Names of all students (please print) Answer Key

CHEM 243 Organic Chemistry I **Points** _____ **(10 max)**

Worksheet #27: November 29, 2021. Complete the following worksheet by collaborating with a group of 3-4 students. You can use a text book or your lecture video notes. You must work together, with the names of all students included on **ONE** sheet and turned in for a group grade. **All the problems on this worksheet are Review Questions for Exam III.**

NOTE: The problems on Worksheets 24-28, and on the Study Guide for Exam IV, will be representative of the problems that might appear on the optional make-up exam.

(1) Electrophilic Addition of Br_2 and Cl_2: General Mechanism Questions (video 8-3). Answer the following questions based on the reaction drawn at the right:

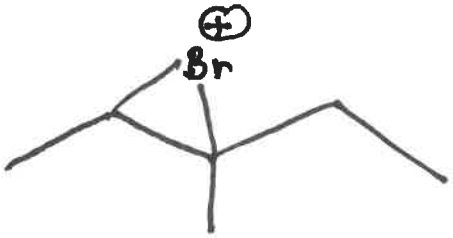
(a) Label the alkene double bond with δ^+ and δ^-

(b) (Fill in the blanks) For the Br_2 reagent, one Br atom has a δ^+ charge, is called the electrophile, and becomes bonded to the δ− carbon of the alkene.

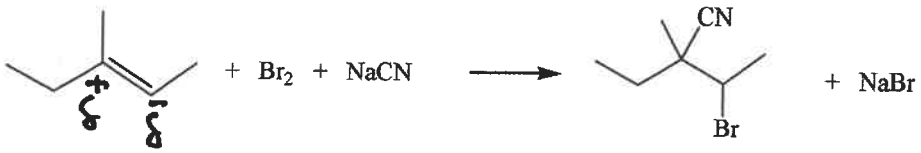
(c) (Fill in the blanks) For the Br_2 reagent, the other Br atom has a δ^- charge, is called the nucleophile, and becomes bonded to the δ+ carbon of the alkene.

(d) Circle the correct response. The key intermediate in this reaction is called the:
(carbocation **bromonium ion** **hydronium ion** **bromide ion)**

(e) Draw the structure of the key intermediate in this reaction:



(2) Electrophilic Addition of Br_2 and a nucleophile: General Mechanism Questions (video 8-3). Answer the following questions based on the reaction drawn at the right:



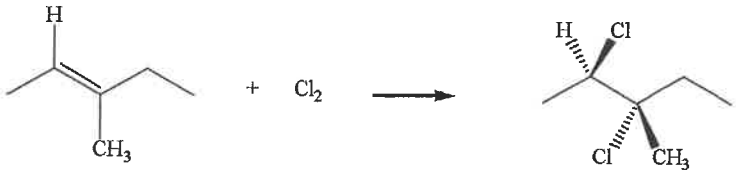
(a) Label the alkene double bond with δ^+ and δ^-

(b) (Circle the correct responses) The (Br, Na, CN) species becomes bonded to the δ^- sp2 carbon, and this species is referred to as the (nucleophile, electrophile, acid, base, spectator).

(c) (Circle the correct responses) The (Br, Na, CN) species becomes bonded to the δ^+ sp2 carbon, and this species is referred to as the (nucleophile, electrophile, acid, base, spectator).

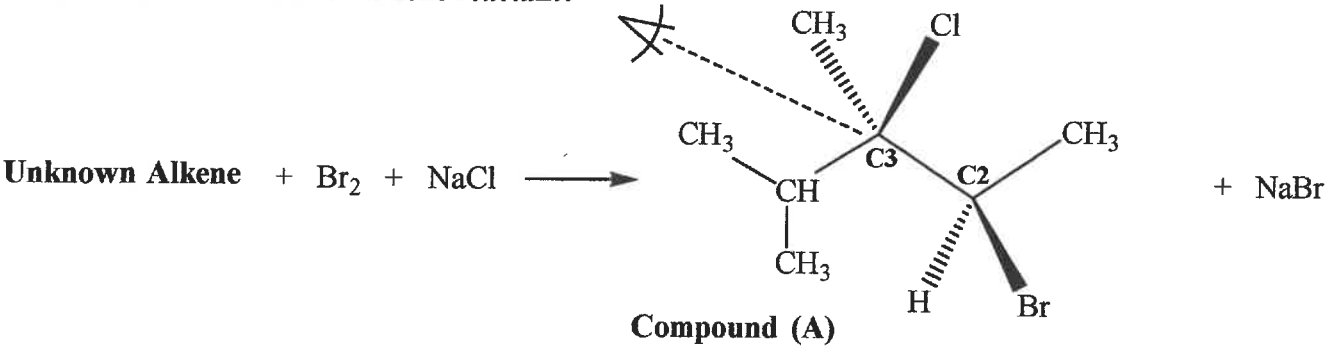
(3) Electrophilic Addition Reaction Stereochemistry. Because of the "halonium ion" intermediate, electrophilic addition of Br_2 and Cl_2 occurs by **anti addition.** What this means is that the electrophile and nucleophile add anti to the double bond, and in the 3D zig-zag structure, one will be the wedge bond and the other the dashed bond:

Example of anti addition of Cl_2:



Note that this is equivalent to the E2 mechanism where the β-H and Lg are eliminated by anti elimination. Both chemical reactions can be studied using Newman Projections.

Electrophilic addition of Br_2 and NaCl to an **unknown alkene reactant** produces the following product (Compound A). **What is the structure of the unknow alkene reactant?**

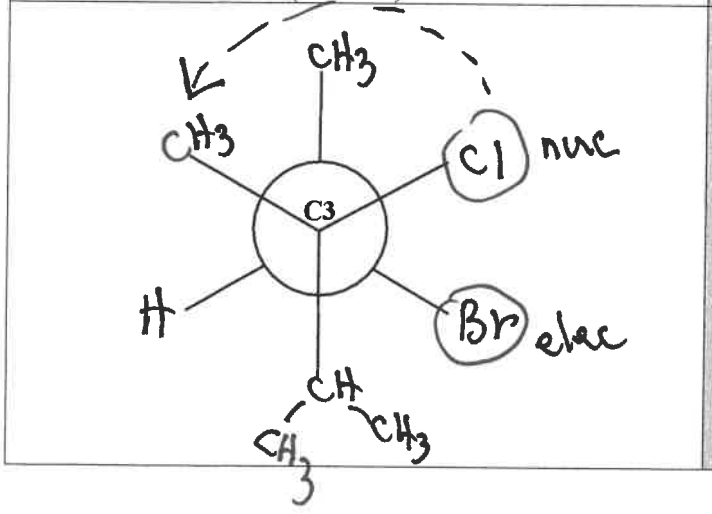


Compound (A)

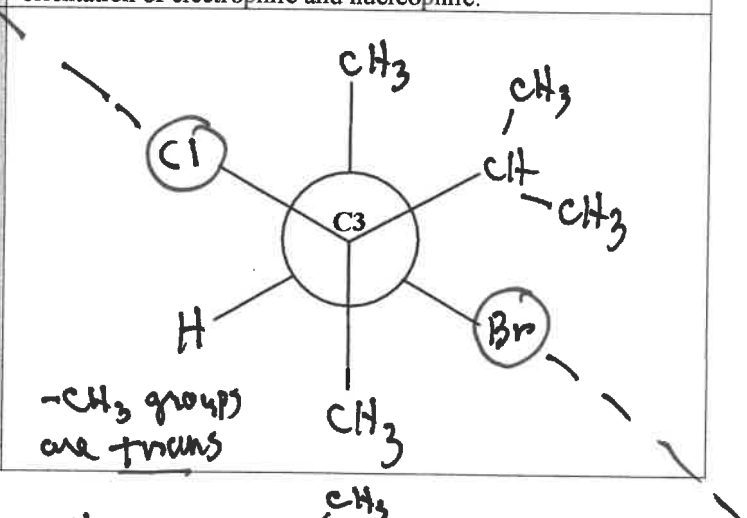
We can analyze the **product** using Newman Projections and our knowledge of the stereospecific electrophilic addition of Br_2 with a nucleophile to determine the structure of the **unknown reactant alkene.**

(a) In looking at the reactants, identify the: electrophile Br^+ and the nucleophile Cl^-

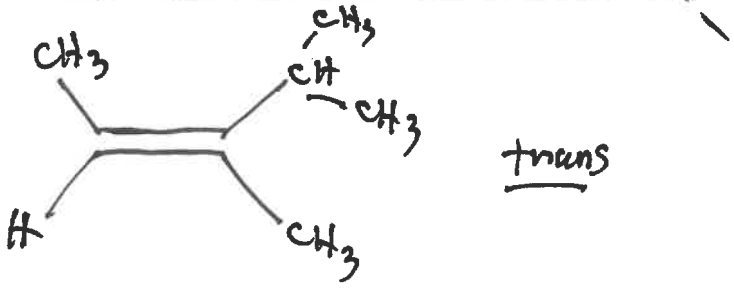
(b) Draw a Newman Projection of the **product** by looking down the C3 – C2 bond (as shown):



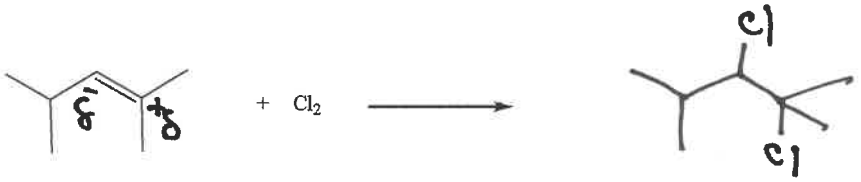
(c) Re-draw your Newman Projection to give the anti orientation of electrophile and nucleophile:

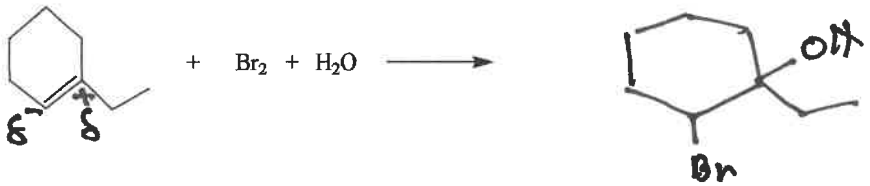


(d) Based on your Newman Projections, draw the structure of the **unknown reactant alkene**, with proper geometry, that will produce the product, Compound (A).



(4) Electrophilic Addition Reactions. Complete the **Electrophilic Addition Reactions** shown below by drawing the structure of the major, neutral organic products. It is NOT necessary to balance these reactions or write the mechanism. There are NO rearrangements and NO intramolecular reactions. Do Not worry about stereochemistry.





(5) Electrophilic Addition of Cl_2 and NH_3 to an Alkene (3 steps). Write a complete mechanism that explains the formation of all products in the balanced net reaction shown below. Your mechanism must consist of a series of individual, balanced chemical equations, and curved arrows to show electron pair movement.