Organic II lecture  
Review for exam 2  
Conjugation, Aromatic and Aromatic Reactions

Another good review is the practice test in the N.S. testing center.

Practice questions:

1. **Draw** the highest occupied molecular orbital (HOMO) for 1,3,5-hexatriene. How many *bonding* and *anti-bonding* interactions in this MO?

2. Predict the product of the following Diels-Alder reaction. Include relevant stereochemistry. (3 points)

\[
\begin{array}{c}
\text{H}_3\text{C} \\
\text{CH}_2
\end{array}
+ 
\begin{array}{c}
\text{NC} \\
\text{CN}
\end{array}
\rightarrow

\text{Product}
\]

3. Predict whether the following reaction will go, and under which conditions. Hint: Use your knowledge of pericyclic reactions, and conservation of molecular orbital theory.

\[
\begin{array}{c}
\text{CH}_3 \\
\text{N}
\end{array}
+ 
\begin{array}{c}
\text{N} \\
\text{O}
\end{array}
\rightarrow
\begin{array}{c}
\text{CH}_3 \\
\text{O}
\end{array}
\]
4. Label the following molecules as aromatic, anti-aromatic, or nonaromatic. Assume planarity.

![Molecules](image1.png)

5. Which compound would have the greatest $\Delta H$ value for hydrogenation?

![Compounds](image2.png)

6. Which of the molecules in problem 5 has the smallest energy gap between its HOMO and LUMO molecular orbitals?

7. For the molecular orbital of benzene shown below, answer the following questions.

![Molecular Orbital](image3.png)

a) How many nodes are present?

b) How many bonding interactions? Antibonding interactions?

c) Using the polygon rule, draw a molecular orbital energy diagram for benzene and indicate with an X where the depicted molecular orbital would exist in the diagram.
8. The following reaction fails to undergo E2 elimination. Explain.

![Chemical structure](image)

9. Which is the best dienophile in the D-A reaction?

![Chemical structures](image)

10. Complete the following:

![Chemical structures](image)

11. Which aromatic ring would undergo nucleophilic aromatic substitution the fastest?

![Chemical structures](image)
12. Circle the answers that correctly describe the behavior of a halide substituent in EAS. A halide is a (weak / strong) inductive (EWG / EDG) and a (weak / strong) resonance (EWG / EDG).

(EWG = Electron withdrawing group and EDG = Electron donating group).

13. Fill in the missing information. Justify!

\[ \text{Cyclohexane} \xrightarrow{\text{Na} / \text{NH}_3, \text{EtOH}} \xrightarrow{\text{NBS}, \text{hv}, 0^\circ \text{C}} \xrightarrow{\text{NBS}, \text{hv}, 80^\circ \text{C}} \]

14. Propose a mechanism to account for the following reaction.

\[ \text{[Structure]} \xrightarrow{\text{NaNH}_2 \text{(excess)}} \text{[Product]} \]

15. Circle correct answers. (EWG / EDG) are most activating in the (ortho / meta / para) position of an aromatic ring for EAS. (EWG / EDG) are most activating in the (ortho / meta / para) position for NAS.
16. Which of the following is the reactive electrophile in the nitration of aromatic rings?
   
   a) $\text{NO}_3^-$ 
   b) $\text{NO}_2$ 
   c) $\text{NO}_2^-$ 
   d) $\text{NO}_3^+$

17. Provide the product of the following reaction:

   \[
   \begin{array}{c}
   \text{Br}_2 / \text{FeBr}_3 \\
   \end{array}
   \]

18. Explain why the following synthesis was unsuccessful.

   1) $\text{HNO}_3 / \text{H}_2\text{SO}_4$
   2) acetyl chloride, $\text{AlCl}_3$
   3) $\text{Zn (Hg)}, \text{HCl}$