GROUP 17 ELEMENTS(HALOGENS)

Group 17 elements: F,Cl,Br,I,At

General electronic configuration:ns^2np^5

ATOMIC & PHYSICAL PROPERTIES

i. Atomic & ionic radii increase from fluorine to iodine.
ii. Ionization enthalpy gradually decreases from fluorine to iodine due to increase in atomic size.
iii. Electron gain enthalpy of fluorine is less than that of chlorine. It is due to small size of fluorine & repulsion between newly added electron &electrons already present in its small 2p orbital.
iv. Electronegativity decreases from fluorine to iodine. Fluorine is the most electronegative element in the periodic table.
v. The colour of halogens is due to absorption of radiations in visible region which results in the excitation of outer electrons to higher energy level.
vi. Bond dissociation enthalpy of fluorine is smaller than that of chlorine is due to electron-electron repulsion among the lone pair in fluorine molecules where they are much closer to each other than in case of chlorine. The trend: Cl-Cl>Br-Br>F-F>I-I.

CHEMICAL PROPERTIES

OXIDATION STATES:-1.However, chlorine, bromine &iodine exhibit +1, +3, +5, +7 oxidation states also.

Fluorine forms two oxides OF_2 and O_2F_2. These are essentially oxygen fluorides because of the higher electronegativity of fluorine than oxygen.

Anomalous behavior of fluorine- due to its small size, highest electronegativity, low F-F bond dissociation enthalpy and absence of d-orbitals.

TRENDS IN PROPERTIES

Bond dissociation Enthalpy(Increasing order): $I_2 < F_2 < Br_2 < Cl_2$

Oxidizing property – $F_2>Cl_2>Br_2>I_2$

Acidic strength- HF<HCl<HBr<HI

Stability & bond dissociation enthalpy- HF>HCl>HBr>HI

Stability of oxides of halogens- I>Cl>Br

Ionic character of halides –MF>MCl>MBr>MI

CHLORINE

PREPARATION

1. $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$
2. $4NaCl + MnO_2 + 4H_2SO_4 \rightarrow MnCl_2 + 4\ NaHSO_4 + 2H_2O + Cl_2$
3. $2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$

4. **DEACON'S PROCESS**

$$4HCl+O_2 \xrightarrow{CuCl_2} 2Cl_2+2H_2O$$

5. By electrolysis of brine solution. Cl_2 is obtained at anode.

PROPERTIES

i. With cold and dilute Cl_2 produces a mixture of chloride and hypochlorite but with hot and concentrated alkalis it gives chloride and chlorate.

$$2\underset{cold\,\&\,dil}{NaOH} + Cl_2 \rightarrow NaCl + NaOCl + H_2O$$

$$6\underset{hot\,\&\,conc}{NaOH} + 3Cl_2 \rightarrow 5NaCl + NaClO_3 + 3H_2O$$

ii. With dry slaked lime it gives bleaching powder.

$Ca(OH)_2+Cl_2 \rightarrow Ca(OCl)Cl+ H_2O$

iii. It is a powerful bleaching agent; bleaching action is due to oxidation

$Cl_2+H_2O \rightarrow 2HCl+(O)$

Colored substance+(O)→colorless substance

iv. Action of concentrated H_2SO_4 on NaCl give HCl gas.

$NaCl+H_2SO_4 \xrightarrow{420K} NaHSO_4+HCl$

3:1 ratio of conc. HCl& HNO_3 is known as aquaregia& it is used for dissolving noble metals like Au and Pt.

OXOACIDS OF HALOGENS (SEE TABLE 7.10& FIG.7.8)

Interhalogen compounds

They are prepared by direct combination of halogens.

Ex: ClF, ClF_3, BrF_5, IF_7

They are more reactive than halogens because X-X' is weaker than X-X bonds in halogens (except F-F).

TYPE	STRUCTURE
XX'_3	Bent T-shaped
XX'_5	Square pyramidal
XX'_7	Pentagonal bipyramidal