

## Fall Workshop #2

### Question #1

Take a few moments to **discuss/review** in your groups how carbon, oxygen and nitrogen atoms might be hybridized from their ground state electron configurations in an **sp<sup>3</sup>**, **sp<sup>2</sup>**, and **sp** fashion. You will likely want to show how electrons are configured in the ground state and how they are configured upon hybridization using an **energy level diagram** like we did in class.

- (a) Be careful to use emptiest orbitals first for carbon and full orbitals first for oxygen.
- (b) Evaluate each resulting hybridization state and propose what type of bonds (sigma/pi) each orbital will likely undergo upon incorporation of these hybridized atoms into organic molecules.
- (c) Identify one functional group that contains each type of hybridized atom (see inside cover of your text).

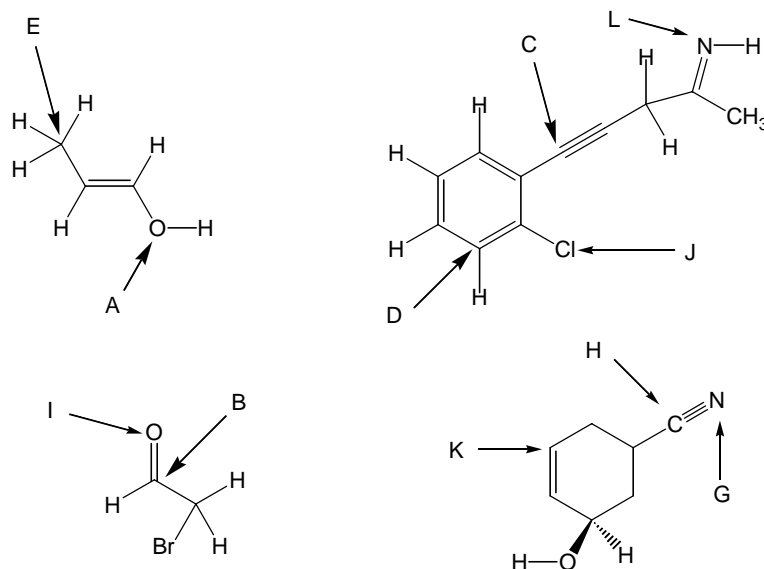
\* use the table below as a guide

<u>hybridization state</u>	<u>atom</u>	<u>hybridized electron configuration (use energy level diagram)</u>	<u># and types of bonds that will be formed/molecular geometry</u>	<u>type of functional group(s) atom is present in (draw structure)</u>
sp <sup>3</sup> carbon	C			
sp <sup>2</sup> carbon	C			
sp carbon	C			
sp <sup>3</sup> nitrogen	N			
sp <sup>2</sup> nitrogen	N			
sp nitrogen	N			
sp <sup>3</sup> oxygen	O			
sp <sup>2</sup> oxygen	O			

### Question #2

Build models using your hand-held model kit for each of the molecules shown below.

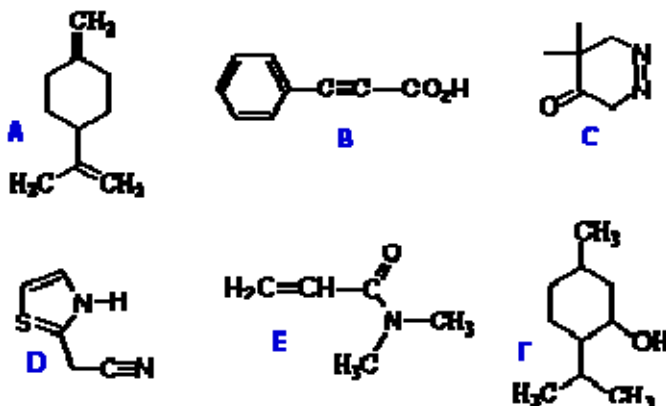
- For each molecule, complete the structure by filling in any missing non-bonding electron pairs.
- Identify the hybridization state for all CARBON, OXYGEN, and NITROGEN atoms. (NOTE: halogens typically are not hybridized).
- For each non-bonding electron pair on OXYGEN or NITROGEN, determine which orbital ( $p$ ,  $sp$ ,  $sp^2$ , or  $sp^3$ ) it resides in.
- Using your hand-held model, describe the molecular geometry around the atoms labeled A-L.
- For each molecule, each person in the workshop should select 1 bond and take a turn describing the type of bond (sigma or pi) as well as the two orbitals (hybrid and/or atomic orbitals) that overlapped to make that bond. For example: C-H sigma bond =  $C_{sp^3} + H_{1s}$
- For each molecule, determine its molecular formula – e.g.  $C_6H_{12}O_3$ . Then using that formula, write at least 1 Lewis structure that is a constitutional isomer of the structure shown. You should employ the Lewis writing rules from the last workshop!



### Question #3

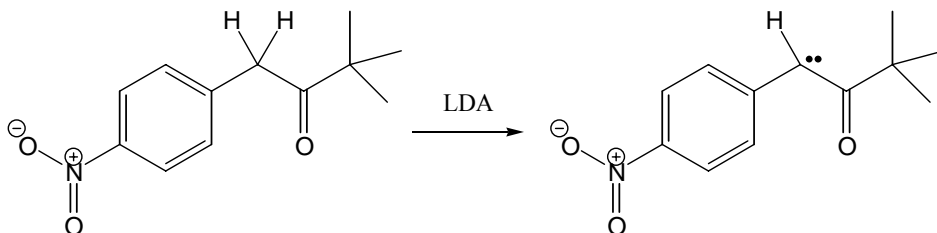
For EACH of the following molecules, determine:

- Number of  $sp^3$  carbons, oxygens, and nitrogens
- Number of  $sp^2$  carbons, oxygens, and nitrogens
- Number of  $sp$  carbons, oxygens, and nitrogens
- Number of carbon-carbon  $\sigma$ -bonds
- Number of  $\pi$ -bonds to carbon

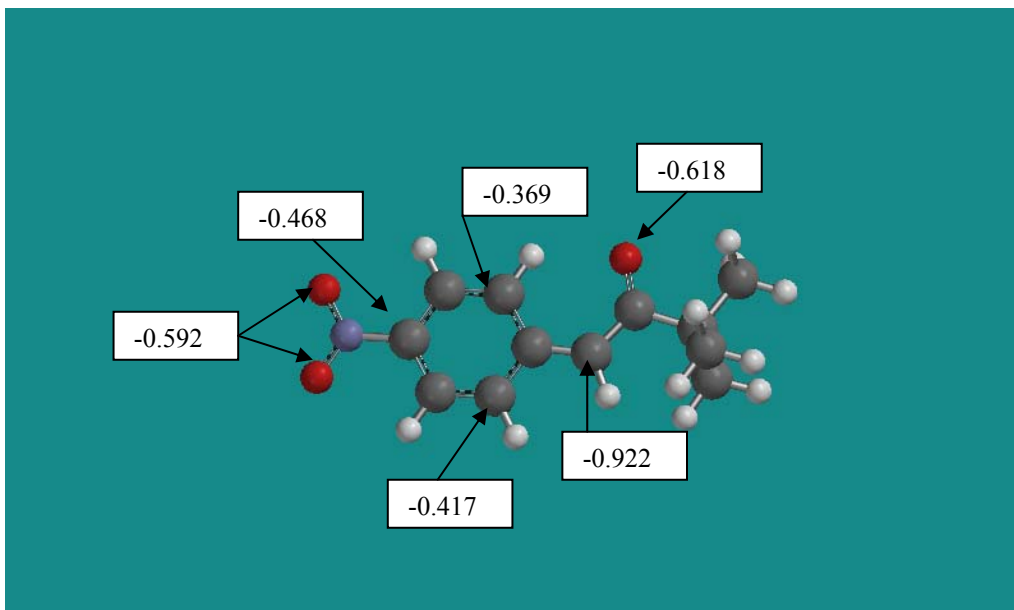


#### Question #4

Strong bases like lithium di-isopropylamide (LDA) can remove hydrogen atoms on the carbon next to (alpha to) the carbonyl group to generate a conjugate base anion. Confirm via formal charge calculation that the product molecule contains a negative charge on the alpha-carbon. In addition, draw as many resonance structures as possible to demonstrate that the charge is not localized on this carbon, but spread throughout the molecule. (NOTE: be sure to fill in any non-bonding electron pairs before you begin.)

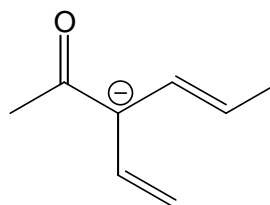
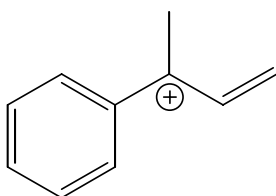


Are the charges indicated on the Spartan image below consistent with the idea that charge is spread out in the structure via resonance? Does it seem reasonable that those atoms indicated are carrying some degree of negative charge? Explain.



#### Question #5

Draw all IMPORTANT resonance structures for each of the following ions.



Question #6 (time permitting)

Split into two teams. Determine a rotation of players who will play the game. Then, go to the following website and play “Jeopardy” Game #3 (review of General Chemistry concepts). Your workshop leader will establish and explain the rules of the game. If there is answer that cannot be explained or if anyone in the group is unclear, then look it up and discuss until a consensus is reached among the group.

[http://chemed.chem.pitt.edu/Jeopardy/organic/game03/single\\_jeopardy.htm](http://chemed.chem.pitt.edu/Jeopardy/organic/game03/single_jeopardy.htm)