Chemistry 140B
Whitesell
Spring Quarter, 2013
Second Midterm Exam, Wednesday May 29, 2013

first name middle initial last name

Student ID Number

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Your answers to this exam are to be *only* your own work. You may use no written or electronic information during this test period other than the six pages of this exam. You may not use the back of any pages for answers. Up to one week (exactly 168 hours) after your exam is available you may submit it 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. You must place your exam in the drop box on the sixth floor of PAC Hall.

your signature (**read the above before signing**)  

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

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your signature

I would like the questions marked with a star (*) reggraded (check box at right)
If you feel that we have made an addition error in your score, check the box at the right
If we have recorded your grade on TED in error, check the box at the right
1. 
   a. In electrophilic, aromatic substitution, a bromine substituent on a benzene ring is:
      - [ ] Activating, o,p directing
      - [X] Deactivating, o,p directing
      - [ ] Activating, m directing
      - [ ] Deactivating, m directing
   b. In electrophilic, aromatic substitution, a nitro group on a benzene ring is:
      - [ ] Activating, o,p directing
      - [ ] Deactivating, o,p directing
      - [ ] Activating, m directing
      - [X] Deactivating, m directing
   c. In electrophilic, aromatic substitution, an alkyl group on a benzene ring is:
      - [X] Activating, o,p directing
      - [ ] Deactivating, o,p directing
      - [ ] Activating, m directing
      - [ ] Deactivating, m directing
   d. In electrophilic, aromatic substitution, an acyl group on a benzene ring is:
      - [ ] Activating, o,p directing
      - [ ] Deactivating, o,p directing
      - [ ] Activating, m directing
      - [X] Deactivating, m directing
   e. In the average bond energy system, the strength of the pi bond of a ketone is:
      - [ ] 104 kcal/mole
      - [X] 179 kcal/mole
      - [ ] 86 kcal/mole
      - [ ] 93 kcal/mole
   f. In the average bond energy system, the strength of the sigma C—O bond of a ketone is:
      - [ ] 104 kcal/mole
      - [X] 86 kcal/mole
      - [ ] 179 kcal/mole
      - [ ] 93 kcal/mole
   g. Cyclic structures in which all of the atoms are sp² are aromatic when:
      - [ ] the number of atoms in the ring = 4n + 2
      - [ ] the number of atoms in the ring = 4n
      - [X] the number of pi electrons in the ring = 4n + 2
      - [ ] the number of pi electrons in the ring = 4n
2. Provide a synthetic pathway that could be used to make the compound shown below from any combination of inorganic reagents and any combination of organic compounds so long as none has more than four carbon atoms. Your answer must fit entirely within the box.
3. Provide a complete mechanism including curved arrows showing the flow of all electrons for the following reaction. Your answer must fit within the box provided.
4. Provide the expected major organic product from the following reactions that have a box at the right. Only show the initially formed product even when that product can undergo further reaction. Provide a starting material that will be transformed to the given product when there is a box at the left. Provide reagents that will effect the shown transformation when there is a box over the arrow. Do not show stereochemistry. You must place your answer in the box provided. Answers outside the boxes will not receive credit.

![Chemical reactions diagram]
5. The proton nmr spectrum shown below was obtained on a compound with the formula: C$_7$H$_{14}$O. Provide a structure in the box provided that is consistent with the spectrum.

6. Provide the structure of the electrophile that reacts with an aromatic compound for each of the following reaction.

- Nitration
- Acylation
- Bromination with Br$_2$ and FeBr$_3$
- Alkylation with CH$_3$Cl

Your signature (in ink)