UCSC, Binder Name _____

Student ID # _____

Organic Chemistry
FINAL EXAM (*400 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, draw a picture of a dog detective on the back page of the exam. You have 2 hours to complete this exam. Pay attention to point values and **parts of problems to skip (pages 6, 7, & 9)** to use your time wisely. Make sure you have all nine (9) pages of problems.

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 (47)	
2 (48)	
3 (46)	
4 (50)	
5 (39)	
6 (40)	
7 (40)	
8 (50)	
9 (40)	
Total	

1. Fundamentals

(a) (*17 points*) Draw **Lewis structures** for the following compounds, including all lone pair and charges, where appropriate.

(i) Ozone (ii) Hydrogen Peroxide (H_2O_2) (iii) Thionyl Chloride ($SOCl_2$)

(b) (*9 points*) Indicate whether the following types of compounds typically act **nucleophiles (N)** or **electrophiles (E).**

Acids _____ Bases _____ Alkenes _____

Alkynes _____ Alkyl Halides _____ Alkoxides _____

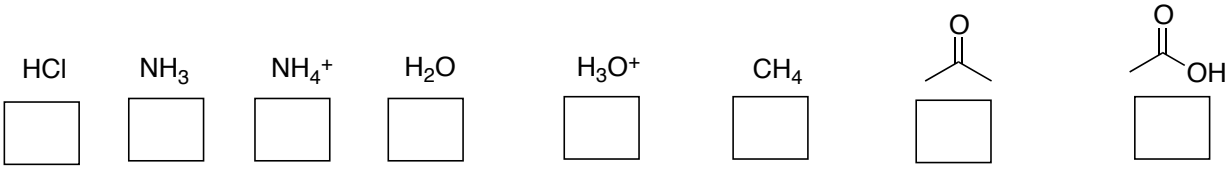
Grignard Reagents _____ Amines _____ Halide ions _____

(c) (*5 points*) Rank the following anions by their ability to act as a leaving group. Identify the best leaving group as "**1**" and the worst leaving groups (there's a tie!) with "**4**".

F^- Br^- Cl^- OH^- I^-

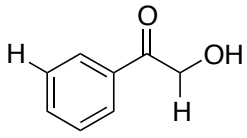
_____ _____ _____ _____ _____

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



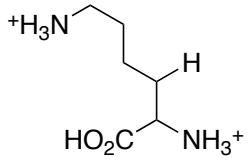
(e) (*8 points*) **Circle the most acidic proton** on each molecule and approximate its pKa (think pKa family).

(i)



Approx. pKa _____

(ii)

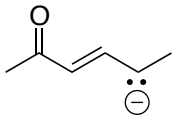


Approx. pKa _____

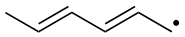
2. Resonance and Aromaticity

(a) (*36 points*) **Draw two additional non-equivalent resonance structures** for the following compounds. Use **arrow-pushing** to show electron movement from one structure to the next. Be sure to indicate formal charges where appropriate.

(i)

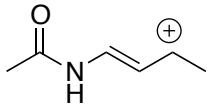


(ii)

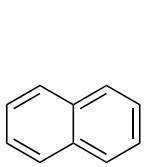


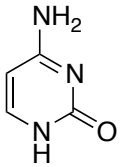
primary radical

(iii)



(b) (*12 points*) **Circle all the compounds that are aromatic.**

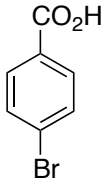




3. Nomenclature

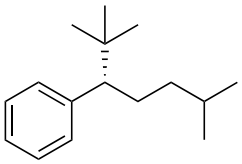
(a) (*28 points*) **Name** the following compounds. **Include stereochemistry** in the name, where appropriate.

(i)



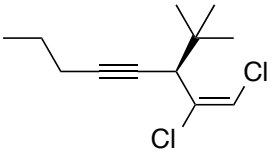
_____

(ii)



_____

(iii)



_____

(b) (*18 points*) **Draw structures** corresponding to the following names.

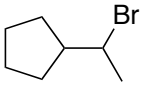
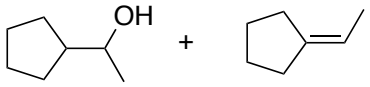
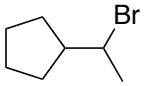
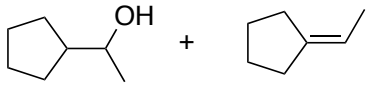
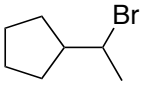
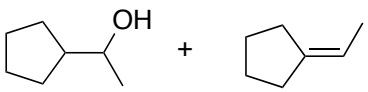
meta-Fluorophenol

5-isopropyl-4-benzyloctane

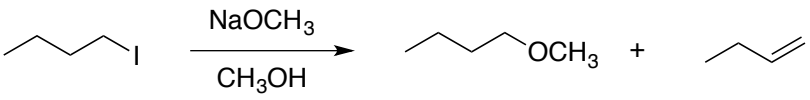
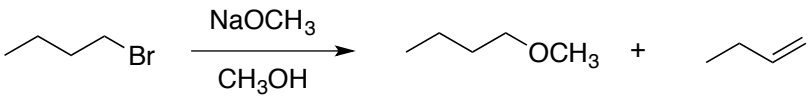
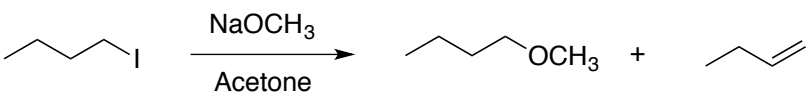
4. Substitution and Elimination Reactions

(a) (*30 points*) Each set of reactions below are happening under similar conditions, but with one variable changed. Indicate the **type of mechanisms** (S_N1, S_N2, E1, E2) are taking place to form the products below then **circle the fastest reaction** in each set.

Set A Mechanisms: _____ and _____

I	1 mol  10 mol H_2O 
II	10 mol  10 mol H_2O 
III	1 mol  50 mol H_2O 

Set B Mechanisms: _____ and _____

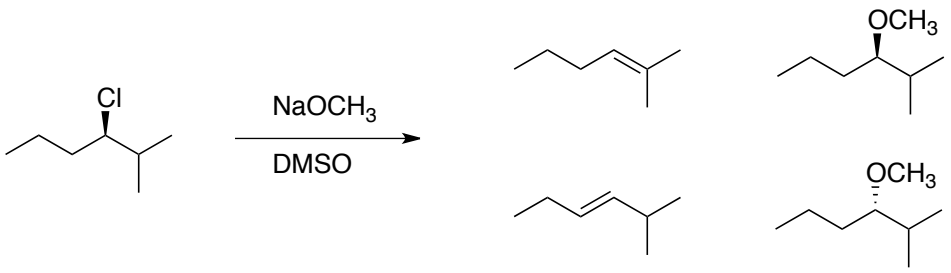
I	
II	
III	

(b) (*20 points*) Show the **arrow-pushing mechanisms** for the reaction in Set A. Since the products are a mixture, you should draw two separate mechanisms. You may ignore stereochemistry.

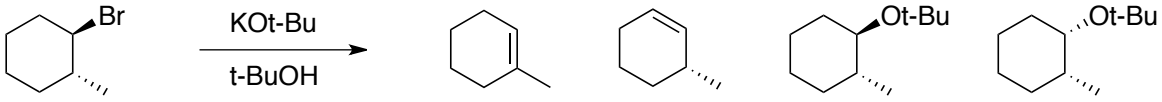
5. Reaction Puzzles

(*39 points*) **Circle the major product(s)** in each reaction. More than one is possible for several reactions.

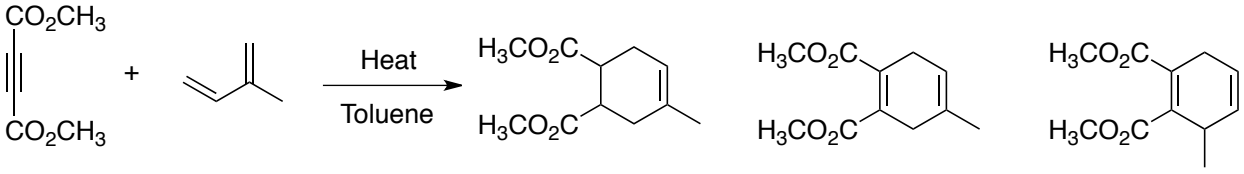
(i)



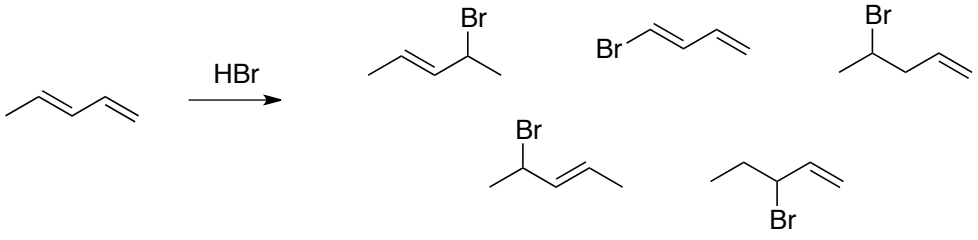
(ii)



(iii)



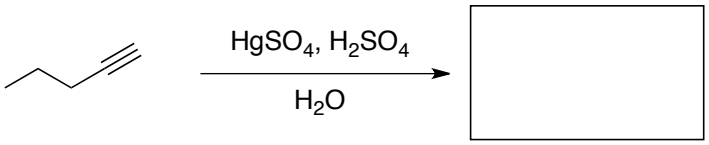
(iv)



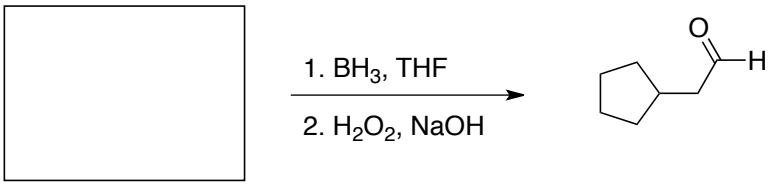
6. Single Step Reactions

(*40 points*) **WHAT'S IN THE BOX??**
Choose any four of the five reactions below and **fill in the missing reactant, reagent, or product**. If no reaction occurs as written, fill in the box with "NR." Put a **large "X"** over the problem you are skipping. Otherwise the first four will be graded.

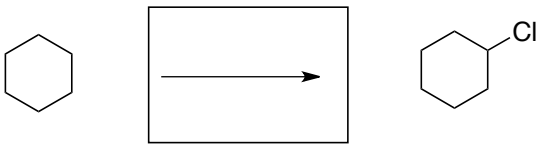
(a)



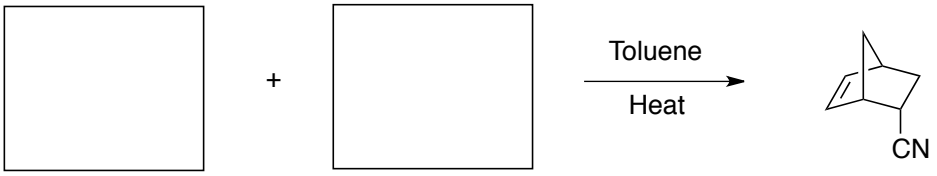
(b)



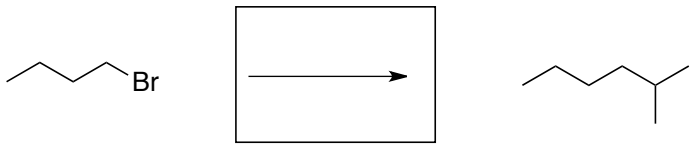
(c)



(d)



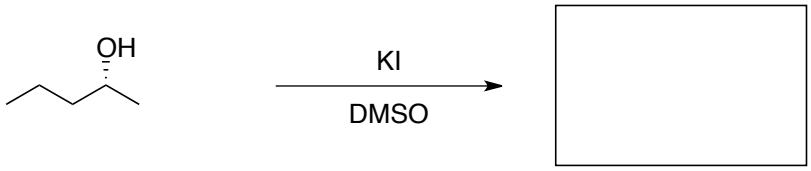
(e)



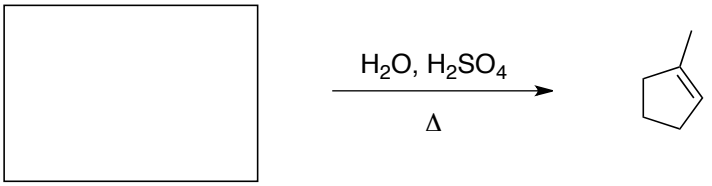
7. Single-Step Reactions

(*40 points*) **WHAT'S IN THE BOX??**
Choose any four of the five reactions below and **fill in the missing reactant, reagent, or product**. If no reaction occurs as written, fill in the box with "NR." Put a **large "X"** over the problem you are skipping. Otherwise the first four will be graded.
Indicate stereochemistry where appropriate.

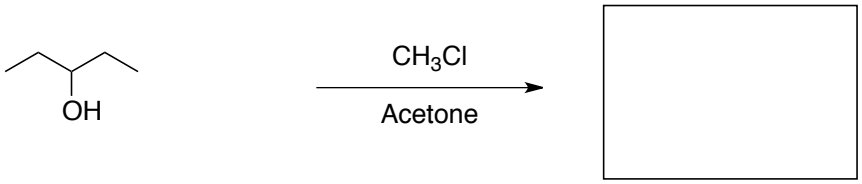
(a)



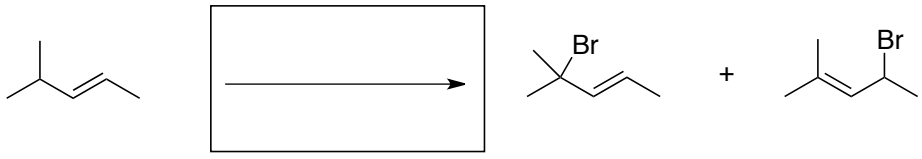
(b)



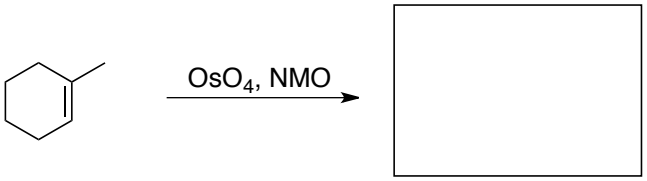
(c)



(d)

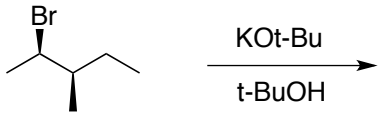


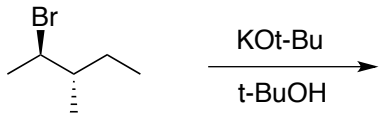
(e)



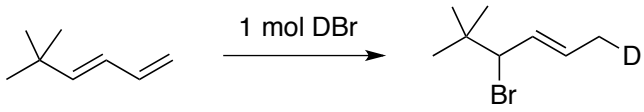
8. Mechanisms

(a) (*30 points*) The elimination of **(2*R*,3*R*)-2-bromo-3-methylpentane** affords an E-alkene but its diastereomer, **(2*R*,3*S*)-2-bromo-3-methylpentane** produces the Z-alkene. Draw the appropriate **Newman projection** of the starting material to explain the stereochemistry in the product. Then draw the **arrow-pushing mechanism** of the reaction and the **product**.





(b) (*20 points*) The bromination of the conjugated diene below with deuterium bromide results in a mixture of products. **Show the arrow-pushing mechanism to explain only the formation of the one product shown.**



9. (*40 points*) **Multi-Step Synthesis**

Choose any two of the following synthetic problems. **Clearly cross out which problems you are skipping with a large "X."** You may use any *alkyl halide* or *organometallic reagent* to introduce new carbons and any other reagents necessary. Show the product after each step. If there is a mixture of products, assume the products are separable so you can move forward with the desired product. No mechanisms or stereochemistry.