Chem 331, Spring 2006

William Jenks

Name_____

PLEASE ALSO WRITE YOUR NAME ON THE TOP OF THE BACK OF YOUR EXAM

Please check off which recitation section you are registered for:

_____ Monday, 2:10 p.m.

_____ Monday, 4:10 p.m.

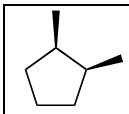
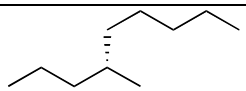
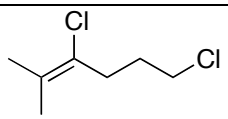
_____ Tuesday, 9:00 a.m.

_____ Tuesday, 11 a.m.

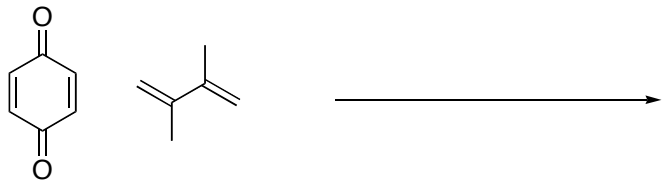
Final Exam
3 May, 2006

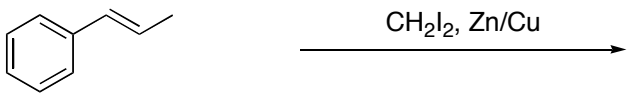
Problem (max score)	Score
I (30)	
II (15)	
III (15)	
IV (15)	
V (21)	
VI (20)	
VII (20)	
VIII (24)	
IX (20)	
X (20)	
Total (200)	

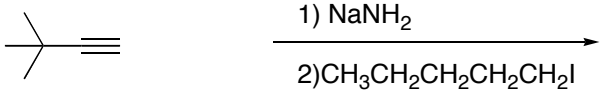
I. 30 points. Nomenclature. Provide the name or structure, as appropriate. Remember to indicate stereochemistry (e.g., R/S, *cis/trans,* or *E/Z* in names and hash/wedge in drawings) as needed.

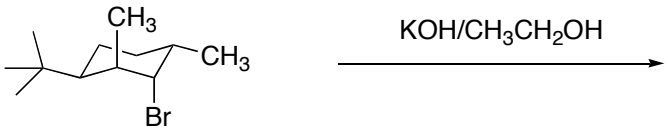
	
	
m-propylphenol	*p*-nitrotoluene
(*Z*)-2-chloro-5-methyl-2-heptene	1,1,-diphenylcyclooctane
3-bromothiophene (The numbering system starts with S="1").	5-(2-methylpropyl)-1-decyne

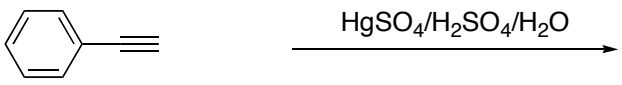
II. 15 points, 3 points each. Provide structures corresponding to the major organic products. You do not need to indicate small-molecule byproducts like NaCl or H_2O.



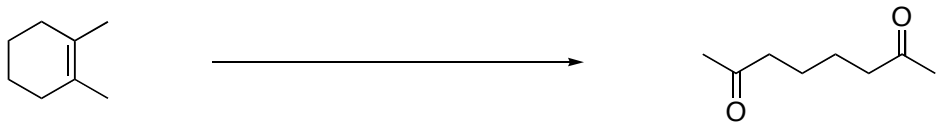


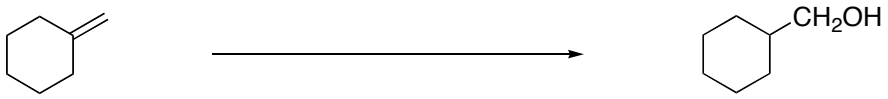


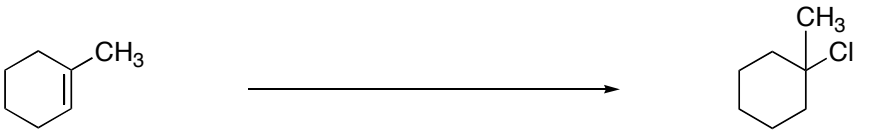


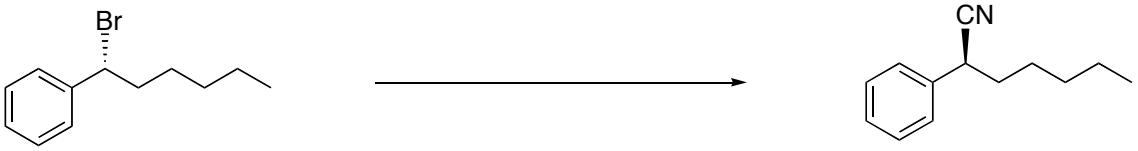


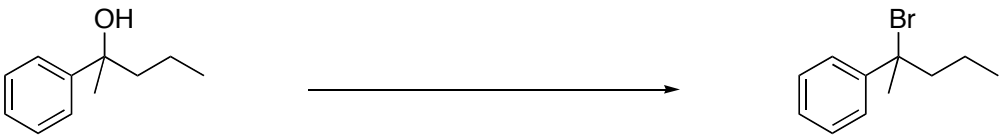
III. 15 points, 3 points each. Provide reagents/conditions to carry out the following transformations. Reagents should contain 4 carbons or fewer. (You may use any appropriate solvent that isn't directly involved.)



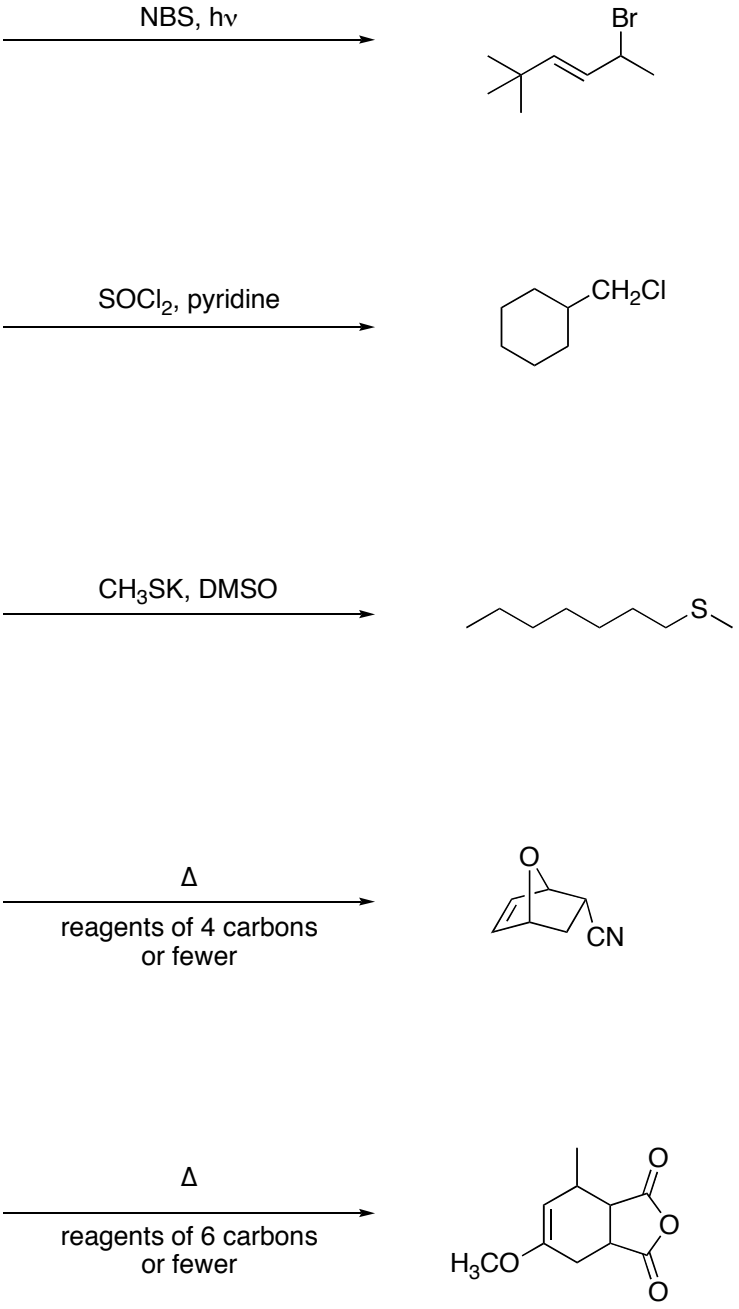








IV. 15 points, 3 each. Provide starting materials that would give the indicated products under the given reaction conditions.



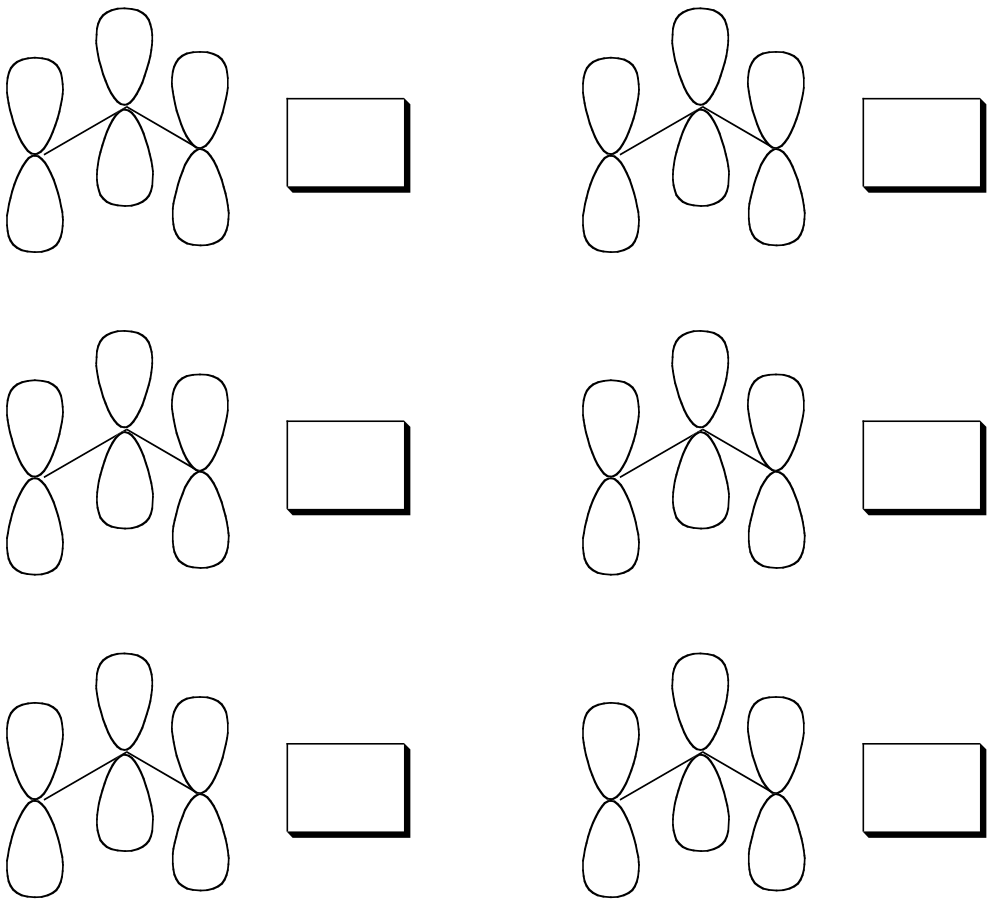
V. 21 points. Consider the allyl cation: $H_2C=CH-CH_2^+$.

How many π-type molecular orbitals are there in this three-carbon system? ¨ _____

How many electrons reside within this π-system? _____

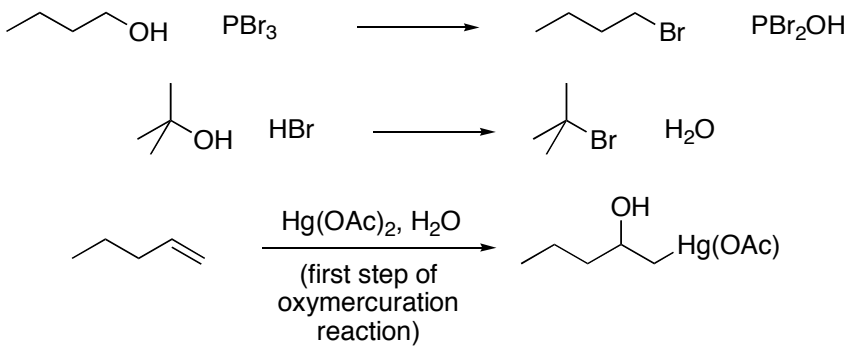
How many π-type orbitals will be filled? _____

Using the C-atom templates, sketch the molecular orbitals. (There may be more templates than you need.). Number them 1 through however-many-you-draw, with "1" being the lowest energy MO, 2 being the second-lowest energy MO, etc.

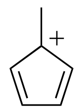


Indicate the filled MO(s) by circling.

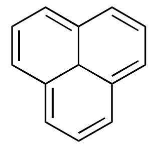
VI. 20 points. Draw out reasonable arrow-pushing mechanisms for **TWO** of the reactions shown below. (If you do more than two, only the first two will be graded.)



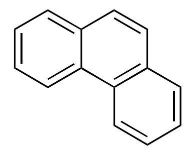
VII. 20 points. For each compound, indicate whether the molecule is aromatic, non-aromatic, or anti-aromatic (as drawn) by marking the appropriate line. *In the little boxes, write down the number of ^{13}C NMR signals the compound will have.*



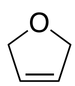
___ Aromatic
___ Not Aromatic
___ Anti-Aromatic



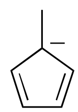
___ Aromatic
___ Not Aromatic
___ Anti-Aromatic



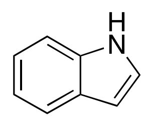
___ Aromatic
___ Not Aromatic
___ Anti-Aromatic



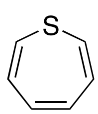
___ Aromatic
___ Not Aromatic
___ Anti-Aromatic



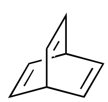
___ Aromatic
___ Not Aromatic
___ Anti-Aromatic



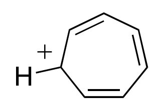
___ Aromatic
___ Not Aromatic
___ Anti-Aromatic



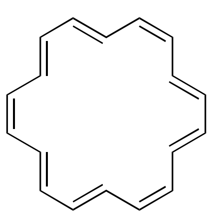
___ Aromatic
___ Not Aromatic
___ Anti-Aromatic



___ Aromatic
___ Not Aromatic
___ Anti-Aromatic

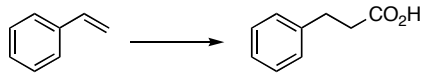


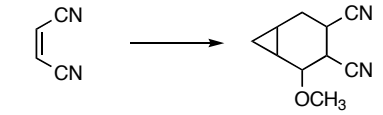
___ Aromatic
___ Not Aromatic
___ Anti-Aromatic

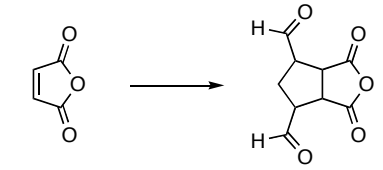


___ Aromatic
___ Not Aromatic
___ Anti-Aromatic

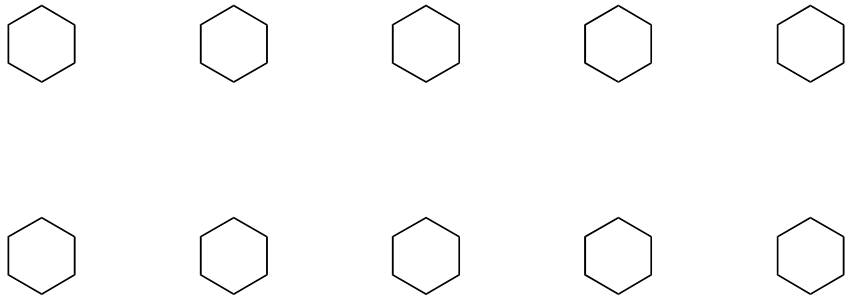
VIII. 24 points. Synthesis. Show how the following transformations could be accomplished using reagents containing 5 carbons or fewer. *More than one reaction is required*.

A 

B 

C 

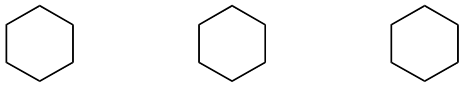
IX. 20 points. There are 8 possible stereoisomers of 1-chloro-3-fluoro-5-methylcyclohexane. Using the templates below, draw them using hash and wedge notation. (There are a couple of extra templates in case you make a mistake and want to cross one or two out.)



Pick a pair of stereoisomers of 1-chloro-3-fluoro-5-methylcyclohexane that are enantiomers, and put a circle around each of them.

Pick a pair of stereoisomers of 1-chloro-3-fluoro-5-methylcyclohexane that are diastereomers, and put a triangle around each of them.

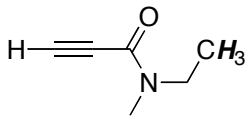
There are only two possible stereoisomers of 1,3,5-trichlorocyclohexane. Using the templates below, draw them using hash and wedge notation. (Again, there is an extra in case you make a mistake.)



Briefly explain why there are only two isomers. Why aren't there 8, like for the case of of 1-chloro-3-fluoro-5-methylcyclohexane?

Put a square around every *meso* stereoisomer of 1-chloro-3-fluoro-5-methylcyclohexane and 1,3,5-trichlorocyclohexane.

X. 20 points. Consider the following molecule and provide appropriate answers:



a. Indicate the hybridization (sp, sp^2, sp^3) at each carbon atom.

b. One methyl group has its H atoms indicated in bold-italic. What is the multiplicity of the ^1H NMR peak for that set of H's? (singlet, doublet, triplet, quartet, quintet, sextet or septet?)

c. The indicated structure is the best resonance form for this molecule. Draw another resonance form that contributes to the actual structure, i.e., another "reasonably good" resonance form.

d. What is the molecular weight of this compound?

e. Draw two other compounds with the same molecular weight.