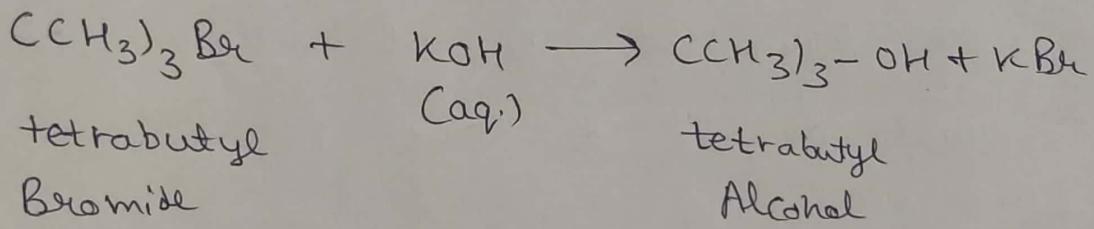


# Alkyl Halides

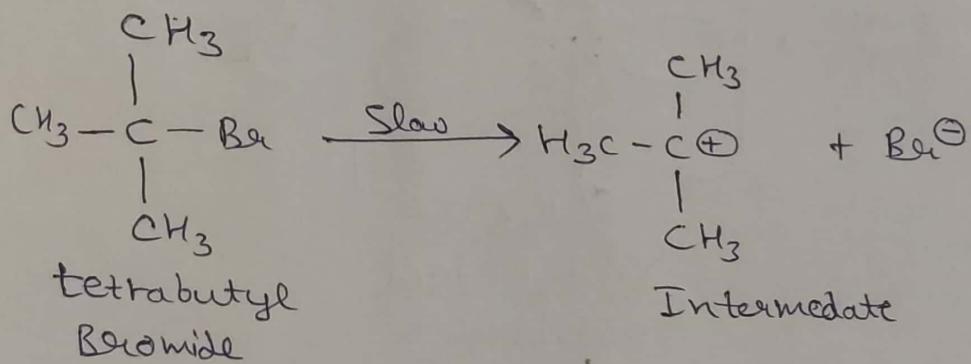
$S_N^1$  Reaction :- It is also known as Unimolecular nucleophilic substitution reaction in which rate of reaction depend upon the conc. of only one reactant that is known as  $S_N^1$  reaction.

e.g:-

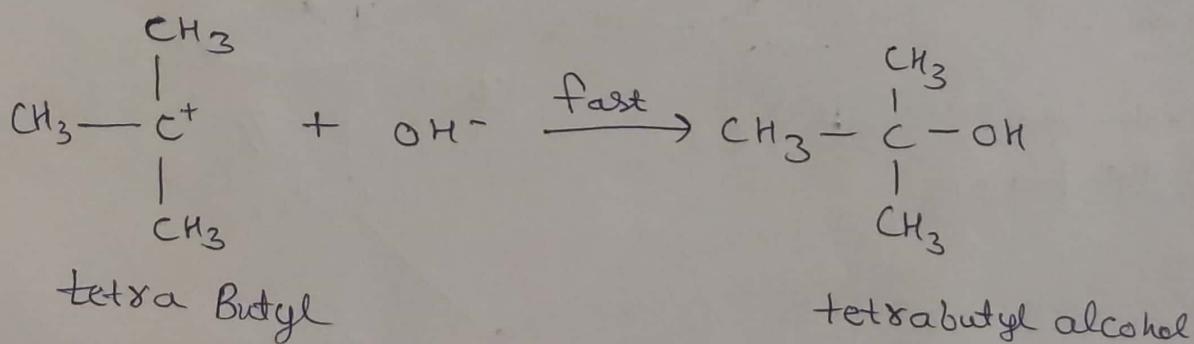


Mechanism :-

Step-I :-



Step-II :-

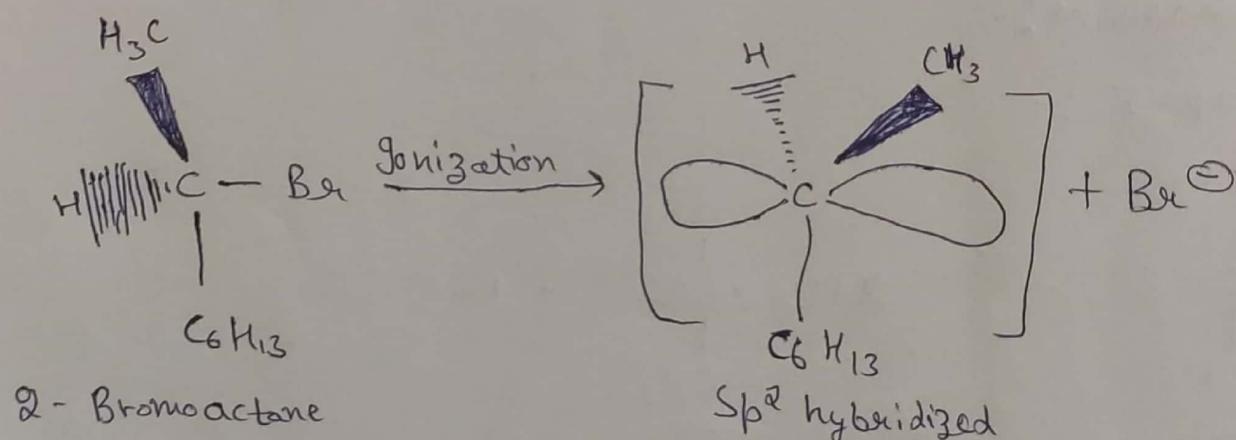


## (2)

### Stereochemistry of $\text{S}^{\text{N}}\text{I}$ reaction :-

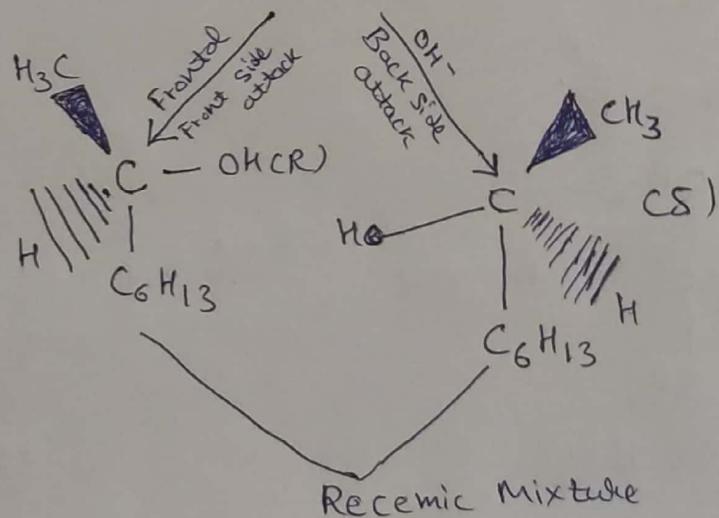
Since in  $\text{S}^{\text{N}}\text{I}$  reaction a planar carbocation intermediate is involve it can be attack by the nucleophilic by the either side thus when un optically active Substrate the attack of nucleophilic attack on one phase of carbocation yield one Enantiomer Of the attack on the other phase would give another isomer, Since two phases are equivalent two Enantiomer are formed in equal amount to give racemic mixture.

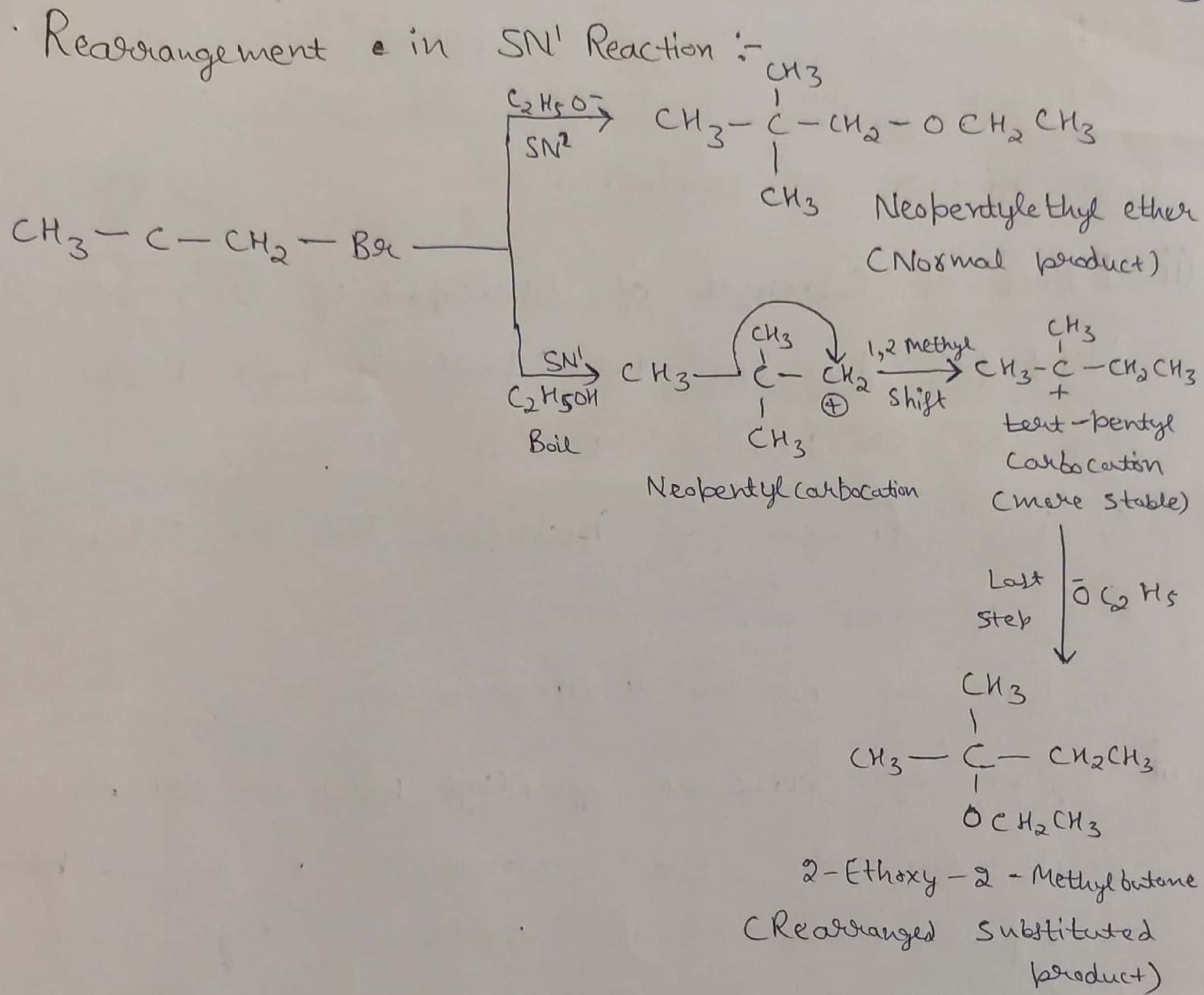
Example :-



→ This sign shows above the plane.

→ This sign shows below the plane.





Factors affecting  $SN^1$  reaction :-

i) Effect of Solvent on  $SN^1$  reaction :-

Polar Solvents favours  $SN^1$  reaction :- More the polarity of the solvent, stronger the solution forces, faster the ionization. Thus more is possibility of  $SN^1$  reaction.

e.g:- Water is the better polar Solvent for  $\text{S}_{\text{N}}^{\text{I}}$  reaction than a mixture of water and ethanol  
then mixture of water.

(ii) Effect of Strength of Nucleophil of  $\text{S}_{\text{N}}^{\text{I}}$  reaction :-

Nucleophil does not take part in rate determining Step of  $\text{S}_{\text{N}}^{\text{I}}$  reaction that is 1st Step.

∴, the strength of Nucleophil has no effect on rate of reaction.

Rate of reaction of Alkyl halide.

(iii) Effect of Structure of Alkyl halide on  $\text{S}_{\text{N}}^{\text{I}}$  reaction:-

Carbocation are the intermediate in the  $\text{S}_{\text{N}}^{\text{I}}$  rxn.  
Therefore, More Stable carbocation form. more rapid will be the  $\text{S}_{\text{N}}^{\text{I}}$  reaction.

Rate :-  $3^\circ > 2^\circ > 1^\circ$  Methyl halide

(iv) Effect of Nature on living group of  $\text{S}_{\text{N}}^{\text{I}}$  reaction:-

In  $\text{S}_{\text{N}}^{\text{I}}$  reaction better the living group leading to the formation of carbocation group and hence more should be the reactivity of alkyl halide in  $\text{S}_{\text{N}}^{\text{I}}$  reaction. Order of Elimination of different living group follow the sequence

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

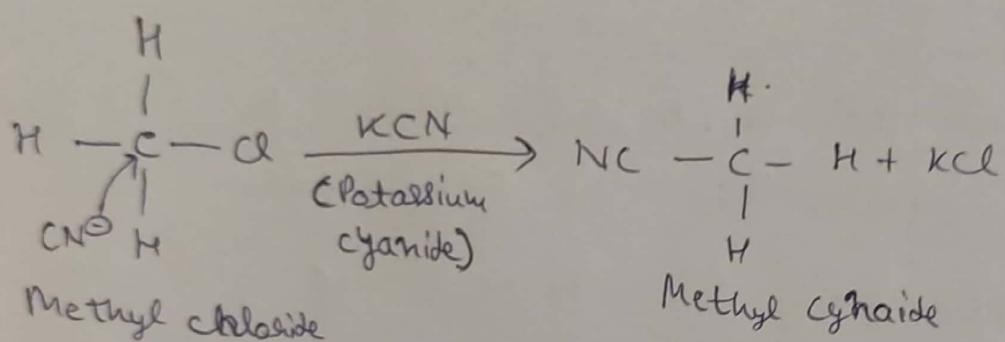
# $SN^2$ Reaction :-

It is bimolecular nucleophilic substitution reaction.

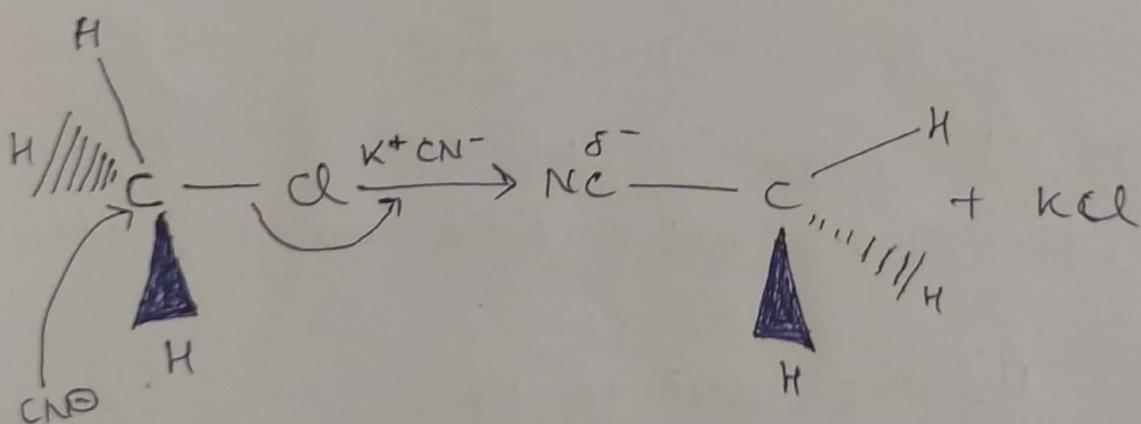
There is no formation of carbocation. It follows 1° carbocation and it is single step reaction.

It follows 2nd order kinetics. Rate of reaction  $\propto [Alkyl\ halide] [Nucleophile]$

Partially attached nucleophile and halide

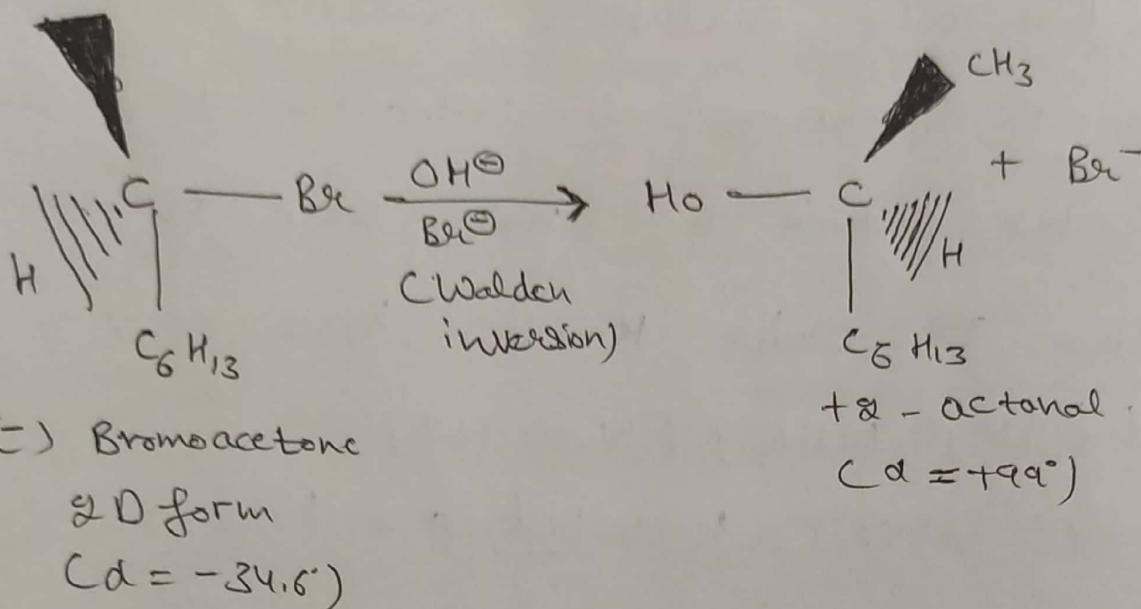


## Mechanism :-



In  $SN^2$  rxn living group departs with pair of  $e^-$ . Simultaneously nucleophilic attack back side to the carbon atom and process inversion.

## Stereochemistry of $\text{S}_{\text{N}}^2$ reaction :-



In  $\text{S}_{\text{N}}^2$  reaction the nucleophilic attack for the back side of living group, Thus the configuration of molecule obtained after the reaction is inverted this inversion of configuration is known as Walden inversion.

The inversion of configuration  $\text{S}_{\text{N}}^2$  reaction can be demonstrated by performing the rxn with pure Enantiomer of chiral Alkyl halide (optically active).

### Factors Affecting $\text{S}_{\text{N}}^2$ reaction :-

(i) Nature and size of Alkyl group in Alkyl halide:-

The rate of  $\text{S}_{\text{N}}^2$  reaction decrease as the size of Alkyl group increase. As a size of Alkyl halide increase the transition state become increase with along

(7)

Such spatial crowding is known as steric hindrance. The energy of a crowded transition state is higher than that of a less crowded transition state.

Thus the rate of reaction decrease as we move in the series of  $1^{\circ} > 2^{\circ} > 3^{\circ}$ .

(ii) Nucleophilicity or Strength of the Nucleophile:-

Since the transition state in  $S_N^2$  reaction is form due to the attack of the nucleophilic reagent on Alkyl halide, stronger the nucleophilic reagent more rapid would be  $S_N^2$  reaction.

(iii) Nature of halogen atom in Alkyl halide:-

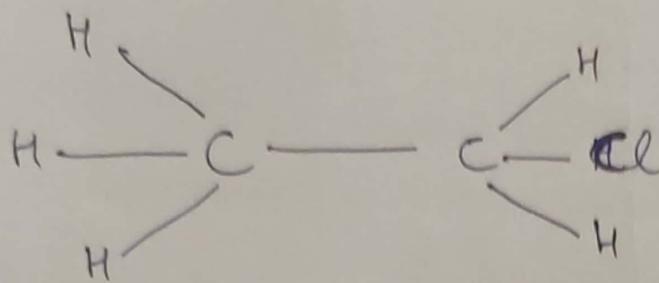
$S_N^2$  reaction of Alkyl halides, the halogen atom ultimately leaves the transition state in the form of a halide ion with a negative charge. The more easily the halide ion  $X^-$  leaves, the more is the rate of reaction.

(iv) Nature of Solvent :- Less polar Solvent favours the  $S_N^2$  reaction.

Order of reactivity  $\rightarrow RI > RBr > RCl > RF$ .

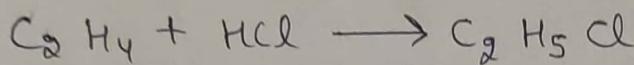
$S_N^1$ reaction	$S_N^2$ reaction
1) Unimolecular.	1) Bimolecular.
2) Two Step reaction.	2) Single Step reaction.
3) follow 1 <sup>st</sup> order Kinetics.	3) follow 2 <sup>nd</sup> order Kinetics.
4) Involvement of Carbocation.	4) There is no involvement of carbocation.
5) Highly polar Solvent.	5) less polar Solvent.
6) Order of reactivity $3^\circ > 2^\circ > 1^\circ$	6) Order of reactivity $1^\circ > 2^\circ > 3^\circ$
7) It is favoured by low concentration of Nucleophil.	7) It is favoured by high concentration of Nucleophil.
8) 3° Alkyl halide are common Substrates.	8) 1° Alkyl halide are common Substrates.
9) Nucleophile can attack the carrying halogen both from back side and front side but back side attack Predominate.	9) Nucleophile can attack on back side.

## Ethyl chloride :- $C_2H_5Cl$



It is also known as chloroethane or monochloroethane.

It is colourless, flammable gas or refrigerated liquid with a faintly sweet odor. It is prepared by hydrochlorination of ethene.



### Properties :-

It has low boiling point and less dense than water and insoluble in water. Its vapors are heavier than air.

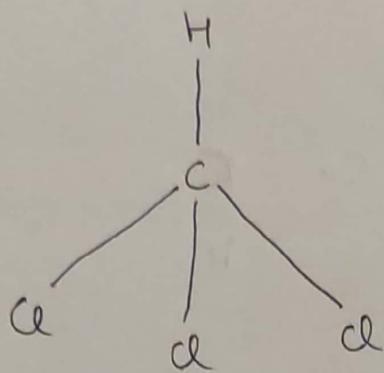
Uses :- i) It is used as refrigerant, an anesthetic and aerosol spray repellent.

ii) In industry it is used to synthesize ethylcellulose which is a thickening agent and used as a binder in paints, cosmetic etc.

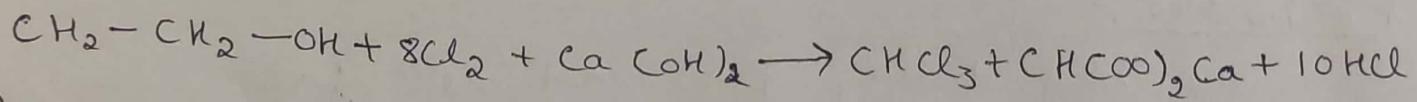
iii) Chloroethane is used to diagnose a dead tooth due to its chilling effect.

iv) It also helps to relieve deep muscle pain

## Chloroform ( $\text{CHCl}_3$ ):-

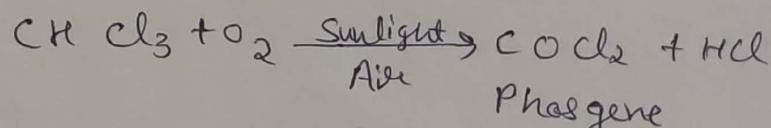


It is also known as trichloromethane. This compound obtained from replacement of three halogens of alkanes by three halogens. So also called trihalogen alkanes. It is prepared by the action of alkali and chlorine on ethyl alcohol or acetone.



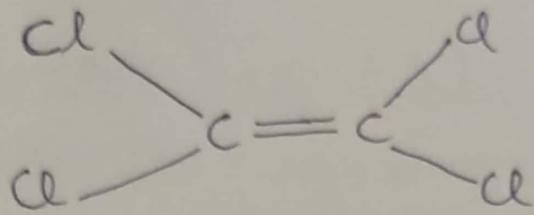
Properties :- It is a colourless liquid with characteristic sweet smell and taste. It is almost insoluble in  $\text{H}_2\text{O}$  but soluble in alcohol, ether etc. Chloroform itself is a very good solvent for oils, fats and halogen etc.

It is non-inflammable but its vapour may be burnt to give green flame. Vapours of chloroform when inhaled in small amount produces unconsciousness.



- Uses :-
- (i) It is used as a solvent for fats, oils, rubber, alkaloids, waxes, resin and iodine.
  - (ii) It is used as cleansing agent in fire extinguishers and in rubber industry.
  - (iii) It is useful in laboratory reagent for testing primary amines.
  - (iv) It is used to prevent ~~purification~~ purification of organic matter.

## Trichloroethylene ( $C_2HCl_3$ ):-



It is synthetic, light sensitive, volatile colourless liquid that is miscible with many non-polar organic solvents. It is a clear non-flammable liquid with a sweet smell.

It will decompose upon heating and emit toxic chloride.

It is synthesized by the chlorination of ethylene.

Uses:- (1) It is used as a solvent for variety of organic materials.

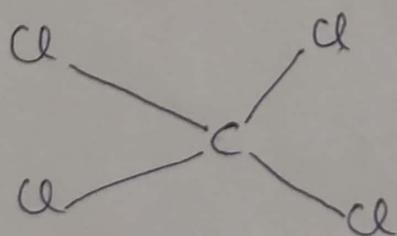
(2) It is used to extract vegetable oils from plant.

(3) It is used for decaffeination (removal of caffeine) from coffee.

(4) It is also used for the preparation of flavouring extracts from spices.

(5) It is also used as a solvent for waterless dying.

## Tetrachloromethane :- ( $CCl_4$ )



It is also known as carbon tetrachloride. It is an organic compound with general formula  $\text{CCl}_4$ .

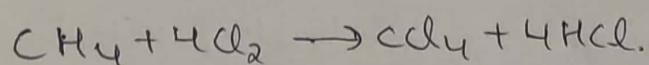
It is colourless liquid having characteristic smell.

It's Boiling point is  $77^\circ\text{C}$

It is non-flammable and poisonous.

It is very slightly soluble in  $\text{H}_2\text{O}$  and miscible with organic solvents. It is good solvent for fats and oils.

It is synthesized by chlorination of Methane.



Uses :- ① It is used in fire extinguisher under the name Pyrene.

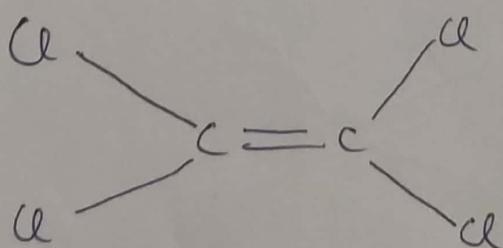
② It is used as a solvent for many organic compounds.

③ It is used as a fumigant.

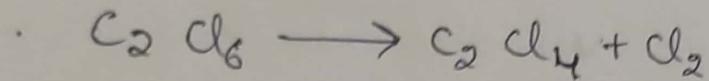
④ It is used to produce chlorofluoro carbon refrigerants R-11 and R-12.

It is also used in detection of neutrinos.

Tetrachloroethylene :-  $(\text{C}_2\text{Cl}_4)$

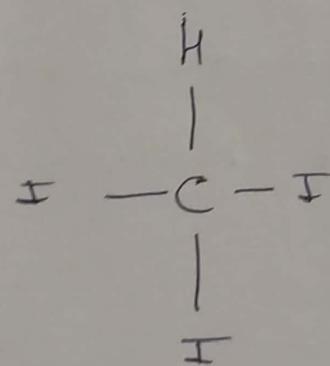


It is also known as tetrachloroethene or per chloroethylene. It is a chloro carbon having general formula  $C_2Cl_4$ . It is colourless, volatile, non-flammable liquid with an ether like odour that may emit toxic fumes or phosgene. It is synthesized by thermal decomposition of hexa chloro ethane.



- Uses :-
- ① It is used as a dry cleaning solvent.
  - ② It is used for the production of chlorofluoro-carbon and hydrofluoro carbons.
  - ③ It is used for testing in coal industry.
  - ④ It is used to clean prints and negatives of cinema film.
  - ⑤ It is used as Antihelminthic agent.

Iodoform  $CHI_3$  :-



Triiodomethane

Iodoform is the organo-iodine compound with ⑯  
the formul.  $\text{CHI}_3$ . It is yellow crystalline solid  
belonging to the family of organic halogen compound.

Iodoform is manufactured by electrolysis of  
aqueous solution containing acetone, iodides and sodium  
carbonate. It is volatile in nature and has a  
penetrating and distinctive odour with a sweetish  
smell. It is also known as carbon triiodide and  
methyl triiodide.

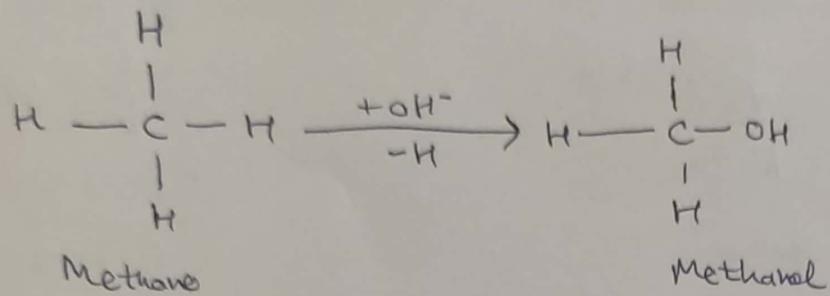
Uses:- ① It is used as disinfectant and antiseptic.

② It is also used for sterilizing the instruments  
which was used for surgery.

③ It is active ingredient in many ear powders  
for dogs and cats along with zinc oxide and  
Propanoic acid which are used to prevent  
infection and facilitate removal of ear hair.

# ALCOHOLS

Alcohols are Hydroxy derivatives of Alkanes.

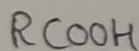
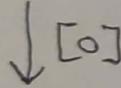
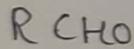
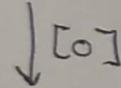
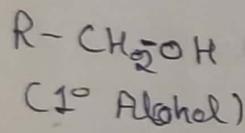


Distinction b/w primary, Secondary and 3° Alcohol :-

Chemical test of Alcohol :-

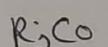
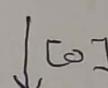
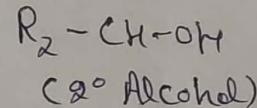
Test - 1st :-

(i) Oxidative test :-

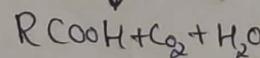
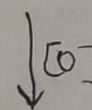


Acid containing

Same number  
of C atom as  
original Alcohol.

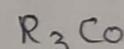
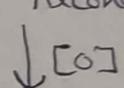
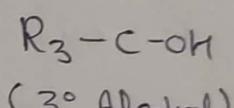


Ketone

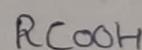
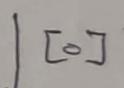


Acid containing lesser  
number of C atom  
as original

Alcohol

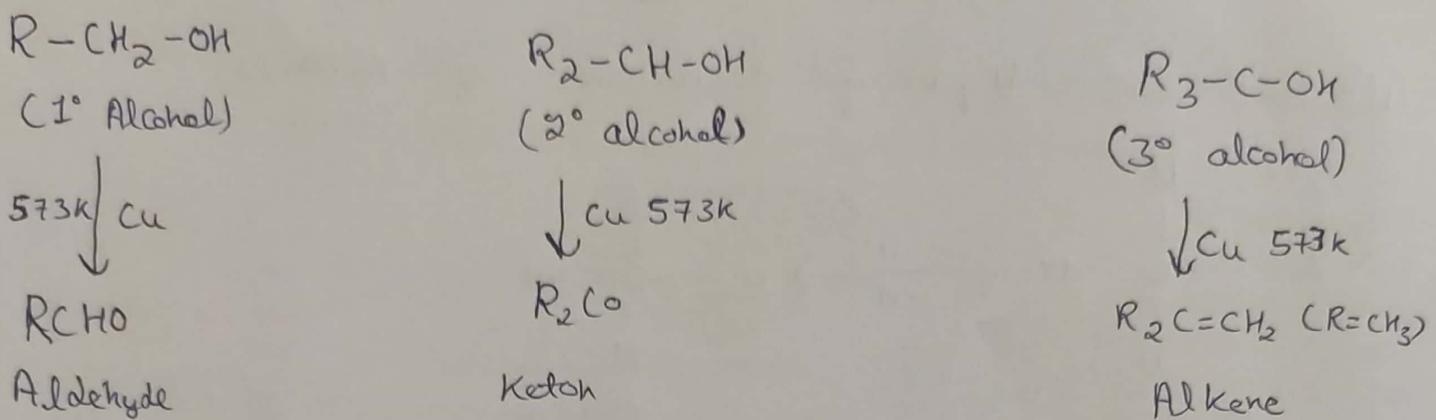


Ketone



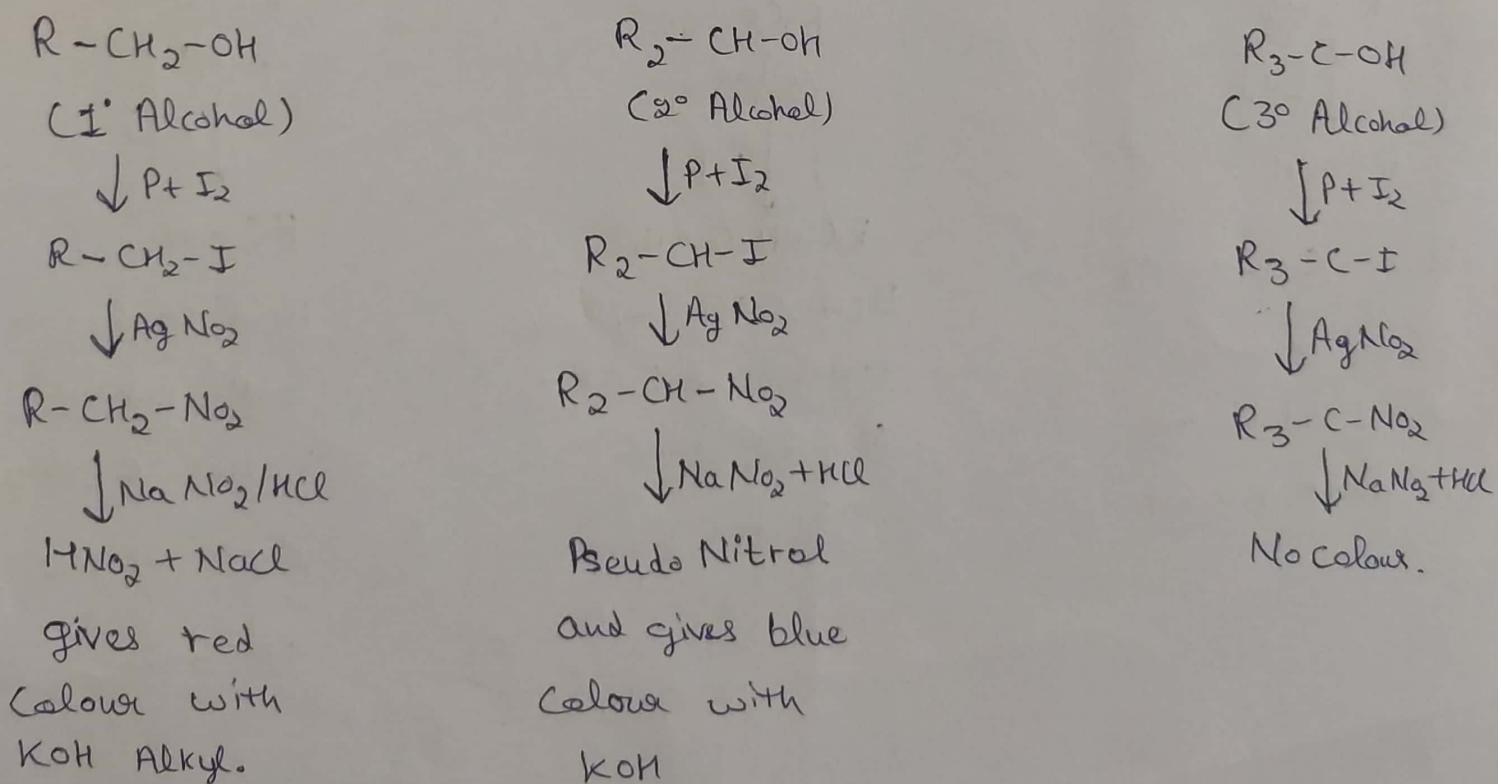
Acid or ketone  
both containing  
Lesser C atom  
than original  
alcohols.

(ii) Action of hot Reduced Copper (catalytic dehydrogenation):

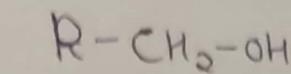


(iii) Victor Meyer's Method :- In this test Various alcohol is firstly treated with I to convert it into corresponding iodide than iodide is.. treated with  $\text{AgNO}_2$  to get corresponding Nitro paraffin.

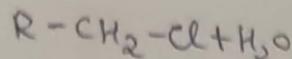
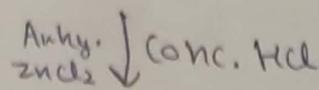
The Nitroparaffin is finally treated with Nitric acid and then made alkaline  $1^\circ$  Alcohol gives - red colour,  $2^\circ$  Alcohol give - blue colour and  $3^\circ$  Alcohol gives - No colour with  $\text{KOH}$  (aq).



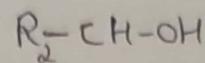
• (Vi) Lucas test :-



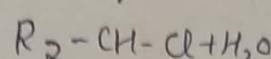
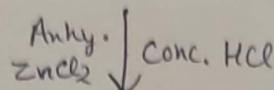
(1° Alcohol)



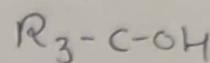
Turbidity  
appear on  
heating



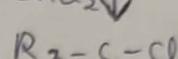
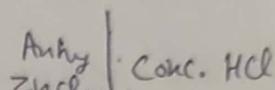
(2° Alcohol)



Turbidity appear  
with in 5 min

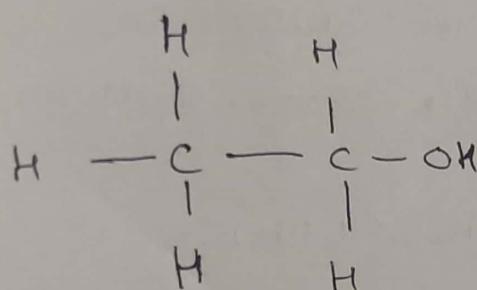


(3° Alcohol)



Turbidity  
appear  
immediately

Ethyl Alcohol :- ( $\text{C}_2\text{H}_5\text{OH}$ )



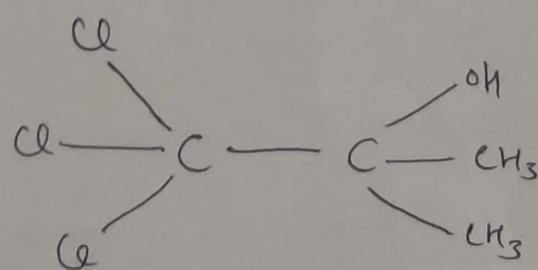
Uses :- ① It is used as an antiseptic

② It is used as an antidote against Methanol and Ethylene glycol poisoning.

③ Medically it is used to depress the C.N.S.

Greater the use of ethanol is like a motor fuel and fuel additives.

Chlorobutanol ( $\text{C}_4\text{H}_7\text{Cl}_3\text{O}$ ) :-



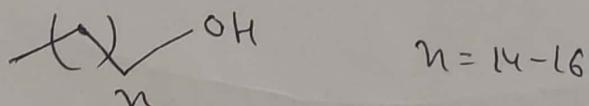
1,1,1-Trichloro-2-Methyl-2-propanol.

- It is anhydrous or contain not more than one half molecule of water on hydration.
  - It is an organic compound with a strong odour and sedative properties.
  - It is colourless and white crystalline powder.
  - It is soluble in  $\text{CHCl}_3$  and slightly soluble in  $\text{H}_2\text{O}$ .

Uses:- ① Chlorobutanol has antibacterial and fungicidal effect.

② It is used as a preservative (0.5%) in injections, eye drops and mouth washes, creams, ointments etc.

(Ceto Stearyl Alcohol  $(\text{CH}_3(\text{CH}_2)_n\text{CH}_2\text{OH})$  :-



- It is a white, waxy solid material in the form of flakes.
  - It is not soluble in  $H_2O$  but soluble in oil.

Uses :- ① It is also called as a local anaesthetic and to reduce pain associated with it.

① g+ is used as an emulsion stabilizer.

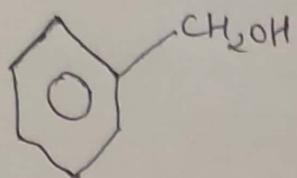
② It is also used as opacifying agent and foam boosting Surfactant as well as an aqueous and non aqueous viscosity increasing agent.

③ It is also used as an emulsion stabilizer.

④ It is commonly used in hair conditioners and other hair products.

(19)

## Benzyl Alcohol ( $C_6H_5CH_2OH$ ) :-

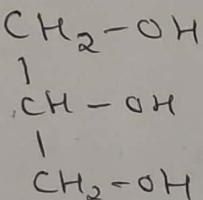


- It is also called as phenyl methanol or phenyl carbinal.
- It is an aromatic alcohol. It is colourless liquid with a mild pleasant aromatic odour.
- It is soluble in diethyl ether.

Uses :-

- ① It is also called as a local anaesthetic and to reduce pain associated with lidocaine injection.
- ② It is used as general solvent for inks, paints, lacquers.
- ③ It is also used as dyeing assistant for filament nylons.
- ④ It is used in hair dyes and topical.

## Glycerol ( $C_3H_8O_3$ ) :-



It is also called as glycerine

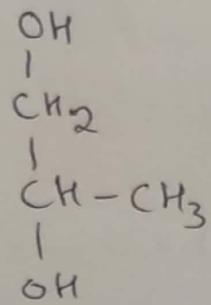
It is trihydroxy sugar alcohol with sweet taste.

It is viscous at room temp. and non-toxic in low concentration.

Uses :-

- ① It is used in cosmetic industry to enhance the texture of lotions and creams.
- ② It is used to preserve food and also enhance the viscosity and texture.

## Propylene Glycol (C<sub>3</sub>H<sub>8</sub>O<sub>2</sub>) :-



Propane - 1,2-diol

It is an organic compound. It is tasteless, odourless, colourless and clear oily liquid that is hygroscopic in nature.

In industry propylene glycol is provide by hydration propylene oxide at temp. 200-220°C.

### Uses :-

- ① It is used as a solvent for food colour and flavouring agent.
- ② It is used as a main ingredients in deodorant sticks
- ③ It is used in hand sanitizer and antibacterial lotion and also used in preparation of Saline Solution.