Final Exam Review

1. Which of the following is NOT a valid resonance structure of benzene?

   a. ![Resonance Structure A]
   b. ![Resonance Structure B]
   c. ![Resonance Structure C]
   d. ![Resonance Structure D]

2a. In the molecule shown below, draw a major resonance structure and label formal charges in the resonance structure, and add lone pairs to both of the structures.

   ![Molecule]

2b. For the two resonance structures above, write the estimated bond angle for each nitrogen molecule.

3. On the lines below each of the following compounds, rank the compounds from the lowest pKa (1) to the highest pKa (4).

   ![Compounds]
4. Circle the most acidic proton from each of the following molecules.

![Molecular structures](image1)

5. For each of the following reactions predict the most stable product of the first step of each reaction.

5a. 

![Reaction](image2)

5b. 

![Reaction](image3)
6. Refer to the following three molecules to answer these questions.

6a. Which compound has the highest melting point, explain your answer.

6b. Which compound has the highest boiling point, explain your answer.

7. Saul Goodman discovers Walter is working on a new drug, the molecule is as follows:

7a. Draw both chair conformations of this molecule and circle the more stable chair conformation.
7b. What is the IUPAC name for this molecule?

7c. Draw an enantiomer and a diastereomer for this molecule

7d. Is this molecule likely soluble in water?

8. Identify the enantiomer of the following molecule (select all that apply)
9. Label each compound below as chiral, meso, or neither

10. In George Washington’s farewell address, he famously wrote the following molecule

10a. Identify all of the functional groups within the molecule.

10b. Identify all of the intermolecular forces

10c. Draw how 3 molecules of water can form hydrogen bonds with the molecule
11. Propose a molecular structure from the following spectra. The molecular formula of the molecule is \( \text{C}_4\text{H}_8\text{O}_2 \).
12. Match the following H-NMR Spectras with their appropriate molecules
13. Refer to the following reaction coordinate diagram to answer the questions below

13a. What step has a negative ΔG?

a. A to B
b. B to C
c. A to C
13b. What is the rate-determining (limiting) step?

   a. A to B  
   b. B to C  
   c. A to C

13c. How many transition states are present in the reaction coordinate diagram?

13d. This reaction is _______

   a. Endothermic  
   b. Exothermic

14. For the following reaction, draw curved arrows to show a mechanism for this reaction. What is this reaction called?
15. Draw an arrow-pushing mechanism for the following reaction

\[
\text{Br} \quad \text{NaOH} \quad \rightarrow \quad \text{H}_2\text{O} + \text{NaBr} + \text{ 苯环}
\]

15b. Draw a reaction coordinate diagram for the reaction.