Homework Week 1

Concepts—Spencer, Bodner, and Rickard, Chapter 8: Intermolecular forces, boiling point & melting point trends, solubility

Chapter 1: Lewis structures, polarity, resonance, bond angles (shapes), molecular orbital theory, hybridization of orbitals

Skills: Draw Lewis structures of a variety of organic molecules containing alcohol, ether, ketone, aldehyde, carboxylic acid, nitro & amine functional groups.
Calculate formal charges
Draw & evaluate importance of resonance structures (push arrows)
Predict bond angles in molecules
Describe bonding using localized bonding model with hybrid orbitals
Construct models (using model kits) that correspond with predicted shapes

Monday--Intro., Lewis Structures, formal charge, functional groups, polarity
Read Lewis structure handout
Read Chapter 1 (Brown & Foote) through section 1.6
Problems 1.4-7, 24, 26-28

Tuesday--VSEPR, polarity, functional groups, resonance
Finish reading Chapter 1
Read Hybridization handout
Problems 1.11-13, 21-23, 33, 34, 36, 37

Wednesday--hybridization
Problems 1.13-15, 38 (and draw important resonance structures of these ions), 42, 49-53

Friday--QUIZ, hybridization, molecular shape
Read through Section 2.3 (Brown & Foote)
Problems 1.16, 46, 54-56, 57-60
The following problem should be turned in on Friday as part of your weekly quiz. Please write your answer on a separate sheet of paper and turn it in with your quiz. This problem should be completed individually.

1. To the right is the framework of the molecule acetamide:
   \[
   \begin{align*}
   &\text{H} \quad \text{O} \\
   &\text{H-C-C-N-H} \\
   &\text{H} \quad \text{H}
   \end{align*}
   \]
   a. Draw the Lewis structure for this molecule—the two most important resonance structures including formal charges.
   b. Estimate the following bond angles:
      - H-C-H
      - H-C-C
      - C-C-O
      - O-C-N
   c. Which atoms, if any, are coplanar (lie in the same plane)?
   d. Determine if this molecule has a net dipole moment, and if it does, indicate on your drawing of the molecule the direction of the net dipole (use the symbol, \(\rightarrow\), to indicate any net dipole).
   e. Consider the following solvent molecules:
      - Ethanol
      - Dichloromethane
      - \(\text{N,N-dimethyl acetamide}\)

      Acetamide dissolves into these solvents because it is able to make favorable intermolecular interactions with these molecules, but the type of interactions it makes may not be the same in each case. Indicate the type of interaction between each of these molecules and acetamide that you think is the most important intermolecular force involved in the solubility of acetamide.

   f. Acetamide has the following physical properties:
      - boiling point = 221 °C, melting point = 80 °C.
      - N,N-dimethyl acetamide, shown at right, has the following physical properties:
      - boiling point = 165 °C, melting point = -20 °C.

Note that N,N-dimethyl acetamide (molar mass = 87.12) is a larger molecule than acetamide (molar mass 59.07). N,N-Dimethyl acetamide has two more C atoms and 4 more H atoms than acetamide. As a result, N,N-dimethyl acetamide’s molar mass is almost 1.5 times greater than acetamide, yet \(\text{N,N-dimethyl acetamide both melts and boils at a lower temperature than the smaller acetamide}\). Rationalize this fact.