Chemistry 140A
Whitesell
Winter Quarter, 2013
Final Exam, Monday March 18

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    first name    middle   last name
           initial

Student ID Number

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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 boxe(s).

__________________________
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. Second order substitution reactions do not occur with the following class of substituents (check all that apply, no partial credit):

- methyl
- secondary
- primary
- tertiary

b. E2 reactions can be used to make alkenes where there is more elimination than substitution for which class of substituents (check all that apply, no partial credit):

- methyl
- secondary
- primary
- tertiary

- polar aprotic solvent
- nonpolar aprotic solvent

c. Dimethyl sulfoxide is an example of a:

- polar protic solvent
- nonpolar protic solvent
- polar aprotic solvent
- nonpolar aprotic solvent

d. Select the molecule with the highest boiling point:

- CH₄
- NH₃
- H₂O
- CH₃OH

e. The “average” strength of a C—C sigma bond is:

- 99
- 83
- 104
- 63

f. The “average” strength of a C=C pi bond is:

- 99
- 83
- 104
- 63

g. The “average” strength of a C—H bond is:

- 99
- 83
- 104
- 63

h. Select the preferred base for E2 reactions:

- hydroxide ion
- ammonia
- methoxide ion
- tertiary butoxide ion

i. Carbocations undergo rearrangements when (check all that apply, no partial credit):

- secondary -> tertiary
- tertiary -> tertiary
- secondary -> primary
- secondary -> secondary

j. A difference in delta G of 2.7 kcal/mole will result in an equilibrium ratio of:

- 1:1
- 100:1
- 10:1
- 1000:1
2. Show the mechanism for the following reaction. Your mechanism must include curved arrows show the flow of electrons for all bonds made and broken. Answers outside the provided box will not receive credit.

![Chemical structure diagram]

3. Using the basic Newman projection shown below, draw the conformation of 2-bromobutane that will produce trans-2-butene by E2 elimination reaction when treated with a base. You may use either enantiomer.

![Newman projection diagram]

Your signature (in ink)_____________________________
4. Provide the expected major organic product from each of the reactions below. You must provide stereochemistry if appropriate. If a racemic mixture is formed, show only one enantiomer. If two centers of chirality are produced, show relative stereochemistry but only one enantiomer.

- \( \text{Br}_2 \) 

- \( \text{Br}_2, \text{H}_2\text{O} \) 

- \( \text{HCl}_3, \text{NaOH} \) 

- \( 1) \text{B}_2\text{H}_6, 2) \text{H}_2\text{O}_2, \text{NaOH} \) 

- \( \text{H}^-, \text{H}_2\text{O} \) 

- \( \text{H}_2, \text{Lindlar Cat.} \) 

- \( \text{Na, EtOH, liq. NH}_3 \)
5. Provide the expected major organic product from each of the reactions below. You must provide stereochemistry if appropriate. If a racemic mixture is formed, show only one enantiomer. If two centers of chirality are produced, show relative stereochemistry but only one enantiomer.

- $\text{Br}$ $\xrightarrow{\text{CH}_3\text{OH}}$ $\text{OCH}_3$ (heat)
- $\text{Br}$ $\xrightarrow{\text{NH}_3 \text{ (large excess)}}$ $\text{NH}_2$
- $\text{Br}$ $\xrightarrow{\text{K}^+ \text{CN}^-}$ $\text{C} \equiv \text{N}$
- $\equiv$ $\xrightarrow{\text{1) Na} \text{ NH}_2 \text{ 2) CH}_3\text{Br}}$ $\equiv \text{CH}_3$
- $\equiv$ $\xrightarrow{\text{1) Br}_2 \text{ in H}_2\text{O} \text{ 2) NaOH}}$
- $\text{OH}$ $\xrightarrow{\text{conc. HCl}}$
- $\text{OH}$ $\xrightarrow{\text{H}_2\text{SO}_4}$
6. Using the chair conformations shown below, draw the more stable conformations of 1,2-, 1,3-, and 1,4-dihydroxycyclohexane.

7. Show the mechanism for the following reaction. Your mechanism must include curved arrows show the flow of electrons for all bonds made and broken. Answers outside the provided box will not receive credit.
8. Provide a sequence of reactions that could be used to prepare the alcohol shown below. Provide all necessary reagents for each step. Your answer must fit entirely within the box provided. (You may start with anything that has no more than 2 carbons.)

\[
\text{OH} \quad \xrightarrow{\text{H}_2\text{O}} \quad \text{L} \quad \xrightarrow{\text{Cr} + 6} \\
\text{CHO} + \text{L} \quad \xrightarrow{\text{H}_2\text{O}} \quad \text{CH}_2\text{OH}
\]

9. Explain clearly why a tertiary carbocation is more stable than a secondary carbocation. You may use up to 30 words with or without pictures.

\[
\text{6 adjacent bonding pairs of electrons (only one shown)}
\]