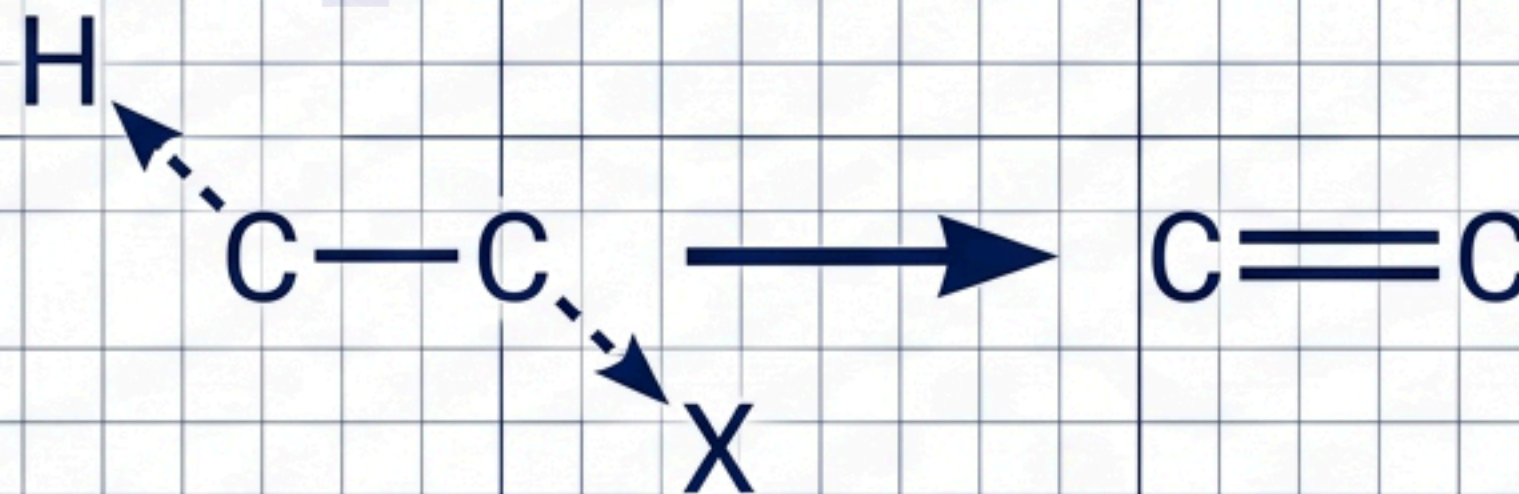


# Elimination: Making Alkenes

A schematic guide to beta-elimination and dehydrohalogenation of haloalkanes.

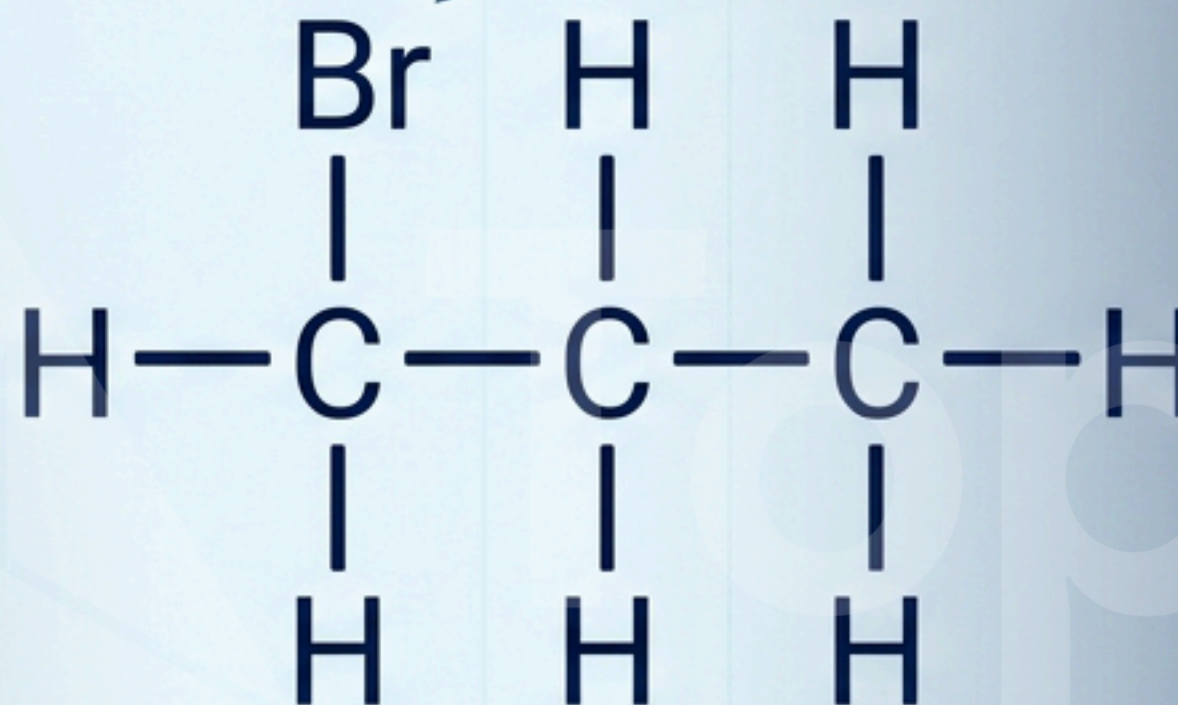


# Mapping the Molecular Anatomy

Halogen (X)  
leaving group

$\alpha$

Carbon on which the halogen atom is directly attached is called the alpha-carbon.

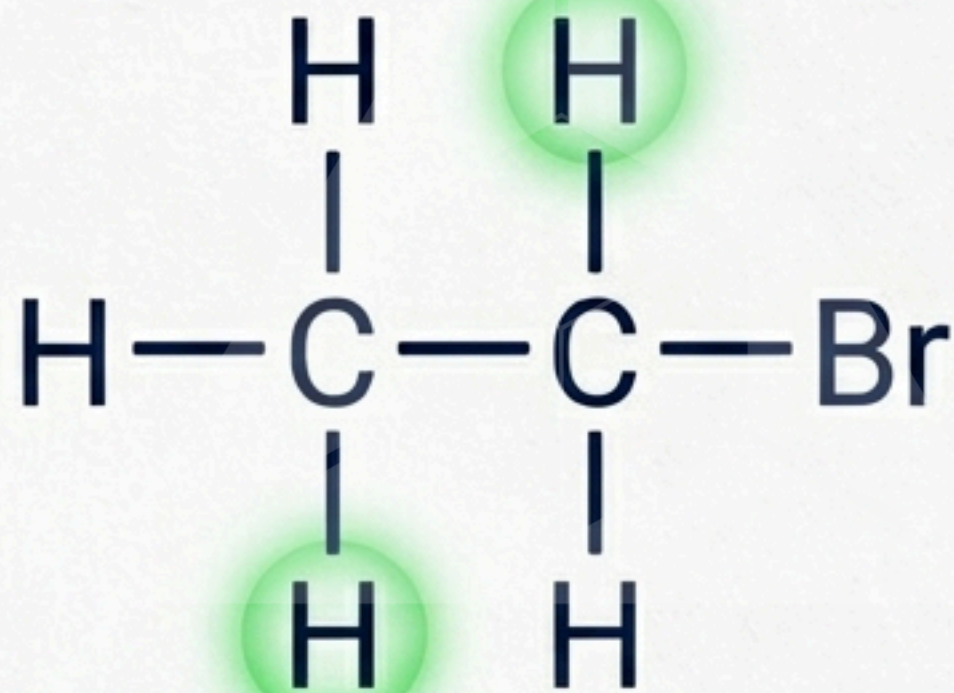


$\beta$

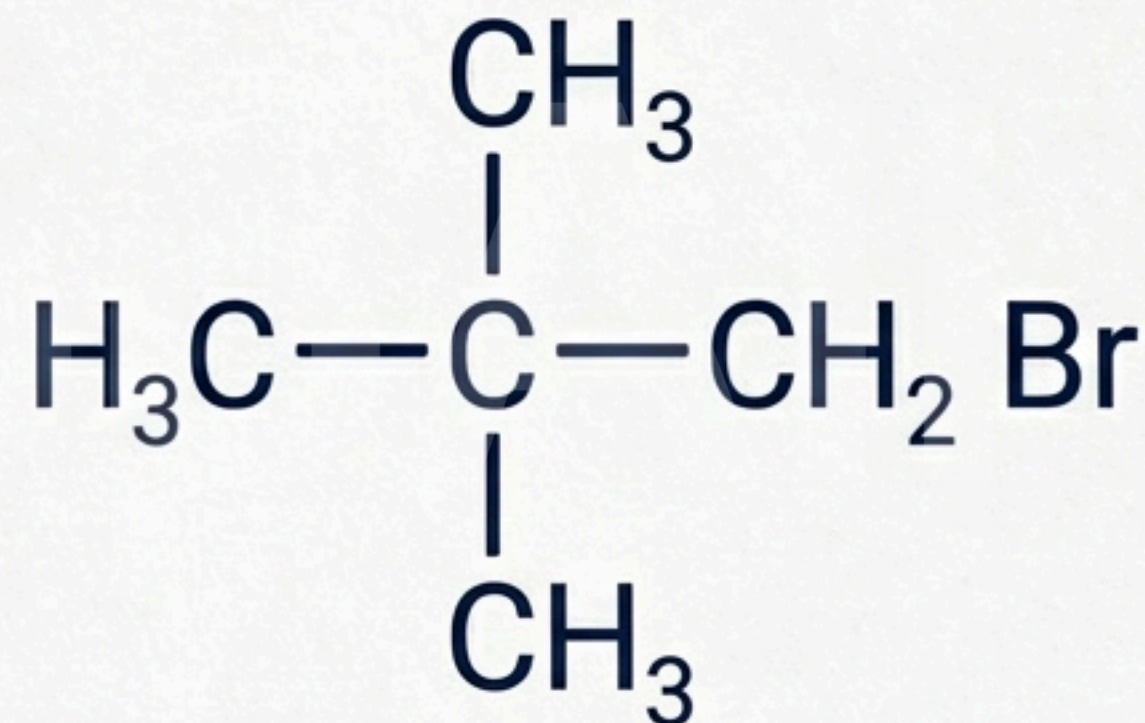
The carbon atom directly adjacent to the alpha-carbon is called the beta-carbon.

# The Beta-Hydrogen Requirement

Elimination is impossible without an available hydrogen atom on the beta-carbon. Since a beta-hydrogen atom is involved in elimination, this process is often specifically called beta-elimination.



Reaction Proceeds



No Reaction



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$$E=mc^2$$



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# The Mechanism: Dehydrohalogenation

When heated with an alcoholic solution of potassium hydroxide, the molecule sheds a hydrogen from the beta-carbon and a halogen from the alpha-carbon, forming an alkene.



**[De] [hydro] [halogen] [ation]**

removal

hydrogen

halogen

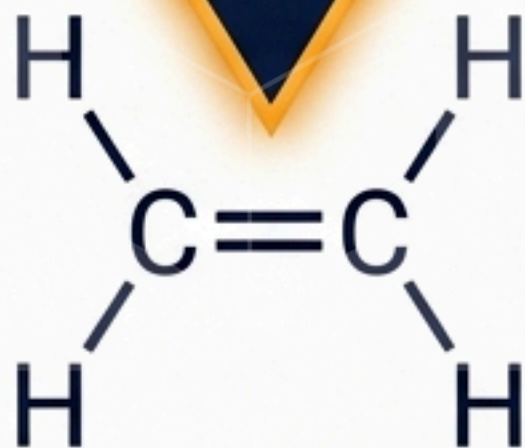
process

# The Reagent Trap: Solvent Determines Outcome

**CRITICAL CONDITION**

Elimination Pathway

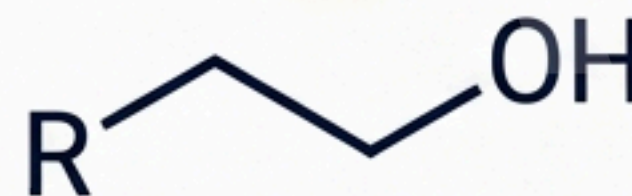
 **Alcoholic KOH**



A bulkier nucleophile/base in alcoholic conditions prefers to abstract a proton.

Substitution Pathway

 **Aqueous KOH**

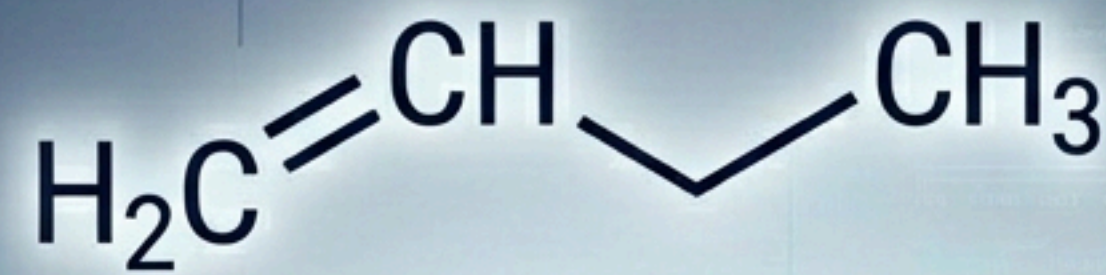
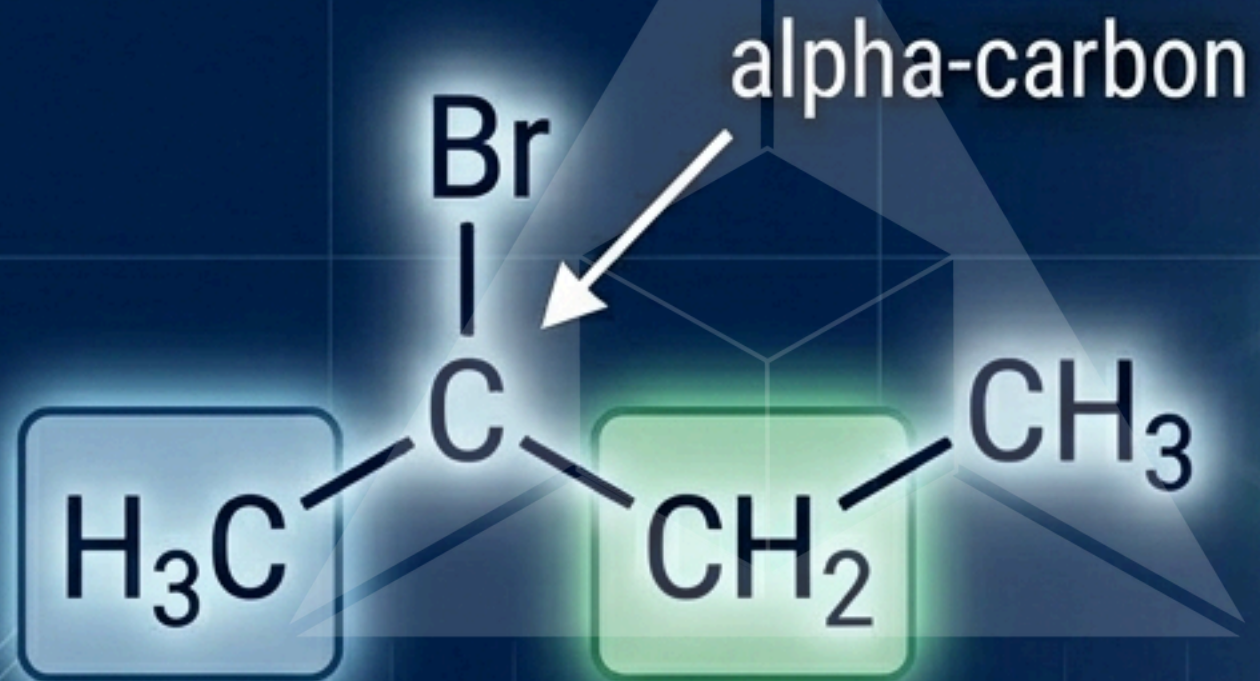


The same reagent in aqueous conditions will attack the carbon to replace the halogen.

**To make alkenes, always use Alcoholic KOH.**

# The Branching Pathway: 2-Bromopentane

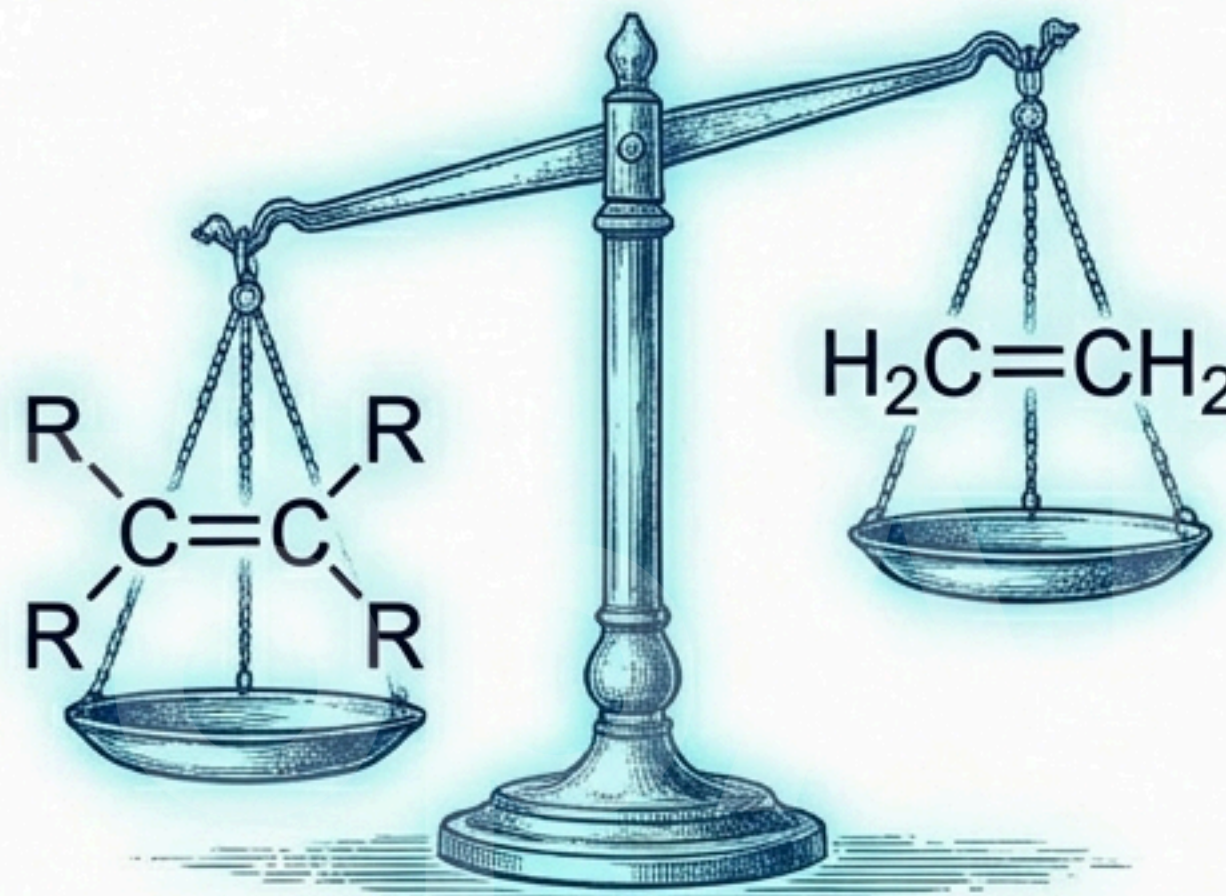
If there is more than one beta-hydrogen available, multiple alkenes can form. Which pathway does the molecule take?



# The Governing Law: Zaitsev's Rule



**Zaitsev's Rule (1875)**

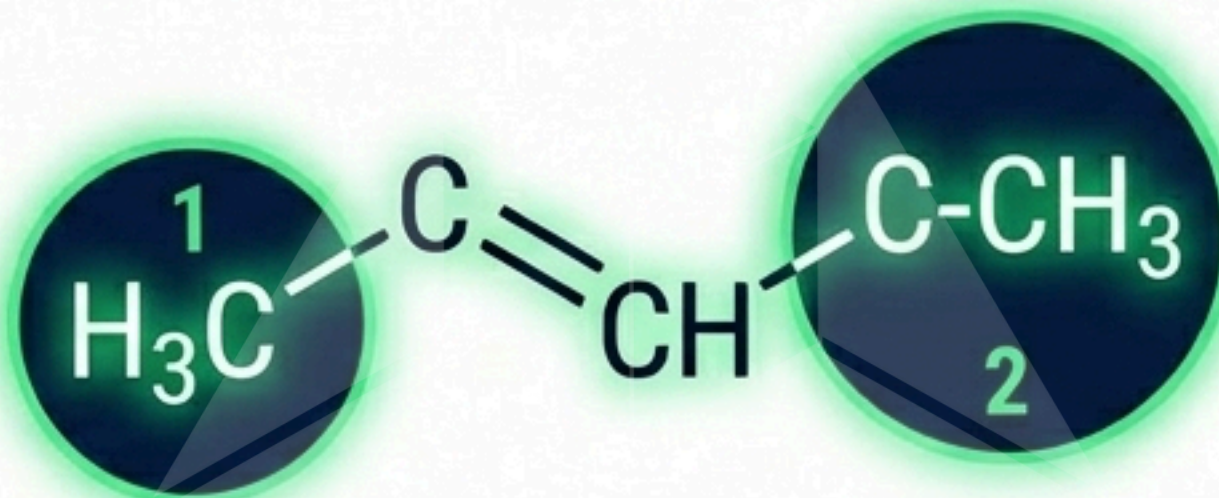


*"In dehydrohalogenation reactions, the preferred product is that alkene which has the greater number of alkyl groups attached to the doubly bonded carbon atoms."*

The more substituted the double bond, the more stable the alkene.  
The molecule will preferentially form the most heavily substituted product.

# Predicting the Blueprint: Major vs. Minor Products

## MAJOR PRODUCT (Pent-2-ene)



Disubstituted double bond.  
More stable, preferred pathway.

## MINOR PRODUCT (Pent-1-ene)



Monosubstituted double bond.  
Less stable, secondary pathway.



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