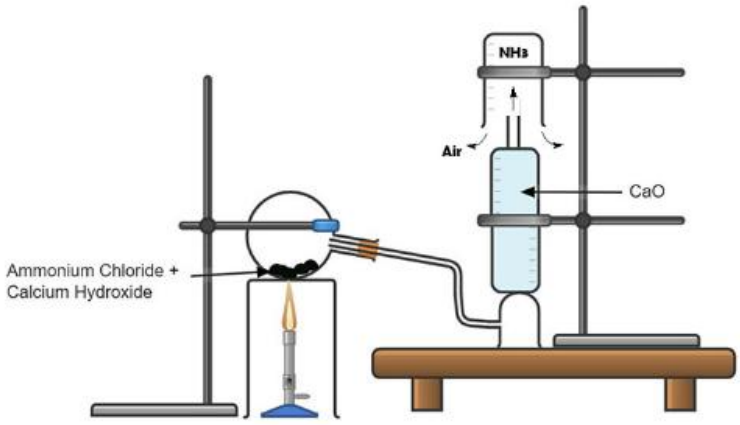
Ammonia

1. Laboratory preparation:



Loboratory Preparation of Ammonia

$$2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O + 2NH_3\uparrow$$

i. When ammonium salts are heated with strong alkali, ammonia gas is produced. [Strong alkali and produced a weaker alkali]

ii. But ammonium nitrate and nitrite cannot be used as they produce N_2O and N_2 when heated.

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$
$$NH_4NO_2 \rightarrow N_2 + 2H_2O$$

iii. $Ca(OH)_2$ is used as it is non deliquescent and cheap.

iv. Excess $Ca(OH)_2$ is used to counteract the loss of ammonium chloride by sublimation.

v. The mouth of the flask is tilted down so that the water formed in the reaction does not trickle back into the heating flask and break it.

vi. As ammonia is lighter than air it is collected by the downward displacement of air. As it is highly soluble in water, it is not collected over water.

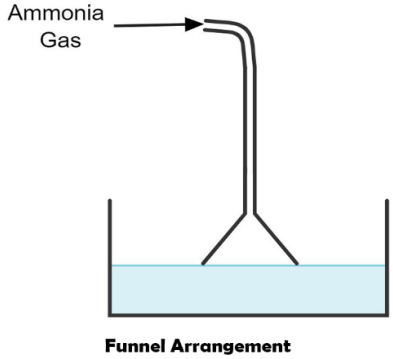
vii. Ammonia is dried by CaO. Ammonia cannot be dried by conc. sulphuric acid, phosphorous pentoxide and anhydrous $CaCl_2$.

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$
$$6NH_3 + P_2O_5 + 3H_2O \rightarrow 2(NH_4)_3PO_4$$
$$CaCl_2 + 4NH_3 \rightarrow CaCl_2.4NH_3$$

2. Magnesium and aluminium nitride when treated with warm water produce ammonia.

$$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$$
$$AlN + 3H_2O \rightarrow Al(OH)_3 + NH_3$$

3. Ammonia gas is passed into water to produce ammonium hydroxide. 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.



Funnel Arrangement

4. Industrial preparation of ammonia:

Name of the process	Haber's Process
Reaction	$N_2 + 3H_2 \rightleftarrows 2NH_3$
Temperature	450-500^oC
Pressure	200 atm
Catalyst	Fe
Promoter	Mo or Al_2O_3
Separation of ammonia from unreacted nitrogen and hydrogen by	i.Liquefaction ii.Absorbing ammonia in water

5. Fountain experiment:

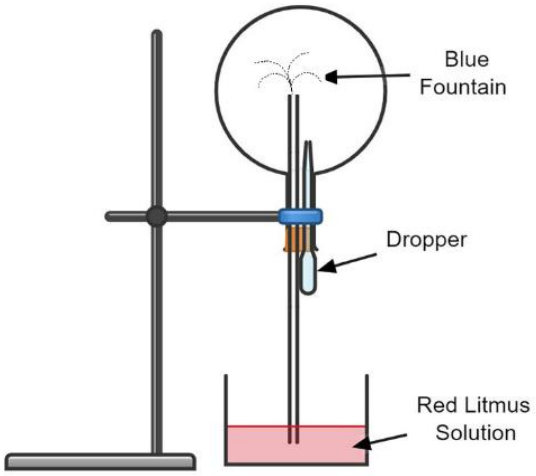
i. Dropper is used in order to spray water inside the round bottomed flask. Ammonia get dissolved in water, to create a partial vacuum, which force the litmus solution to push inside the round bottomed flask.

ii. The observation is red litmus solution produce a blue fountain inside the round bottomed flask.

iii. Conclusion:

a) Ammonia is highly soluble in water

b) Aqueous solution of ammonia is alkaline in nature.



6. Reactions:

Property of Ammonia	Reaction	Observation
	$4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$ (Oxidation of ammonia without catalyst)	Ammonia burns with a yellowish green flame
	$4NH_3 + 5O_2 \xrightarrow{Pt,\ 800\ ^oC} 6H_2O + 4NO$ $2NO + O_2 \rightarrow 2NO_2$ (Oxidation of ammonia with catalyst)	Reddish brown vapours produced.
Reducing nature	• $2NH_3 + 3CuO \rightarrow 3Cu + 3H_2O + N_2$ • $2NH_3 + 3PbO \rightarrow 3Pb + 3H_2O + N_2$	• Black solid produce a reddish brown residue. • Yellow solid produce a greyish residue.
	$8NH_3 + 3Cl_2 \rightarrow N_2 + 6NH_4Cl$ (Excess ammonia)	Yellowish green coloured chlorine gas disappears to form a white fumes.
	$NH_3 + 3Cl_2 \rightarrow 3HCl + NCl_3$ (Excess chlorine)	Yellow coloured explosive liquid formed.
Basic Nature	$NH_3 + HCl \rightarrow NH_4Cl$ $NH_3 + HNO_3 \rightarrow NH_4NO_3$ $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$	

7. Test for ammonia:

i. Physical property: Pungent smelling gas

ii. Ammonia produce a dense white fumes when comes in contact with a glass rod dipped in conc. HCl.

iii. Ammonia turns Nessler's reagent brown.

iv. Ammonia gas when passed through copper sulphate solution, a pale blue ppt. produced. When passed in excess an inky blue solution produced.

8. Other points:

i. Ammonia is a polar covalent compound.

ii. It is monoacidic in nature as it furnishes one hydroxyl ion.

$$NH_3 + H_2O \rightarrow NH_4OH$$

$$NH_4OH \rightleftharpoons NH_4^+ + OH^-$$