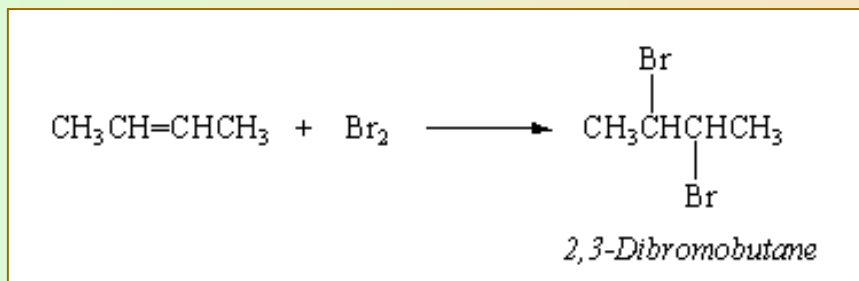


# The Reactions of Alkenes

## Alkenes

Unsaturated hydrocarbons such as alkenes and alkynes are much more reactive than the parent alkanes.

They react rapidly with bromine, for example, to add a Br<sub>2</sub> molecule across the C=C double bond (addition reaction).



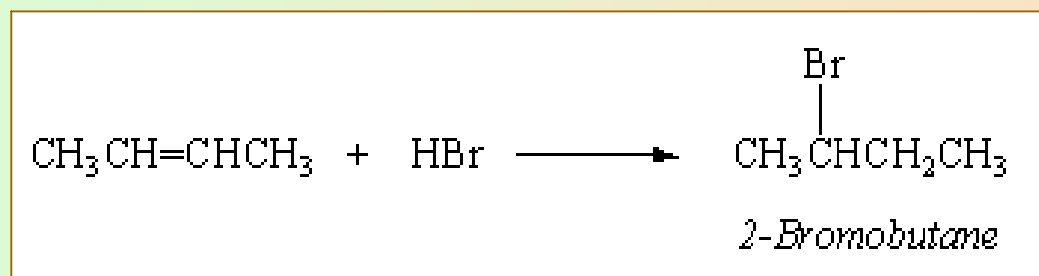
This reaction provides a way to test for alkenes or alkynes. Solutions of bromine in CCl<sub>4</sub> have an intense red-orange color.

When Br<sub>2</sub> in CCl<sub>4</sub> is mixed with a sample of an alkane, no change is initially observed. When it is mixed with an alkene or alkyne, the color of Br<sub>2</sub> rapidly disappears.

## Alkenes

Hydrogen bromide (HBr) adds across a C=C double bond to form the corresponding alkyl bromide, in which the hydrogen ends up on the carbon atom that had more hydrogen atoms to begin with (Markovnikov).

Addition of HBr to 2-butene, for example, gives 2-bromobutane.



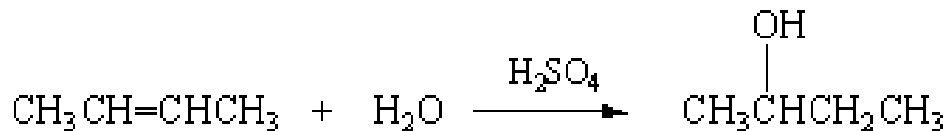
# The Reactions of Alkenes

## Alkenes

H<sub>2</sub> adds across double (or triple bonds) in the presence of a suitable catalyst to convert an alkene (or alkyne) to the corresponding alkane.



In the presence of an acid catalyst, it is even possible to add a molecule of water across a C=C double bond.



# The Reactions of Alkenes

## Markovnikov's rule

In theory, two products can form when an unsymmetric reagent such as HBr is added to an unsymmetric C=C double bond.

In practice, only one product is obtained. When HBr is added to 2-methylpropene, for example, the product is 2-bromo-2-methylpropane, not 1-bromo-2-methylpropane.

