ORGANIC CHEMISTRY - I

UNIT 3 NOTES

ALKYL HALIDES

- SN1 & SN2 REACTIONS
- QUALITATIVE TEST OF ALCOHOLS

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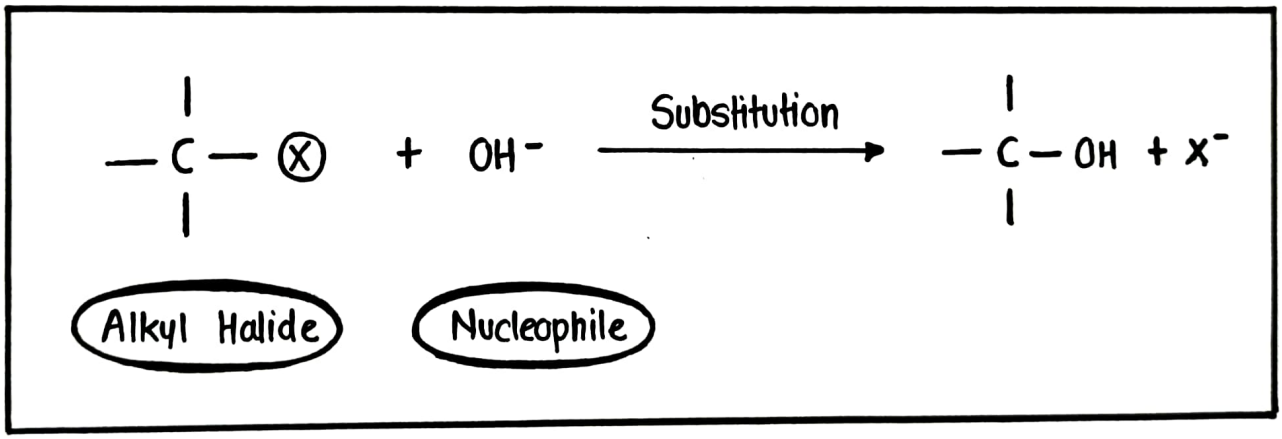
SN_1 & SN_2 Reactions

- SN_1 & SN_2 reactions are nothing but simply a type of Nucleophilic Substitution Reaction.
- A Nucleophilic substitution reaction is a type of organic reaction in which an atom or group of an atom is replaced from substrate by a nucleophile.
- The substitution can be occur either in one or two step.
- The two step mechanism is known as SN^1 Reactions while the one step mechanism is known as SN^2 Reactions.
- Nucleophilic substitution reactions mainly occurs in Alkyl Halides and Alcohols.



Types Of Nucleophilic Substitution Reaction

They are of mainly two types

① SN^1 Reaction

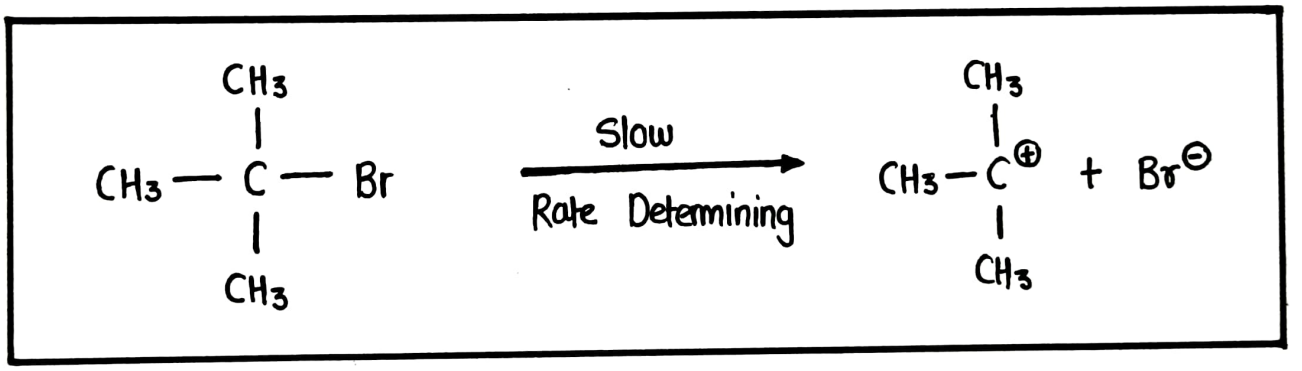
② SN^2 Reaction

S_N1 Reaction

- S_N1 stands for Unimolecular Nucleophilic Substitution Reaction.
- It is a two step process.
- The reaction follows First order kinetics.
- The reaction takes place in the presence of weak base. or weak nucleophile.
- Order of reactivity → $3^\circ > 2^\circ > 1^\circ$

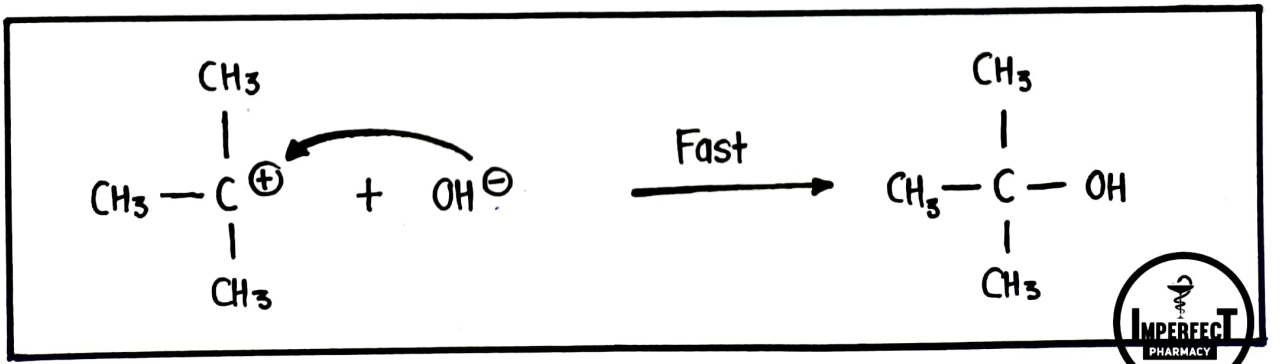
STEP - I

It is slow & rate determining step in which carbocation is formed.



STEP - II

Attack of Nucleophile on carbocation to give product.

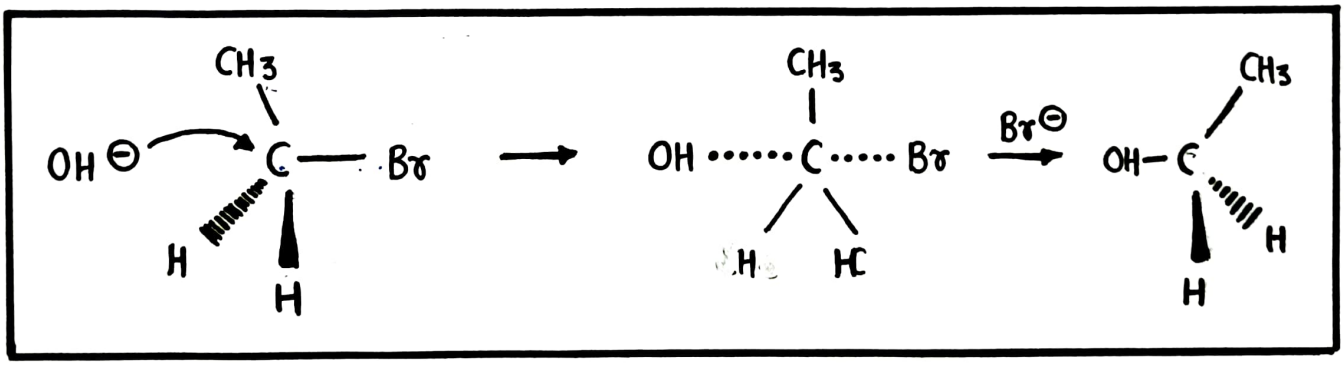


S_N2 Reaction

- S_N2 stands for Bimolecular Nucleophilic substitution Reaction.
- It is a one step process
- The reaction follows Second Order kinetics.
- Formation of Transition state takes place.
- Reactivity order $1^\circ > 2^\circ > 3^\circ$

Mechanism Of S_N2 Reaction

In S_N2 reaction the nucleophile attacks on carbon atom of Alkyl halide from backside which results in the formation of transition state & ultimately give product of opposite / inverted configuration to that of initial Alkyl halide.



S_N1 Reaction	S_N2 Reaction
• It is a unimolecular Reaction • It follows 1st order kinetics • It is a two step process • Reactivity order : $3^\circ > 2^\circ > 1^\circ$	• It is a bimolecular Reaction • It follows second order kine. • It is a one step process • Reactivity order : $1^\circ > 2^\circ > 3^\circ$

FACTORS AFFECTING S_N1 & S_N2

There are following various factors that affect S_N1 & S_N2 reactions :

Nature Of Alkyl Halide :
- Reactivity order of Alkyl Halides for S_N1 : $3^\circ > 2^\circ > 1^\circ$
- Reactivity order of Alkyl Halides for S_N2 : $1^\circ > 2^\circ > 3^\circ$

Nature of Leaving Group :
- More easily the leaving group removed from carbon atom faster will be substitution reaction.

$$R\text{-}I > R\text{-}Br > R\text{-}Cl > R\text{-}F$$

Nature of Solvent :
- Generally Polar Protic Solvents are used for S_N1 reactions.
- Polar Aprotic solvents are used for S_N2 reactions.

Qualitative Test For Alcohols

- Qualitative Test for alcohols are some chemical test that are used to identify the presence of alcohol in a particular solution.
- Some of them (Mainly Lucas & Victor Mayer) are also used to differentiate between Primary (1°), Secondary (2°) and Tertiary Alcohols (3°).
- These are 4 most common qualitative test for Alcohols.

① Sodium Metal Test
② Cerric Ammonium Nitrate Test
③ Lucas Test
④ Victor Mayer Method.

Sodium Metal Test

Alcohols with a small dry piece of sodium metal give effervescence due to liberation of hydrogen gas.

$$2\,ROH + 2\,Na \longrightarrow 2\,RO^-Na^+ + H_2\uparrow$$

Cerric Ammonium Nitrate Test

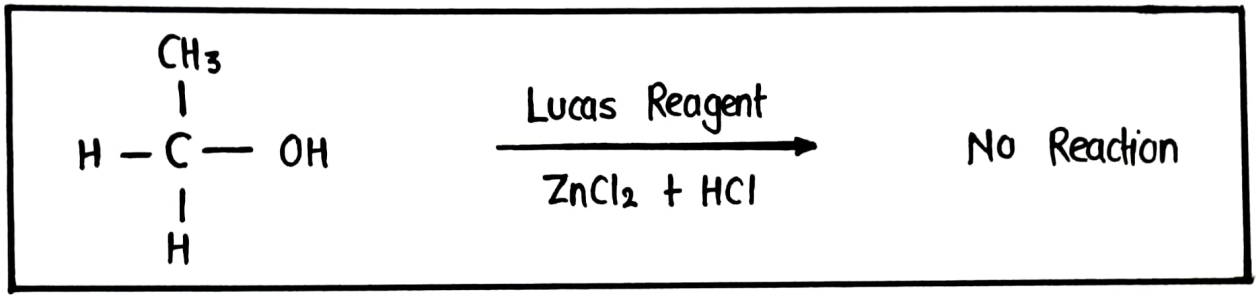
Alcohols with few drops of ceric ammonium nitrate reagent give red colour.

$$2\,ROH + (NH_4)_2\,Ce\,(NO_3)_6 \longrightarrow (ROH)_2\,Ce\,(NO_3)_4 + 2\,NH_4NO_3 + \text{Red Complex}$$

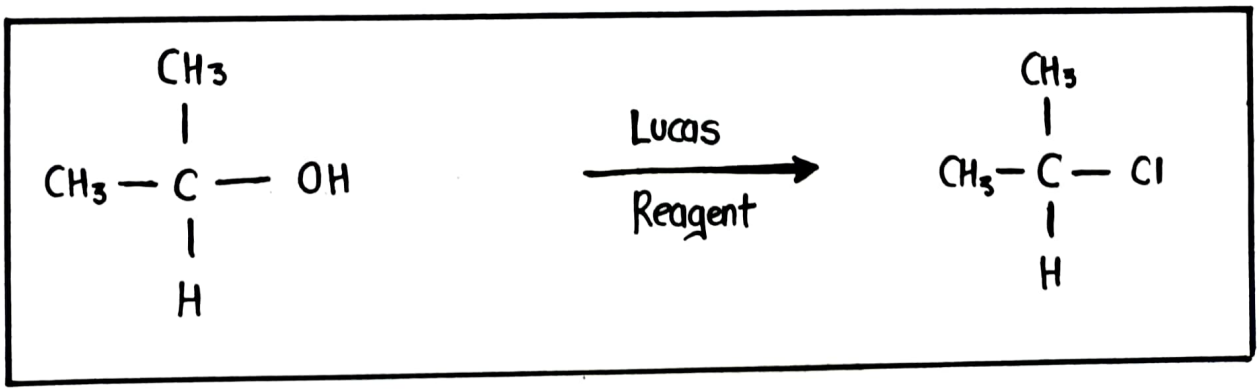
LUCAS TEST

- Lucas test is mainly used to differentiate between Primary Secondary and Tertiary alcohols.
- In this test alcohols are treated with a solution of HCl and Zinc Chloride to form Alkyl halides

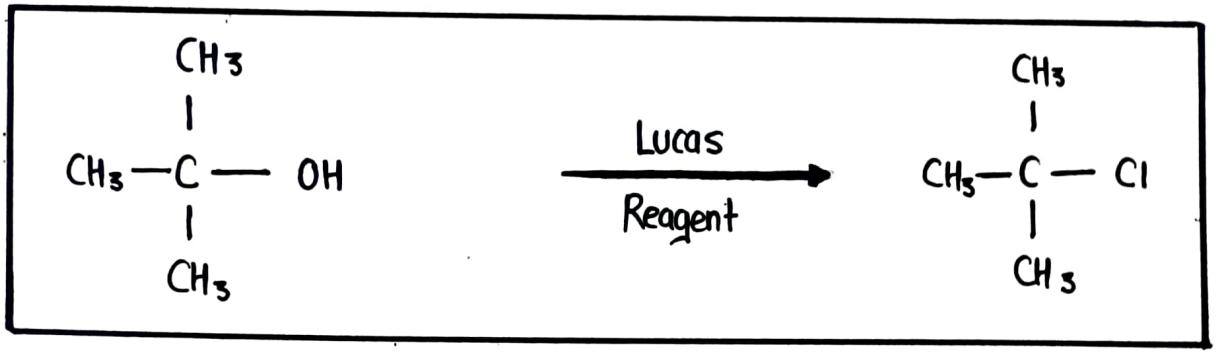
① **Primary Alcohols** : Primary Alcohols gives no reaction with Lucas reagent at room temperature



② **Secondary Alcohols** : Secondary Alcohols reacts with Lucas Reagent and gives reaction approxiamately in 5 minutes & a cloudiness appears.



③ **Tertiary Alcohol** : Tertiary Alcohols reacts with Lucas reagent & gives instant reaction & an immediate cloudiness appears.



VICTOR MAYER METHOD

- Victor Mayer's test is one of the most commonly used method to differentiate between 1°, 2° & 3° Alcohol.
- The following series of reactions carried out in Victor Mayers Test.

(i) The alcohol is first treated with iodine in the presence of red phosphorus to obtain Alkyl Iodide.
(ii) The Alkyl iodide is then treated with silver nitrate to form nitroalkane.
(iii) The nitroalkane is finally treated with nitrous acid & the resulting solution is made alkaline by adding caustic soda.

Primary Alcohol : Gives Red colour

Secondary Alcohol : Gives Blue colour

Tertiary Alcohol : No Colour

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