

UCSC, Binder

Name Key

Student ID # _____

1 (24)	
2 (37)	
3 (22)	
4 (16)	
5 (16)	
6 (22)	
7 (21)	
8 (18)	
9 (24)	
Total	

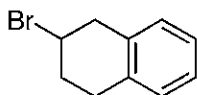
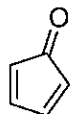
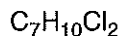
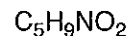
**Survey of Organic Chemistry
EXAM 2 (200 points)**

In each of the following problems, you will use your knowledge of organic chemistry conventions to answer the questions in the proper manner. Be sure to read each question carefully. For extra credit, write down your favorite summer location on the last page of the exam. You have the entire class period (2 hours) to complete this exam. Pay attention to point values and problems to skip to use your time wisely.

Keep your eyes on your own paper. Electronic devices of any kind are not allowed, including cell phones and calculators. Any student found using any of said devices, or found examining another student's exam, will be promptly removed from the exam room and at minimum will receive a zero on this exam. Such an incident may also be considered a form of academic dishonesty and reported to the UCSC Judiciary Affairs Committee.

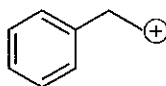
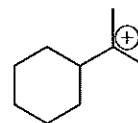
1. Fundamentals

(a) (4 points) Provide the **degrees of unsaturation** in the following structures or formulas.

5422

1 pt. ea

(b) (8 points) Rank the following carbocations from **most stable (1)** to **least stable (4)**.

3241

2 pts ea.

(c) (12 points) Indicate whether the following types of compounds are **nucleophiles (N)** or **electrophiles (E)**.

Acids EBases NAlkenes N

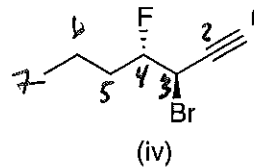
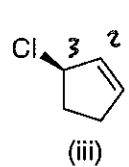
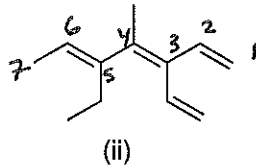
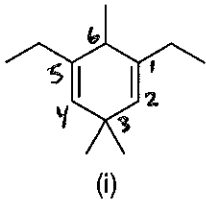
2 pts ea.

Alkynes NAlkyl Halides EOrganometallic reagents (ex. R_2CuLi , $RMgBr$, RLi) N

2. Nomenclature

(a) (12 points) Name **any three** of the following compounds. Indicate in the parentheses which three compounds you are choosing. Include stereochemistry in the name, where appropriate.

4 pts ea.



(i) 1,5-Diethyl-3,3,6-trimethyl-1,4-Cyclohexadiene
(3E,5E)

(ii) 5-Ethyl-4-methyl-3-vinyl-1,3,5-heptatriene

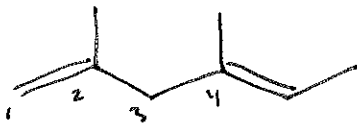
(iii) R-3-Chlorocyclopentene

(iv) (3R,4S)-3-Bromo-4-fluoroheptyne

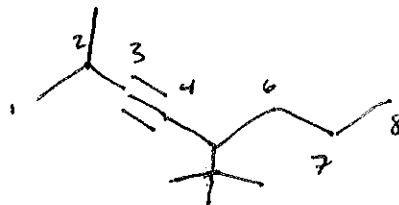
(b) (15 points) **Choose any three** and draw structures corresponding to the following names.

5 pts ea.

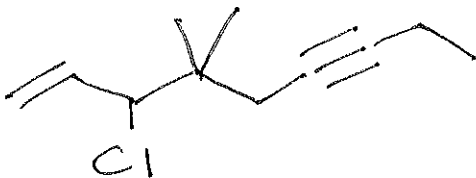
(4E)-2,4-Dimethyl-1,4-hexadiene



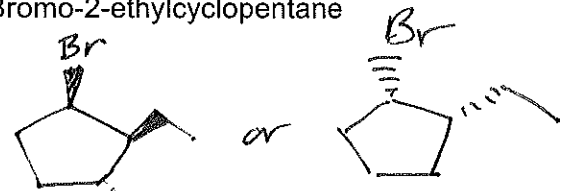
5-tert-Butyl-2-methyl-3-octyne



3-Chloro-4,4-dimethyl-1-nonen-6-yne

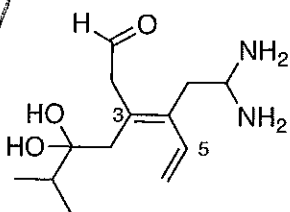


cis-1-Bromo-2-ethylcyclopentane

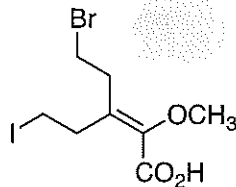


(d) (10 points) Provide a *cis/trans* or *E/Z* designation for each isomerizable alkene on the lines provided. Write "NI" if the alkene is non-isomerizable.

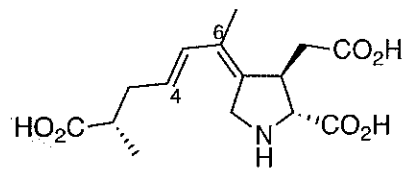
2 pts ea



3 Z, 5 NI



E



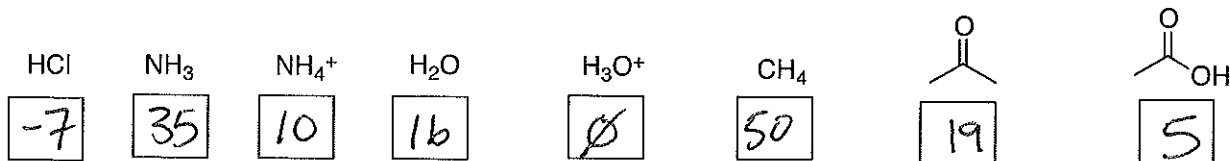
Isodomonic acid H

4 E, 6 Z
trans

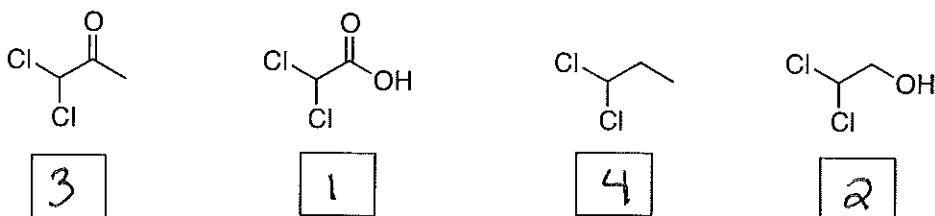
3. Acid-Base Chemistry

(a) (8 points) List the pKa values that belong to each compound in the boxes below.

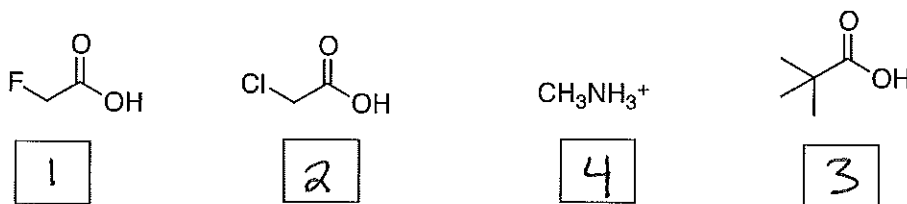
1pt ea

(b) (10 points) Rank the following sets of molecules from **most acidic (1)** to **least acidic (4)**.

(i)

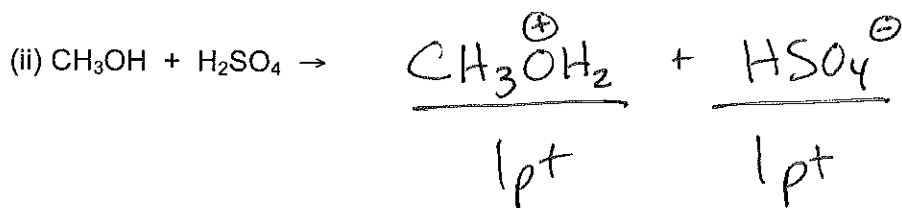
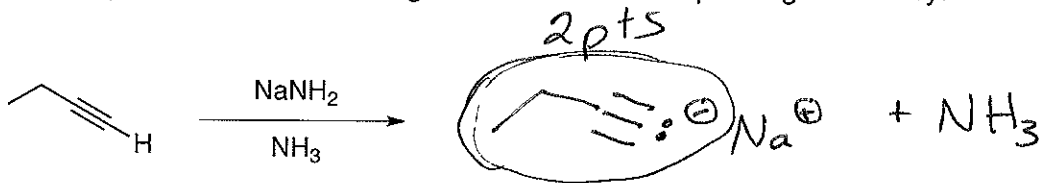


(ii)

5pts/part
if all correct
OR 1pt.
each
(partial)

(c) (4 points) Draw the products in the following reactions. No arrow-pushing necessary.

(i)

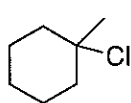
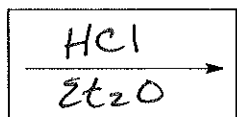
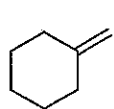


MUST have charges

4. Single step reactions – FILL IN THE BOX. **Choose any four** of the five reactions below and fill in the missing reactant, reagent/solvent, or product. Put a large "X" over the problems you are skipping. Otherwise the first four will be graded. Show stereochemistry in the products where appropriate. For (a), (b), (d), and (e) below, circle whether the product(s) is/are achiral, racemic, or a mixture of diastereomers.

(16 points) Complete any four of the reactions below.

(a)

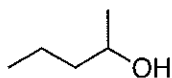


1
Achiral

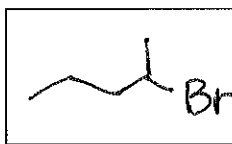
Racemic

Mixture of Diastereomers

(b)



HBr



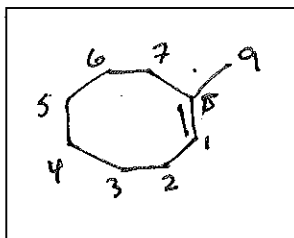
1
Achiral

Racemic

Mixture of Diastereomers

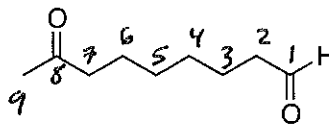
(c)

4

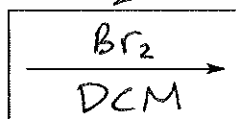
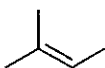


1. O₃

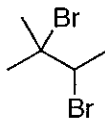
2. Zn, H⁺



(d)



(CH₂Cl₂)

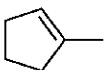


Achiral 1

Racemic

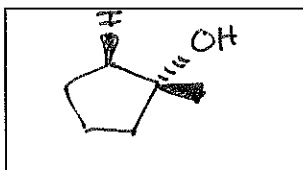
Mixture of Diastereomers

(e)



I₂

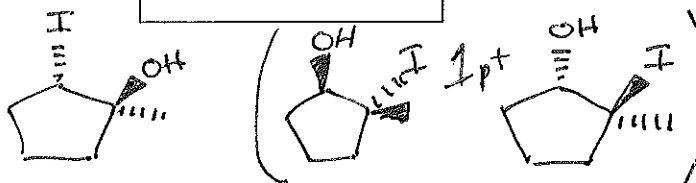
H₂O



Achiral 1

Racemic

Mixture of Diastereomers



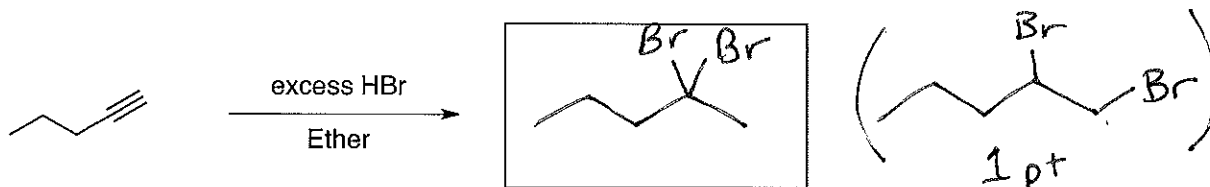
4

5. Single-step reactions continued...

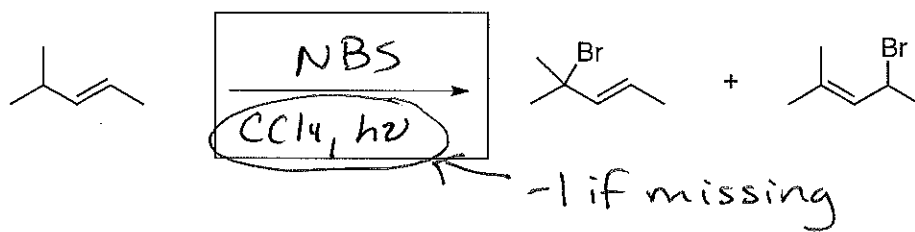
4 pts each

(16 points) FILL IN THE BOX. **Choose any four** of the five reactions below and fill in the missing reactant, reagent/solvent, or product. Put a large "X" over the problems you are skipping. Otherwise the first four will be graded. Ignore stereochemistry.

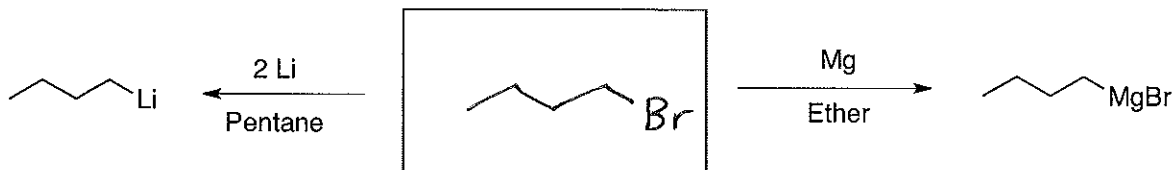
(g)



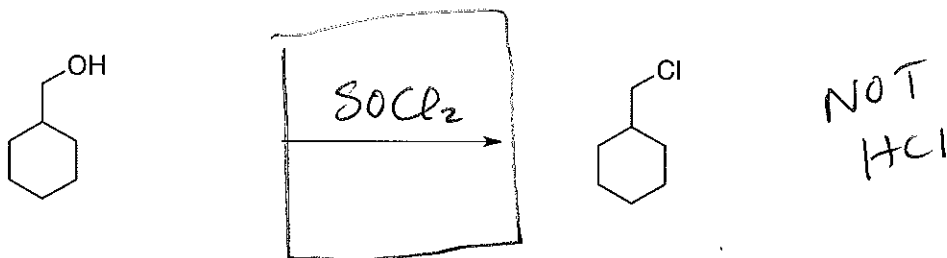
(h)



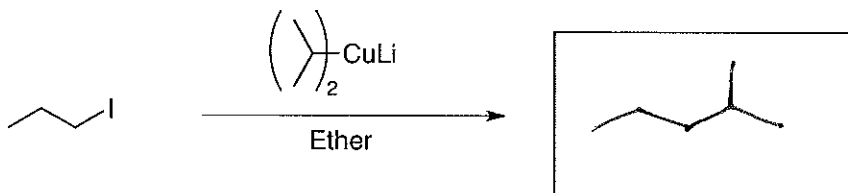
(i)



(j)



(k)

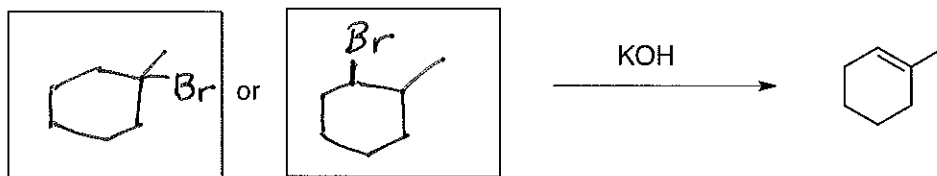


6. Reaction Puzzles

(a) (12 points) Choose any two of the three reaction schemes below (i through iii) and Fill in the Box with the missing reactants, reagents, and products. Ignore stereochemistry.

(i)

Cl
or
H

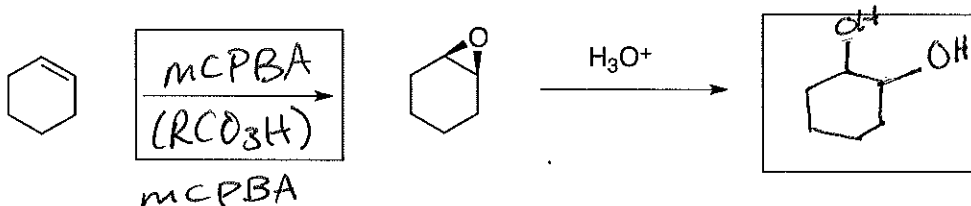


(2 possible starting materials)

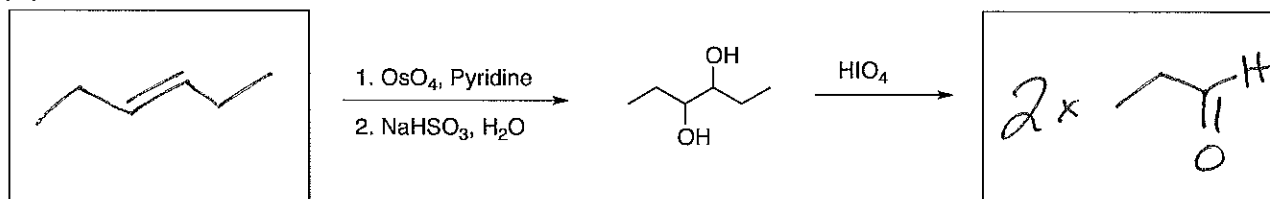
* constitutional isomers *

3 pts/
box

(ii)

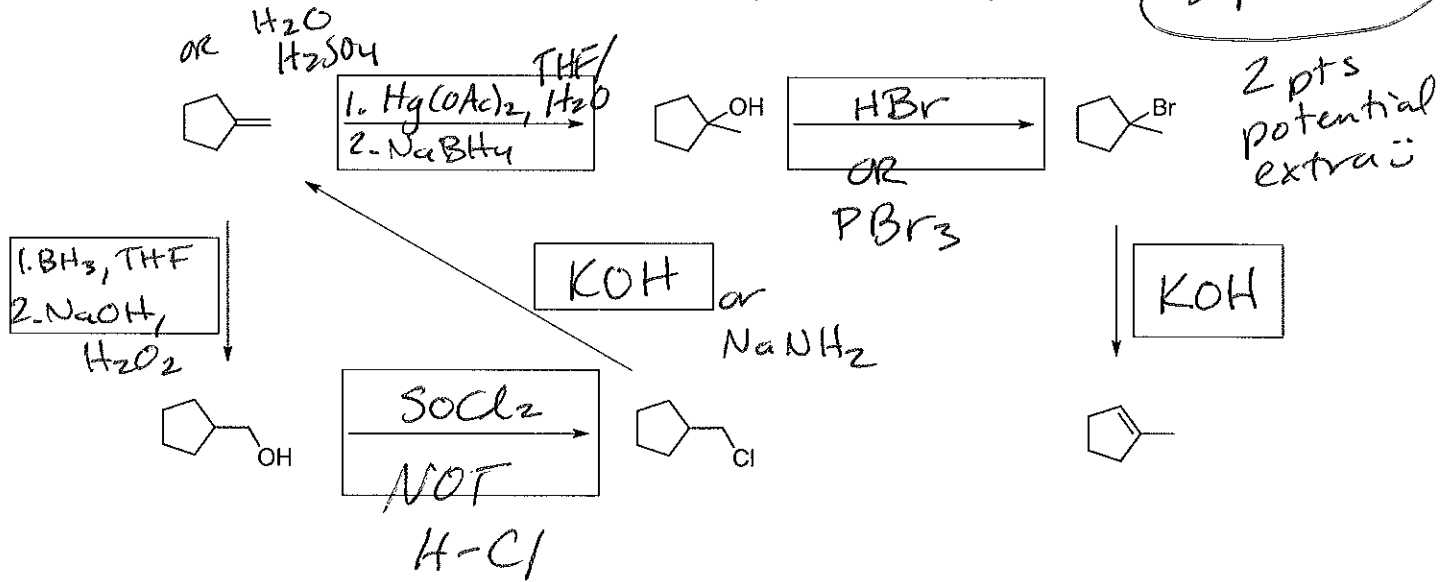


(iii)



(b) (10 points) Fill in the missing reagents below to complete the reaction puzzle.

2 pts/box



2 pts potential extra

21 pts

7. **Determination of unknowns.** Use the information below to elucidate the structures of compounds **A**, **B**, **C**, **D1**, and **D2**. Use the space below to show your work and write your final answers in the boxes below. *Only your final answers will be graded.*

Compound A (C_6H_8) reacts with 2 molar equivalent of hydrogen with Pd/C catalyst to give **compound B** (C_6H_{12}).

Upon treatment of **A** with ozone followed by zinc under acidic conditions, only one **product C** is formed. **C** is a dialdehyde (two aldehydes) with molecular formula $C_3H_4O_2$.

Compound A also reacts with 2 molar equivalents of OsO_4 and yields 2 **stereoisomeric products** (**D1** and **D2**) with molecular formula $C_6H_{12}O_4$ after treatment with aqueous sodium bisulfite.

$A \xrightarrow[2H_2]{Pd/C} B$
 $C_6H_8 \xrightarrow[2H_2]{Pd/C} C_6H_{12}$
 $3^\circ \quad 1^\circ \text{ unsat}$

2 π bonds
 1 ring
 \downarrow 1. O_3
 2. Zn^+

stereoisomers
D1 & **D2** ($C_6H_{12}O_4$)
 $1^\circ \text{ unsat (ring)}$

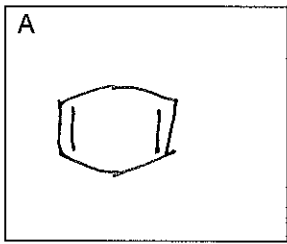
C dialdehyde $C_3H_4O_2$
 $2^\circ \text{ unsat (aldehydes)}$
 only possible dialdehyde

$H-C(=O)-CH_2-C(=O)-H$

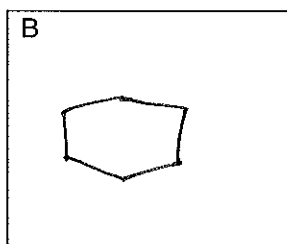
$H-C(=O)-CH_2-C(=O)-H \xleftarrow{O_3} \text{Cyclohexene} \text{ (A)}$

must be 2 alkenes in A

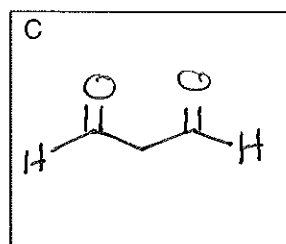
A



B

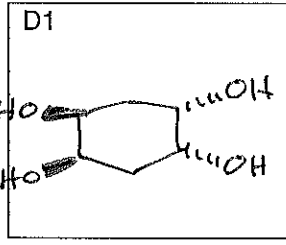


C

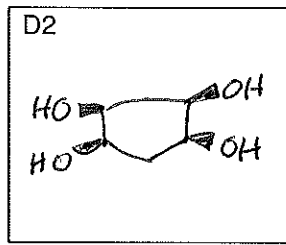


4 pts/box

D1



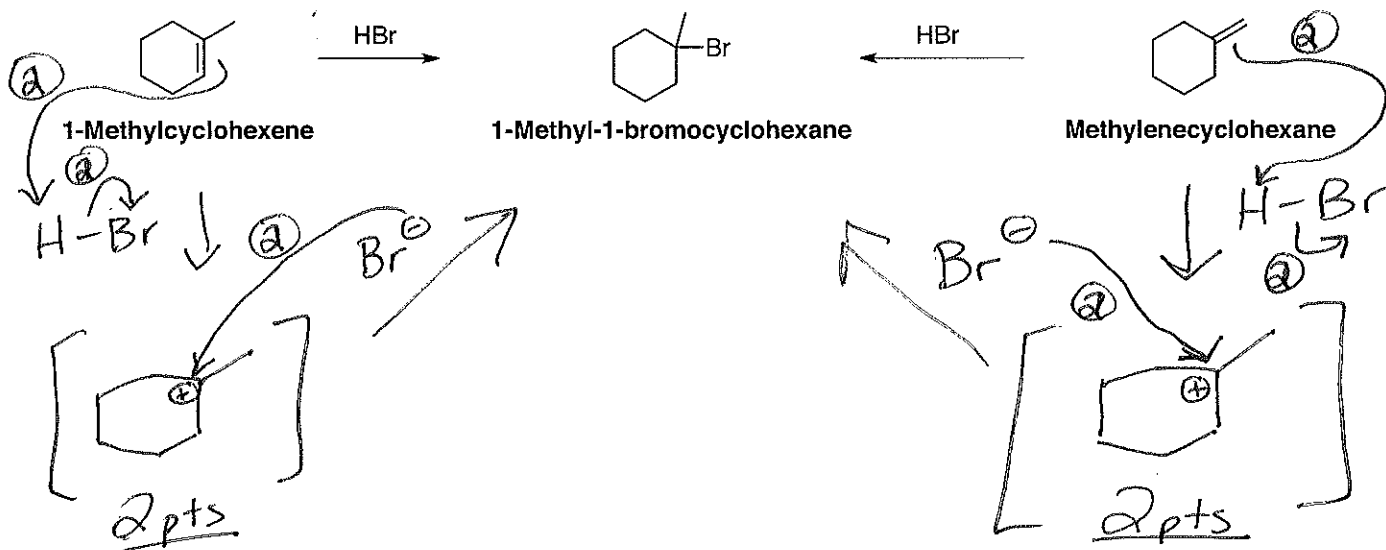
D2



21 pts if all correct

8. (18 points) Mark and Nick are beginning students in an organic chemistry lab and are arguing about the best way to synthesize **1-methyl-1-bromocyclohexane**. Mark thinks that hydrobromination of **1-methylcyclohexene** is best, but Nick thinks **methylenecyclohexane** is a better choice for the starting material. Their labmate Kat Ayan breaks up the fight and reassures them that either route is suitable.

- (i) Draw arrow-pushing mechanisms for both reactions.
 (iii) Give a *brief* explanation for why Kat was right.



Kat is right because both alkenes
 form the same carbocation intermediate



9. (24 points) Allylic bromination of 2-hexene with NBS yields a mixture of four products, all of which are constitutional isomers of each other. In the space provided below, show the arrow-pushing mechanisms for the bromination of 2-hexene to all four products using the abbreviated form of radical bromine given (only show propagation steps).

