Study of Compounds- Hydrogen Chloride

1. Laboratory preparation:

$$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$$

   i. Sulphuric acid is used as it is non-volatile.
   ii. Sodium chloride is used as it is cheap.
   iii. Nitric acid is not used as it is volatile.
   iv. Temperature is kept below 200^oC as above 200^oC,
      a. Sodium sulphate is formed, which form a hard crust on the glass and is difficult to remove.
      b. Fuel is wasted.
      c. Glass may crack.
   v. HCl is collected by the upward displacement of air. It is not collected over water, since it is highly soluble in water.
   vi. HCl gas is dried by passing through conc. Sulphuric acid. It is not dried by using P_2O_5 and CaO.

$$2P_2O_5 + 3HCl \rightarrow POCl_3 + 3HPO_3$$
$$CaO + 2HCl \rightarrow CaCl_2 + H_2O$$

2. Fountain experiment:
   i. Dropper is used in order to spray water inside the round bottomed flask. HCl get dissolved in water, to create a partial vacuum, which force the litmus solution to push inside the round bottomed flask.
   ii. The observation is blue litmus solution produce a red fountain inside the round bottomed flask.
   iii. Conclusion:
      a) HCl is highly soluble in water
      b) Aqueous solution of HCl is acidic in nature.
3. HCl gas is passed into water to produce Hydrochloric Acid. To do so an inverted funnel arrangement is used. The funnel arrangement is preferred as it-
   i. Prevent the back suction of water.
   ii. Provide a large surface area.
4. Reactions:

Property of HCl	Reaction	Observation
Acidic Property	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$	Colourless gas produced which burns with a pop sound.
	$ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$ $Zn(OH)_2 + 2HCl \rightarrow ZnCl_2 + 2H_2O$	
	$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2\uparrow$	Colourless gas produced which turns lime water milky but has no effect on acidic potassium dichromate solution.
	$Na_2SO_3 + 2HCl \rightarrow 2NaCl + H_2O + SO_2\uparrow$	Colourless gas with suffocating smell of burning sulphur produced which turns lime water milky and turns acidic potassium dichromate solution green from orange.
	$Na_2S + 2HCl \rightarrow 2NaCl + H_2S\uparrow$	Colourless gas with rotten egg smell produced which turns lead acetate paper black.
	$HCl + NH_3 \rightarrow NH_4Cl$	Dense white fumes of ammonium chloride
Precipitation reaction	• $Pb(NO_3)_2 + 2HCl \rightarrow PbCl_2 \downarrow + 2HNO_3$ • $Hg_2(NO_3)_2 + 2HCl \rightarrow Hg_2Cl_2 \downarrow + 2HNO_3$ • $AgNO_3 + HCl \rightarrow AgCl \downarrow + HNO_3$	• White ppt which is soluble in hot water. • White ppt • Curdy white ppt which is

		soluble in ammonium hydroxide but reappears on adding nitric acid.
Reducing nature	$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2\uparrow + 2H_2O$	Greenish yellow gas evolved which turns starch KI paper blue black.

5. Test for HCl gas:
   i. Physical test- Irritating smell
   ii. Produce dense white fumes when comes in contact with a glass rod dipped in ammonium hydroxide.
   $$HCl(g) + NH_3(g) \rightarrow NH_4Cl(s)$$
   iii. Both HCl(g) and acid produce a curdy white ppt when react with silver nitrate solution which is soluble in ammonium hydroxide but reappears on adding nitric acid.
   $$AgNO_3 + HCl \rightarrow AgCl\downarrow + HNO_3$$
   $$AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O$$
   diammine silver (I) chloride
6. Other points:
   i. HCl is a volatile monobasic acid.
   ii. It forms an azeotropic mixture at 110^oc with 22.2 % concentration.
   iii. Dilute HCl react with sodium thiosulphate solution to produce a yellow ppt and colouless gas with suffocating smell of burning sulphur which turns lime water milky and turns acidic potassium dichromate solution green from orange.
   $$Na_2S_2O_3 + 2HCl \rightarrow 2NaCl + H_2O + SO_2\uparrow + S\downarrow$$
   iv. HCl is a polar covalent compound which readily ionises in water to produce H^+ ion.
   v. A mixture of 1part by volume of conc HNO_3 and conc HCl is called aqua regia. It can dissolve Pt and Au.