

THE d- AND f-BLOCK ELEMENTS

Period	Group																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H <small>Hydrogen</small>																	2 He <small>Helium</small>
2	3 Li <small>Lithium</small>	4 Be <small>Beryllium</small>											5 B <small>Boron</small>	6 C <small>Carbon</small>	7 N <small>Nitrogen</small>	8 O <small>Oxygen</small>	9 F <small>Fluorine</small>	10 Ne <small>Neon</small>
3	11 Na <small>Sodium</small>	12 Mg <small>Magnesium</small>	d-block elements										13 Al <small>Aluminium</small>	14 Si <small>Silicon</small>	15 P <small>Phosphorus</small>	16 S <small>Sulfur</small>	17 Cl <small>Chlorine</small>	18 Ar <small>Argon</small>
4	19 K <small>Potassium</small>	20 Ca <small>Calcium</small>	21 Sc <small>Scandium</small>	22 Ti <small>Titanium</small>	23 V <small>Vanadium</small>	24 Cr <small>Chromium</small>	25 Mn <small>Manganese</small>	26 Fe <small>Iron</small>	27 Co <small>Cobalt</small>	28 Ni <small>Nickel</small>	29 Cu <small>Copper</small>	30 Zn <small>Zinc</small>	31 Ga <small>Gallium</small>	32 Ge <small>Germanium</small>	33 As <small>Arsenic</small>	34 Se <small>Selenium</small>	35 Br <small>Bromine</small>	36 Kr <small>Krypton</small>
5	37 Rb <small>Rubidium</small>	38 Sr <small>Strontium</small>	39 Y <small>Yttrium</small>	40 Zr <small>Zirconium</small>	41 Nb <small>Niobium</small>	42 Mo <small>Molybdenum</small>	43 Tc <small>Technetium</small>	44 Ru <small>Ruthenium</small>	45 Rh <small>Rhodium</small>	46 Pd <small>Palladium</small>	47 Ag <small>Silver</small>	48 Cd <small>Cadmium</small>	49 In <small>Indium</small>	50 Sn <small>Tin</small>	51 Sb <small>Antimony</small>	52 Te <small>Tellurium</small>	53 I <small>Iodine</small>	54 Xe <small>Xenon</small>
6	55 Cs <small>Cesium</small>	56 Ba <small>Barium</small>	57 La <small>Lanthanum</small>	72 Hf <small>Hafnium</small>	73 Ta <small>Tantalum</small>	74 W <small>Tungsten</small>	75 Re <small>Rhenium</small>	76 Os <small>Osmium</small>	77 Ir <small>Iridium</small>	78 Pt <small>Platinum</small>	79 Au <small>Gold</small>	80 Hg <small>Mercury</small>	81 Tl <small>Thallium</small>	82 Pb <small>Lead</small>	83 Bi <small>Bismuth</small>	84 Po <small>Polonium</small>	85 At <small>Astatine</small>	86 Rn <small>Radon</small>
7	87 Fr <small>Francium</small>	88 Ra <small>Radium</small>	89 Ac <small>Actinium</small>	104 Rf <small>Rutherfordium</small>	105 Db <small>Dubnium</small>	106 Sg <small>Seaborgium</small>	107 Bh <small>Berkelium</small>	108 Hs <small>Hassium</small>	109 Mt <small>Mendelevium</small>	110 Ds <small>Darmstadtium</small>	111 Rg <small>Roentgenium</small>	112 Cn <small>Copernicium</small>	113 Nh <small>Nihonium</small>	114 Fl <small>Flerovium</small>	115 Mc <small>Moscovium</small>	116 Lv <small>Livermorium</small>	117 Ts <small>Tennessine</small>	118 Og <small>Oganesson</small>

f-block elements

58 Ce <small>Cerium</small>	59 Pr <small>Praseodymium</small>	60 Nd <small>Niobium</small>	61 Pm <small>Promethium</small>	62 Sm <small>Samarium</small>	63 Eu <small>Europium</small>	64 Gd <small>Gadolinium</small>	65 Tb <small>Terbium</small>	66 Dy <small>Dysprosium</small>	67 Ho <small>Holmium</small>	68 Er <small>Erbium</small>	69 Tm <small>Thulium</small>	70 Yb <small>Ytterbium</small>	71 Lu <small>Lutetium</small>
90 Th <small>Thorium</small>	91 Pa <small>Protactinium</small>	92 U <small>Uranium</small>	93 Np <small>Neptunium</small>	94 Pu <small>Plutonium</small>	95 Am <small>Americium</small>	96 Cm <small>Curium</small>	97 Bk <small>Berkelium</small>	98 Cf <small>Californium</small>	99 Es <small>Einsteinium</small>	100 Fm <small>Fermium</small>	101 Md <small>Mendelevium</small>	102 No <small>Nobelium</small>	103 Lr <small>Lruthenium</small>

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THE d- AND f-BLOCK ELEMENTS

Introduction to d-block elements

Group→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Period																			
1																			
2																			
3																			
4																			
5																			
6																			
7																			

d-block Elements										f-block Elements													
21	22	23	24	25	26	27	28	29	30	58	59	60	61	62	63	64	65	66	67	68	69	70	71
Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
39	40	41	42	43	44	45	46	47	48	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
57	72	73	74	75	76	77	78	79	80														
La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg														
89	104	105	106	107	108	109	110	111	112														
Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn														

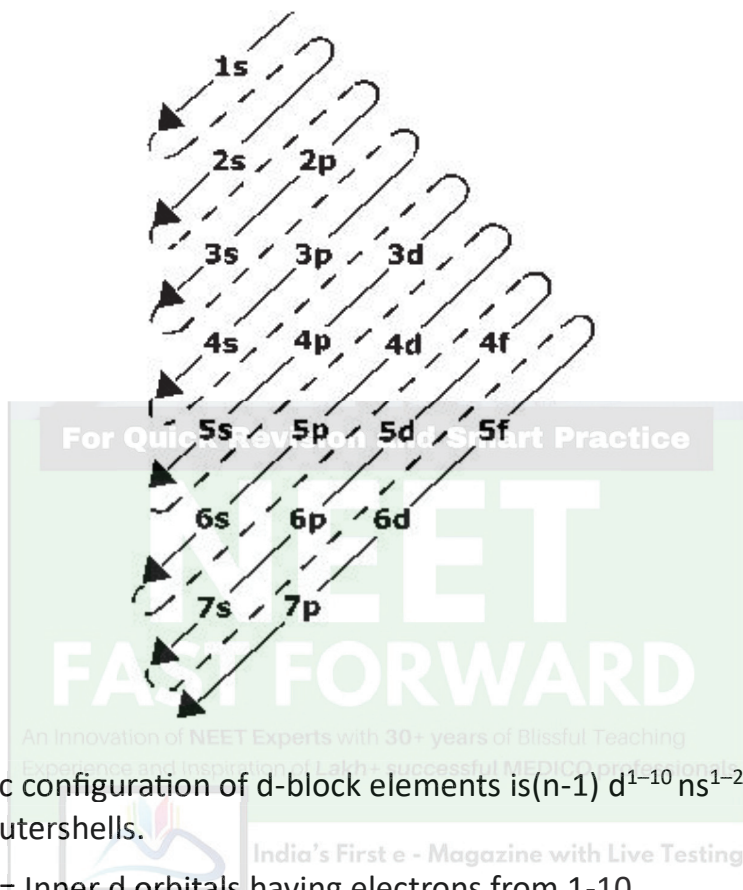
- In the periodic table the d block consist of the elements of group 3 to 12.
- The d orbital of the d-block elements in four periods are filled.
- The three series of the transition metals are 3d series from Sc to Zn, 4d series from Y to Cd and 5d series from La to Hg.
- The fourth 6d series begins from Ac and is incomplete till now.

Position of d-block in periodic table

1	2	d-block elements																2			
H	He																				
Li	Be																				
Na	Mg																				
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr				
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe				
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn				
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og				

- The d-block elements are found in the middle section of s- and p- block elements in the periodic elements.
- This lead to its name 'transition' due to its position between s- and p- block elements.

Electronic Configurations of the d-Block Elements



- The electronic configuration of d-block elements is $(n-1) d^{1-10} ns^{1-2}$. They have two incomplete outershells.
- Where $(n-1)$ = Inner d orbitals having electrons from 1-10.
- ns = Outermost orbital may have one or two
- $(n-1) d^{10} ns^2$ represents the electronic configurations of Zn, Cd and Hg.
- They exhibit variable valency that differ by units of one.

Element	Symbol	Electronic Configuration
Scandium	Sc	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^2$
Titanium	Ti	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
Vanadium	V	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$
Chromium	Cr	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$
Manganese	Mn	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$
Iron	Fe	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$
Cobalt	Co	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^2$
Nickel	Ni	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2$
Copper	Cu	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$
Zinc	Zn	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$

Physical Properties

- The transition metals are hard and tough. They have low volatility but Zn, Cd and Hg are an exception.



- They have high melting and boiling points due to the greater quantity of electrons from (n-1) d along with the ns electrons metallic

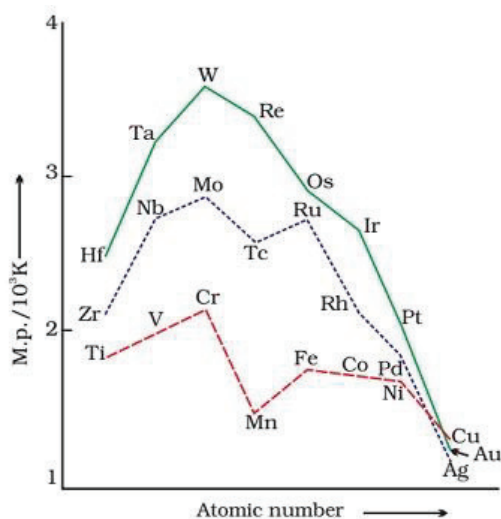
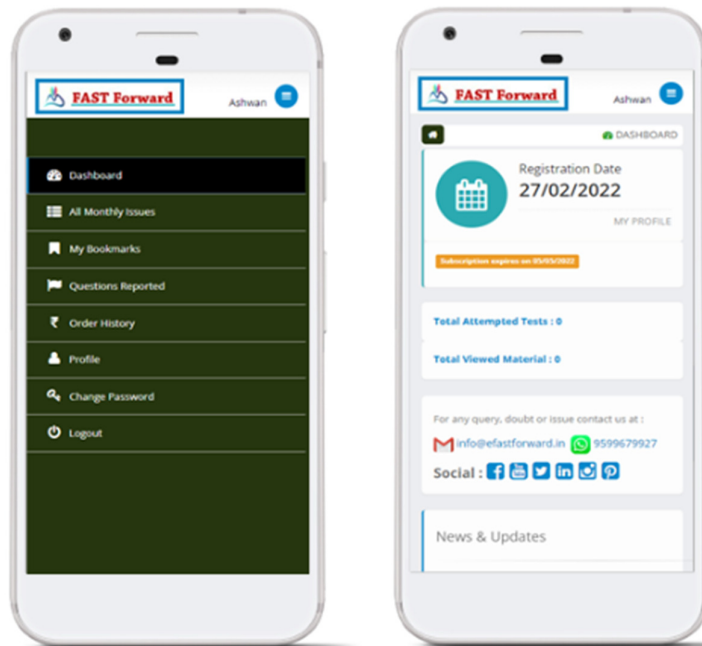


Fig. The trends in melting point of d-block elements.



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