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Dehydrogenation (Dehydration) of Alcohols, Reaction, Mechanism Steps (For CBSE, ICSE, IAS, NET, NRA 2022)

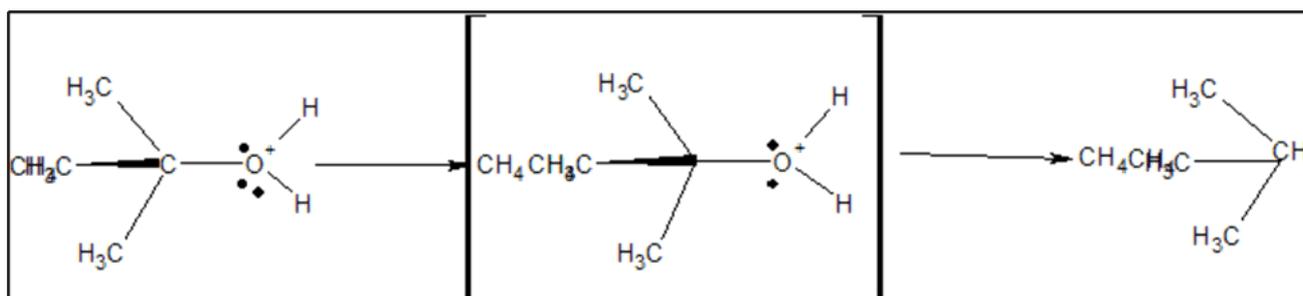
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Mechanism of Dehydration of Alcohols

- **Dehydration of alcohols** can follow E_1 or E_2 mechanism. For primary alcohols, the elimination reaction follows E_2 mechanism while for secondary and tertiary alcohol elimination reaction follows E_1 mechanism.
- Generally, it follows a **three-step mechanism**. The steps involved are explained below.

Formation of Protonated Alcohol

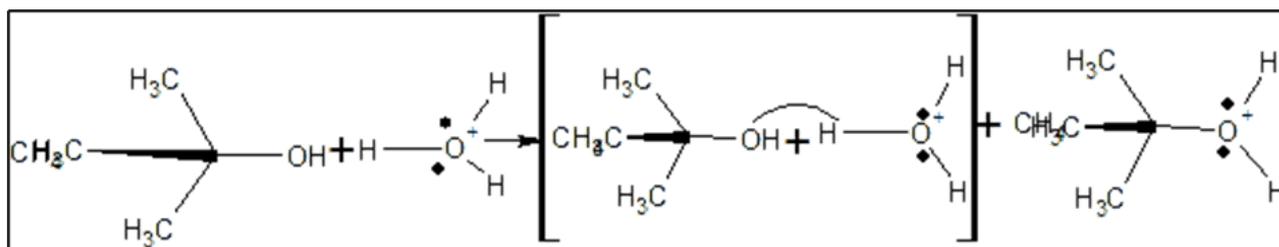
In this step, the alcohol is acted upon by a protic acid. Due to the lone pairs present on oxygen atom, it acts as a Lewis base. Protonation of alcoholic oxygen takes place which makes it a better leaving group. It is a reversible step which takes place very quickly.



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Formation of Protonated Alcohol**Carbocation Formation**

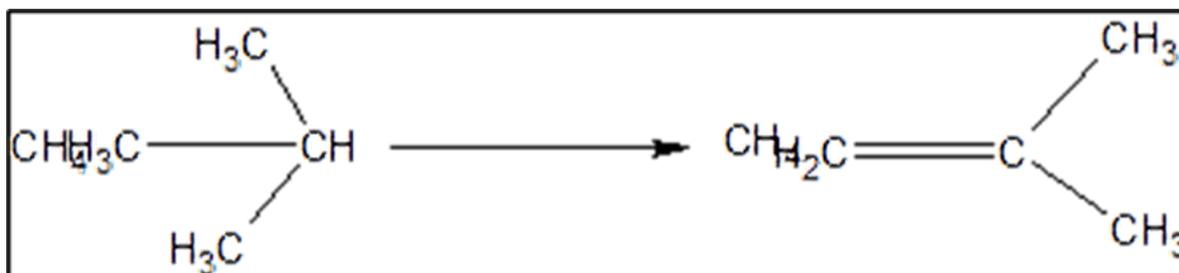
In this step, the $C - O$ bond breaks generating a carbocation. This step is the slowest step in the mechanism of dehydration of an alcohol. Hence, the formation of the carbocation is considered as the rate-determining step.



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Carbocation Formation**Alkene Formation**

This is the last step in the dehydration of alcohols. Here the proton generated is eliminated with the help of a base. The carbon atom adjacent to the carbocation breaks the existing $C - H$ bond to form $C = C$. Thus, an alkene is formed.



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Questions

What is Catalytic Dehydrogenation of Alcohols?

Answer:

- On catalytic dehydrogenation, primary alcohols give aldehydes, secondary alcohols give ketones and tertiary alcohols give alkene.
- Primary and secondary alcohols show a type of beta-elimination in which $-OH$ group from alpha and hydrogen from beta carbon.

What is Hydrogenation and Its Application?

Answer:

- Hydrogenation in the presence of a catalyst is the chemical reaction between the hydrogen and other compounds.
- For example; hydrogenation is used in Petrochemical Industry to turn alkenes into alkanes (paraffins) and cycloalkanes.
- The hydrogenation of vegetable ghee from vegetable oils is often used to produce.

What is the Process of Hydrogenation?

Answer:

- Hydrogenation is the mechanism where, in the presence of a catalyst, the hydrogen atoms bind to a compound's double bond, allowing its conversion to a single bond.
- Hydrogenation is commonly used during food products manufacturing where unsaturated fats and oil are converted into saturated fats and oils.

What is the Difference between Dehydration and Dehydrogenation?

Answer:

Dehydration is a reaction involving the removal or release of one or more molecules of water while dehydrogenation is a reaction involving the removal of one or more molecules of hydrogen.

What is Catalytic Dehydrogenation of Alcohol?

Answer:

- Primary alcohols give aldehydes on catalytic dehydrogenation, secondary alcohols give alkene to ketones, and tertiary alcohols.
- Primary and secondary alcohols show a form of beta-elimination in which $-OH$ alpha group and beta carbon hydrogen group.