

NAME (PRINT CLEARLY) Answer Key

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I am on my honor that I will not discuss the contents of this exam with anyone until after 6:00 pm on Monday, December 9, and will notify Dr. Brush if I am made aware of any cases of academic dishonesty.

I understand and agree to these conditions (signature) _____

CHEM 243 ORGANIC CHEMISTRY I
Exam IV PART I, Friday, December 6, 2024

Answer all questions in the space provided, continuing on the back if necessary. **Read each question carefully and be sure to answer all parts to each question!** This exam is worth a total of 150 points (Parts I & II are 75 points each).

An answer key to this exam will be linked to the course web page.

(32) 1. _____

(25) 2. _____

(5) 3. _____

(13) 4. _____

PART I Sub-total (75) = _____

PART I _____ + PART II _____ = EXAM IV Grade _____ (150) = _____ %

IF YOU DO NOT UNDERSTAND A QUESTION, PLEASE ASK FOR AN EXPLANATION!

1. (32 Points) Answer the following questions as indicated.

(a) Indicate whether the following statements are **True or False**.F Rearrangements are most likely to occur in SN2 and E2 reactionsT In the addition of ^-CN to a bromonium ion, the nucleophile adds to the most substituted carbonF In electrophilic addition reactions, the nucleophile has a full or partial positive chargeT In the electrophilic addition of Br_2 to an alkene, the key intermediate is called a bromonium ionT In electrophilic addition reactions, Na^+ is never used as an electrophileF In the electrophilic addition of Cl_2 to an alkene, the two Cl atoms add to the same side of the double bond

(b) Answer the following questions based on the electrophilic addition reaction drawn below:

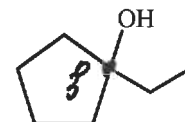
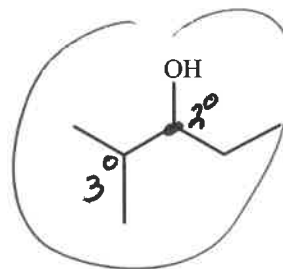
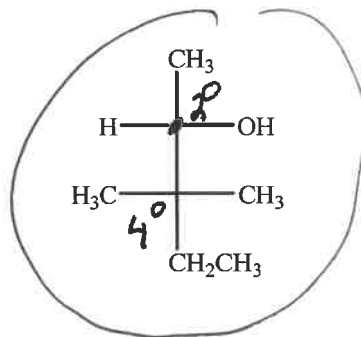
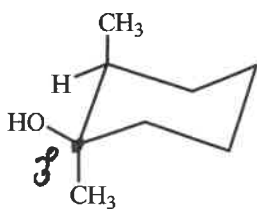
(i) In the alkene, label the sp^2 carbons with δ^+ and δ^- (ii) (Circle the correct responses) The (H_2O , Cl^- , Cl^+) species becomes bonded to the δ^- sp^2 carbon, and this species is referred to as the (nucleophile, electrophile, acid, base).(iii) (Circle the correct responses) The (H_2O , Cl^- , Cl^+) species becomes bonded to the δ^+ sp^2 carbon, and this species is referred to as the (nucleophile, electrophile, acid, base).(iv) Which of the following best describes **all roles** played by H_2O in this reaction? Circle all that apply.

Catalyst

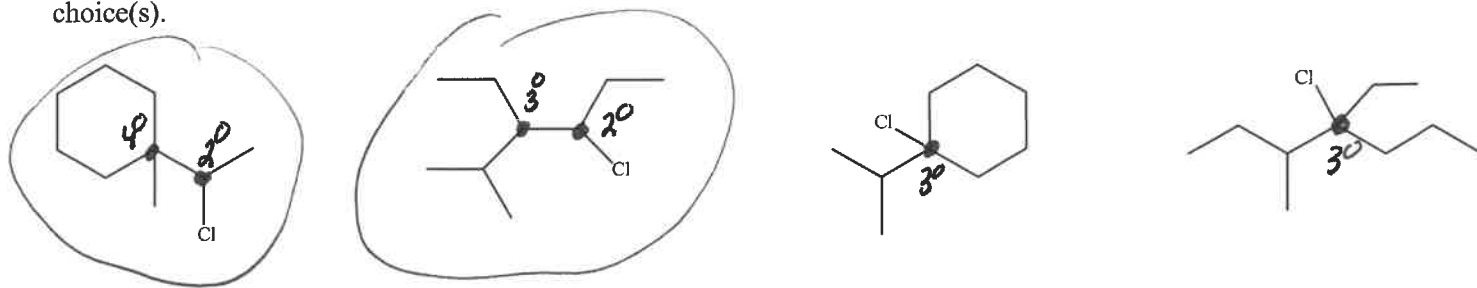
Acid

BaseNucleophile

Leaving Group

provides the H^+ electrophile(c) Which of the following alcohols will most likely undergo **rearrangement** upon **E1 dehydration** with H_2SO_4 ? Circle your choice(s).

(d) Which of the following molecules will be most likely to undergo **rearrangement** in an SN1 reaction? Circle your choice(s).



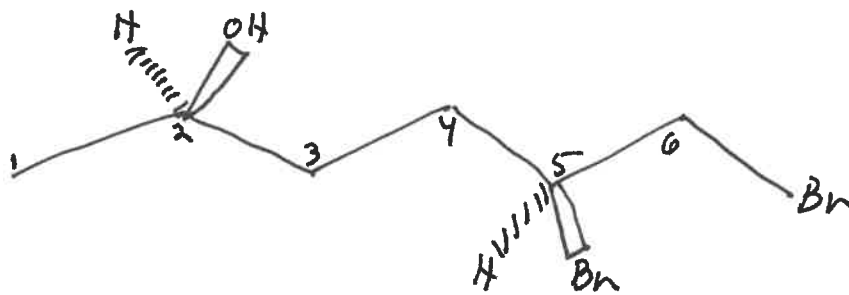
(e) Explain your reasoning to question (d) above.

Rearrangements are likely to occur when a 2° carbocation is adjacent to a 3° or 4° carbon. After the shift of an "H" or "Cl", a more stable 3° carbocation will form.

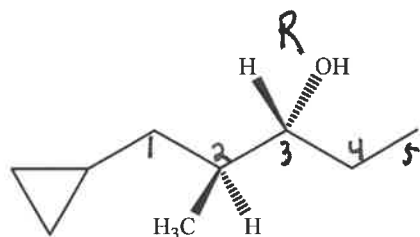
2. (25 Points) Alcohol Nomenclature.

- If a name is given draw an accurate zig-zag structure (use wedge and dash bonds for all chiral carbons).
- If a structure is drawn, give an accurate IUPAC name (assign configurations using the R/S prefix).

(a) (2R, 5S)-5,6-dibromo-2-hexanol

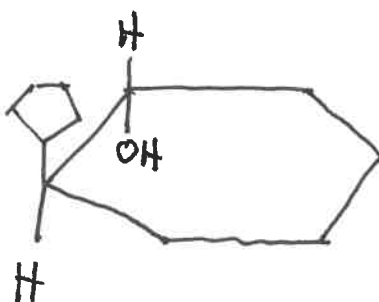


(b)



(2S, 3R)-1-cyclopropyl-2-methyl-3-pentanol

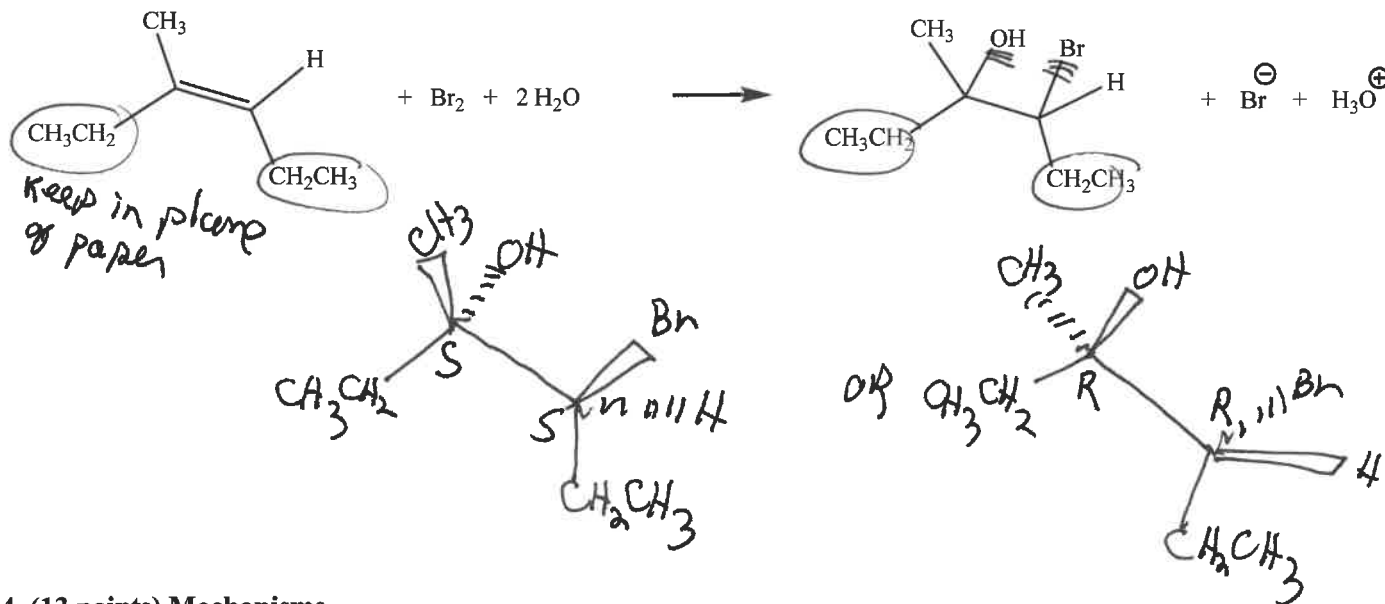
(c) trans-2-cyclopentyl cyclohexanol



3. (5 Points) Stereochemistry in the Electrophilic Addition of Br₂ and a Nucleophile.

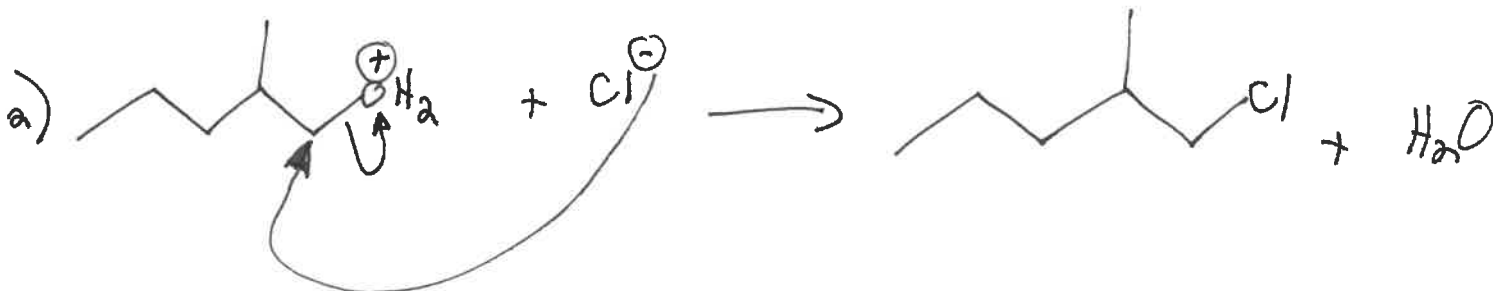
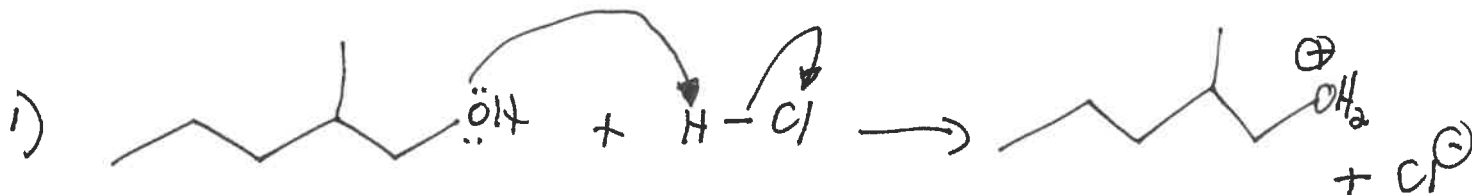
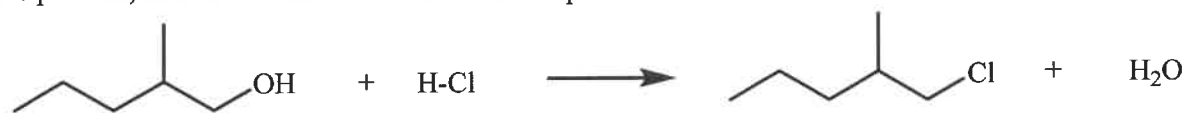
(i) Draw the 3D structure of any ONE of the two enantiomer products of the reaction shown below. Use proper wedge and dash bonds.

(ii) Label the configuration at each chiral carbon as R or S.



4. (13 points) Mechanisms.

(a) SN₂ Addition of HCl to an Alcohol (2 steps). Write a complete mechanism that explains the formation of all products in the balanced Net Equation shown below. Your mechanism must consist of a series of individual, balanced chemical equations, and curved arrows to show electron pair movement.



(b) In the reaction given above, what roles are played by the H-Cl ions? CIRCLE all the best answer(s):

Leaving Group

Nucleophile

Acid

Base

Catalyst

provides an H⁺ electrophile