(II) Action with ~~H2O~~

(II) Action with Ammonia:-

Depending upon the amount of halogen and reaction conditions, ammonia gives different products.

(a) with flourine

$$8NH_3 + 3F_2 \longrightarrow 6NH_4F + N_2\uparrow$$

excess

(b) with chlorine.

$$8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2\uparrow$$

excess

$$4NH_3 + 3Cl_2 \longrightarrow NCl_3 + 3NH_4Cl$$

nitrogen trichloride.

(c) with bromine

$$8NH_3 + 3Br_2 \longrightarrow NH_4Br + N_2\uparrow$$

excess

$$4NH_3 + 8Br_2 \longrightarrow 3NH_4Br + N_2\uparrow$$

$$4NH_3 + 3Br_2 \longrightarrow 3NH_4Br + NBr_3$$

(d) with iodine, a brown ppt. is formed

$$5NH_3 + 3I_2 \longrightarrow 3NH_4I + NI_3 \cdot NH_3$$

nitrogen triodide monoammonate (brown ppt).

IV) Bleaching action of halogen.

~~F_2 does~~ Fluorine does not bleaches due to strong oxidizing action that destroys the substances in presence of moisture. So it cannot be used as bleaching agent.

Iodine is weakest oxidizing agent so no bleaching properties. Br_2 is mild bleaching agent. But chlorine ~~and bromine~~ is good bleaching agent in presence of moisture.

$$Cl_2 + H_2O \xrightarrow{\text{sunlight}} HCl + HClO$$

$$HClO \longrightarrow HCl + O.$$

hypochlorous acid.

coloured matter + O $\longrightarrow$ colourless matter

~~Chlorine~~ chlorine bleaches colour by oxidation. and bleached matter does not regain its orginal colour.

Uses of halogen.

(2) chlorine.

(i) Used as disinfectant and germicide for sterlization of drinking water

(ii) used for preparation of AgCl which is used in photographic film.

(III) Used to manufacture insecticides such

as DDT, bleaching powder ($CaOCl_2$) etc.

(iv) Used for preparation of poisonous gas.
eg. phosgene ($COCl_2$)
mustard gas ($C_4H_8Cl_2S$)
tear gas ($C_6H_5CN_2$)

(b) Bromine

(i) Used to manufacture dyes, drugs, tear gas, benzol bromides

(ii) Bromides of Na, K, and Ca are used in medicine. as nerve seditatives.

(iii) Used to manufacture, photographic film, paper etc.

(iv) Detection of unsaturation in organic compounds.

(c) Iodine

(i) Used as antiseptic in the form of tincture of iodine (mixture of $I_2 + KI$)

(ii) Used in manufacture of photographic film and paper

(iii) 0.023% KI is used in common salt

(iv) It is used in cloud seeding in artificial rain.

Preparation of haloacids.

HCl, HBr, and HI.

HF They HCl, HBr, and HI are also called hydrogen halides.

1. Laboratory preparation of Hydrogen Chloride HCl.

→ In lab, HCl gas is prepared by heating common salt (NaCl) with non volatile concentrated sulphuric acid.

$$NaCl + H_2SO_4 \xrightarrow[\text{low temp}]{\Delta} NaHSO_4 + HCl \uparrow$$

$$2NaCl + H_2SO_4 \xrightarrow[\text{high temp.}]{\Delta} Na_2SO_4 + 2HCl \uparrow$$

#Test of HCl gas:-

1). When HCl gas is exposed to the rod dipped in $AgNO_3$ solution, a curdy white ppt is formed.

$$HCl + AgNO_3 \longrightarrow AgCl + HNO_3$$

~~$HCl + NH_3 \longrightarrow NH_4Cl$~~ White ppt

2). When HCl gas is exposed to the rod containing liquor ammonia, dense fumes are observed.

$$HCl + NH_3 \longrightarrow NH_4Cl$$

White dense fumes.

Preparation of aqueous HCl

HCl is highly water soluble, so aqueous HCl is prepared by dissolving HCl gas in water in ati-suction device. Thus produced acid is conc HCl. which is 36% by weight.

2. Laboratory preparation of HBr

In Lab Hydrogen Bromide (HBr) is prepared by action of bromine on moist red-phosphorous.

$$P_4 + 6Br_2 + 12H_2O \longrightarrow 4H_3PO_3 + 12HBr$$

→ aqueous ~~HCl~~ HBr is prepared by dissolving hydrogen bromide gas in water using the anti suction device.

Test of HBr gas.

It gives pale yellow precipitate(ppt) with silver nitrate solution.

$$AgNO_3 + HBr \longrightarrow AgBr\downarrow + HNO_3$$

Pale yellow ppt.

Laboratory preparation of hydrogen iodide (HI).

Hydrogen iodide is prepared by dropping water on moist red phosphorous and iodine.

$$P_4 + 6I_2 + 12H_2O \longrightarrow 4H_3PO_3 + 12HI.$$

aqueous hydroiodic acid can be prepared by dissolving ~~HBr~~ HI gas in water using an anti suction device.

→ Test of iodine.

When few drops of H_2SO_4 is added violet vapour with pungent odour and produced yellow ppt on $AgNO_3$ solution.

Chemical properties of Hydrogen acids.

1). Acidic nature.

In dry state they are (HCl, HBr, HI) are covalent molecules. so they cannot turn blue litmus into red, but in aqueous solution they change blue litmus into red.

Halogen acid ionizes as.

$$HX(g) + H_2O(l) \rightleftharpoons \underset{\text{hydronium ion.}}{H_3O^+} + X^-(aq)$$

The acid strength of halogen acid decreases from HI to HF.

HI > HBr > HCl > HF.

HI is strongest acid due to strong ionization and weak intermolecular hydrogen molecules among the HI molecules. i.e HI ionizes in water easily than HBr. HCl and HF.

iv. It reacts with base forms salt & water.

$$HX + NaOH \longrightarrow NaX + H_2O$$

[X = Cl, Br, I]

v. It reacts with metal like Zn, Na, Fe etc and liberate H_2 gas.

(HCl, HBr etc.)

$$Zn + 2HX \longrightarrow ZnX_2 + H_2\uparrow$$

$$Na + 2HX \longrightarrow NaX_2 + H_2\uparrow$$

2) Action with conc H_2SO_4

Conc. H_2SO_4 oxidizes HBr, HI to give Br_2 and I_2. but it cannot liberate Cl from HCl.

$$2HBr + 2H_2SO_4 \longrightarrow 2H_2O + SO_2 + Br_2$$

$$2HI + 2H_2SO_4 \longrightarrow 2H_2O + SO_2 + I_2$$

37. Reducing property.

Reducing power of halogen acid increases on order as

$HF < HCl < HBr < HI$.

HF is weakest because of greater the bond dissociation energy. than HCl & HBr & HI.

(a) Reducing properties of HCl,

HCl reduces strong oxidizing agent like, MnO_2, $K_2Cr_2O_7$, $KMnO_4$ etc and greenish yellow Cl_2 gas is evolved.

i) $MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2\uparrow$

reddish brown — colourless.

ii) $2KMnO_4 + 16HCl \longrightarrow 2KCl + MnCl_2 + 8H_2O + 5Cl_2$.

(b) Reducing properties of HBr & HI

HBr & HI reduces,

MnO_2 to MnX_2.

H_2SO_4 to SO_2.

decolourize $KMnO_4$ solution,

decolourize acidified $K_2Cr_2O_7$ into green.

i) With H_2SO_4

ii) With H_2SO_4.

$$2HX + H_2SO_4 (conc) \longrightarrow 2H_2O + SO_2\uparrow + X_2\uparrow$$

$X = Br, I.$

iii) With HNO_3.

$$2HNO_3 + 2HX \longrightarrow 2H_2O + 2NO_2\uparrow + X_2$$

$X = Br, I$

iii). With $K_2Cr_2O_7$.

$$K_2Cr_2O_7 + 4H_2SO_4 + 6HX \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3X_2$$

green

iv). With MnO_2.

$$MnO_2 + 4HX \longrightarrow MnX_2 + 2H_2O + X_2$$

4. Precipitation reaction:- (Solubility)

of HX.

Halogen acids give precipitation with silver nitrate and lead acetate solution

(a) With silver nitrate solution:-

i). HCl gives curdy white ppt.

$$AgNO_3 + HCl \longrightarrow AgCl\downarrow + HNO_3$$

curdy white ppt.

(b) HBr gives curdy pale yellow ppt

$$AgNO_3 + HBr \longrightarrow AgBr\downarrow + HNO_3$$

pale yellow ppt

(a) HI gives a yellow ppt

$HI + AgNO_3 \longrightarrow AgI + HNO_3$.

yellow ppt

(b) with lead acetate solution.

i). HCl & HBr gives white ppt

$2HX + (CH_3COO)_2Pb \longrightarrow PbX_2\downarrow + 2CH_3COOH$

white ppt.

ii) HI gives yellow ppt

$2HI + (CH_3COO)_2Pb \longrightarrow PbI_2\downarrow + 2CH_3COOH$.

yellow ppt.

Uses of Halo acids.

(a) Hydrochloric acid (HCl).

(i) → used to prepare aquaregia which is used to dissolve nobel metals (Gold, Platinum)

(ii) used to manufacture corn syrup.

iii). used in lab and industry next to H_2SO_4.

iv). Gastric juice contain HCl in stomach used for digestion of food.

(b) (HBr / hydrogen bromide.

(High cost less use)

(i) used in preparation of bromides like

Agar — used in printography

[illegible] — used in

Nitric — used in medicine as sleeping

[illegible]

[illegible]

[illegible]