

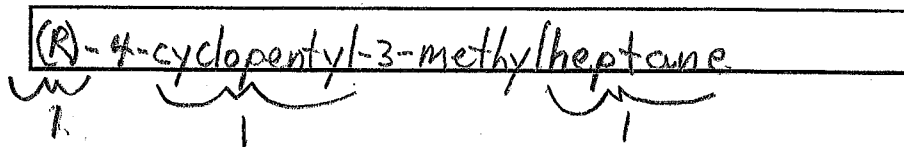
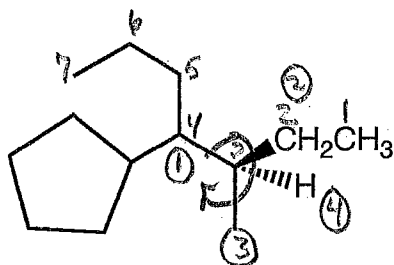
Final Exam, Fall 2024

A. Nomenclature: (9 points)

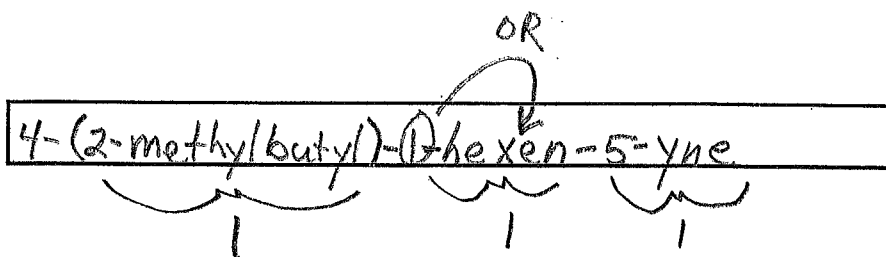
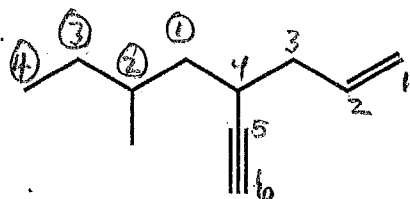
Give an acceptable IUPAC name for each compound. Be sure to indicate the stereochemistry where appropriate.

⊖ if chain numbered from the wrong end

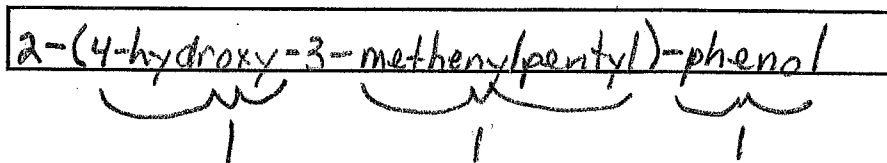
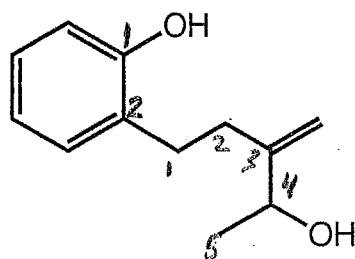
1.



2.



3.



B. Facts: 25 points

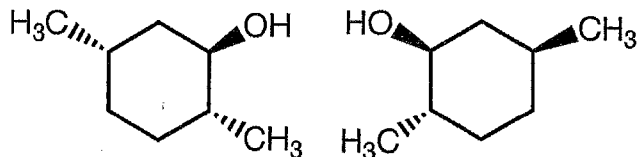
1. Does the following equilibrium lie to the Left or the Right? (2 pts.)



* Remember, OH is not a strong enough base to deprotonate a terminal alkyne.

right

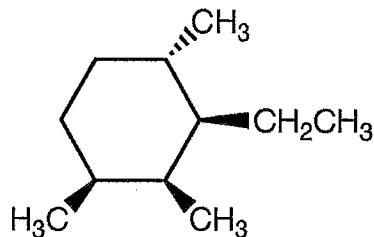
2. Label the following pair as identical, structural isomers, enantiomers or diastereomers. (2 pts.)



diastereomers

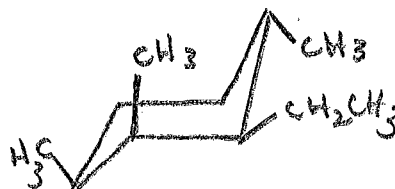
stereoisomers that are not mirror images

3. Consider the substituted cyclohexane below. In the more stable chair conformation, how many methyl groups are in **equatorial** positions? (2 pts.)

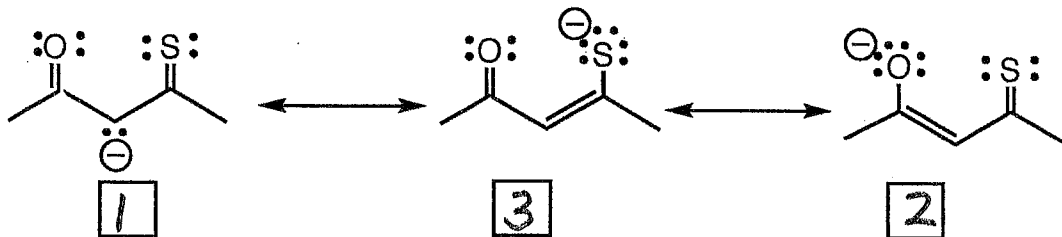


answer:

2



4. Consider the resonance contributors below.

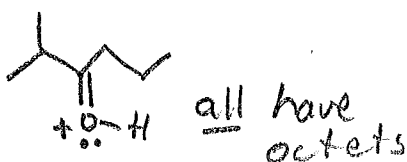
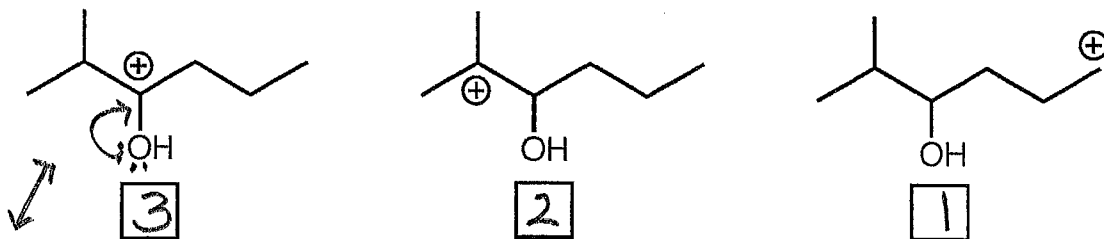


a. Place the contributors in order of increasing importance to the hybrid. (1=contributes least, 3=contributes most) (3 pts.)

b. Place the hybridization of the sulfur atom in the box. (2 pts.)

sp²

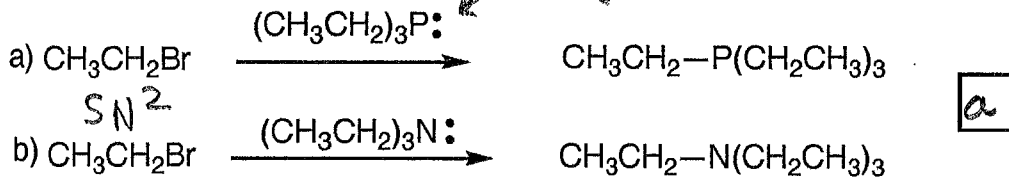
5. Place the carbocations in order of increasing stability. (1=least stable, 3=most stable) (3 pts.)



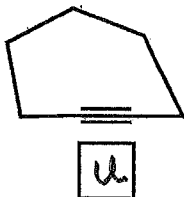
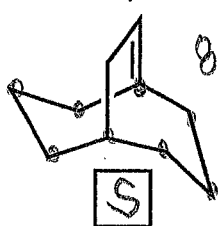
2



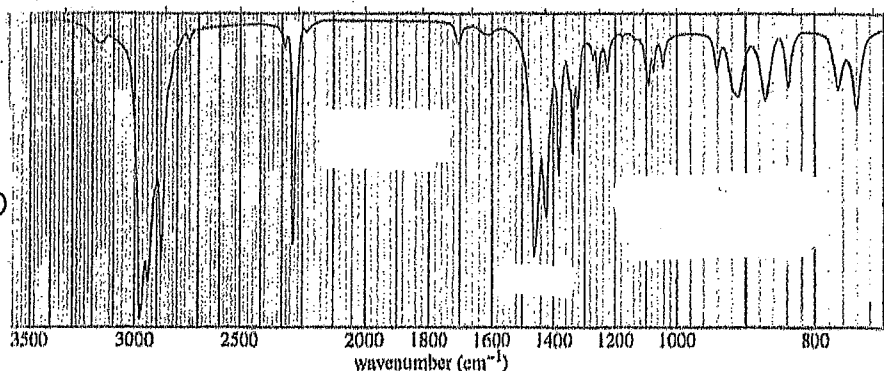
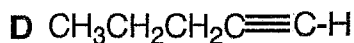
6. Compare the reaction rates of reaction a) and reaction b), and place the letter of the faster reaction in the box. (2 pts.) *Read the directions. There is no "same".*



7. Label the compounds as stable (S) or unstable (U). (2 pts.)

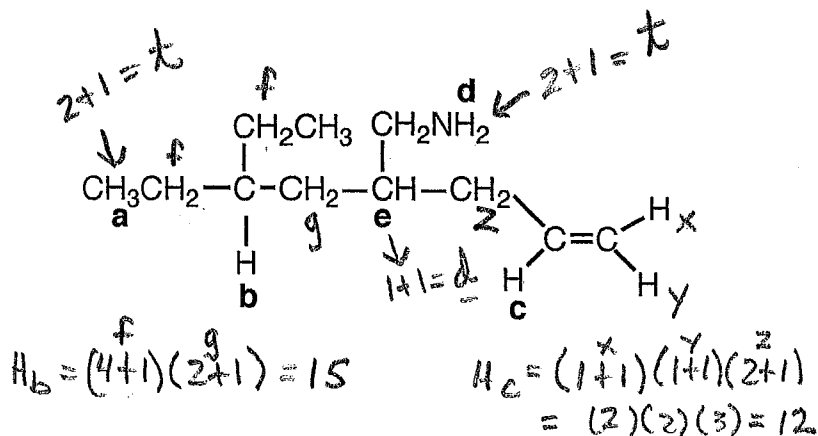


8. Carefully examine the spectrum and the compounds below. Place the letter of the correct compound in the box beside the spectrum. (2 pts.)



B

9. Answer the following questions for the molecule shown below and place the answers in the appropriate boxes. (i) What are the theoretically predicted multiplicities (splitting patterns) of the signals for the protons labeled a, b, and c? (ii) Under ultrapure conditions, what is the theoretically predicted multiplicity of the signal for the protons labeled d? (iii) What is the theoretically predicted multiplicity of the signal for the carbon atom labeled e in the off-resonance decoupled (proton spin coupled) C-13 NMR? (5 pts.)



(i) multiplicity of H_a 3 or 3

multiplicity of H_b 15

multiplicity of H_c 12

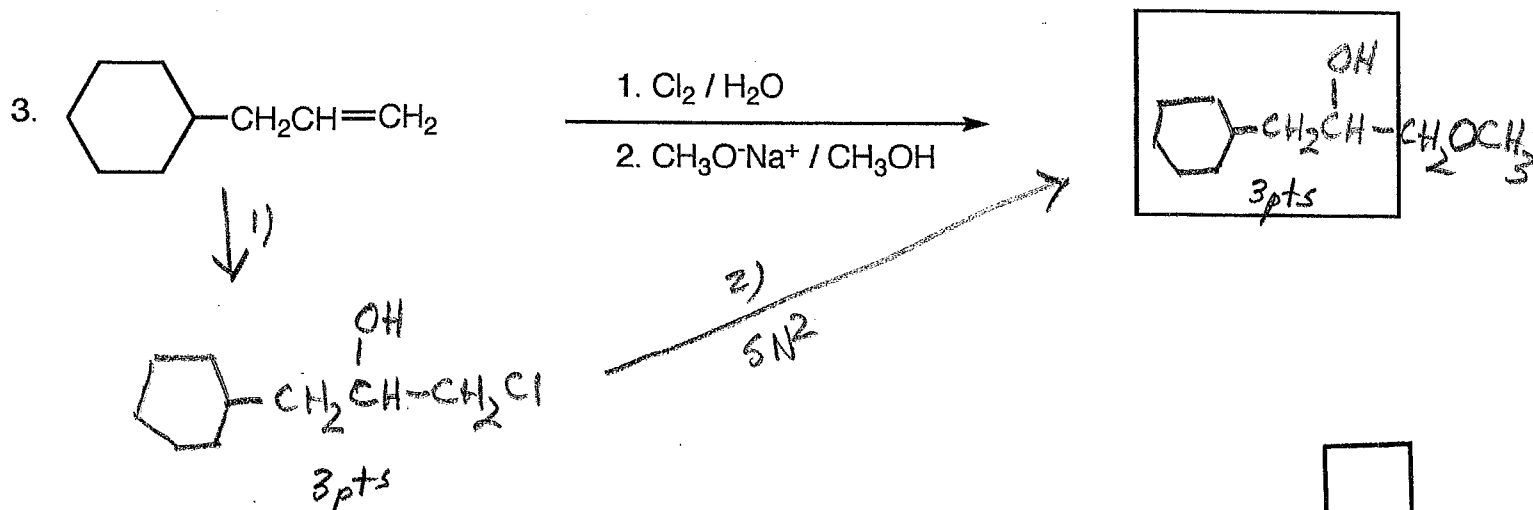
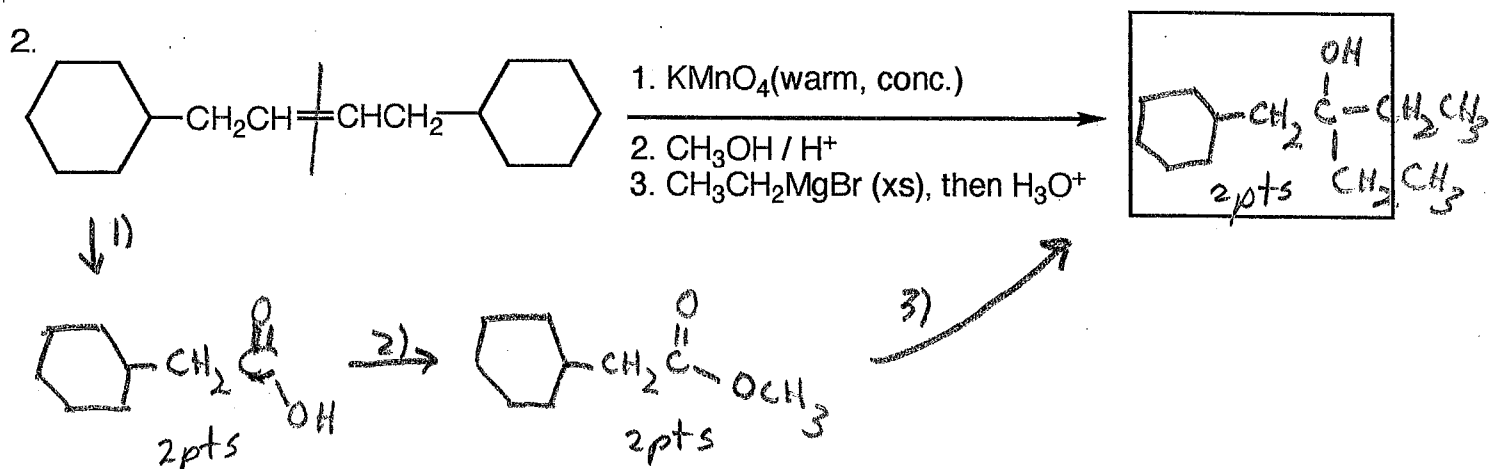
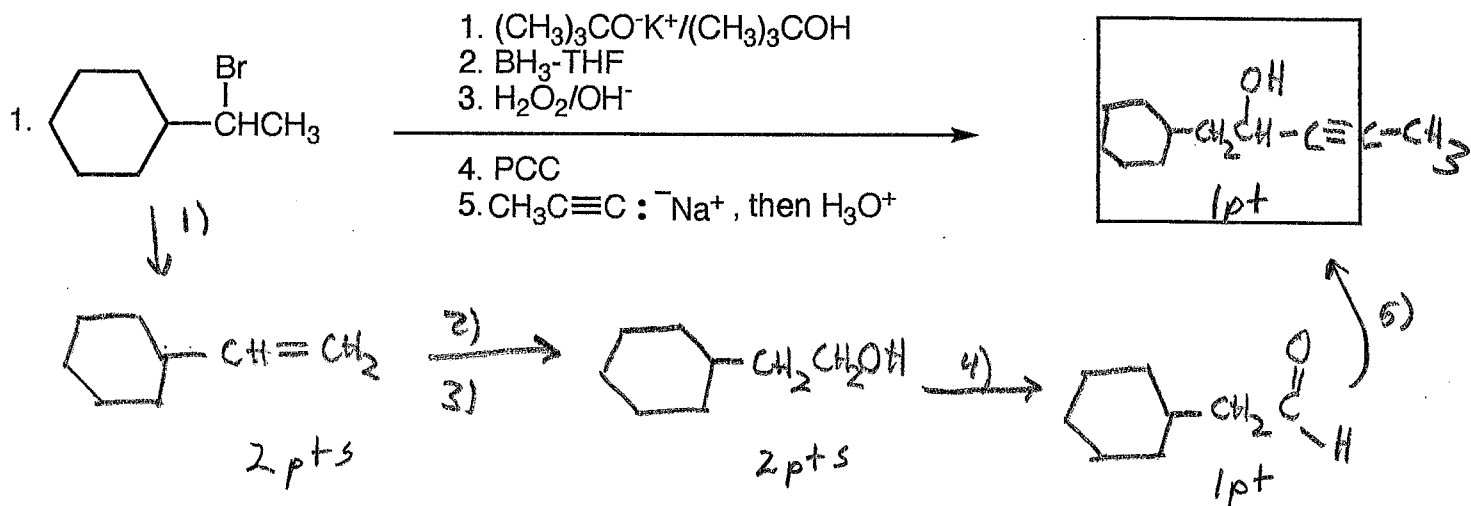
(ii) multiplicity of H_d 3 or 3

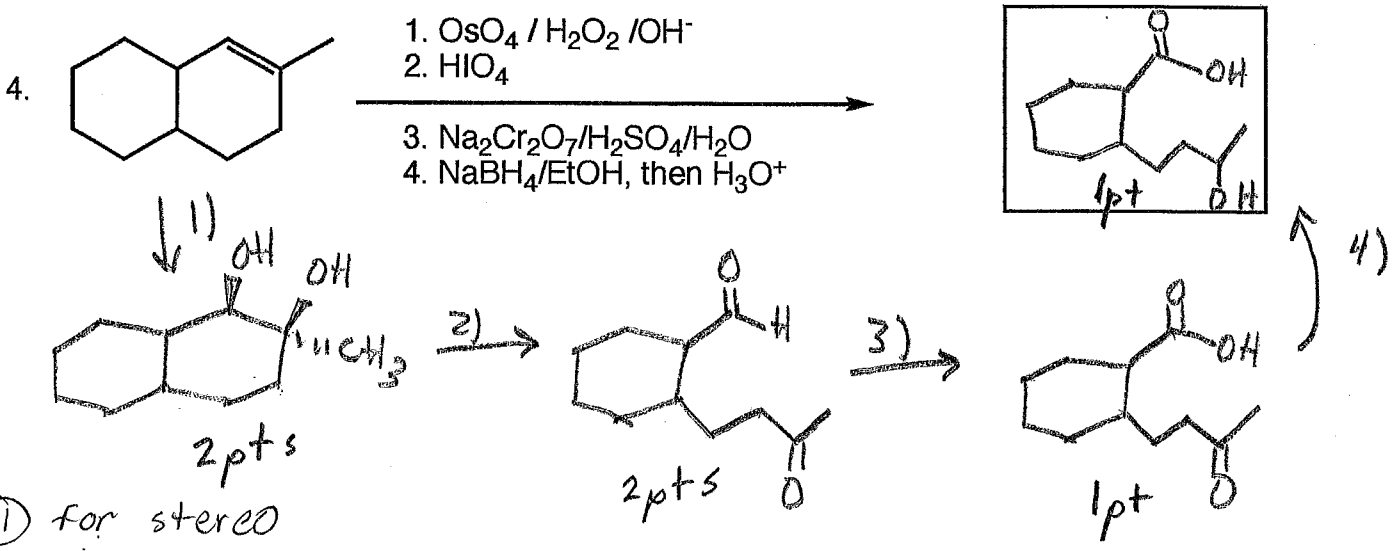
(iii) multiplicity of C_e 2 or 2



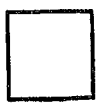
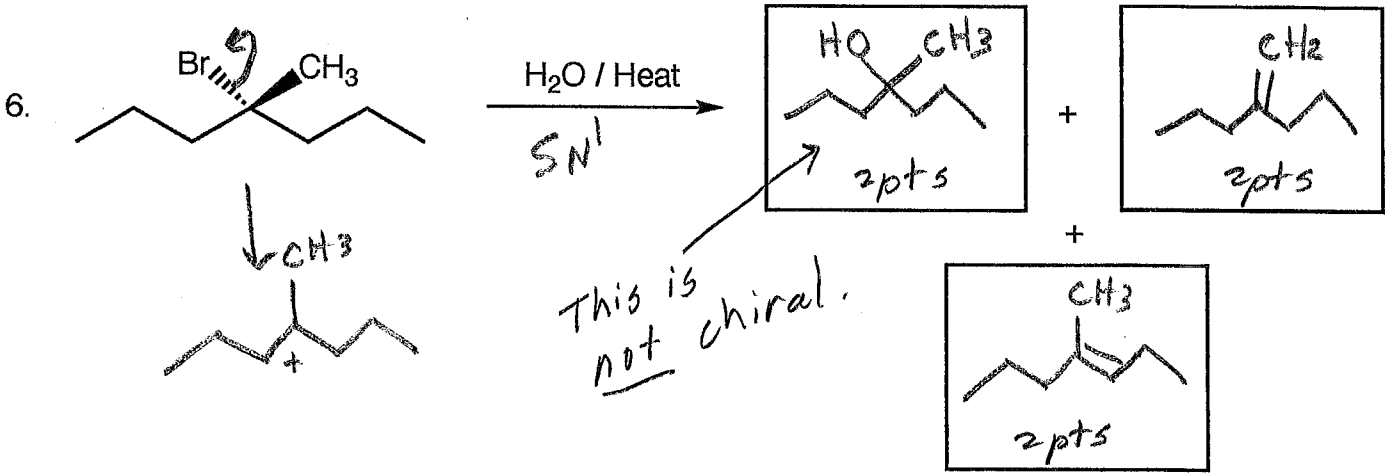
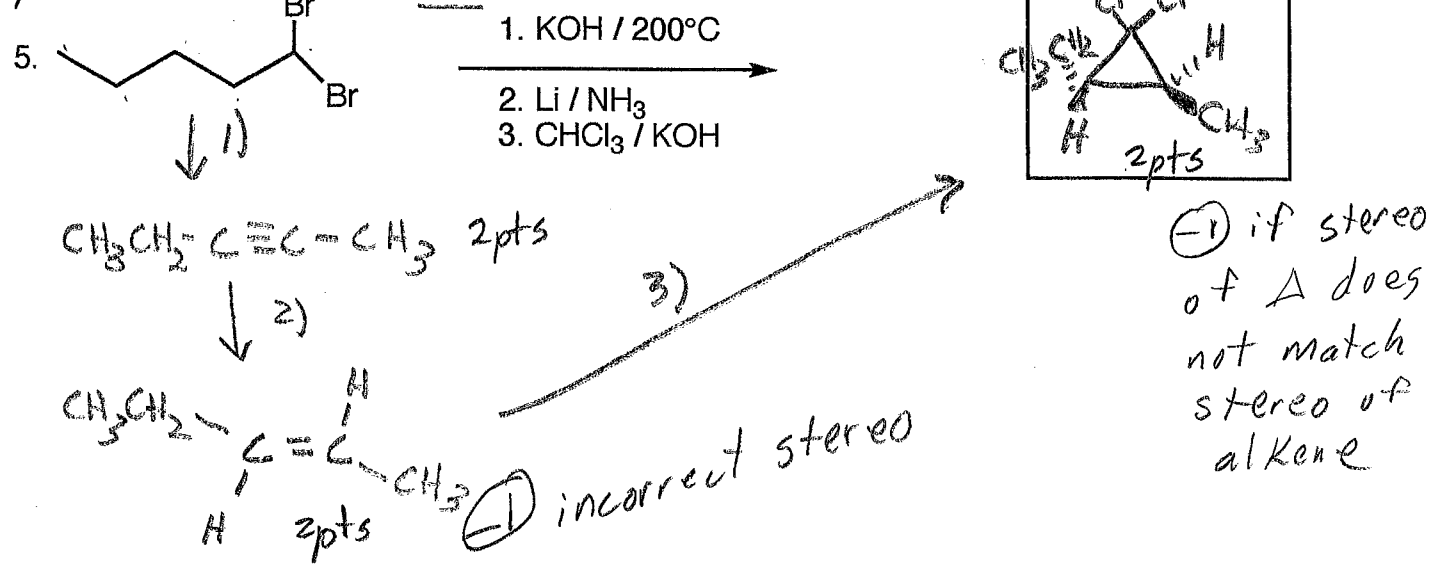
C. Reactions: Total = 36 points, 6 points each

Please provide the major product in the answer box unless otherwise indicated. Indicate stereochemistry if applicable. Full credit is awarded only when the product of each step in a multi-step reaction is shown below the reaction.



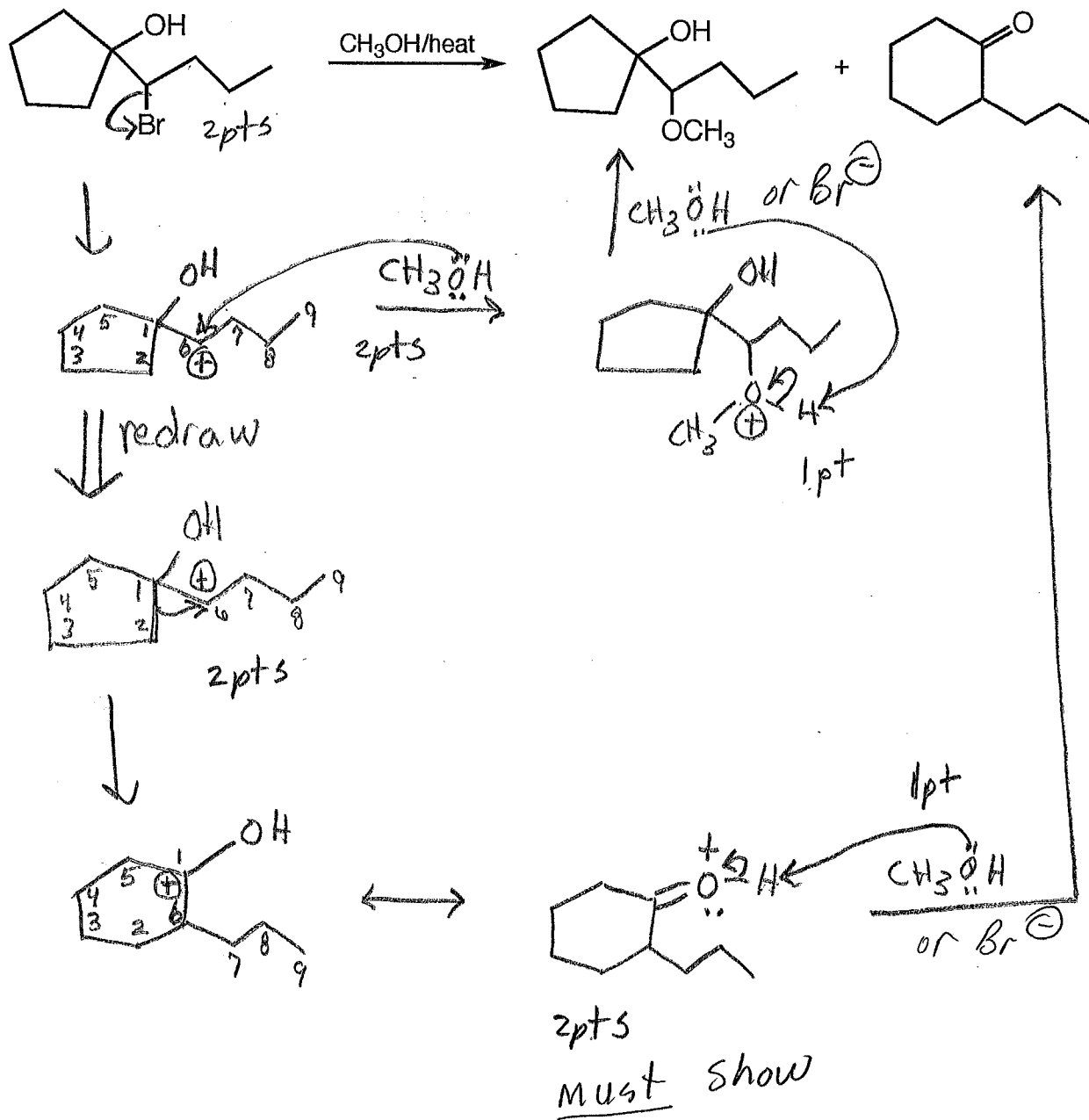


trans vic-diol will not react to give product 2. \rightarrow so zero for step 2



D. Mechanisms: (10 points)

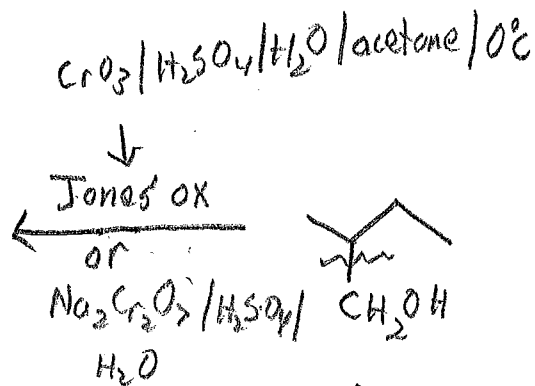
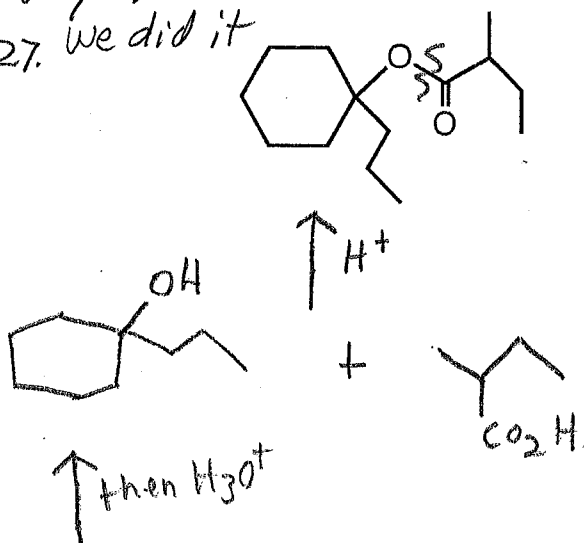
The reaction below produces a mixture of products. Provide a clear mechanism to explain the formation of the products shown. Use curved arrows to indicate "electron flow". Remember to show only one step at a time. Show all intermediates and all formal charges. **If more than one resonance contributor is possible, be sure to show the more stable contributor.**



E. Synthesis: 10 Points

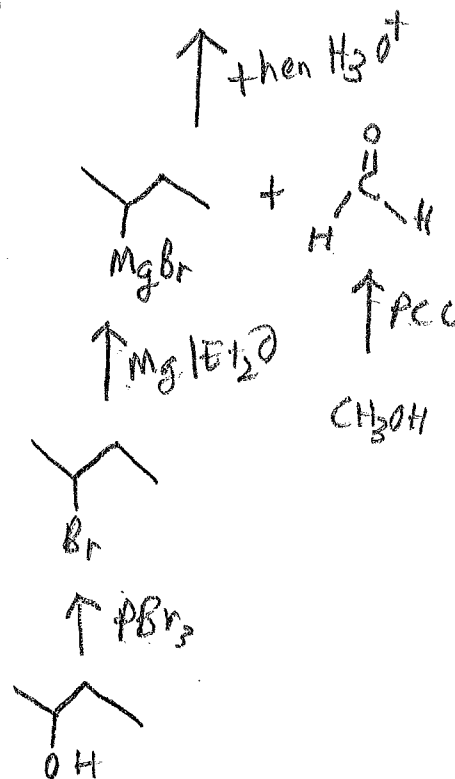
Synthesize the compound below using any of the following reagents: **CYCLOHEXANONE**, alcohols of four carbons or less, any inorganic reagents, any peroxy acids, and any oxidizing or reducing agents.

* Strategy very similar to quiz #27. We did it in class!



If you were doing retro synthesis, not knowing that this is cyclohexanone would not have prevented you from getting 10pts.

CC1CCCCC1=O + BrC1CCCCC1
 $\uparrow Mg / Et_2O$
CC1CCCCC1O
 $\uparrow PBr_3$
CC1CCCCC1O



extra penalties:

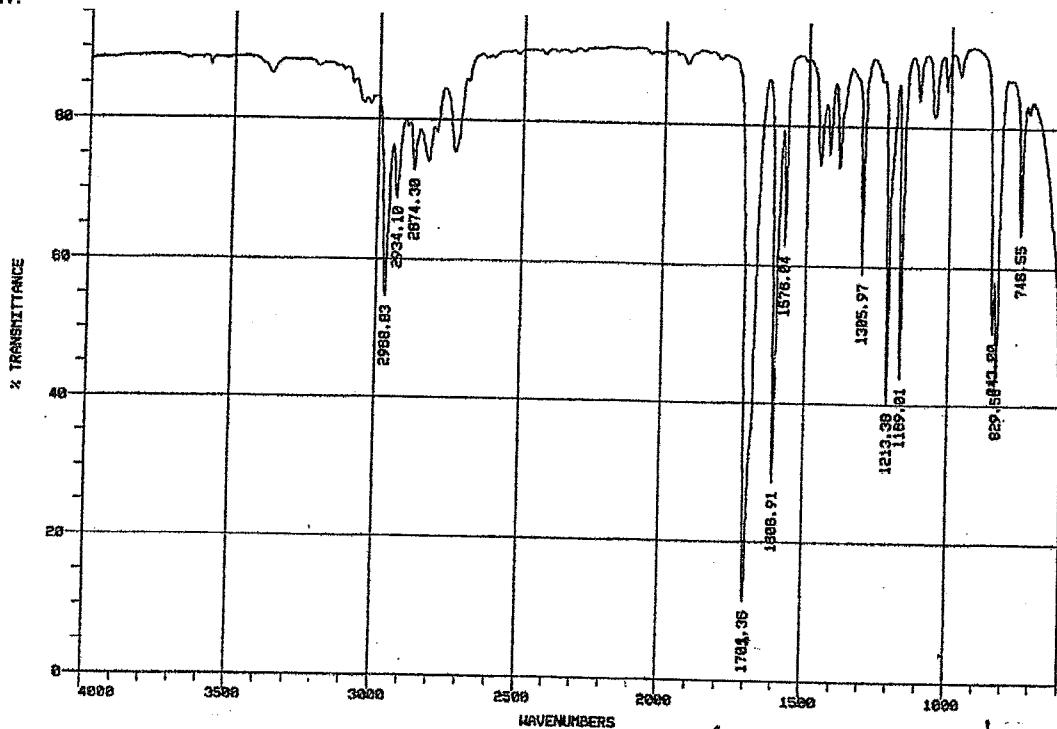
- $RMgX$ in presence of $OH!$
- starting with an organic material that is not allowed. C1CCCCC1 is obviously not cyclohexanone.

C1CCCCC1O was ignored in grading.



F. Spectroscopy: 10 Points (A gift)

A compound with the formula $C_9H_{10}O$ exhibits the IR, 1H NMR, and proton-spin decoupled ^{13}C NMR spectra shown below. Please identify this compound and draw the structure in the box provided below.



Partial credit for incorrect answers %

any O 1pt

if O 2pts

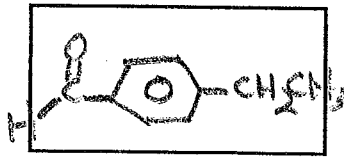
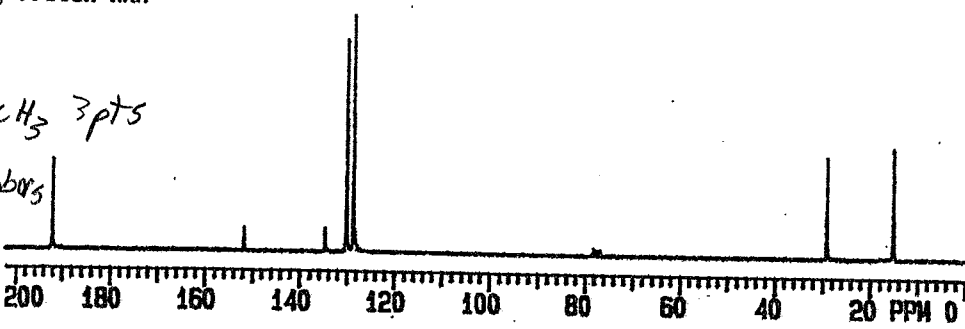
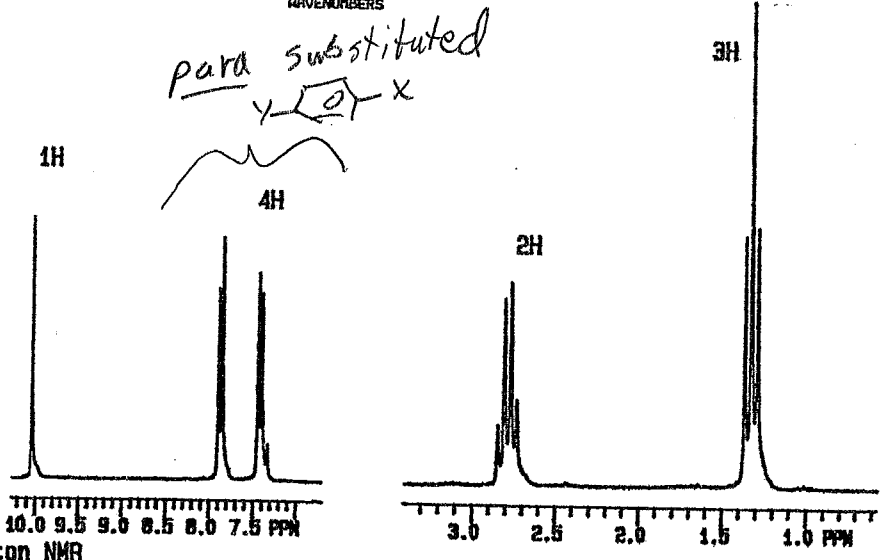
aldehyde 2pts

Ketone 1pt

isolated CH_2CH_3 3pts

No H neighbors on this side

para substituted γ - C_6H_4 -X



-2 if not para

