations.



Skill 2: Draw orbital overlap pictures.

* After determining hybridization of each atom, draw atoms with orbitals in correct orientations.
* Use artistic ability to draw overlap pictures in three dimensions with acceptable angles.

Problem 4. Determine the hybridization of each carbon atom in the molecule below, and drawn a full orbital overlap picture.



Problem 5. Given that the hybridization of the nitrogen, carbon, and oxygen atoms in the following molecule are all sp2, draw an orbital overlap picture.



Problem 6. Draw an orbital overlap picture of the molecule below. Indicate the angle between the pi bond and the lone pair.



Skill 3: Apply orbital overlap pictures

* When orbitals overlap, electrons in those orbitals become more stable.
* Conjugation occurs when p orbitals are adjacent to one another and are capable of overlapping.
* All atoms in a conjugated system must have a p orbital. Therefore, atoms that are part of a conjugated system are not sp3 hybridized, even if they have four areas of electron density.
* Identify conjugated systems by locating pi bonds and any adjacent atoms that have pi bonds or lone pairs.
* Lone pairs in conjugated systems are delocalized over multiple atoms.
* Lone pairs that are not part of a conjugated system are localized into one hybridized orbital.
* Simplified orbital overlap pictures have sigma bonds drawn as lines, but orbitals are drawn for lone pairs and pi systems.

Problem 7. Which of the compounds in problems 4-6 have a conjugated system? Explain.

Problem 8. Predict the hybridization of each atom in these compounds. Identify the conjugated systems.



Problem 9. Draw a simplified orbital overlap picture for the compounds below, and use the picture to show which of the lone pairs is localized and which is delocalized.

