Chemistry 116 Sec. A (2:00-5:00)
Final Exam
"Organic Chemistry - Fall 2000"
December 12, 2000

Instructions: You have until 5:00 p.m. to complete the exam. At that time, I will request that all remaining test takers cease writing, turn their exams over, and pass them to their rightmost isle. If you finish before 4:55 p.m. you may turn in the exam at the front of the room prior to leaving. If you finish within the final 5 min. of class, please turn your exam over and remain seated until I call for the remaining exams to be turned in. *In fairness to all, anyone still working on the exam after "time" is called will receive a grade of zero!*

Be sure to read the instructions for each question. It may be helpful to skim the entire exam and solve the easier questions first.

Restroom Policy: Only one person at a time will be allowed to go to the restroom. If you need to go, bring your exam down to the front of the room and pick it up when you return.

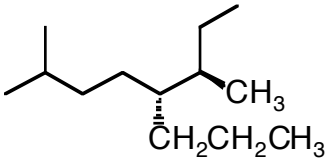
Exam Agreement: I, _____, have read and agree to
(Please print)
abide by the instructions above. On my honor, I have neither given nor accepted any help during this exam.

Signature: _____

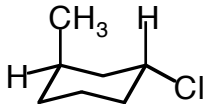
College: _____

DO NOT OPEN THIS EXAM UNTIL INSTRUCTED TO DO SO

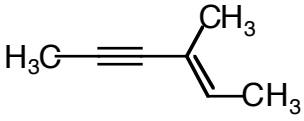
1. Provide an unambiguous (IUPAC or common) name for each of the following compounds. Be sure to indicate stereochemistry where appropriate. (18 points)



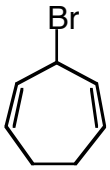
(5*R*,6*R*)-2,6-Dimethyl-5-propyloctane



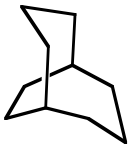
(1*R*,3*R*)-1-Chloro-3-methylcyclohexane



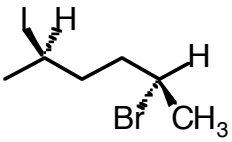
(*E*)-3-Methylhex-2-en-4-yne



3-Bromocyclohepta-1,4-diene

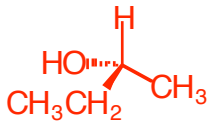
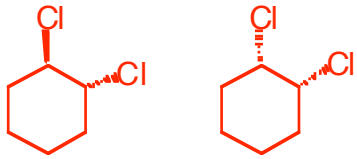
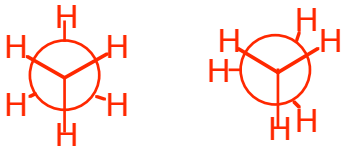
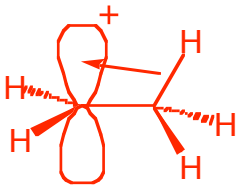


Bicyclo[3.3.2]decane

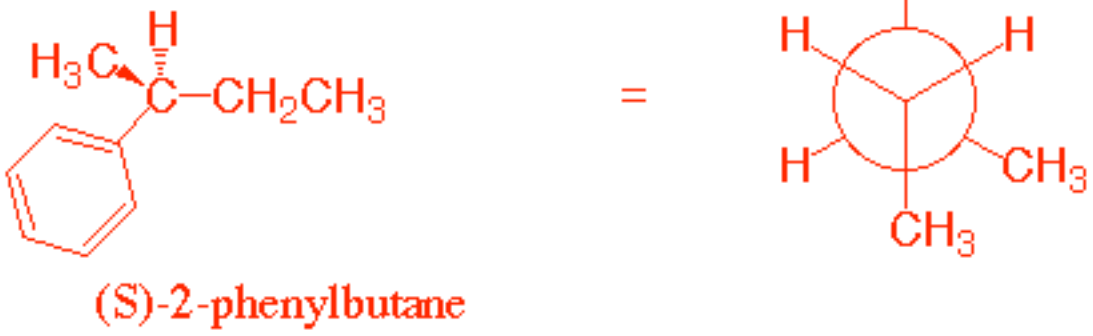


(2*R*,5*R*)-2-Bromo-5-iodohexane

2. Fill in the boxes below. *Note: any answers outside of the boxes will not be graded.* (24 points)

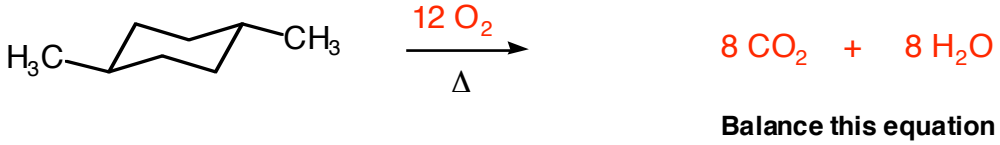
	Definition	**Example**
An optically active molecule	A molecule that rotates plane polarized light.	
Diastereomers	Stereoisomers that are not mirror images.	
Lewis Base	An electron donor.	HOH
Conformers	Two identical molecules with different spatial arrangements of atoms that result from rotation about a single bond.	
Hyperconjugation	A stabilizing feature of carbocations where σ electrons in an adjacent C-H or C-C bond spread into the empty *p* orbital.	
Polar Aprotic Solvent	A solvent that possesses a dipole moment, but does not possess hydrogens capable of H-bonding.	CH_3-O-CH_3

3. Draw a Newman projection of the *most stable conformer* of (*S*)-2-phenylbutane looking down the C_2-C_3 bond. (5 points)

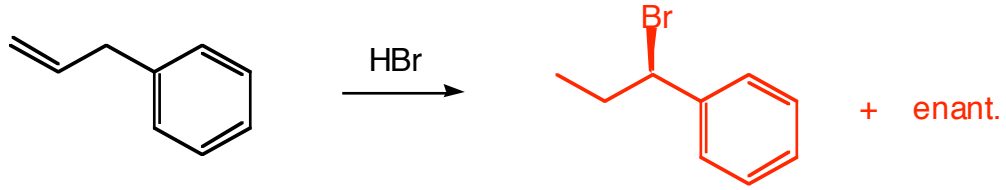


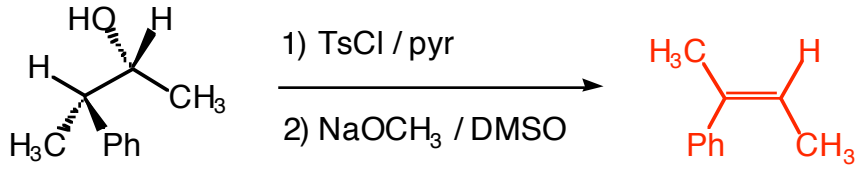
(S)-2-phenylbutane

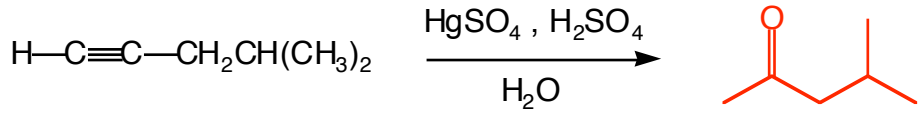
4. Draw the **major product** of each of the following reactions. *Be sure to include stereochemistry in your answers where appropriate.* (4 points each)

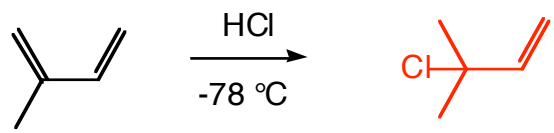
(a) 

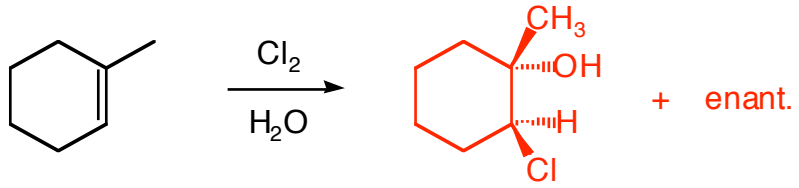
Balance this equation

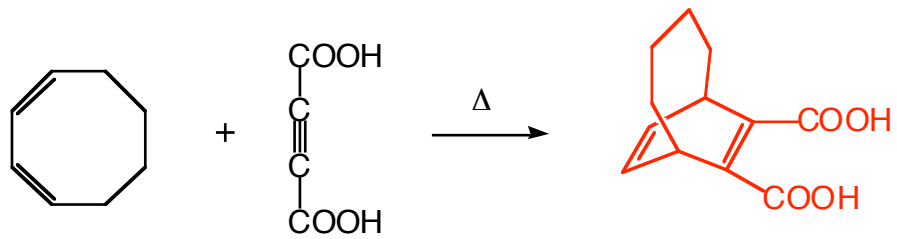
(b) 

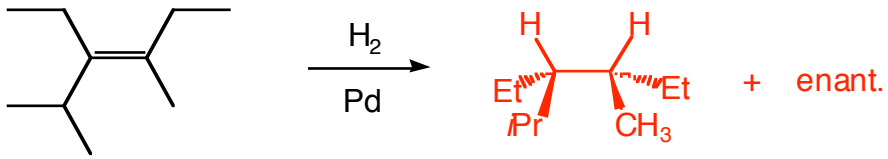
(c) 

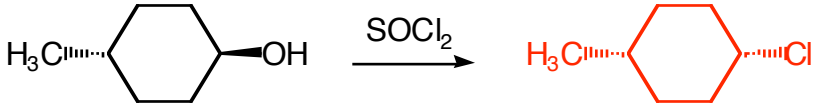
(d) 

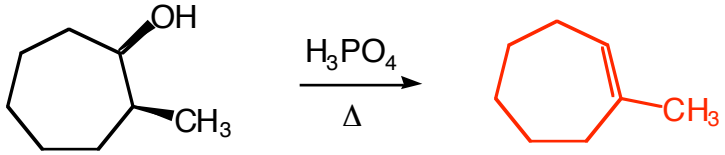
(e) 

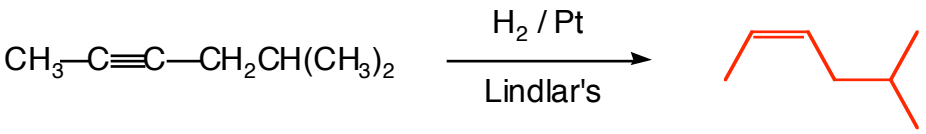
(f) 

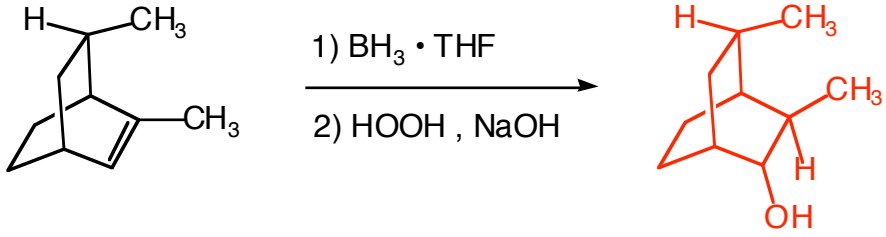
(g) 

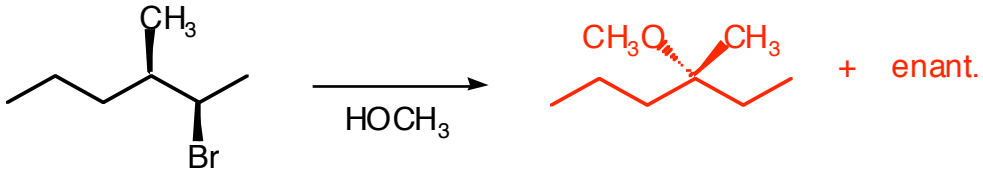
(h) 
H2
Pd
H
H
Et
Et
iPr
CH3
+ enant.

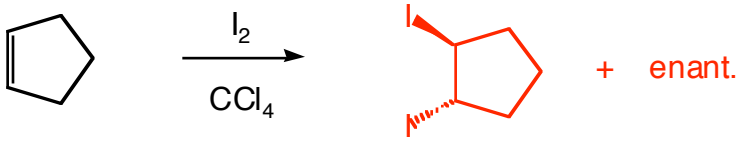
(i) 
H3C
OH
SOCl2
H3C
Cl

(j) 
OH
CH3
H3PO4
Δ
CH3

(k) 
CH3—C≡C—CH2CH(CH3)2
H2 / Pt
Lindlar's

(l) 
H
CH3
CH3
1) BH3 • THF
2) HOOH , NaOH
H
CH3
CH3
H
OH

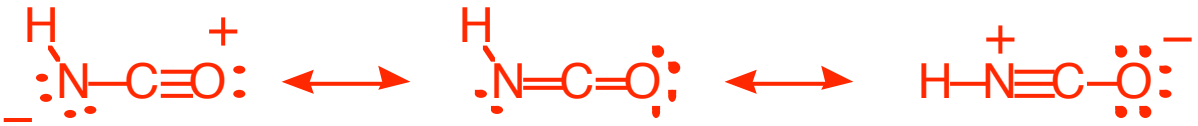
(m) 
CH3
Br
HOCH3
CH3O
CH3
+ enant.

(n) 
I2
CCl4
I
+ enant.

5. Consider a molecule with the following condensed structural formula:

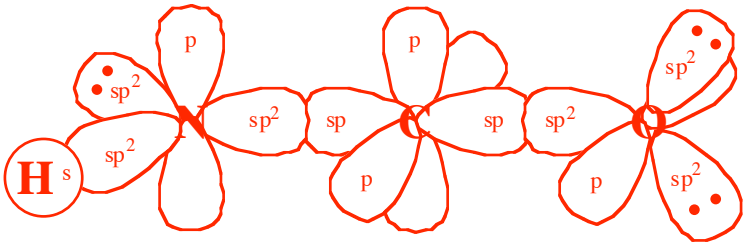
HNCO

a) Draw the three most stable resonance contributors for this molecule and rank them according to their stability (1=most stable, 3=least stable). For full credit, you must show all lone pairs of electrons and formal charges. (8 points)



3 1 2

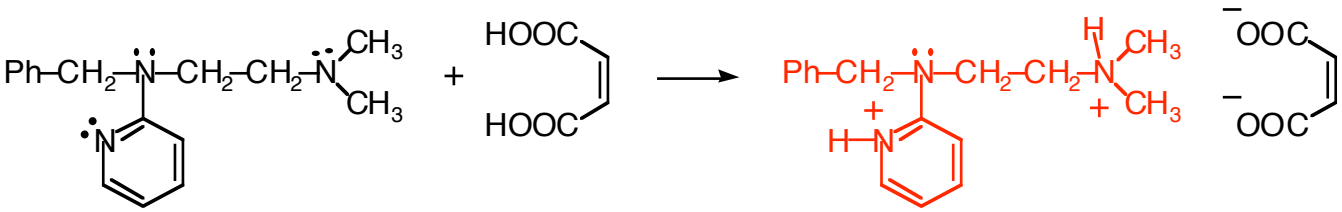
b) Provide an accurate orbital picture for the major resonance contributor. For full credit, clearly label each of the orbitals and bond angles in your picture. (5 points)



$\angle_{HNC} = 120°$

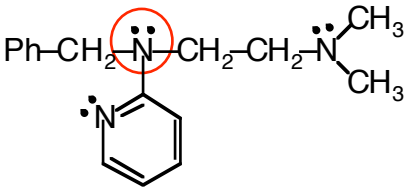
$\angle_{NCO} = 180°$

6. Tripelennamine is a powerful antihistamine. However, in its neutral form it is nearly insoluble in water. In order to get the drug into the body, pharmaceutical companies react tripelennamine with maleic acid in a double acid-base reaction to form an extremely soluble complex. Draw the cationic part of the complex in the space provided below: (4 points)



Tripelennamine

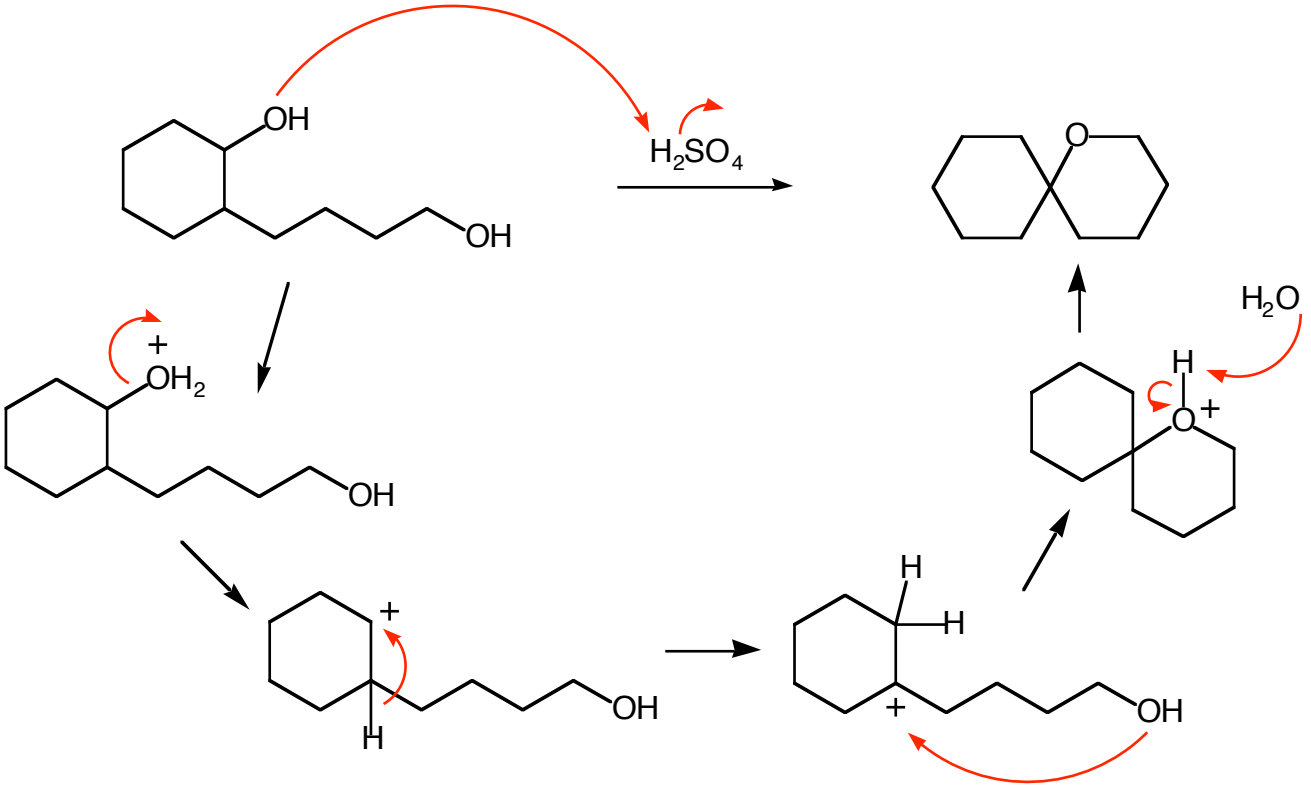
One of the nitrogens in tripelennamine is not very basic. Circle it and provide an explanation for your decision using words or pictures (4 points).



Tripelennamine

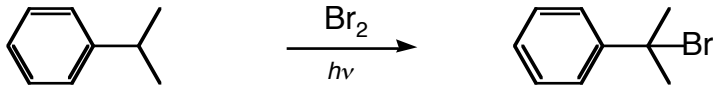
This set of lone pairs is in conjugation with the *p* orbitals of the pyridine ring. This reduces their ability to act as a base.

7. Propose a mechanism for the following reaction. For full credit, show the products of each step and any formal charges. (8 points)

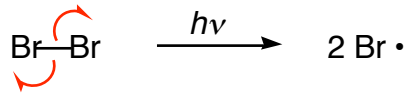


8. *Read these instructions carefully before proceeding*. Provide a mechanism for the following radical substitution reaction, paying close attention to the following details: (10 points)

a) label the three major steps of the reaction (initiation, propagation, and termination),
b) include any intermediates and their *resonance structures* in your mechanism,
c) provide at least 3 plausible termination steps

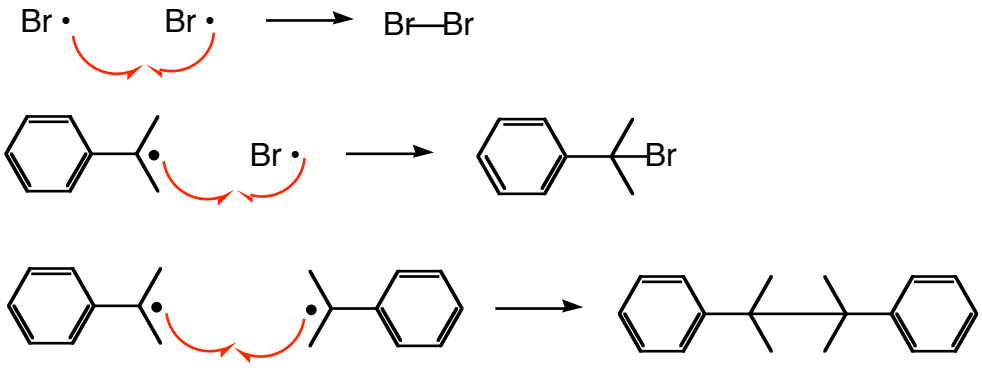


Initiation

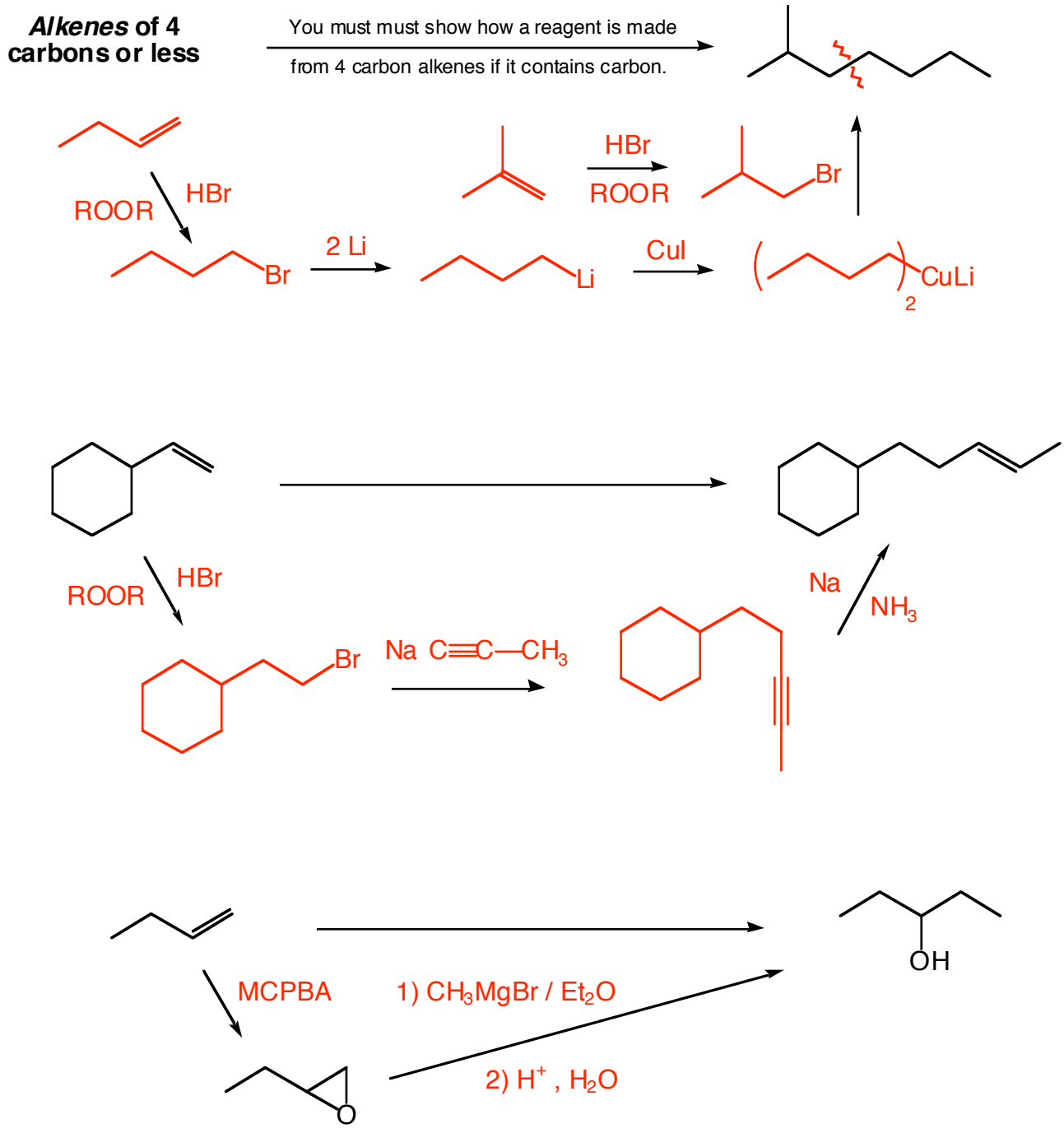


Propagation

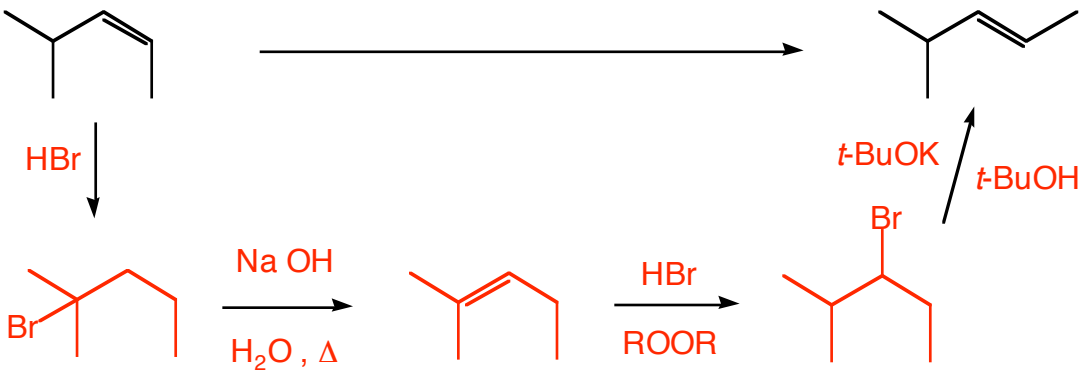
Termination

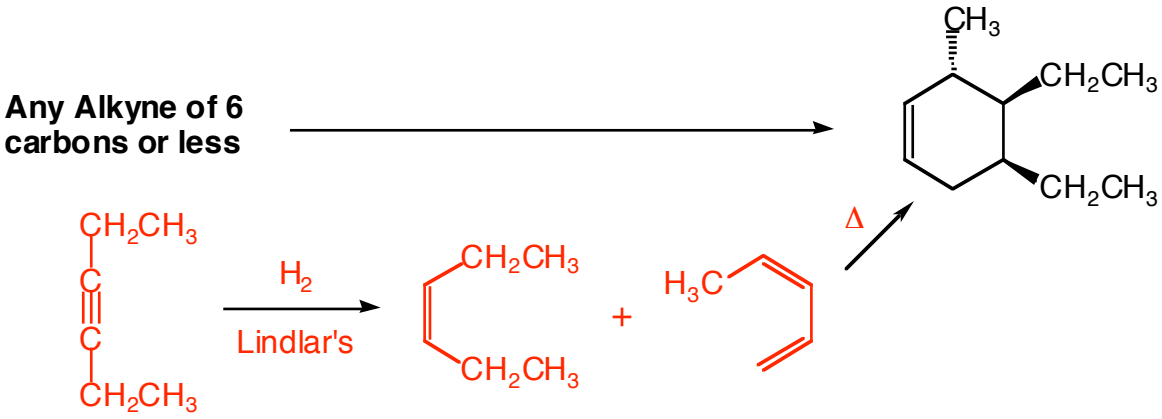


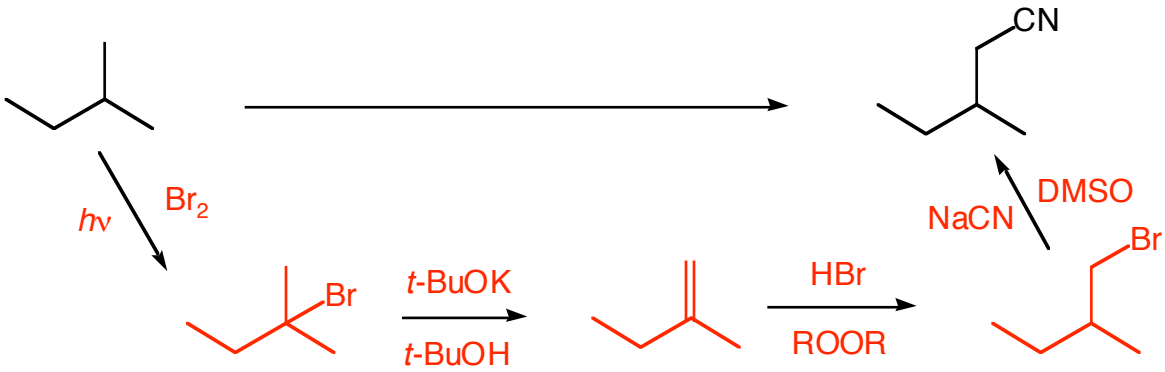
9. (Choose 4 out of 6) Propose a synthesis (sequence of reactions) that will accomplish each of the following transformations. *Be sure to include the products of each step*. Clearly indicate which four you wish for me to grade. If no indication is made, I will grade the first four. (8 points each)



synthesis (cont'd)...

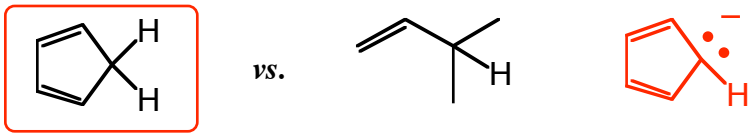






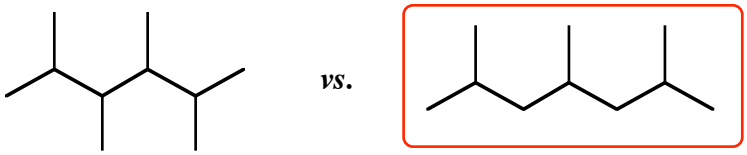
10. For each pair of molecules shown, circle the one that best fits the accompanying description and provide a concise rationale for your choice. Pictures *may* be required for full credit! (3 points each)

Most acidic molecule



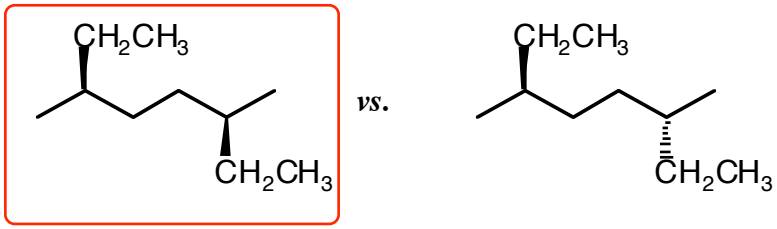
The conjugate base is aromatic, thus making it very stable and driving the acid-base equilibrium towards that side of the reaction.

Highest melting point



This molecule is more symmetrical and can thus pack together more easily. The closer the packing, the stronger the intermolecular interactions and the more energy that is needed to melt the sample.

Rotates plane polarized light



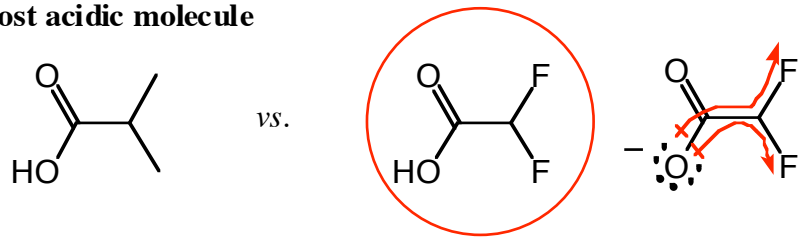
The circled molecule is chiral while the other molecule is achiral. Chiral molecules rotate plane polarized light.

The better nucleophile in water

CH_3NH_2 *vs.* CH_3PH_2

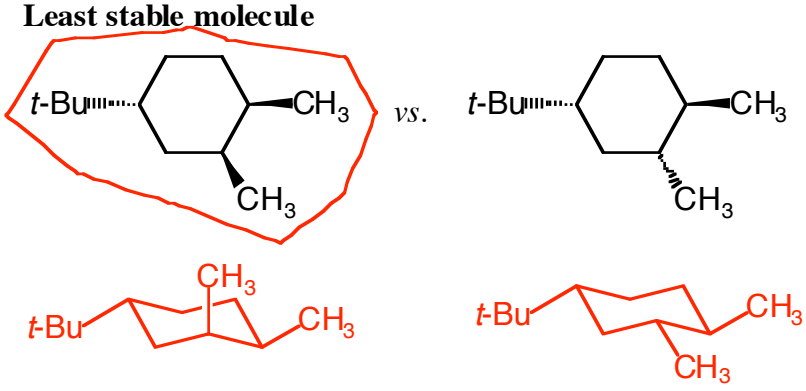
Since phosphorous has a larger electron cloud, it is more able to break out of its shell of solvation than the nitrogen-based nucleophile.

Most acidic molecule



The conjugate base shown is stabilized by induction of charge. The more stable the conjugate base, the greater the force driving the acid-base equilibrium towards that side of the reaction.

Least stable molecule



A substituent in the equatorial position is energetically more favorable than one in an axial position.

Grading Summary

Page	Point Value	Points Earned
2	18	
3	24	
4	13	
5	28	
6	28	
7	21	
8	18	
9 & 10	32	
11	18	
	Total Score =	