Chemistry 3B, Midterm 1

Tuesday, October 8, 2002

Student name: ____________________________

Student signature: ________________________

Write TA's name or Lecture Only: ____________

1. Please make sure that the exam has 9 pages including this one.

2. Please write your answers in the spaces provided.

3. Write clearly; illegible or ambiguous answers will be considered incorrect.

4. Only writing implements are allowed (No Calculators).

GOOD LUCK!

1. 8 points
2. 30 points
3. 50 points
4. 37 points
5. 35 points
6. 20 points

Total 180 points

MINI-PERIODIC TABLE

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</table>
1. Provide structures for the following chemical names (8 points)

- m-chlorobenzoic acid
- benzyl chloride
- 2-chloro-3-fluorotoluene
- 3,4-dimethoxybenzaldehyde

2. Answer the following questions. Every wrong answer cancels a correct answer (30 points).

(a). Rank the compounds according to those that would react most rapidly with Br₂, FeBr₃ to those that would react the least rapidly [1 = most rapid, 5 = least rapid] (6 points).

(b). Circle the compounds that are aromatic (6 points).

(c). Circle the compounds that are anti-aromatic (6 points).
(d). Rank the dienes according to those that would undergo a Diels-Alder from most to least rapidly [1 = most rapid, 5 = least rapid] (6 points).

(c). Upon treatment with methanol, each of the following compounds produces methyl ether products with the rate-determining step being formation of a carbocation intermediate. Rank the compounds from 1 to 5 for rate of reaction [1 = fastest rate, 5 = slowest rate] (6 points).

3. For each of the following reactions supply the missing reagents or major organic product in the space provided. If no reaction is expected indicate by N.R. (50 points total).

(a)

(b) Iodination is a very stable intermediate, which undergoes iododide.

N.B. It is more stable than bromodide.

(b) Please refer to directive exercise 1.

(c)

1. HNO₃, H₂SO₄
2. H₂SO₄, Δ

(d)
4. 35 points total.

(a) Show an energy level diagram for the molecular orbitals of the tropylum anion drawn below (10 points).

(b) Place the electrons in the appropriate molecular orbitals. Does the electron placement establish the molecule as aromatic or antiaromatic? Briefly explain (one sentence is all that is necessary) (5 points).
(c) Show an energy level diagram for the molecular orbitals of the cyclopentadienyl anion drawn below (10 points).

(d) Place the electrons in the appropriate molecular orbitals. Does the electron placement establish the molecule as aromatic or antiaromatic? Briefly explain (one sentence is all that is necessary) (5 points).

(c) The compound below has a rather large dipole moment. Indicate what you think that that dipole moment might be (with an arrow: NOT a number) and give a brief explanation. Hint: draw resonance structures (7 points).
5. Provide detailed mechanisms for the following transformations (35 points).

(a) 20 points

\[
\text{benzene} + \begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} \xrightarrow{\text{AlCl}_3} \text{product}
\]

\[
\begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} \xrightarrow{\text{step 1}} \begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} \xrightarrow{\text{step 2}} \begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} \xrightarrow{\text{step 3}} \begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} \xrightarrow{\text{step 4}} \begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} + \text{AlCl}_3
\]

\[
\begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} \xrightarrow{\text{step 1}} \begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} \xrightarrow{\text{step 2}} \begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} \xrightarrow{\text{step 3}} \begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} \xrightarrow{\text{step 4}} \begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} + \text{AlCl}_3
\]
(b) 15 points

\[
\begin{align*}
\text{CH}_2=\text{CH}_2 & \xrightarrow{\text{DCI}} \text{CH}_2=\text{CH}_2\text{D} + \text{CH}_2=\text{CH}_2\text{D} \\
\text{CH}_2=\text{CH}_2 & \xrightarrow{\text{H}_2\text{O}+\text{H}^+} \text{CH}_2=\text{CH}_2^+ \xleftarrow{\text{H}_2\text{O}} \text{CH}_2=\text{CH}_2^+ \xrightarrow{\text{H}_2\text{O}+\text{H}^+} \text{CH}_2=\text{CH}_2^+ + 2\text{H}_2\text{O}
\end{align*}
\]
6. Provide the most efficient synthesis. You may employ any reagents of your choice (20 points).

Wrong order. Can't do FC on brominated benzene.