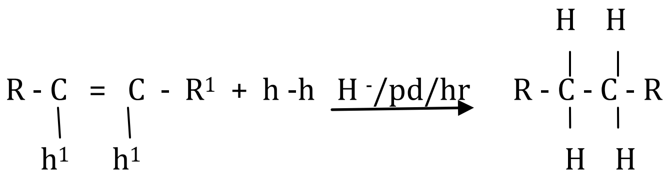
HYDROCARBONS

PREPARATION OF AN ALKANE-

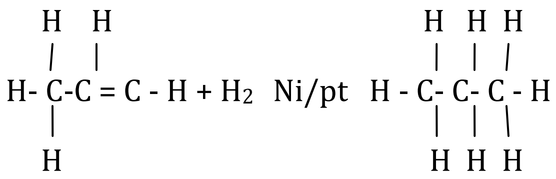
(1) Hydrogenation Reduction- Reduction of unsaturated HC



$$R-\underset{h^1}{C}=\underset{h^1}{C}-R^1+h-h\xrightarrow{H^-/pd/hr}R-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-R$$

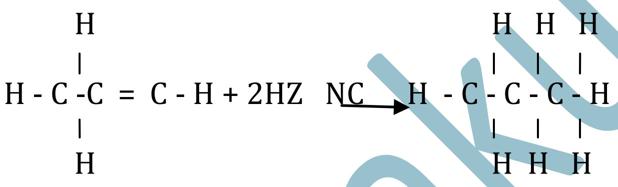
Alkene

=>Convert Propene to Propane



$$H-\overset{H}{\underset{H}{C}}-\overset{H}{C}=C-H+H_2\quad Ni/pt\quad H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H$$

=>Propene to Propane



$$H-\overset{H}{\underset{H}{C}}-C=C-H+2HZ\xrightarrow{NC}H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H$$

=>Reduction of Alky Halide (Acidic Medium)

$$R-X+H_2\ \underset{Z_n/\ HCl}{\overset{Z_{n}\text{-}Cu/Ethanol}{\overline{\qquad\qquad\qquad}}}\ R-H+HX$$

(alkane)

$$CH_3-CH_2-I+H_2\ \underset{Z_n/\ HCl}{\overset{Z_{n}\text{-}Cu/Ethanol}{\overline{\qquad\qquad\qquad}}}\ CH_3CH_3+HI$$

Ethyle Helide)(Ethane)

WURTZ REACTION

$R-X + 2Na + X-R \xrightarrow{\text{Dry Ether}} R-R + 2\,NaX$

alkyl halide (Alkane)

R-X on treatment with Na metal in the presence of a dry ether gives higher alkanes, this is known as Wurtz Reaction. It is used for the preparation of higher alkanes containing an even number of a carbon atom.

->Convert Bromoethane to Butane

$CH_3-CH_2-Br + 2Na + CH_3-CH_2-Br \xrightarrow{\text{Dry Ethane}} CH_3-CH_2-CH_2-CH_3 + 2NaBr$

Limitations of Wurtg Red^n

$CH_3-I + Na + I-C_2H_5 \xrightarrow{\text{Dry ethane}} CH_3-CH_3 + C_2H_5-C_2H_5 + CH_3-C_2H_5 + NAI$

$CH_3-I + 2Na + I-CH_3 \xrightarrow{\text{Dry ethane}} CH_3-CH_3 + 2NAI$

Etane

$C_2H5-I + 2Na + I-C_2H_5 \xrightarrow{\text{Dry ethane}} C_2H_5-C_2H_5 + 2\,NAI$

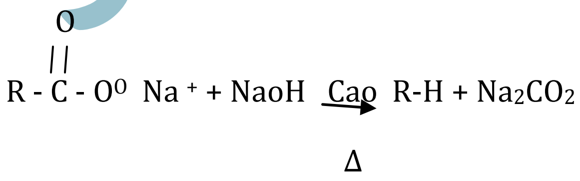
Butane

$CH_3-I + 2Na + I-C_2H_5 \xrightarrow{\text{Dry ethane}} CH_3-C_2H_5 + 2NAI$

Propane

If 2 different alkyl halides are taken in the wurtg Red^n, then it gives a mixture of 3 alkanes (different). As they are very close in their B.P, so may can't be separated by fractional distillation.

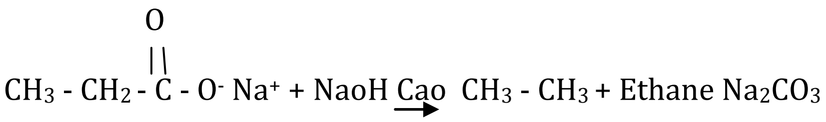
From Carboxylic acid - Decarboxylation (Removal of CO_2)



$$R-\overset{\overset{O}{||}}{C}-O^{0}\ Na^{+} + NaoH \xrightarrow[\Delta]{\text{Cao}} R-H + Na_2CO_2$$

(sodium salt of carboxylic acid) (Alkane)

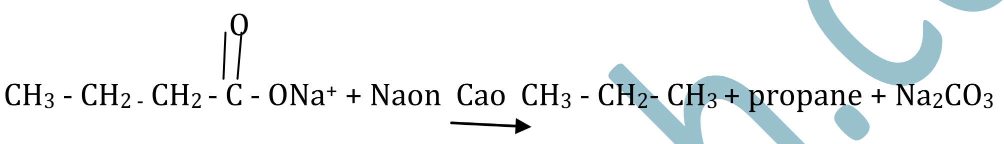
The process of elimination of CO_2 from a carboxylic acid is known as decarboxyliation.



$$CH_3 - CH_2 - \overset{\overset{O}{||}}{C} - O^- Na^+ + NaoH \xrightarrow{Cao} CH_3 - CH_3 + Ethane\ Na_2CO_3$$

Sodium Propanoate

Question: Sodium salt of which acid is used for the preparation of propane. write chemical equation.



$$CH_3 - CH_2 - CH_2 - \overset{\overset{O}{||}}{C} - ONa^+ + Naon \xrightarrow{Cao} CH_3 - CH_2 - CH_3 + propane + Na_2CO_3$$

Sodium Butanoate

KOLBE ELECTROLYTIC METHOD

An aqueous solution of sodium or potassium salt of a carboxylic acid on electrolysis gives alkane containing an even number of carbon atoms at the anode.

$2CH\ COO^- Na^+ 2H\ O$

Sodium acetate

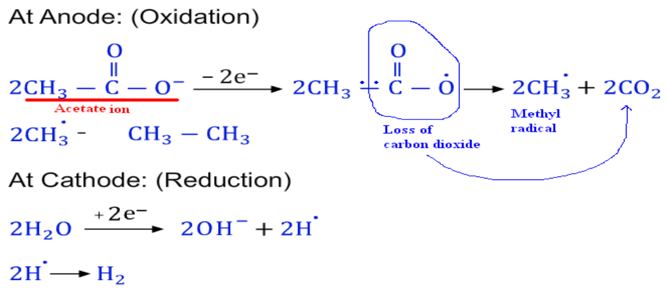
$\downarrow$ Electrolysis

$CH_3 - CH_3 + 2CO_2 + H_2 + 2NaOH$

The reaction is supposed to follow the following path:

i) $2CH_3\ COO^- Na^+ \longrightarrow 2CH_3 - C - O^- + 2Na^+$

ii) At anode:



PHYSICAL PROPERTIES

Alkanes are almost non-polar molecules because of the covalent nature of C-C and C-H bonds and due to the very little difference in electronegativity between carbon and hydrogen atom.

BOILING POINTS

Ethane < Propane < Butane

There is an increase in boiling point with increase in molecular mass. This is due to the fact that the inter molecular forces increase with increase vander Waal in mole.

Pentane > 2- Methylbutane > 2.2 - Dimethylpropane

In the isomeric alkanes, with the increase in a number of branched chains, the molecule attains the shape of a sphere. This result in a smaller area in contact and therefore, there are weak vander waalforces between molecule. so, that have a low boiling point.

CHEMICAL PROPERTIES

Substitution Reaction- The reaction in which hydrogenatom of alkane are substituted are known as substitution reaction.

$CH_4 + Cl_2 \xrightarrow{hv} CH_3Cl + HCl$

$CH_3Cl + Cl_2 \xrightarrow{hv} CH_3Cl_2 + HCl$

$CH_2Cl_2 + Cl_2 \xrightarrow{hv} CHCl_3 + HCl$

$CnCl_3 + Cl_2 \xrightarrow{hv} CCl_3 + HCl$

$F_2 > Cl_2 > Br_2 > I_2$

↓ ↓

Reactible gives Reversible reaction

-> the rate of reaction of alkane with halogen is $F_2 > Cl_2 > Br_2 > I_2$

-> Iodination reaction so it can be carried out in the presence of oxidizing agent like HIO_3 or HNO_3

$CH_4 + I_2 \rightleftharpoons CH_3I + HI$

$HIO_3 + 5HI \longrightarrow 3I_2 + 3H_20$

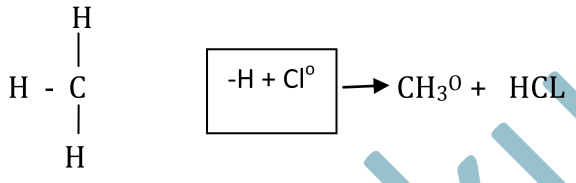
MECHANISM OF HALOGENATION OF METHANE

1) Chain Initiation -

$CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$

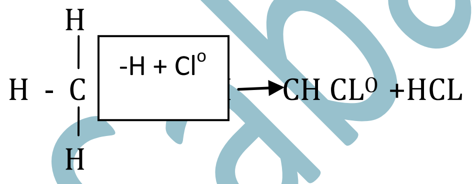
$Cl_2 \xrightarrow{hv} Cl^o + Cl^o$

2.) Chain Propogation -



$\text{H} - \overset{\text{H}}{\underset{\text{H}}{\text{C}}} \quad \boxed{-H + Cl^o} \longrightarrow CH_3{}^0 + HCL$

$CH_3{}^0 + Cl^o + Cl^o - Cl^o \longrightarrow CH_3Cl + Cl^0$



$\text{H} - \overset{\text{H}}{\underset{\text{H}}{\text{C}}} \boxed{-H + Cl^o} \longrightarrow CH\ CL^0 + HCL$

$CH_2\,Cl^0 + Cl^o + Cl^o - Cl^o \longrightarrow CH_2Cl_2 + Cl^0$

Till CCC_3

3) Chain Termination

If no sunlight -> $Cl^o + Cl^o \longrightarrow Cl_2$

-> $CH_3^0 + Cl^o \longrightarrow CH_3Cl$

-> $CH_3^o + CH_3 \longrightarrow C_2H_6$

COMBUSTION REACTION

When carbon compound reacts with O_2.

Complete oxidation - $CH\ H_2N + 2 + \left(\frac{3n+1}{2}\right) O_2 \longrightarrow HCO_2 + (N+1)\ H_2O + \Delta$

Incomplete Oxidation- $CH\ H_2N + 2 + O_2 \longrightarrow HC\ (S) + {}^{(N+1)}\ H_2O(l)$

Controlled Oxidation- $2\ CH4 + O_2 \xrightarrow{Cu/523K/100\ atm} 2CH_3OH$

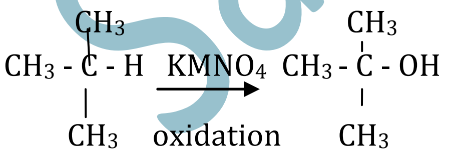
(Alcohol)

$CH4 + O_2 \xrightarrow{MO_2O_3} HCH0 + H_2O$

(Aldehyde)

$2CH_3 - CH_3 + 3O_2 \xrightarrow{(CH_3COO)_2Mn} 2CH_3COOH + 2H_2O$

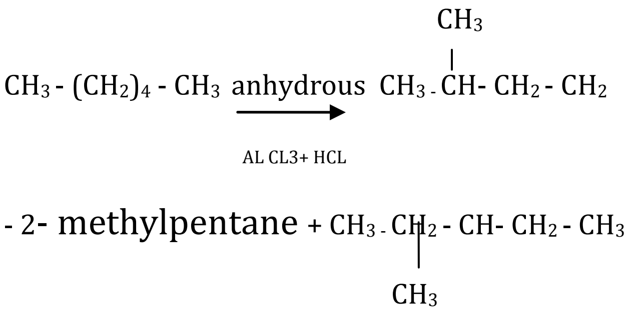
(carboxylic acid)



$$CH_3 - \overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{C}} - H \xrightarrow[oxidation]{KMNO_4} CH_3 - \overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{C}} - OH$$

= It is making alcohol and not carboxylic because the tertiary carbon does not have valency to hold carboxylic acid.

ISOMERISM REACTION



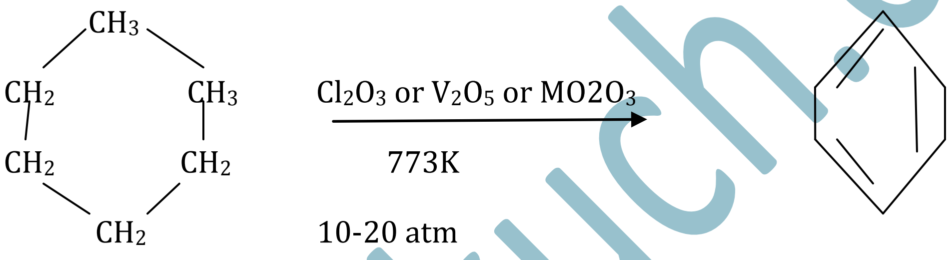
$$CH_3 - (CH_2)_4 - CH_3 \xrightarrow[AL\ CL3+\ HCL]{anhydrous} CH_3 - \underset{}{\overset{CH_3}{\overset{|}{C}H}} - CH_2 - CH_2$$

$$-\ 2\text{- methylpentane} + CH_3 - CH_2 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_3$$

3- methylpantane

In presence of anhydrons $AlCl_3$ + HCL an alkane gives isomers (chain).

AROMATISATION OR REFORMING



H - Hexanane

Benzane

(aromatic compound)

REACTION WITH STEAM

$$CH_4 + H_2O \xrightarrow[\Delta]{Ni\ \ Co} + 3H_2$$

REACTION OF CARBON COMPOUND WITH H₂O(g)

=> Pyrolysis Or Cracking-

$$C_6H_{14} \xrightarrow{773\ K} C_6H_{12} + H_2$$

$$C_6H_{14} \xrightarrow{773\ K} C_4H_8 + C_2H_6$$

$$C_6H_{14} \xrightarrow{773\ K} C_3H_6 + C_2H_4 + CH_4$$

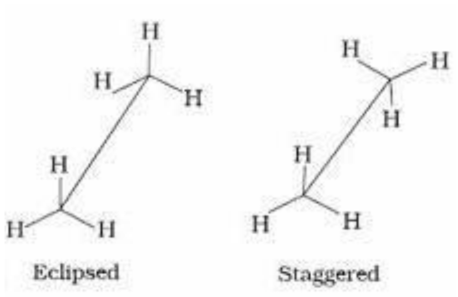
CONFORMATION

Conformations Alkanes contain carbon-carbon sigma (σ) bonds. Electron distribution of the sigma molecular orbital is symmetrical around the internuclear axis of the C–C bond which is not disturbed due to rotation about its axis. This permits free rotation about C–C single bond. This rotation results in different spatial arrangements of atoms in space which can change into one another. Such spatial arrangements of atoms which can be converted into one another by rotation around a C-C single bond are called conformations or conformers or rotamers. Alkanes can thus have an infinite number of conformations by rotation around C-C single bonds. However, it may be remembered that rotation around a C-C single bond is not completely free. It is hindered by a small energy barrier of 1-20 kJ mol–1 due to the weak repulsive interaction between the adjacent bonds. Such a type of repulsive interaction is called torsional strain.

Conformations of ethane: Ethane molecule (C_2H_6) contains a carbon – carbon single bond with each carbon atom attached to three hydrogen atoms. Considering the ball and stick model of ethane, keep one carbon atom stationary and rotate the other carbon atom around the C-C axis. This rotation results into an infinite number of spatial arrangements of hydrogen atoms attached to on e carbon atom with respect to the hydrogen atoms attached to the other carbon atom. These are called conformational isomers (conformers). Thus, there are an infinite number of conformations of ethane. However, there are two extreme cases. One such conformation in which hydrogen atoms attached to two carbons are as closed together as possible is called eclipsed conformation and the other in which hydrogens are as far apart as possible are known as the staggered conformation. Any other intermediate conformation is called a skew conformation. It may be remembered that in all the conformations, the bond angles and the bond lengths remain the same. Eclipsed and the staggered conformations can be represented by Sawhorse and Newman projections.

SAWHORSE PROJECTIONS

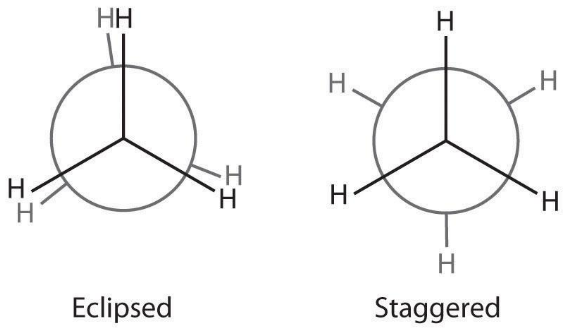
In this projection, the molecule is viewed along the molecular axis. It is then projected on paper by drawing the central C–C bond as a somewhat longer straight line. The Upper end of the line is slightly tilted towards right or left hand side. The front carbon is shown at the lower end of the line, whereas the rear carbon is shown at the upper end. Each carbon has three lines attached to it corresponding to three hydrogen atoms. The lines are inclined at an angle of 120° to each other. Sawhorse projections of eclipsed and staggered conformations of ethane are depicted in Fig-



Sawhorse projection of Ethane

NEWMAN PROJECTIONS

In this projection, the molecule is viewed at the C–C bond head on. The carbon atom nearer to the eye is represented by a point. Three hydrogen atoms attached to the front carbon atom are shown by three lines drawn at an angle of 120° to each other. The rear carbon atom (the carbon atom away from the eye) is represented by a circle and the three hydrogen atoms are shown attached to it by the shorter lines drawn at an angle of 120° to each other. The Newman's projections are depicted in fig-



Newman Projection of Ethane

RELATIVE STABILITY OF CONFORMATIONS:

As mentioned earlier, in staggered form of ethane, the electron clouds of carbon-hydrogen bonds are as far apart as possible. Thus, there are minimum repulsive forces, minimum energy and maximum stability of the molecule. On the other hand, when the staggered form changes into the eclipsed form, the electron clouds of the carbon – hydrogen bonds come closer to each other resulting in an increase in electron cloud repulsions. To check the increased repulsive forces, the molecule will have to possess more energy and thus has lesser stability. As already mentioned, the repulsive interaction between the electron clouds, which affects the stability of a conformation, is called torsional strain. The Magnitude of torsional strain depends upon the angle of rotation about C–C bond. This angle is also called dihedral angle or torsional angle. Of all the conformations of ethane, the staggered form has the least torsional strain and the eclipsed form, the maximum torsional strain. Thus, it may be inferred that rotation around C–C bond in ethane is not completely free. The energy difference between the two extreme forms is of the order of 12.5 kJ mol–1, which is very small. Even at ordinary temperatures, the ethane molecule gains thermal or kinetic energy sufficient enough to overcome this energy barrier of 12.5 kJ mol–1 through intermolecular collisions. Thus, it can be said that rotation about carbon-carbon single bond in ethane is almost free for all practical purposes. It has not been possible to separate and isolate different conformational isomers of ethane.

ALKENES

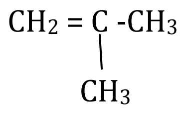
ISOMERISM

=> Structural Isomerism-

For e.g., Butane

1)- $CH_2 = CH- CH_2 - CH_3$ But -1-ene

2)- $CH_3 - CH= CH - CH_3$ But -2-ene

3)-


$$CH_2 = \underset{\displaystyle CH_3}{\underset{|}{C}} - CH_3$$

2-Methylprop-1-ene

Structure 1) & 3) and 2) and 3) are examples of chain isomers.

Whereas 1.) & 2) are examples of positions isomerism.

=> Stereo Isomer

The restricted rotation of an atom around a doubly bonded carbon atom gives rise to different geometries. the stereo isomers of this type are called geometrical isomers.

It is of two types -

1. Cis Isomers

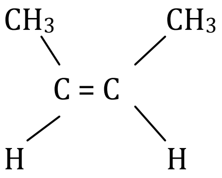
2. Trans Isomers

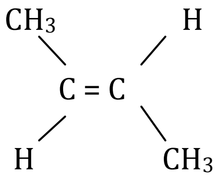
Solid - trans BP > Cis

Cis- In which two identical atoms or groups lie on the same side of the double bond.

Trans- the isomers of the type in which identical atoms or groups lie on the opposite side of the double bond.

For e.g.,- But -2-ene CH_3 - CH= CH- CH_3





Cis- 2- butene	Trans-2-Butene
- Less stable	- stable
- (B.P - 277 K)	- (B.P - 274 K)
- Polar	- Non Polar

...

Cis-isomers of alkene is more polar that trans isomer.

The dipole moment of trans is almost zero. so, trans-but-2-ene is non-polar because in trans the two methyl groups are in the opposite direction.

Triple moment of C-CH_3 bond cancels out the effect of each other. So, trans is non- polar.

PREPARATION OF ALKENE FROM-

Alkyne $\xrightarrow{\text{partial catalystic Hydrogenation}}$ Alkene

Partial Catalystic Hydrogenation

Palladised charcoal/lindlar's catalyst

Sodium in liquid ammonia

$H - C \equiv C - H \xrightarrow{Pd/C - BaSo_4 \text{ or } Na/ \text{ liquid } NH_3} CH_2 = CH_2$

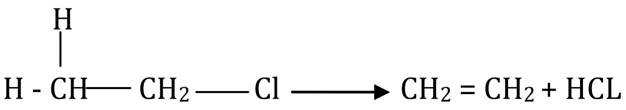
Ethyne	Ethene
Cis alkene	Trans Alkene
Pd/C	Na/ liquid NH_3
(Lindlar's Catalyst)	

=>**ALKYL HALIDES**

Dehydrogenation of alkyl halide or Beta elimination reaction-

$$\overset{B}{CH_3} - \overset{H}{\underset{X}{C}} - H \xrightarrow{\text{Alckon}} H - \overset{H}{C} = \overset{H}{C} - H + HX$$

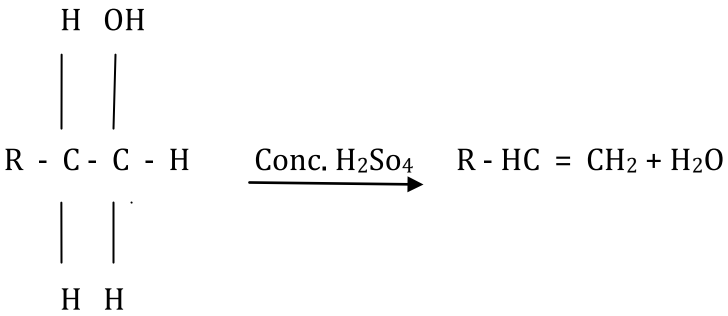
(X = Cl, Br, I)



$$H - \overset{H}{CH} - CH_2 - Cl \longrightarrow CH_2 = CH_2 + HCL$$

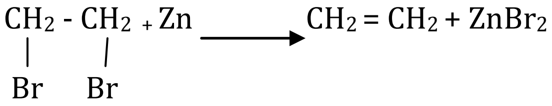
=>**ALCOHOL**

Dehydration of Alcohol/ Beta elimination reaction



$$R - \underset{H}{\overset{H}{C}} - \underset{H}{\overset{OH}{C}} - H \xrightarrow{\text{Conc. } H_2So_4} R - HC = CH_2 + H_2O$$

=>**VICINAL DIHALIDE**



$$\underset{Br}{CH_2} - \underset{Br}{CH_2} + Zn \longrightarrow CH_2 = CH_2 + ZnBr_2$$

Dibromoethane Ethene

Dihalides in which two halogen atoms are attached to two adjacent carbon atom.

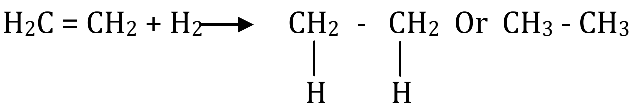
Dehalogenation

Chemical properties of alknes

=>Electrophilic addition Reaction - Alkenes are the rich sources of loosely held pi e^- due to which they show addition reaction in which electrophiles add on to the C=C to form addition products.

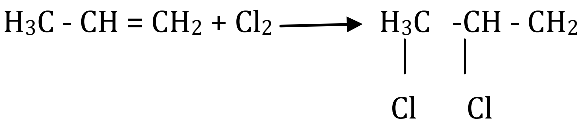
Reaction in Alkenes-

Addition of dihydrogen



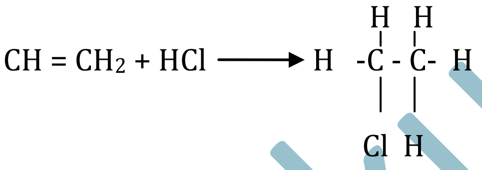
$$H_2C = CH_2 + H_2 \longrightarrow \underset{\underset{H}{|}}{CH_2} - \underset{\underset{H}{|}}{CH_2} \text{ Or } CH_3 - CH_3$$

<u>Addition of Halogens</u>



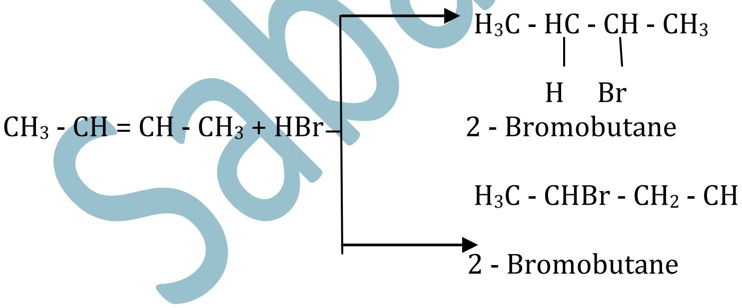
$$H_3C - CH = CH_2 + Cl_2 \longrightarrow \underset{\underset{Cl}{|}}{H_3C} - \underset{\underset{Cl}{|}}{CH} - CH_2$$

<u>Addition of Halogen Acid</u>



$$CH = CH_2 + HCl \longrightarrow H - \overset{\overset{H}{|}}{\underset{\underset{Cl}{|}}{C}} - \overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}} - H$$

Symmetrical alkene - i.e- Similar groups attached to double bond. For e.g., But-2-ene



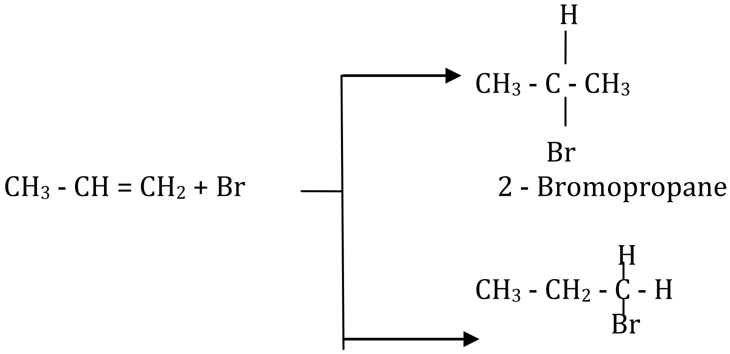
$$CH_3 - CH = CH - CH_3 + HBr \longrightarrow H_3C - \underset{\underset{H}{|}}{HC} - \underset{\underset{Br}{|}}{CH} - CH_3$$

2 - Bromobutane

$$\longrightarrow H_3C - CHBr - CH_2 - CH$$

2 - Bromobutane

Unsymmetrical alkene



$$CH_3 - CH = CH_2 + Br \rightarrow CH_3 - \underset{Br}{\overset{H}{C}} - CH_3 \quad ; \quad CH_3 - CH_2 - \underset{Br}{\overset{H}{C}} - H$$

2 - Bromopropane

(minor Product)

1- Bromopropane

MARKOVNIKOV'S RULE

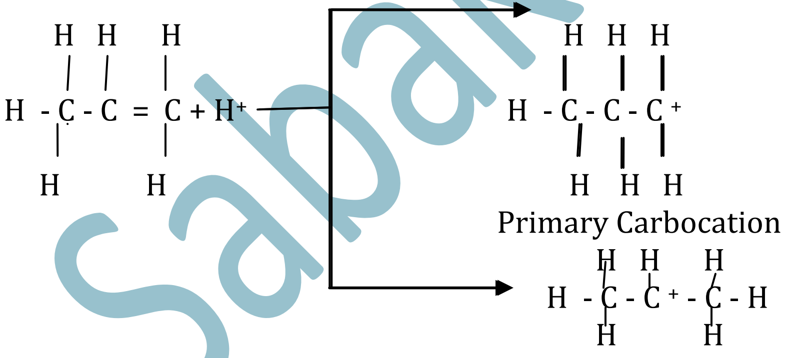
During the addition of an unsymmetrical reagent to an unsymmetrical alkene, the negative part of the attacking reagent is added to the unsaturated carbon which possess lesser number of hydrogen atoms.

Mechanism

Step 1-

$HBr \rightarrow H^+ + Br^-$

Step-2



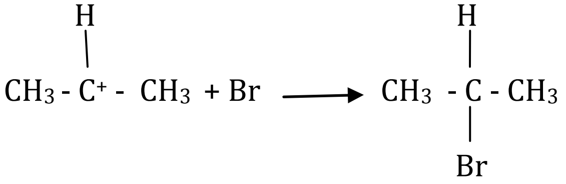
$$H - \underset{H}{\overset{H}{C}} - \overset{H}{C} = \underset{H}{\overset{H}{C}} + H^+ \rightarrow H - \underset{H}{\overset{H}{C}} - \underset{H}{\overset{H}{C}} - \underset{H}{\overset{H}{C}}^+ \quad ; \quad H - \underset{H}{\overset{H}{C}} - \overset{H}{C}^+ - \underset{H}{\overset{H}{C}} - H$$

Primary Carbocation

Secondary Carbocation

Order of stability of carbocation- $3^0 > 2^0 > 1^0$

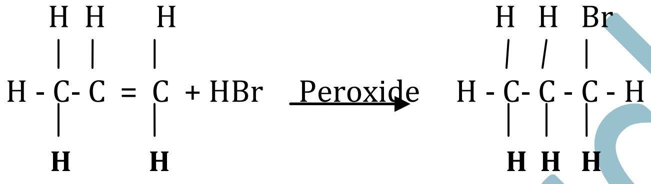
Step 3 -



$$CH_3-\overset{H}{\overset{|}{C^+}}-CH_3 + Br \longrightarrow CH_3-\overset{H}{\overset{|}{\underset{Br}{\underset{|}{C}}}}-CH_3$$

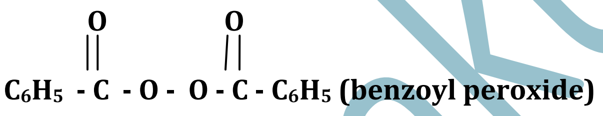
Secondary carbocation 2- Bromopropane

<u>Anti Markovnikov Rule</u>(Periodic effect) (opposite of Markovnikov's Rule)



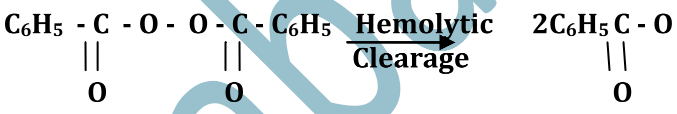
$$H-\overset{H}{\underset{H}{C}}-\overset{H}{C}=\overset{H}{\underset{H}{C}} + HBr \xrightarrow{\text{Peroxide}} H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{Br}{\underset{H}{C}}-H$$

Step-1

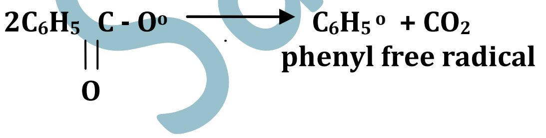


$$C_6H_5-\overset{O}{\overset{||}{C}}-O-O-\overset{O}{\overset{||}{C}}-C_6H_5$$

(benzoyl peroxide)



$$C_6H_5-\underset{O}{\underset{||}{C}}-O-O-\underset{O}{\underset{||}{C}}-C_6H_5 \xrightarrow[\text{Clearage}]{\text{Hemolytic}} 2C_6H_5\underset{O}{\underset{||}{C}}-O$$



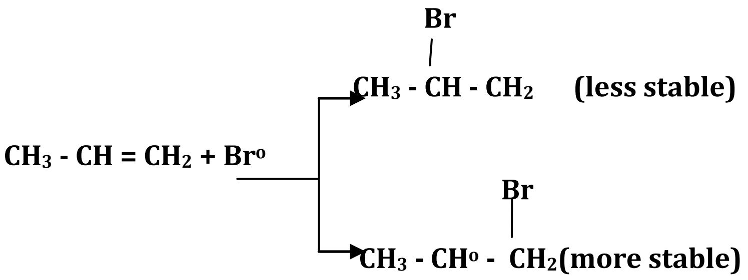
$$2C_6H_5\underset{O}{\underset{||}{C}}-O^o \longrightarrow C_6H_5{}^o + CO_2$$

phenyl free radical

$C_6H_5 + HBr \longrightarrow C_6H_6 + Br$

Bromine free radical

Step 2

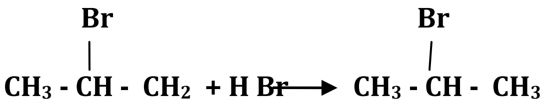


$$CH_3 - CH = CH_2 + Br^o \rightarrow CH_3 - \overset{Br}{\overset{|}{CH}} - CH_2 \quad \text{(less stable)}$$

$$CH_3 - CH = CH_2 + Br^o \rightarrow CH_3 - CH^o - \overset{Br}{\overset{|}{CH_2}} \quad \text{(more stable)}$$

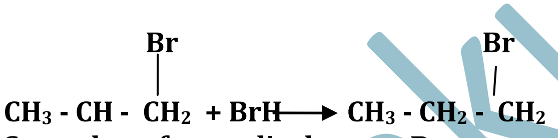
Br is automatically in (2°) CH_2

Order of stability of free radical is 3°>2°>1°



$$CH_3 - \overset{Br}{\overset{|}{CH}} - CH_2 + H\,Br \rightarrow CH_3 - \overset{Br}{\overset{|}{CH}} - CH_3$$

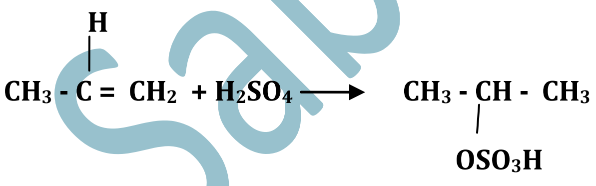
primary free radical **2 - Bromopropane**



$$CH_3 - CH - \overset{Br}{\overset{|}{CH_2}} + BrH \rightarrow CH_3 - CH_2 - \overset{Br}{\overset{|}{CH_2}}$$

Secondary free radical **Bromopropane**

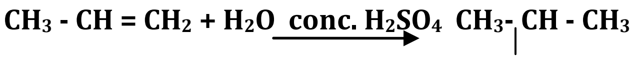
ADDITION SULPHURIC ACID



$$CH_3 - \overset{H}{\overset{|}{C}} = CH_2 + H_2SO_4 \rightarrow CH_3 - \underset{\underset{OSO_3H}{|}}{CH} - CH_3$$

$H_2SO_4 \rightarrow H^+ + CO - SO_2 - OH$

ADDITION OF WATER



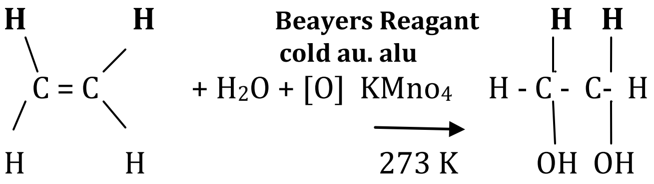
$$CH_3 - CH = CH_2 + H_2O \xrightarrow{conc.\ H_2SO_4} CH_3 - \underset{|}{CH} - CH_3$$

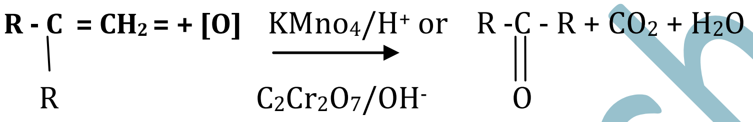
(water) **(alcohol)**

Alkene

$H_2O \rightarrow H^+ + OH^-$

OXIDATION REACTION

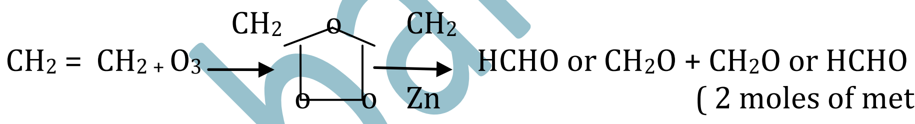




$$R-\underset{|\atop R}{C}=CH_2 = + [O] \xrightarrow[C_2Cr_2O_7/OH^-]{KMno_4/H^+ \text{ or}} R-\underset{\|\atop O}{C}-R + CO_2 + H_2O$$

$$R-CH = CH-R \xrightarrow[K_2Cr_2O7/OH^-]{KMno_4/H^+} 2R-CooH$$

OZONOLYSIS



(2 moles of methane)

POLYMERIZATION

Polythe

ethane

Polythene is formed by the combination of a large number of ethane molecules at high temperature, pressure and in the presence of a catalyst. The large molecules obtained are called polymers and the method is called polymerization.

ALKYNES

$C_nH_{2n} - 2$

Vicinal Dihalide

Eq.of question $H_2C - CH_2 \xrightarrow{alckon} A \xrightarrow{NaNH_2} B$

Find A and B

$H_2 - C - C - H_2$ alckon $H - C = CH_2$ $NaNH_2$ $HC \equiv CH + NH_2 - Nacl$

From Cal carbide
(if comes it is done only for the preparation of Ethyl)

$CaCO_3 \longrightarrow Cao + CO_2$
(Lime stone) (quick lime)

$CaO + 3C \longrightarrow CaC_2 + CO$
quick lime coke calcium carbide

$CaC_2 + H_2O \longrightarrow Ca(OH)_2 + HC = CH$ −
calcium carbide calcium hydroxide ethyne

CHEMICAL PROPERTIES

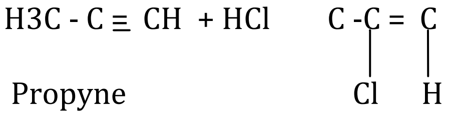
1. Acidic Nature of alkynes- In Ethyne, the carbon is Sp hybridized due to maximum percentage of 'S' character, the Sp hybridized orbital's of carbon atoms in ethyne molecules have the highest electro negatively so these attract the shared electron pair of the CH bond of ethyne to a greater extent than that of the Sp^2 hybridized of orbital's of carbon in ethene and Sp^3 hybridized orbital of carbon in ethane for eg.

$HC \equiv CH + Na \quad HC \equiv C\,Na + 1/2\, H_2$

Ethyne
This reaction is not shown by Alkanes and alkynes so it can be used to distinguish between alkyne, alkane and alkene.

Electrophillic addition reaction

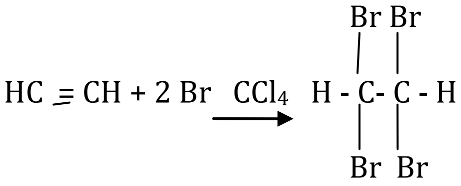
1) Addition of Halogen acid (HX)



$H_3C - C \equiv CH + HCl \quad C - \underset{Cl}{C} = \underset{H}{C}$

Propyne

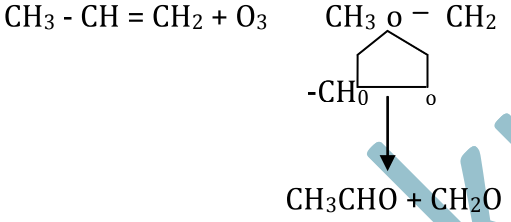
2) Addition of Halogen



$HC \equiv CH + 2\,Br \xrightarrow{CCl_4} H - \underset{Br}{\overset{Br}{C}} - \underset{Br}{\overset{Br}{C}} - H$

Reddish- orange color of the solution of bromine in CCl_4 is decolorized. This is the test for unsaturation.

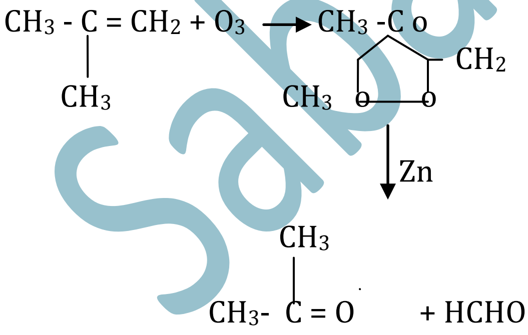
OZONOLYSIS



$CH_3 - CH = CH_2 + O_3$

$CH_3CHO + CH_2O$

(Ethanal) (Methanal)



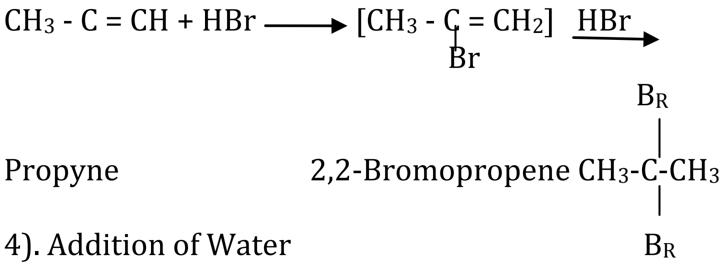
$CH_3 - \underset{CH_3}{C} = CH_2 + O_3$

Zn

$CH_3 - \overset{CH_3}{C} = O \quad + HCHO$

(Ketone) (Aldehyde)

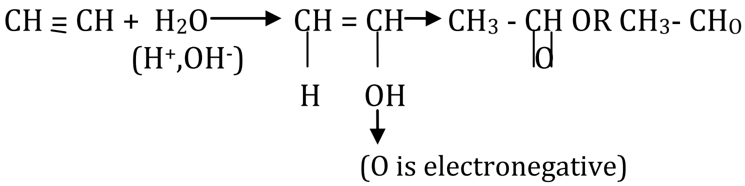
3). Addition of HBr



$$CH_3 - C = CH + HBr \longrightarrow [CH_3 - \underset{Br}{C} = CH_2] \xrightarrow{HBr} CH_3-\underset{B_R}{\overset{B_R}{C}}-CH_3$$

Propyne 2,2-Bromopropene

4). Addition of Water



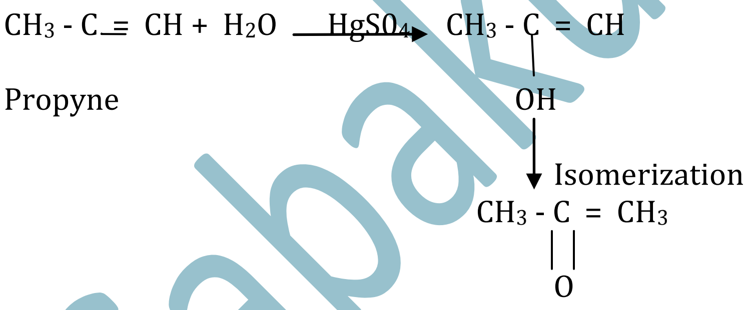
$$CH \equiv CH + H_2O \xrightarrow[(H^+,OH^-)]{} \underset{H}{CH} = \underset{OH}{CH} \longrightarrow CH_3 - \underset{O}{\underset{||}{CH}} \text{ OR } CH_3- CH_O$$

(O is electronegative)

$$\underset{(H^+,OH^-)}{CH = CH + H_2O} \xrightarrow[60^0]{HgS0_4 / H_2S0_4}$$

$H^+/ HgSO_4$

$$CH = CH \xrightarrow[H^+/ HgSO_4]{HgS0_4 / H_2S0_4}$$



$$CH_3 - C \equiv CH + H_2O \xrightarrow{HgS0_4} CH_3 - \underset{OH}{C} = CH$$

Propyne

Isomerization

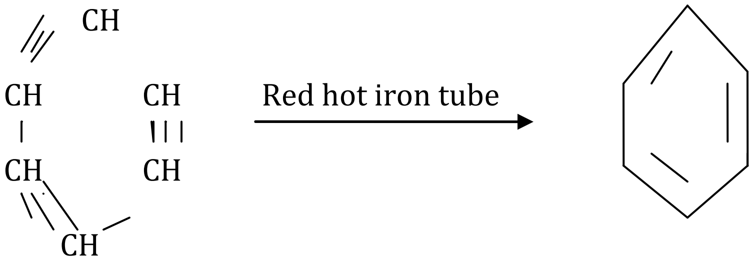
$$CH_3 - \underset{O}{\underset{||}{C}} = CH_3$$

POLYMERIZATION

Polymerization-

(a) Linear Polyethyne

(b) cyclic

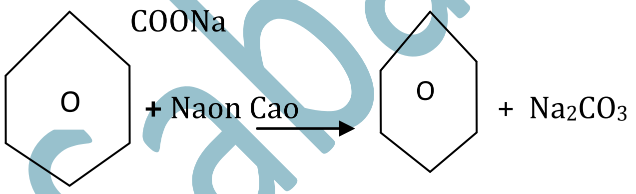


Aromatic Hydrocarbon

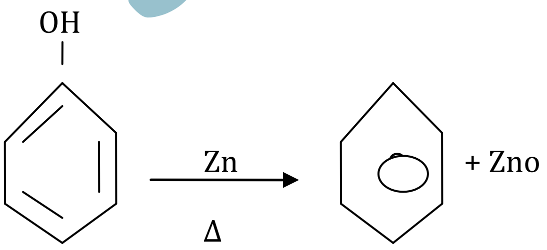
Laboratory Preparation of Benzene

- Cyclic Polymerization of ethyne (done at back)
- Decarboxylation of Aromatic Acid
- Reduction of Phenol

=>Decarboxylation of Aromatic Acid

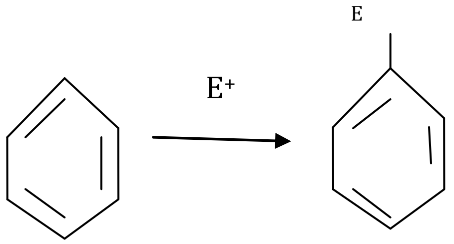


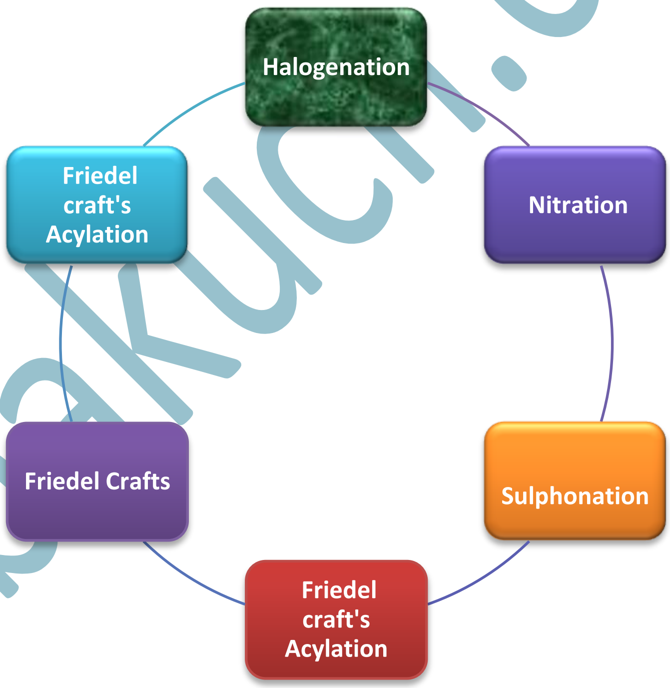
=>Reduction of Phenol



CHEMICAL PROPERTIES OF AROMATIC

1). Electrophillic Substitution Reaction-





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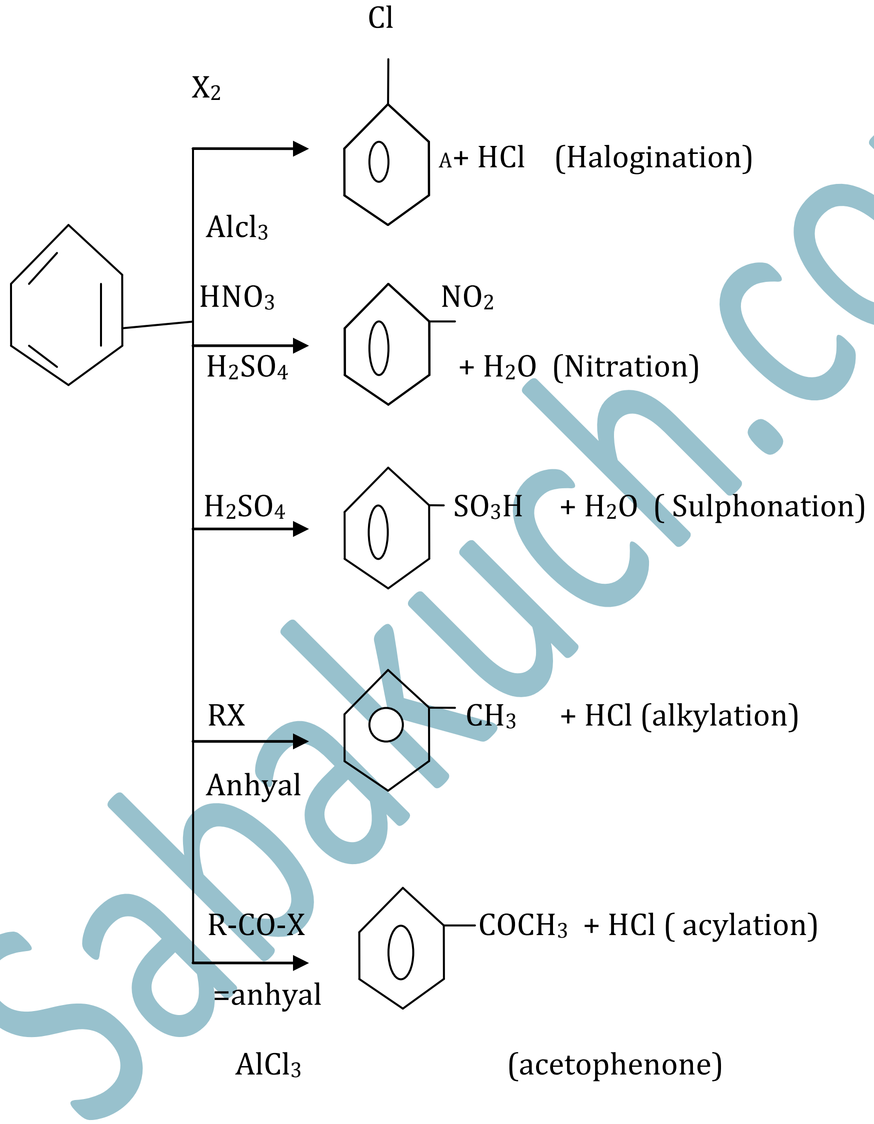
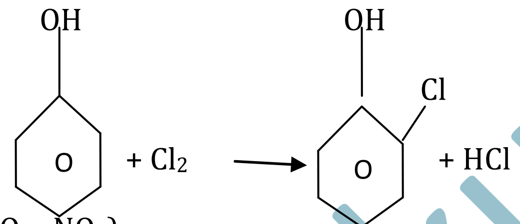

Cl
X2
A+ HCl (Halogination)
Alcl3
HNO3
NO2
H2SO4
+ H2O (Nitration)
H2SO4
SO3H + H2O (Sulphonation)
RX
CH3 + HCl (alkylation)
Anhyal
R-CO-X
COCH3 + HCl (acylation)
=anhyal
AlCl3
(acetophenone)

DIRECTIVE INFLUENCE OF FUNCTIONAL GROUP IN MONO-SUBSTITUTION OF BENZENE

COH, (l, OCH_3)

1.) Electron donating group on the benzene ring are ortho- para directing because one pair of a substitutional atom undergoes resonance with the pi e^- of the benzene ring and e^- density increases at ortho and para e^- density increases at ortho and para so, they are ortho-para directing.



(CO_2 , NO_2)

2.) Electron Withdrawing group on the benzene ring are meta directing because these groups direct the incoming group to the meta position-