Electrophilic addition is a reaction between an electrophile and nucleophile, adding to double or triple bonds. An electrophile is defined by a molecule with a tendency to react with other molecules containing a donatable pair of electrons. Thus, it is an "electron lover." A nucleophile is one that possesses a lone pair of electrons that can be easily shared. In essence, all nucleophiles are Lewis bases that attack nonhydrogen atoms (Lewis acids).

Introduction

In a general electrophilic addition reaction, one of the pi bonds is removed and creates two new sigma bonds. Another electrophilic addition reaction known as halohydration includes bromoalcohol, more commonly known as bromohydrin. There are a variety of electrophilic reactions, and therefore a variety of different products that are very useful. It simply depends on which reagents are used to determine the final product.

Step 1

In the first step there is an electrophilic addition of bromine to the cyclopentene, forming a cyclic bromonium ion or also known as an open-chained carbenium ion (Troll, T). For more information about the cyclic Bromonium Ion please look at Electrophilic Addition of Halogens to Alkenes.

Step 2

Now the nucleophilic water molecule attacks the back of the more substituted carbon and pushes the bromonium ion onto the less substituted carbon. In general the regiochemistry of this reaction follows Markovnikov’s rule (Troll, T). The stereochemistry of the reaction is anti-addition because of better orbital overlap from backside attack, which means that the Br and the H2O are on opposite sides of the double bond. The electrophilic bromide in the product becomes linked to the less substituted carbon. The nucleophile attacks the more substituted carbon, because the carbon is more positively polarized than the other carbon.

Step 3
The negatively charged bromonium ion that was not used in the reaction is still floating freely in the water. The bromine atom attacks one of the H's located on the water molecule. The Hydrogen drops off its electrons on the oxygen molecule making the oxygen neutral.

Final Product

Finally we are left with the trans-2-Bromocyclopentanol and hydrobromination. Here's the entire mechanism in gumdrop form. (Orange = C, Yellow = H, Red = Br, White = O)

References


Problems

Just for some extra practice try and answer the following questions

1. What is the product for the following reaction

2. What is the product for the following reaction

3. Write the products (hint what acts as an electrophile and what acts as the nucleophile)
4. What is the stereochemistry and the Regiochemistry of Bromoalcohol?

5. In Markovnikov Addition the electrophile attacks the more substituted carbon and the nucleophile attacks the less substituted carbon?
   
   A. True
   
   B. False

Answers

1.

\[
\text{CH}_3\text{CH}_2\text{CHCH}_2\text{OH} + \text{CH}_3\text{Cl} \rightarrow \text{Br}
\]

2.

\[
\text{CH}_3\text{CH}_2\text{OH} + \text{Br} \rightarrow \text{CH}_3\text{Br}
\]

3. [Empty space]
4. Stereochemistry: Anti-Addition & Regiochemistry: Markovnikov

5.B. False

Contributors

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Additional Resources

*MasterOrganicChemistry*

Addition Reactions – Elimination’s Opposite

Addition Reactions - Regiochemistry

Addition Reactions - Stereochemistry

*Carey 4th Edition On-Line Activity*

Reactions of Alkenes

*Leah4Sci*

Alkene Reactions - Introduction

*Cliffs Notes*

Electrophilic additions to alkenes

*Web Pages*

Electrophilic addition to alkenes

Reactivity of alkenes and alkynes