

Key

CHEM 344-002
ORGANIC CHEMISTRY II Spring 2012
Exam I Information and Study Guide

Key

CHEM 344-002 Exam I is scheduled for **Wednesday, February 15 in room CON 120**. You may begin the exam as early as 7:30 AM. All exams will be collected at 8:50 AM. If you need additional time, you must provide me with up-to-date documentation from the Academic Achievement Center.

Please note that the Conant doors will unlock at 7:30 AM!

Exam Coverage: Exam questions will be based on your understanding of the lecture material, booster quizzes, worksheets, text readings, and text problems. Reviewing this material will help you assess your background knowledge, and identify your strengths and weaknesses to direct your study and review. Please note that the questions on worksheets, booster quizzes, and from the text are only representative of the topics for which you are responsible.

Review Session: Tuesday, February 14, 4:00 PM, Room CON 473

Contact information: ebrush@bridgew.edu, 508-531-2116

Miscellaneous Notes:

1. Exams written in ink are preferred; regrade requests on exams written in pencil may not be considered.
2. You will not be allowed to share any materials with another student during the exam.
3. You will be provided with scrap paper, a periodic table, and appropriate data. I DO NOT provide calculators, pens, or pencils.
4. Cell phones and other electronic devices must be switched off during exams. There is a 10-point penalty for any disruption caused by these devices. If you need your cell phone on please let me know.
5. Academic dishonesty on exams will result in dismissal from the class and an F course grade.

Policy on Missed Exams. If you are absent from CHEM 344 and all other classes on the day of the exam, you must contact me **by phone or email** by 10:00 AM. To qualify for a make-up exam you must provide me with a written excuse that includes the name, address, and phone number of a person in authority who can justify why you could not be on campus the day of the Exam. *Illness requiring a doctor's care or personal emergencies are the only acceptable excuses.* All other excuses will result in a zero exam grade, although your Booster Point total will replace the missed exam (except for the Final). It is up to my discretion to give you a make-up exam, *at my convenience*, on the day following the scheduled exam date. Please note that every effort will be made to keep the make-up exam at the same level of difficulty as the regularly scheduled exam. **CHEM 344 students get one and only one make up exam each semester.**

If you simply arrive late and have a reasonable excuse, you can still take the exam!

Remember: I will collect your text problem notebook for Booster Points (0-5 pts) on the day of the exam only! You should pick up your graded notebook before you leave the exam room.

KEY CONCEPTS FOR REVIEW. All material from CHEM 343 is fair game: acid/base reactions, structure and nomenclature, stereochemistry, comparing structures, mechanisms. Be sure to include the material on Booster #1, the CHEM 343 Review Worksheet, in your study.

Chapter 11: Alcohol nomenclature, synthesis of alcohols and ethers by SN1 and SN2 (Booster #1), acid-base reactions of alcohols, acid catalyzed alcohol dehydration (E1/E2 elimination), acid mediated substitution reactions of alcohols with HX, alcohol substitution reactions with the tosyl leaving group, acid-catalyzed ether synthesis, stereochemistry in the reactions of epoxides.

Chapter 12: Oxidation/reduction reactions of alcohols; Grignard reactions with aldehydes, ketones, epoxides, esters; multi-step synthesis.

Chapter 9: Interpretation of IR spectra (identification of functional groups based on characteristic IR absorption bands), ^1H NMR spectroscopy (equivalent protons, chemical shift); Identification of unknown structures using hydrogen deficiency, IR and NMR data.

SUPPLEMENTAL REVIEW PROBLEMS. These are additional problems to help your review. I will post an answer key no later than Friday. These problems should be included with your review of the lecture notes, boosters, worksheets, text readings, and text problems.

1. Answer the following questions as indicated.

(a) Which of the following terms are best associated with SN2 reactions? Circle all that apply.

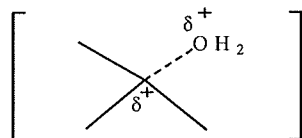
rearrangement

stereospecific

carbocations

good nucleophiles

(b) The transition state structure shown below is most consistent with which type(s) of mechanism(s)? Circle your choice(s).



dehydration

E2

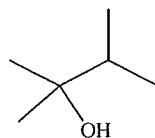
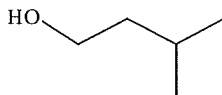
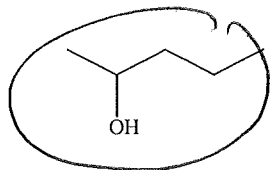
E1

SN1

SN2

acid/base

(c) Which of the following alcohols will be oxidized to a ketone with H_2CrO_4 ?



CH_3OH

(d) Which of the following terms are best associated with Grignard reactions? Circle all that apply.

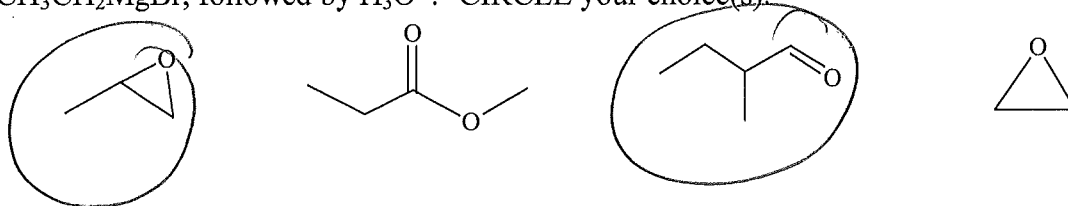
Grignard reagent is a weak base

alcohol products

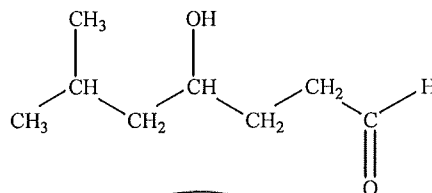
carbonium ion

ether solvent

(e) Which of the following compounds will produce a 2° alcohol product following reaction with the Grignard reagent, $\text{CH}_3\text{CH}_2\text{MgBr}$, followed by H_3O^+ ? CIRCLE your choice(s).



(f) Consider the compound drawn to the right.

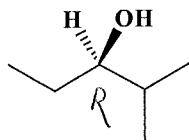
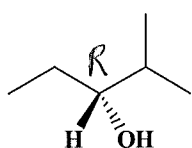


What is the Hydrogen Deficiency? 2

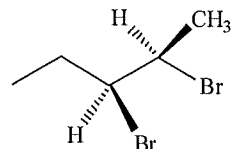
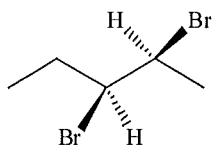
This compound will have diagnostic IR bands at (circle): 2250cm^{-1} 1700cm^{-1} 530cm^{-1} 3300cm^{-1}

How many sets of signals will appear in the ^1H NMR spectrum for this compound? 8

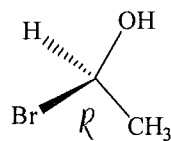
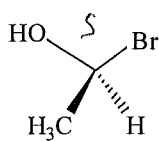
(h) What is the relationship between the following pairs of compounds?



answer Identical



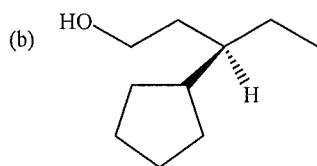
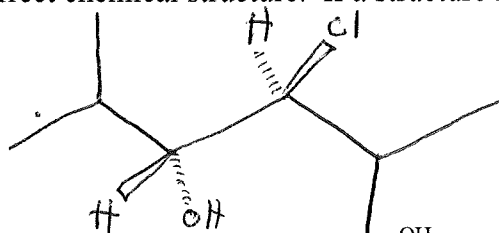
answer Diastereomers



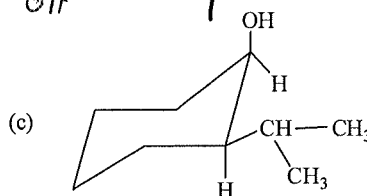
answer Enantiomers

2. Nomenclature. If a name is given, draw the correct chemical structure. If a structure is drawn, give the IUPAC name.

(a) (3R, 4S)-4-chloro-2,5-dimethyl-3-hexanol



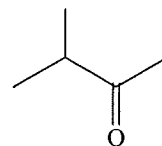
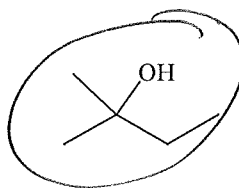
(R)-3-cyclopentylpentanol



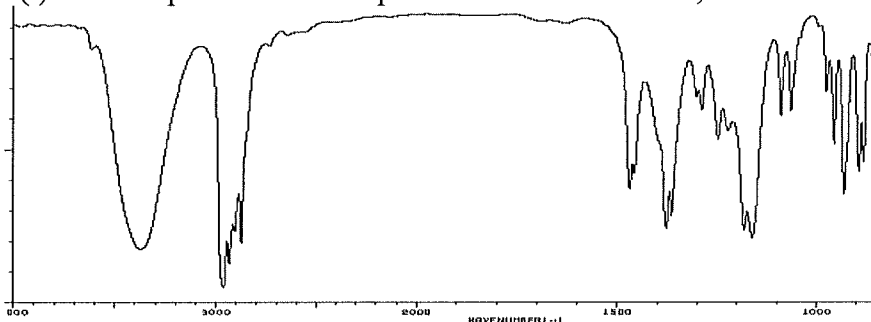
cis-2-isopropylcyclohexanol

3. Structure Identification.

(a) Compound A is an unknown organic compound believed to be one of the two molecules shown on the right. The unknown was analyzed by IR and ^1H NMR.



(i) The IR spectrum of Compound A is shown below, and is most consistent with which unknown? Explain.



There is an OH band at 3200-3500, so the alcohol on the left is consistent!



(ii) Compound A reacts with H_2SO_4 forming a new compound. Compound A does not react with NaBH_4 . What do these two pieces of information tell you about Compound A? Draw the structure of the product formed in the reaction of Compound A with H_2SO_4 .

Compound A must be an alcohol, which will dehydrate with H_2SO_4 , but not be reduced by NaBH_4 . This completely eliminates the ketone.

(b) Another unknown organic compound (B) has a formula of $\text{C}_5\text{H}_{10}\text{O}$.

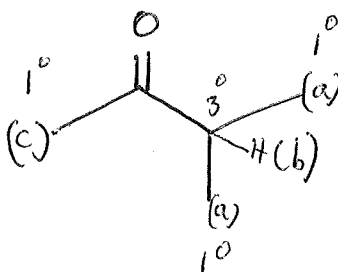
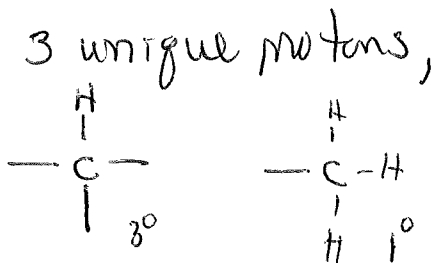
(i) What is the Hydrogen Deficiency of Compound B and what does this tell you about the compound?

$\text{HD} = \frac{2n+2}{2} = \frac{12}{2} = 6$
 $\frac{6 - 10}{2} = 2$
 $\text{HD} = 2$, so one double bond or one ring.
 could be alkene or ring or carbonyl.

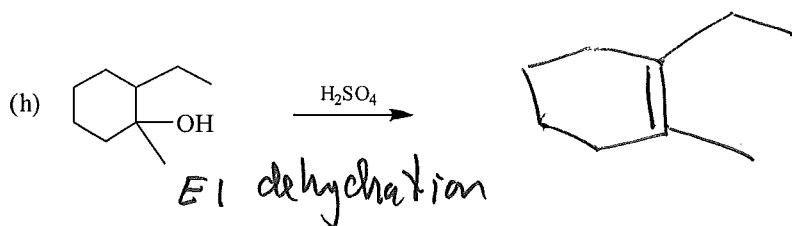
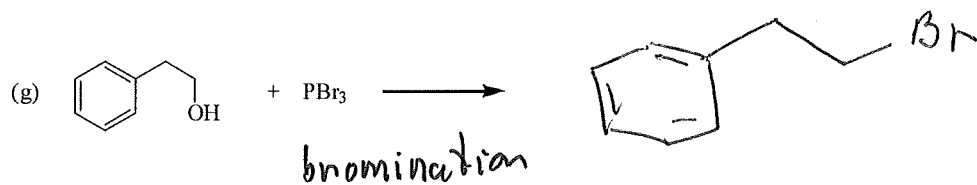
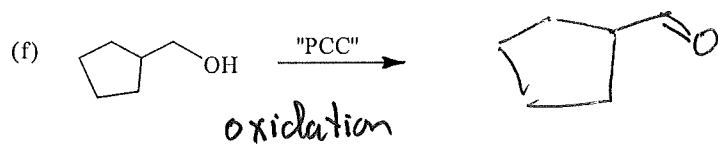
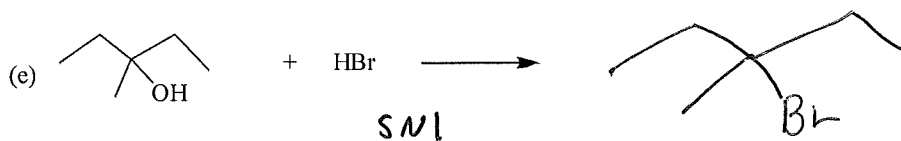
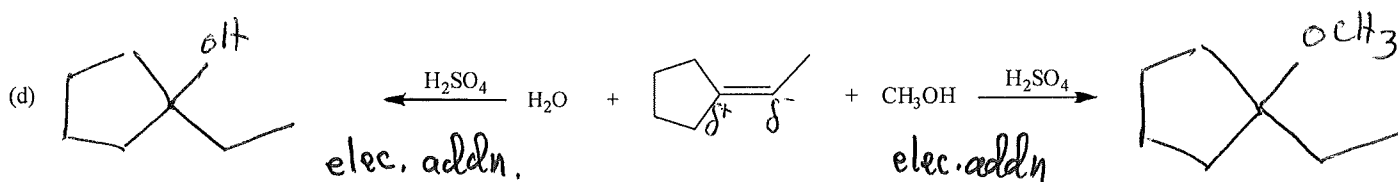
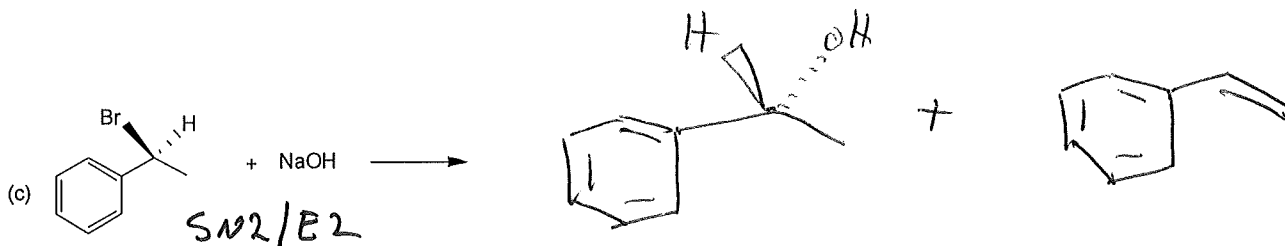
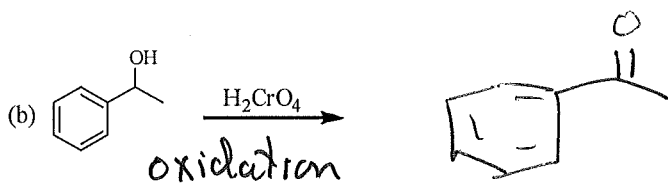
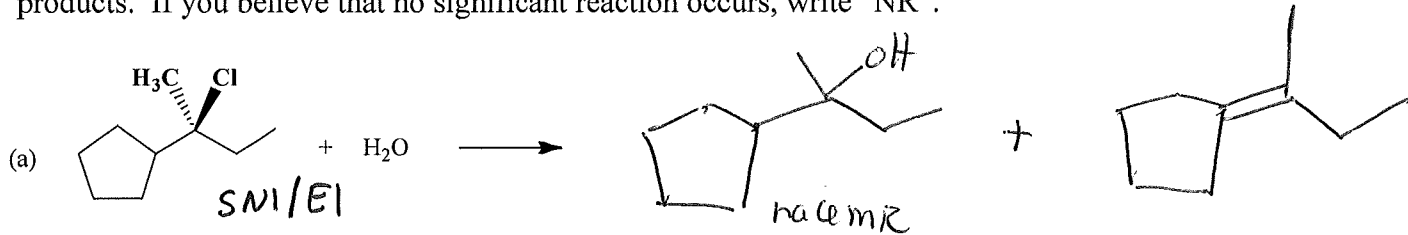
(ii) The IR spectrum for Compound B has a sharp band at 1700 cm^{-1} . What does this suggest?

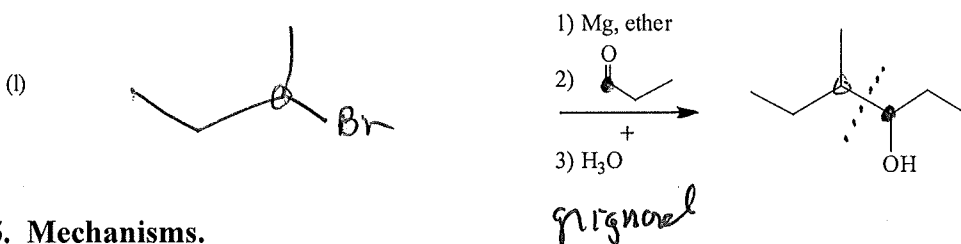
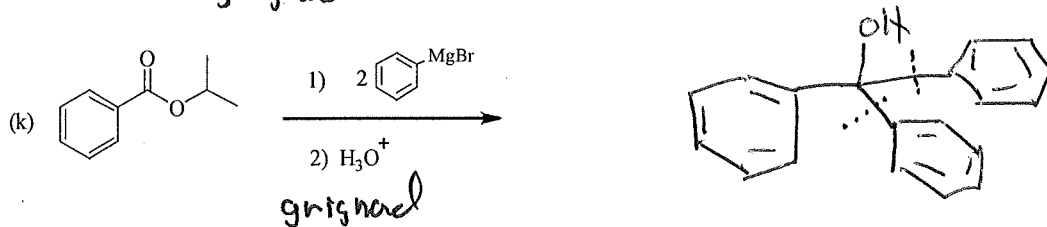
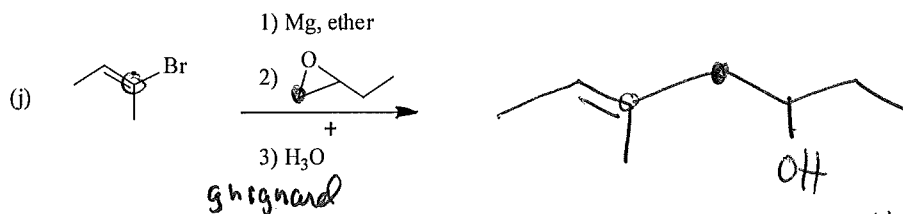
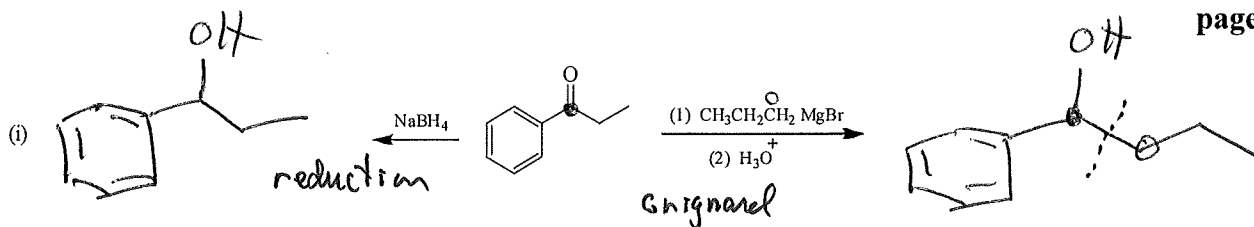
There is a carbonyl, $\text{C}=\text{O}$

(iii) The ^1H NMR spectrum for Compound B has 3 signals, and there is one 3° carbon and three 1° carbons. Based on the IR and NMR data, propose a structure for Compound B. Your structure must be consistent with all the above data. Please label each set of equivalent H's (a, b, ...).



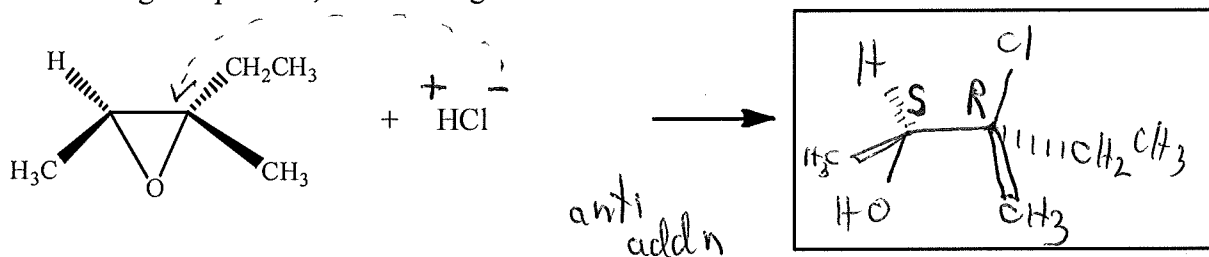
4. Reactions. Complete the reactions shown below by drawing the structure of the major, neutral organic products. If you believe that no significant reaction occurs, write "NR".



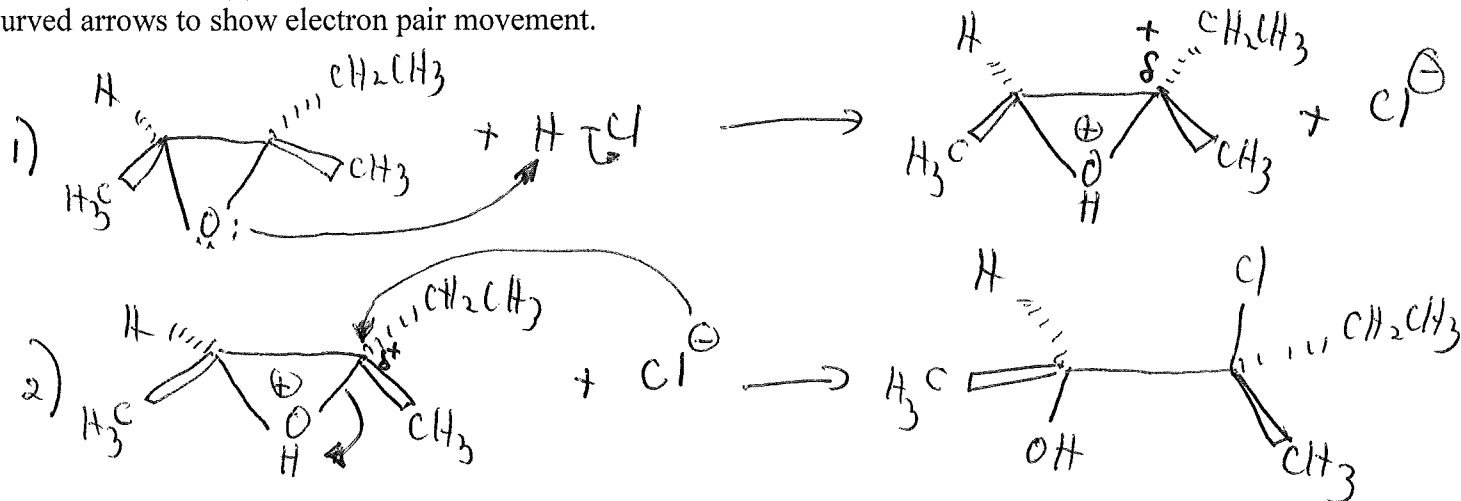


5. Mechanisms.

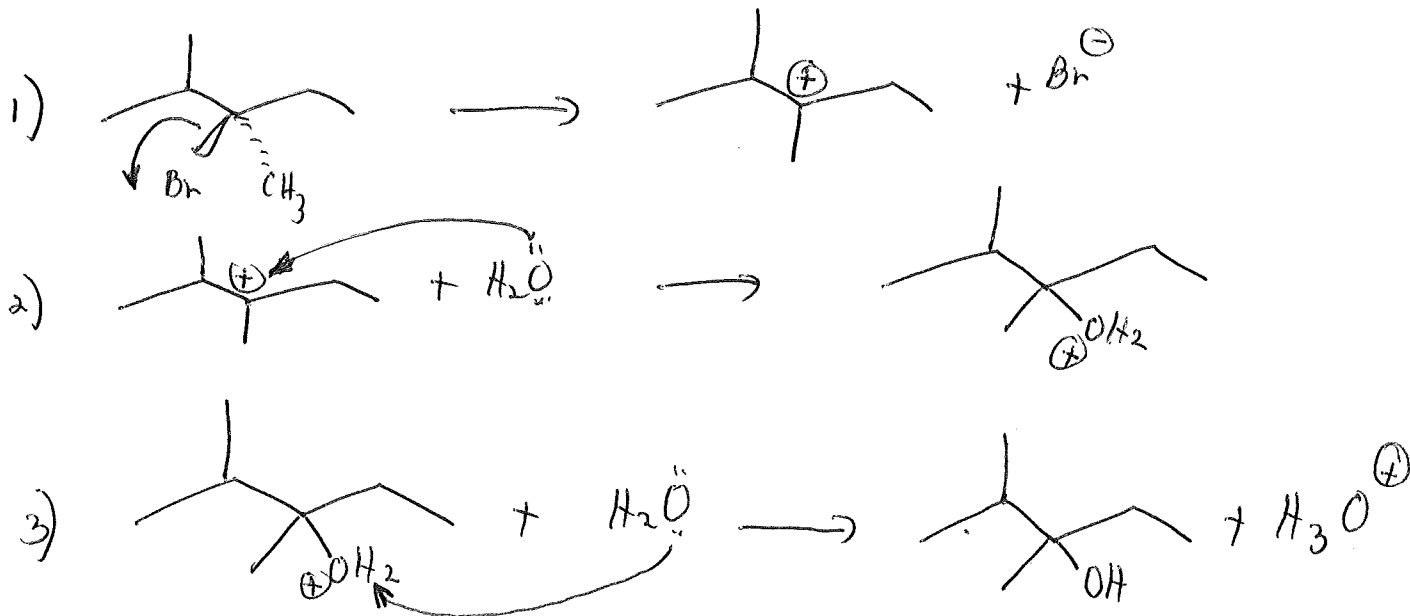
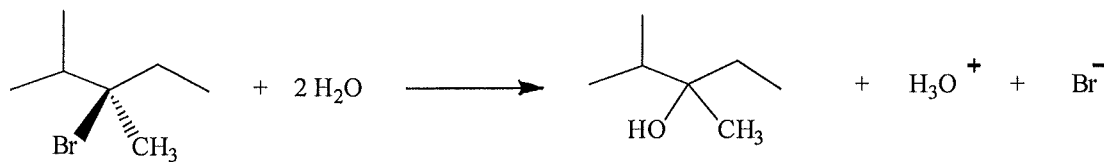
(a) **Stereochemistry.** Complete the following reaction (SN2 epoxide ring opening) by drawing the correct 3-D structure of the organic product, and labeling each chiral center as R or S.



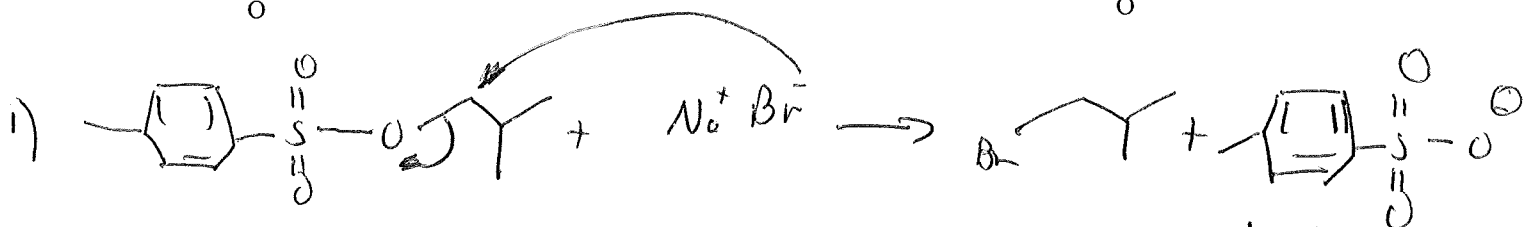
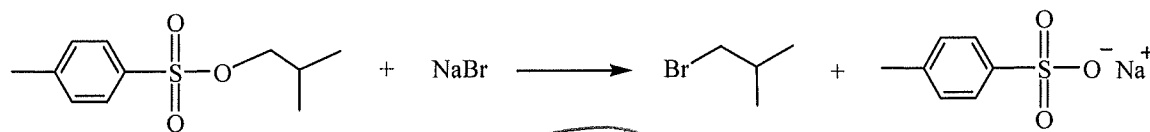
Now, write a complete mechanism that explains the formation of all products in the balanced net reaction. Your mechanism must: (1) consist of a series of individual, numbered, balanced chemical equations, and (2) use curved arrows to show electron pair movement.



(b) Consider the balanced, net SN1 reaction shown below. Write a complete mechanism that explains the formation of all products in the balanced net reaction. Your mechanism must: (1) consist of a series of individual, numbered, balanced chemical equations, and (2) use curved arrows to show electron pair movement.

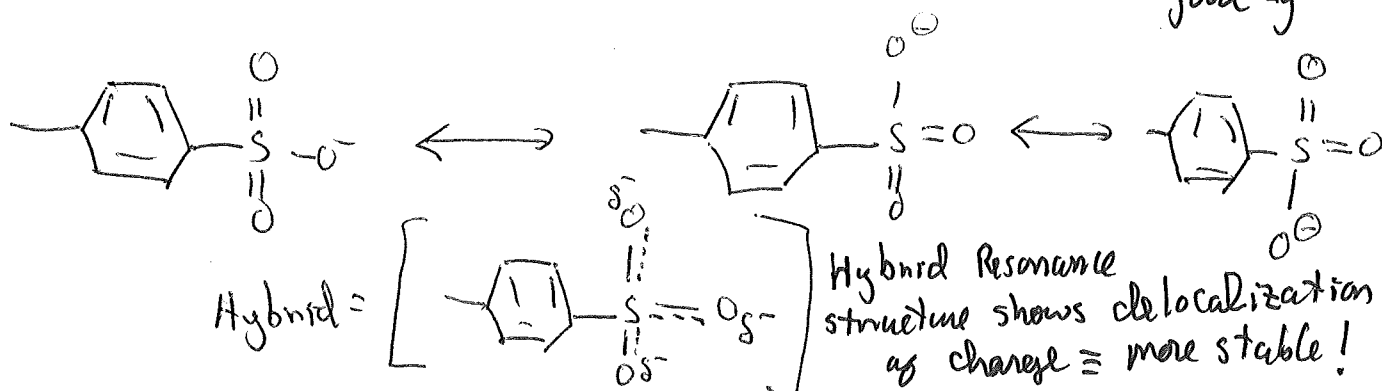


(c) Propose a mechanism for the one-step SN2 reaction shown below. Identify the leaving group, and explain, using resonance structures, whether this is a good leaving group.

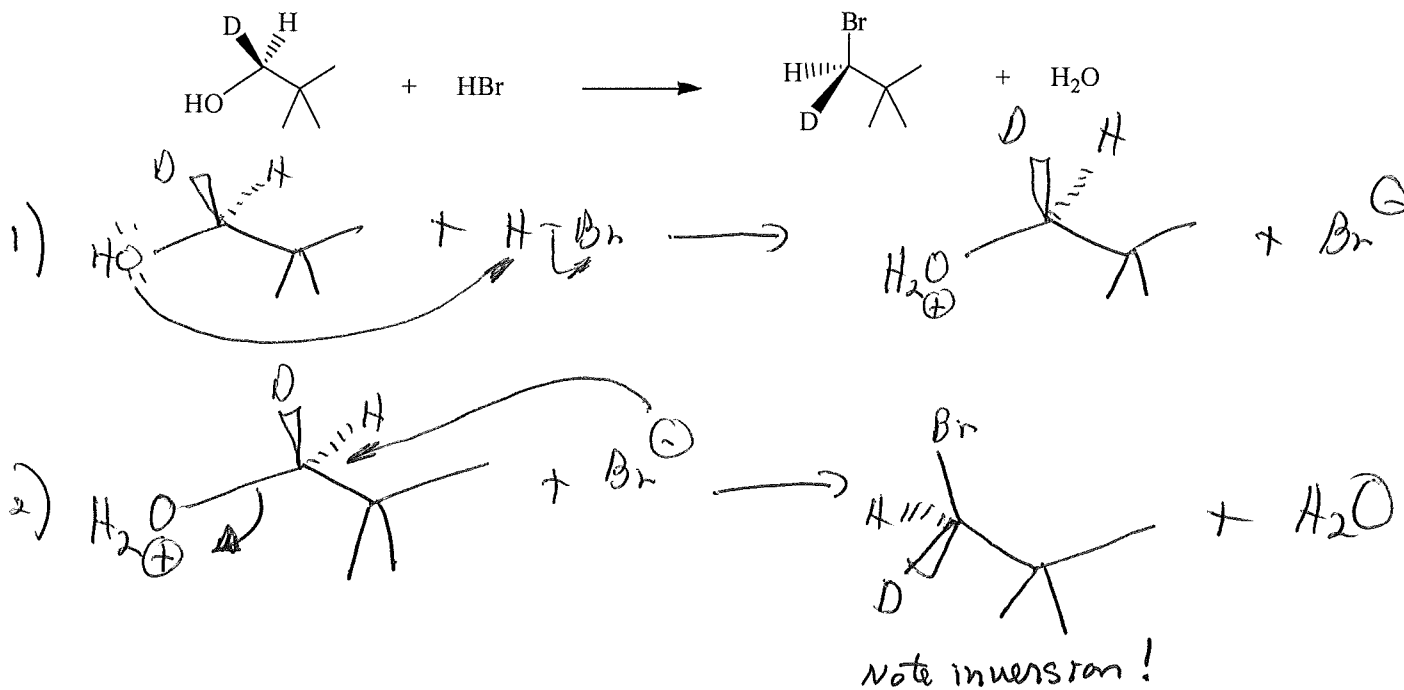


The Lg that forms is a good one as it's a weak base.

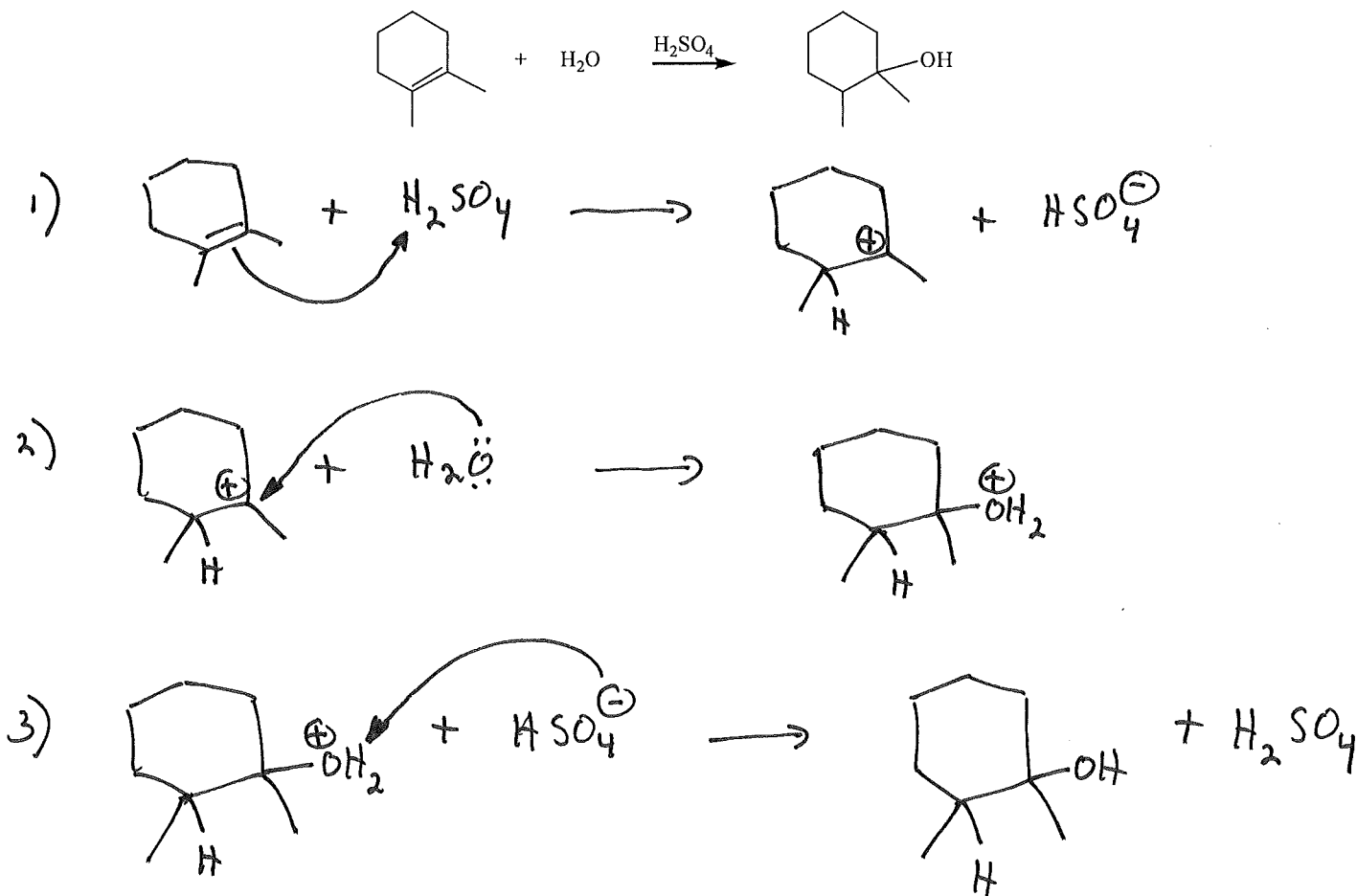
weak base = good Lg



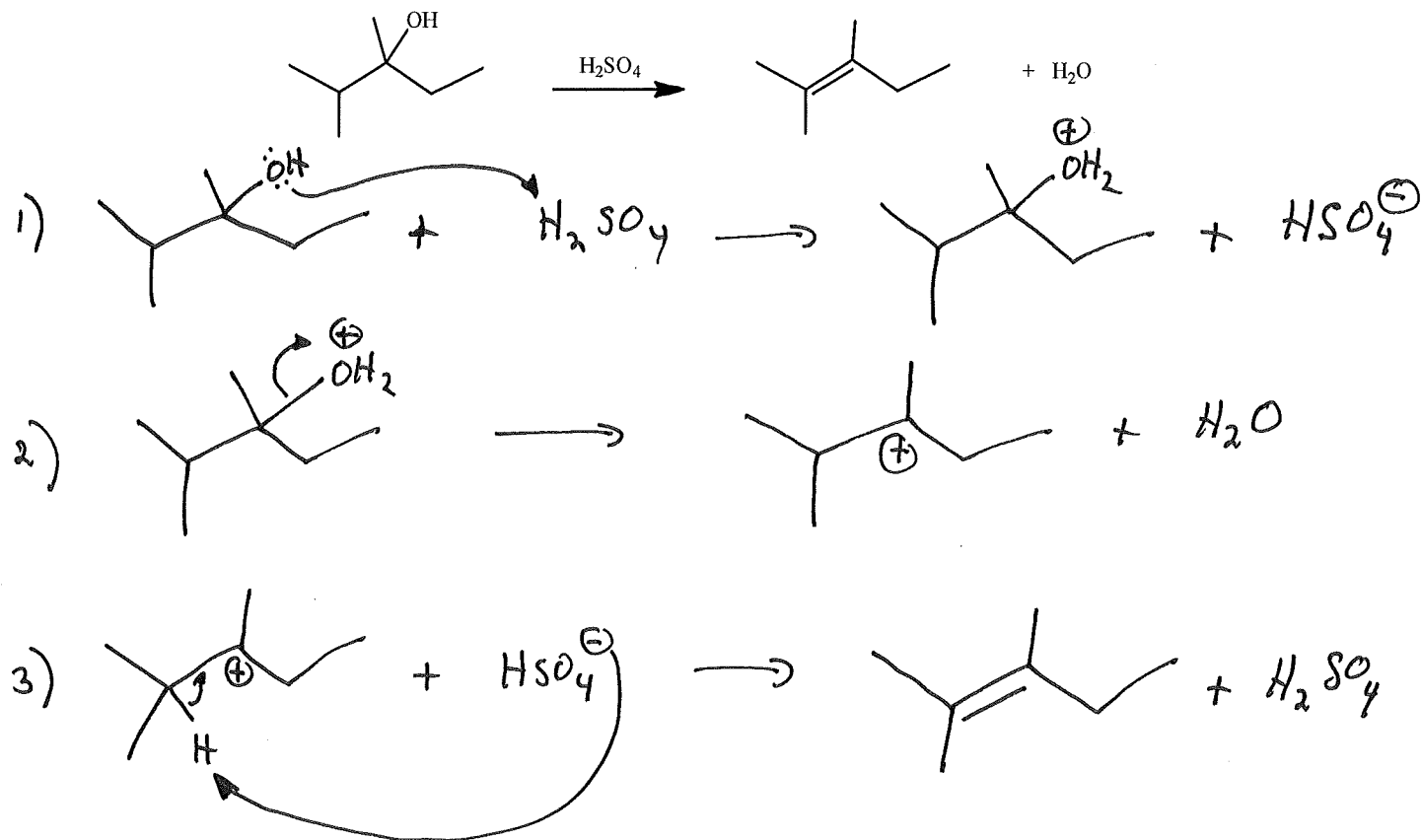
(d) Write a complete mechanism that explains the formation of all products in the balanced Net Equation for the S_N2 substitution reaction shown below. Your mechanism must: (1) consist of a series of individual, numbered, balanced chemical equations, and (2) use curved arrows to show electron pair movement.



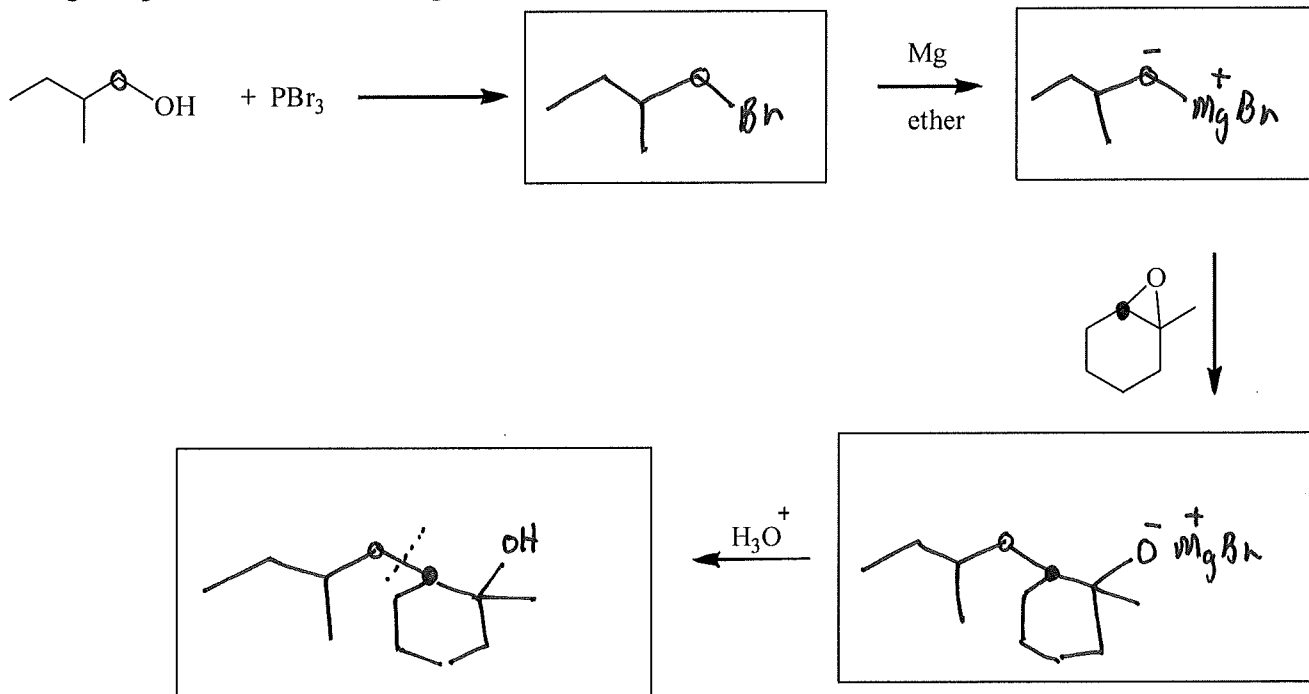
(e) Write a complete mechanism that explains the formation of all products in the balanced Net Equation for the Electrophilic Addition (hydration) reaction shown below. Your mechanism must: (1) consist of a series of individual, numbered, balanced chemical equations, and (2) use curved arrows to show electron pair movement.



(f) Write a complete mechanism that explains the formation of all products in the balanced net equation for the E1 reaction shown below. Your mechanism must: (1) consist of a series of individual, numbered, balanced chemical equations, and (2) use curved arrows to show electron pair movement.

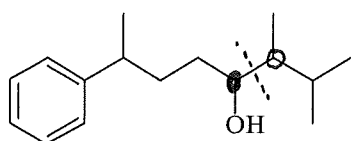


6. Multistep Grignard Synthesis. Complete the multistep Grignard Synthesis below by writing the structure of the organic products from each step in the boxes.



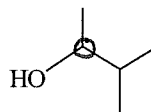
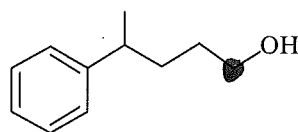
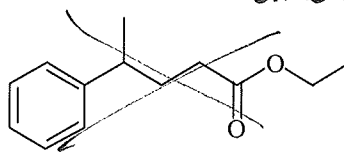
7. Multi-step Synthesis. Propose a multi-step synthesis for the target compound shown below using the organic compounds given, and any other necessary reagents.

Since No symmetry in Target,
No use for the ester!

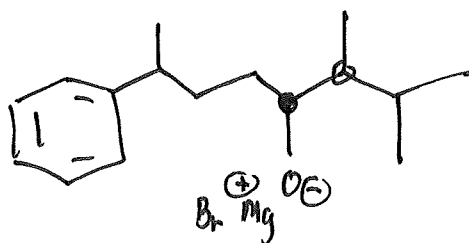
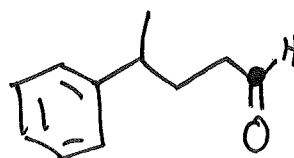
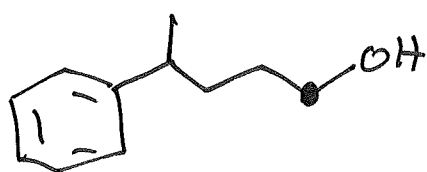
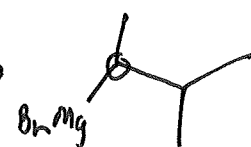
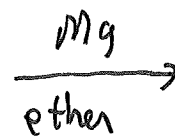
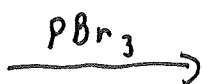
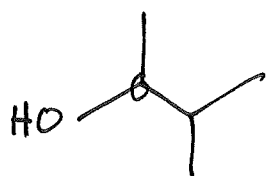


Target Molecule

Stockroom:



Mg, ether, HCl(aq), PBr_3 , HCl, PCC, $H_2C=O$



HCl(aq)

