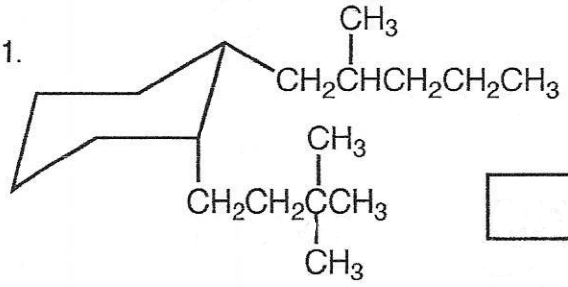
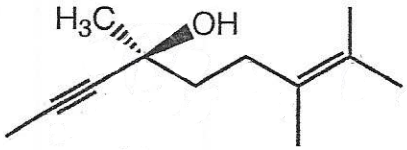
Final Exam F2021

A. Nomenclature: (12 points)
Give an acceptable IUPAC name for each compound. Be sure to indicate the **stereochemistry** where appropriate.

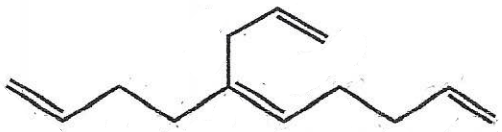
1.



2.

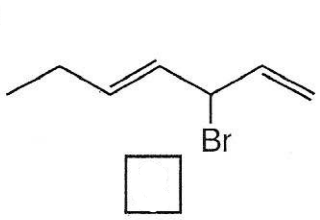


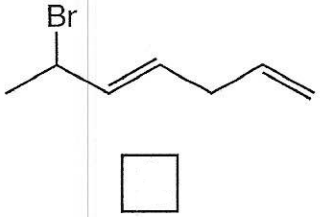
3.

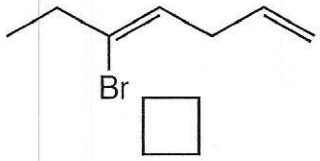


B. FACTS: 24 points

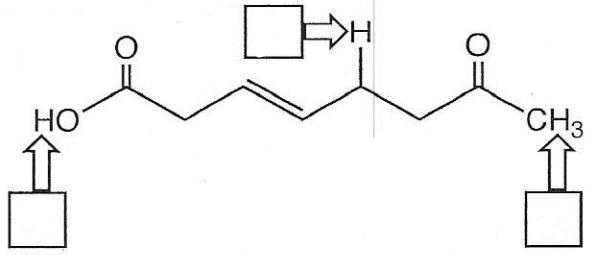
1. Place the compounds in order of increasing reaction rate with H_2O. (1=slowest, 3=fastest rate) (3 pts.)



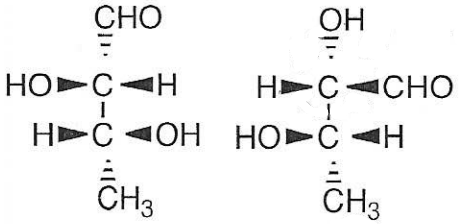




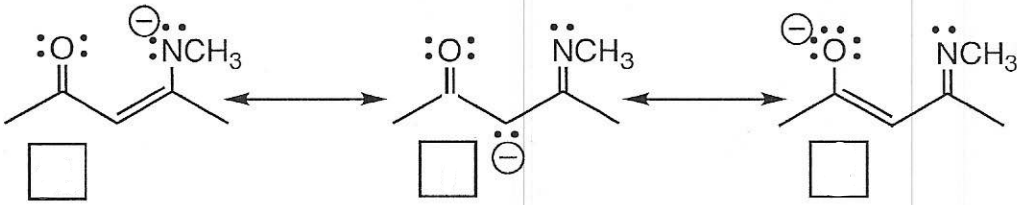
2. Place the indicated hydrogen atoms in order of increasing acidity. (1=least, 3=most) (3 pts.)



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



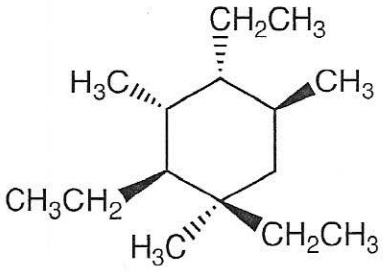
4.Consider the resonance contributors below.



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

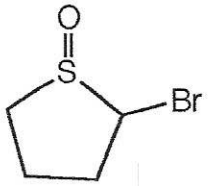
b. Place the hybridization of the nitrogen atom in the box. (2 pts.)

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

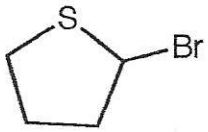


answer:

6. If the compound below will produce a useful Grignard reagent, place **Y** in the box. If it will not, place **N** in the box. (2 pts.)

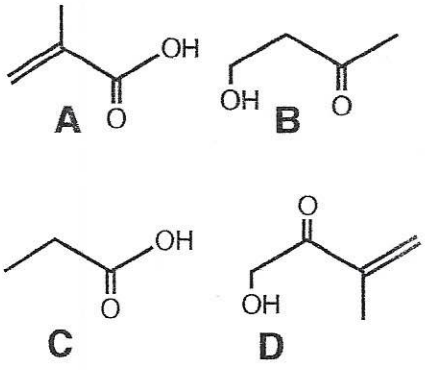


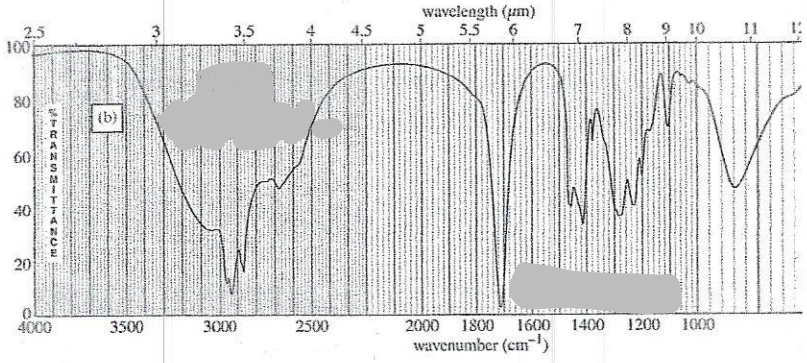
☐



☐

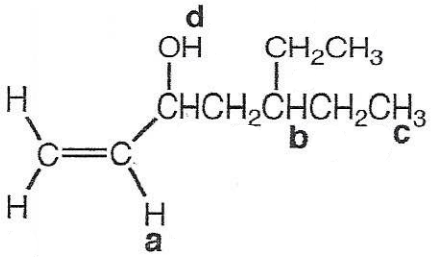
7.Carefully examine the spectrum and the compounds below. Place the letter of the correct compound in the box beside the spectrum. (2 pts.)





☐

8. Answer the following questions for the molecule shown below and place the answers in the appropriate boxes. (i) How many signals would be observed in the ^{1}H NMR spectrum? (ii) What are the theoretically predicted multiplicities (splitting patterns) of the signals for the protons labeled **a**, **b**, and **c** in the ^{1}H NMR? (iii) Under ultrapure conditions, what is the theoretically predicted multiplicity of the signal for the proton labeled **d**? (5 pts.)



(i) number of signals ☐

(ii) multiplicity of H_a ☐

multiplicity of H_b ☐

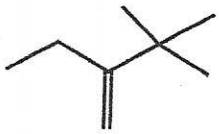
multiplicity of H_c ☐

(iii) multiplicity of H_d ☐

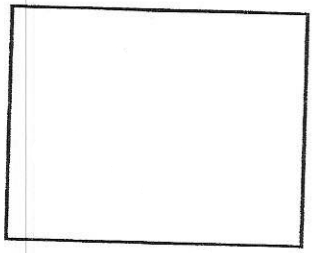
☐

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.**

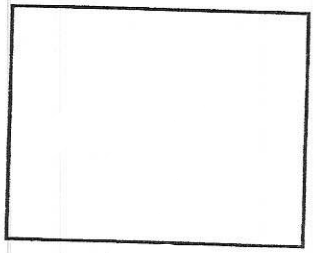
1.



NBS/Light →

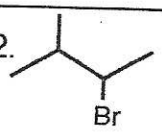


+

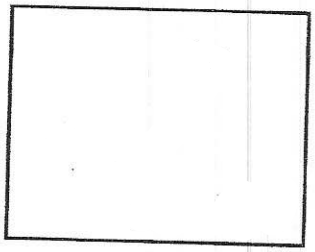


2.

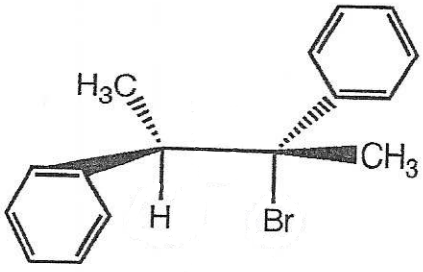
1. K°
2.



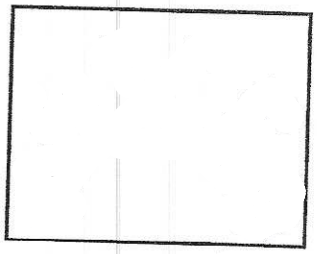
3. Br_2/H_2O →

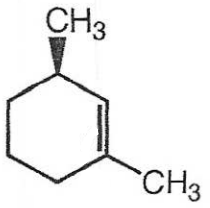


3.

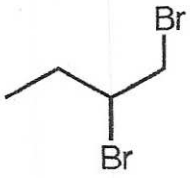


1. $CH_3O^-Na^+/CH_3OH$
2. $CHCl_3/KOH$ →



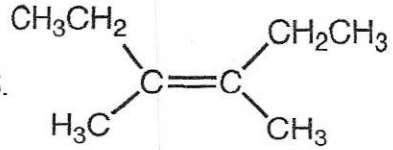
4. 

H_3O^+ → [ ] + [ ]

5. 

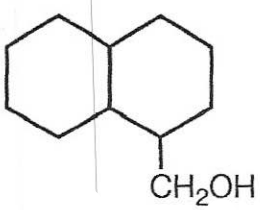
1. KOH / 200°C
2. Sia_2BH
3. H_2O_2 / OH-
4. H_2 / Ra-Ni

→ [ ]

6. 

1. OsO_4 / H_2O_2 /OH^-
2. HIO_4
3. $CH_3C{\equiv}C:\ ^-Na^+$, then H_3O^+
4. H_2 / $Pd(BaSO_4)$ / quinoline

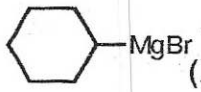
→ [ ]

7. 

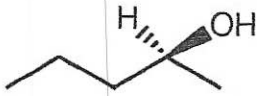
H_2SO_4 / Heat

Major + Minor + Minor

8. $CH_3CH_2CH{=}CHCH_2CH_3$

1. $KMnO_4$ (warm,conc.)
2. CH_3OH / H^+
3. 

(XS), then H_3O^+

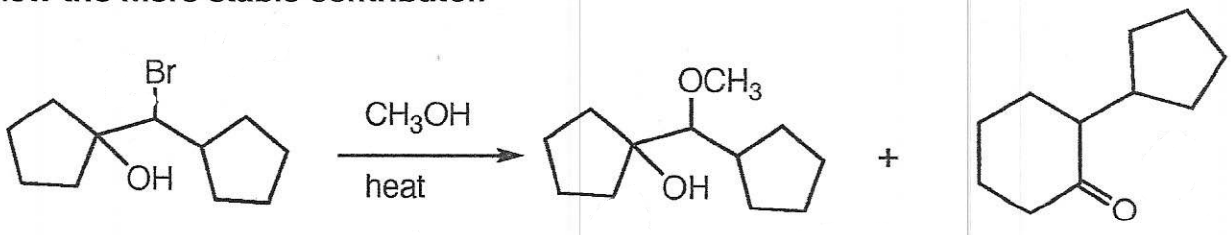
9. 

1. PBr_3
2. $CH_3S^-Na^+/CH_3CN$

1. pTsCl/pyridine
2. $CH_3S^-Na^+/CH_3CN$

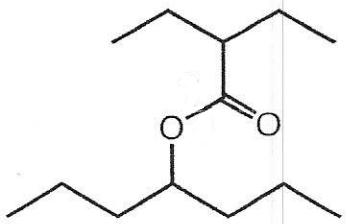
D. Mechanisms: (10 points)

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: **alcohols** of **five carbons or less**, any inorganic reagents, and any oxidizing or reducing agents.



F. Spectroscopy: 8 Points

A compound with the formula $C_{10}H_{12}O_2$ 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.