Transition and inner transition elements Summary

- IUPAC defines transition metal as an element whose atom has an incomplete d sub shell or which can give rise to cations with an incomplete d sub shell. They occupy the central position of the periodic table, between s and p block elements,
- d- Block elements composed of 3d series (4th period) Scandium to Zinc (10 elements), 4d series (5th period) Yttrium to Cadmium (10 elements) and 5d series (6th period) Lanthanum, Haffinium to mercury.
- the general electronic configuration of d- block elements can be written as

  [Noble gas] $(n-1)d^{1-10}ns^{1-2}$,

  Here, $n = 4$ to 7. In periods 6 and 7, the configuration includes

  $((n-2)f$ orbital ; [Noble gas] $(n-2)f^{14}(n-1)d^{1-10}ns^{1-2}$.
- All the transition elements are metals. Similar to all metals the transition metals are good conductors of heat and electricity. Unlike the metals of Group-1 and group-2, all the transition metals except group 11 elements are hard.
- As we move from left to right along the transition metal series, melting point first increases as the number of unpaired d electrons available for metallic bonding increases, reach a maximum value and then decreases, as the d electrons pair up and become less available for bonding.
- Ionization energy of transition element is intermediate between those of s and p block elements. As we move from left to right in a transition metal series, the ionization enthalpy increases as expected.
- The first transition metal Scandium exhibits only +3 oxidation state, but all other transition elements exhibit variable oxidation states by loosing electrons from (n-1)d orbital and ns orbital as the energy difference between them is very small.
- In 3d series as we move from Ti to Zn, the standard reduction potential $\left(E^0_{M^{2+}/M}\right)$ value is approaching towards less negative value and copper has a positive reduction potential. i.e., elemental copper is more stable than Cu^{2+}.

- Most of the compounds of transition elements are paramagnetic. Magnetic properties are related to the electronic configuration of atoms.
- Many industrial processes use transition metals or their compounds as catalysts. Transition metal has energetically available d orbitals that can accept electrons from reactant molecule or metal can form bond with reactant molecule using its d electrons.
- Transition metals form a number of interstitial compounds such as TiC, $ZrH_{1.92}$, Mn_4N etc .
- Transition elements have a tendency to form coordination compounds with a species that has an ability to donate an electron pair to form a coordinate covalent bond.
- In the inner transition elements there are two series of elements. 1) Lanthanoids (previously called lanthanides) 2) Actinoids (previously called actinides)
- Lanthanoids have general electronic configuration $[Xe]\ 4f^{1-14}\ 5d^{0-1}\ 6s^2$
- The common oxidation state of lanthanoides is +3
- As we move across 4f series, the atomic and ionic radii of lanthanoids show gradual decrease with increse in atomic number. This decrese in ionic size is called lanthanoid contraction.
- The electronic configuration of actinoids is not definite. The general valence shell electronic configuration of 5f elements is represented as $\left[Rn\right]5f^{2-14}6d^{0-2}7s^2$.
- Like lanthanoids, the most common state of actinoids is +3. In addition to that actinoids show variable oxidation states such as +2 , +3 , +4 ,+5,+6 and +7.