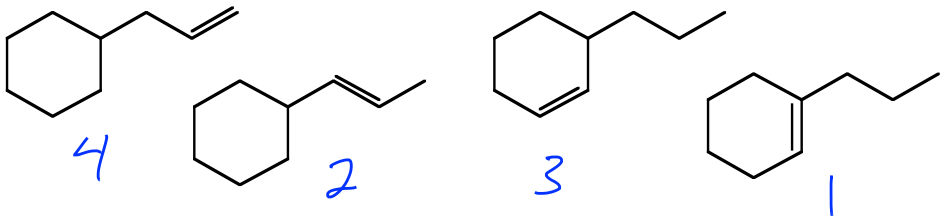
JASPERSE CHEM 350 FINAL EXAM VERSION 2

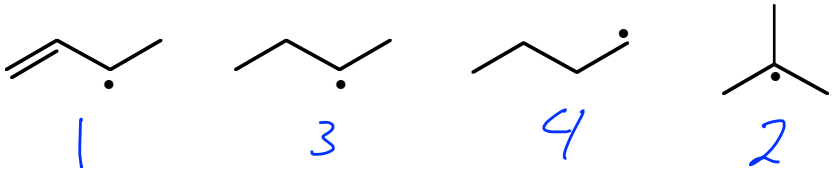
Note: Good for practice, but significantly longer than the real one will be.

1. Rank the Following, from most to least. 2 points each.

a. Stability

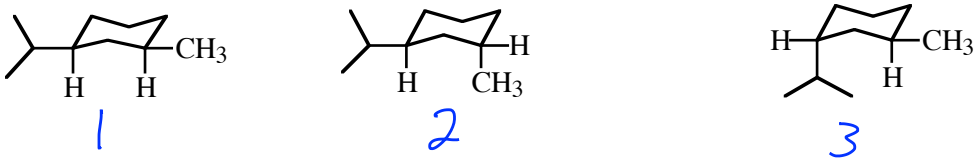


b. Stability



allylic > isolate 3° > 2° > 1°

c. Stability

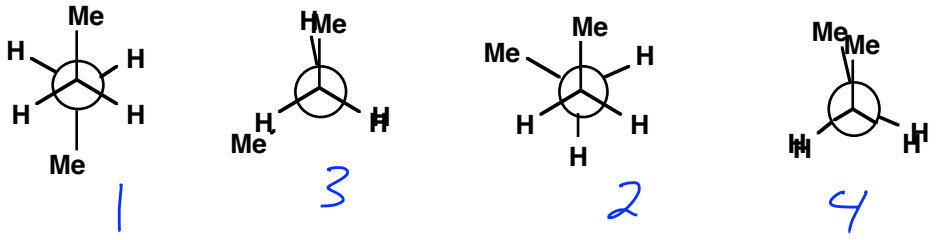


d. Acidity

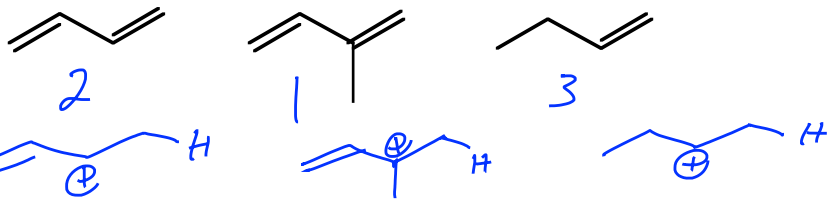
CH_3OH $PhCO_2H$ NH_3 CH_3CH_3

2 1 3 4

e. Stability

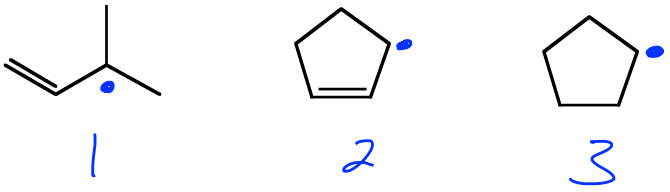


f. Reactivity toward HBr



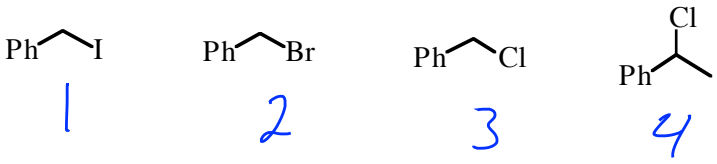
R⊕ stability

g. Reactivity toward Br_2/hv

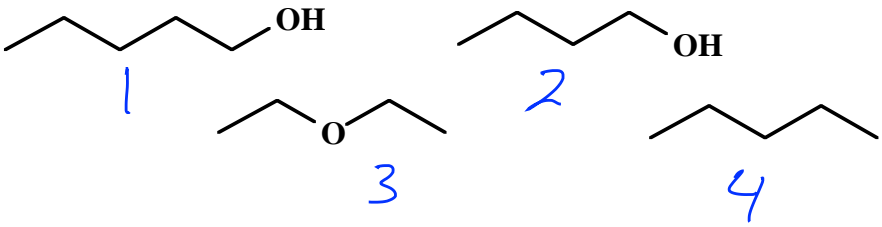


R•

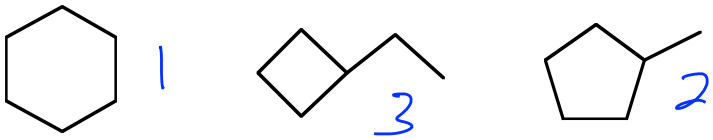
h. Reactivity toward S_N2



i. Boiling Point

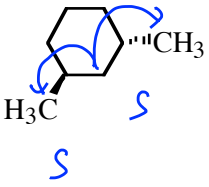


j. Stability



2. Provide names or structures for the following. 3 points each. Note: don't forget to specify stereochemistry!

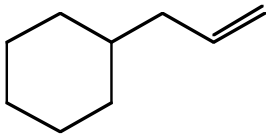
a.



trans-1,3-dimethylcyclohexane

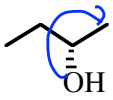
If optically active: (1S,3S)-1,3-dimethylcyclohexane

b.

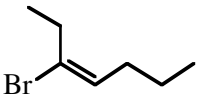


allylcyclohexane

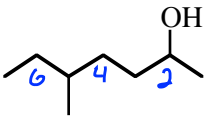
or 3-cyclohexylpropene

c. 

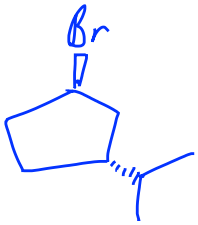
optically actve S-2-butanol

d. 

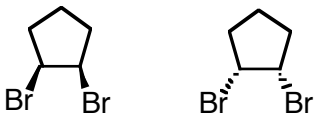
E-3-bromo-3-heptene

e. 

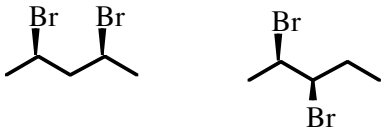
5-methyl-2-heptanol
or heptan-2-ol

f. trans-1-bromo-3-isopropylcyclopentane 

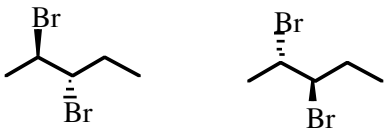
3. Classify the pairs of molecules as totally different, identical, structural isomers, diastereomers, or enantiomers. (2 points each)

a. 

same

b. 

structural isomers

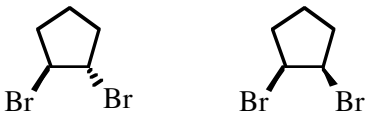
c. 

enantiomers

3. (continued) Classify the pairs of molecules as totally different, identical, structural isomers, diastereomers, or enantiomers. (2 points each)

d.  diastereomers

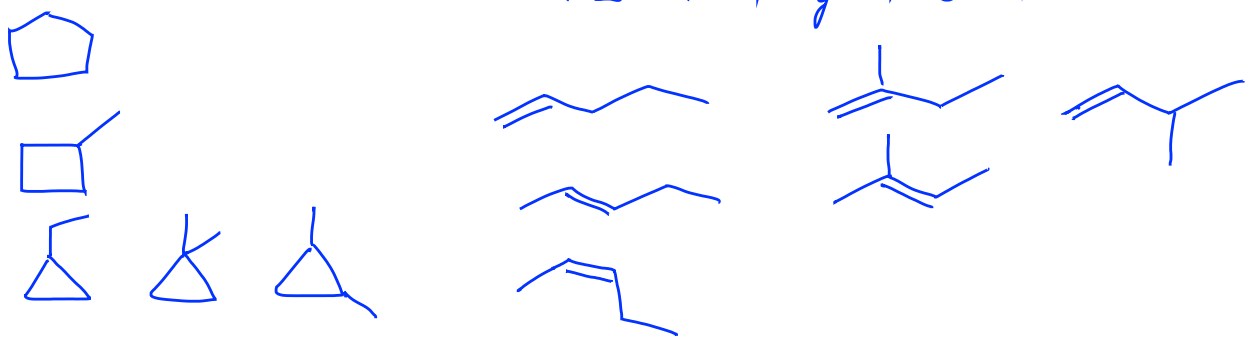
e.  identical

f.  diastereomers

f.  enantiomers

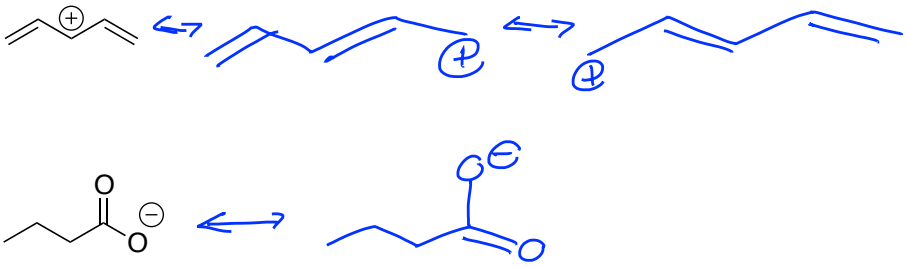
4. Draw at least four different isomers for C_5H_{10}. (There are lots more than four…) (6 points)

↳ EU=1 ring or alkene

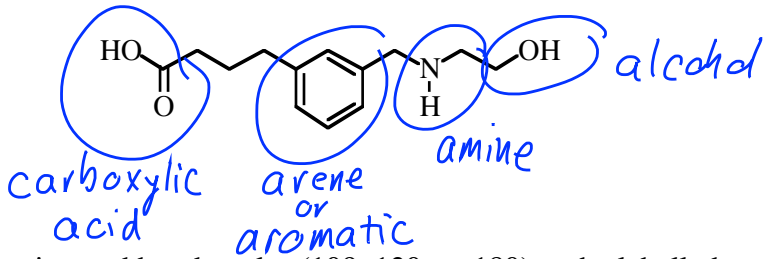


5. (a) Draw the appropriate number of lone pairs on the oxygen atom,
(b) Assign a formal charge on oxygen if appropriate,
(c) Draw an additional resonance structure for the following, and
(d) Identify which of the two structures would make the greater contribution to the hybrid. (4 points)

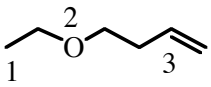
6. Draw resonance structures for each of the following:.



7. Identify the functional groups in the following molecule. (4 points)

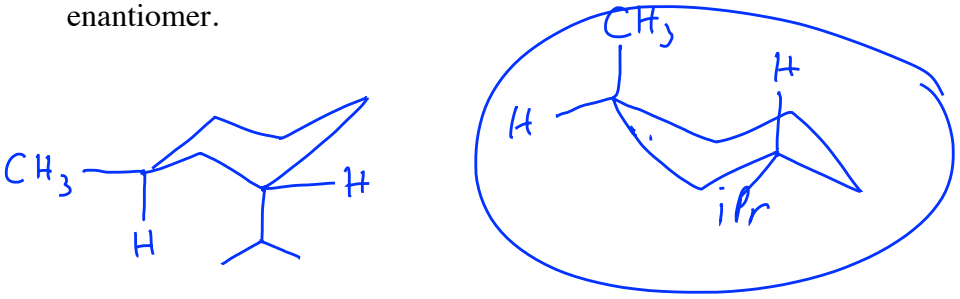


8. Classify the hybridization and bond angles (109, 120, or 180) at the labelled atoms. (4 points)



C-1 sp^3 109 O-2 sp^3 109 C-3 sp^2 120

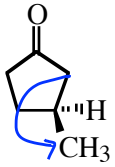
9. Draw both chair conformations of trans-1-methyl-3-isopropylcyclohexane, and circle the more stable one. (5 points.)
Note 1: It will simplify things if you abbreviate the isopropyl group as "R".
Note 2: Make sure that your second chair has the same "configuration" as the first, and is not an enantiomer.



10. Classify each chiral carbon as R or S. (Some structures may have more than one chiral carbon!) (2 points each)

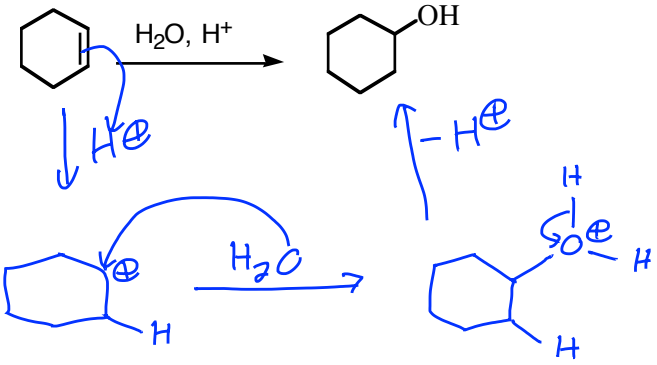
a. 

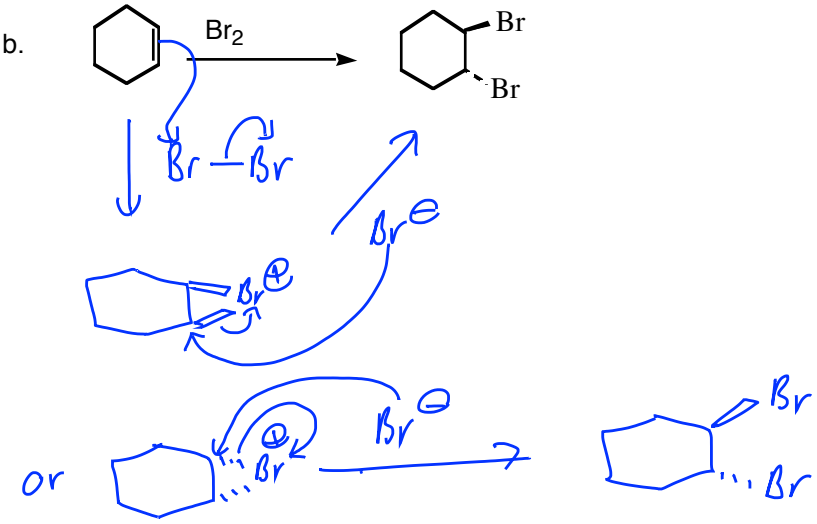
S

b 

S

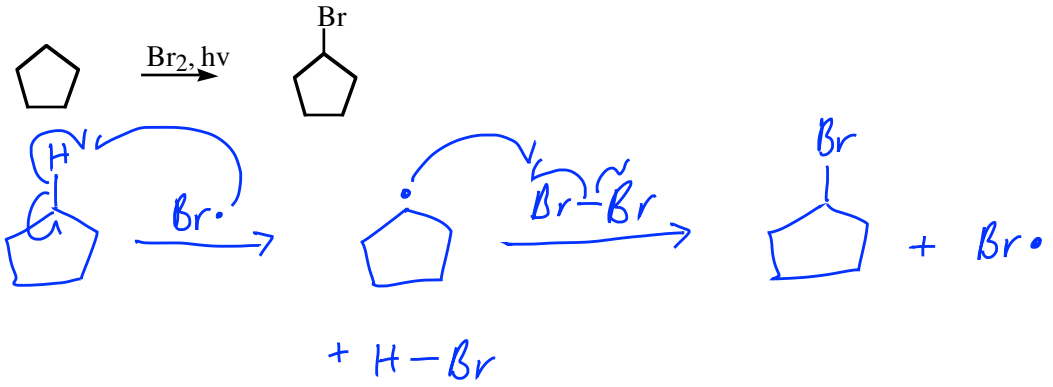
11. Mechanisms Problem. Draw the mechanism for the following reactions, and write "slow" next to the rate-determining step. Be sure to draw all intermediates, and to correctly draw "electron-movement" arrows or half-arrows. For radical reactions, draw propagation steps only. 4 points each.

a. 

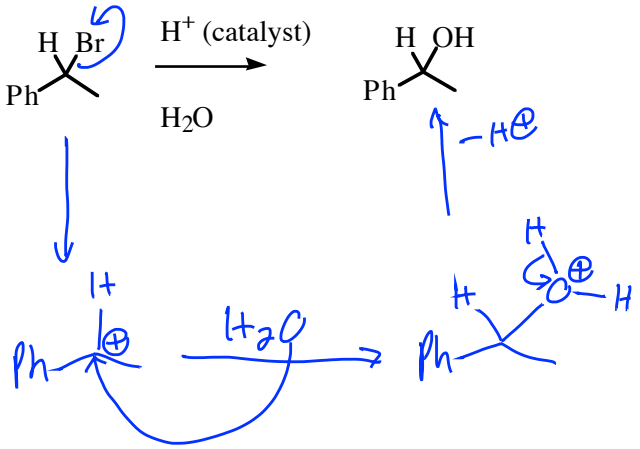
b. 

Mechs, continued

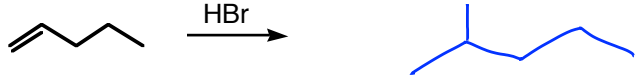
c.

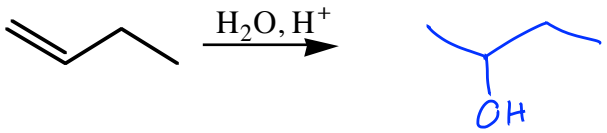


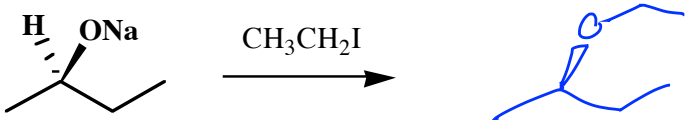
d.

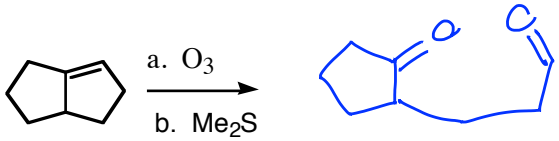


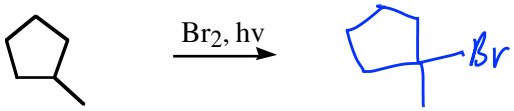
12. Predict the major products for the following reactions. In each case, pay careful attention to orientation and stereochemistry. Draw just one product in each case. (3 points each)

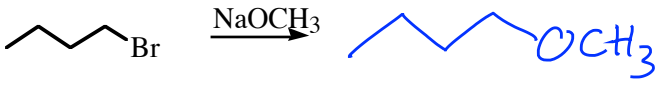
a. 

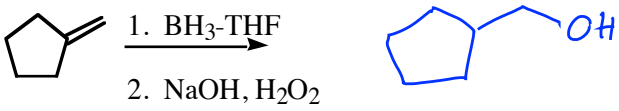
b. 

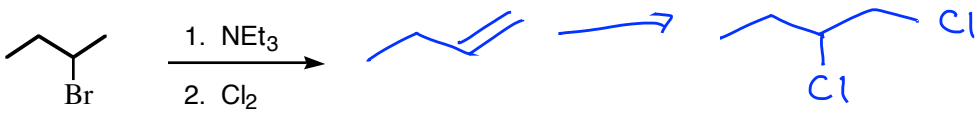
c. 

d. 

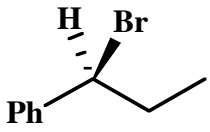
e. 

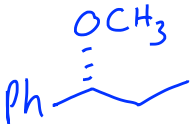
f. 

g. 

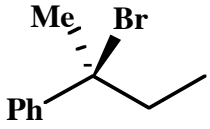
h. 

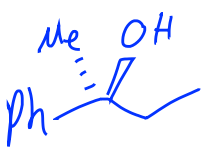
13. Draw the substitution products for the following reactions. (Do not draw any accompanying elimination products.) Include stereochemistry in your answer, and if two substitution products are formed, draw them both. Assume the starting material is optically active as drawn. (3 points each)

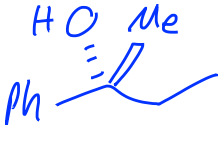
a. 

NaOMe → 

SN2
Inversion,
single isomer

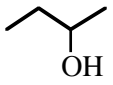
b. 

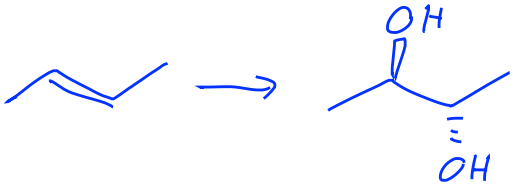
H_2O, cat. HBr → 

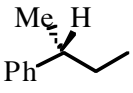
+ 

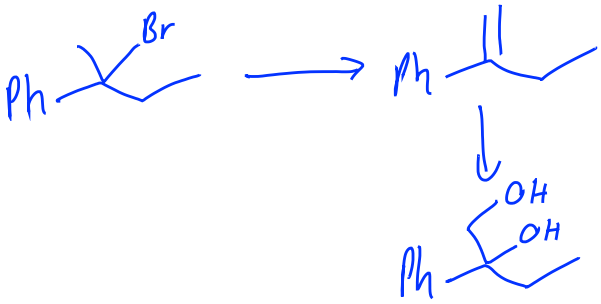
SN1
Racemization
Both enantiomers

14. Draw the products of the following multi-step sequences. (4 points each)

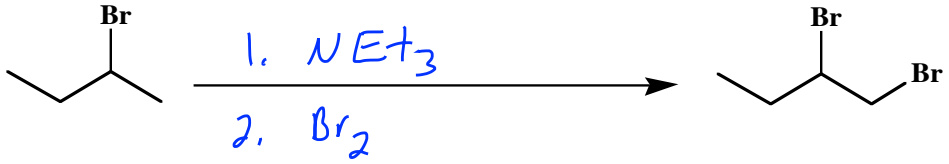
a. 

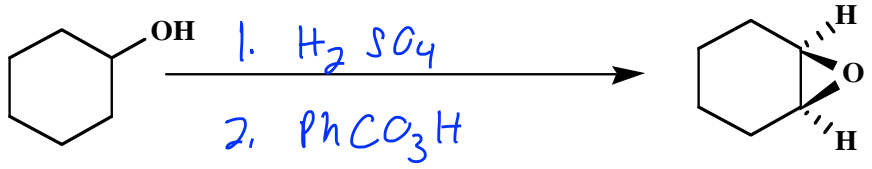
1. H_2SO_4
2. CH_3CO_3H, H_2O


b. 

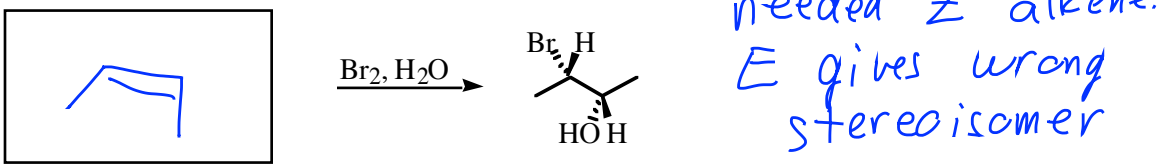
1. Br_2, hv
2. NEt_3
3. CH_3CO_3H, H_2O


15. Provide reagents for the following transformations. More than one step is needed in each case. (4 points each)

a. 

b. 

16. Provide the appropriate reactant for the following transformation. (3 points)



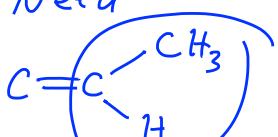
needed Z alkene.
E gives wrong stereoisomer

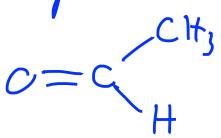
17. Suggest a structure for **A** that is consistent with the following information. (There is more than one possible solution, but you only need to provide one.) (5 points)

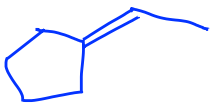
EU = 2
1 ring
1 alkene
(based on both hydrogenation + ozonolysis)

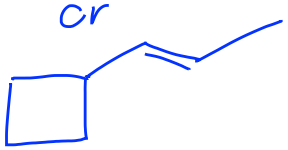
A C_7H_{12} achiral
1. O_3
2. Me_2S
→ **C** C_5H_8O achiral + C_2H_4O

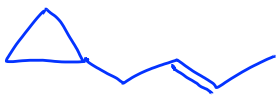
H_2, Pt
↓
B C_7H_{14} achiral

Need 

to give 

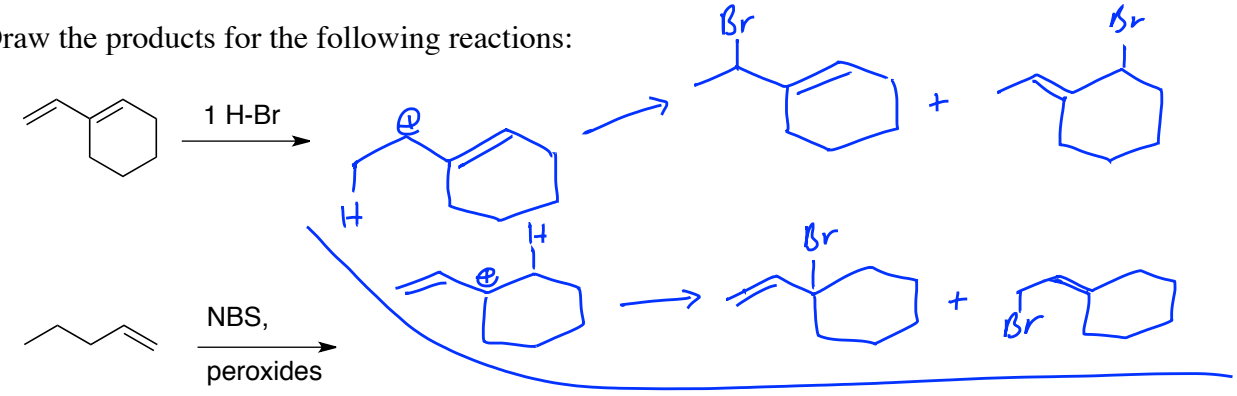
or 

or 

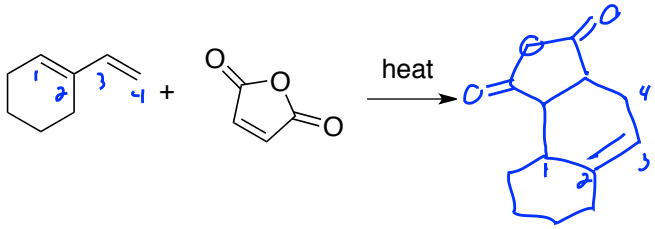


18. Draw the products for the following reactions:

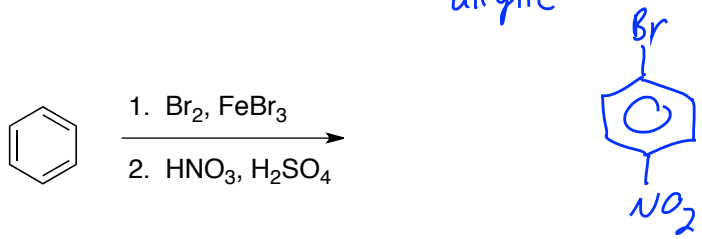
Flawed problem. Not clear which allylic cation you should use. Protonation on the left gives allylic where both + carbons are 2°; protonation on the right gives a hybrid of a 3°/1° cation.

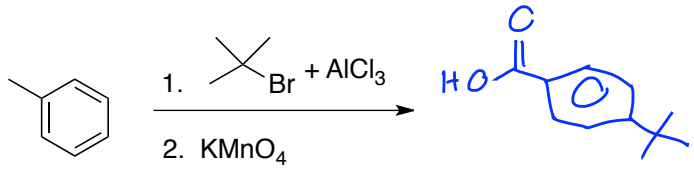
a. 

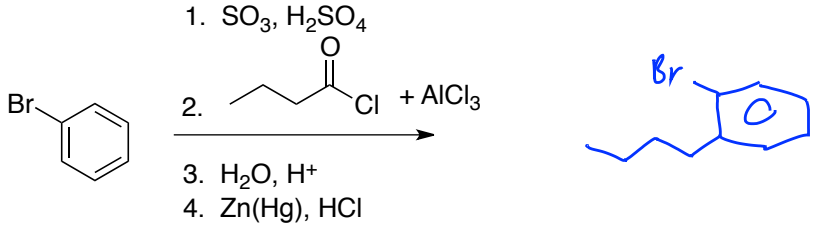
b. 

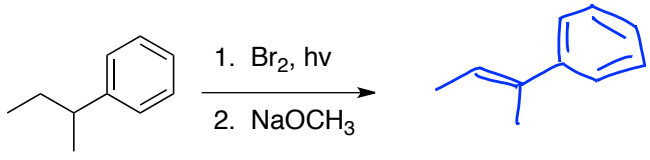
c. 

d. 

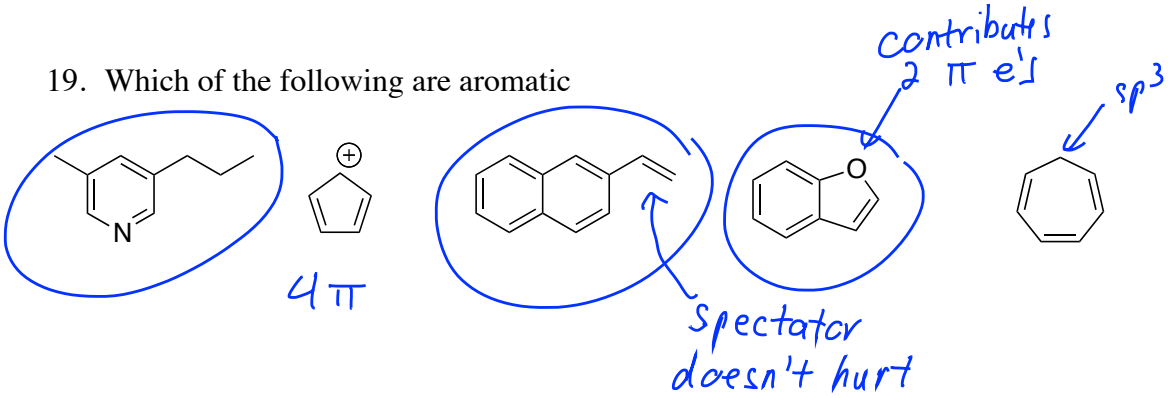
e. 

f. 

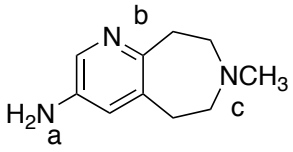
g. 

h. 

19. Which of the following are aromatic

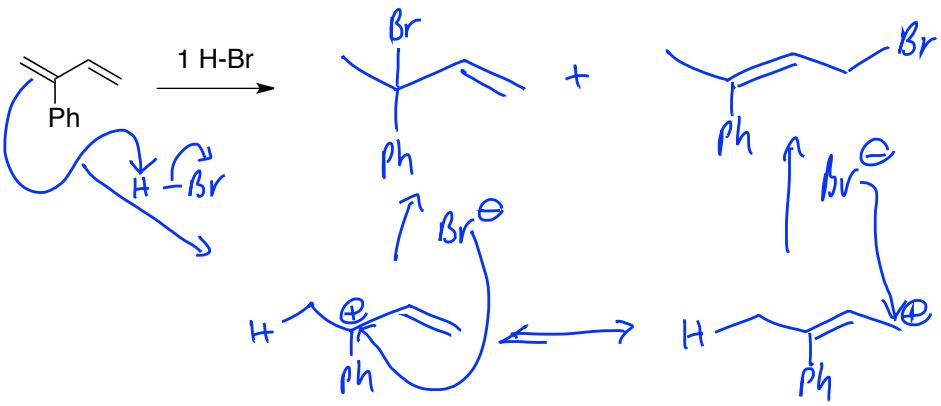


20. Classify the lone pair hybridization on the three nitrogen atoms in the following molecule:



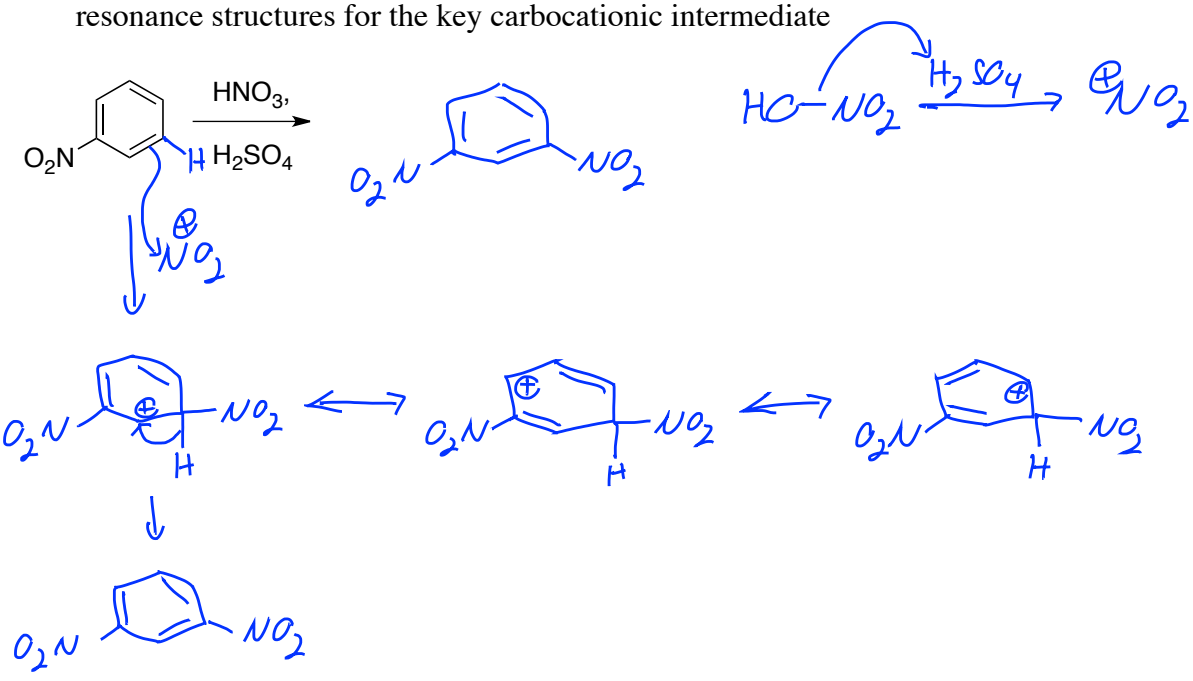
	atom	lone pair
N_a	sp^2	p
N_b	sp^2	sp^2
N_c	sp^3	sp^3

21. Draw the major products and mechanism for the following reaction:

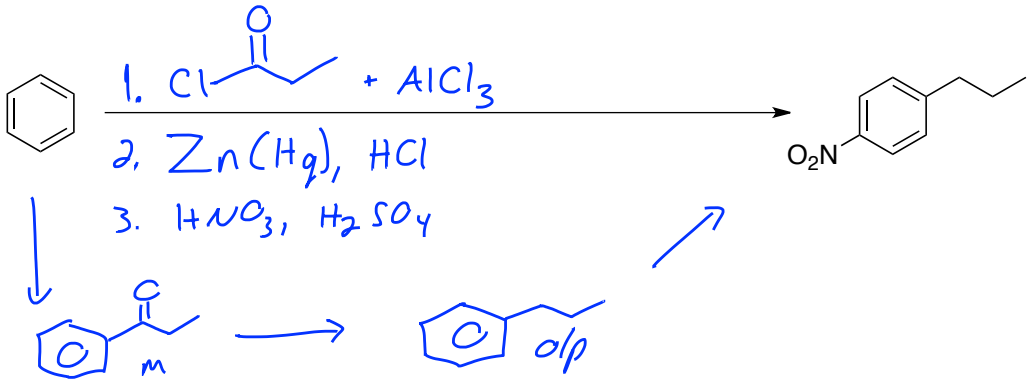


Protonation occurs on the left-most carbon, because that gives by far the best cation. 3° allylic and conjugated to the phenyl as well. The asymmetric allylic cation gives two different products (1,2 and 1,4 addition).

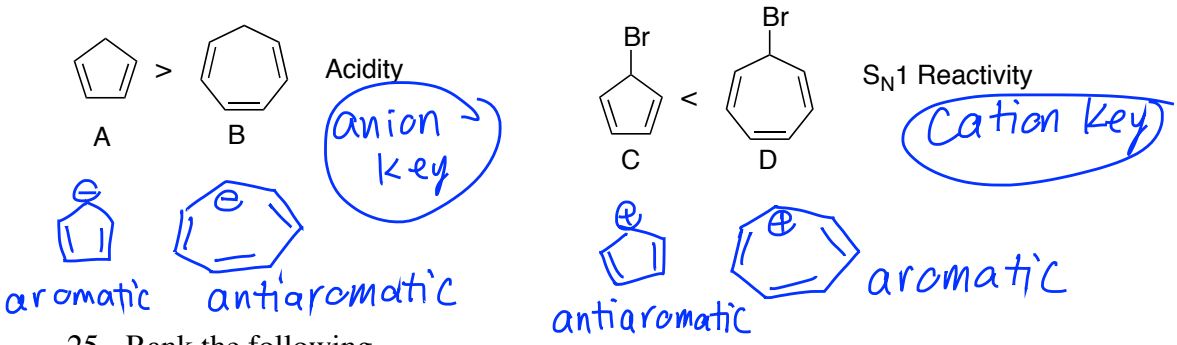
22. Draw the major product and mechanism for the following reaction. Draw all of the resonance structures for the key carbocationic intermediate



23. Design a synthesis for the following:



24. Explain why **A** is more acidic than **B**, but **C** is less reactive than **D** towards S_N1 reactivity



25. Rank the following