



# West Virginia University

Bennett Department of Chemistry  
Chemistry 233

## Exam II

*April 9<sup>th</sup>, 2015*

Name: key

This exam is a closed book, closed notes.  
Calculators and a molecular model set are allowed.  
You must show your work in order to receive partial credited.

Question I (24 points): \_\_\_\_\_

Question II (37 points): \_\_\_\_\_

Question III (12 points): \_\_\_\_\_

Question IV (19 points): \_\_\_\_\_

Question V (9 points): \_\_\_\_\_

Question VI (19 points): \_\_\_\_\_

Total (out of 120): \_\_\_\_\_

Question I. Basic concepts (1.5 point each, 24 points total)

a) Label the following molecule with the right term (6 pts).

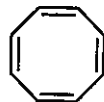
A: Aromatic; B: non-aromatic; C: anti-aromatic



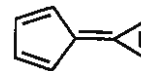
C



B



B



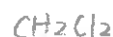
A

b) Give examples of the following term (6 pts).

Protic solvent



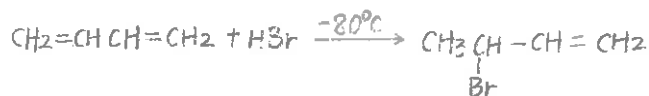
Aprotic polar solvent



1,4-Addition



Kinetic control



c) Draw the structure or the exact compounds for the following reagents (6 pts).

pyrrole



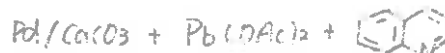
indole



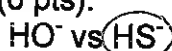
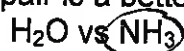
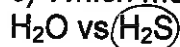
imidazole



Lindlar catalyst

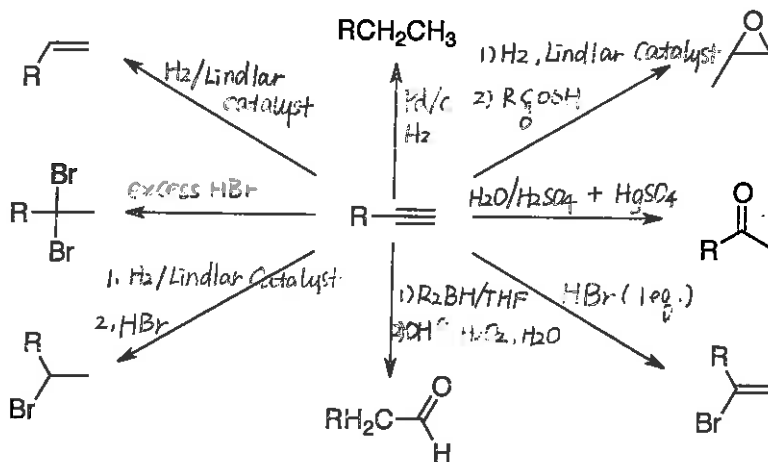


c) Which member of each pair is a better nucleophile (6 pts).

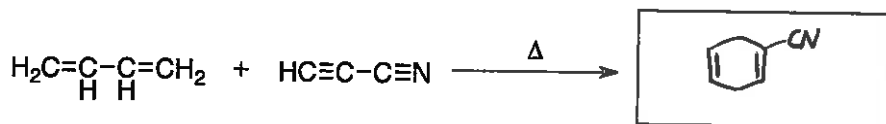
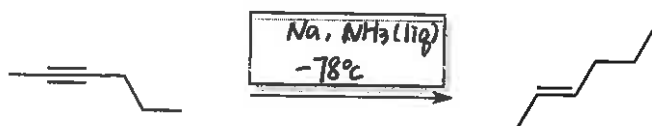
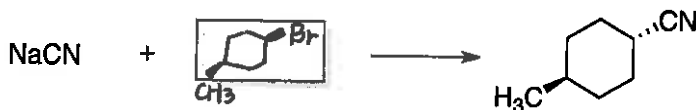


Question II. Reactions (37 points total)

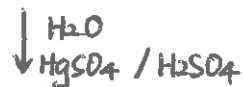
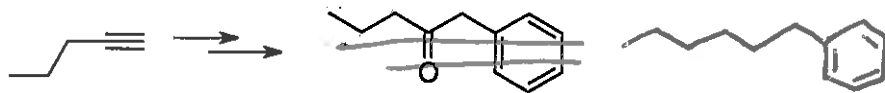
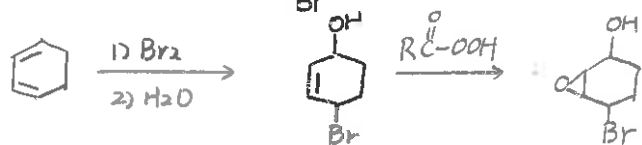
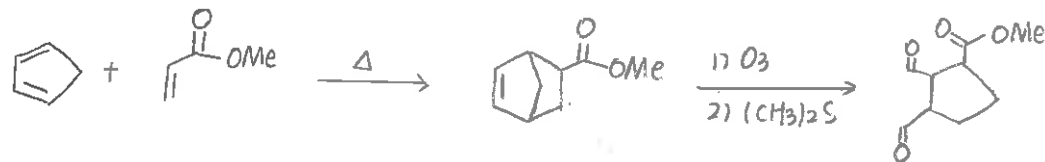
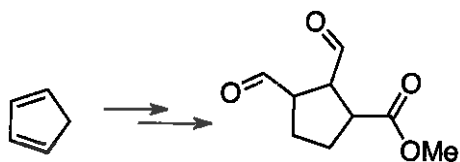
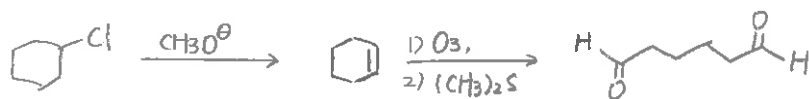
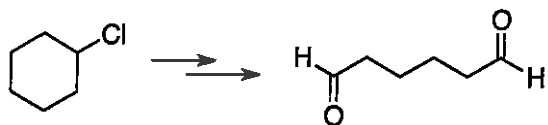
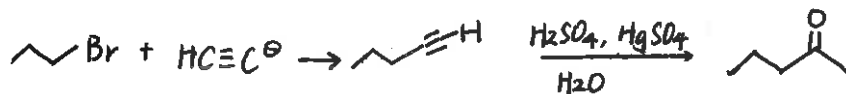
a) Draw the reagents needed for the following syntheses (12 pts).



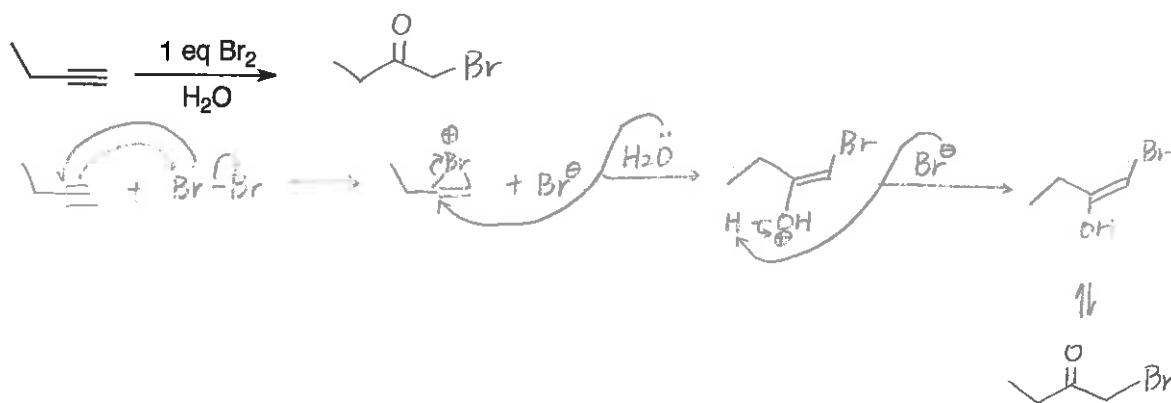
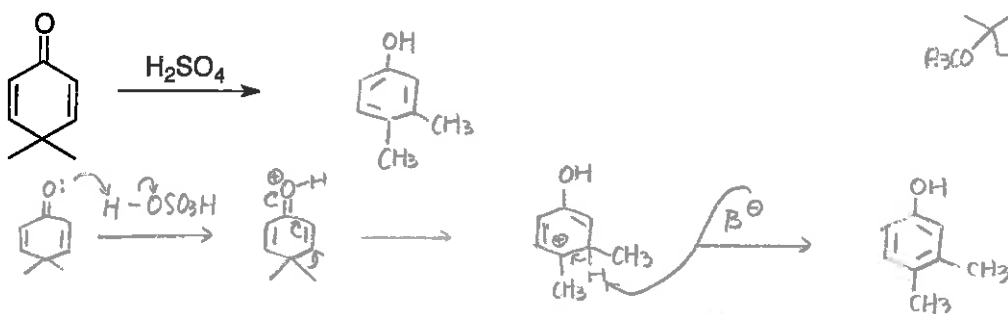
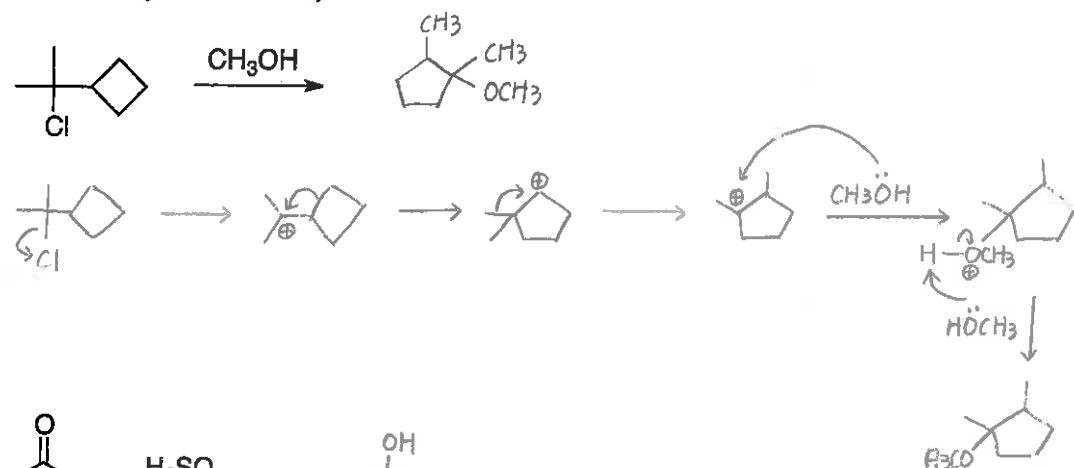
b) Fill in the blank for the following equation (2 points each, 10 pts total)



c) Synthesis the following molecules from the given starting materials (3 pts each, 15 pts total)



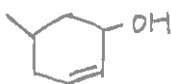
Question III. Provide the product and detailed electron pushing mechanism (4 pts each, 12 points total)



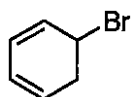
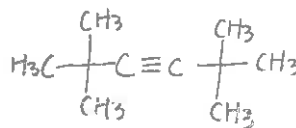
Question IV. Little things (19 points total)

a) Nomenclature: structure to name and name to structure (1.5 points each, 6 pts total)

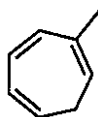
5-methyl-2-cyclohexenol



di-tert-butylacetylene

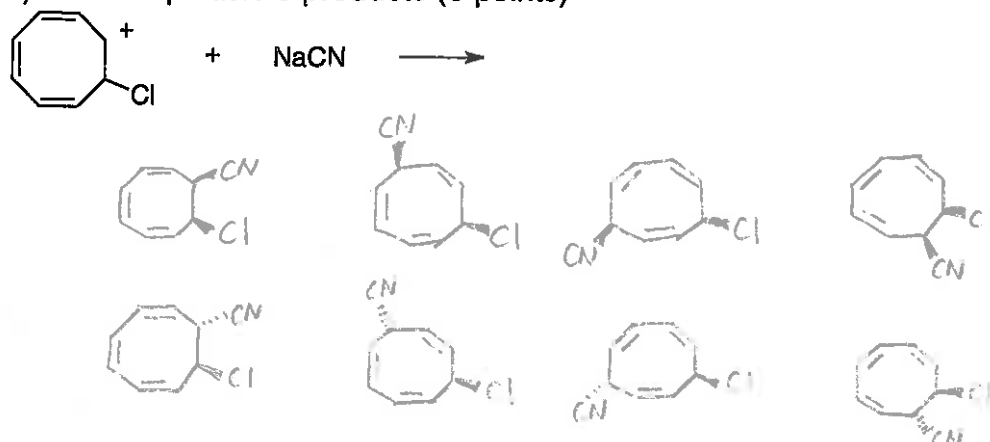


5-bromo-1,3-cyclohexadiene

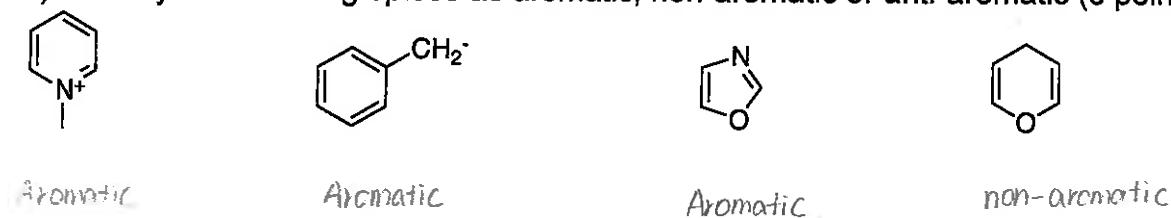


2-methyl-1,3,5-cycloheptatriene

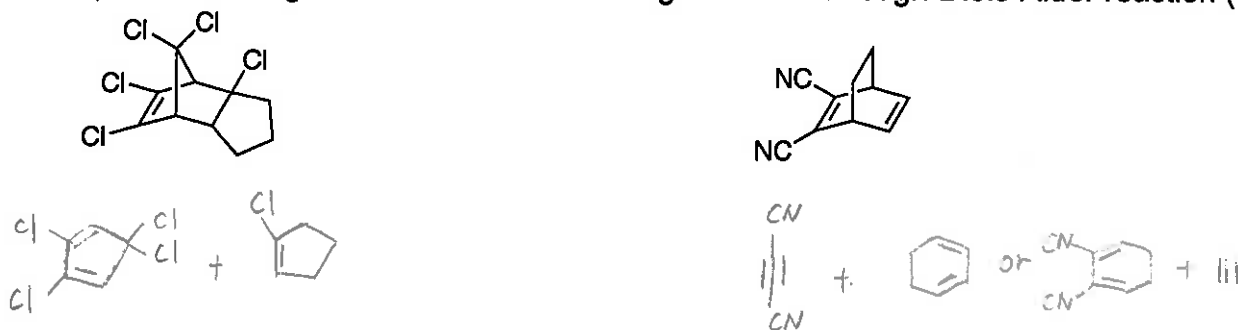
b) Draw all plausible products (3 points)



c) Classify the following species as aromatic, non-aromatic or anti-aromatic (6 points)

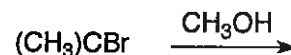
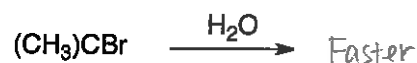
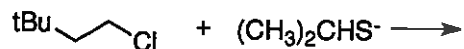
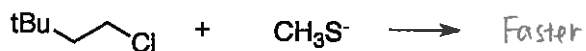


d) Draw starting materials for the following molecule through Diels-Alder reaction (4 pts)



Question V. Rank (9 points total)

a) Which reaction went faster? (3 points)



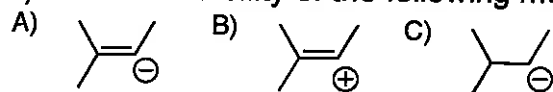
c) Explain why the following molecule is very hard to run substitution reaction? (2 pts)



It will not undergo an  $S_N2$  reaction because of steric hindrance to back-side attack.

It will not undergo an  $S_N1$  reaction, because the carbocation that would be formed is unstable since the ring structure prevents it from achieving the  $120^\circ$  bond angles required for an  $sp^2$  carbon.

d) Rank the stability of the following molecules and explain why. (3 points)

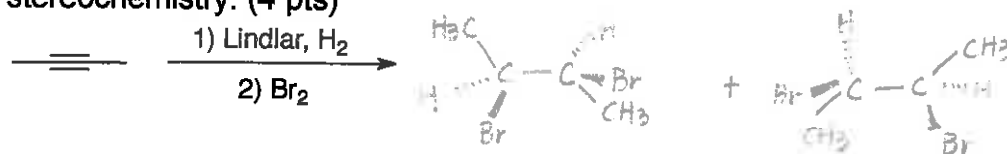


See exam 1

e) Structure of THF and why THF is better solvent than diethyl ether for positively charged species. (3 pts)

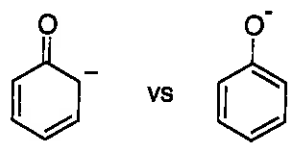
THF can solvate a charge better than diethyl ether can because the floppy ethyl substituents of diethyl ether provide steric hindrance, making it difficult for the nonbonding electrons of the oxygen to approach the positive charge that is to be solvated.

f) Draw the product of the following reactions and make sure clearly label the stereochemistry. (4 pts)



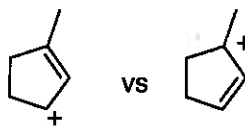
The end!

b) Which resonance contributor is more stable? (3 points)



vs

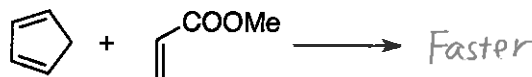
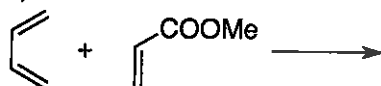
more stable



vs

more stable

c) Rank the reaction rate for the following reactions and explain why? (3 points)



is more reactive than because has the double bonds locked in an s-cis conformation while can exist in both s-cis and s-trans conformations.

Question V. Why questions (19 points total)

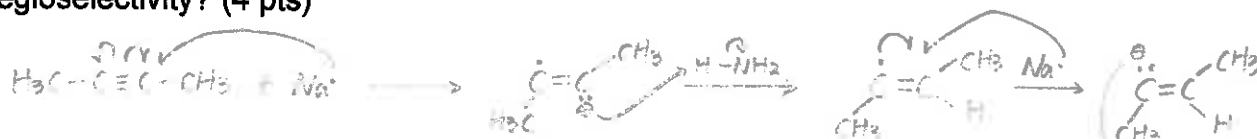
a) Draw the major product and explain why the regioselectivity? (3 pts)



-OMe is electron donating group, therefore, has its charge distribution as

-CN is electron withdrawing group, has the charge distribution as

b) Draw the detailed mechanism of of alkyne reduction by Na/NH<sub>3</sub>, explain the regioselectivity? (4 pts)



Both the radical anion and vinylic anion can have either the cis or the trans configuration. The cis and trans radical anions are in equilibrium, and so are the cis and trans vinylic anions. In each case, the equilibrium favors the trans isomer. The greater stability of the trans isomers is what causes the product to be a trans alkene.

