

UCSC, Binder

Name \_\_\_\_\_

Student ID # \_\_\_\_\_

**Organic Chemistry**  
**FINAL EXAM (400 points)**

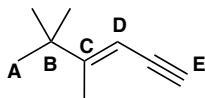
In each of the following problems, you will use your knowledge of organic chemistry conventions to answer the questions in the proper manner. Be sure to read each question carefully. You have 3 hours to complete this exam. Pay attention to point values and problems to skip to use your time wisely.

**Keep your eyes on your own paper.** Notes, cheat sheets, and 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.

<b>1</b> (40)	
<b>2</b> (40)	
<b>3</b> (50)	
<b>4</b> (40)	
<b>5</b> (30)	
<b>6</b> (45)	
<b>7</b> (28)	
<b>8</b> (32)	
<b>9</b> (50)	
<b>10</b> (50)	
<b>Total</b>	/ 400 (5 extra points built in)
	%

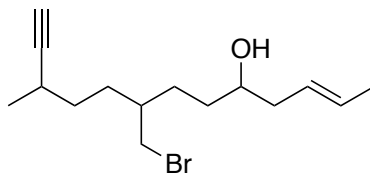
**1. Fundamentals**

(a) (15 points) Consider the structure below and fill in the table to indicate **hybridization**, **geometry**, and **substitution pattern for carbons A-E**.

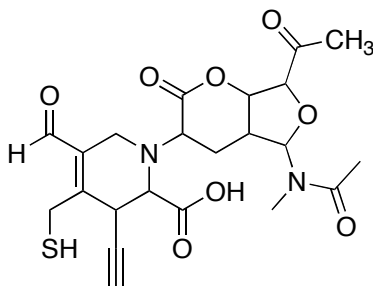


Carbon	Hybridization ( $sp^3$ , $sp^2$ , $sp$ )	Geometry (tetrahedral, trigonal planar, or linear)	Substitution ( $1^\circ$ , $2^\circ$ , $3^\circ$ , or $4^\circ$ )
A			
B			
C			
D			
E			

(b) (15 points) **Circle and name each functional group**, then indicate whether that functional group is more likely to act as a **nucleophile (N)** or **electrophile (E)** based on the synthesis reactions learned in 8A.



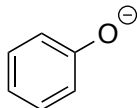
(c) (10 points) Consider the large and hopefully familiar molecule below. **Circle and name any five functional groups**.



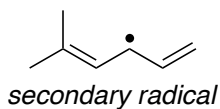
**2. Resonance and Aromaticity**

(a) (24 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.

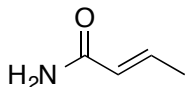
(i)



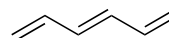
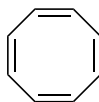
(ii)



(iii)



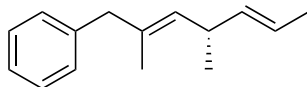
(b) (16 points) **Circle all the compounds that are aromatic.**



**3. Nomenclature**

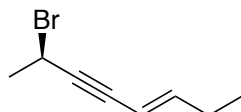
(a) (23 points) **Name** the following compounds. **Include stereochemistry** in the name, where appropriate.

(i)



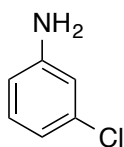
\_\_\_\_\_

(ii)



\_\_\_\_\_

(iii)



\_\_\_\_\_

(b) (21 points) **Draw structures** corresponding to the following names.

*ortho*-iodotoluene*(R)*-8-Methyl-1-benzylcyclooctene

(c) (6 points) Consider an organic compound with 3 chiral centers with assignments (3*S*,6*S*,7*S*). **What is the relationship of that compound to the following stereoisomers?**

(3*R*,6*S*,7*S*)(3*R*,6*R*,7*R*)(3*S*,6*R*,7*R*)

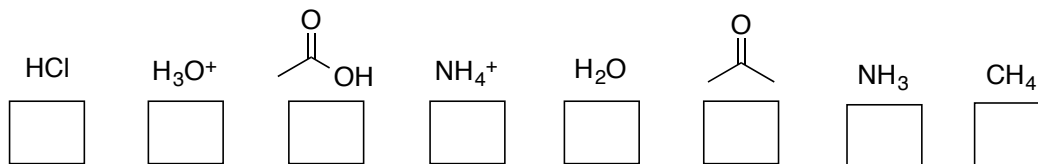
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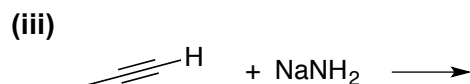
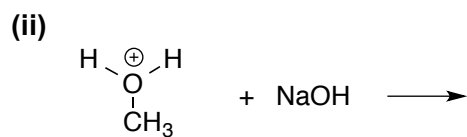
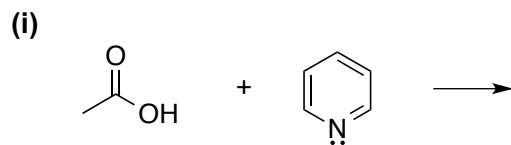
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## 4. Acid-Base Chemistry

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

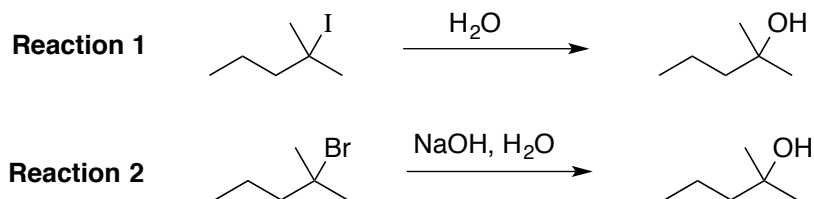


(b) (32 points) **Choose any two.** Draw the **products** in the following reactions and indicate the **direction of the equilibrium**. Be sure the reaction is balanced. No arrow-pushing necessary.



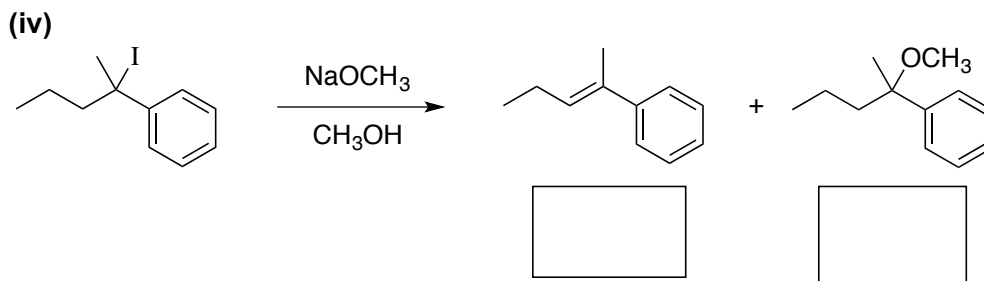
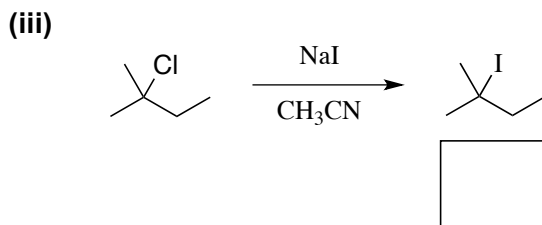
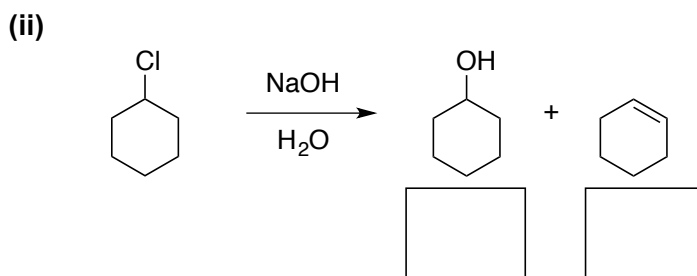
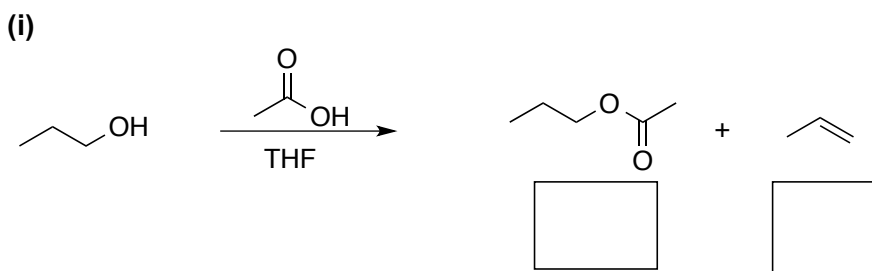
## 5. Substitution and Elimination Reactions

(a) (6 points) Consider the following substitution reactions. Which reaction is faster?



Reaction 1 or Reaction 2 or Neither (Circle one)

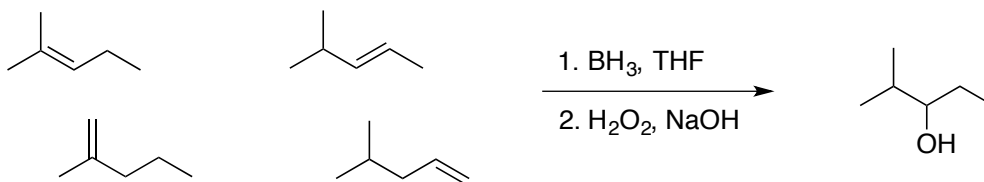
(b) (24 points) Fill in the box to indicate whether the reaction as written proceeded by SN1, SN2, E1, or E2.



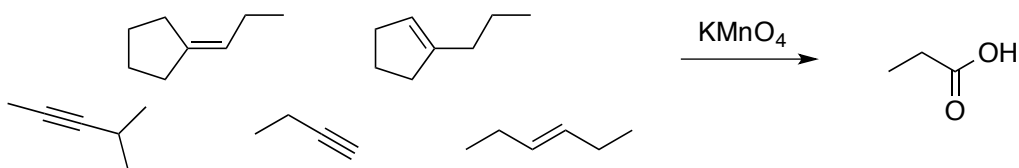
## 6. Reaction Puzzles

(a) (18 points) Circle each of the starting materials that could potentially give the indicated compound as one of the products.

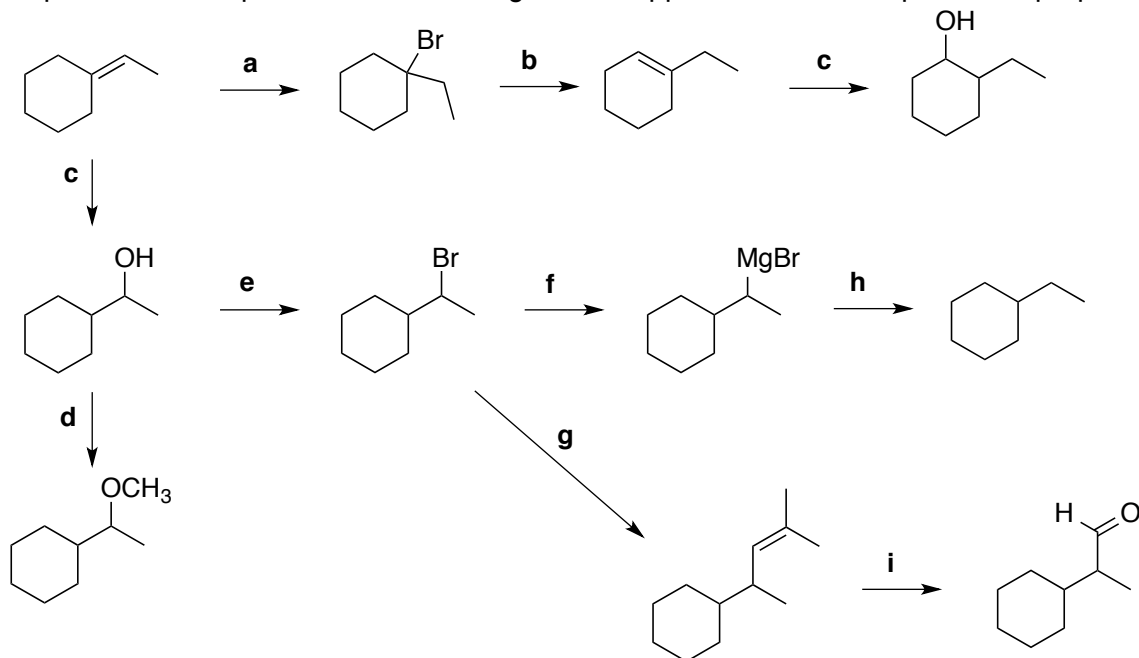
(i)



(ii)



(b) (27 points) Consider the following reaction puzzle and indicate the reagents required for each step in the blanks provided below. Reagents "c" appears twice in the puzzle on purpose!



a \_\_\_\_\_ b \_\_\_\_\_ c 1. \_\_\_\_\_ 2. \_\_\_\_\_

d \_\_\_\_\_ e \_\_\_\_\_ f \_\_\_\_\_

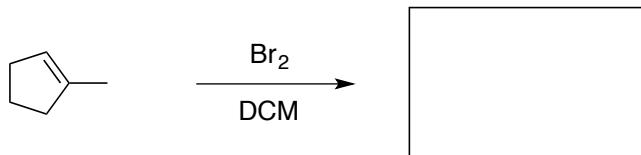
g \_\_\_\_\_ h \_\_\_\_\_ i 1. \_\_\_\_\_ 2. \_\_\_\_\_

## 7. Single Step Reactions

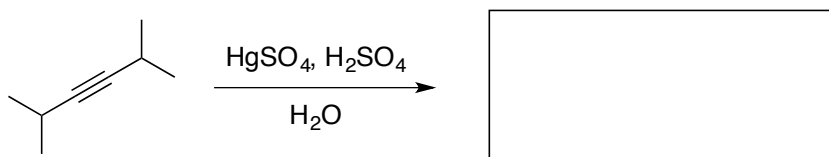
(28 points) **WHAT'S IN THE BOX?!?!**

**Choose any four** of the five reactions below and fill in the missing **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.

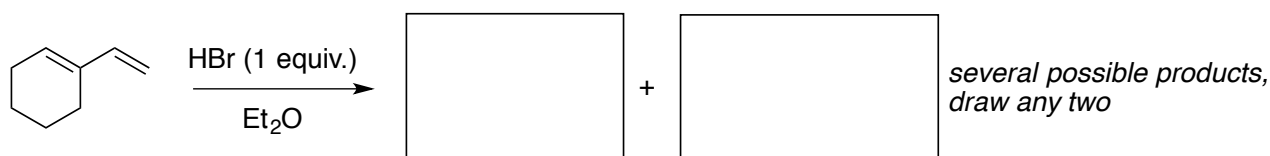
(a)



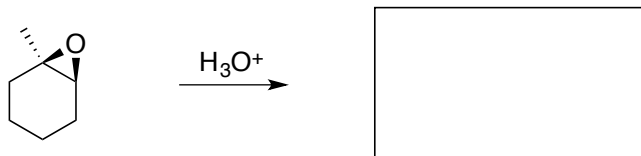
(b)



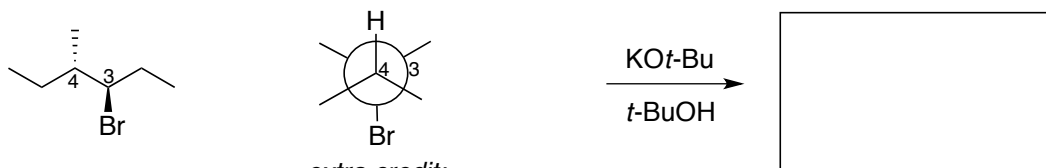
(c)



(d)



(e)



*extra credit:*  
complete Newman projection of the alkyl halide,  
siting down the 4-3 bond,  
in the proper conformation for elimination

**DRAW A LARGE 'X' OVER THE PROBLEM YOU ARE SKIPPING!**

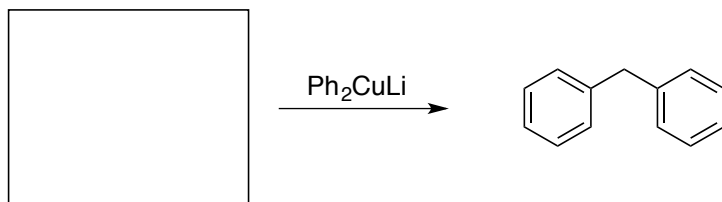


## 8. Single-Step Reactions

(32 points) **WHAT'S IN THE BOX?!?**

**Choose any four** of the five reactions below and fill in the missing **reactant**. Put a **large "X"** over the problem you are skipping. Otherwise **(a)** through **(d)** will be graded, even if one is blank. **Indicate stereochemistry** where appropriate.

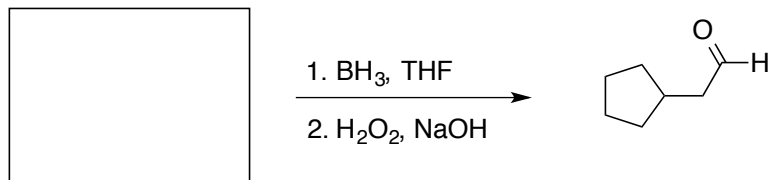
(a)



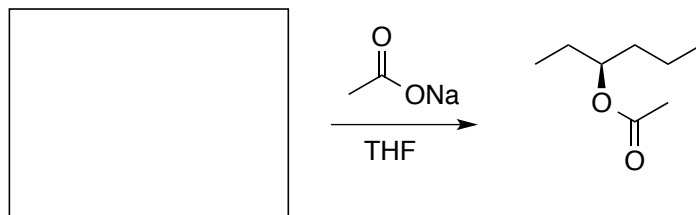
(b)



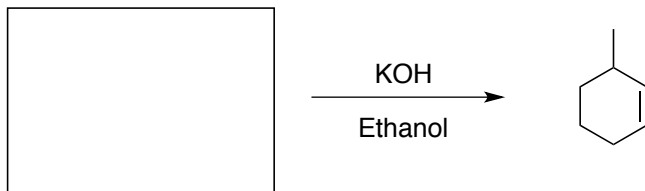
(c)



(d)

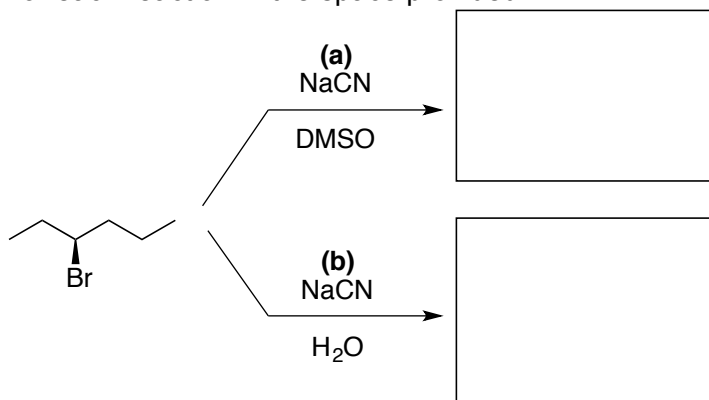


(e)

**DRAW A LARGE 'X' OVER THE PROBLEM YOU ARE SKIPPING!**

**9. Mechanisms**

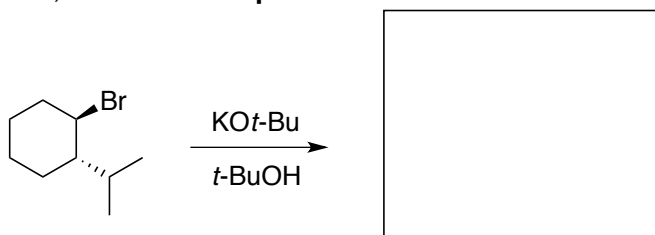
(i) (30 points) The stereochemical outcome of substitution reactions can be controlled with the choice of solvent. **Draw the products** in reactions (a) and (b) below then **draw the full arrow-pushing mechanism** for each reaction in the space provided.



Mechanism for reaction (a)

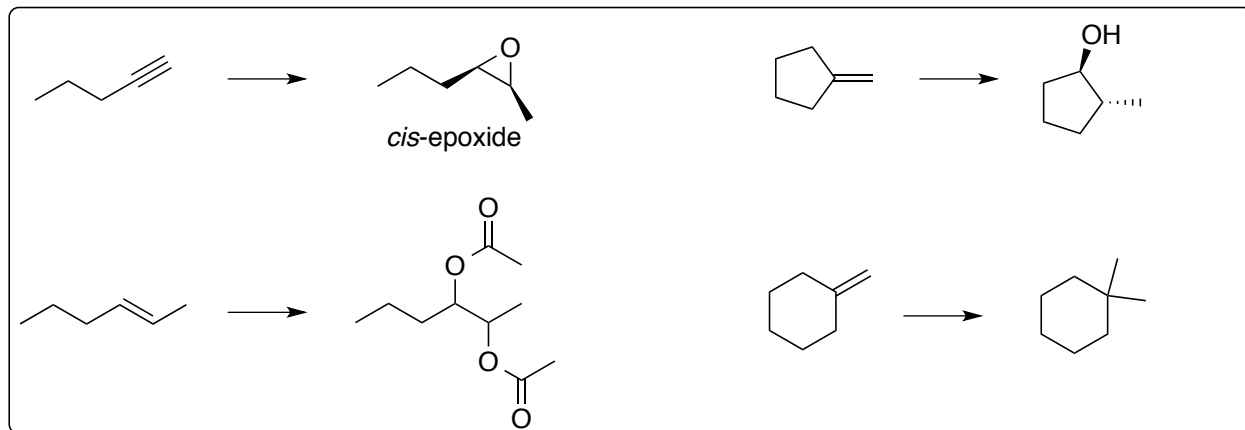
Mechanism for reaction (b)

(ii) (20 points) The **regiochemistry** of elimination reactions is dictated by the stereochemistry of the starting material. Consider the alkyl halide below and its reaction with potassium *tert*-butoxide. There is only one product in this reaction and it is slightly unexpected, unless you understand the 3D-nature of the mechanism. Draw the alkyl halide in the proper **chair conformation** to facilitate the elimination mechanism (not necessarily the most stable conformation), **add arrows** to show the mechanism on the chair, and **draw the product**.



**10. (50 points) Multi-Step Synthesis**

**Choose any two** of the following synthetic problems. You may use any alkyl halide to introduce new carbons and any other reagents necessary. Show the product after each synthetic step. Remember to number or at least count carbons!



**CHOOSE ANY TWO. DRAW A LARGE 'X' OVER THE SKIPPED PROBLEMS IN THE BOX.**