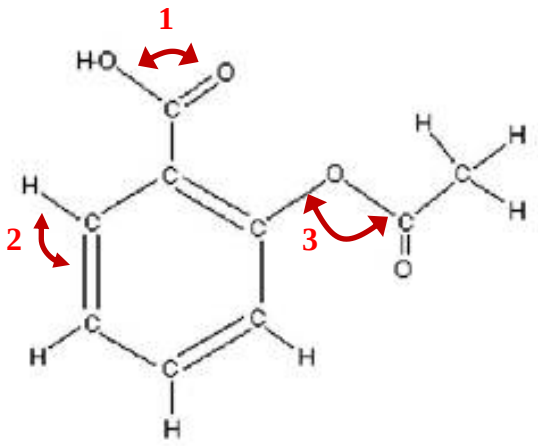
REVIEW QUESTIONS
Final Exam

1. A solution is prepared by mixing 20.0 mL of CH_3OH (d = 0.791 g/mL) with 100.0 mL of CH_3CN (d= 0.786 g/mL). Calculate the mole fraction of CH_3OH and the molality of this solution.

2. At 63.5°C, the vapor pressure of water is 175 mmHg and that of ethanol (C_2H_5OH) is 400 mmHg. A solution is made by mixing equal masses of water and ethanol. What is the mole fraction of ethanol in the vapor above this solution?

3. Shown below is the structural formula for acetylsalicylic acid, better known as aspirin.
   a) What are the approximate bond angles marked 1, 2 and 3?

   b) What are the hybridization of the central atoms in each of these angles?



4. Allene (C_3H_4) is an important intermediate in synthesis of many organic compounds.

   a) Draw a Lewis structure for allene (all carbons are bonded together).

   b) How many sigma and pi bonds are present in this molecule?

5. When 0.55 g of a nonelectrolyte solute is dissolved in 32.0 g of benzene, the freezing point of the solution is measured to be 0.36°C lower than the freezing point value the pure solvent. Calculate the molar mass of this solute. (K_f for benzene = 5.12°C/m)

6. When an atom or group of atoms is substituted for H in benzene (C_6H_6), its boiling point changes. Explain the order of the following boiling points: C_6H_6 (80°C), C_6H_5Cl (132°C), C_6H_5Br (156°C), C_6H_5OH (182°C)

Answers:

1) molality = 6.28 m ; X_{solute} = 0.205

2) $X_{ethanol}$ in vapor = 0.472

3) (**1**) 120°; sp^2 (**2**) 120°; sp^2 (**3**) 109.5°; sp^3

4) 6 sigma bonds and 2 pi bonds

5) $2.4x10^2$ g/mol

6) Substitutions in the benzene molecule provide more intermolecular forces and therefore increase the boiling points of the substituted molecules.

   Chloro and bromo substituted benzenes have London forces and therefore are affected by the molar masses. Bromobenzene with the larger molar mass has higher boiling point than chlorobenzene with lower molar mass.

   Hydroxy substituted benzene has H-bonding and therefore has the highest boiling point of all the substituted molecules, since it is the strongest of the intermolecular forces.