Separation of noble gases from air:

- Noble gases are separated by the following two methods. 1. Physico - Chemical methods
  2. Physical methods

Physico - chemical methods:

Chemical methods involve separation of noble gases from air and Physical method involves separation of noble gases from one another.

Ramsay - Rayleigh's first method:

- CO_2 is removed from air by passing through soda lime and potassium hydroxide solution.
- O_2 is removed by passing air through finely divided copper in a long tube.
- N_2 is removed by passing air over hot Mg ribbon.
- The process is repeated till oxygen and nitrogen are completely removed.

Ramsay - Rayleigh's second method:

- A 50 litre round bottomed flask is fitted with a five holed rubber cork.
- Platinum electrodes are introduced into two holes.
- NaOH solution is pumped into the flask through one hole and it emerges out of the flask through another hole.
- A mixture of dry air and oxygen mixed in the ratio 9:11 is passed into the flask through the other hole.
- Electricity is passed through the electrodes at a potential difference of 6000 to 8000 volts.
- N_2 and O_2 present in air combine to form the oxides of nitrogen, which are absorbed by NaOH solution.
- The mixture of noble gases contains a little oxygen which is removed by passing through alkaline pyrogallol solution.

  $N_2 + O_2 \rightarrow 2NO$

  $2NO + O_2 \rightarrow 2NO_2$

  $2NO_2 + 2NaOH \rightarrow NaNO_2 + NaNO_3 + H_2O$

Fischer - Ringe's method:

Air is passed through a mixture of 90% CaC_2 and 10% $CaCl_2$ heated to 800^0C in an iron tube.

$CaC_2 + N_2 \rightarrow CaCN_2 + C$

$C + O_2 \rightarrow CO_2$

$2C + O_2 \rightarrow 2CO$

N_2 and O_2 are thus removed from air.

CO is converted into CO_2 by passing over hot CuO and CO_2 is absorbed by KOH solution.

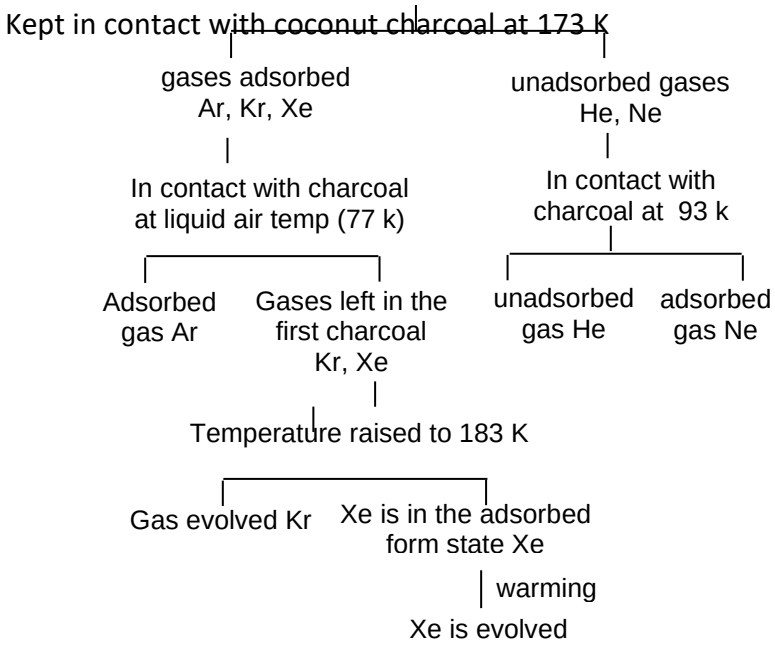
$CO + CuO \rightarrow Cu + CO_2$

$2KOH + CO_2 \rightarrow K_2CO_3 + H_2O$

Separation of noble gases from one another by Dewar's method (physical method)

- This method is based on the adsorption by activated charcoal.
- All the noble gases except helium can be adsorbed over activated charcoal.
- Adsorption of inert gas on the charcoal depends on temperature.
- Adsorption of inert gases on coconut charcoal increases with the increase of the atomic weight.
- Inert gas with low atomic weight is more adsorbed at low temperature.
- The mixture of inert gases is brought in contact with coconut charcoal kept in Dewar's flask at 173K.
- Ar, Kr and Xe are adsorbed and He and Ne remain unadsorbed at 173K.
- The unadsorbed He and Ne are seperated.
- The mixture of He and Ne is introduced into another bulb containing coconut charcoal at 93K
- At this temperature only Ne is adsorbed leaving behind helium which is seperated.
- Ne is recovered by warming the charcoal.
- The first charcoal having adsorbed Ar, Kr and Xe is brought in contact with another charcoal at 77 K.
- Ar, being a lighter gas diffuses into this charcoal at 77 K and is recovered by warming separately.
- The temperature of the first charcoal at 77 K and is recovered by warming separately.
- The temperature of the first charcoal containing Kr and Xe is raised to 183 K.
- At this temperature Kr comes out of the charcoal.
- Xe which is in the adsorbed state is recovered by warming the charcoal.

Schematic representation of separation of noble gases: Noble gas mixture - He, Ne, Ar, Kr, Xe



Separation of noble gases from liquid air:

- Based on the difference in boiling points, noble gases can be separated from liquid air and from one another by fractional evaporation method.
- B.P. order: He < Ne < N_2 < Ar < O_2 < Kr < Xe
- The process is done in Claude's apparatus.
- Liquid air on fractional distillation gives two fractions. The entire process is schematically represented below.

Isolation of Argon, Krypton and Xenon :