This page gives you the facts and a simple, uncluttered mechanism for the electrophilic addition reactions between the hydrogen halides and alkenes like ethene and cyclohexene. Hydrogen halides include hydrogen chloride and hydrogen bromide.

**Electrophilic addition reactions involving hydrogen bromide**

Alkenes react with hydrogen bromide in the cold. The double bond breaks and a hydrogen atom ends up attached to one of the carbons and a bromine atom to the other. In the case of ethene, bromoethane is formed.

\[
\ce{CH_2=CH_2 + HBr \rightarrow CH_3CH_2Br}
\]

With cyclohexene you get bromocyclohexane.

The structures of the cyclohexene and the bromocyclohexane are often simplified:

Be sure that you understand the relationship between these simplified diagrams and the full structures.

**The mechanisms**

The reactions are examples of electrophilic addition. With ethene and HBr:

and with cyclohexene:
Electrophilic addition reactions involving the other hydrogen halides

Hydrogen chloride and the other hydrogen halides add on in exactly the same way. For example, hydrogen chloride adds to ethene to make chloroethane:

\[
\text{CH}_2=\text{CH}_2 + \text{HCl} \rightarrow \text{CH}_3\text{CH}_2\text{Cl}
\]

The only difference is in how fast the reactions happen with the different hydrogen halides. The rate of reaction increases as you go from HF to HCl to HBr to HI.

HF > HCl > HBr > HI

The reason for this is that as the halogen atoms get bigger, the strength of the hydrogen-halogen bond falls. Bond strengths (measured in kiloJoules per mole) are:

H-F (569 kJ) > HCl (432 kJ) > HBr (366 kJ) > HI (298 kJ)

As you have seen in the HBr case, in the first step of the mechanism the hydrogen-halogen bond gets broken. If the bond is weaker, it will break more readily and so the reaction is more likely to happen.

The mechanisms

The reactions are still examples of electrophilic addition. With ethene and HCl, for example:

This is exactly the same as the mechanism for the reaction between ethene and HBr, except that we've replaced Br by Cl. All the other mechanisms for symmetrical alkenes and the hydrogen halides would be done in the same way.

Contributors

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