C Ni B

Cu

Fe

Ar

- In 1800, only **31** elements were known.
- By 1865 -------- doubled to **63**.
- At present **114** elements are known.

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- **WHY DO WE NEED TO CLASSIFY THESE ELEMENTS ?**

Std-XI science- Lecture-14

Unit 3:

CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

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Periodic Table- *defination*

- *Periodic table may be defined as the table giving the arrangement of all the known elements according to their properties so that similar elements fall within the same vertical column & dissimilar elements are separated.*

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Dobereiner's Triads

Element	Atomic weight	Element	Atomic weight	Element	Atomic weight
Li	7	Ca	40	Cl	35.5
Na	23	Sr	88	Br	80
K	39	Ba	137	I	127

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- The next reported attempt to classify elements was made by a
- French geologist, A.E.B. de Chancourtois in 1862.
- He arranged the then known elements in order of increasing atomic weights and made a cylindrical table of elements to display the periodic recurrence of properties.
- This also did not attract much attention.

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Newlands' Octaves

Element	Li	Be	B	C	N	O	F
At. wt.	7	9	11	12	14	16	19
Element	Na	Mg	Al	Si	P	S	Cl
At. wt.	23	24	27	29	31	32	35.5
Element	K	Ca					
At. wt.	39	40					

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Mendeleev’s Periodic law

- ***The properties of the elements are in periodic function of their atomic weights.***

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Mendeleev's Periodic Table

Groups	0	I	II	III	IV	V	VI	VII	VIII
Oxide: Hydroxide	R	R_2O RH	RO RH_2	R_2O_3 RH_3	RO_2 RH_4	R_2O_5 RH_3	RO_3 RH_2	R_2O_7 RH	RO_4
1		H 1.008							
2	He 4.0	Li 6.939	Be 9.012	B 10.81	C 12.011	N 14.007	O 15.999	F 18.998	
3	Ne 19.9	Na 22.99	Mg 24.31	Al [illegible]	Si 28.09	P 30.974	S 32.06	Cl 35.453	
4 First Series Second Series	Ar 38	K 39.102 Cu 63.54	Ca 40.08 Zn [illegible]	Sc 44.96	Ti 47.90	V 50.94 As 74.92	Cr 52.20 Se 78.96	Mn 54.94 Br 79.909	Fe Co Ni 55 58 58
5 First Series Second Series	Kr 81.8	Rb 85.47 Ag [illegible]	S[illegible] [illegible]7.62 Cd 112.40	In 114.82	Zr 91.22 Sn 118.69	Nb 92.91 Sb 121.75	Mo 95.94 Te 127.60	T 99 I 126.90	Ru Rh Pd 101 102 106
6 First Series Second Series	Xe 128	Cs 132.90 Au 196.97	Ba 137.34 Hg 200.59	La 138.91 Tl 204.37	Hf 178.49 Pb 207.19	Ta 180.95 Bi 208.98	W 183.85		Os Ir Pt 190 192 195

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Mendeleev's Periodic Table

SERIES	GROUPS OF ELEMENTS 0	I	II	III	IV	V	VI	VII	VIII
1	-	Hydrogen H 1.008	-	-					[redacted]
2	Helium He 4.0	Lithium Li 7.03	Beryllium Be 9.1	Boron B 11.0	Carbon C 12.0	Nitrogen N 14.04	Oxygen O 16.00	Fluorine F 19.0	
3	Neon Ne 19.9	Sodium Na 23.5	Magnesium Mg 24.3	Aluminium Al 27.0	Silicon Si 28.4	Phosphorus P 31.0	Sulphur S 32.06	Chlorine Cl 35.45	
4	Argon Ar 38	Potassium K 39.1	Calcium Ca 40.1	Scandium Sc 44.1	Titanium Ti 48.1	Vanadium V 51.4	Chromium Cr 52.1	Manganese Mn 55.0	Iron Fe 55.9 Cobalt Co 59 Nickel Ni 59 (Cu)
5		Copper Cu 63.6	Zinc Zn 65.4	Gallium Ga 70.0	Germanium Ge 72.3	Arsenic As 75	Selenium Se 79	Bromine Br 79.95	
6	Krypton Kr 81.8	Rubidium Rb 85.4	Strontium Sr 87.6	Yttrium Y 89.0	Zirconium Zr 90.6	Niobium Nb 94.0	Molybdenum Mo 96.0	-	Ruthenium Ru 101.7 Rhodium Rh 103.0 Palladium Pd 106.5 (Ag)
7		Silver Ag 107.9	Cadmium Cd 112.4	Indium In 114.0	Tin Sn 119.0	Antimony Sb 120.0	Tellurium Te 127.6	Iodine I 126.9	
8	Xenon Xe 128	Caesium Cs 132.9	Barium Ba 137.4	Lanthanum La 139	Cerium Ce 140	-	-	-	[redacted]
9		-	-	-	-		-	-	
10	-	-	-	Ytterbium Yb 173	-	Tantalum Ta 183	Tungsten W 184	-	Osmium Os 191 Iridium Ir 193 Platinum Pt 194.9 (Au)
11		Gold Au 197.2	Mercury Hg 200.0	Thallium Tl 204.1	Lead Pb 206.9	Bismuth Bi 208	-	[redacted] -	
12	-	-	Radium Ra 224	-	Thorium Th 232	-	Uranium U 239		
HIGHER SALINE OXIDES	R	R_2O	RO	R_2O_3	RO_2	R_2O_5	RO_3	R_2O_7	RO_4
HIGHER GASEOUS HYDROGEN COMPOUNDS					RH_4	RH_3	RH_2	RH	

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MODERN PERIODIC LAW

- ***The physical and chemical properties of the elements are periodic functions of their atomic numbers.***

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Modern Periodic Table

Representative Elements | Representative Elements | Noble gases

s block | d block (Transition elements) | p block

Period	1	2	3	4	5	6	7	8	9	10	11	12						
1	1 H 1.0																	2 He 4.0
2	3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
3	11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9
4	19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.8	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.9	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
5	37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc (99)	44 ru 101.1	45 Rh 102.3	46 Pd 106.4	47 Ag 107.9	48 cd 112	49 In 114	50 Sn 118	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
6	55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 181.0	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (210)	85 At 210	86 Rn 222
7	87 Fr (223)	88 Ra (226)	89 Ac** (227)	104 Rf (261)	105 Db (262)	106 Sg (263)												

f block (Inner transition elements)

Lanthanides*	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm 145	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.5
Actinides*	90 Th 232.0	91 Pa 231	92 U 238.1	93 Np 242	94 Pu 237	95 Am 243	96 Cm 247	97 Bk 245	98 Cf 251	99 Es 254	100 Fm 253	101 Md 256	102 No 254	103 Lr 257

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Representative elements | GROUP NUMBER | d-Transition elements | Representative elements | Noble gases

1 H $1s^1$

PERIOD NUMBER	1 IA	2 IIA	3 IIIA	4 IVA	5 VA	6 VIA	7 VIIA	8 ←	9 VIII	10 →	11 IB	12 IIB	13 IIIB	14 IVB	15 VB	16 VIB	17 VIIB	18 0
1																		2 He $1s^2$
2	3 Li $2s^1$	4 Be $2s^2$											5 B $2s^22p^1$	6 C $2s^22p^2$	7 N $2s^22p^3$	8 O $2s^22p^4$	9 F $2s^22p^5$	10 Ne $2s^22p^6$
3	11 Na $3s^1$	12 Mg $3s^2$											13 Al $3s^23p^1$	14 Si $3s^23p^2$	15 P $3s^23p^3$	16 S $3s^23p^4$	17 Cl $3s^23p^5$	18 Ar $3s^23p^6$
4	19 K $4s^1$	20 Ca $4s^2$	21 Sc $3d^14s^2$	22 Ti $3d^24s^2$	23 V $3d^34s^2$	24 Cr $3d^54s^1$	25 Mn $3d^54s^2$	26 Fe $3d^64s^2$	27 Co $3d^74s^2$	28 Ni $3d^84s^2$	29 Cu $3d^{10}4s^1$	30 Zn $3d^{10}4s^2$	31 Ga $4s^24p^1$	32 Ge $4s^24p^2$	33 As $4s^24p^3$	34 Se $4s^24p^4$	35 Br $4s^24p^5$	36 Kr $4s^24p^6$
5	37 Rb $5s^1$	38 Sr $5s^2$	39 Y $4d^15s^2$	40 Zr $4d^25s^2$	41 Nb $4d^45s^1$	42 Mo $4d^55s^1$	43 Tc $4d^55s^2$	44 Ru $4d^75s^1$	45 Rh $4d^85s^1$	46 Pd $4d^{10}$	47 Ag $4d^{10}5s^1$	48 Cd $4d^{10}5s^2$	49 In $5s^25p^1$	50 Sn $5s^25p^2$	51 Sb $5s^25p^3$	52 Te $5s^25p^4$	53 I $5s^25p^5$	54 Xe $5s^25p^6$
6	55 Cs $6s^1$	56 Ba $6s^2$	57 La* $5d^16s^2$	72 Hf $4f^{14}5d^26s^2$	73 Ta $5d^36s^2$	74 W $5d^46s^2$	75 Re $5d^56s^2$	76 Os $5d^66s^2$	77 Ir $5d^76s^2$	78 Pt $5d^96s^1$	79 Au $5d^{10}6s^1$	80 Hg $5d^{10}6s^2$	81 Tl $6s^26p^1$	82 Pb $6s^26p^2$	83 Bi $6s^26p^3$	84 Po $6s^26p^4$	85 At $6s^26p^5$	86 Rn $6s^26p^6$
7	87 Fr $7s^1$	88 Ra $7s^2$	89 Ac** $6d^17s^2$	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Uuu	112 Uub	–	114 Uuq	–	Uuh	–	–

f- Inner transition elements

*Lanthanoids $4f^{1-14}5d^{0-1}6s^2$	58 Ce $4f^15d^16s^2$	59 Pr $4f^35d^06s^2$	60 Nd $4f^45d^06s^2$	61 Pm $4f^55d^06s^2$	62 Sm $4f^65d^06s^2$	63 Eu $4f^75d^06s^2$	64 Gd $4f^75d^16s^2$	65 Tb $4f^95d^06s^2$	66 Dy $4f^{10}5d^06s^2$	67 Ho $4f^{11}5d^06s^2$	68 Er $4f^{12}5d^06s^2$	69 Tm $4f^{13}5d^06s^2$	70 Yb $4f^{14}5d^06s^2$	71 Lu $4f^{14}5d^16s^2$
**Actinoids $5f^{0-14}6d^{0-2}7s^2$	90 Th $5f^06d^27s^2$	91 Pa $5f^26d^17s^2$	92 U $5f^36d^17s^2$	93 Np $5f^46d^17s^2$	94 Pu $5f^66d^07s^2$	95 Am $5f^76d^07s^2$	96 Cm $5f^76d^17s^2$	97 Bk $5f^96d^07s^2$	98 Cf $5f^{10}6d^07s^2$	99 Es $5f^{11}6d^07s^2$	100 Fm $5f^{12}6d^07s^2$	101 Md $5f^{13}6d^07s^2$	102 No $5f^{14}6d^07s^2$	103 Lr $5f^{14}6d^17s^2$

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- A modern version, the so-called "**long form**" **of the Periodic Table** of the elements, is the most convenient and widely used.
- The horizontal rows *(which Mendeleev called series)* are called periods
- **and** the vertical columns, **groups.**
- Elements having similar outer electronic configurations in their atoms are arranged in vertical columns, referred to as **groups or families.**

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- According to the recommendation of International Union of Pure and Applied Chemistry (IUPAC), the groups are numbered from 1 to 18 replacing the older notation of groups IA … VIIA, VIII, IB … VIIB and 0

- There are altogether seven periods.

- The period number corresponds to the highest principal quantum number *(n) of the elements* in the period.

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- The first period contains 2 elements.
- The subsequent periods consists of 8, 8, 18, 18 and 32 elements, respectively.
- The seventh period is incomplete and like the sixth period would have a theoretical maximum *(on the basis of quantum numbers)* of 32 elements

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Number of elements in different periods

Period	n	Orbitals	electrons	Elements
First	1			
Second	2			
Third	3			
Fourth	4			
Fifth	5			
Sixth	6			
Seventh	7			

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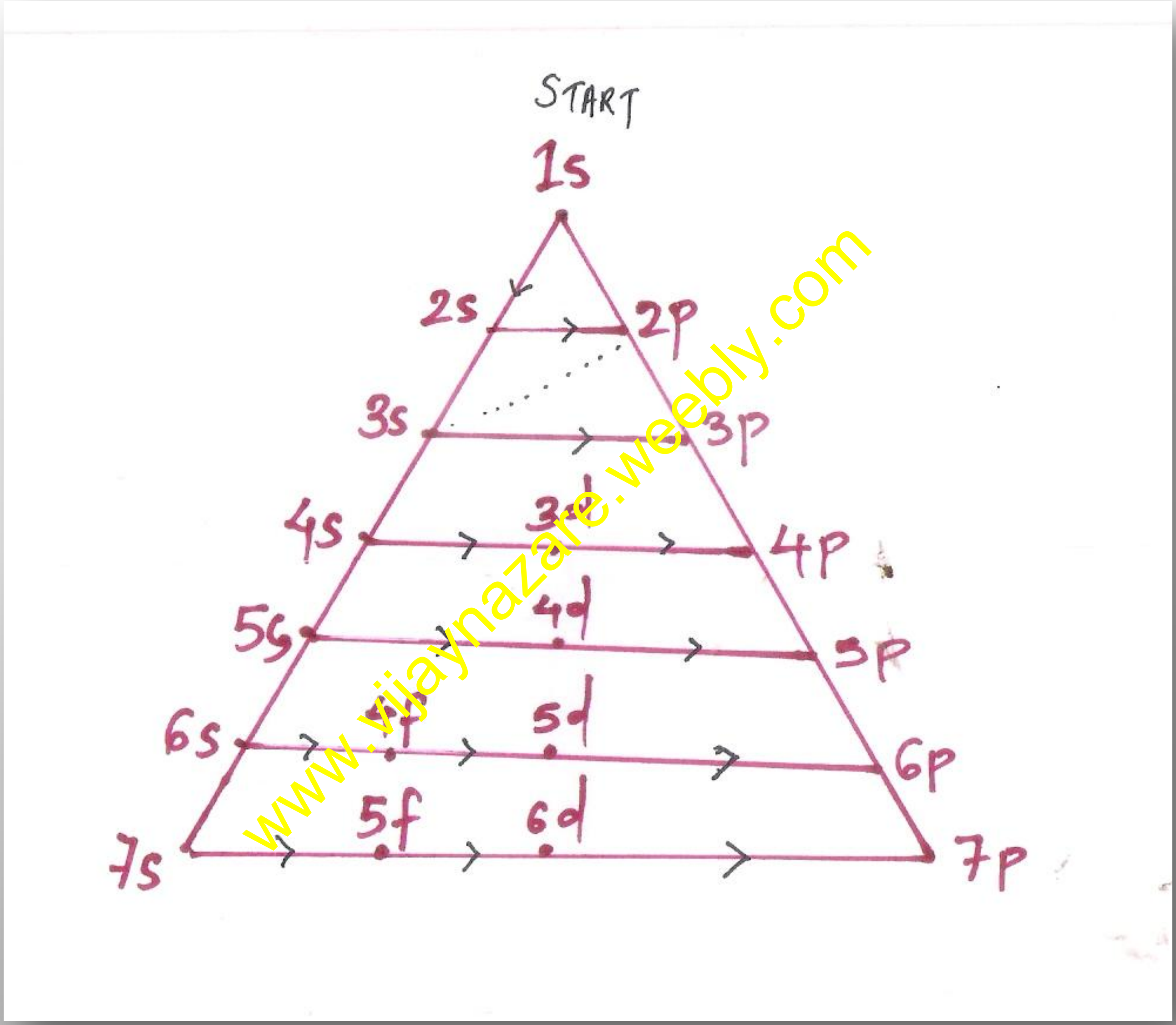

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Number of elements in different periods

Period	n	Orbitals	electrons	Elements
First	1	1s	2	2
Second	2	2s,2p	2 +6	8
Third	3	3s,3p	2 +6	8
Fourth	4	4s,3d,4p	2 +10+6	18
Fifth	5	5s,4d,5p	2 +10+6	18
Sixth	6	6s,4f,5d,6p	2 +14+10+6	32
Seventh	7	7s,5f,6d,7p	2 +14 +10+6	32*

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Lanthanoids and actinoids

- In this form of the Periodic Table, 14 elements of both sixth and seventh periods (lanthanoids and actinoids, respectively) are placed in separate panels at the bottom*.

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58	59	60	61	62	63	64	65	66	67	68	59	70	71
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOMENCLATURE OF ELEMENTS WITH ATOMIC NUMBERS > 100

- For example, both American and Soviet scientists claimed credit for discovering element 104.

- The Americans named it Rutherfordium
- whereas Soviets named it Kurchatovium.

- To avoid such problems, the IUPAC has made recommendation that until a new element's discovery is proved, and its name is officially recognized,

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- A systematic nomenclature be derived directly from the atomic number of the element using the numerical roots for 0 and numbers 1-9.

- which make up the atomic number and "ium" is added at the end.

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Notation for IUPAC Nomenclature of Elements

Digit	Name	Abbreviation
0	nil	n
1	un	u
2	bi	b
3	tri	t
4	quad	q
5	pent	p
6	hex	h
7	Sept	s
8	Oct	o
9	enn	e

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Nomenclature of Elements with Atomic Number Above 100

Atomic Number	Name	Symbol	IUPAC Official Name	IUPAC Symbol
101	Unnilunium	Unu	Mendelevium	Md
102	Unnilbium	Unb	Nobelium	No
103	Unniltrium	Unt	Lawrencium	Lr
104	Unnilquadium	Unq	Rutherfordium	Rf
105	Unnilpentium	Unp	Dubnium	Db
106	Unnilhexium	Unh	Seaborgium	Sg
107	Unnilseptium	Uns	Bohrium	Bh
108	Unniloctium	Uno	Hassnium	Hs
109	Unnilennium	Une	Meitnerium	Mt
110	Ununnillium	Uun	Darmstadtium	Ds
111	Unununnium	Uuu	Rontgenium*	Rg*
112	Ununbium	Uub	*	*
113	Ununtrium	Uut	+	
114	Ununquadium	Uuq	*	*
115	Ununpentium	Uup	+	
116	Ununhexium	Uuh	*	*
117	Ununseptium	Uus	+	
118	Ununoctium	Uuo	+	

* Official IUPAC name yet to be announced   + Elements yet to be discovered

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- Thus, the new element first gets a temporary name, with symbol consisting of three letters.
- Later permanent name and symbol are given by a vote of IUPAC representatives from each country.
- The permanent name might reflect the country *(or*
- *state of the country)* in which the element was discovered, or pay tribute to a notable scientist.
- As of now, elements with atomic numbers up to 112, 114 and 116 have been discovered.
- Elements with atomic numbers 113, 115, 117 and 118 are not yet known.

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- **Problem 1.**
- What would be the IUPAC name and symbol for the element with atomic number 120?

- **Solution**
- From Table, the roots for 1, 2 and 0 are un, bi and nil, respectively.
- Hence, the symbol and the name respectively are Ubn and unbinilium.

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- **Problem 2.**
- What would be the IUPAC name and symbol for the element with atomic number 116?

- **Solution**
- From Table, the roots for 1, 1 and 6 are un, un and hex, respectively.
- Hence, the symbol and the name respectively are Uuh and ununhexium.

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Number of elements in a period

Number of elements in each period is twice the number of atomic **orbitals** available in the energy level that is being filled.

The first period ($n = 1$) starts with the filling of the lowest level ($1s$) and therefore has two elements — hydrogen ($1s^1$) and helium ($1s^2$) when the first shell (K) is completed.

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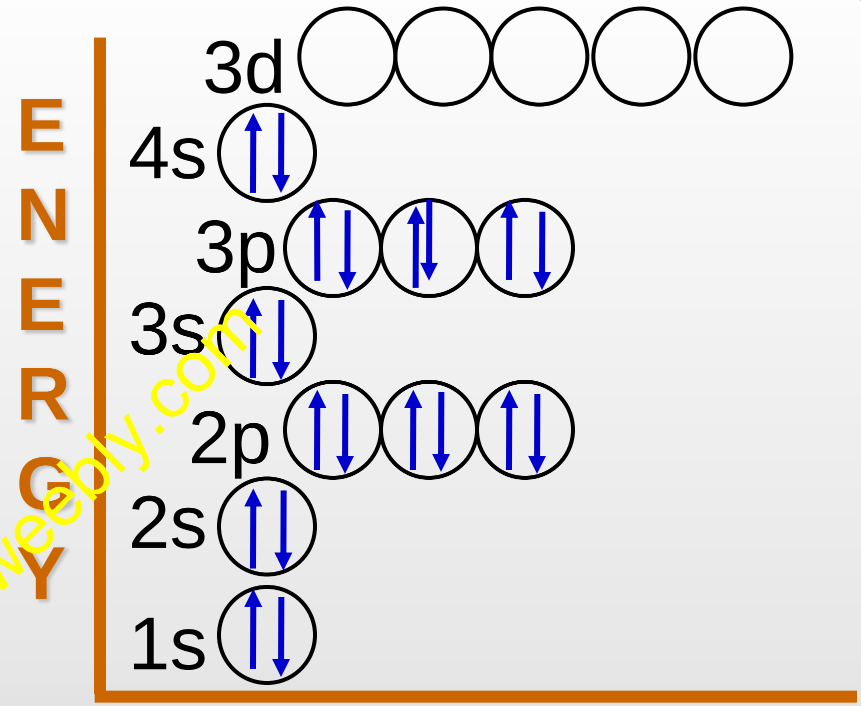
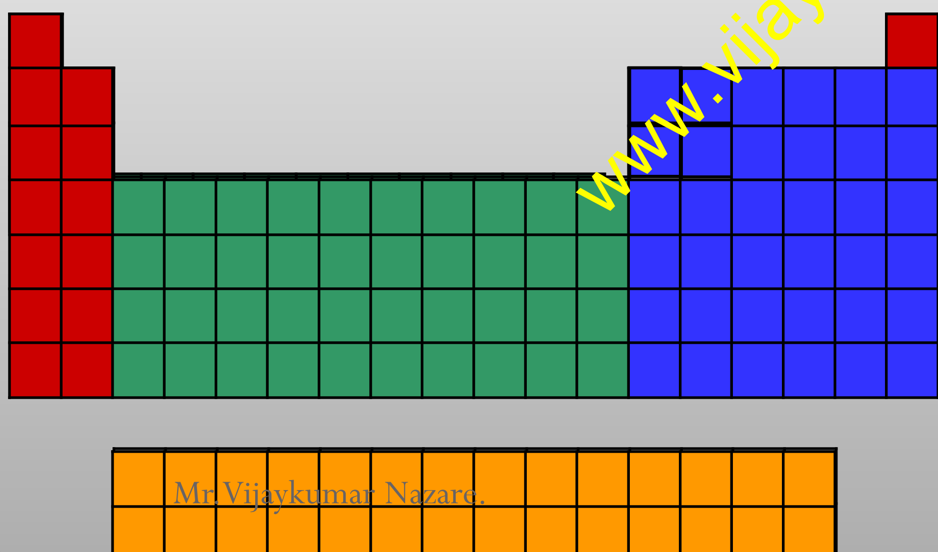
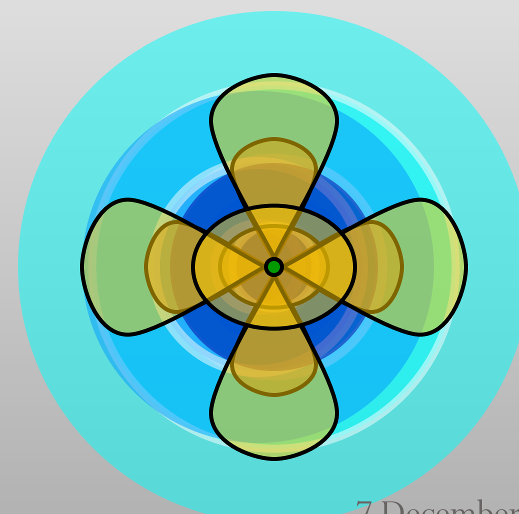
n	l	m_l	m_s
1	0(s)	0	
2	0(s)	0	
	1(p)	-1, 0, 1	
3	0(s)	0	
	1(p)	-1, 0, 1	
	2(d)	-2,-1, 0,1, 2	
4	0(s)	0	







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7 December 2012

Movie: periodic table of the elements: t10-20

The second period ($n = 2$)

- The second period ($n = 2$) starts with lithium and the third electron enters the $2s$ orbital.
- The next element, beryllium has four electrons and has the electronic configuration $1s^2 2s^2$.
- Starting from the next element boron, the $2p$ orbitals are filled with electrons,
- where the L shell is completed at neon ($2s^2 2p^6$).
- Thus there are 8 elements in the **second period**.

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The third period (n = 3)

The third period ($n = 3$) begins at sodium, and the added electron enters a 3*s* orbital. Successive filling of 3*s* and 3*p* orbitals gives rise to the third period of 8 elements from sodium to argon.

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The fourth period (n = 4)

- The fourth period ($n = 4$) starts at potassium, and the added electrons fill up the 4*s* orbital.

- Now you may note that before the 4*p* orbital is filled, filling up of 3*d* orbital's becomes energetically favorable and we come across the so called

- 3*d* **transition series** of elements.

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- **3*d* transition series** starts from scandium ($Z = 21$) which has the electronic configuration $3d^1 4s^2$.

- The 3*d* orbital's are filled at zinc ($Z=30$) with electronic configuration $3d^{10} 4s^2$.

- The fourth period ends at krypton with the filling up of the 4*p* orbitals.

Altogether we have **18** elements in this **fourth period**

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The fifth period (n = 5)

- The fifth period is beginning with rubidium is similar to the fourth period and contains the *4d* **transition series**

- starting at yttrium ($Z = 39$).

- This period ends at xenon with the filling up of the 5*p* orbitals.

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The sixth period (n = 6)

✓contains 32 elements and successive electrons

✓enter 6*s*, 4*f*, 5*d* and 6*p* orbitals, in the order — filling up of the 4*f* orbitals begins with

✓cerium (Z = 58) and ends at lutetium (Z = 71)

✓ to give the 4*f*-**inner transition series**

✓which is called the **lanthanoid series**.

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The seventh period ($n = 7$)

- is similar to the sixth period with the successive filling up of the $7s$, $5f$, $6d$ and $7p$ orbitals and includes most of the man-made **radioactive** elements.

- This period will end at the element with atomic number 118 which would belong to the noble gas family.

- Filling up of the $5f$ orbital's after actinium ($Z = 89$) gives the $5f$-**inner transition series** known as the **actinoid series**.

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The $4f$ and $5f$ -**inner transition series** of elements are placed separately in the Periodic Table to maintain its structure and to preserve the principle of classification by keeping elements with similar properties in a single column.

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Problem

How would you justify the presence of 18 elements in the 5th period of the Periodic Table?

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Problem

1. How would you justify the presence of 18 elements in the 5th period of the Periodic Table?

Solution:

When $n = 5$, $l = 0, 1, 2, 3$.

The order in which the energy of the available orbital's $4d$, $5s$ and $5p$ increases is $5s < 4d < 5p$.

The total number of orbitals available are 9.

The maximum number of electrons that can be accommodated is 18; and therefore 18 elements are there in the 5th period.

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Groupwise Electronic Configurations

Atomic number	Symbol	Electronic configuration
3	Li	$1s^2 2s^1$ (or) $[He]2s^1$
11	Na	$1s^2 2s^2 2p^6 3s^1$ (or) $[Ne]3s^1$
19	K	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ (or) $[Ar]4s^1$
37	Rb	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^1$ (or) $[Kr]5s^1$
55	Cs	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6 6s^1$ (or) $[Xe]6s^1$
87	Fr	$[Rn]7s^1$

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Classification of elements in to s-, p-, d-, f- BLOCKS

s-BLOCK

	1	2
1s		
2s	Li	Be
3s	Na	Mg
4s	K	Ca
5s	Rb	Sr
6s	Cs	Ba
7s	Fr	Ra

d-BLOCK

	3	4	5	6	7	8	9	10	11	12
3d	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
4d	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd
5d	La	Hf	Ta	W	Pt	Os	Ir	Pt	Au	Hg
6d	Ac	Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub

p-BLOCK

	13	14	15	16	17	18
						He
2p	B	C	N	O	F	Ne
3p	Al	Si	P	S	Cl	Ar
4p	Ga	Ge	As	Se	Br	Kr
5p	In	Sn	Sb	Te	I	Xe
6p	Tl	Pb	Bi	Po	At	Rn
7p	—	Uuq	—	—	—	—

f-BLOCK

Lanthanoids 4f	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Actinoids 5f	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

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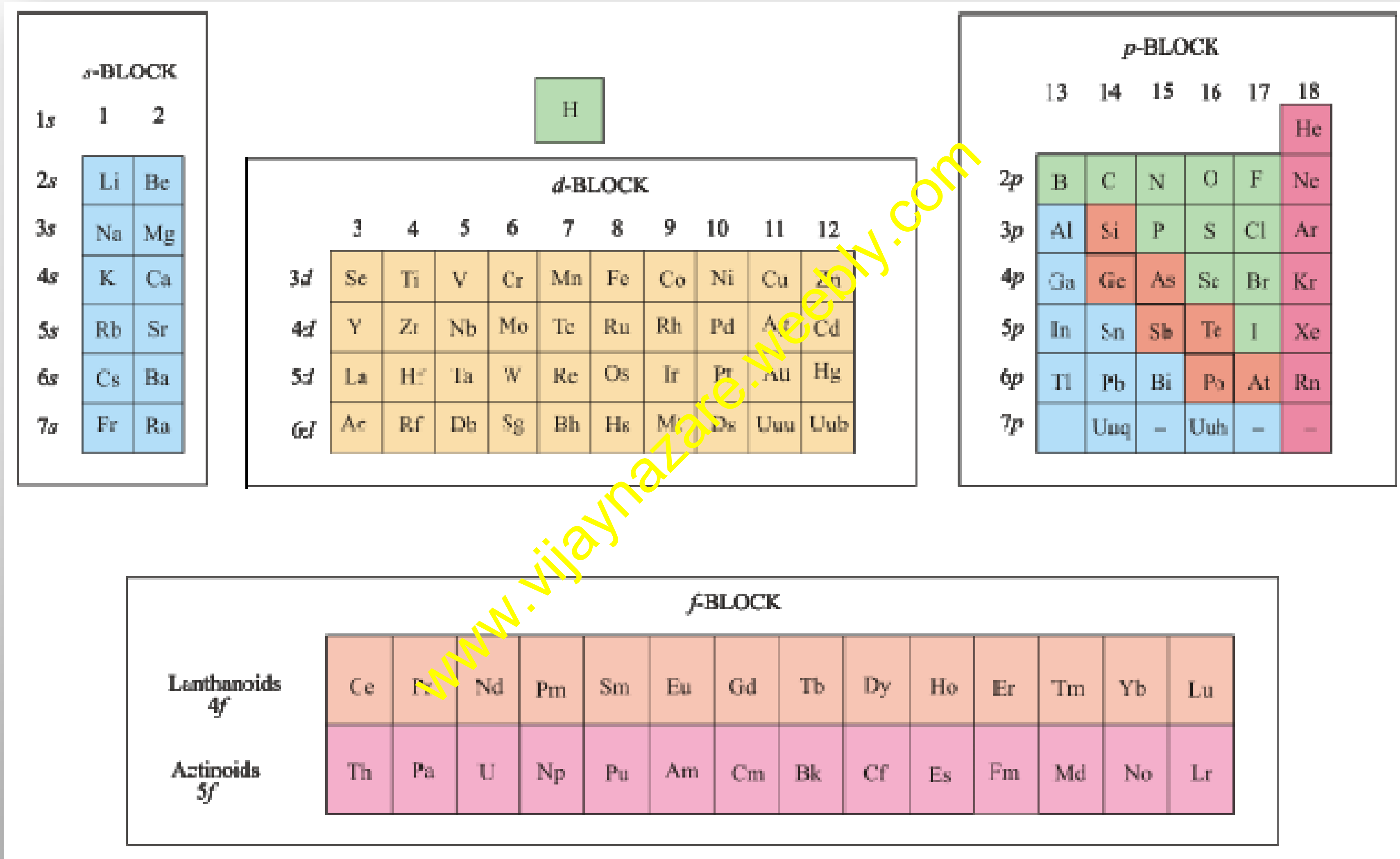
s-, p-, d-, f- BLOCKS



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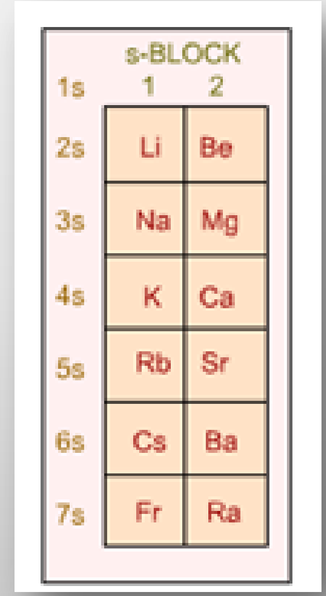
The s-Block Elements



- The elements of Group 1 (alkali metals) and Group 2 (alkaline earth metals) which have ns^1 and ns^2 outermost electronic configuration belong to the **s-Block Elements**

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The s-Block Elements

- Main points (properties)

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- They are all reactive metals with low ionization enthalpies.

- They lose the outermost electron(s) readily to form 1^+ ion (in the case of alkali metals) or 2^+ion (in the case of alkaline earth metals).

- The metallic character and the reactivity increase as we go down the group.

- Because of high reactivity they are never found pure in nature.

- The compounds of the *s*-block elements, with the exception of those of lithium and beryllium are predominantly ionic.

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- **They have low ionization potentials.**
- **They have very small electron gain enthalpies.**
- **They are solids at room temperature** ***(Cs is liquid at about at 35°C)***
- **Their hydroxides are basic in nature.**

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- Except H all elements of s-Block elements are **active metals**.
- They have +1/ +2 oxidation state.
- They form **basic oxides**
- They impart characteristic **colour** to the flame
- Generally they form **ionic salts** with nonmetals.

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The *p*-Block Elements

The ***p*-Block Elements** comprise those belonging to Group 13 to 18 and these together with the ***s*-Block Elements** are called the **Representative Elements or Main Group Elements**.

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The *p*-Block Elements

- The outermost electronic configuration varies from ns^2np^1 to ns^2np^6 in each period.

At the end of each period is a noble gas element with a closed valence shell ns^2np^6 configuration.

All the orbitals in the valence shell of the **noble gases** are completely filled by electrons and it is very difficult to alter this stable arrangement by the addition or removal of electrons.

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The *p*-Block Elements

Main points (properties)

- Most of p-Block elements are non-metals.
- They have variable oxidation states.
- They form acidic oxides
- They impart no characteristic colour to the flame
- Generally they form covalent compounds. Halogens form salts with alkali metals

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The *p*-Block Elements

Main points (properties) cont…d

- They have high ionization potentials.
- They have very large electron gain enthalpies.
- They are solids/liquids/gases at room temperature (Br is liquid)
- The aqueous solutions their oxides are acidic in nature.

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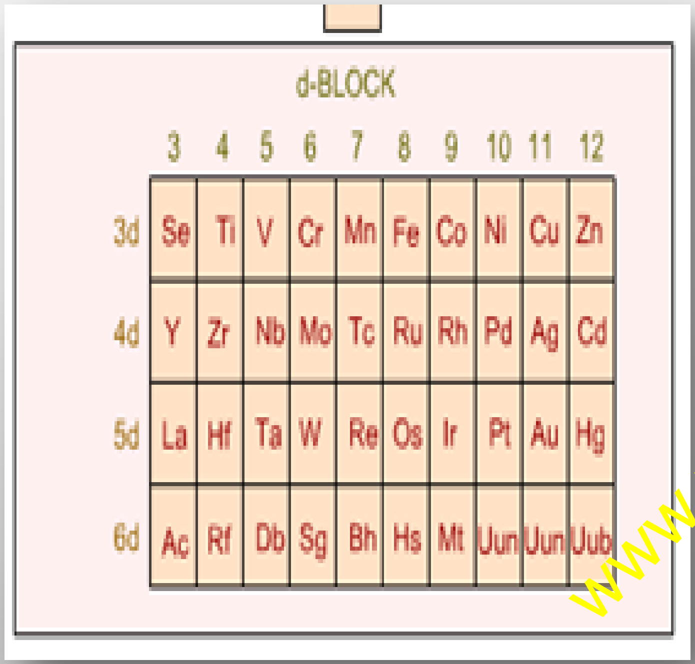
d-Block elements:



- These elements lie in between s-block and p-block elements.

- These elements are called transition elements as they show transitional properties between s and p-block elements.

- The general electronic configuration of d-block elements is $(n-1)d^{1-10}ns^{0-2}$.

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Properties of d-Block elements:

- Most of the d-block elements are metals.

- Most of them exhibit variable oxidation states because of the presence of partly filled d- orbitals. *(Except Sc, Zn, Cd etc.)*

- Many of their compounds are coloured.

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Properties of d-Block elements:

- They readily form complexes by acting as Lewis acids.

- They easily form coloured complexes

- Most of them and their compounds show ferromagnetic & paramagnetic behaviour.

- They act as good catalysts.

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The *f-Block Elements* (Inner-Transition Elements)

- The two rows of elements at the bottom of the Periodic Table, called the **Lanthanoids,** Ce(*Z* = 58) – *Lu*(*Z* = 71) *and*
- **Actinoids,**Th(*Z* = 90) – *Lr* (*Z* = 103) *are characterised by* the outer electronic configuration

$$(n-2)f^{1-14}\ (n-1)d^{0-1}ns^2$$

- *The last electron added to each* element is filled in *f*- orbital.
- *These two series of* elements are hence called the **Inner- Transition Elements** (*f-Block Elements*).

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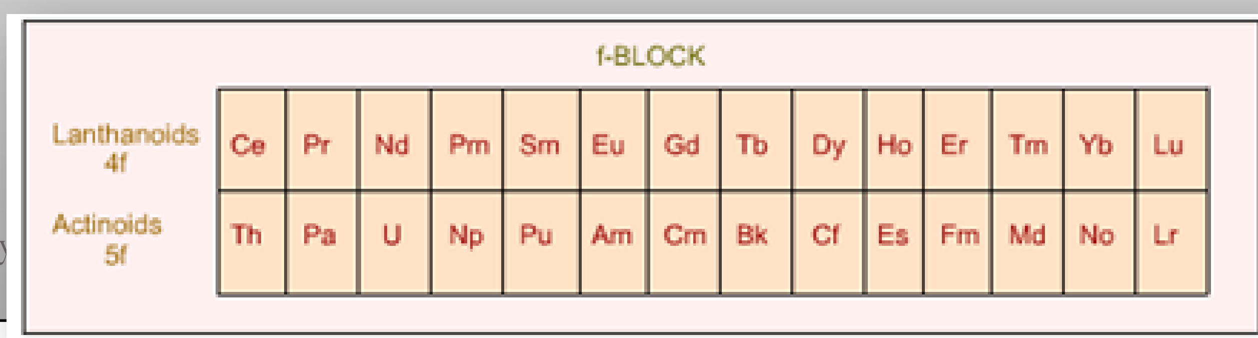
f-BLOCK

Lanthanoids 4f	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Actinoids 5f	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Properties of f-Block elements:

- They are all metals.
- Within each series, the properties of the elements are quite similar.
- The chemistry of the early actinoids is more complicated than the corresponding lanthanoids, due to the large number of oxidation states possible for these actinoid elements.
- Actinoid elements are radioactive.

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Properties of f-Block elements: cont..d

- Many of the actinoid elements have been made only in nanogram quantities or even less by nuclear reactions and their chemistry is not fully studied.
- The elements after uranium are called **TransuraniumElements.**

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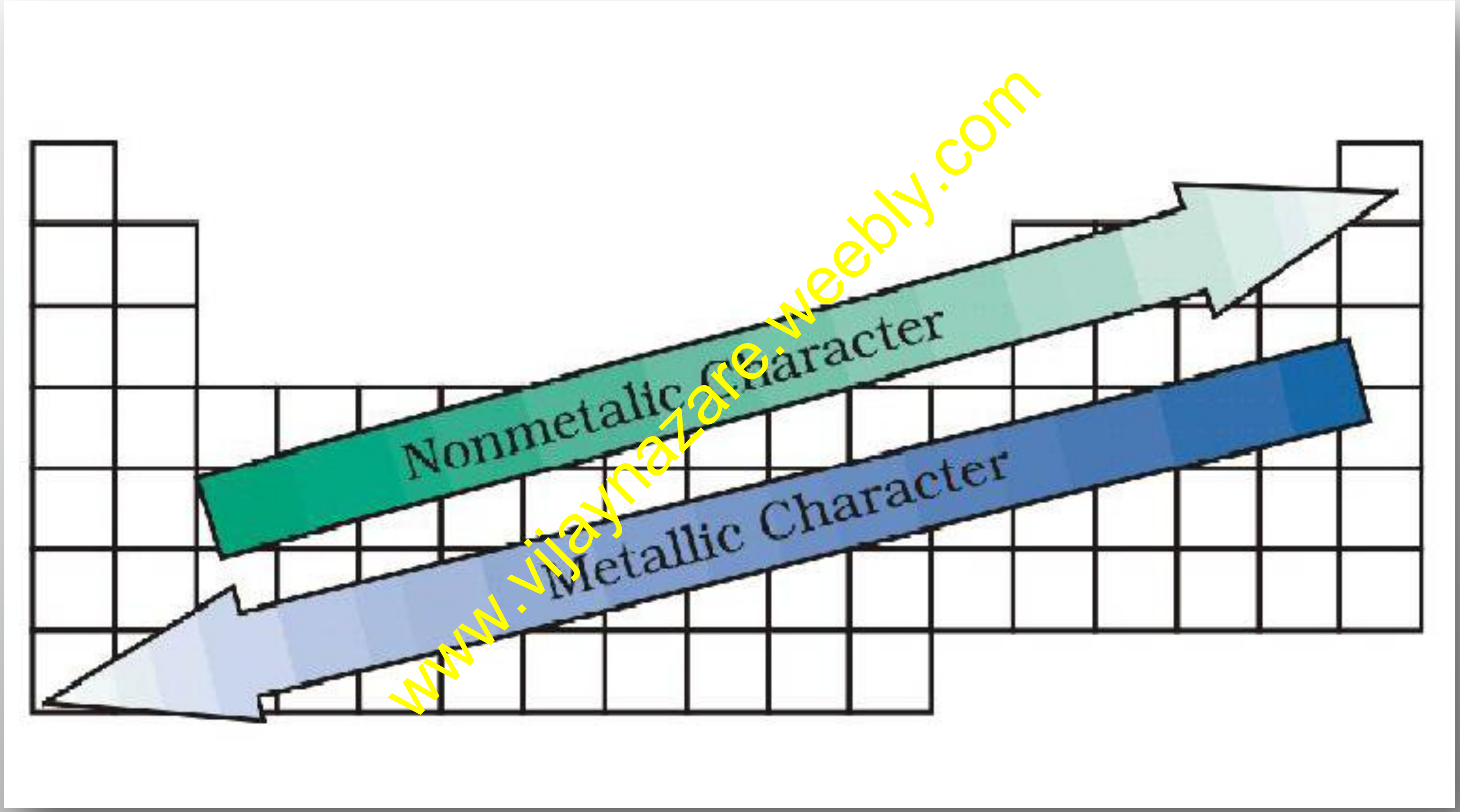
Metals, Non-metals and Metalloids



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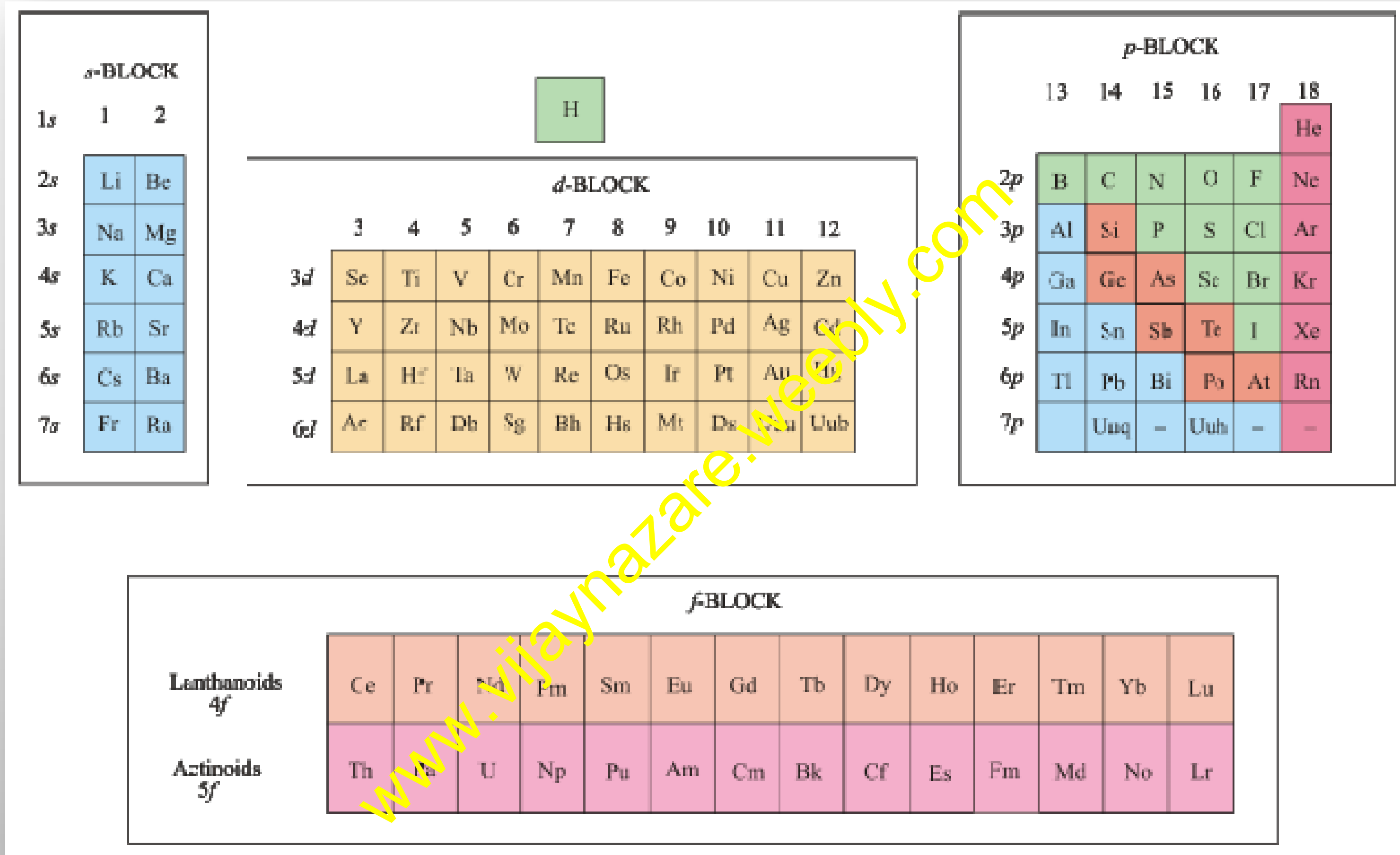
Metals, Non-metals and Metalloids



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METALS ( )

NON-METALS ( )

METALLOIDS ( )

Trends in Physical Properties

1. ***Atomic Radius***
2. ***Ionic Radius***
3. ***Ionization Enthalpy***
4. ***Electron Gain Enthalpy***
5. ***Electro negativity***

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Atomic Radius

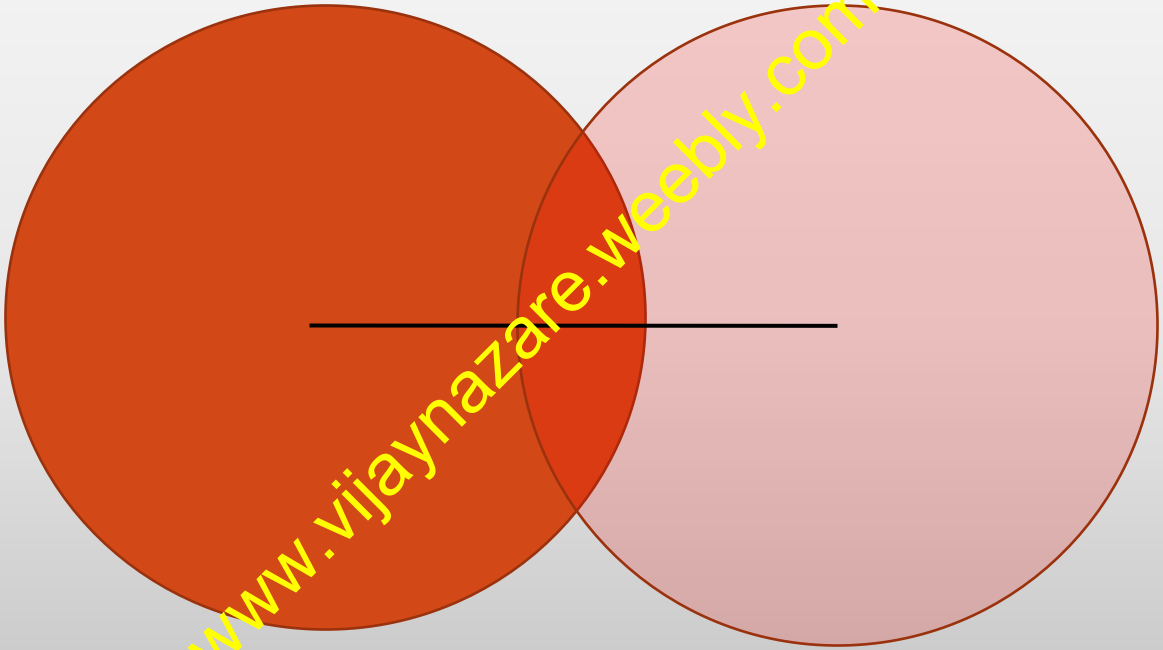

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Table 3.6(a) Atomic Radii/pm Across the Periods

Atom (Period II)	Li	Be	B	C	N	O	F
Atomic radius	152	111	88	77	74	66	64
Atom (Period III)	Na	Mg	Al	Si	P	S	Cl
Atomic radius	186	160	143	117	110	104	99

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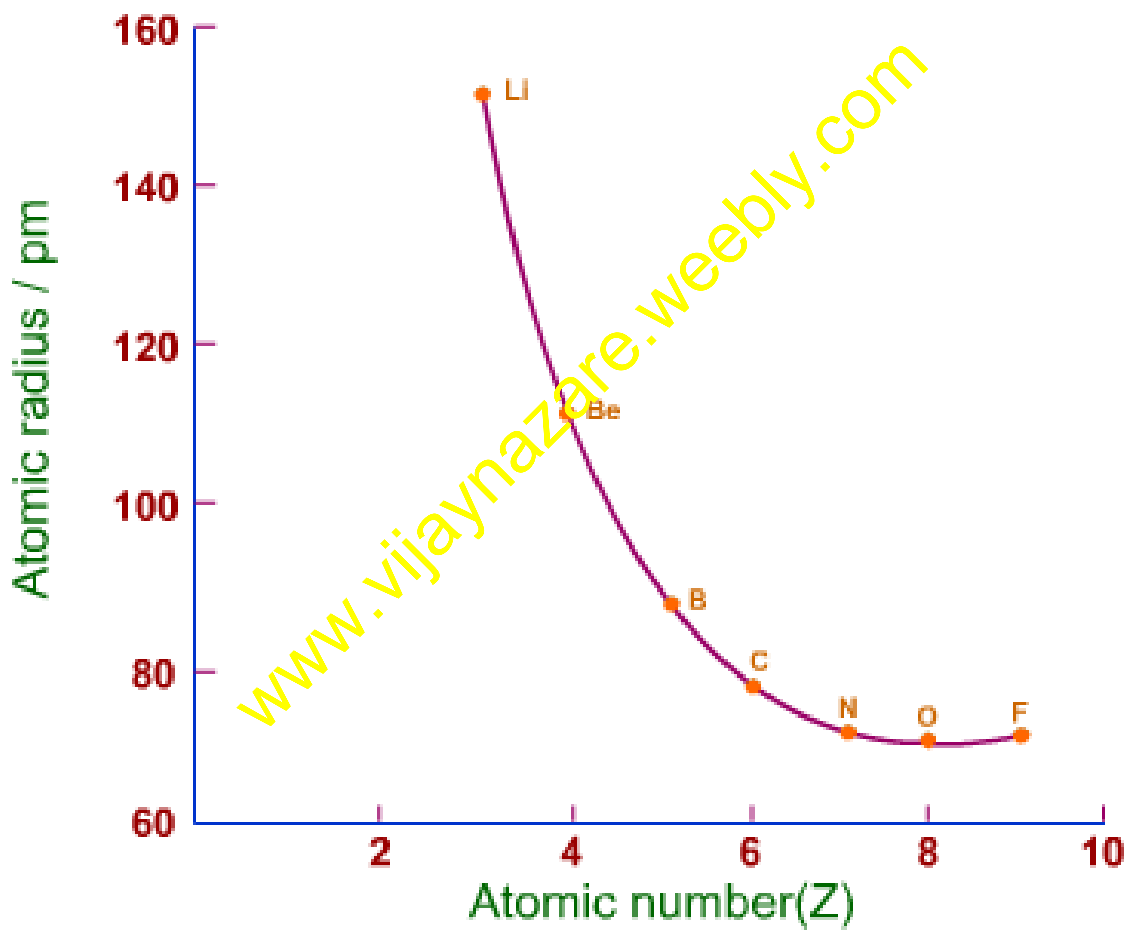
Table 3.6(b) Atomic Radii/pm Down a Family

Atom (Group I)	Atomic Radius	Atom (Group 17)	Atomic Radius
Li	152	F	64
Na	186	Cl	99
K	231	Br	114
Rb	244	I	133
Cs	262	At	140

Variation of atomic radius with atomic number across the second period



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Ionic Radius

- A cation is smaller than its parent atom
- because it has fewer electrons while its nuclear charge remains the same.
- The size of an anion will be larger than that of the parent atom
- because the addition of one or more electrons would result in increased repulsion among the electrons and a decrease in effective nuclear charge.

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Ionization Enthalpy

A quantitative measure of the tendency of an element to lose electron is given by its **Ionization Enthalpy.**

Or

It represents the energy required to remove an electron from an isolated gaseous atom (X) in its ground state.

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- The first ionization enthalpy generally increases as we go across a period and decreases as we descend in a group.
- ionization enthalpy and atomic radius are closely related properties.
- To understand these trends, we have to consider two factors :
  1. (i) the attraction of electrons towards the nucleus, and
  2. (ii) the repulsion of electrons from each other.

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Effective nuclear charge

- The effective nuclear charge experienced by a valence electron in an atom will be less than the actual charge on the nucleus because of **"shielding" or "screening" of the valence** electron from the nucleus by the intervening core electrons.

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“shielding” or “screening effect”

- For example, the 2*s electron in* lithium is shielded from the nucleus by the inner core of 1*s electrons.*

- *As a result, the* valence electron experiences a net positive charge which is less than the actual charge of +3.

- In general, shielding is effective when the orbital's in the inner shells are completely filled.

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Electron Gain Enthalpy

When an electron is added to a neutral gaseous atom (X) to convert it into a negative ion, the enthalpy change accompanying the process is defined as the **Electron Gain Enthalpy**

$$X(g) + e^- \rightarrow X^-(g)$$

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Electronegativity

A qualitative measure of the ability of an atom in a **chemical compound to attract shared** electrons to itself is called **electronegativity**.

Electronegativity, is a chemical property which describes the power of an atom *(or, more rarely, a functional group)* to attract electrons towards itself.

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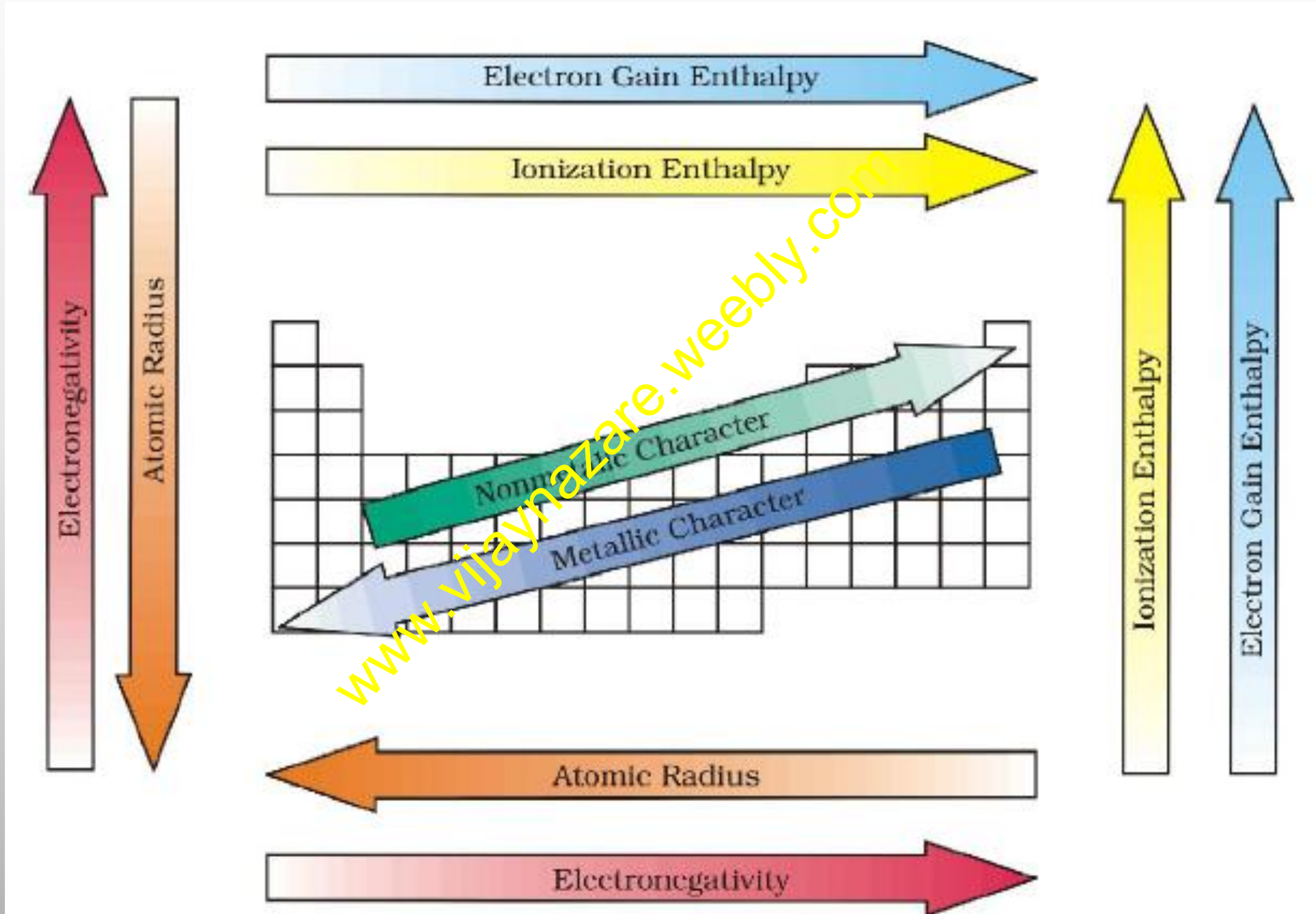
Trends in Physical Properties



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Periodic Trends in Chemical Properties

1. *Periodicity of Valence or Oxidation States.*

2. *Anomalous Properties of Second Period Elements.*

3. **Periodic Trends and Chemical Reactivity**

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Thank you

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