Chemistry 140B
Whitesell
Winter Quarter, 2013
2nd Exam, Monday March 4

first name     middle initial     last name

Student ID Number

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Key

Your answers to this exam are to be only your own work. You may use no written information during this test period other than the seven pages of this exam. You may not use the back of any pages for answers. You may submit your exam for regrading if and only if you have made NO marks on the exam except for a star (*) ON THIS PAGE next to the number(s) of the question(s) you would like regarded and your signature(s) and check(s) below. Exams must be turned in no later than 1 week exactly from the date of the notice on TED that they are available.

your signature (read the above before signing)

To request regrading, sign below and check the appropriate box(es).

your signature

I would like the questions marked with a star (*) regraded (check box at right)
If you feel that we have made an addition error in your score, check the box at the right
If you believe your grade was recorded incorrectly on TED, check the box at the right
1a. In electrophilic, aromatic substitution, the correct order of rates of reaction for the following substituent present on the ring is:

- OOH > -CH₃ > -Cl > -NO₂
- -CH₃ > -OH > -NO₂ > -Cl

b. In electrophilic, aromatic substitution, a bromine substituent on a benzene ring is:

- Activating, o,p directing
- Deactivating, o,p directing

b. In electrophilic, aromatic substitution, a bromine substituent on a benzene ring is:

- Activating, o,p directing
- Deactivating, o,p directing

- Activating, m directing
- Deactivating, m directing

c. In electrophilic, aromatic substitution, an acyl substituent on a benzene ring is:

- Activating, o,p directing
- Deactivating, o,p directing

- Activating, m directing
- Deactivating, m directing

d. The correct bond energy (in kcal/mol) for an allylic CH bond (as in H₂C=CH–CH₃) is:

- 111
- 88

- 101
- 98.6

e. Cyclic structures are aromatic when:

- the number of atoms in the ring = 4n + 2
- the number of atoms in the ring = 4n
- the number of pi electrons in the ring = 4n + 2
- the number of pi electrons in the ring = 4n

f. The aromatic stabilization energy (in kcal/mole) of benzene is:

- 21
- 16

- 36
- 28
2. Show the mechanism for each of the following electrophilic aromatic substitution reaction. Your mechanism must include curved arrows showing the flow of electrons for all bonds made and broken. Answers outside the provided box will not receive credit.

![Mechanism Image]

3. Provide a complete mechanism including curved arrows showing the flow of all electrons for all bonds made and broken for the following reaction. Answers outside the provided boxes will not receive credit.

![Mechanism Image]

Your signature (in ink)___________________________
4. Provide a complete set of reagents that can be used to accomplish each of the following transformations. Your answers must fit entirely within the boxes provided.

\[ \text{Sn} \quad HCl \]

\[ \text{H}_{2}SO_{4} \quad \text{H}_{2}O \Delta \]

5. Provide a sequence of reactions (including required reagents) that could be used to prepare the alcohol below from any combination of organic molecules none of which has more than 4 carbon atoms. Your answer must fit in the box provided.

Your signature (in ink) __________________________
6. Provide the expected major organic product from each of the following reactions. Show ONLY one enantiomer for products with one center of chirality. If two centers are present in the product, you must show relative stereochemistry but, again, show only one enantiomer. You must place your answer in the box provided. Answers outside the boxes will not receive credit.

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\begin{align*}
\text{C}_6\text{H}_5 & \text{H}_3\text{COCl} \quad \text{AlCl}_3 \\
\text{C}_6\text{H}_5\text{Cl} & \text{CH}_3\text{CH}_2\text{Cl} \\
\text{O} & \\
\text{C}_6\text{H}_5 & \text{HNO}_3 \quad \text{H}_2\text{SO}_4 \\
\text{C}_6\text{H}_5 & \text{Cl}_2 \quad \text{FeCl}_3 \\
\text{C}_6\text{H}_5\text{NO}_2 & \text{SO}_3 \quad \text{H}_2\text{SO}_4
\end{align*}
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7. Provide the expected major organic product from each of the following reactions. You must place your answer in the box provided. Answers outside the boxes will not receive credit.
8. Provide the appropriate phasing of the p orbitals that would result in the 3 molecular orbitals of an allylic anion. They must be show going from highest energy at the top to lowest at the bottom. Indicate the number of electrons in each orbital in the boxes provided. If there are none, write a zero.

![Diagram of p orbitals and number of electrons](image)