If you would like your grade early, you must email me. I will reply once the grades are complete.

Name ___________________________

ORGANIC CHEMISTRY CH 351-03 (Wilson)
Final Exam
December 15, 2004

Question 1 _________ (24)
Question 2 _________ (20)
Question 3 _________ (21)
Question 4 _________ (30)
Question 5 _________ (42)
Question 6 _________ (39)
Question 7 _________ (24)
E. C. _________ (5)

TOTAL _________ (200)

“The intellect has little to do on the road to discovery. There comes a leap in consciousness, call it intuition or what you will, and the solution comes to you and you don't know how or why.”

- Albert Einstein
1. The following molecule is Vancomycin, an last defense antibiotic. Use it to answer the questions below.

   a. Circle and name six functional groups present. (2 pts each)

   b. Put a triangle around any sp\(^2\) hybridized carbon and any sp\(^2\) hybridized oxygen. Put a box around any sp\(^3\) hybridized carbon and any sp\(^3\) hybridized oxygen. (2 pts each)

   c. There are 17 stereocenters in this molecule. Draw an arrow to one R stereocenter and one S stereocenter and indicate which is R and which is S. (2 pts each)

2. For the following, use 3-bromo-4-chloro-hexane.

   a. Draw the structure using a “flat” representation below. (4 pts)
b. Draw four of the possible stereoisomers of this compound using “wedge and dash” on the flat representation. Label each stereocenter R or S. (6 pts)

c. Label each of the drawings in part b as A, B, C etc. Give the relationship between each of the compounds (i.e.: A&B are ____; B&C are ____; etc.). (6 pts)

d. Draw any one of the drawings in part b in a Newman projection, sighting down the C3-C4 bond. Clearly indicate your choice, and be sure that you have maintained stereocenters! (4 pts)

(21) 3. What is the relationship between the seven of the following eight sets of molecules (3 pts each)? Your choices are: identical compound; resonance structure; structural (constitutional) isomer; geometric isomer; enantiomer; diastereomer; completely different compound.

a. AND
b. 

\[
\begin{align*}
\text{CHO} & \quad \text{Cl} \\
\text{H} & \quad \text{H} \\
\text{CH}_2\text{OH} & \quad \text{CHO}
\end{align*}
\]

AND


c. (3Z)-3-methoxy-6-methyl-3-heptene

\[
\begin{align*}
\text{CH}_3\text{O} & \quad \text{HO}_2
\end{align*}
\]

AND

d. 

\[
\begin{align*}
\text{Et} & \quad \text{Me}
\end{align*}
\]

AND

e. (3R, 4R) 3,4-dimethyl-1-cylohexene

\[
\begin{align*}
\text{Me} & \quad \text{Et}
\end{align*}
\]

AND

f. 

\[
\begin{align*}
\text{C} & \quad \text{C}
\end{align*}
\]

AND

g. 

\[
\begin{align*}
\text{Br} & \quad \text{OH} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H}
\end{align*}
\]

AND

h. 

\[
\begin{align*}
\text{HO} & \quad \text{Br} \\
\text{HO} & \quad \text{H} \\
\text{H} & \quad \text{H}
\end{align*}
\]

AND
4. Synthesize the two of following three molecules using reasonable synthetic steps. Your legal starting materials include: mono-alcohols (R with one OH on it) of five carbons or less, mono-alkenes (R with one double bond on it) of five carbons or less, acetylene (HCCH), bases for elimination and deprotonation (KOtBu, nBuLi, NaNH₂, LDA, etc.), inorganic reagents (CN, NBS, mCPBA, CO₂, TsCl, and MsCl are all “inorganic”), and solvents as needed. Keep in mind that if a carbon-containing group is added to a molecule, **you must use legal starting materials or synthesize the appropriate piece**. Use good, high yielding steps that will work. Use steps that will give the piece you are carrying on as the major product. There may be many correct answers to these questions. Use hints and clues scattered through the rest of the exam! (15 pts each)
[This space left blank for your answer(s) for problem 4]
5. Give the IUPAC name for the starting material for **EACH** of the indicated reactions (3 pts each). Give the product(s) for **six** out of the **eight** questions below (5 pts each). Indicate clearly which questions you would like graded.

**a.**

\[
\text{1) NBS, light} \\
\text{2) H}_3\text{O}^+ \\
\text{3) NaCN, DMSO}
\]

**b.**

\[
\text{1) H}_2\text{, Lindlar's cat} \\
\text{2) Br}_2\text{, H}_2\text{O}
\]

**c.**

\[
\text{1) BH}_3\text{-THF} \\
\text{2) KOH, H}_2\text{O}_2 \\
\text{3) SOCl}_2
\]

**d.**

\[
\text{1) PBr}_3 \\
\text{2) KOtBu, EtOH} \\
\text{3) oxone, acetone}
\]
e. 

\[ \text{[cyclic structure]} \]

1) Br$_2$, light
2) KOMe, MeOH
3) O$_3$
4) Zn, H$_2$O

g. \[
\text{CH}_3\text{CH}_2\text{CH(iBu)}\text{CH}_2\text{CH(tBu)}\text{CH}_2\text{CH}_3
\]

1) Br$_2$ (xs), light
2) MeOH, heat

h. 

\[
\begin{align*}
\text{CH}_3 & - \text{Br} \\
\text{H} & - \text{CH}_3 \\
\text{H} & - \text{Br} \\
\text{CH}_3 & - \\
\end{align*}
\]

1) NaOH, acetone
2) KOMe, MeOH
6. Given the following four reactions, choose three and give reasonable mechanisms. Be sure to show each step, all intermediates, the flow of electrons from one step to the next, **ALL** resonance structures (if any), and form only the products indicated. There may be other products formed which are not shown. (13 pts each)

i. \[ \text{H}-\text{Br} \quad \text{tBu}-\text{O}-\text{O}-\text{tBu} \quad -70^\circ\text{C} \]

ii. \[ \begin{align*} \text{H}_3\text{O}^+ &+ \quad \text{OH}^- &+ \quad \text{OH}^- &+ \quad \text{EtO} \quad \text{EtO} \quad \text{H-I} \quad \text{EtO} \quad \text{EtO} \quad \text{EtO} \quad \text{I} \end{align*} \]

iii. \[ \text{EtO} \quad \text{EtO} \quad \text{H-I} \quad \text{EtO} \quad \text{EtO} \quad \text{I} \]

iv. \[ \text{OMs} \quad \text{iPrOH} \quad \text{heat} \quad \text{OiPr} \quad \text{OiPr} \quad \text{OiPr} \]
[This space left blank for your answer for problem 6]
7. Given the following roadmap questions, give structures for A, B and C (3 pts each). There is only one correct answer for each, however, partial credit may be given for correct answers carried through the reaction sequence. Keep in mind that there are molecular formulas given for a reason!

a. 

\[ \text{A} = \text{B} = \text{C} = \]

b. 

\[ \text{A} = \text{B} = \text{C} = \]

(5) BONUS: Give your favorite starting material for synthesis (2 pts). Give a reason why this is your favorite starting material (ex: what about it is useful, why do you like it, what makes it special to you?) (3 pts).