Check here if you DO NOT want your grade posted by the last four digits of your student ID#.

Name __________________________

Organic Chemistry CH 352-01 (Wilson)

Final Exam

May 3, 2001

NOTES: EACH carbon with the incorrect number of bonds and formal charge will cost you TWO points. EACH time an $S_N2$ reaction is performed on an $sp^2$ hybridized carbon, it will cost you FIVE points.

Question 1 _______ ()
Question 2 _______ ()
Question 3 _______ ()
Question 4 _______ ()
Question 5 _______ ()
Question 6 _______ ()
Question 7 _______ ()
Question 8 _______ ()
Question 9 _______ ()
Question 10 _______ ()
BONUS _______ ()

TOTAL _______ (200)

“Define ‘resonance’? Sure, that’s where you live.”

“Success consists of going from failure to failure without loss of enthusiasm.”

--Winston Churchill
1. Assistant Beaker is cleaning up the organic laboratory. He has found containers labeled “carboxylic acid derivatives” in the hood. Given just the IR spectra of the derivatives, determine what kind of derivative is in each container. Give reason(s) for each choice.

Container A

Container B
Given the following elemental analysis, MS, IR, $^1$H NMR, and $^{13}$C NMR spectra of a compound, answer the following questions.

Elemental Analysis: 71.1 % C; 5.1 % H; 23.8 % N.

Mass Spectrum:
IR:

13C NMR:

1H NMR:
a. What is the molecular formula of this compound? (3 pts)

b. What are the units of unsaturation for this compound? (3 pts)

c. What feature(s) is (are) present in the IR that indicate functional group(s)? Be specific, list peaks! (4 pts.)

d. What information, if any, does the $^{13}$C NMR spectrum give you (details like chemical shift and coupling patterns may be important here)? (5 pts)

e. What features about the $^1$H NMR spectrum indicate anything about functional groups or connectivity about the compound (details like integration, chemical shift, and/or coupling patterns may be important here)? (7 pts.)
4. The H-O on phenols is more acidic than regular alcohols, but less acidic than carboxylic acids. Draw the structures for p-methoxyphenol, o-cyano-phenol, and m-fluorophenol. Which one of these is the strongest acid (label it 1)? Which is the weakest acid (label it 3)? Give a thoughtful, but brief explanation to your answers. Drawings may be helpful.

5. Give the structures for A, B, and C for the following road map. There is only one correct answer, but incorrect answers which are carried through the problem may be given partial credit.
6. Give mechanisms for three out of the following four reactions. You may use the next blank page, or backs of pages if you wish. Be sure to include all pertinent resonance structures and arrow pushing to show the flow of electrons. Note: Small molecules (H₂O, CO₂, HCl, etc.) may be lost which are not shown as products!

I. \( \text{N}_2 \text{Cl} \rightarrow \text{N} = \text{N} - \text{O} \text{Me} \)

II. \( \text{KOH, heat} \rightarrow \text{CO}_2 \text{Me} + \text{CH}_3\text{NH}_2 \)

III. \( \text{TsOH} \rightarrow \text{O} \)

IV. (This page left blank for your work)
7. Synthesize the following three compounds, OR synthesize two and then one of those in a second unique way (judgment will be made as to how unique each synthesis is from the other). Legally allowable starting materials are: benzene; monofunctional organic molecules of four carbons or less (carboxylic acid derivatives are NOT monofunctional); unsubstituted dithiane; bases for deprotonation (KOTBu, LDA, etc.) and any inorganic reagent (NBS, PPh3, etc. are “inorganic”) or solvent required to carry out the transformation. Compounds containing nitrogen must derive their nitrogen from an inorganic source (NaCN,
NaN₃, HNO₃, etc.). You may always separate ortho from para products, if you show both.

(This page left blank for your work)
8. What are the products of the following reactions (choose 11 of the 14 shown!)? Be mindful of details such as stereochemistry and regiochemistry, and be aware of the possibility of having multiple products from a given reaction.

a. 

b. 

c. 

d. 

e. 

f. 

g.
9. Why would anyone use a protecting group? Give an example of what advantages this may have, if any.

10. Circle the best answer for **ALL** of the following questions.