"बेटी बचाओ, बेटी पढ़ाओ"

JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Faculty of Education & Methodology

Faculty Name	-	JV'n Dr. Mangat Singh (Assistant Professor)
Program	-	V/2023-Semester / Year
Course Name	-	(B.Sc. B.Ed. ZBC/PCM)-V-SEM

Academic Day starts with –

- Greeting with saying **'Namaste'** by joining Hands together following by 2-3 Minutes Happy session, Celebrating birthday of any student of the respective class and **National Anthem**.

Lecture Starts with -

- Topic will be discussed- **General Properties of d-Block elements**
- Introduction & Brief Discussion about the Topic

Transition elements (TE) exhibit almost similar properties because of the similar electronic configuration of their peripheral shell. This happens due to the addition of each new electron to the penultimate 3d shell. By this the effective nuclear charge increases and therefore shields between the nucleus and the outer 4s shell electron increase.

- University Library Reference- *Concise Inorganic Chemistry by J D Lee*
- Questions to check the understanding level of students-

1. Why are E- values for Mn, Ni and Zn more negative than expected?
2. Why is the first ionization enthalpy of Cr is lower than that of Zn?
3. Transition elements show high melting points. Why?
4. Explain why does color of $KMnO_4$, disappears when oxalic acid is added to its solution in an acidic medium.
5. Reactivity of transition elements decreases almost regularly from Sc to Cu. Explain.

- Small Discussion About Next Topic- ***F-block elements***

General Properties of d-Block elements

Transition elements (TE) exhibit almost similar properties because of the similar electronic configuration of their peripheral shell. This happens due to the addition of each new electron to the penultimate 3d shell. By this the effective nuclear charge increases and therefore shields between the nucleus and the outer 4s shell electron increase. The general properties of the transition elements are as follows:

- Form stable complexes
- Exhibit high melting and boiling points
- Contain a large charge/radius ratio
- Form generally paramagnetic compounds
- They are hard in nature and possess high densities due to their smaller size
- Exhibits profound catalytic activity due to variable oxidation states
- Show variable oxidation states
- Form colored complexes due to unpaired electrons which undergo d-d transitions.

Metallic Nature

Transition elements have unpaired electrons in the 3d-orbital and therefore demonstrate the qualities of metals, such as ductility and malleability. They are excellent conductors of electricity and heat due availability of free electrons. Except for Mercury, which is fluid all other transition elements are hard and brittle.

Melting and boiling points

Transition elements show high melting and boiling points. This is associated with the overlapping of (n-1)d orbitals and the formation of covalent bonding of the unpaired d orbital electrons. The elements, **Zn, Cd,** and **Hg** have completely filled (n-1)d orbitals and therefore they cannot frame covalent bonds. Thus, they have a **lower melting point than** other *d*-block elements.

Ionic Radii

The transition elements have a significantly higher density than the s-block elements. Their densities decrease graduallyfrom Sc to Cu because of an irregular decrease in metallic radii and simultaneously increase in increase in atomic mass. The ionic radius pattern of is Transition elements similar to that of their atomic radii pattern. Hence, for ions of thesame charge, the ionic radius decreases gradually with an increase in atomic number.

Ionization Potential

The ionization potential value of d-block elements lies in between the elements belonging to s and p-block. They are less electropositive than the *s*-block elements. Henceforth, they do not frame ionic compounds but can form covalent compounds. The high ionization energy is associated with their small size.The ionization potential of *d*-block elements increases from left to right. The ionization energies (IE) of the elements of the first transition series increasedue to an increase in the effective nuclear charge. For example, Cr and Cu have higher energies than their neighbors.

Electronic configuration

The external electronic configuration is consistent. There is a gradual filling of 3d orbitals across the series starting from scandium. The exception behavior in the electronic configuration is observed in chromium and copper, as they acquire stable half-filled and fully-filled electronic configurations. In Cr, both the 3d and 4s orbitals have electrons, but none of the orbitals is completely filled. This concluded that the energies of both 3d and 4s orbitals are comparatively close for atoms in this row. The general electronic configurations of 3d, 4d, and 5d series elements are given below:

First series: $1s^2 2s^2 p^6 3s^2 p^6 d^{1\text{-}10} 4s^2$

Second series: $1s^2 2s^2 p^6 3s^2 p^6 d^{1\text{-}10} 4s^2 p^6 d^{1\text{-}10} 5s^2$

Third series: $1s^2 2s^2 p^6 3s^2 p^6 d^{1\text{-}10} 4s^2 p^6 d^{1\text{-}10}\ 5s^2 p^6 d^{1\text{-}10} 6s^2$

An orbital of lower energy is filled first. Therefore, 4s orbital is lower in energy and therefore filled first to its full degree. After the filling of the 4s orbital, the 3d orbital with higher energy is filled. The precisely, half-filled, and totally filled d-orbitals are exceptionally stable.

Oxidation state

All the transition elements, of the 3d series (Except Sc and Zn) show variable oxidation states. The oxidation state of 3d-elements increases from their common oxidation states (+2) at first to a maximum level up to +7 in the middle of the series.

The elements scandium through manganese (Sc to Mn), show the highest oxidation state (+7) as their valence shell shows loss of all of the electrons in both the *s* and *d* orbitals. Iron forms oxidation states from 2+ to 6+. Elements in the first transition series form ions with a charge of 2+ or 3+. However, elements of the 4d and 5d series generally are more stable in higher oxidation states than the elements of the 3d series.