## General characteristics of Halo-Alkanes.

(1) Organic compounds in which halogen atom (F, Cl, Br, I) is directly linked with saturated carbon atom are known as halo-alkanes. General formula is  $C_n H_{2n+2-m} X_m$  (X = F, Cl, Br, I) and m = no. of halogen atom; n = no. of carbon atoms.

(2) Depending on the number of halogen atoms present in the halogen derivative, these are termed as mono-, di-, tri-, tetra-, and polyhalogen derivatives.

 $\begin{bmatrix} CH_{4} \xrightarrow{-H} CH_{3} - X \xrightarrow{-H} CH_{2} - X_{2} \xrightarrow{-H} CH_{-H} X_{3} \xrightarrow{-H} CH_{-X} X_{4} \end{bmatrix}$   $\begin{bmatrix} CH_{4} \xrightarrow{-H} CH_{3} - X \xrightarrow{-H} CH_{2} - X_{2} \xrightarrow{-H} CH_{-X} X_{2} \xrightarrow{-H} CH_{-X} X_{4} \xrightarrow{-H}$ 

(i) Monohalogen derivatives are termed as alkyl halides.

Example:  $CH_3Cl$   $C_2H_5Br$   $C_3H_7I$ Methyl chloride Ethyl bromide Propyl iodide

Monohalogen derivatives or alkyl halides are classified as primary (1°), secondary (2°) or tertiary (3°) depending upon whether the halogen atom is attached to primary, secondary or tertiary carbon atoms.



(ii) The dihalogen derivatives are mainly of three types

(a) Gem-dihalides: In these derivatives both the halogen atoms are attached to the same carbon atom. These are also called alkylidene halides.

$$CH_{3}CH \xrightarrow{Cl}_{Cl}$$
;  $CH_{3} - CBr_{2} - CH_{3}$   
Ethylidene chloride

(b) Vic-dihalides: In these derivatives, the halogen atoms are attached to adjacent (Vicinal) carbon atoms. These are also termed as alkylene halides.

 $\begin{array}{ccc} CH_2Cl.CH_2Cl \hspace{0.1 cm} ; \hspace{1cm} CH_3CHCl.CH_2Cl \\ \text{Ethylene chloride} \end{array} \hspace{0.1 cm} ; \hspace{1cm} CH_3CHCl.CH_2Cl \\ \text{Propylene chloride} \end{array}$ 

(c)  $\alpha$ - $\omega$  halides (Terminal dihalides): In these derivatives, the halogen atoms are attached to terminal carbon atoms. These are also called polymethylene halides.

 $CH_{2}BrCH_{2}CH_{2}Br ; Cl - CH_{2} - CH_{2}$ 

(iii) The tri-halogen derivatives are termed as halo-forms

Example: CHCl<sub>3</sub> ; CHBr<sub>3</sub> ; CHI<sub>3</sub> Chloroform Bromoform / Odoform

(iv) In tetra-halogen derivatives all the four halogen atoms are attached to the same carbon atom in derivatives of methane.

Example:  $CCl_4$ ;  $CBr_4$ Carbon tetrachlor ide ; Carbon tetrabromi de

In other derivatives, the four halogen atoms are attached to different carbon atoms, e.g.,

(3) The common and IUPAC names of some halogen derivatives are listed here.

Formula of halogen derivatives	Common name	IUPAC name
CH <sub>3</sub> Cl	Methyl chloride	Chloromethane
$CH_3CH_2Br$	Ethyl bromide	Bromoethane
CH <sub>3</sub> CHBrCH <sub>3</sub>	Isopropyl bromide	2-Bromopropane

$CH_3CH_2CH_2CH_2Cl$	n-Butyl chloride	1-Chlorobutane
$CH_3$ $CH - CH_2Br$ >	Isobutyl bromide	1-Bromo -2-
CH <sub>3</sub>		methylpropane
CH <sub>3</sub>	Tertiary butyl bromide	2-Bromo –2-
$CH_3 - C - CH_3$		methylpropane
Br		
CH <sub>3</sub> CH Cl Cl	Ethylidene chloride	1,1-Dichloroethane
$CH_2Cl.CH_2Cl$	Ethylene chloride	1,2,-Dichloroethane
CHCl <sub>3</sub>	Chloroform	Trichloromethane
CHI <sub>3</sub>	Iodoform	Tri-iodomethane
CCl <sub>4</sub>	Carbon tetrachloride	Tetrachloromethane

Usually, the simple and lower members are called by common names and higher members are given IUPAC names.

(4) Higher members of alkyl halides show following types of isomerism,

(i) Chain isomerism: 
$$CH_3 - CH_2 - CH_2 - CH_2 - X \longleftrightarrow CH_3 - CH_2 - CH_2 - X$$
  
(ii) Position isomerism:  $CH_3 - CH_2 - CH_2 - X \longleftrightarrow CH_3 - CH_2 - CH_3$   
(iii) Position isomerism:  $CH_3 - CH_2 - CH_2 - X \longleftrightarrow CH_3 - CH_3 - CH_3$ 

2-Halopropan e

(iii) Optical isomerism: This is due to the presence of asymmetric carbon atom in secondary butyl halide.

$$\begin{array}{c}H\\CH_{3}-\overset{|}{C}-CH_{2}CH_{3}\\Br\\(2-Bromobutan e)\end{array}$$

The total number of isomers in alkyl halides are: Propyl  $(C_3H_7 - X)$  has two isomers, Butyl  $(C_4H_9 - X)$  has four isomers, and Pentyl  $(C_5H_{11} - X)$  has eight isomers.

(5) Halo-alkanes contain  $sp^3$  hybridised carbon atom bonded to halogen atom or atoms.