MASTERJEE CLASSES

ESSENTIAL CONCEPTS OF INORGANIC CHEMISTRY

Get well-prepared for exams with quick revision of important concepts of inorganic chemistry.

CONCEPT MAP

CLASS XII

General Principles and Processes of Isolation of Elements

Main steps involved in extraction of metals :

- **Concentration of the ore :** *Hydraulic separation* (based on difference in densities of ore) : for oxide ores; *Froth floatation* (based on preferential wetting of ore (by oil) and gangue (by water)) : for sulphide ores; *Electromagnetic separation* (based on difference in magnetic properties) : for magnetic impurities/ores; *Leaching* : chemical method.
- **Conversion of ore to oxide :** *Calcination* (limited supply or in absence of air) : for carbonates and hydrated oxides; *Roasting* (in excess of air) : for sulphide ores.
- **Reduction of oxide to free metal :** *Smelting* : Reduction with carbon; *Alumino-thermite process* : Reduction with Aluminium; *Auto-reduction* : for less electropositive metals; *Electrometallurgy* : Electrolysis of fused oxide.
- **Refining of crude metals :** *Liquation* : for metals having low boiling points; *Distillation* : for volatile metals; *Poling* : for metals having own oxides as impurities; *Electrorefining* : for Cu, Ag, Au, Ni, Cr, Al; *Zone refining* : for Si, Ge, Ga.; *van-Arkel method* : for Ti and Zr; *Chromatography* : for elements available in minute quantities (coloured pigments). *Cupellation* : used when impurities of metals present, forms volatile oxides.

d - and *f*-Block Elements

- ***d*-block elements :** $(n-1)d^{1-10}ns^{0-2}$
  - $3d$ series : $_{21}Sc - _{30}Zn$; $4d$ series : $_{39}Y - _{48}Cd$
    $5d$ series : $_{57}La, _{72}Hf - _{80}Hg$; $6d$ series : $_{89}Ac, _{104}Rf - _{112}Cn$
  - Acidic character : $\underset{+2}{MnO} < \underset{+8/3}{Mn_3O_4} < \underset{+3}{Mn_2O_3} < \underset{+4}{MnO_2} < \underset{+7}{Mn_2O_7}$
  - Ionic character : $MnO > Mn_3O_4 > Mn_2O_3 > MnO_2 > Mn_2O_7$

    $\underbrace{MnO \quad Mn_2O_3}_{\text{Basic}} \quad \underbrace{MnO_2}_{\text{Amphoteric}} \quad \underbrace{MnO_3 \quad Mn_2O_7}_{\text{Acidic}}$
  - Colors :

Ti^{3+}	V^{3+}	Mn^{3+}	Fe^{3+}	Fe^{2+}	Cu^{2+}	Co^{2+}	Ni^{2+}
Purple	Green	Violet	Yellow	Green	Blue	Pink	Green

- ***f*-block elements :** $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$
  - Lanthanides or $4f$-series : Ce($Z = 58$) to Lu ($Z = 71$)
  - Actinides or $5f$-series : Th($Z - 90$) to Lr ($Z - 103$)
  - $La(OH)_3$ to $Lu(OH)_3$: Basicity decreases
  - $La^{3+}(4f^0)$, $Gd^{3+}(4f^7)$, $Lu^{3+}(4f^{14})$ → Colourless.
  - Colors :

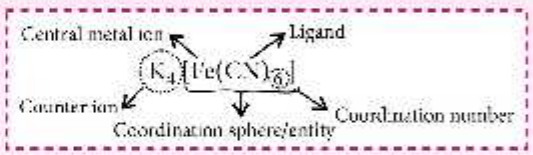
$Pr^{3+}(4f^2)$	$Tm^{3+}(4f^{12})$	$Na^{3+}(4f^3)$	$Sm^{3+}(4f^5)$
Green	Green	Pink	Yellow

  - $Ce^{3+}(4f^1)$ and $Yb^{3+}(4f^{13})$ } Colourless despite of having unpaired electrons (exceptions).

The *p* - Block Elements

- **Group 15 (Nitrogen family) :** ns^2np^3
  Bond angle, Thermal stability and Basic strength : $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$
  - Boiling point : $PH_3 < AsH_3 < NH_3 < SbH_3 < BiH_3$
  - Melting point : $PH_3 < AsH_3 < SbH_3 < NH_3$
  - Reducing nature : $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$
  - Bond angle : $PF_3 < PCl_3 < PBr_3 < PI_3$
  - Lewis acid strength : $PCl_3 > AsCl_3 > SbCl_3$; $PF_3 > PCl_3 > PBr_3 > PI_3$
- **Group 16 (Oxygen family) :** ns^2np^4
  - Bond angle and Thermal stability : $H_2O > H_2S > H_2Se > H_2Te$
  - Volatility : $H_2S > H_2Se > H_2Te > H_2O$
  - Acidic strength and Reducing nature : $H_2O < H_2S < H_2Se < H_2Te$
  - Stability : $SF_6 > SeF_6 > TeF_6$
- **Group 17 (Halogen family) :** ns^2np^5
  - Oxidising power : $F_2 > Cl_2 > Br_2 > I_2$
  - Boiling point : $HCl < HBr < HI < HF$
  - Melting point : $HCl < HBr < HF < HI$
  - Dipole moment and Thermal stability : $HF > HCl > HBr > HI$
  - Bond length, Acidic strength and Reducing nature : $HF < HCl < HBr < HI$
  - Acidic strength : $HClO < HClO_2 < HClO_3 < HClO_4$; $HClO > HBrO > HIO$; $HClO_4 > HBrO_4 > HIO_4$
  - Oxidising power : $HClO > HClO_2 > HClO_3 > HClO_4$
- **Group 18 (Noble gases) :** ns^2np^6
  - Melting and boiling points, Ease of liquefaction, Solubility, Adsorption and Polarisability : He < Ne < Ar < Kr < Xe < Rn
  - Thermal conductivity : He > Ne > Ar > Kr > Xe

Coordination Compounds



- **EAN Rule (Effective Atomic Number):**
  EAN = $Z_{(\text{Metal atom})}$ − Oxidation number of metal + 2 × Coordination number
- **Spectrochemical series :** (Increasing order of CFSE)
  $I^- < Br^- < SCN^- < Cl^- < F^- < OH^- < C_2O_4^{2-} < O^{2-} < H_2O < NCS^- < EDTA^{4-} < NH_3 < en < NO_2^- < CN^- < CO$
- $\mu = \sqrt{n(n+2)}$ B.M.
- If $\Delta_o < P$, high spin complex, if $\Delta_o > P$, low spin complex.
- CFSE = $(-0.4x + 0.6y)\Delta_o$, $\Delta_t = 4/9\,\Delta_o$
  where, x = no. of e^-s in t_{2g} orbitals, y = no. of e^-s in e_g orbitals.)