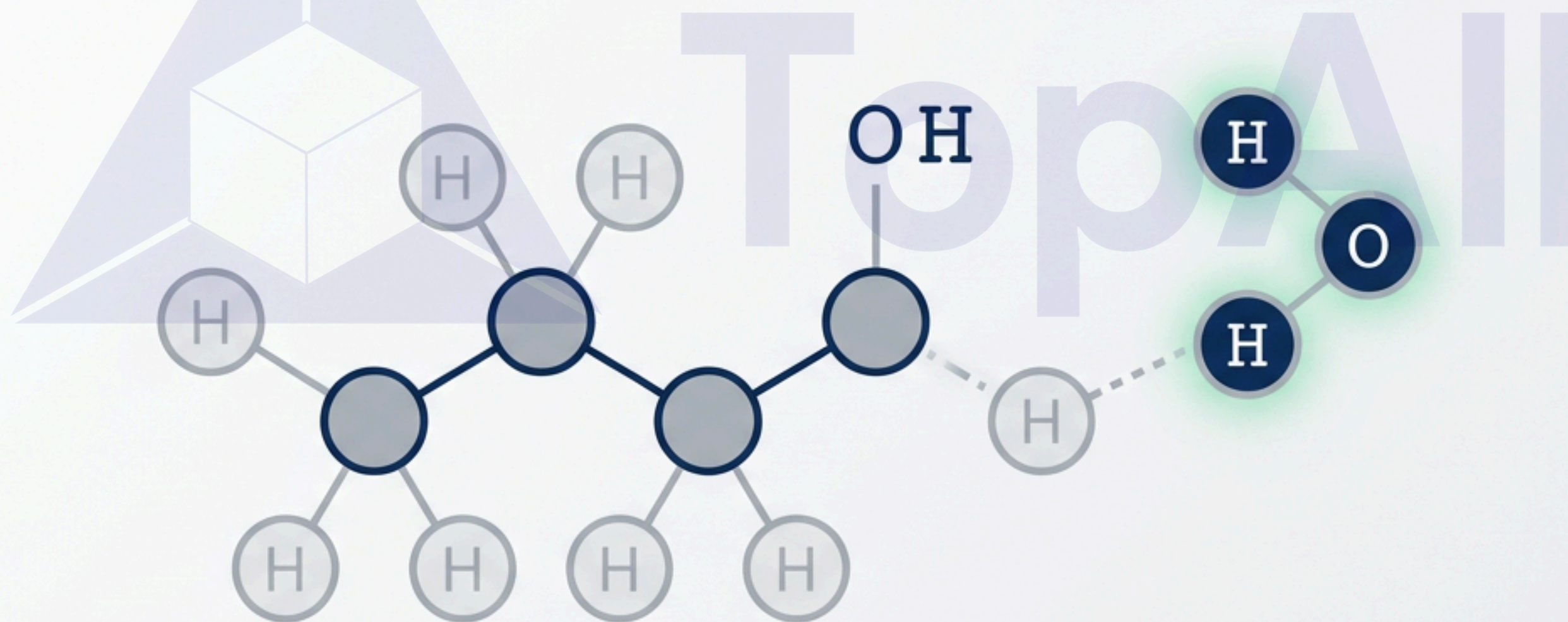


Alcohols Lose Water to Make Alkenes

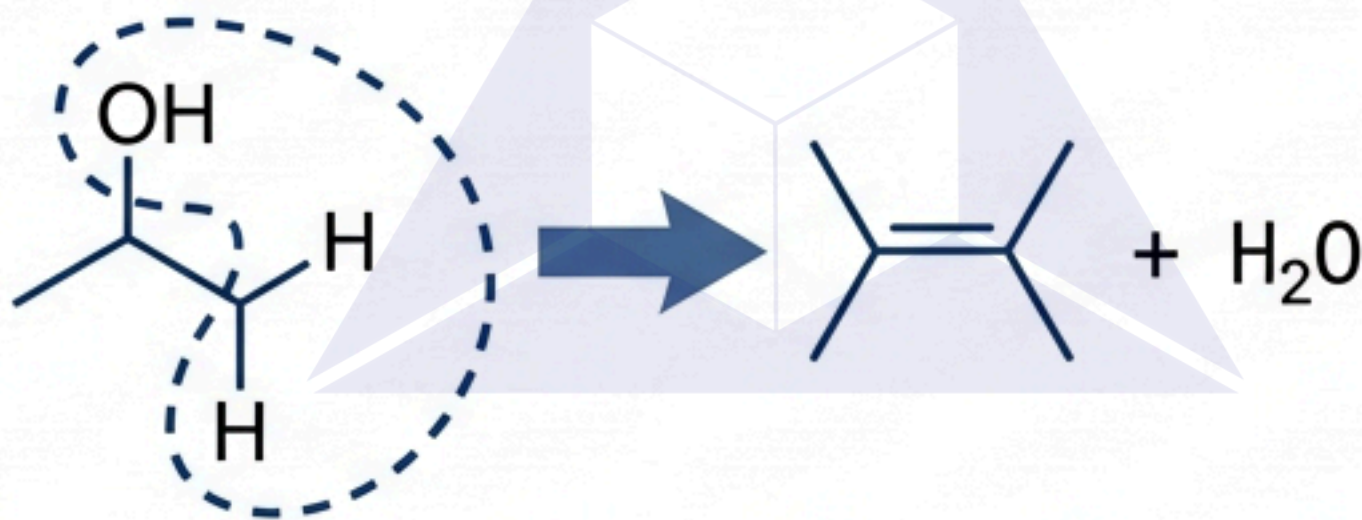
The Dehydration Mechanism: From Alcohols to Alkenes



What is Dehydration?

The Concept

The removal of a molecule of water from an alcohol to form an alkene.



The Reagents

Protic Acids:

Concentrated H_2SO_4 or H_3PO_4

Catalysts:

Anhydrous Zinc Chloride (ZnCl_2) or Alumina

Takeaway: Dehydration requires an acid catalyst to proceed.

The Standard Reaction: Ethanol to Ethene





You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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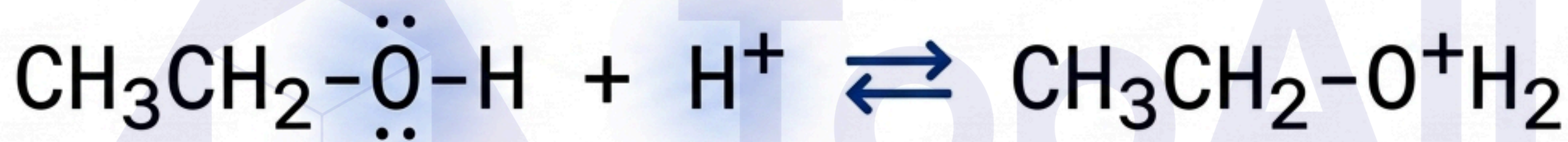
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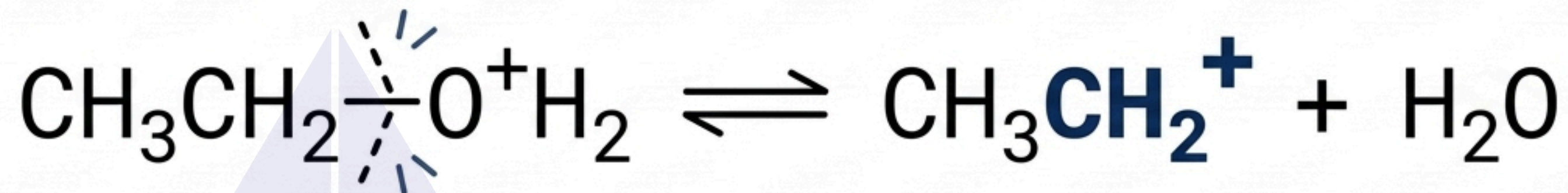
Step 1: Protonated Alcohol Formation

**Fast Step*



The oxygen atom of the hydroxyl group has lone pairs of electrons. It acts as a base and accepts a proton (H^+) from the acid catalyst.

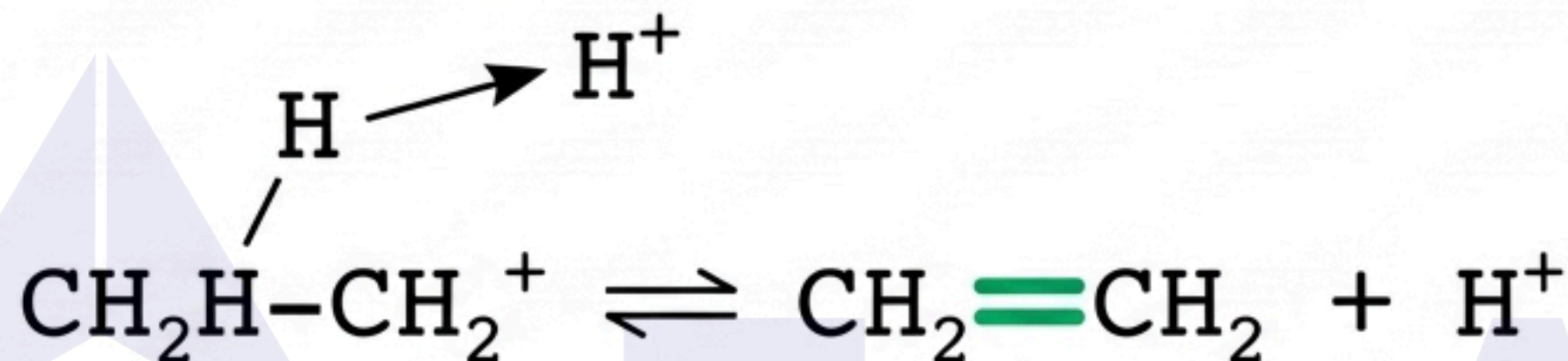
Step 2: Carbocation Formation



The protonated alcohol loses a molecule of **water** to form an ethyl carbocation.

⚠ Important: This is the slowest step, making it the **Rate-Determining Step** of the entire reaction.

Step 3: Proton Elimination



A proton is eliminated from the **adjacent carbon**, allowing the electrons to fold down and form the carbon-carbon double bond (ethene).

The acid catalyst (H^+) used in Step 1 is regenerated here. Ethene is removed as it forms to drive the equilibrium forward.

Reactivity Order: $3^\circ > 2^\circ > 1^\circ$

Tertiary alcohols are the easiest to dehydrate because they form the most stable tertiary carbocations during Step 2.

	1° (Primary)	2° (Secondary)	3° (Tertiary)
Carbocation Stability	Least Stable	More Stable	Most Stable
Required Conditions	Harsh (conc. H_2SO_4 , 443K)	Milder (85% H_3PO_4 , 440K)	Mildest (20% H_3PO_4 , 358K)

Increasing Ease of Dehydration





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