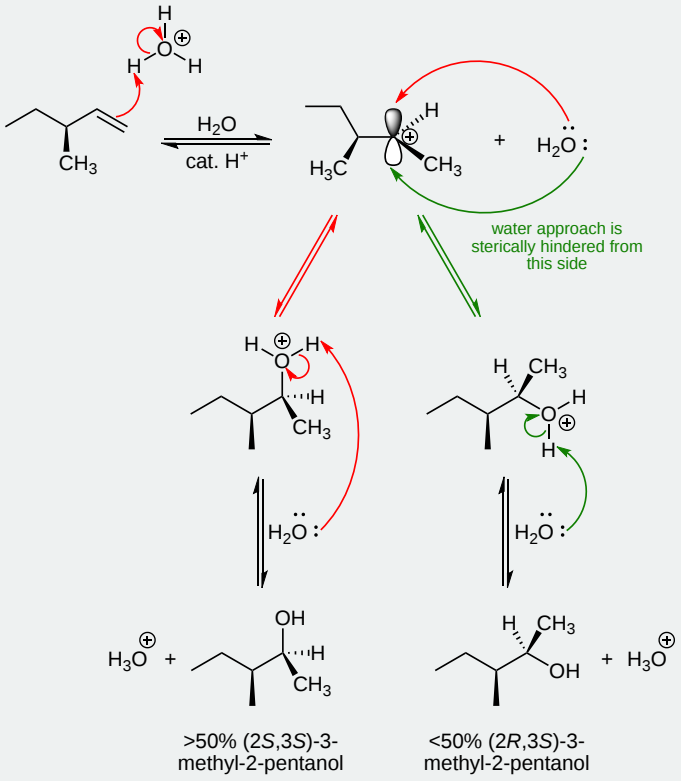
8.13: STEREOCHEMISTRY OF REACTIONS - ADDITION OF H_2O TO A CHIRAL ALKENE

OBJECTIVE

After completing this section, you should be able to explain why the addition of H_2O to a chiral alkene leads to unequal amounts of diastereomeric products.

STUDY NOTES

In the previous section, the addition of water to the achiral alkene produced a racemic mixture of two enantiomeric alcohols. They are produced in equal amounts so the mixture is optically inactive. What would occur if we carried out a similar reaction on a chiral alkene? Consider (*S*)-3-methyl-1-pentene reacting with water (acid catalyzed). Proton addition produces a carbocation intermediate that is chiral (* denotes stereogenic centre). That intermediate does not have a plane of symmetry and therefore attack by water is not equal from the top and bottom. This ultimately produces *R* and *S* products in a non 50:50 ratio.



In the previous section (8.12), an achiral alkene yielded a racemic mixture product. In this section, the starting alkene is chiral. If we consider (S)-3-methyl-1-pentene, it contains a chiral center, thus is optically active. When (S)-3-methyl-1-pentene undergoes acid-catalyzed hydration, it creates a second chiral center. There is the possibility of four products. Do they all form? The do not. Let's see why.

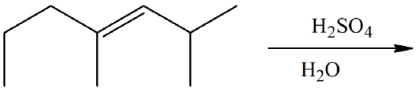
In the reaction, only one site is being reacted at. The S-configuration at C3 just goes along for the ride never participating in the actual mechanism. If you do not react at that site, then the stereochemistry will remain the unchanged, so it will stay with the S-configuration. However, at C2 we are reacting and water can still approach the planar carbocation from either side. Therefore at the C2 site, there will be some R-configuration and some S-configuration. The final product with be a mixture of enantiomers of 2-pentanol. Since the carbocation does not have a plane of symmetry (as was the case in the previous section), there will not be equal attack on either face. One of the faces may be slightly hindered due to sterics, which would result in a little less nucleophilic attack. Instead of obtaining a 50:50 diasteriomeric mixture of products, it would have a slightly different ratio of R to S due to this unequal attack.

EXERCISES

QUESTIONS

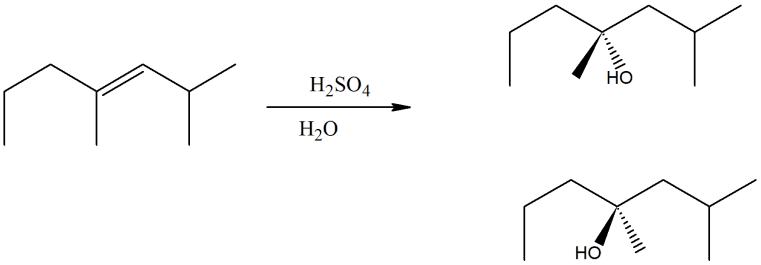
Q8.13.1

Predict the products of the following reaction showing stereochemistry.



SOLUTIONS

S8.13.1



The products (Markovnikov) are diastereomers of one another.

CONTRIBUTORS AND ATTRIBUTIONS

-
-
- Lauren Reutenauer (Amherst College)
- Dr. Krista Cunningham
