Study of Compounds

Hydrogen Chloride

- In laboratory, hydrogen chloride gas is prepared by heating sodium chloride with concentrated sulphuric acid.
- It is also prepared by burning hydrogen gas in the atmosphere of chlorine gas or by exposing hydrogen gas and chlorine gas to diffused sunlight.
- It is colourless and pungent-smelling with sour taste and a very irritating odour.
- It is extremely soluble in water.
- Hydrogen chloride is neither combustible nor does it support combustion.
- On heating at above 500°C, it dissociates into hydrogen and chlorine.
- On mixing with ammonia gas, it forms dense white fumes due to formation of ammonium chloride.
- Aqueous solution of hydrogen chloride is called **hydrochloric acid**.
- It is prepared by dissolving hydrogen chloride in water.
- It reacts with metals to form respective chlorides and hydrogen gas.
- **Aqua regia** is a mixture of 3 parts of concentrated hydrochloric acid and 1 part of concentrated nitric acid. It is a very corrosive acid and is the only known acid that can dissolve gold.

Hydrochloric Acid

- It is acidic in nature and hence turns blue litmus paper red.
- It is prepared by dissolving hydrogen chloride in the water.

Properties

- It is a colourless and has pungent chocking smell.
- It forms metallic chloride with the release of hydrogen gas.

- It produces sulphur dioxide gas, sodium chloride, water and sulphur as yellow ppt. This reaction is used to distinguish thiosulphates and sulphites.
- It reacts with lead nitrate to give white precipitate of lead and mercury (I) chloride.
- It forms salt and water when reacts with oxides and hydroxides.
- When three parts of concentrated HCl and one part of concentrated HNO_3 are mixed, aqua regia is formed

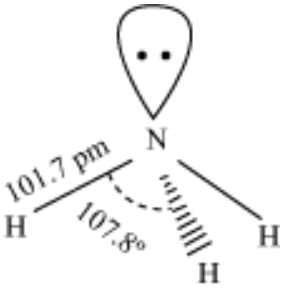
Used:

- For purifying bone black
- In medicines
- In cleaning metal surfacess and tanning
- As a reagent in laboratory

Ammonia

- On a small scale, ammonia is obtained from ammonium salts, which decompose when treated with caustic soda or lime. It forms metal salt, water, and ammonia gas.
- Ammonia can also be prepared by treating metal nitrides with warm water.

- It has trigonal pyramidal structure with nitrogen atom at the apex.



- **Forms**
  - Dry ammonia gas (gaseous ammonia)
  - Liquid ammonia (liquified ammonia)
  - Liquor ammonia fortis (saturated solution of ammonia in water)
  - Laboratory bench reagent (dilute solution of liquor ammonia)
- On large scale, ammonia is obtained by **Haber's process**.
  - Raw material: Mixture of hydrogen and nitrogen gases in the ratio 3:1
  - Pressure: 200 atm to 900 atm pressure
  - Temperature: 450 − 500°C
  - Catalyst: Finely divided iron
  - Promoter: molybdenum or Al_2O_3
- **Properties**:
  - It is a colourless non-poisonous gas with a characteristic pungent odour.

    - It is lighter than air and extremely soluble in water because of hydrogen bonding.
    - It can be liquefied when cooled to 10 ^{o} C under pressure of 6 atm. It forms white crystals on cooling.
    - It has basic nature because of the presence of lone pair of electrons.
    - It acts as a reducing agent.
    - Inhaling this gas causes irritation to the eyes and respiratory system.
- **Uses**:
    - Due to high dielectric constant, ammonia is a good solvent for ionic compounds.
    - It is used as a cleaning agent for removing grease in dry cleaning.
    - It is used in the manufacturing of artificial silk.
    - It is used as laboratory reagent.

Properties of Ammonia

- It is a colourless gas with a pungent odour.
- It is extremely soluble in water.
- It is oxidised in excess of oxygen with and without catalyst.
- All soluble salts of metals react with aqueous ammonia to form their respective insoluble hydroxide and ammonium salts.
- Ammonia is used in the production of various nitrogen fertilisers (ammonium nitrate, urea, ammonium phosphate, and ammonium sulphate).
- It decomposes at high temperature or by electric sparks.
- It forms ammonium salts when reacts with acids.
- Ammonia undergoes catalytic oxidation with platinum rods to form nitrogen dioxide.
- It is a good reducing agent.

Nitric acid

- It is prepared in laboratory by distilling equal parts of mixture of sodium nitrate or potassium nitrate with concentrated sulphuric acid.

- On a large scale, nitric acid is prepared by **Ostwald's process**.

- Nitric acid behaves as a strong acid in aqueous solution.

- Pure nitric acid is unstable towards heat and decomposes to form nitrogen dioxide.

- Metal oxides, hydroxides, carbonates, and hydrogen carbonates react with dilute nitric acid to form their respective soluble metallic nitrates.

- Nitric acid can oxidise most metals and non-metals.

- Nitrates are the salts of nitric acid with metals.
- They are prepared by treating metals and metallic compounds with nitric acid.
- All nitrates decompose on heating. The products of decomposition depend on the type of nitrate i.e., whether it is a metal or non-metal. It liberates reddish brown fumes of nitrogen dioxide. Thus, it can be used as a test for nitrates.
- Alkali metal nitrates decompose on heating to form respective nitrites and oxygen while heavy metal nitrates decompose on heating to form respective metallic oxides, nitrogen dioxide, and oxygen.

Sulphuric Acid

- Concentrated sulphuric acid is known as oil of vitriol. It occurs in free state in hot water of sulphur springs. In combined state, it occurs as mineral sulphates.
- Sulphuric acid is prepared by contact process. It involves burning of a pure and dry mixture of two parts of sulphur or sulphide ores and one part of air in the presence of vanadium pentoxide or platinised asbestos as catalyst.
- Chemical reactions of H_2SO_4 are because of its

1. low volatility
2. strong acidic character
3. strong affinity for water
4. ability to act as an oxidising agent

- Dilute sulphuric acid reacts with active metals, metal oxides, metal hydroxides, metal carbonates, metal sulphites to form their respective metal sulphates and acid sulphates.
- Because of low volatility, it can be used for the manufacture of more volatile acids from their corresponding salts.
- It is a strong dehydrating agent. Because of its strong affinity for water, sulphuric acid removes water from hydrated salts and organic compounds.
- Concentrated sulphuric acid is a moderately strong oxidising agent and can oxidise both metals and non-metals.