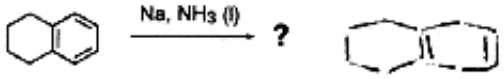
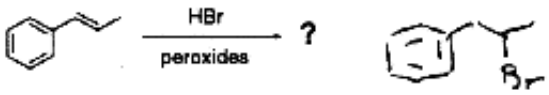
NAME_____

1. (20 points) Provide the missing reagents or products for the following reactions. Carefully show the stereochemistry of each product (if relevant) using wedges and dashes.

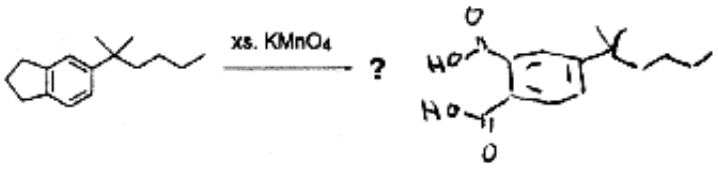
a.



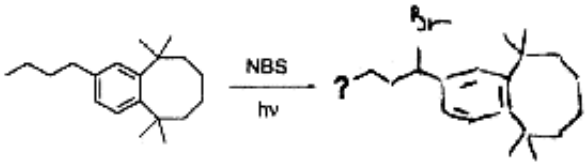
b.



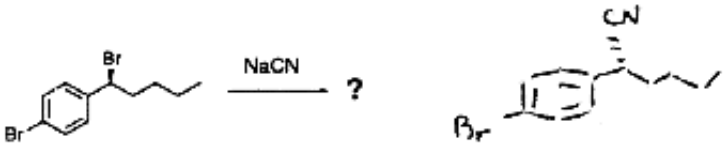
c.



d.

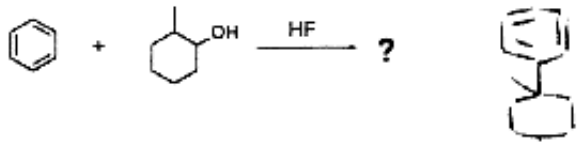


e.

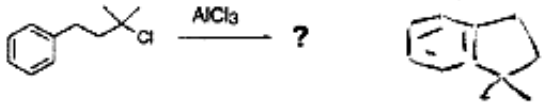


NAME_____

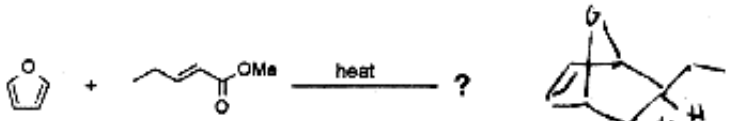
f.


OH
HF
?

g.

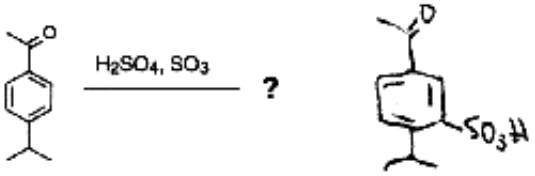

Cl
AlCl3
?

h.


O
OMe
O
heat
?

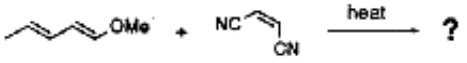
O
H
H
CO2Me

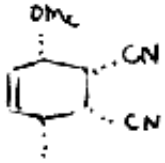
i.


O
H2SO4, SO3
?

O
SO3H

j.

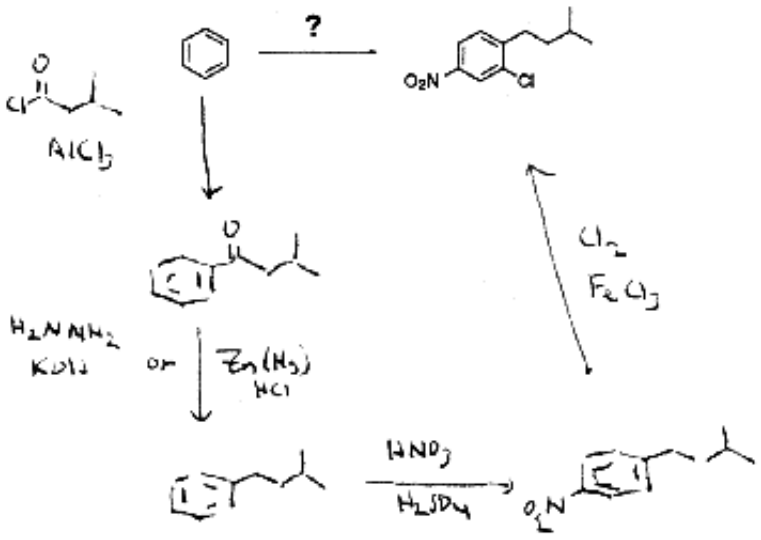

OMe
NC
CN
heat
?


OMe
CN
CN

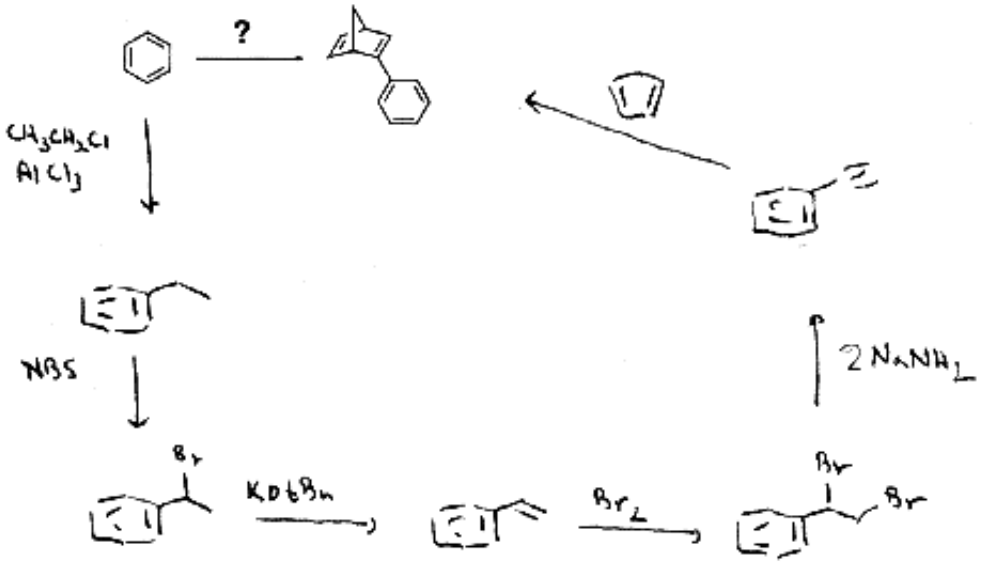
NAME_____

2. (30 points) Propose a synthesis of the target compounds starting with the substrate provided and any other chemical reagents. Several steps are required in each case. You do not have to show mechanisms for each of the individual steps, but do show the products formed from each of the reactions you perform.

A.



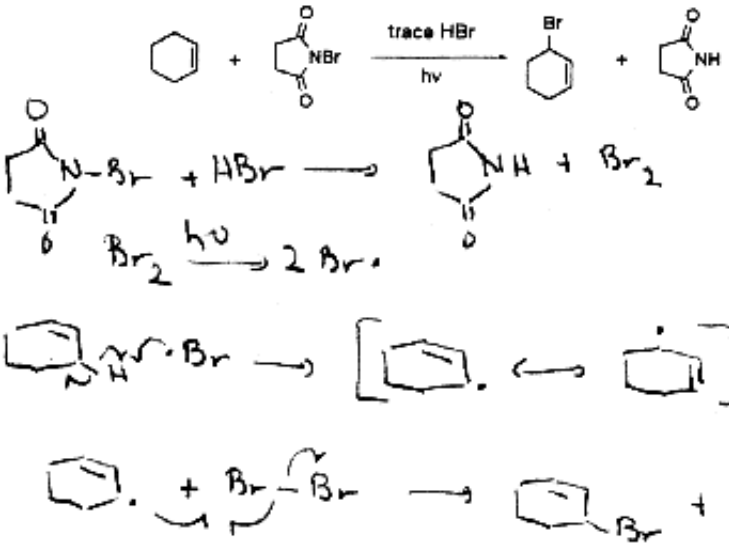
B.



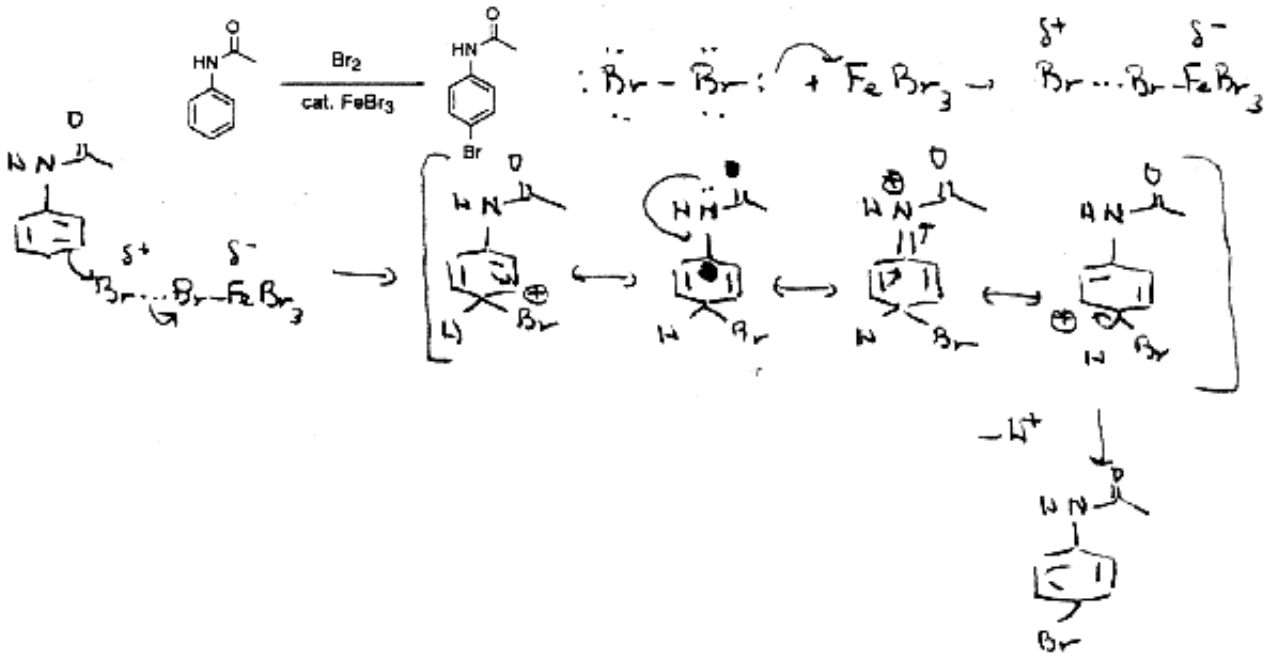
NAME_____

3. (30 points) Write out a detailed, stepwise mechanism for the following transformations. Draw all reasonable resonance structures for any intermediates along the reaction pathway.

a.



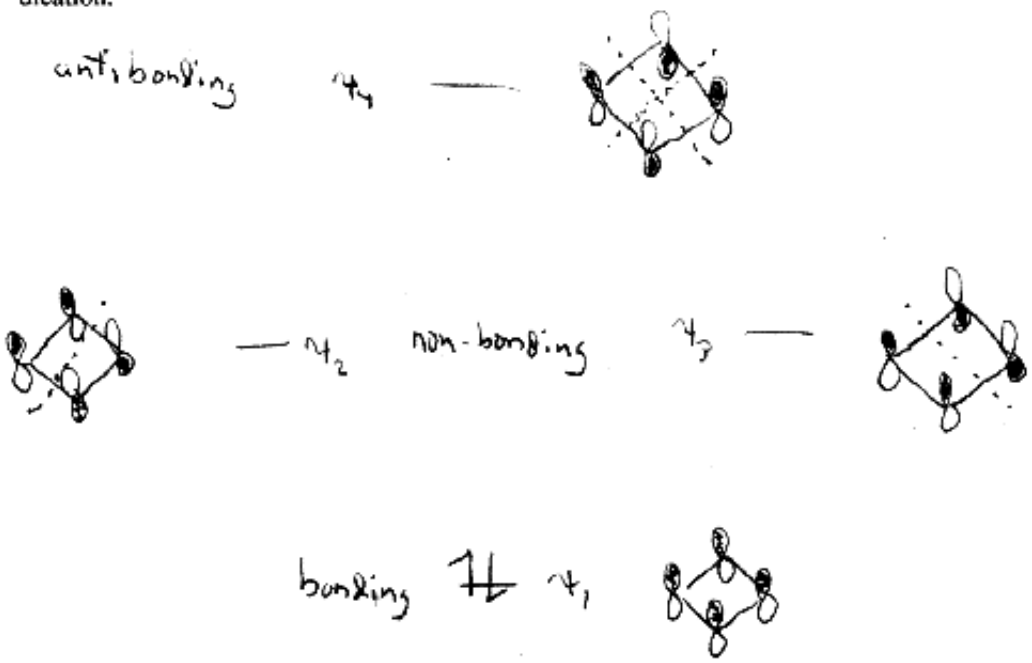
b.



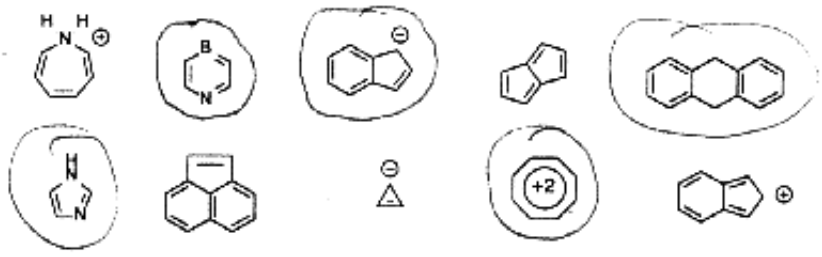
NAME _____

4. (20 points)

A. Draw the Hückel π molecular orbitals for the cyclobutadiene system and arrange them in order of increasing energy. Label the molecular orbitals as bonding, nonbonding, and antibonding as appropriate for their energy levels. Finally, on this diagram show the electron distribution for cyclobutadienyl dication.



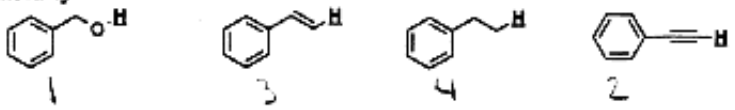
B. Circle the molecules that are aromatic according to Hückel's theory.



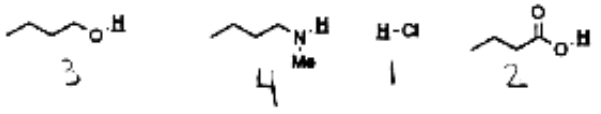
NAME _____

5. (25 points) Rank the following [1→4 (5), 1 = greatest or most] according to the indicated criteria.

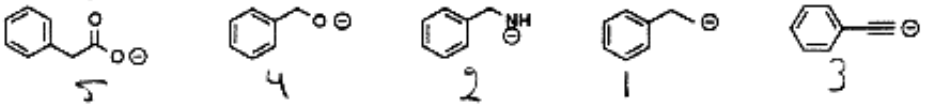
a. Proton acidity



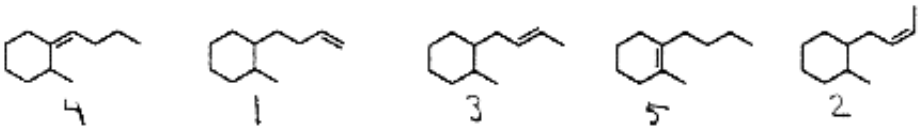
b. Proton acidity



c. Basicity



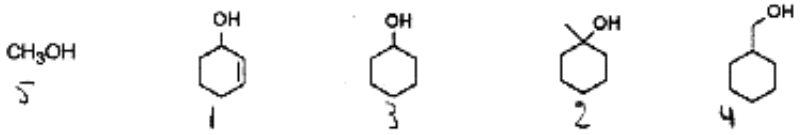
d. Heat of combustion



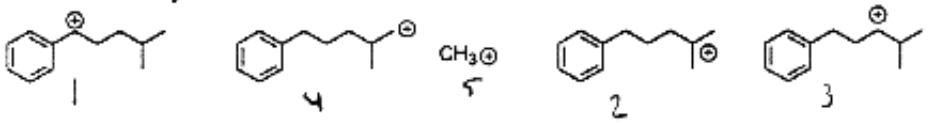
e. Rate of reaction with *tert*-butanol

HBr 2 HCl 3 HI 1 HF 4

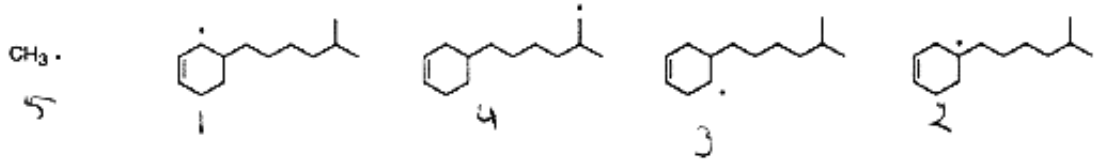
f. Rate of reaction with HCl



g. Cation stability

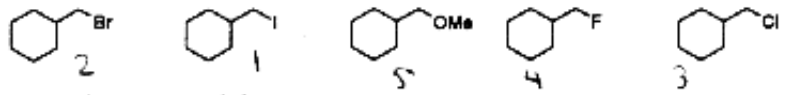


h. Radical stability



NAME_____

i. Rate of reaction with NaCN

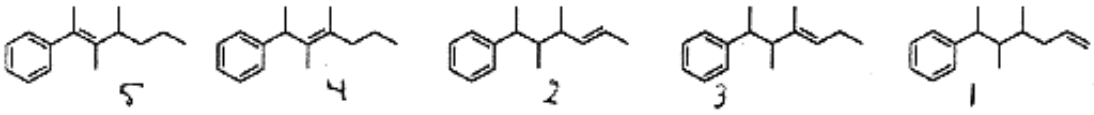


2 1 5 4 3

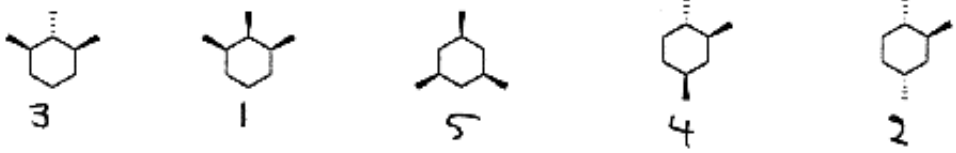
j. Rate of reaction with cyclohexane

F_2	H_2/Pt	Br_2	I_2	Cl_2
1	5	3	4	2

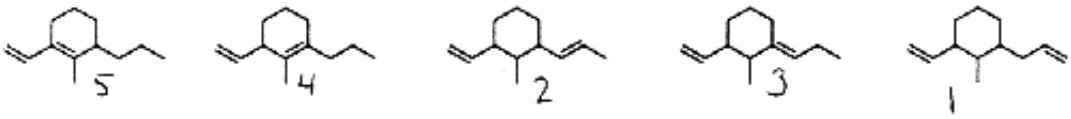
k. Heat of hydrogenation


5 4 2 3 1

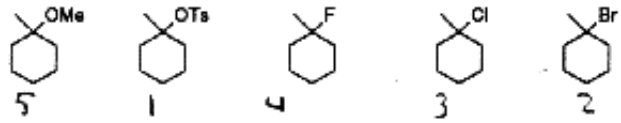
l. Heat of combustion


3 1 5 4 2

m. Heat of hydrogenation

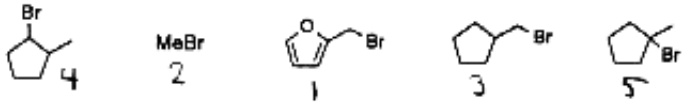

5 4 2 3 1

n. Rate of reaction with potassium *tert*-butoxide



5 1 4 3 2

o. Rate of S_N2 reaction with sodium acetylide



4 2 1 3 5

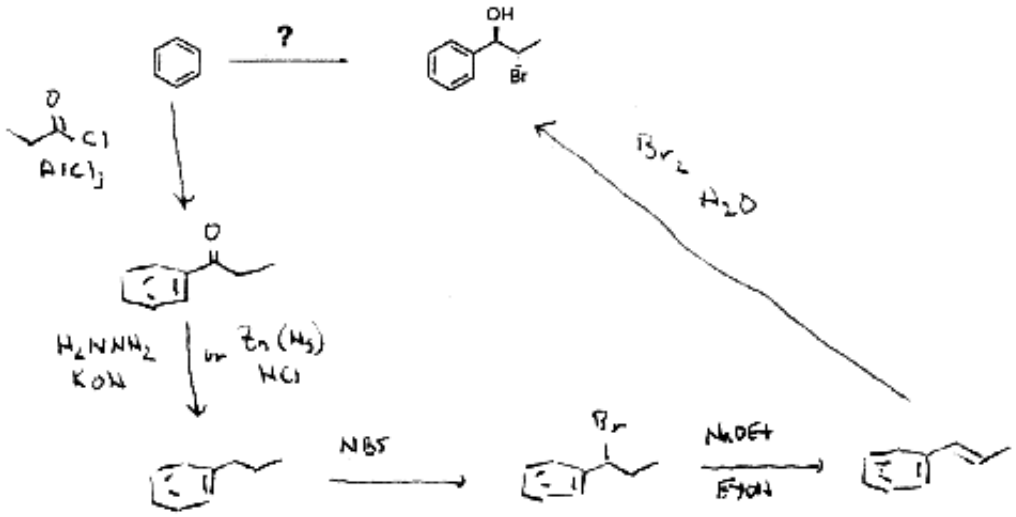
p. Rate of reaction with cyclohexene

HBr	HF	HI	HCl	H_2O
2	4	1	3	5

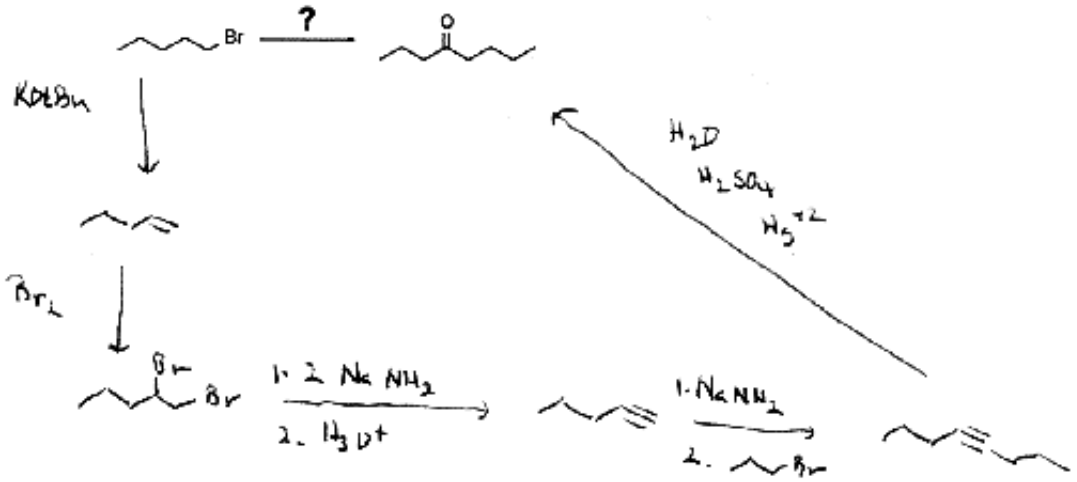
NAME _____

6. (20 points) Propose a synthesis of the target compounds starting with the substrate provided and any other chemical reagents. Several steps are required in each case. You do not have to show mechanisms for each of the individual steps, but do show the products formed from each of the reactions you perform.

A.



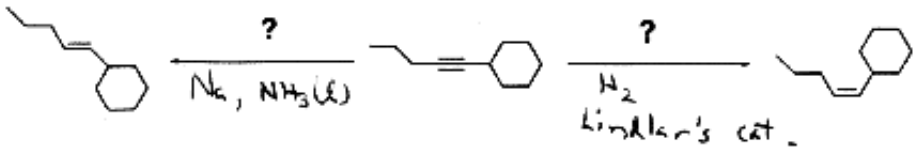
B.



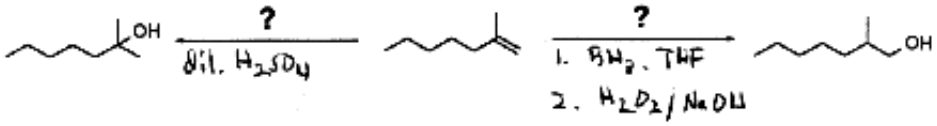
NAME_____

7. (25 points) Provide the missing reagents and reaction conditions where necessary for the following reactions.

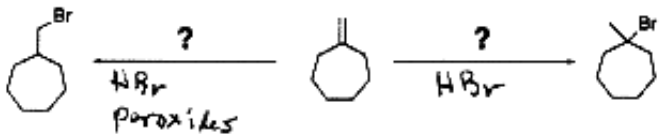
a.



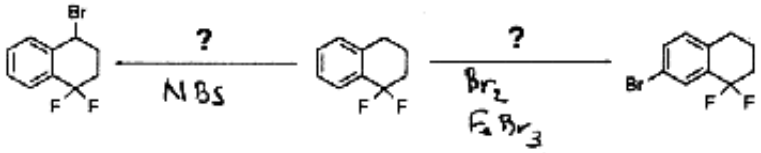
b.



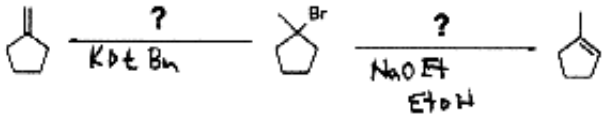
c.



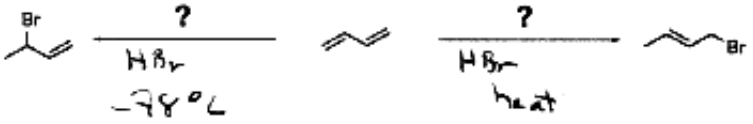
d.



e.



f.

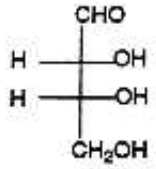


NAME_____

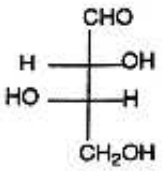
8. (30 points)

a. Label each of the following pairs of structures as homomers, enantiomers, diastereomers, or constitutional isomers, and indicate whether each compound is chiral or achiral using the check boxes.

Diastereomers

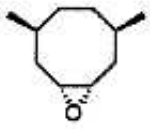


☒ Chiral ☐ Achiral



☒ Chiral ☐ Achiral

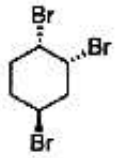
Diastereomers



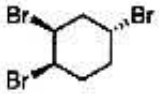
☐ Chiral ☒ Achiral

☐ Chiral ☒ Achiral

Enantiomers

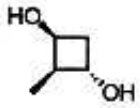


☒ Chiral ☐ Achiral

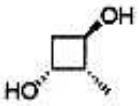


☒ Chiral ☐ Achiral

Enantiomers

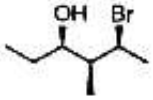


☒ Chiral ☐ Achiral

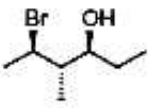


☒ Chiral ☐ Achiral

Diastereomers

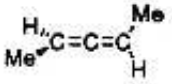


☒ Chiral ☐ Achiral

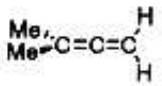


☒ Chiral ☐ Achiral

Constitutional isomers



☒ Chiral ☐ Achiral



☐ Chiral ☒ Achiral

b. Draw all of the isomers of C_4H_6.

$HC\equiv CCH_2CH_3$ $CH_2=C=CHCH_3$

$CH_3C\equiv CCH_3$