

NAME (PRINT CLEARLY) _____

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**.

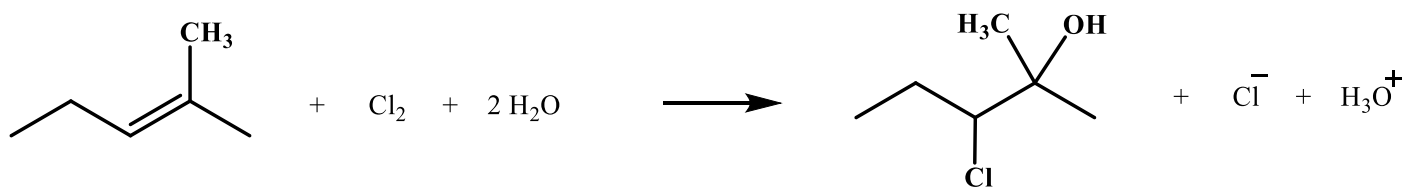
_____ Rearrangements are most likely to occur in SN2 and E2 reactions

_____ In the addition of CN^- to a bromonium ion, the nucleophile adds to the most substituted carbon

_____ In electrophilic addition reactions, the nucleophile has a full or partial positive charge

_____ In the electrophilic addition of Br_2 to an alkene, the key intermediate is called a bromonium ion_____ In electrophilic addition reactions, Na^+ is never used as an electrophile_____ 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^- **sp² 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^+ **sp² 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.

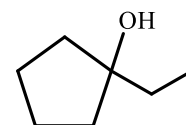
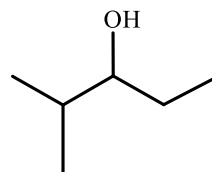
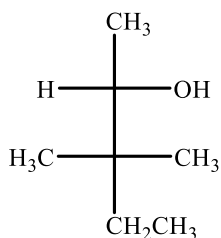
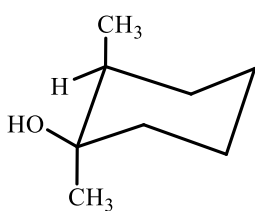
Catalyst

Acid

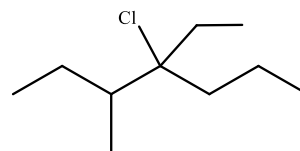
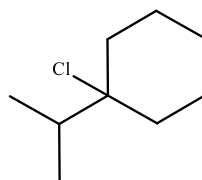
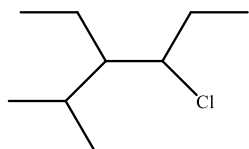
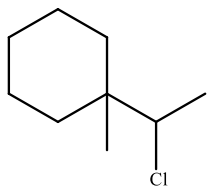
Base

Nucleophile

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).



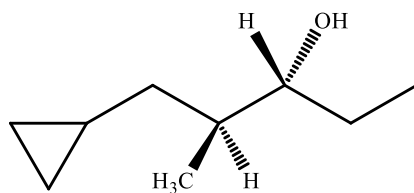
(e) Explain your reasoning to question (d) above.

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

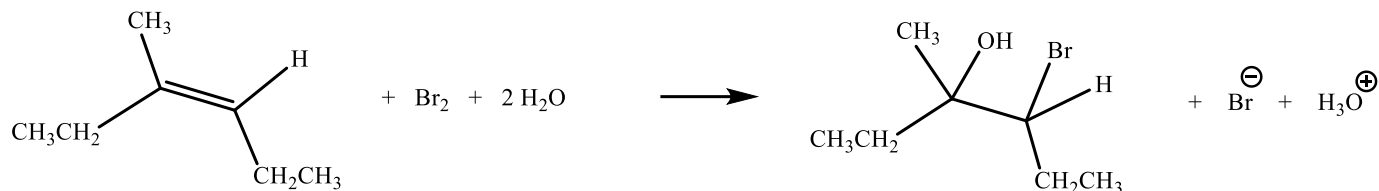
(b)



(c) trans-2-cyclopentyl cyclohexanol

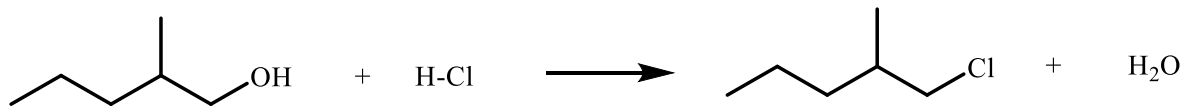
3. (5 Points) Stereochemistry in the Electrophilic Addition of Br₂ and a Nucleophile.

- (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