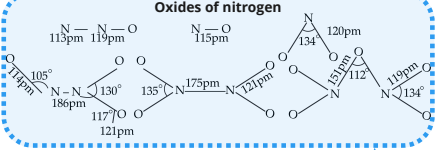
Class : 12th Chemistry
Chapter-7 : The P- Block Elements (Part_1)

Oxides of nitrogen



Physical properties

Polyatomic, metallic character increases down the group. N and P are non-metals, As and Sb metalloids and Bi metal. B.P increases top to bottom and M.P. increases upto As and then decreases upto Bi. Except Ni all show allotropy

Dinitrogen preparation

- **In laboratory:**

$$NH_4Cl + NaNO_2 \longrightarrow N_2 + 2H_2O + NaCl$$

- **Thermal decomposition:**

$$(NH_4)_2Cr_2O_7 \xrightarrow{Heat} N_2 + 4H_2O + Cr_2O_3$$

$$Ba(N_3)_2 \longrightarrow Ba + 3N_2$$

- **Properties:**

$$6Li + N_2 \xrightarrow{\Delta} 2Li_3N$$

$$3Mg + N_2 \xrightarrow{\Delta} Mg_3N_2$$

$$N_2 + 3H_2 \xrightarrow{773K} 2NH_3\ \Delta_fH^\circ = 46.1\ KJ\ mol^{-1}$$

$$N_2 + O_2 \xrightarrow{\Delta} 2NO$$

Ammonia Preparation

$$NH_4CO\ NH_2 + 2H_2O \longrightarrow (NH_4)_2CO_3 \rightleftharpoons 2NH_3 + H_2O + CO_2$$

$$N_2 + 3H_2 \rightleftharpoons 2NH_3\ \Delta_fH^\circ = -46.1\ kJ\ mol^{-1}$$

Properties: Colourless with pungent odour, soluble in water

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

$$ZnSO_4 + 2NH_4OH \longrightarrow Zn(OH)_2 + (NH_4)SO$$

(white ppt)

$$FeCl_3 + NH_4OH \longrightarrow Fe_2O_3.xH_2O + NH_4Cl$$

(Brown ppt)

The P- Block Elements

Group 15 Elements

Electronic Configration
ns^2np^3

Elements
$_7N$, $_{15}P$, $_{33}As$, $_{51}Sb$, $_{83}Bi$

Ionization enthalpy
Decreases down the group due to gradual increase in atomic size.

Chemical properties
Common O.N : –3, +3 and +5. Nitrogen shows anomalous behaviour.

Electro-negativity
Decreases down the group with increasing atomic size.

Atomic and Ionic radii
Increase in size down the group.

Group 16 Elements

Electronic configuration : ns^2np^4

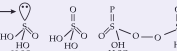
Atomic and ionic radii : Increase down the group

- IE : Decreases down the group
- Electron Gain enthalpy : O hass less–ve than S.
- Electro-negativity : Decreases with increase in atomic number
- Physical properties : O and S are non metals, Se and Te metalloids whereas Po is a metal. All exhibit allotropy
- M.P. and B.P. : Increases down the group
- Chemical properties : variable

  Reactivity with hydrogen : stable hydrides

  Reactivity with halogens : $F^- > Cl^- > Br^- > I^-$

- Oxoacids of S :—→



- Dioxygen (O_2) :

Preparation : $2KClO_3 \xrightarrow[MnO_2]{\Delta} 2KCl + 3O_2$

Properties : Colourless and odourless gas

$$2Ca + O_2 \longrightarrow 2CaO;\ 4Al + 3O_2 \longrightarrow 2AlO_3$$

$$2SO_2 + O_2 \xrightarrow{V_2O_5} 2SO_3;\ 4HCl + O_2 \xrightarrow{CuCl} 2Cl + 2H_2O$$

Group 18 Elements

- Occurrence: All except radon occur in atmosphere
- Electronic configuration: $ns^2 np^6$ except He
- IE : High
- Atomic radii: Increases down group
- Electron gain enthalpy: Largely positive
- Physical properties: Monoatmic, colourless, odorless and tasteless. Sparingly soluble in water.
- Chemical properties: Least reactive xenone-fluorine compound: XeF_2, XeF_4 and XeF_6
- Xenone oxygen compounds: XeO_3, $XeOF_2$, $XeOF_4$

The P- Block Elements

Chemical properties

Allexhibit – 1oxidation state Cl, Br andlexhibit+1, +3,+5and + 7.O.N
Reactivity towards hydrogen : H – F > H – Cl > H – Br > H – I
Reactivity towards oxygen : F form OF_2(stable) and O_2F_2
Reactivity towards metals : MF > MCl > MBr > MI
Reactivity towards other halogens: Forms XX', XX'_3, XX'_5 and XX'_7.

Group 17 Elements

Occurrence
F and Cl are fairly abundant while Br and I less so

Electron gain enthalpy
Less –ve down the group

Electronic configuration
ns^2np^5

Electro-negativity
High, decreases down the group

Atomic Ionic radii
Smallest in periods but increases from F to I

Physical properties
F and Cl are gases, Br is liquid and I solid

M.P. and B.P.
Increases with atomic number

IE
Decreases down the group

Chlorine

Preparation: $MnO_2 + 4HCl \longrightarrow MnCl_2 + Cl_2 + 2H_2O$

Deacon's process: $4HCl + O_2 \xrightarrow[CuCl_2]{} 2Cl_2 + 2H_2O$

Properties : Greenish yellow gas with pungent and suffocating odour.

Heavier than air

$2Al + 3Cl_2 \longrightarrow 2AlCl_3$
$H_2 + Cl_2 \longrightarrow 2HCl$
$H_2S + Cl_2 \longrightarrow 2HCl + S$
$8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$
$2NaOH + Cl_2 \longrightarrow NaCl + NaOCl + H_2O$
(cold and dilute)
$2Ca(OH)_2 + 2Cl_2 \longrightarrow Ca(OCl)_2 + CaCl_2 + 2H_2O$
$CH_4 + Cl_2 \xrightarrow{uv} CH_3Cl + HCl$
$C_2H_4 + Cl_2 \xrightarrow{RT} C_2H_4Cl_2$
$2FeSO_4 + H_2SO_4 + Cl_2 \longrightarrow Fe_2(SO_4)_3 + 2HCl$