II B.Sc

III SEMESTER

INORGANIC CHEMISTRY

UNIT I

CHEMISTRY OF d BLOCK ELEMENTS PART 1

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CHEMISTRY OF d-BLOCK ELEMENTS

INTRODUCTION

- **when the differentiating electron enters into the d orbital then the elements are called as d block elements**
- **The d block elements are present in the middle of the periodic table i.e; present between s block and p block**

Each d orbital accommodate 10 electrons.

The d block elements consists of three complete series each of 10 elements, involving the filling of 3d,4d,5d subshells and they are named as 3d series (Sc to Zn), 4d series (Y to Cd) and 5d series (La to Hg).

In addition to this, there is a fourth incomplete series i.e, 6d series.

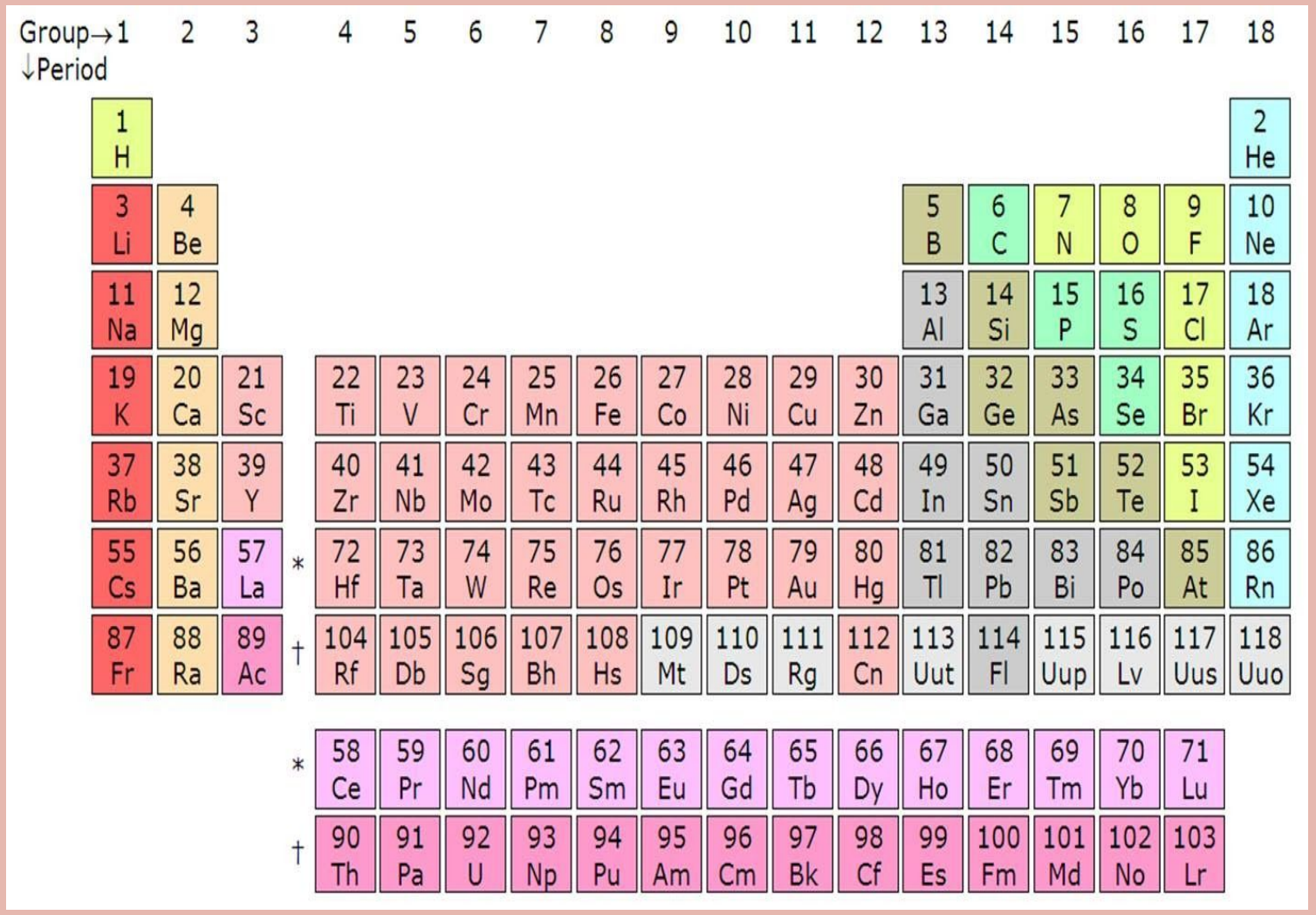
- **The general electronic configuration of d block elements is**

  $(X)\ (n-1)\ d^{1-10}\ ns^{1}$ or ^{2}

  Where X is noble gas

- **The d block elements are also called as transition elements.**

- **The transition elements are those elements having a partially filled d subshells.**
- **The general properties of transition elements are**
  1. **They are usually high melting point**
  2. **They have several oxidation states**
  3. **The usually form coloured compounds**
  4. **They have magnetic property**
- **All the transition elements are d block elements are not transition elements.**


Group→1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
↓Period
1 H
2 He
3 Li
4 Be
5 B
6 C
7 N
8 O
9 F
10 Ne
11 Na
12 Mg
13 Al
14 Si
15 P
16 S
17 Cl
18 Ar
19 K
20 Ca
21 Sc
22 Ti
23 V
24 Cr
25 Mn
26 Fe
27 Co
28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
33 As
34 Se
35 Br
36 Kr
37 Rb
38 Sr
39 Y
40 Zr
41 Nb
42 Mo
43 Tc
44 Ru
45 Rh
46 Pd
47 Ag
48 Cd
49 In
50 Sn
51 Sb
52 Te
53 I
54 Xe
55 Cs
56 Ba
57 La
*
72 Hf
73 Ta
74 W
75 Re
76 Os
77 Ir
78 Pt
79 Au
80 Hg
81 Tl
82 Pb
83 Bi
84 Po
85 At
86 Rn
87 Fr
88 Ra
89 Ac
†
104 Rf
105 Db
106 Sg
107 Bh
108 Hs
109 Mt
110 Ds
111 Rg
112 Cn
113 Uut
114 Fl
115 Uup
116 Lv
117 Uus
118 Uuo
* 58 Ce 59 Pr 60 Nd 61 Pm 62 Sm 63 Eu 64 Gd 65 Tb 66 Dy 67 Ho 68 Er 69 Tm 70 Yb 71 Lu
† 90 Th 91 Pa 92 U 93 Np 94 Pu 95 Am 96 Cm 97 Bk 98 Cf 99 Es 100 Fm 101 Md 102 No 103 Lr

Electronic configuration of d block elements:

The electronic configuration of 3d series is as follows

Scandium-Sc- $(Ar)3d^1 4s^2$
Titanium- Ti- $(Ar)3d^2 4s^2$
Vanadium-V-$(Ar)3d^3 4s^2$
Chromium -Cr-$(Ar)3d^4 4s^2$ (or) $(Ar)3d^5 4s^1$
Manganese-Mn-$(Ar)3d^5 4s^2$
Iron -Fe- $(Ar)3d^6 4s^2$
Cobalt-Co-$(Ar)3d^7 4s^2$
Nickel-Ni-$(Ar)3d^8 4s^2$
Copper-Cu- $(Ar)3d^9 4s^2$ (or) $(Ar)3d^{10} 4s^1$

Zinc-Zn-$(Ar)3d^{10} 4s^2$

From the above it was observed that chromium and copper shows different electronic configuration than other elements because we know that partially and completely filled penultimate shells are more stable.

To get stability in chromium and copper one s electron is goes to the d orbital.

similarly in 4d and 5d series molybdenum,silver,tungsten and gold shows anomalous electronic configuration.

Molybdenum- Mo- (Kr) $4d^5 5s^1$
Silver- Ag- (Kr) $4d^{10} 5s^1$
Tungsten -W- (Xe) $5d^5 6s^1$
Gold-Au- (Xe) $5d^{10} 6s^1$

Variable oxidation state or variable valency:

d block elements are metals and are electropositive in nature and having number of electrons these are exist in positive oxidation State due to less energy difference between S orbital and d orbital. they losses both s electron and the electron, exhibit variable oxidation States.

The oxidation states of 3d series elements are as follows

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
+2	+2	+2	+1	+2	+2	+2	+2	+1	+2
+3	+3	+3	+2+3	+3	+3	+3	+3	+2	
	+4	+4	+4	+4	+4	+4	+4		
		+5	+5	+5	+5	+5			
			+6	+6	+6				
				+7					

The minimum oxidation state of 3d series is due to s electrons and the maximum oxidation state is due to both s and d electrons.

But this maximum oxidation state is only upto Manganese. After manganese due to pairing of electrons in d orbitals gives extra stability to the element and requires higher energy to remove electrons. Hence after manganese the minimum oxidation state is

produced due to unpaired electrons in d orbitals and electrons in s orbital.

The common oxidation state of d block elements is +2.

The maximum oxidation state of 3d series is + 7 i.e, shown by Mn.

Similarly 4d and 5d series shows variable oxidation States. The maximum oxidation state of 4d and 5d series is + 8, shown by Ruthenium(Ru) and Osmium(Os) respectively.