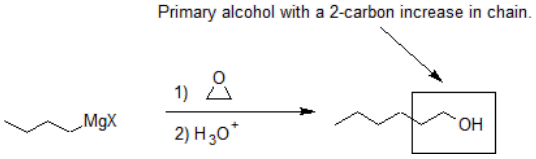
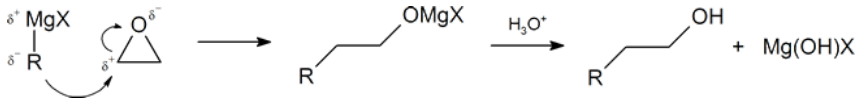
15.9: REACTIONS OF EPOXIDES WITH GRIGNARD AND ORGANOLITHIUM REAGENTS

GRIGNARD REACTIONS WITH EPOXIDES

Grignard reactions with ethylene oxide produce a primary alcohol containing two more carbon atoms than the original Grignard reagent.

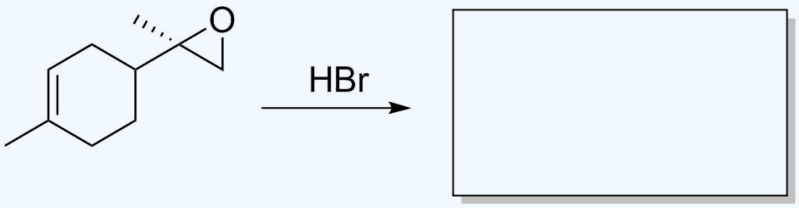


The first step of the mechanism is shown below. With the second step following the protonation step common to the other reaction pathways studied in this section. This reaction follows the same S_N2 mechanism as the opening of epoxide rings under basic conditions since Grignard reagents are both strong nucleophiles and strong bases.

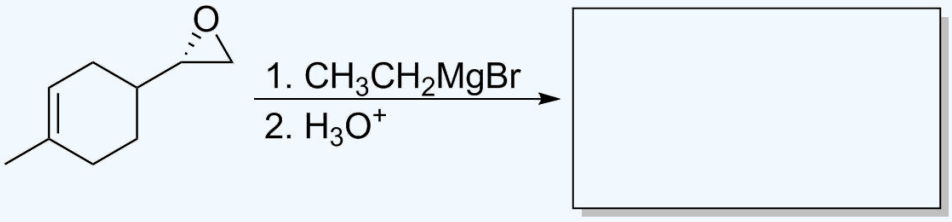


Exercise

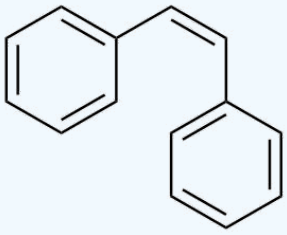
12. Given the following, predict the product assuming only the epoxide is affected. (Remember stereochemistry)



13. Predict the product of the following, similar to above but a different nucleophile is used and not in acidic conditions. (Remember stereochemistry)

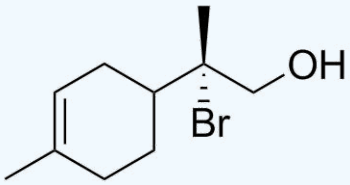


14. Epoxides are often very useful reagents to use in synthesis when the desired product is a single stereoisomer. If the following alkene were reacted with an oxyacid to form an epoxide, would the result be a enantiomerically pure? If not, what would it be?



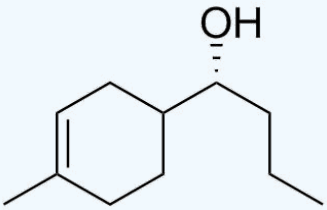
Answer

12.



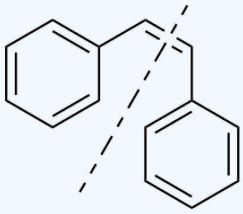
Note that the stereochemistry has been inverted

13.

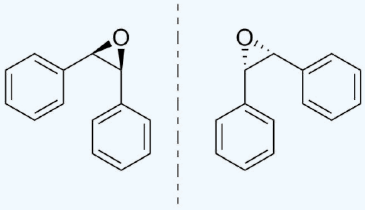


14.

First, look at the symmetry of the alkene. There is a mirror plane, shown here.



Then, think about the mechanism of epoxidation with an oxyacid, take for example *m*CPBA. The mechanism is concerted, so the original *cis* stereochemistry is not changed. This leads to "two" epoxides.



However, these two mirror images are actually identical due to the mirror plane of the *cis* geometry. It is a meso compound, so the final result is a single stereoisomer, but not a single enantiomer.

CONTRIBUTORS AND ATTRIBUTIONS

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