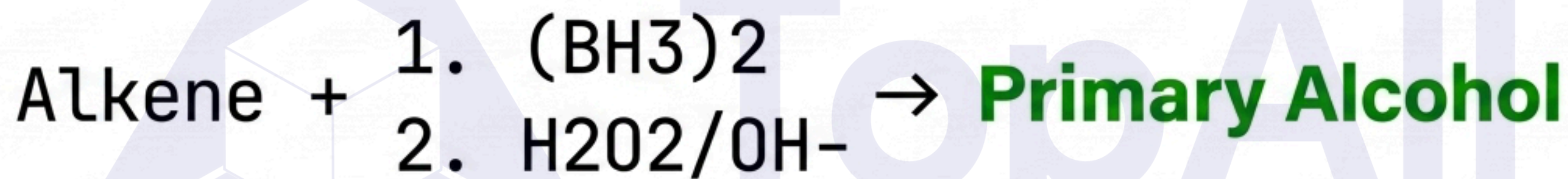


Anti-Markovnikov Alcohol Formation

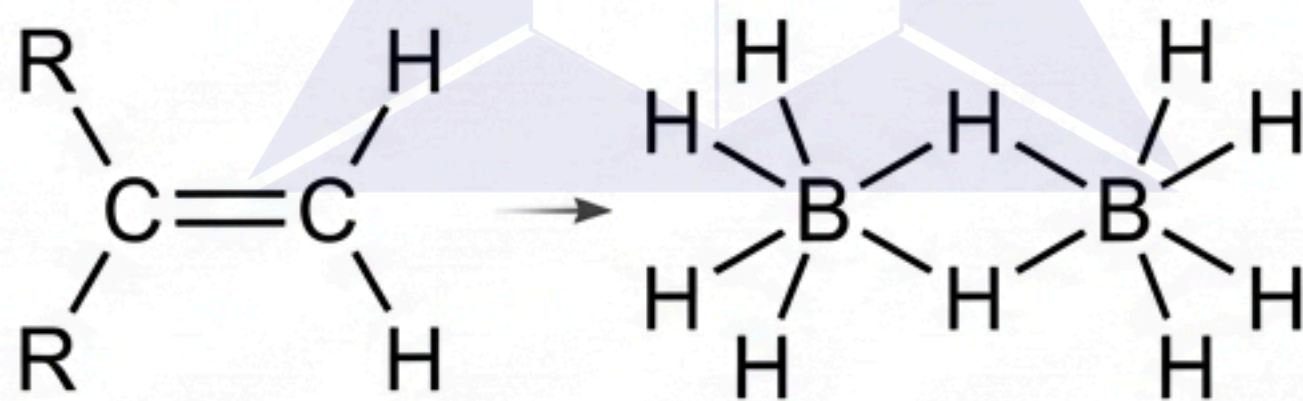
Hydroboration-Oxidation of Alkenes



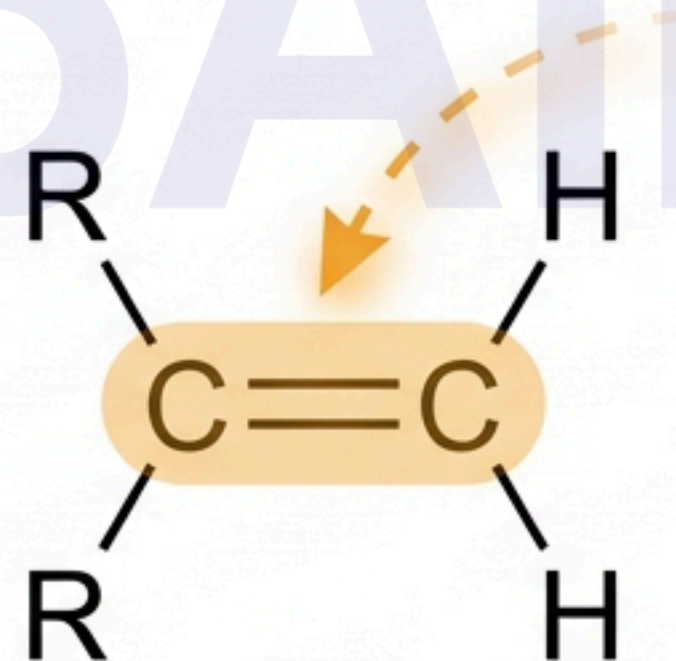
Historical Context: H.C. Brown's 1959
Discovery (1979 Nobel Prize in Chemistry)

Diborane Addition

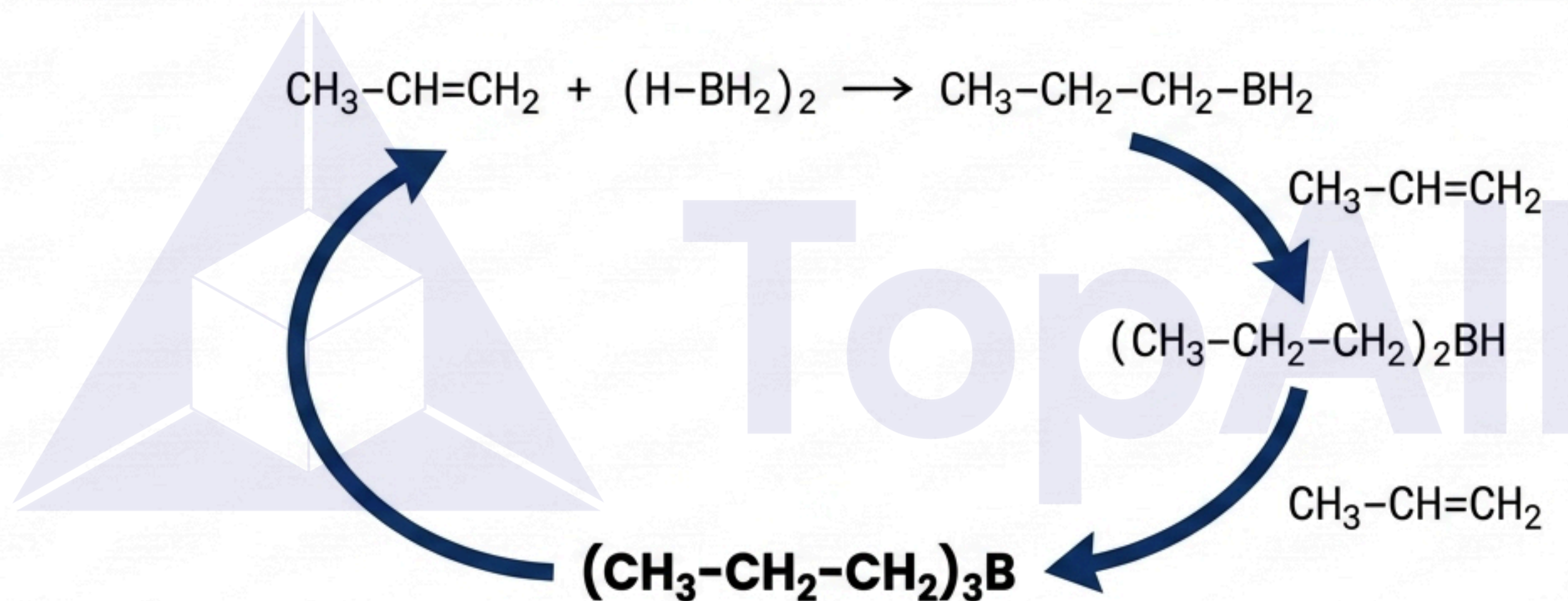
Diborane (BH_3)₂ acts as the electrophilic reagent.



The boron atom specifically targets the double bond.



Iterative Trialkyl Borane Formation



The reaction does not stop at a single addition. It iterates until all three B-H bonds are replaced by alkyl groups, forming a bulky trialkyl borane intermediate.



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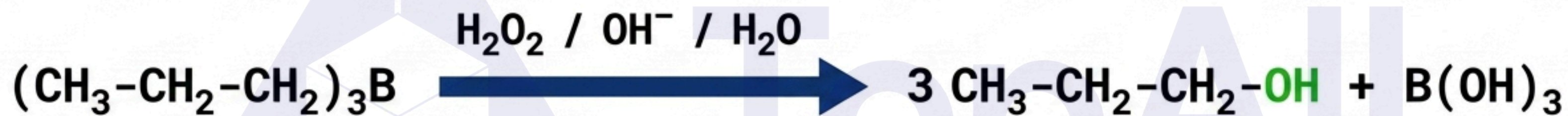
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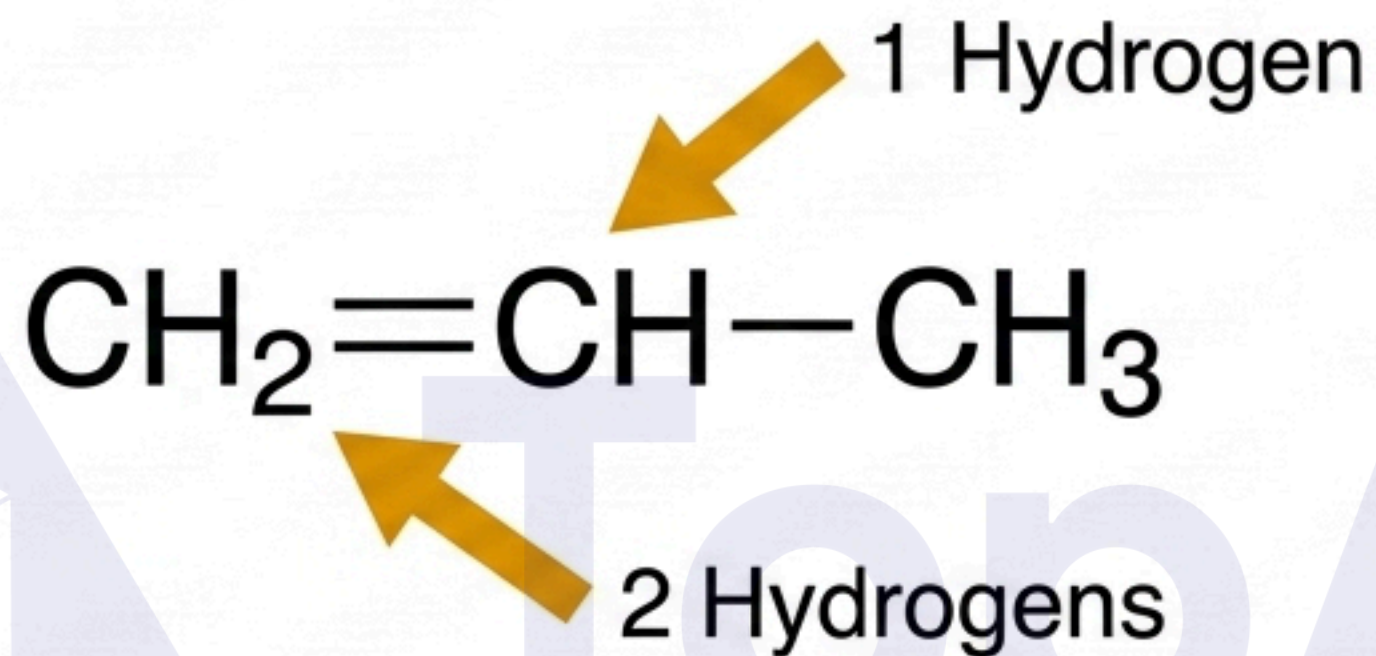
Oxidative Cleavage

Mechanism: Step 3



Aqueous sodium hydroxide and hydrogen peroxide oxidatively cleave the C–B bond, replacing the boron atom with a hydroxyl (–OH) group.

The Governing Orientation Rule



Boron attaches to the sp^2 carbon carrying the greater number of hydrogen atoms.

Consequently, the final $-\text{OH}$ group is added in a way that appears opposite to Markovnikov's rule.

Choosing the Right Synthesis Pathway

	Acid-Catalyzed Hydration	Hydroboration-Oxidation
Reagents	$\text{H}_2\text{O}, \text{H}^+$	1. $(\text{BH}_3)_2$ 2. $\text{H}_2\text{O}_2, \text{OH}^-$
Regioselectivity	Markovnikov	Anti-Markovnikov
Primary Outcome	Yields secondary or tertiary alcohols (carbocation rearrangement possible).	Excellent yield of primary alcohols (No rearrangement).

Exam Takeaway: Hydroboration-Oxidation

Reagents

Step 1: Diborane
 $(\text{BH}_3)_2$ or B_2H_6

Step 2: Hydrogen
peroxide in
aqueous alkali
 H_2O_2 / NaOH

Regioselectivity

**Anti-Markovnikov
addition.**

The hydroxyl group
attaches to the less
substituted carbon
of the double bond.

Final Yield

Produces primary
alcohols from
terminal alkenes in
excellent yield.

A Nobel Prize-winning synthetic pathway (H.C. Brown, 1979).



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