Unit

8

The *d*- and *f*-Block Elements

d-BLOCK ELEMENTS

- The elements that lie in between *s*-block and *p*-block elements are called transition elements as they show transitional properties between *s* and *p*-block elements.

  It means *d* and *f*-block elements are collectively known as transition elements, however these are distinguished from each other as outer and inner transition metals respectively. *d*-block elements are simply known as transition elements.

  d-block elements in their ground state or in most common oxidation state have partially filled *d*-orbitals. General electronic configuration of *d*-block elements is $(n-1)\,d^{1\text{-}10}\,ns^{0\text{-}2}$.

  It is obvious from the electronic configuration that in transition elements valence electrons are present in outermost shell as well as $(n-1)$ *d*-orbital *i.e.* penultimate (last but one) shell.

Classification of *d*-Block Elements

- Classification of *d*-block elements : In the periodic table, there are four main transition series of elements corresponding to filling of 3*d*, 4*d*, 5*d* and 6*d* subshells in 4th, 5th, 6th and 7th periods.

Series	Elements
First transition series or 3*d* series	Sc (At. no. 21) to Zn (At. no. 30)
Second transition series or 4*d* series	Y (At. no. 39) to Cd (At. no. 48)
Third transition series or 5*d* series	La (At. no. 57), Hf (At. no. 72) to Hg (At. no. 80)
Fourth transition series or 6*d* series	Ac (At. no. 89), Rf (At. no. 104) to Uub (At. no. 112)

Electronic Configuration

- **First transition series (3*d*) :**

Element	Symbol	Electronic Configuration
Scandium	Sc (21)	[Ar] $3d^1\ 4s^2$
Titanium	Ti (22)	[Ar] $3d^2\ 4s^2$
Vanadium	V (23)	[Ar] $3d^3\ 4s^2$
Chromium*	Cr (24)	[Ar] $3d^5\ 4s^1$
Manganese	Mn (25)	[Ar] $3d^5\ 4s^2$
Iron	Fe (26)	[Ar] $3d^6\ 4s^2$
Cobalt	Co (27)	[Ar] $3d^7\ 4s^2$
Nickel	Ni (28)	[Ar] $3d^8\ 4s^2$
Copper*	Cu (29)	[Ar] $3d^{10}\ 4s^1$
Zinc	Zn (30)	[Ar] $3d^{10}\ 4s^2$

- **Second transition series (4*d*) :**

Element	Symbol	Electronic Configuration
Yttrium	Y (39)	[Kr]$4d^1\ 5s^2$
Zirconium	Zr (40)	[Kr]$4d^2\ 5s^2$
Niobium*	Nb (41)	[Kr] $4d^4\ 5s^1$
Molybdenum*	Mo (42)	[Kr] $4d^5\ 5s^1$
Technetium	Tc (43)	[Kr] $4d^5\ 5s^2$
Ruthenium*	Ru (44)	[Kr] $4d^7\ 5s^1$
Rhodium*	Rh (45)	[Kr] $4d^8\ 5s^1$
Palladium*	Pd (46)	[Kr] $4d^{10}\ 5s^0$
Silver*	Ag (47)	[Kr] $4d^{10}\ 5s^1$
Cadmium	Cd (48)	[Kr] $4d^{10}\ 5s^2$

- **Third transition series (5*d*) :**

Element	Symbol	Electronic Configuration
Lanthanum	La (57)	[Xe]$5d^1\ 6s^2$
Hafnium	Hf (72)	[Xe]$4f^{14}\ 5d^2\ 6s^2$
Tantalmn	Ta (73)	[Xe]$4f^{14}\ 5d^3\ 6s^2$
Tungsten	W (74)	[Xe]$4f^{14}\ 5d^4\ 6s^2$
Rhenium	Re (75)	[Xe]$4f^{14}\ 5d^5\ 6s^2$
Osmium	Os (76)	[Xe]$4f^{14}\ 5d^6\ 6s^2$
Iridium	Ir (77)	[Xe]$4f^{14}\ 5d^7\ 6s^2$
Platinum	Pt (78)	[Xe]$4f^{14}\ 5d^9\ 6s^1$
Gold	Au (79)	[Xe]$4f^{14}\ 5d^{10}\ 6s^1$
Mercury	Hg (80)	[Xe]$4f^{14}\ 5d^{10}\ 6s^2$

*Exceptional electronic configurations due to extra stability of half filled and fully filled orbitals.