17th

F
Cl
Br
I
*At

① Halogen family

② e^- Conf = ns^2np^5

③ Atomic size F < Cl < Br < I

④ I.E F > Cl > Br > I

⑤ ΔH_{eg} Cl > F > Br > I

B.E $\Rightarrow$ F_2 Cl_2 Br_2 I_2

★ $Cl_2 > Br_2 > F_2 > I_2$

Physical prop.

(1) M.P/B.P ↑ down the group

(2) Halogens are diamag. and colourful

F_2 = Pale yellow

Cl_2 = greenish yellow

Br_2 = Reddish Brown

I_2 = Violet

Colour due to HOMO – LUMO transition

(3) F_2 and Cl_2 react with water Br_2 and I_2 Sparingly in water but complete soluble organic solvent

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Oxid. State and Covalency

$Cl = 3s^2 3p^5 \quad 3d$

G-S = 

$(E.S)_I$ = 

$(E.S)_{II}$ = 

$(E.S)_{III}$ = 

Cl | Br | I

1	3	5	7

$\overset{+1}{HOCl} \quad \overset{+3}{HClO_2} \quad \overset{+5}{HClO_3} \quad \overset{+7}{HClO_4}$

-1 O.S F

F shows only single oxidation state

-1

① Halogens are Highly Reactive and React with metals and non metal

Reactivity $F_2 > Cl_2 > Br_2 > I_2$

② they Readily accept e^-

So they are good O.A

order of oxidising power

$F_2 > Cl_2 > Br_2 > I_2$

$$\text{★}\quad F_2 + X^- \longrightarrow X_2 + F^-$$
$$(Cl^-/Br^-/I^-) \qquad (Cl_2/Br_2/I_2)$$

$$Cl_2 + \underset{Br^-/I^-}{X^-} \longrightarrow X_2 + Cl^-$$
$$(Br_2/I_2)$$

$$Br_2 + X^- \longrightarrow I_2 + Br^-$$
$$(I^-)$$

Reaction with water

$$F_2 + H_2O \longrightarrow H^+ + F^- + O_2$$

disprop.

$$X_2 + H_2O \longrightarrow HX + HOX$$

(Cl_2/Br_2)

$$I_2 + H_2O \longrightarrow X$$

$$I^- + H^+ + O_2 \longrightarrow I_2 + H_2O.$$

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Reaction with H_2

Reaction with H_2 they form Hydrogen Halides (Hydra acid)

order of acidic strength

$HF < HCl < HBr < HI$

Size ↑ B.S ↓

B.P

$(HF) > (HI) > HBr > HCl$

High B.P due to

H-Bonding

Reaction with oxygen

$+^2OF_2$ $\quad O = -2$

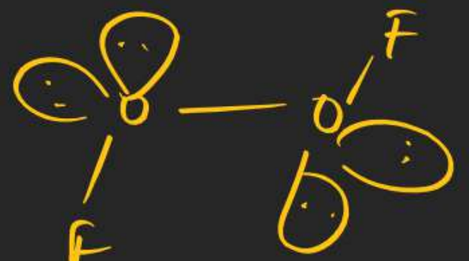
$+^1O_2F_2$ $\quad O = -1$

$O = +2$

$O = +1$

only OF_2 stable at 298 K

O_2F_2



Open book like structure

sp^3

Mto Polar

Non planar

O_2F_2 is use to recover Pu from spent nuclear reactor in the form of PuF_6

Cl_2O Cl_2O_6 ClO_2 Cl_2O_7

(ClO_2 (explosive))

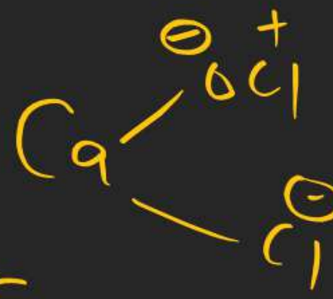
(ClO_2 bleaching agent — for paper pulp or textile industry)

$\xrightarrow{-H_2O}$ Cl_2O

anhydrous

of $\underline{\underline{HOCl}}$

(hypochlorous acid)



(bleaching powder)

$I > Cl > Br$

based on thermodynamically and Kinetically.

I_2O_4 I_2O_5 I_2O_7 Insoluble solids

decompose on Heating

I_2O_5 is use for estimation of CO

Reaction with Metal

$$Mg + Br_2 \longrightarrow MgBr_2$$

Order of Ionic ch.

$$MF > MCl > MBr > MI$$

Prep of F_2

(Moissan Process)

$$CaF_2 + H_2SO_4 \longrightarrow CaSO_4 + HF$$

$$HF + KF \longrightarrow KHF_2$$

KHF_2 electrolysis

$$KHF_2 \longrightarrow K^+ + HF_2^-$$

$$HF_2^- \longrightarrow F_2 \text{ (anode)}$$

Prep. of Cl_2

$NaCl$ (fused)

$$NaCl \longrightarrow Na^+ + Cl^-$$

at anode

$$Cl^{\ominus} \longrightarrow \frac{1}{2} Cl_2 + e^-$$

$NaCl$ (aq.)

$$NaCl \longrightarrow Na^+ + Cl^-$$

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

at anode

$$Cl^- \longrightarrow \frac{1}{2} Cl_2 + e^-$$

$$Cl^- + \text{conc.}\ H_2SO_4 + MnO_2 \xrightarrow[(O.A)]{} Cl_2$$

Industrial prep.

Deacon process

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

Prep. →

1. Greenish yellow gas
2. Soluble in water
3. $Cl_2 + H_2O$ → good O.A / good bleaching agent

$P_4 + Cl_2 \longrightarrow PCl_3$

$S_8 + Cl_2 \longrightarrow S_2Cl_2$

$Al + Cl_2 \longrightarrow AlCl_3$

it has great hydrogen affinity

$C_{10}H_{16} + Cl_2 \longrightarrow C + HCl$

$H_2S + Cl_2 \longrightarrow HCl + S$

$H_2 + Cl_2 \longrightarrow HCl$

Reaction with NH_3

$$Cl_2 + NH_3 \text{ (excess)} \longrightarrow NH_4Cl + N_2$$

$$Cl_2 + NH_3 \text{ (excess)} \longrightarrow NCl_3 + HCl$$

(NCl_3: explosive)

Reaction with NaOH

$$Cl_2 + NaOH \text{ (cold/dil)} \longrightarrow NaCl + NaOCl$$

$$Cl_2 + NaOH \text{ (hot/conc)} \longrightarrow NaCl + NaClO_3$$

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Composition of bleaching powder

$Ca(OCl)Cl \cdot CaCl_2 \cdot Ca(OH)_2 \cdot 2H_2O$

① A water loses it's yellow colour on standing due to formation of HOCl and HCl

$Cl_2 + H_2O \longrightarrow \boxed{HOCl} + HCl$

$HCl + (O)$

S.O.A

HCl

$NaCl + Conc.\ H_2SO_4 \longrightarrow HCl + NaHSO_4$

$NaCl + NaHSO_4 \longrightarrow HCl + Na_2SO_4$

Prop:

(1) Colourless, Pungent smell

(2) It gives White dense fumes with NH_4OH (NH_3 solution)

$NH_4OH + HCl \longrightarrow NH_4Cl$ (White dense fumes)

(3) Soluble in water

HCl use in aqua regia

$$3HCl + HNO_3 \longrightarrow NOCl + H_2O + \underbrace{Cl}_{\text{S.O.A}}$$

(orange-red) aqua regia dissolve Pt and Au

$$Pt + Cl \longrightarrow [PtCl_6]^{-2}$$ Soluble

$$Au + Cl \longrightarrow [AuCl_4]^{\ominus}$$

Soluble