**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 <u>ASK</u> 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 SN1 and E1 reactions

_____ In the addition of $^{-}CN$ to a bromonium ion, the nucleophile adds to the least substituted carbon

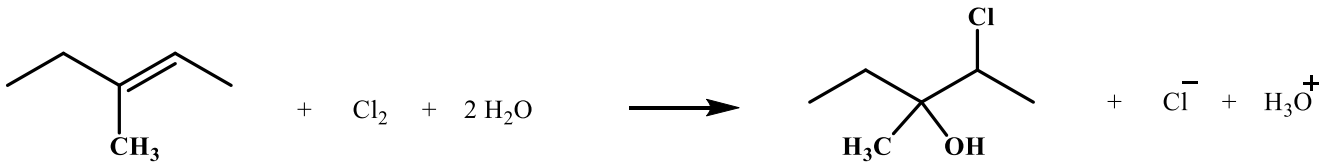
_____ In electrophilic addition reactions, the electrophile has a full or partial positive charge

_____ In the electrophilic addition of $Br_2$ to an alkene, the key intermediate is called a carbocation

_____ In electrophilic addition reactions, $Na^+$ is a better electrophile than $H^+$

_____ In the electrophilic addition of $Cl_2$ to an alkene, the two Cl atoms add to opposite sides of the double bond

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




(i) In the alkene, label the sp2 carbons with $\delta^+$ and $\delta^-$

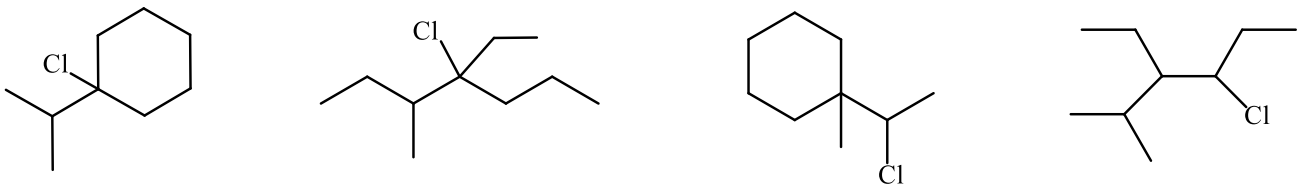
(ii) (Circle the correct responses) The **( $H_2O$ , $Cl^-$, $Cl^+$ )** species becomes bonded to the **$\delta^+$ sp2 carbon**, and this species is referred to as the **( nucleophile, electrophile, acid, base).**

(iii) (Circle the correct responses) The **( $H_2O$ , $Cl^-$, $Cl^+$ )** species becomes bonded to the **$\delta^-$ sp2 carbon**, and this species is referred to as the **( nucleophile, electrophile, acid, base).**

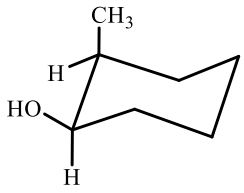
(iv) Which of the following best describes **<u>all roles</u>** played by **$H_2O$** in this reaction? Circle all that apply.

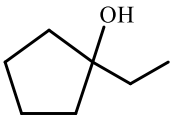
**Nucleophile** **Leaving Group** **Catalyst** **Acid** **Base** **provides the $H^+$ electrophile**

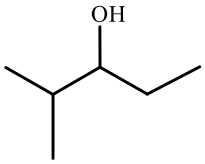
(c) Which of the following molecules will be most likely to undergo **<u>rearrangement</u>** in an SN1 reaction? Circle your choice(s).

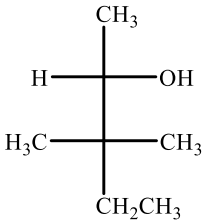


(d) Which of the following alcohols will most likely undergo **<u>rearrangement</u>** upon **E1 dehydration** with $H_2SO_4$? Circle your choice(s).



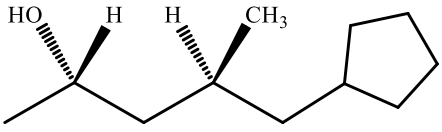

(e) Explain your reasoning to question (d) above.

**2. (25 Points) Alcohol Nomenclature.**

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

(a) (2R, 3R)-2,6-dibromo-3-hexanol

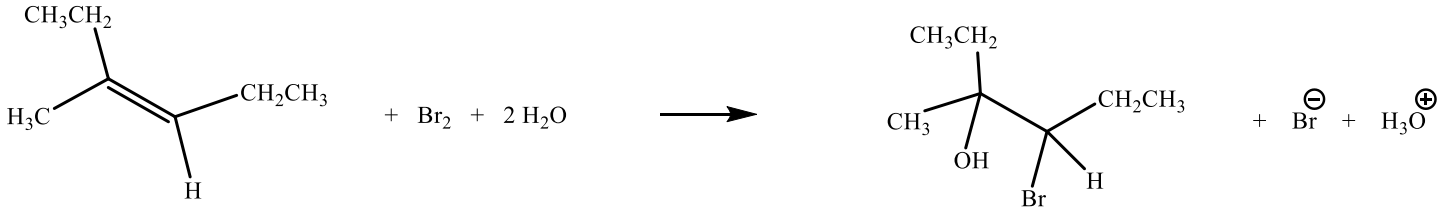
(b)




(c) cis-4-cyclopropyl cyclohexanol

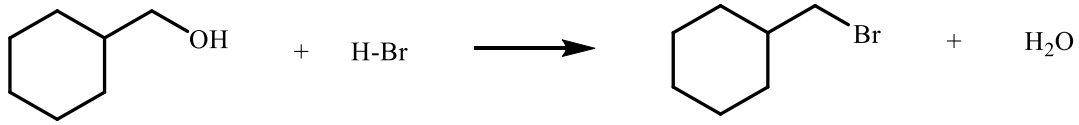
**3. (5 Points) Stereochemistry in the Electrophilic Addition of $Br_2$ and a Nucleophile.**

(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 HBr 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-Br** ions? CIRCLE all the best answer(s):

**Nucleophile** **Leaving Group** **Catalyst** **Acid** **Base** **provides an $H^+$ electrophile**