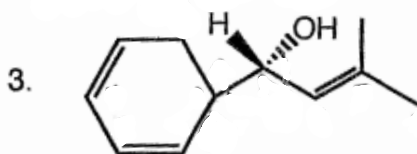
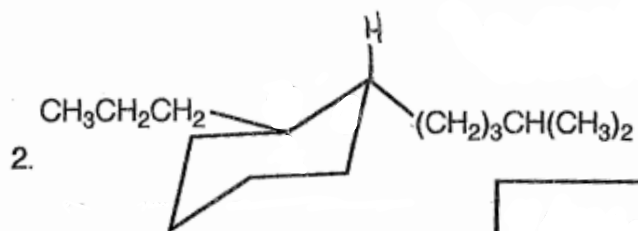
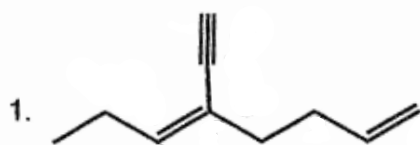


# Final Exam Fall 2023

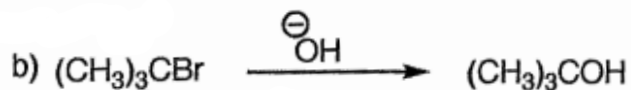
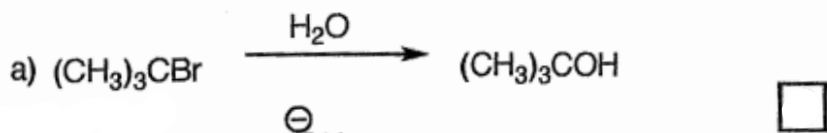
## A. Nomenclature: (9 points)

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

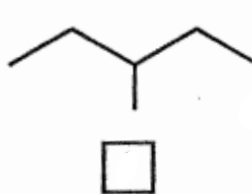
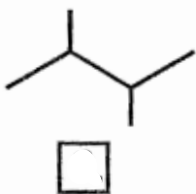
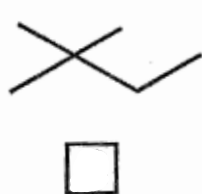


**B. Facts: 27 points**

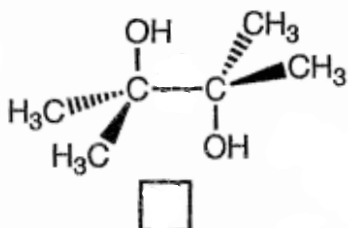
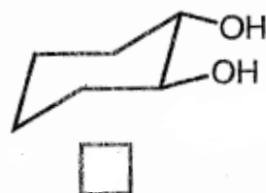
1. Compare the reaction rates of reaction **a)** and reaction **b)**, and place the letter of the faster reaction in the box. If both have the same rate, put **S** in the box. (2 pts.)



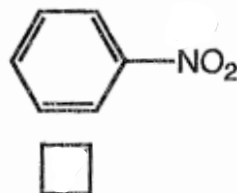
2. Place the compounds in order of increasing melting point. (1=lowest, 3=highest) (3 pts.)



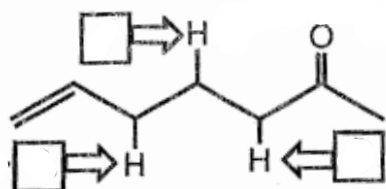
3. If a compound below will undergo periodic acid cleavage, place a Y in the box. If it will not, put N in the box. (2 pts.)



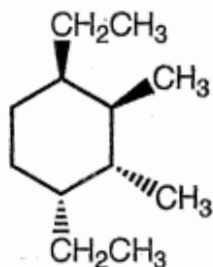
4. If a compound below will react with a Grignard reagent, place a Y in the box. If it will not, put N in the box. (2 pts.)



5. Place the indicated hydrogen atoms in order of increasing acidity. (1=least, 3=most) (3 pts.)



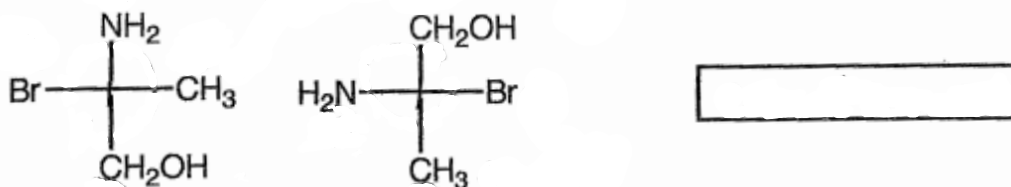
6. Consider the substituted cyclohexane below. In the more stable chair conformation, how many methyl groups are in **equatorial** positions? (2 pts.)



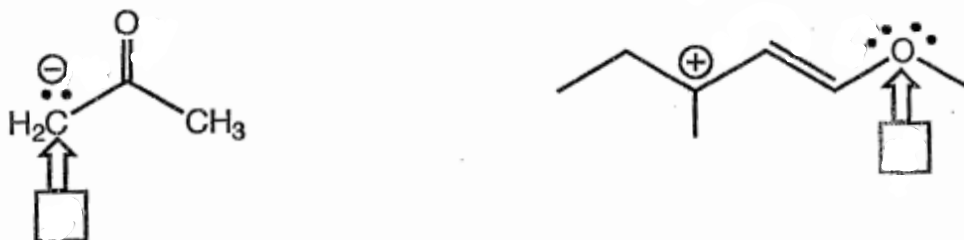
Answer:



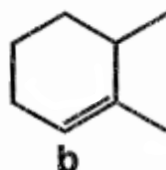
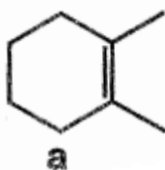
7. Label the following pair as identical, structural isomers, enantiomers or diastereomers. (2 pts.)



8. In the boxes, provide the hybridization of the indicated atoms. (2 pts.)

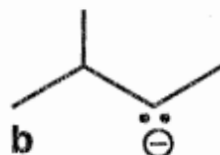
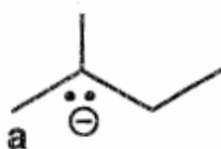


9. Which compound has the higher heat of hydrogenation, **a** or **b**? (2 pts.)



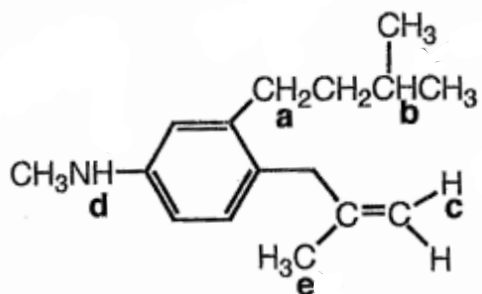
Answer:

10. Which anion is more stable, **a** or **b**? (2 pts.)



Answer:

11. 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 proton labeled **d**? (iii) What is the theoretically predicted multiplicity of the signal for the carbon atom labeled **e** in the proton spin coupled C-13 NMR? (5 pts.)



(i) multiplicity of  $H_a$

multiplicity of  $H_b$

multiplicity of  $H_c$

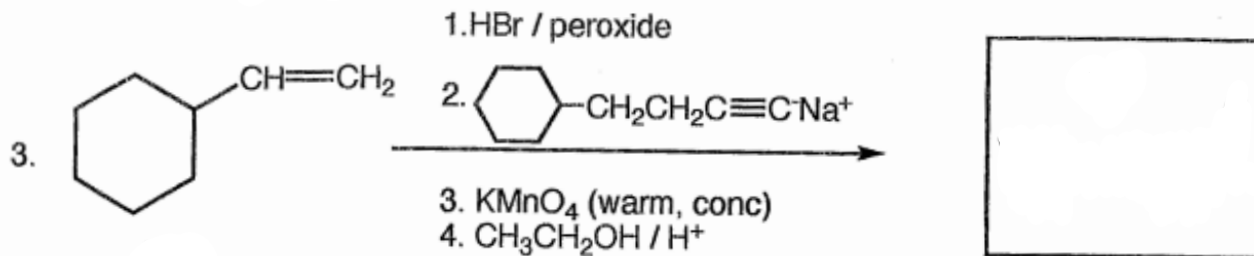
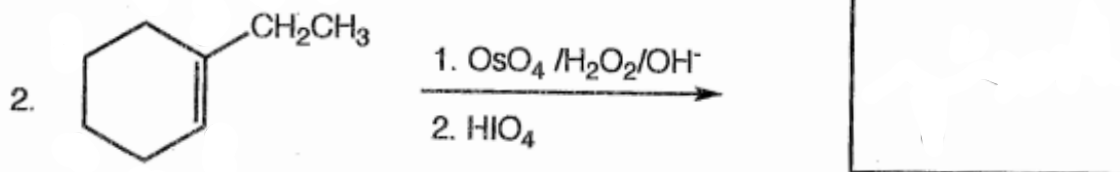
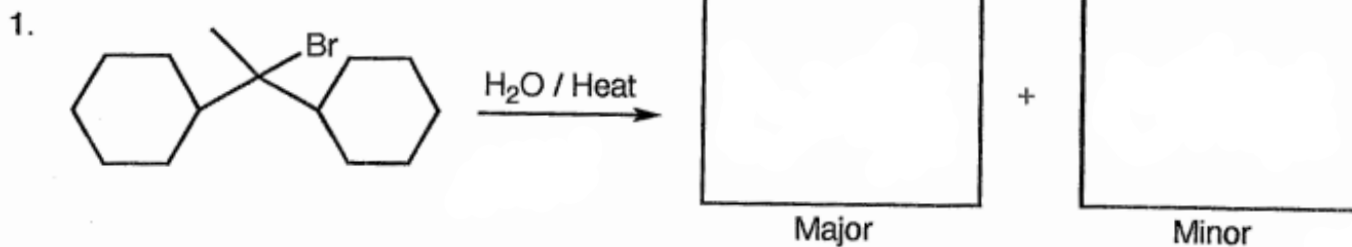
(ii) multiplicity of  $H_d$

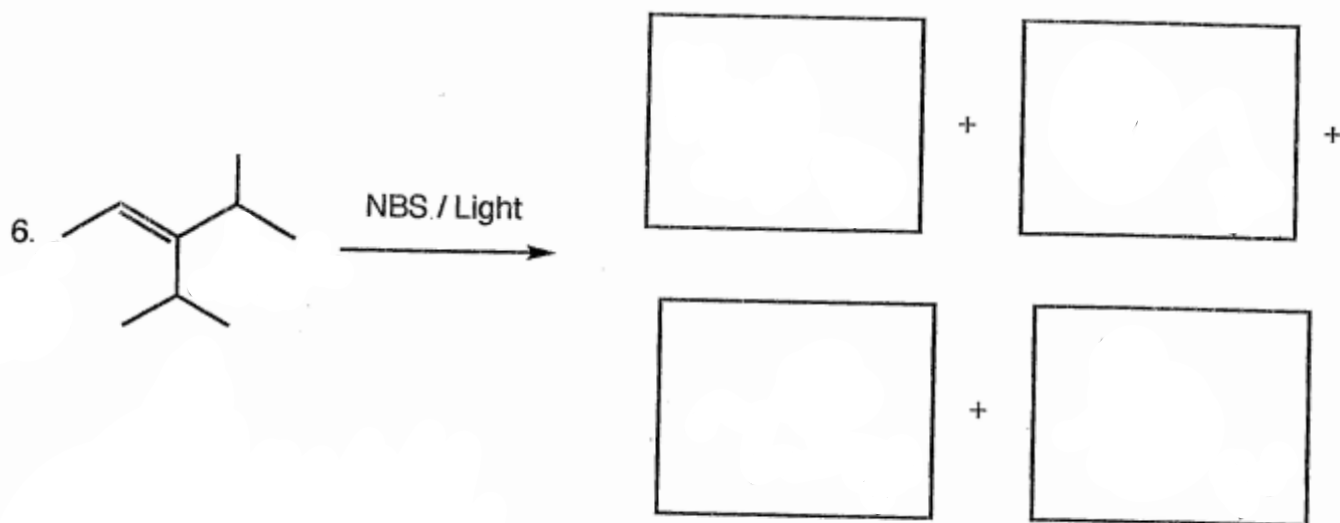
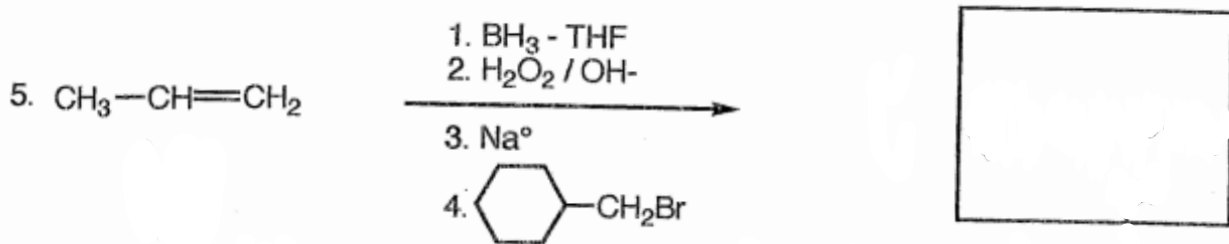
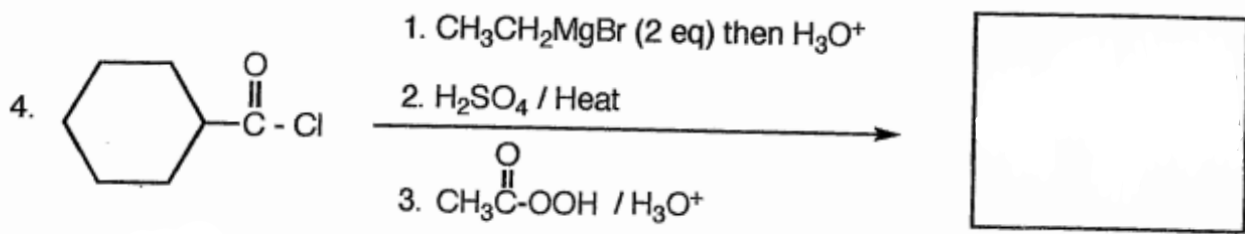
(iii) multiplicity of  $C_e$

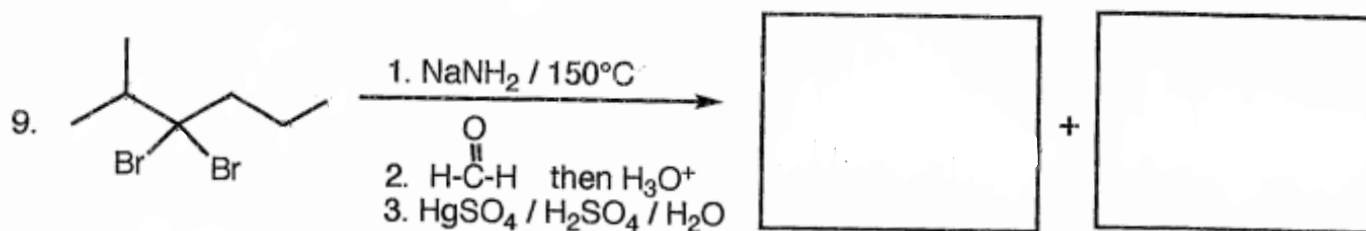
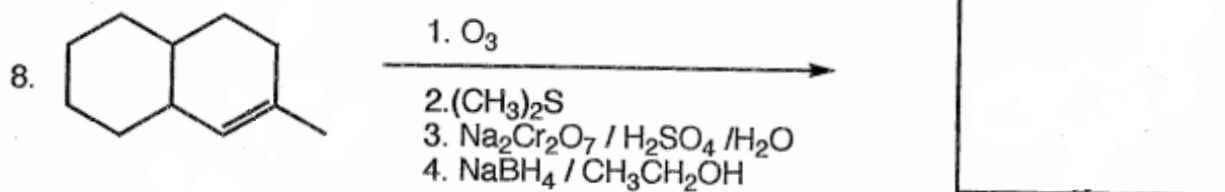
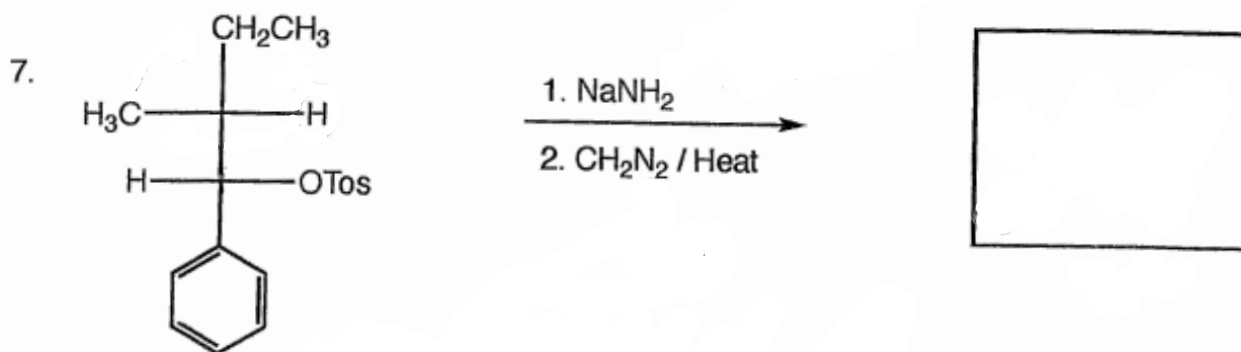


**C. Reactions:** Total = 36 points, 4 points each

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.**

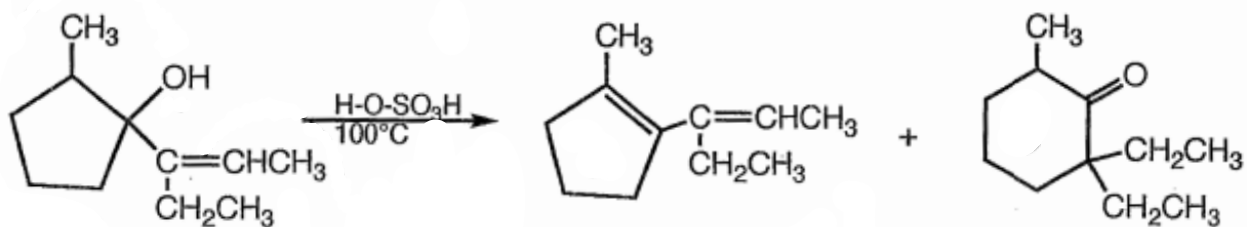






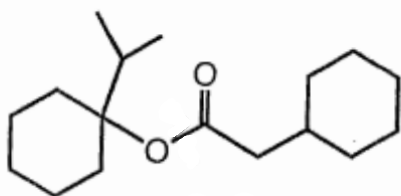
**D. Mechanisms: (10 points )**

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

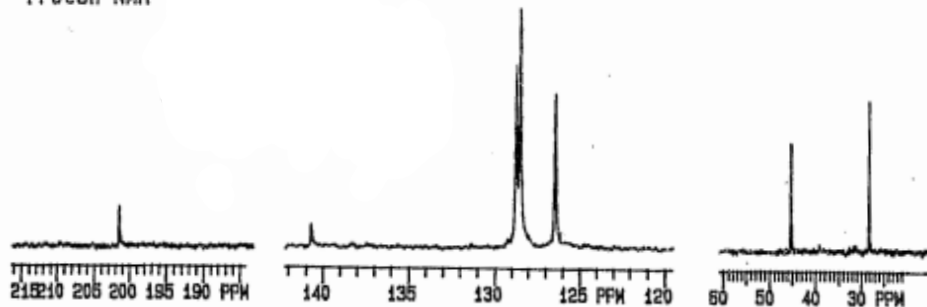
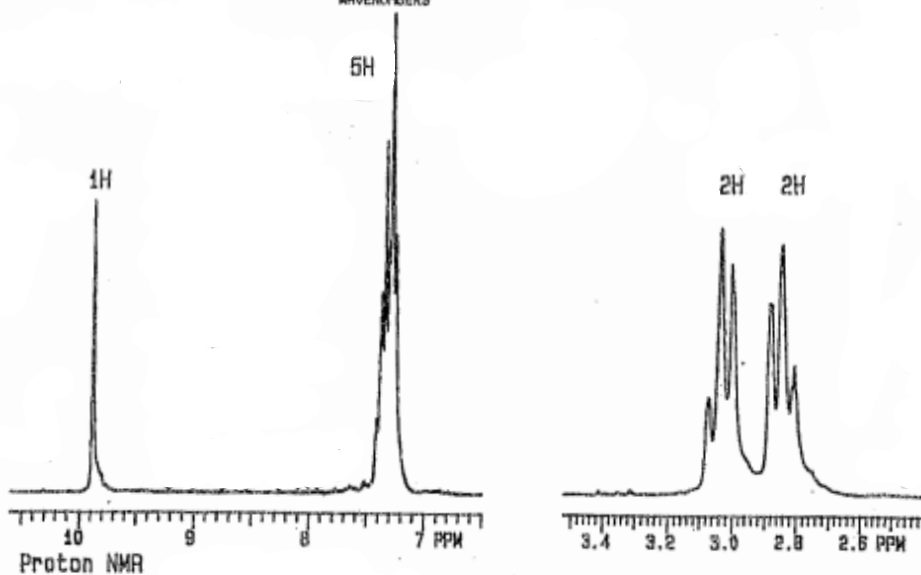
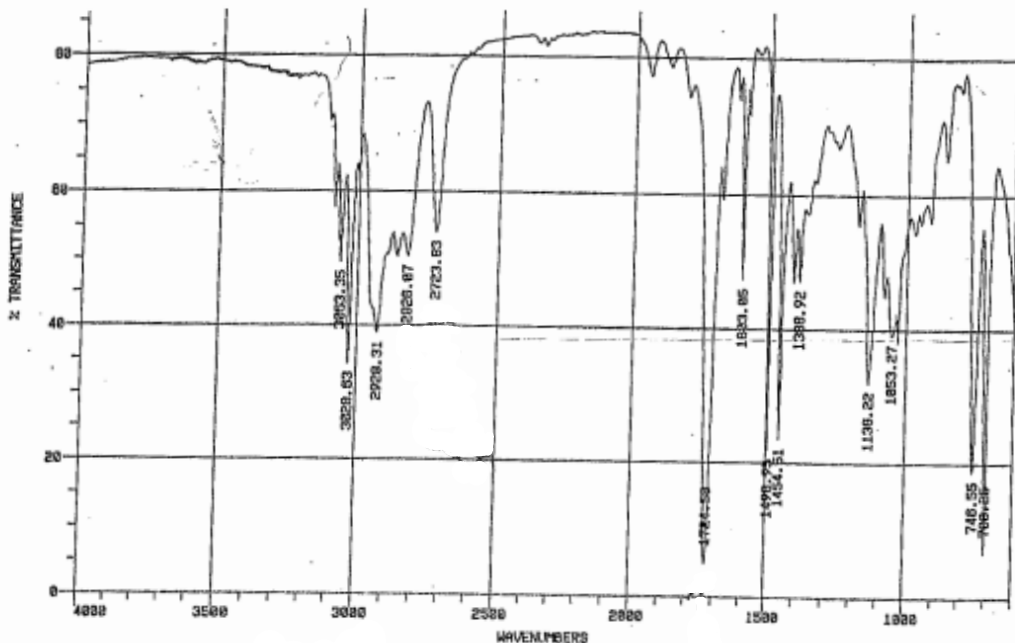
Synthesize the molecule below using any of the following reagents: cyclohexene, **alcohols** or **alkenes of three carbons or less**, any inorganic reagents, and any oxidizing or reducing agents.





**F. Spectroscopy: 8 Points**

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.



Carbon 13 NMR

