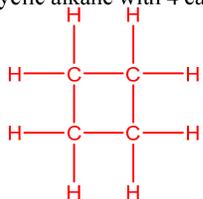
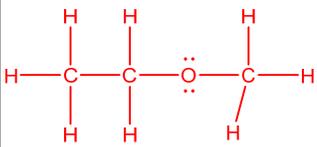
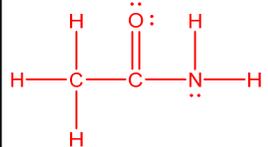


Discussion Worksheet #2 Partial Answers
Bonding Theory

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

<p>cyclic alkane with 4 carbons</p> 	<p>C_3H_8O ether</p> 	<p>C_3H_8O alcohol</p>
<p>unsaturated 3-carbon compound</p>	<p>amide with 2 carbons</p> 	<p>2 different $C_2H_4Cl_2$ compounds</p>

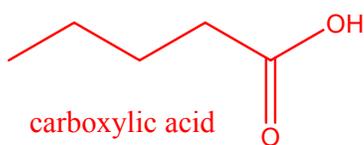
Problem 2. Draw bond line structures of six different molecules with the molecular formula $C_5H_{10}O_2$. Label at least 7 different functional groups in these molecules.

There are many possibilities. Here are three to get you started. You should also be able to draw an ester and an aldehyde.

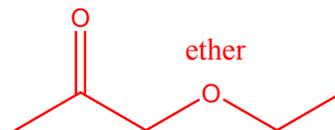
alcohol



alkene



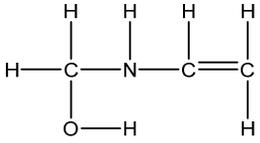
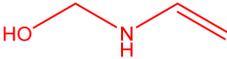
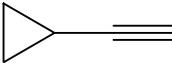
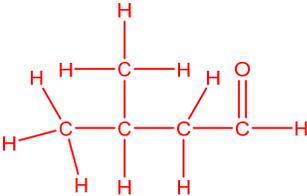
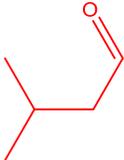
carboxylic acid



ketone

ether

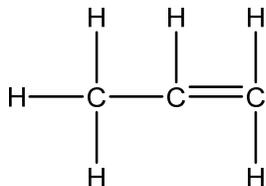
Problem 2. Redraw the following molecules using other representations.

Lewis Dot	Condensed	Bond-line
	$\text{HOCH}_2\text{NHCHCH}_2$	
	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHCHOCH}_3$	
		
	$(\text{CH}_3)_2\text{CHCH}_2\text{CHO}$	

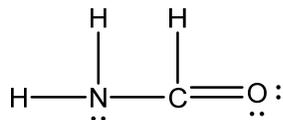
Skill 2: Draw orbital overlap pictures.

- 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.

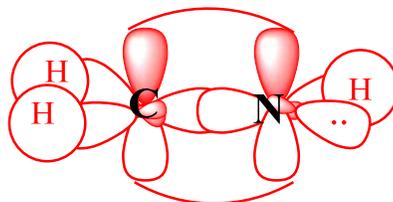
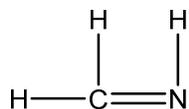
Problem 4. Determine the hybridization of each carbon atom in the molecule below, and drawn a full orbital overlap picture.



Problem 5. Given that the hybridization of the nitrogen, carbon, and oxygen atoms in the following molecule are all sp^2 , 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.



The lone pair on the nitrogen is orthogonal to the p orbital, so the bond angle is 90° .

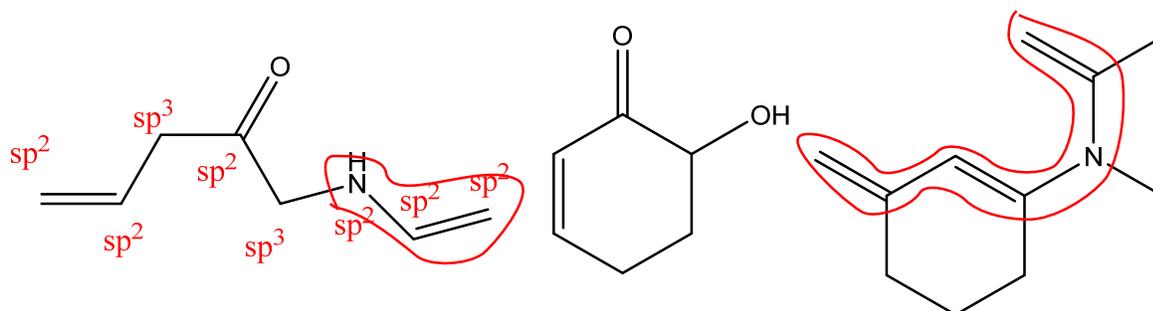
Skill 3: Apply orbital overlap pictures

- 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 sp^3 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.

Compounds in 4 and 6 are not conjugated. The compound in problem 5 has a conjugated system of three atoms. This can be recognized because...

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.

