Week 2 Worksheet

1. Drawn below is the chemical structure for tamsulosin, an alpha-blocker molecule that is often used in urology to treat symptomatic benign prostatic hyperplasia. At each lettered arrow, please complete the following:
   i. Give the atom’s hybridization
   ii. Describe all bonds connected to the specified atom
   iii. Predict the atom’s geometry

![Chemical Structure of Tamsulosin](image)

2. For each molecule listed below, please complete the following:
   i. Draw the 3-D structure
   ii. Draw dipole arrows from each atom
   iii. Determine whether or not the molecule has a net dipole
   iv. Determine the geometry
   v. Will the molecule be hydrophobic or hydrophilic?

   a. NH$_4^+$  b. H$_3$O$^+$  c. SiCl$_4$  d. ClO$_3^-$
3. For the following molecule, determine the number of:
   a. \( \text{sp}^3 \) carbons \( \underline{\phantom{0}} \)
   b. \( \text{sp}^2 \) carbons \( \underline{\phantom{0}} \)
   c. \( \text{sp} \) carbons \( \underline{\phantom{0}} \)
   d. carbon-carbon sigma bonds \( \underline{\phantom{0}} \)
   e. pi bonds \( \underline{\phantom{0}} \)

   ![Molecule Diagram]

4. List the type of bond, and the orbitals that overlap to make that bond, in the following molecules:

5. Identify the longer bond and the stronger bond in each set of molecules below.
   a. \( \text{C} - \text{C} \) vs. \( \text{C} = \text{C} \)
   b. \( \text{H} - \text{Br} \) vs. \( \text{H} - \text{Cl} \)
   c. \( \text{C} - \text{O} \) vs. \( \text{C} - \text{S} \)
   d. \( \text{O} = \text{O} \) vs. \( \text{N} = \text{N} \)
   e. \( \text{Si} \equiv \text{C} \) vs. \( \text{Si} - \text{C} \)
6. Draw the net dipole movement for the following molecules about the central carbon atom.

\[ \text{NH}_2 \quad \text{H} \quad \text{Cl} \quad \text{CH}_2\text{CH}_3 \]

\[ \text{CH}_2\text{CH}_2\text{O} \]

7. Rank the following in order of increasing pKa value for the hydrogen atom.

\[ \text{CH}_2\text{CH}_2\text{O} \quad \text{CH}_2\text{CH}_2\text{OH} \]

\[ \text{ClCH}_2\text{CH}_2\text{O} \quad \text{ClCH}_2\text{CH}_2\text{OH} \quad \text{CH}_2\text{COOH} \]

8. Identify the products of each acid-base reaction and decide if the reaction favors the products or reactants. Assume one equivalent of each reagent.

\[ \text{NH}_3 \quad \text{OH} + \text{HCl} \]
9. Below is tetracycline, an antibiotic commonly used to treat acne and skin infections. Circle and name all functional groups. Indicate whether or not each functional group can participate in a hydrogen bond as a hydrogen bond donor and/or acceptor (or neither).