THE D-AND F-BLOCK ELEMENTS

INTRODUCTION OF D-BLOCK ELEMENTS

❖ **TRANSITION ELEMENTS (D&F BLOCK ELEMENTS)**

D-BLOCK ELEMENTS

INTRODUCTION

(a) The element lying between s- and p-block element of the periodic table are collectively known as transition or transitional elements. (T.E'.S.)

(b) Their properties are transitional between the highly electropositive s- block element to least electropositive p-block element.

(c) In d- block elements, the last differentiating electron is accommodated to the penultimate shell.

(d) The general electronic configuration of transition element is $(n-1)d^{1-10}\ ns^{0,\ 1\ or\ 2}$

(e) These elements either in their atomic state or in any of their common oxidation state have partly filled (n-1)d orbitals of $(n-1)^{th}$ main shell.

(f) The transition elements have an incompletely filled d-level. Since Zn, Cd, Hg elements have d^{10} configuration and are not considered as transition elements but they are d-block elements.

Electronic Configuration

Ist Transition Series

Symbol	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Atomic No.	21	22	23	24	25	26	27	28	29	30
3d electrons	1	2	3	5	5	6	7	8	10	10
4s electrons	2	2	2	1	2	2	2	2	1	2

Irregular electronic configuration Cr, Cu

IInd Transition Series

Symbol	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd
Atomic No.	39	40	41	42	43	44	45	46	47	48
4d electrons	1	2	4	5	5	7	8	10	10	10

5s electrons	2	2	1	1	2	1	1	0	1	2

Irregular electronic configuration Nb, Mo, Ru, Rh, Pd, Ag

IIIrd Transition Series

Symbol	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg
Atomic No.	57	72	73	74	75	76	77	78	79	80
5d electrons	1	2	3	4	5	6	7	9	10	10
6s electrons	2	2	2	2	2	2	2	1	1	2

Irregular electronic configuration W, Pt, Au

GENERAL PROPERTIES OF D-BLOCK ELEMENTS

(a) The properties of d-block elements of any given period are not so much different from one another as those of the same period of non-transition elements.

(b) It is due to the fact that, in transition series, there is no change in number of electrons of outermost shell and only change occur in (n-1)d electron from member to member in a period.

Metallic Character

(a) All the d-block elements are metals as the numbers of electrons in the outer most shell are one or two.

(b) They are hard, malleable and ductile (except Hg). IB group elements Cu, Ag and Au are most ductile and soft.

(c) These are good conductor of heat and electricity (due to free e^{-}) Elements of IB group are most conductive in nature. Their order of conductivity is

$$Ag > Cu > Au > Al$$

(d) Covalent and metallic bonding both exist in the atom of transition metals.

(e) The presence of partially filled d-subshell favour covalent bonding and metallic bonding. These bonding are favorable also due to possession of one or two electron in outermost energy shell.

Reducing Power

(a) Reducing power of d-block elements depends on their electrode potential.

(b) Standard oxidation potential (SOP) of Cu is minimum in the 3d series so it is least reducing elements in 3d series.

(c) Au is the least reducing element in the d-block because of highest +ve value of Standard reduction potential.

(d) The poor reducing capacity of the transition metal is due to high heats of vaporization, high ionization potential and low heat of hydration of their ions, because reduction potential depends upon all these three factors.

Density

(a) The atomic volume of the transition elements are low, compared with s-block, so their density is comparatively high ($D = M/V$)

(b) Os (22.57 gm cm^{-3}) and Ir (22.61 gm cm^{-3}) have highest density.

(c) In all the groups (except IIIB) there is normal increase in density from 3d to 4d series, and from 4d to 5d, it increases just double. Due to lanthanide contraction

Ex. $Ti < Zr << Hf$

(d) In 3d series

Sc Ti V Cr Mn Fe Co Ni — Density increases; Cu Zn — Density decreases

(e) In 3d series highest density – Cu lowest density – Sc

(f) Some important orders of density

$Fe < Ni < Cu$ $Fe < Cu < Au$ $Fe < Hg < Au$

Melting and boiling points

(a) Melting and boiling point of d-block > s-block

Reason: Stronger metallic bond and presence of covalent bond formed by unpaired (d-electrons.)

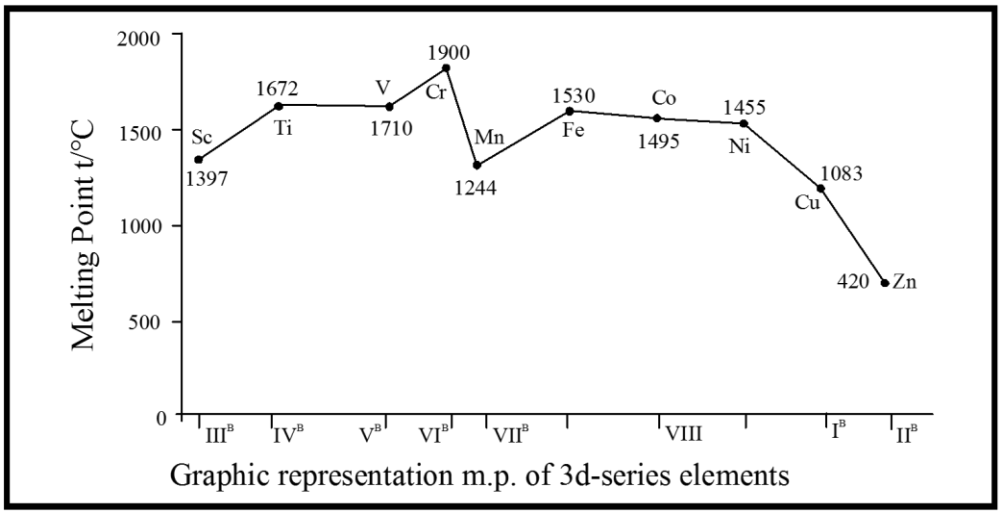
(b) In Zn, Cd, and Hg there is no unpaired electron present in d-orbital, hence due to absence of covalent bond melting and boiling point are very low in series. (Volatile metals Zn, Cd, Hg)

(c) In 3d series Sc to Cr melting and boiling point increases then Mn to Zn melting and boiling point decreases

(d) As the number of d-electron increases, the number of covalent bonds between the atoms are expected to increase up to Cr-Mo-W family where each of the d-orbital has only unpaired electrons and the opportunity for covalent sharing is greatest.

(e) Mn and Tc have comparatively low melting point, due to weak metallic bond because of stable Half filled (d5) configuration

(f) Lowest melting point Hg (– 38°C), Highest melting point W (~ 3400°C)



Graphic representation m.p. of 3d-series elements