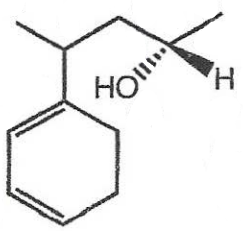
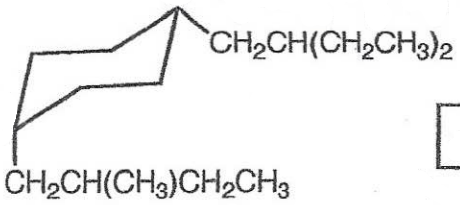
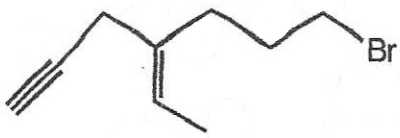
Final Exam, F 2022

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

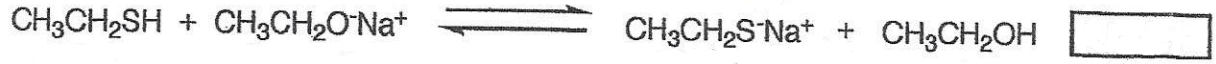
1. 

2. 

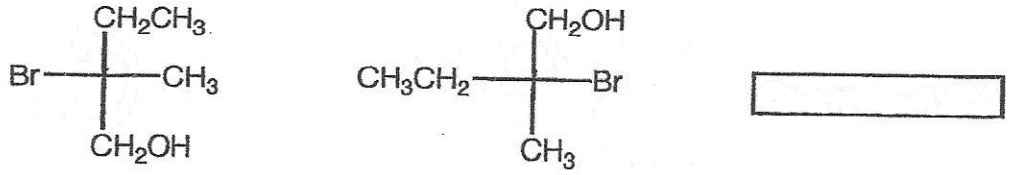
3. 

B. Facts: 24 points

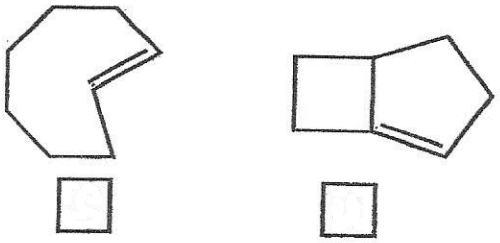
1. Does the following equilibrium lie to the Left or the Right? (2 pts.)



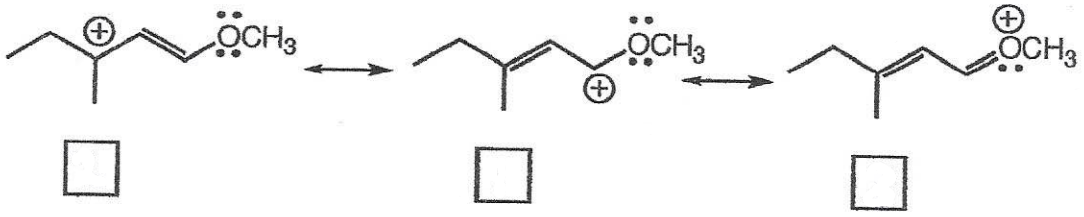
2. Label the following pair as identical, structural isomers, enantiomers or diastereomers. (2 pts.)



3. Label the alkenes below as stable (**S**) or unsatble (**U**) (2 pts.)



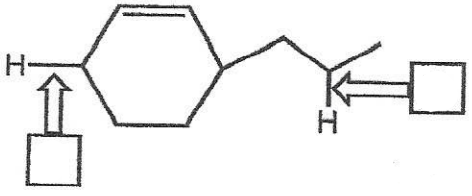
4. Consider the resonance contributors below.



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 oxygen atom in the box. (2 pts.)

5. Place the indicated bonds in order of increasing bond dissociation energy. (1=lowest energy, 2=highest energy) (2 pts.)



6. Compare the reaction rates of reaction **a)** and reaction **b)**, and place the letter of the faster reaction the box. (2 pts.)

a) $CH_3CH_2Br \xrightarrow{CH_3O^{\ominus}Na^+} CH_3CH_2{-}OCH_3$

b) $CH_3CH_2Br \xrightarrow{CH_3\overset{\ominus}{N}H\ Na^+} CH_3CH_2{-}NHCH_3$

☐

7. Draw the tautomer of the compound below in the box. (2 pts.)

☐

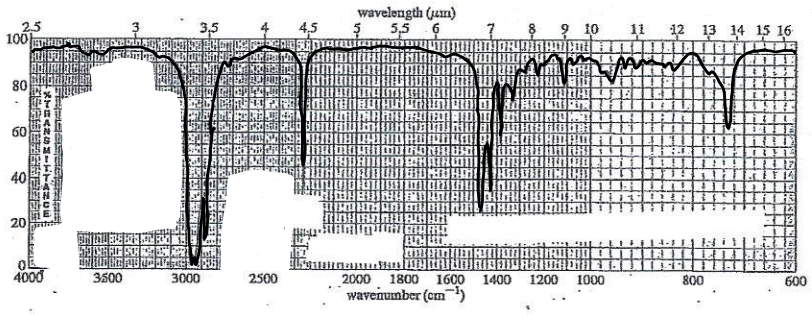
8. Carefully examine the spectrum and the compounds below. Place the letter of the correct compound in the box beside the spectrum. (2 pts.)

A $CH_3CH_2CH_2C{\equiv}C{-}H$

B $CH_3CH_2C{\equiv}C{-}CH_2CH_2OH$

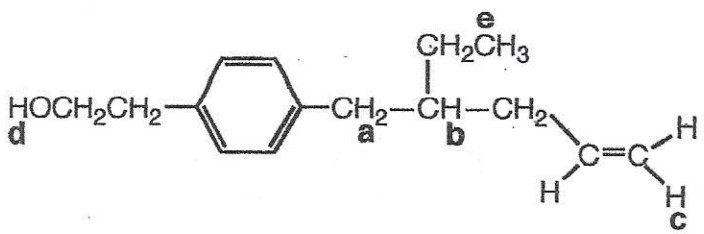
C $CH_3CH_2CH_2CH_2CN$

D $CH_3CH_2C{\equiv}C{-}CH_2CH_3$



☐

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 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 ☐

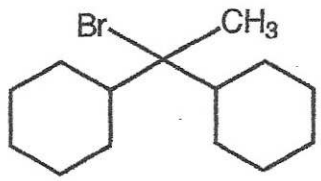
(ii) multiplicity of H_d ☐

(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.**

1.



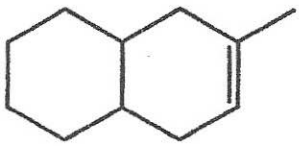
H_2O/Heat

+

Major

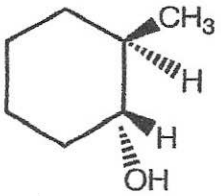
Minor

2.

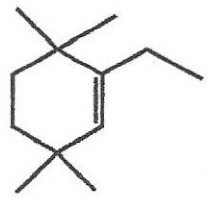


1. cold $KMnO_4$
2. HIO_4
3. $CrO_3/H_2SO_4/H_2O$/acetone/0°C
4. $NaBH_4$ / EtOH

3.



1. PBr_3
2. NaI/acetone
3. $CH_3O^-Na^+$

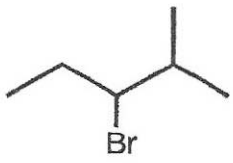
4. 

NBS/Light →

+

5. 

1. H_2SO_4 / Heat →
2. BH_3-THF
3. H_2O_2 / OH-
4. $Na_2Cr_2O_7/H_2SO_4/H_2O$
5. $CH_3C{\equiv}C{:}\ ^{-}Na^{+}$ then H_3o^{+}

6. 

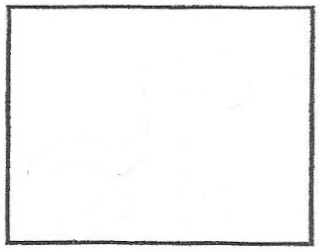
$(CH_3)_3CO^{-}K^{+}$ →
$(CH_3)_3COH$

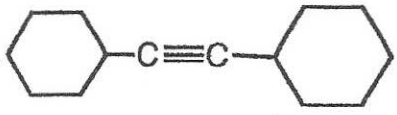
+

7. 

1. Cl_2/H_2O
2. Na°

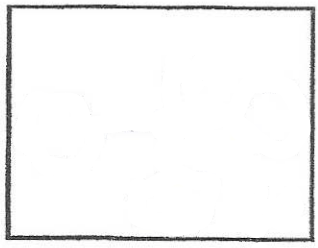
3. CH_3Br



8. 

1. $KMnO_4$ (warm,conc)
2. CH_3CH_2OH/H^+

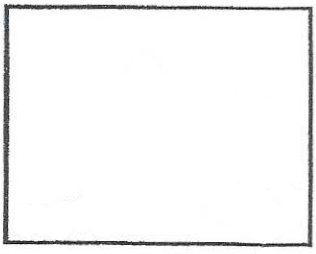
3.  MgBr (2 eq) then H_3O^+



9. 

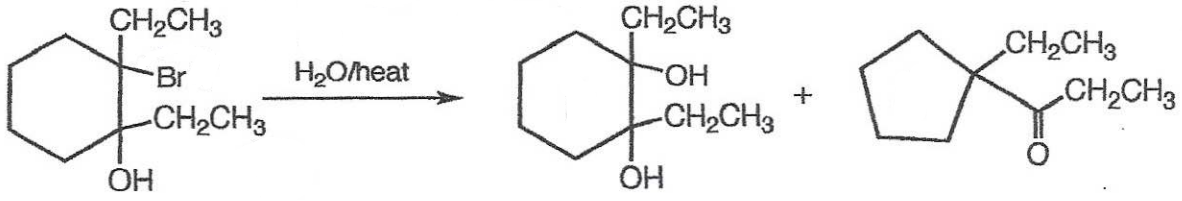
1. KOH/200°C
2. Na / NH_3

3. MCPBA



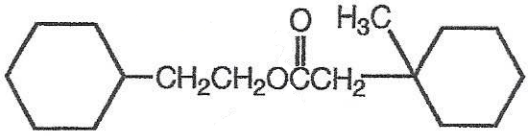
D. Mechanisms: (10 points)

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: **cyclohexanol**, alcohols or alkenes of **two carbons or less**, any inorganic reagents, any peroxy acids, and any oxidizing or reducing agents.



F. Spectroscopy: 8 Points

A compound with the formula $C_{10}H_{12}O$ exhibits the IR, ^{1}H NMR, and proton-spin decoupled ^{13}C NMR spectra shown below. Please identify this compound and draw the structure in the box provided below.