Introduction

Noble gases belong to 'O' group and P - block.

- Helium, Neon, Argon, Krypton, Xenon and Radon are collectively known as noble gases or Aerogens or rare gases.
- They have completed s and p orbitals in the outer shell.
- As they are chemically inert these are known as inert gases.
- Since some compounds of these elements are prepared recently they are rightly called as noble gases instead of inert gases.
- As they are rarely present in nature they are called rare gases.
- These elements are also known as aerogens because they are available in air
- These elements are placed in between the most electronegative halogens and the most electropositive alkali metals.
- These elements Show 'O' oxidation state.
- Every period starts with + 1 oxidation state and ends with - 1 oxidation state. The presence of noble gases with 'O' oxidation state in between them is justified.
- All these elements have the general electronic configuration $ns^2\ np^6$ in their valence shell except helium, which has$1s^2$ configuration.
- He has no penultimate shell

  Ne has 2 electrons in penultimate shell

  Ar has 8 electrons in penultimate shell

  Kr, Xe, Rn have 18 electrons in penultimate shell

  The only element which has 32 electrons in the anti penultimate shell is Radon.

Discovery of noble gases:

- Helium was discovered in the chromosphere of sun during the total solar ecclipse by Janssen and Lockyer. D_3 line in the spectrum is related to Helium. Helios means sun.
- Later this gas was separated from nitrogen by Ramsay.
- Raleigh discovered argon in atmospheric nitrogen. He first noticed nitrogen obtained from air is heavier than pure nitrogen and it may be due to the presence of some heavier gas.
- Argon means lazy
- Later it was found that the argon obtained from air is a mixture of several inert gases.
- Ramsay and Travers isolated 16 litres of liquid argon from the atmospheric nitrogen and subjected to fractional distillation at different reduced pressures and separated Neon. Neon means new.
- Ramsay evaporated one litre of liquid air untill a very small amount is left over.

- The spectrum of the small amount of liquid air indicated the presence of a new element and named it as krypton. Krypton means hidden.
- Ramsay separated yet another element from krypton by fractional distillation and named it as xenon. Xenon means stranger.
- Radon was discovered from the radioactive disintegration of radium.

Occurrence:

- Except radon all the noble gases occur in free state in atmospheric air, sun, stars, natural gas etc.
- Helium is present in natural gas to an extent of 2%.
- It is found in minerals in occluded form.
- % by volume in air: Ar > Ne > Kr > He > Xe
- % by weight in air: Ar > Ne > Kr > Xe > He

Physical properties:

- These are colourless, odourless and tasteless gases.
- All these are monoatomic gases.
- Density melting point boiling points atomic weight and atomic radius increase down the group with increase in atomic number.
- There are weak Vanderwaal's forces of attraction between the atoms.
- Vanderwaal's forces increase with the increase in size of the atoms.
- These elements have the highest ionization potentials in the periodic table due to stable configuration.
- He has the highest ionization potential in the periodic table.
- Ionization potential decreases with the increase in atomic size down the group.
- These elements have 'zero' electron affinity due to the completely filled S and P orbitals.
- Heat of vaporisation increases from He to Rn.
- Solubility in water increases from He to Rn.
- Least soluble and least readily liquifiable gas among all the known gases is He.
- The ease of liquification increases from He to Rn with the increase in Vanderwaal's forces of attraction.
- At 4.2K He can be condensed to a liquid called helium - 1.
- When it is cooled to 2.2 K it gives another liquid Helium-ll which possesses the properties of a gas.
- Helium-ll shows unusual properties and has extremely low viscosity and very high thermal conductivity.

- It has been termed as a degenerate gas or a fourth state of matter of a superfluid and it flows upwards.
- Xenon hexafluoro platinate $XePtF_6$ was the first noble gas compound reported by N. Bartlett.

Reactivity:

- He and Ne are chemically inert and they do not form any compounds. Their chemical inertness is due to very high ionization potential, zero electron affinity and the absence of vacant d-orbitals in valence shell.
- Ar, Kr and Xe will show some reactivity due to low ionization potentials and presence of vacant d-orbitals in valence shell.
- Xe is more reactive than Ar and Kr due to it's low ionisation potential.
- Radon is radioactive and it will not show chemical reactivity.
- Xe shows tendency to lose electrons in many of it's reactions. Therefore, Xe combines with only more electronegative elements like F and O' or electronegative groups like $OSeF_5$ and $OTeF_5$.
- Xe does not combine with less electronegative elements like Cl_2or N_2.