



# Chemistry of d-block elements

- THE ELEMENTS IN WHICH THE DIFFERENTIATING ELECTRON ENTER INTO  $(n-1)d$  ORBITAL ARE KNOWN AS d-BLOCK ELEMENTS.
- THESE ELEMENTS ARE ALSO CALLED AS TRANSITION ELEMENTS.
- THESE ELEMENTS ARE CLASSIFIED INTO 3d,4d,5d,6d SERIES ELEMENTS DEPENDING UPON THE FILLING UP OF ORBITAL.

# Periodic table

1A												8A															
1 1.008 <b>H</b> Hydrogen											2 4.003 <b>He</b> Helium																
2A												3A		4A		5A		6A		7A		8A					
3 6.941 <b>Li</b> Lithium	4 9.012 <b>Be</b> Beryllium											5 10.811 <b>B</b> Boron	6 12.011 <b>C</b> Carbon	7 14.007 <b>N</b> Nitrogen	8 15.999 <b>O</b> Oxygen	9 18.988 <b>F</b> Fluorine	10 20.180 <b>Ne</b> Neon										
3B		4B		5B		6B		7B		8B		1B		2B		3B		4B		5B		6B		7B		8B	
11 22.990 <b>Na</b> Sodium	12 24.305 <b>Mg</b> Magnesium	13 26.982 <b>Al</b> Aluminum	14 28.086 <b>Si</b> Silicon	15 30.974 <b>P</b> Phosphorus	16 32.066 <b>S</b> Sulfur	17 35.453 <b>Cl</b> Chlorine	18 39.948 <b>Ar</b> Argon																				
19 39.098 <b>K</b> Potassium	20 40.078 <b>Ca</b> Calcium	21 44.956 <b>Sc</b> Scandium	22 47.88 <b>Ti</b> Titanium	23 50.942 <b>V</b> Vanadium	24 51.996 <b>Cr</b> Chromium	25 54.938 <b>Mn</b> Manganese	26 55.933 <b>Fe</b> Iron	27 58.933 <b>Co</b> Cobalt	28 58.693 <b>Ni</b> Nickel	29 63.546 <b>Cu</b> Copper	30 65.39 <b>Zn</b> Zinc	31 69.732 <b>Ga</b> Gallium	32 72.61 <b>Ge</b> Germanium	33 74.922 <b>As</b> Arsenic	34 78.972 <b>Se</b> Selenium	35 79.904 <b>Br</b> Bromine	36 94.80 <b>Kr</b> Krypton										
37 84.468 <b>Rb</b> Rubidium	38 87.62 <b>Sr</b> Strontium	39 88.906 <b>Y</b> Yttrium	40 91.224 <b>Zr</b> Zirconium	41 92.906 <b>Nb</b> Niobium	42 95.95 <b>Mo</b> Molybdenum	43 98.907 <b>Tc</b> Technetium	44 101.07 <b>Ru</b> Ruthenium	45 102.906 <b>Rh</b> Rhodium	46 106.42 <b>Pd</b> Palladium	47 107.868 <b>Ag</b> Silver	48 112.411 <b>Cd</b> Cadmium	49 114.818 <b>In</b> Indium	50 118.71 <b>Sn</b> Tin	51 121.760 <b>Sb</b> Antimony	52 127.6 <b>Te</b> Tellurium	53 126.904 <b>I</b> Iodine	54 131.29 <b>Xe</b> Xenon										
55 132.905 <b>Cs</b> Cesium	56 137.327 <b>Ba</b> Barium	57-71 Lanthanides	72 178.49 <b>Hf</b> Hafnium	73 180.948 <b>Ta</b> Tantalum	74 183.85 <b>W</b> Tungsten	75 186.207 <b>Re</b> Rhenium	76 190.23 <b>Os</b> Osmium	77 192.22 <b>Ir</b> Iridium	78 195.08 <b>Pt</b> Platinum	79 196.967 <b>Au</b> Gold	80 200.59 <b>Hg</b> Mercury	81 204.383 <b>Tl</b> Thallium	82 207.2 <b>Pb</b> Lead	83 208.980 <b>Bi</b> Bismuth	84 208.982 <b>Po</b> Polonium	85 209.987 <b>At</b> Astatine	86 222.018 <b>Rn</b> Radon										
87 223.020 <b>Fr</b> Francium	88 226.025 <b>Ra</b> Radium	89-103 Actinides	104 (261) <b>Rf</b> Rutherfordium	105 (262) <b>Db</b> Dubnium	106 (266) <b>Sg</b> Seaborgium	107 (264) <b>Bh</b> Bohrium	108 (269) <b>Hs</b> Hassium	109 (268) <b>Mt</b> Meitnerium	110 (269) <b>Ds</b> Darmstadtium	111 (272) <b>Rg</b> Roentgenium	112 (277) <b>Cn</b> Copernicium	113 unknown <b>Uut</b> Ununtrium	114 (289) <b>F1</b> Flerovium	115 unknown <b>Uup</b> Ununpentium	116 (298) <b>Lv</b> Livermorium	117 unknown <b>Uus</b> Ununseptium	118 unknown <b>Uuo</b> Ununoctium										
Lanthanides		57 138.906 <b>La</b> Lanthanum	58 140.115 <b>Ce</b> Cerium	59 140.908 <b>Pr</b> Praseodymium	60 144.24 <b>Nd</b> Neodymium	61 144.913 <b>Pm</b> Promethium	62 150.36 <b>Sm</b> Samarium	63 151.966 <b>Eu</b> Europium	64 157.25 <b>Gd</b> Gadolinium	65 158.925 <b>Tb</b> Terbium	66 162.50 <b>Dy</b> Dysprosium	67 164.930 <b>Ho</b> Holmium	68 167.26 <b>Er</b> Erbium	69 168.934 <b>Tm</b> Thulium	70 173.04 <b>Yb</b> Ytterbium	71 174.967 <b>Lu</b> Lutetium											
Actinides		89 227.028 <b>Ac</b> Actinium	90 232.038 <b>Th</b> Thorium	91 231.036 <b>Pa</b> Protactinium	92 238.029 <b>U</b> Uranium	93 237.048 <b>Np</b> Neptunium	94 244.064 <b>Pu</b> Plutonium	95 243.061 <b>Am</b> Americium	96 247.070 <b>Cm</b> Curium	97 247.070 <b>Bk</b> Berkelium	98 251.080 <b>Cf</b> Californium	99 (254) <b>Es</b> Einsteinium	100 257.095 <b>Fm</b> Fermium	101 258.1 <b>Md</b> Mendelevium	102 259.101 <b>No</b> Nobelium	103 (262) <b>Lr</b> Lawrencium											
Alkali Metal		Alkaline Earth		Basic Metal		Halogen		Noble Gas		Non Metal		Rare Earth		Semi Metal		Transition Metal											

ATOMIC NUMBER

ATOMIC MASS

ELEMENT SYMBOL

CHEMICAL NAME



- 3d series elements starts with Sc (z=21) and ends with Zn (z=30)
- 4d series elements starts with Y (z=39) and ends with Cd (z=48)
- 5d series elements starts with La (z=57) and ends with Hg (z=80)
- 6d series elements starts with Ac (z=89) and it is an incomplete series

- d-block elements exhibit various types of properties they are

1 .Metallic character

2 .Melting and boiling points

3 .Atomic and ionic radii

4 .Atomic volume and densities reactivity

5 .Ionization potential

6 .Electronic configuration

7 .Variable oxidation states

8 .Complex formation

9 .colour

10 .magnetic properties

11 .catalytic properties



## 4d-series:

elements	Atomic Number	Symbol	Electronic configuration
<u>Ytterium</u>	39	Y	[Kr] 4d <sup>1</sup> 5s <sup>2</sup>
Zirconium	40	<u>Zr</u>	[Kr] 4d <sup>2</sup> 5s <sup>2</sup>
Niobium	41	<u>Nb</u>	[Kr] 4d <sup>4</sup> 5s <sup>1</sup>
Molybdenum	42	Mo	[Kr] 4d <sup>5</sup> 5s <sup>1</sup>
Technetium	43	<u>Tc</u>	[Kr] 4d <sup>5</sup> 5s <sup>2</sup>
Ruthenium	44	<u>Ru</u>	[Kr] 4d <sup>7</sup> 5s <sup>1</sup>
Rhodium	45	<u>Rh</u>	[Kr] 4d <sup>8</sup> 5s <sup>1</sup>
Palladium	46	Pd	[Kr] 4d <sup>10</sup> 5s <sup>0</sup>
Silver	46	Ag	[Kr] 4d <sup>10</sup> 5s <sup>1</sup>
Cadmium	48	<u>Cd</u>	[Kr] 4d <sup>10</sup> 5s <sup>2</sup>



## 5d-series:

• Element	Symbol	At. No.	Electronic configuration
• Lanthanum	<i>La</i>	57	$[\text{Xe}] 5d^1 6s^2$
• Hafnium	<i>Hf</i>	72	$[\text{Xe}] 4f^{14} 5d^2 6s^2$
• Tantalum	<i>Ta</i>	73	$[\text{Xe}] 4f^{14} 5d^3 6s^2$
• Tungsten	<i>W</i>	74	$[\text{Xe}] 4f^{14} 5d^4 6s^2$
• Rhenium	<i>Re</i>	75	$[\text{Xe}] 4f^{14} 5d^5 6s^2$
• Osmium	<i>Os</i>	76	$[\text{Xe}] 4f^{14} 5d^6 6s^2$
• Iridium	<i>Ir</i>	77	$[\text{Xe}] 4f^{14} 5d^7 6s^2$
• Platinum	<i>Pt</i> *	78	$[\text{Xe}] 4f^{14} 5d^{10} 6s^0$
• <b>Gold</b>	<b><i>Au</i></b> *	<b>79</b>	<b><math>[\text{Xe}] 4f^{14} 5d^{10} 6s^1</math></b>
• Mercury	<i>Hg</i>	80	$[\text{Xe}] 4f^{14} 5d^{10} 6s^2$

**$[\text{Xe}] = 54$**



- Oxidation states: d-block elements show various oxidation states.

- 3d-series:

Elements	Electronic configuration	Known oxidation states
Sc	[Ar] 3d <sup>1</sup> 4s <sup>2</sup>	+3
Ti	[Ar] 3d <sup>2</sup> 4s <sup>2</sup>	+1, +2, +3, +4
V	[Ar] 3d <sup>3</sup> 4s <sup>2</sup>	+1, +2, +3, +4, +5
Cr	[Ar] 3d <sup>5</sup> 4s <sup>1</sup>	+1, +2, +3, +4, +5, +6
Mn	[Ar] 3d <sup>5</sup> 4s <sup>2</sup>	+1, +2, +3, +4, +5, +6, +7
Fe	[Ar] 3d <sup>6</sup> 4s <sup>2</sup>	+1, +2, +3, +4, +5, +6
Co	[Ar] 3d <sup>7</sup> 4s <sup>2</sup>	+1, +2, +3, +4, +5
Ni	[Ar] 3d <sup>8</sup> 4s <sup>2</sup>	+1, +2, +3, +4
Cu	[Ar] 3d <sup>10</sup> 4s <sup>1</sup>	+1, +2, +3
Zn	[Ar] 3d <sup>10</sup> 4s <sup>2</sup>	+2





- Magnetic Properties: Based upon attraction, repulsion in a external magnetic field the substances are classified into
  - 1) Dia magnetic substances
  - 2) Para magnetic substances
  - 3) Ferromagnetic substances
- If substance placed in external magnetic field if it repells from external magnetic field it is called as dia magnetic substance. ex:  $H^+$ , He,  $Cu^+$



- If substance placed in external magnetic field if it weakly attracts towards external magnetic field it is called as para magnetic substance. ex: except Zn all 3d series elements
- If substance placed in external magnetic field if it strongly attracts towards external magnetic field it is called as ferro magnetic substance ex: ,Fe,Co,Ni

- Catalytic Properties: d-block elements exhibit different catalytic properties.

ex: Ni, Fe & Mo,  $V_2O_5$ ,  $MnO_2$ .

- Complex formation: elements of transition series exhibit tendency to form complex compounds. Ions of transition metals having small size, large charge and suitable electronic configuration form complexes easily.

The background is a light green gradient. It features several realistic water droplets of various sizes scattered across the top and bottom edges. On the left side, there are thin, dark brown lines representing blades of grass or reeds.

**Thank u**