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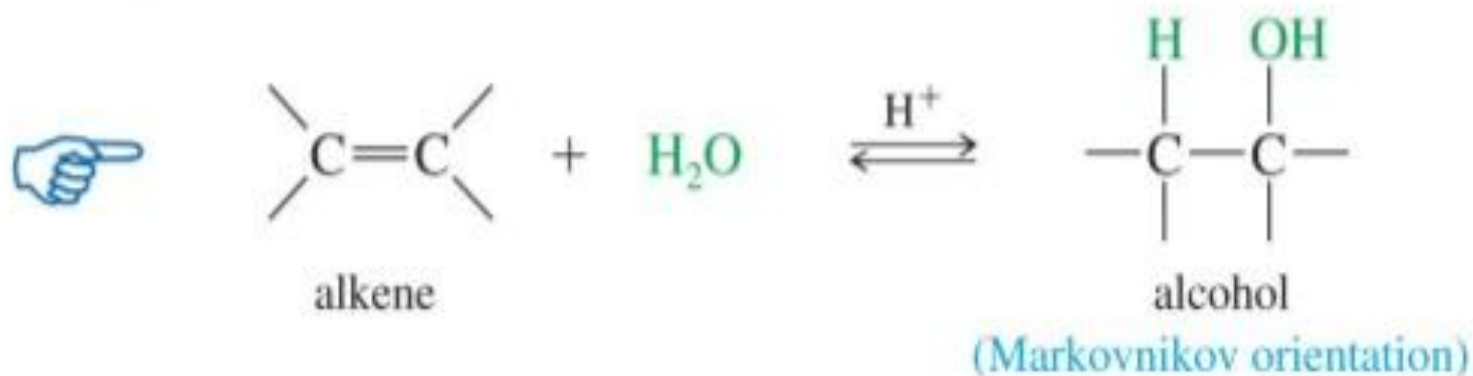
Preparation of alkyl alcohol from alkene, through:

- Acid catalyzed hydration
- Hydroboration Oxidation
- Oxymercuration Demercuration

Acid Catalyzed Hydration

Hydration of Alkenes

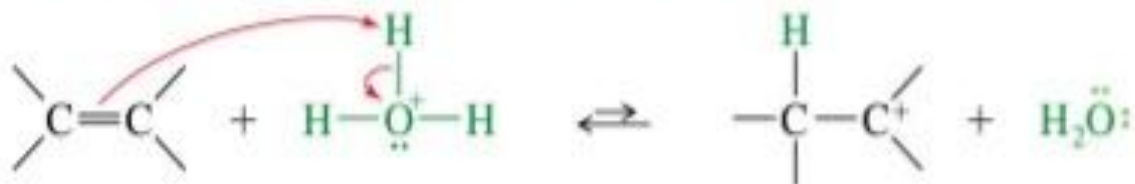
Hydration of an alkene



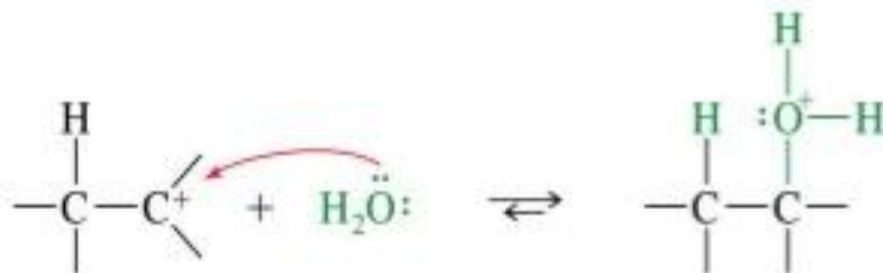
- The Markovnikov addition of water to the double bond forms an alcohol.
- This is the reverse of the dehydration of alcohol.
- Uses dilute solutions of H_2SO_4 or H_3PO_4 to drive equilibrium toward hydration.

Mechanism for Hydration

Step 1: Protonation of the double bond forms a carbocation.



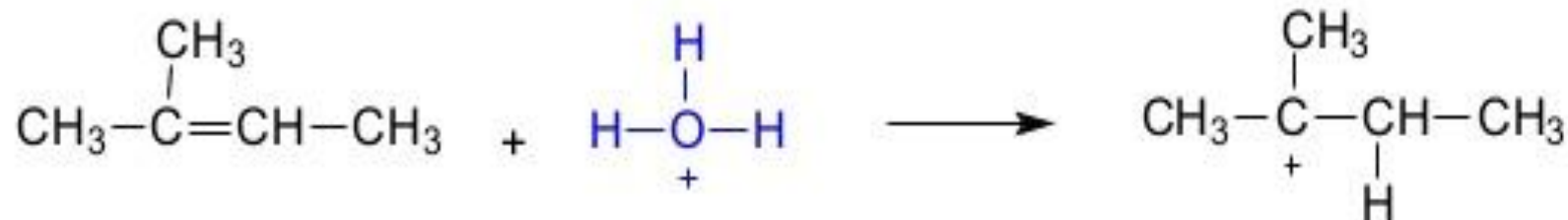
Step 2: Nucleophilic attack by water.



Step 3: Deprotonation to the alcohol.

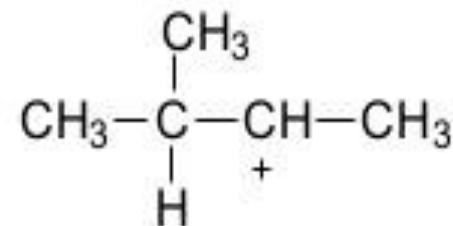


Orientation of Hydration



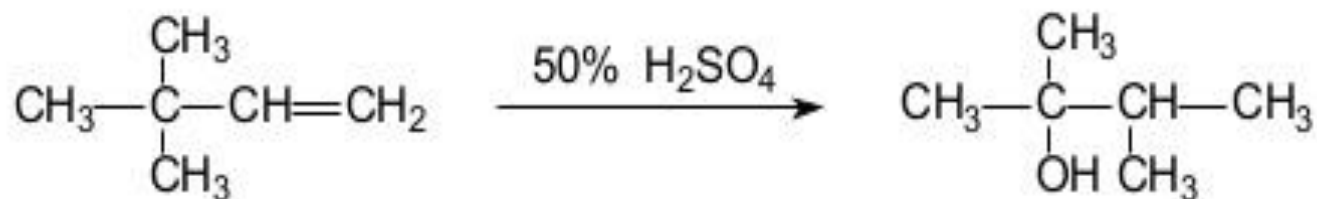
3^o, more stable

The protonation follows Markovnikov's rule: The hydrogen is added to the less substituted carbon in order to form the most stable carbocation.

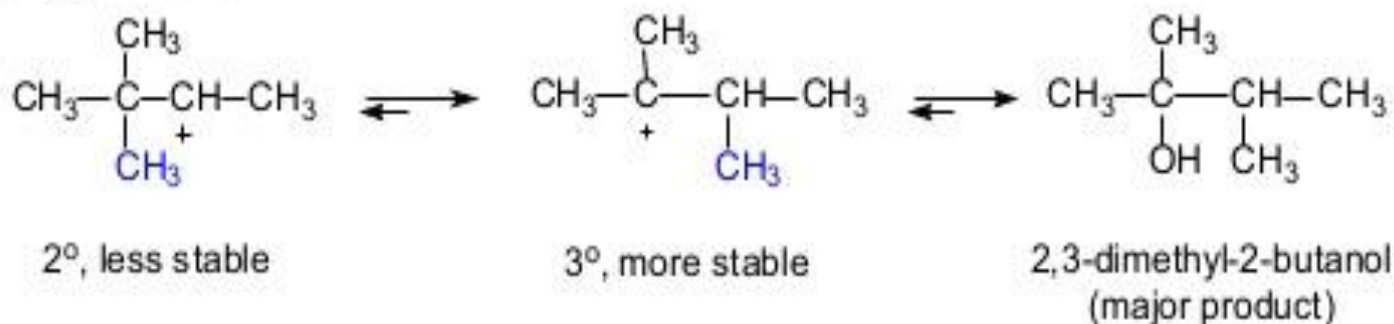


2^o less stable,
not formed

Rearrangements



Rearrangement:

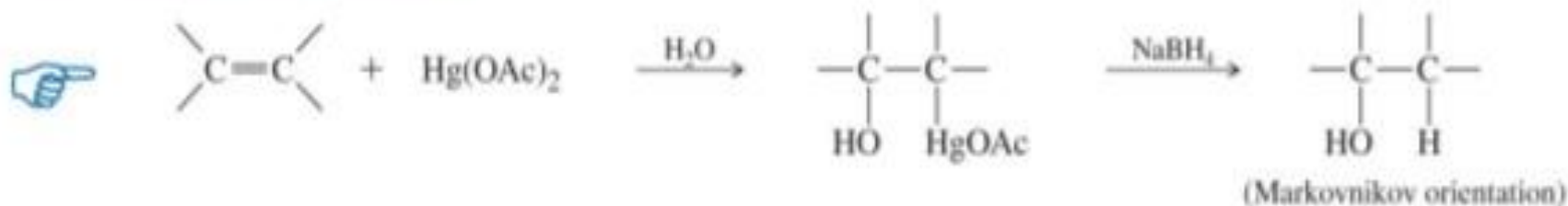


- Rearrangements can occur when there are carbocation intermediates.
- A methyl shift after protonation will produce the more stable tertiary carbocation.

Oxymercuration-Demercuration

Oxymercuration–Demercuration Reaction

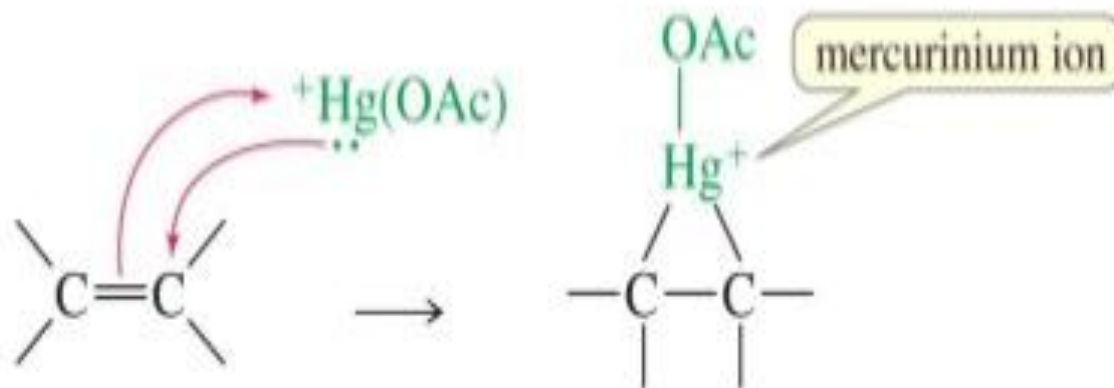
Oxymercuration–Demercuration



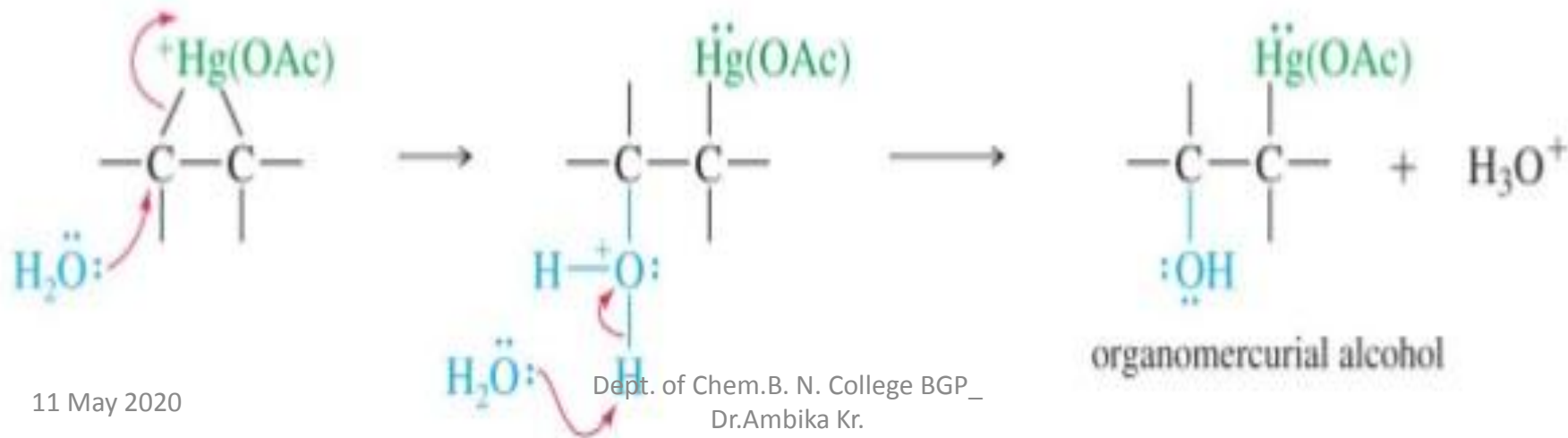
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- Markovnikov addition of water to the double bond.
- No rearrangements.
- This is a two-step process.

Mechanism of Oxymercuration

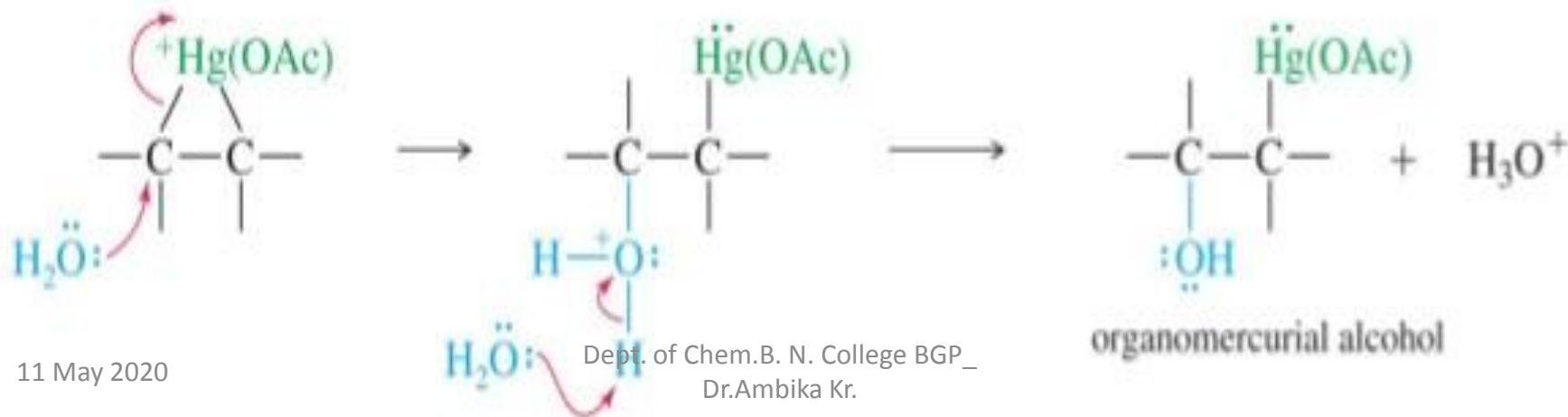


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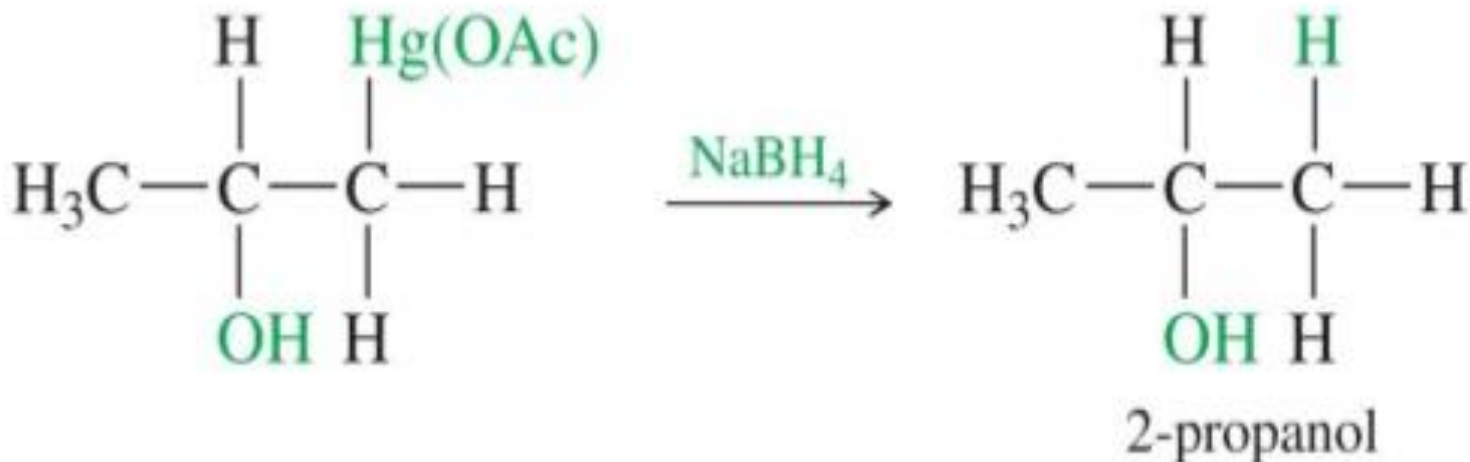


Mercurinium Ion Opening

- Water adds to the more substituted carbon to form the Markovnikov product.
- Water approaches the mercurinium ion from the side opposite the ring (anti addition).



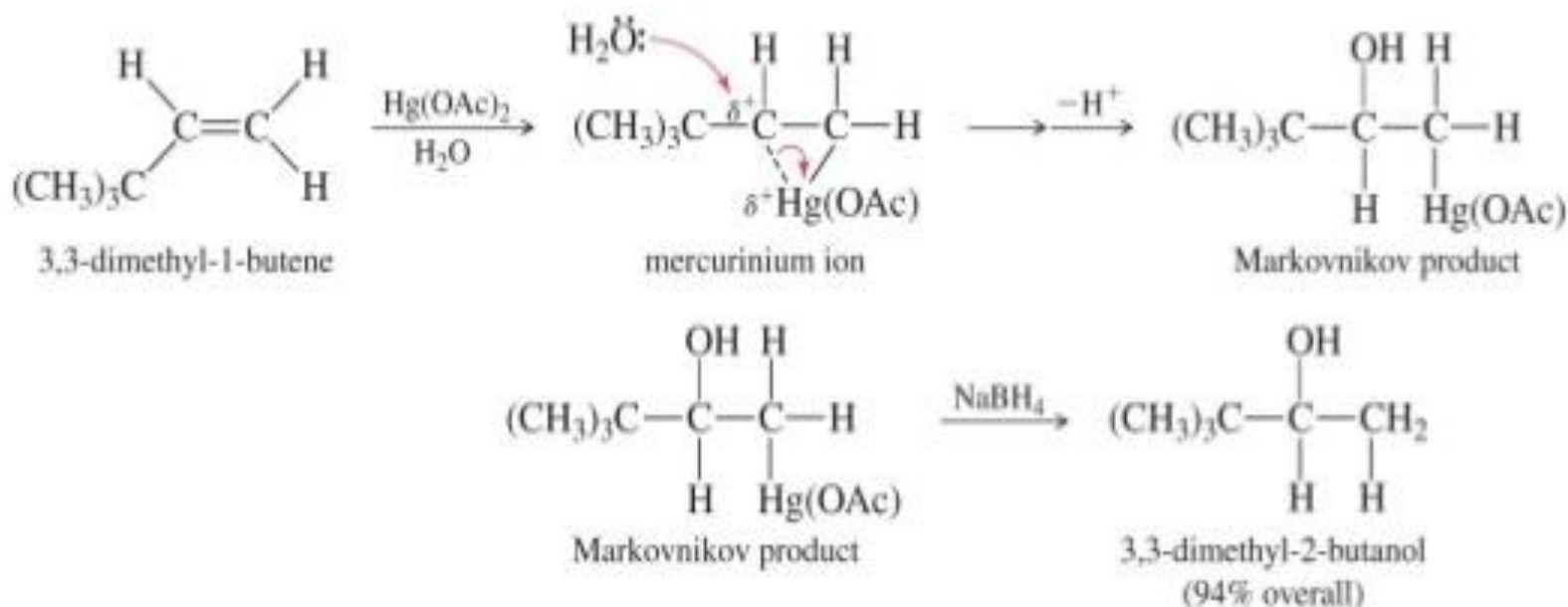
Demercuration Reaction



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- In the demercuration reaction, a hydride furnished by the sodium borohydride (NaBH_4) replaces the mercuric acetate.
- The oxymercuration-demercuration reaction gives the Markovnikov product with the hydroxy group on the most substituted carbon.

Oxymercuration–Demercuration of 3,3,-Dimethyl-1-butene

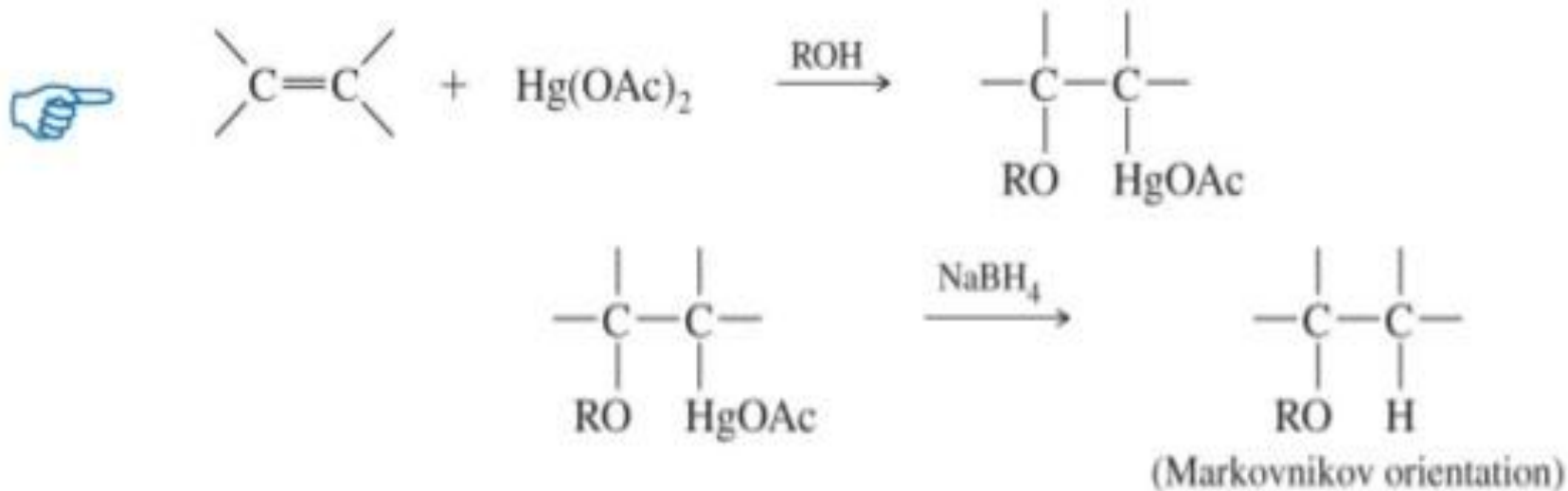


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The reaction does not suffer from rearrangements because there is no carbocation intermediate.

Alkoxymercuration–Demercuration

If the nucleophile is an alcohol, ROH, instead of water, HOH, an ether is produced.

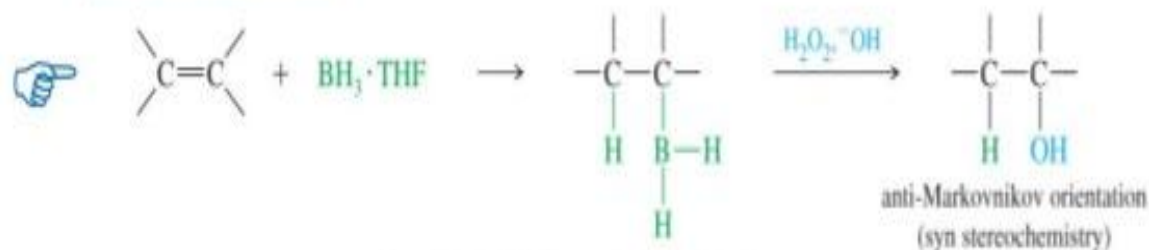


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Hydroboration Oxidation

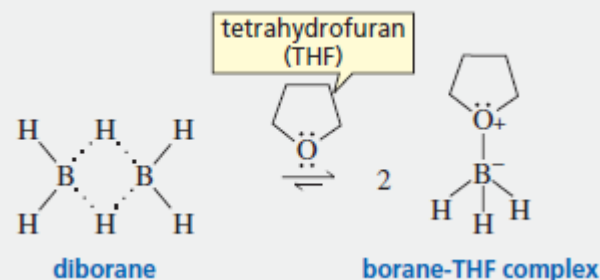
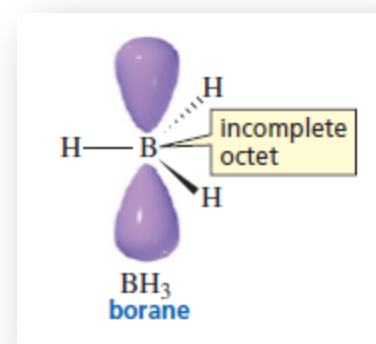
Hydroboration of Alkenes

Hydroboration-oxidation:

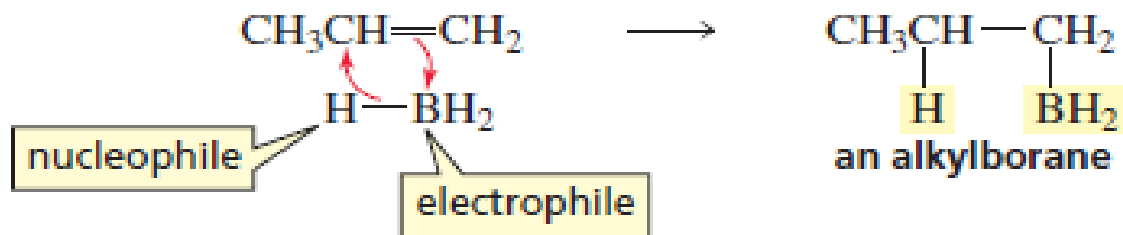


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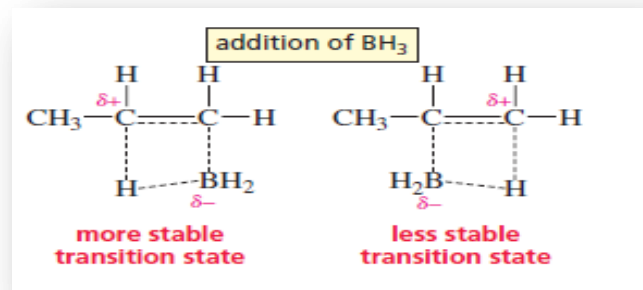
- The reaction adds water across the double bond with anti-Markovnikov orientation.
- BH_3 (borane) is a strong Lewis acid.
- Diborane (B_2H_6) is a dimer of borane and it is in equilibrium with a small amount of BH_3 .
- $\text{BH}_3 \cdot \text{THF}$ is the most commonly used form of borane.



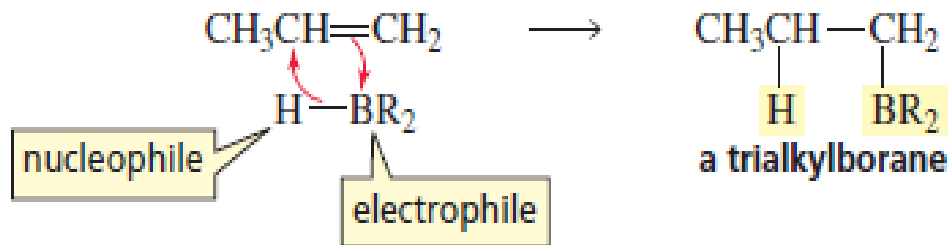
MECHANISM FOR HYDROBORATION WITH BH_3



- Borane adds to the double bond in a single step, with boron adding to the less substituted carbon and hydrogen adding to the more highly substituted carbon.
- This orientation places the partial positive charge in the transition state on the more highly substituted carbon atom.

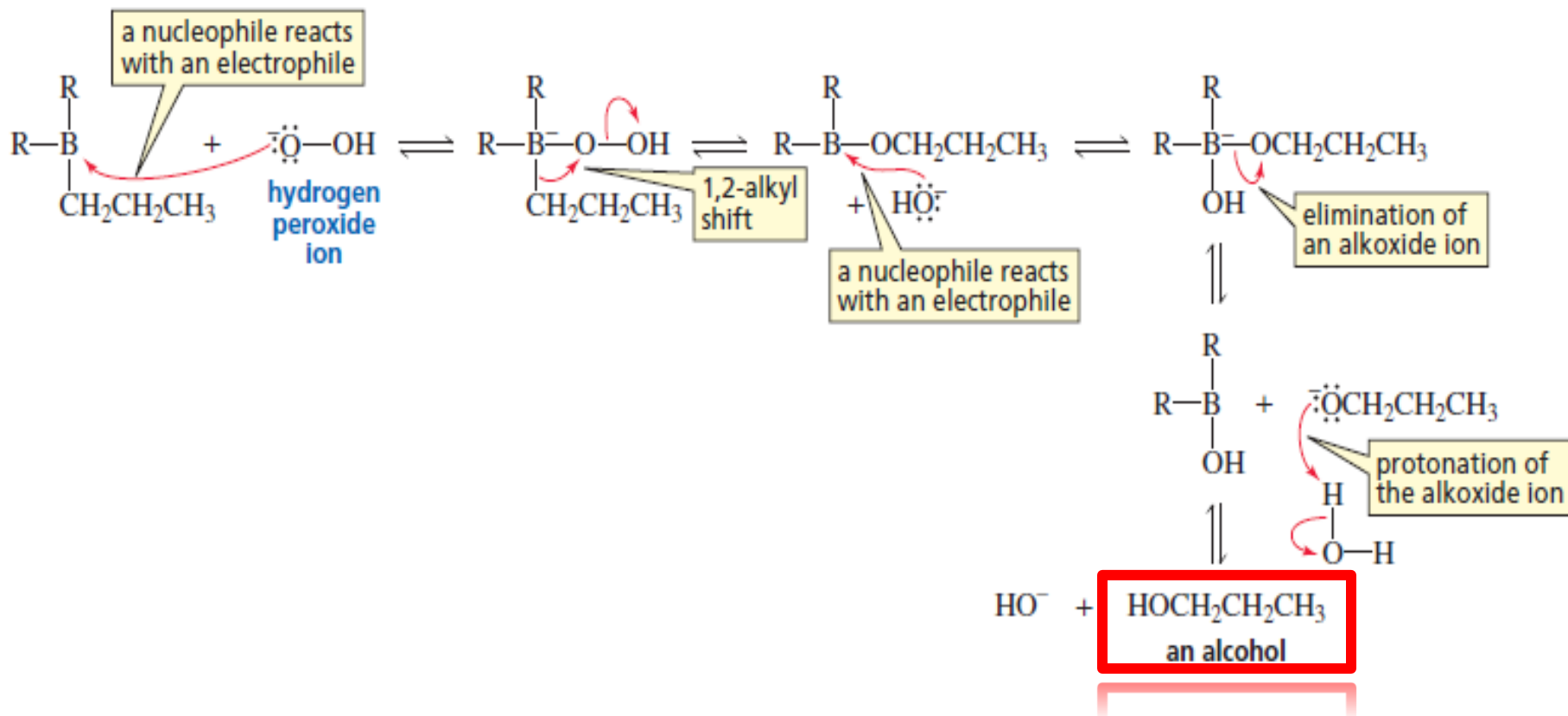


Further in last step (overall 3 steps):



Where $\text{R} = -\text{CH}_2\text{CH}_2\text{CH}_2$

MECHANISM FOR THE OXIDATION REACTION



The mechanism for the oxidation reaction shows the following:

- A hydrogen peroxide ion (a nucleophile) shares a pair of electrons with the boron of $R_2BCH_2CH_2CH_3$ (an electrophile).
- A 1,2-alkyl shift displaces a hydroxide ion, allowing boron to no longer be negatively charged.
- A hydroxide ion shares a pair of electrons with the boron of $R_2BOCH_2CH_2CH_3$.
- An alkoxide ion is eliminated, allowing boron to no longer be negatively charged.
- Protonating the alkoxide ion forms the alcohol.

H⁺/H₂O

?

1. BH₃

?

2. H₂O/OH⁻

1. Hg(OAc)₂/H₂O

?

2. NaBH₄

