CHEM 108A, Summer 2016 Last Name, First Initial _____

1. Fundamentals

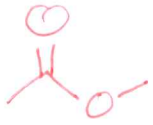
(a) (*12 points*) Indicate whether the following types of compounds act as **nucleophiles (N)** or **electrophiles (E).**

4pts each

Acids E Bases N Alkenes N

(b) (*12 points*) For each functional group, **draw a simple example containing 3 carbons.**

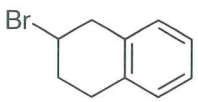
2pts each

Ester	Ether	Ketone	Alcohol	Carboxylic Acid	Alkyl Halide
					

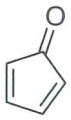
F Br I

(c) (*8 points*) Provide the **degrees of unsaturation** in the following structures or formulas.

2 pts each



5



4

C_7H_{12}

$C_7H_{10}Cl_2$

2

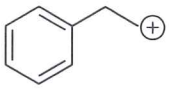
C_5H_8

$C_5H_9NO_2$

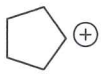
C_5H_{12}

2

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

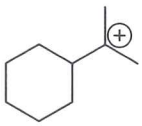


3



2

4



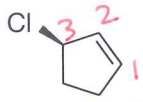
1

ranking off by just one → 6pts otherwise 2pts each

2. Nomenclature

10 each

(a) (*30 points*) Name the following compounds. Include stereochemistry in the name, where appropriate.

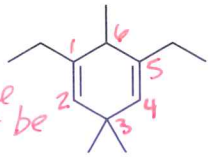


2 2 2 1 1 2

R-3-chlorocyclopentene

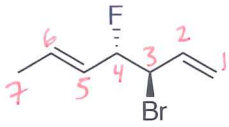
correct # → 2pts

cyclo alkene must be 1,2



2 2 2

1,5-diethyl-3,3,6-trimethyl-1,4-cyclohexadiene

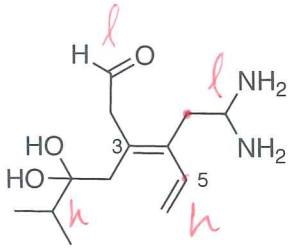


1 1 1 1 2 2

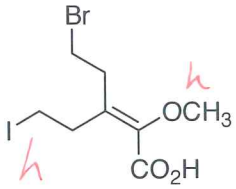
(3R,4S)-3-bromo-4-fluoro-1,5-heptadiene

correct # → 2pts

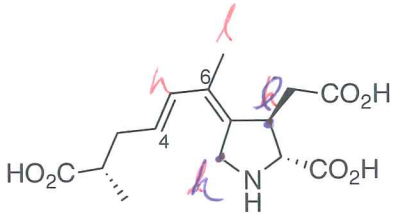
(b) (*10 points*) Provide a *cis/trans* or *E/Z* designation for each isomerizable alkene on the lines provided. Write "NI" if the alkene is non-isomerizable (cannot be assigned).



3 Z, 5 NI



E



Isodomoic acid H

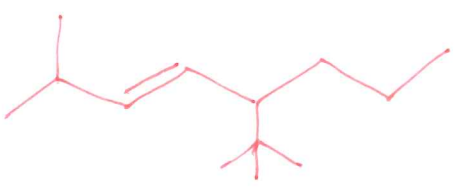
4 E, 6 ~~E~~ Z

OR trans

2 each

(c) (*10 points*) Draw structures corresponding to the following names.

trans-5-*tert*-Butyl-2-methyl-3-octene

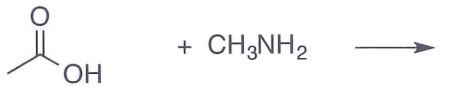


(4*E*)-2,4-Dimethyl-1,4-hexadiene

3. Acid-Base & Arrow Pushing

(a) (*12 points*) Draw the products in the following reactions. No arrow-pushing necessary here.

(i)

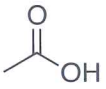


1pt/charge

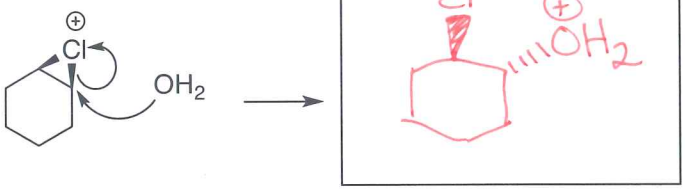
(ii) $CH_3OH + H_2SO_4 \rightarrow$

(b) (*8 points*) List the pKa values that belong to each compound in the boxes below (not given in order of acidity).

1pt each

HCl	NH_3	NH_4^+	H_2O	H_3O^+	CH_4		
-7	35	10	16	∅	50	19	5

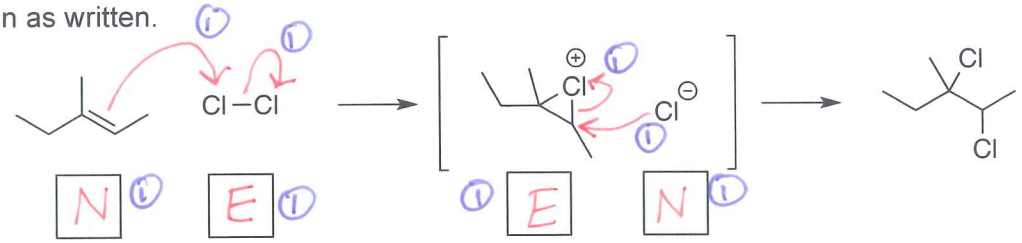
(c) (*4 points*) Follow the curved arrows and **draw the product** in the box provided.

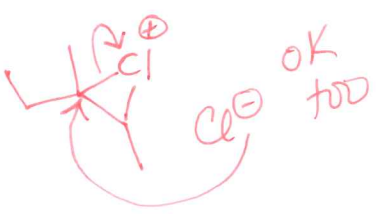


Include stereochemistry

2pts -anti

(d) (*16 points*) Indicate whether each reaction component is a **nucleophile (N)** or **electrophile (E)** in the boxes provided, then **add curved arrows** to indicate electron movement to complete the reaction as written.

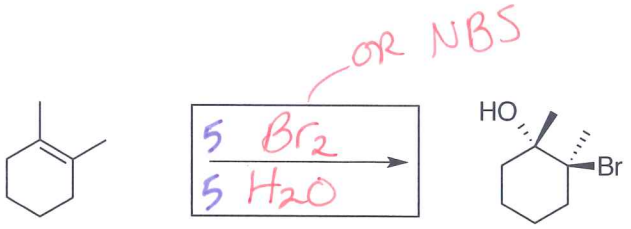




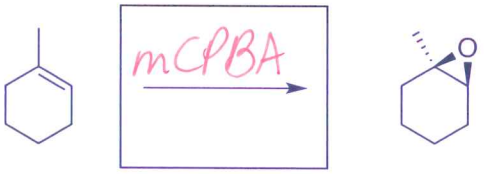
10 each

4. (*60 points*) **Single step reactions** – FILL IN THE BOX with the appropriate reactant, reagent, or product to complete each reaction. *Show stereochemistry in the products where appropriate.*

(a)

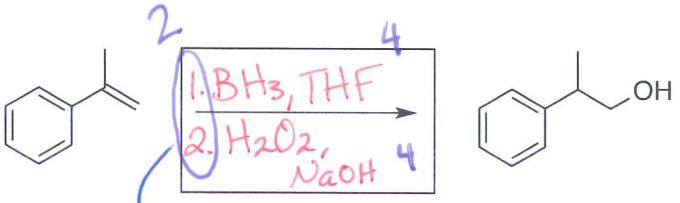


(b)



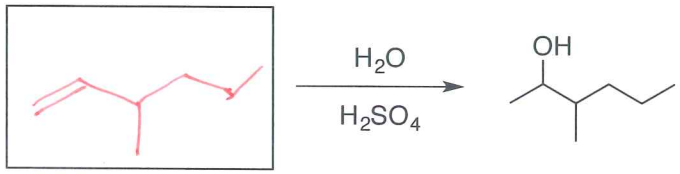
RCO_3H
peroxyacid

(c)

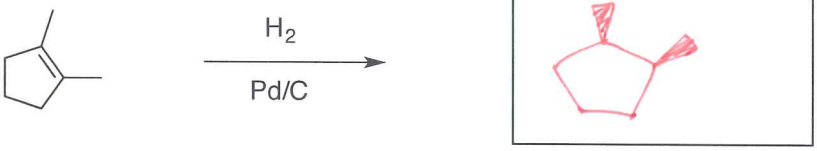


separating steps is important!

(d)

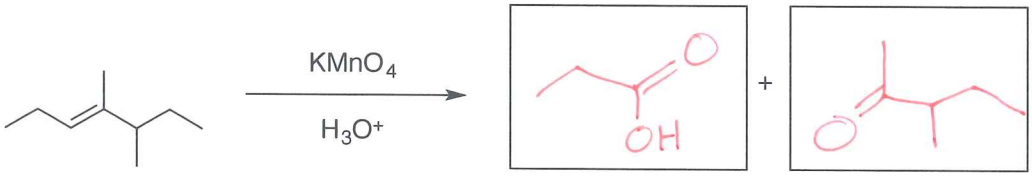


(e)



3 pts - syn

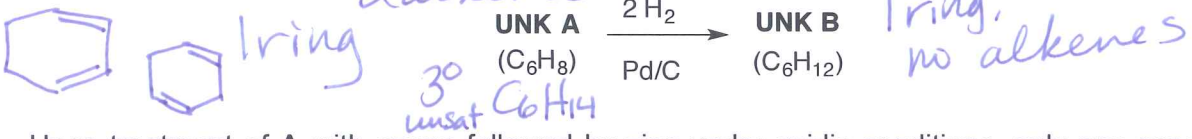
(f)



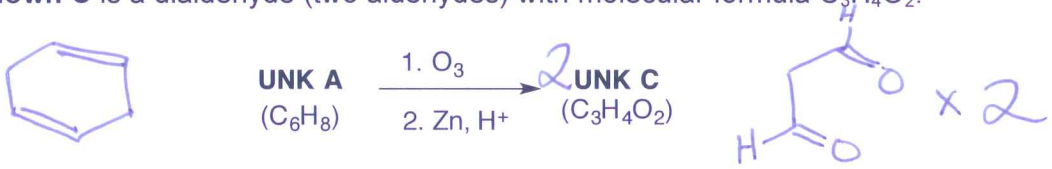
5 5

5. (*60 points*) **Reaction Puzzle: 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.*

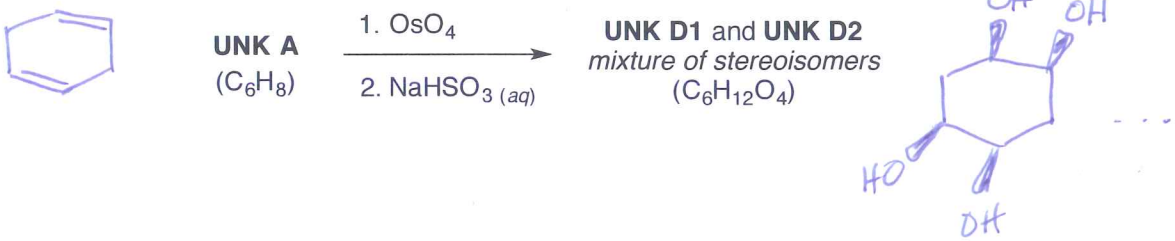
Unknown A (C_6H_8) reacts with 2 molar equivalents of hydrogen with Pd/C catalyst to give **unknown B** (C_6H_{12}).



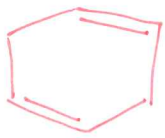
Upon treatment of **A** with ozone followed by zinc under acidic conditions, only one **product C** is formed. **Unknown C** is a dialdehyde (two aldehydes) with molecular formula $C_3H_4O_2$.



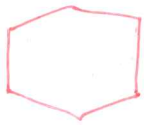
Compound A also reacts with 2 molar equivalents of OsO_4 and yields **2 stereoisomeric products** (**D1** and **D2**) with molecular formula $C_6H_{12}O_4$ after treatment with aqueous sodium bisulfite.



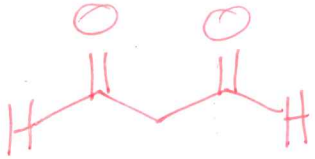
A



B

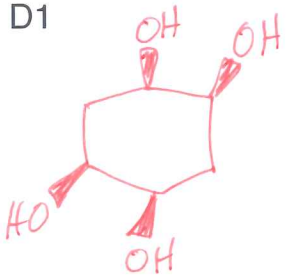


C

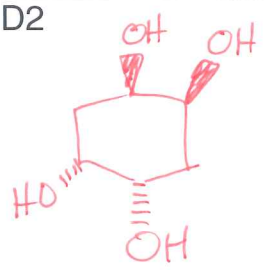


[redacted]

D1

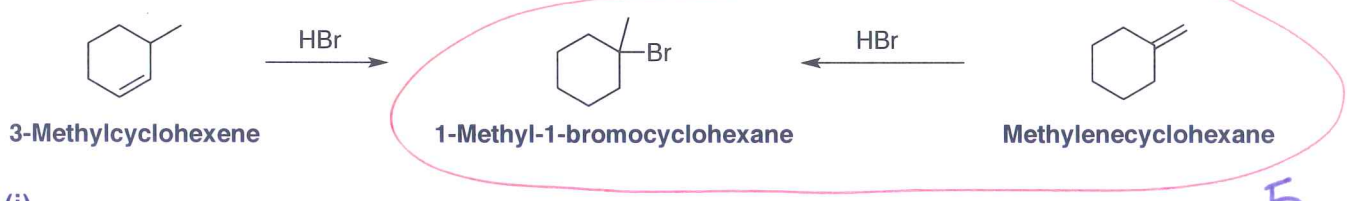


D2



6. (*50 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 wants to start with **3-methylcyclohexene** while Nick thinks **methylenecyclohexane** is a better choice for the starting material. Their lab-mate Kat Ayan breaks up the fight, tells them that both could theoretically give the same product, but that one route is more ideal.

(i) Draw separate arrow-pushing mechanisms for both reactions.
(ii) Circle the better synthetic route and give a *brief explanation* for your choice.



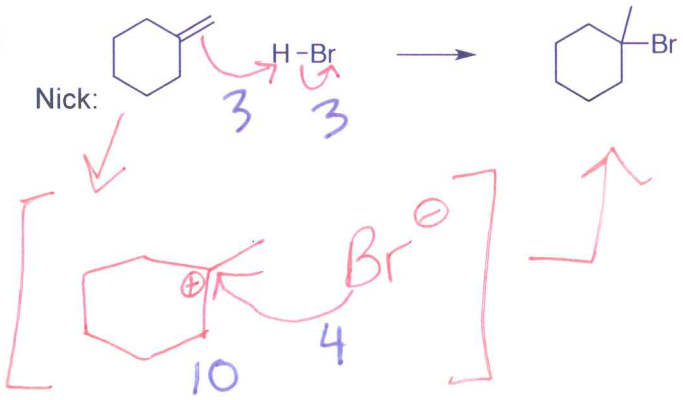
3-Methylcyclohexene **1-Methyl-1-bromocyclohexane** **Methylenecyclohexane**

5

(i)

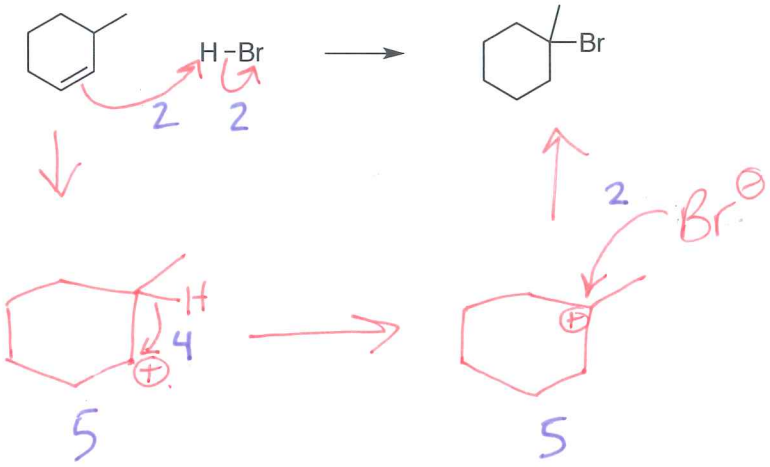
20

Nick:



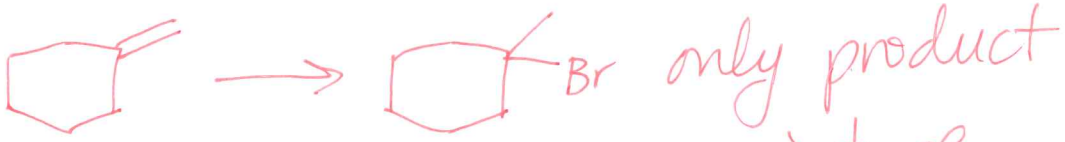
20

Mark:



5

(ii) Explanation (plus don't forget to circle your choice for the better route above)...



only product

other rxn will give a mixture