PERIODIC TABLE

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Modern Periodic Table

Group →		S-block Representative elements												p-Block Representative elements					
Period ↓		1	2											13	14	15	16	17	18
1	Radius E.N. I.P. Ea	^{1}H 0.30 2.10 1311 -----	----											-------	--------	-----	-----	-----	^{2}He 1.20 ----- 2372 0.00
2	Electron affinity values of some important elements are given in this periodic Table.	^{3}Li 1.23 1.00 520 -0.61	^{4}Be 0.89 1.50 899 0.00	1. Bromine is the only non-metal which is liquid at room temp. 2. Hg is the only metal which is liquid at room temp. 3. Tungston has the highest m.p. among metals. 4.Carbon has the highest m.p. among non-metals 5. Highest density is for- Os or Ir 6. Li- The lightest metal					7. Ag – Best conductor 8. Diamond – Hardest natural substance. 9. Fluorine – Most electronegative 10.Chlorine – Highest Ea value. 11. He – Maximum I.P. 12. Inert gases – Zero Ea value 13. Cs 0r Fr- Lowest I.P. 14. Cs- The most electropositive					^{5}B 0.80 2.00 801 -0.30	^{6}C 0.77 2.50 1086 -1.25	^{7}N 0.74 3.00 1403 -0.20	^{8}O 0.74 3.50 1314 -1.48	^{9}F 0.72 4.00 1681 -3.60	^{10}Ne 1.60 ----- 2080
3		^{11}Na 1.57 0.90 496	^{12}Mg 1.36 1.20 737	3	4	5	6	7	8	9	10	11	12	^{13}Al 1.25 1.50 577	^{14}Si 1.17 1.80 786	^{15}P 1.10 2.10 1012	^{16}S 1.04 2.50 999	^{17}Cl 0.99 3.00 1255 -3.80	^{18}Ar 1.91 ----- 1521
				d-Block Transition elements															
4		^{19}K 2.03 0.80 419	^{20}Ca 1.74 1.00 590	^{21}Sc 1.44 1.30 631	^{22}Ti 1.32 1.50 656	^{23}V 1.22 1.60 650	^{24}Cr 1.17 1.60 652	^{25}Mn 1.17 1.50 717	^{26}Fe 1.17 1.80 762	^{27}Co 1.16 1.80 758	^{28}Ni 1.15 1.80 736	^{29}Cu 1.17 1.90 745	^{30}Zn 1.25 1.60 906	^{31}Ga 1.25 1.60 579	^{32}Ge 1.22 1.80 760	^{33}As 1.21 2.00 947	^{34}Se 1.14 2.40 941	^{35}Br 1.14 2.80 1142 -3.50	^{36}Kr 2.00 ----- 1351
5		^{37}Rb 2.16 0.80 403	^{38}Sr 1.91 1.00 549	^{39}Y 1.62 1.20 616	^{40}Zr 1.45 1.40 674	^{41}Nb 1.34 1.60 664	^{42}Mo 1.29 1.80 685	^{43}Tc - 1.90 703	^{44}Ru 1.24 2.20 711	^{45}Rh 1.25 2.20 720	^{46}Pd 1.28 2.20 804	^{47}Ag 1.34 1.90 731	^{48}Cd 1.41 1.70 876	^{49}In 1.50 1.70 558	^{50}Sn 1.40 1.80 708	^{51}Sb 1.41 1.90 834	^{52}Te 1.37 2.10 869	^{53}I 1.33 2.50 1191 -3.20	^{54}Xn 2.20 ----- 1170
6		^{55}Cs 2.35 0.70 376	^{56}Ba 1.98 0.90 503	^{57}La 1.69 1.10 541	^{72}Hf 1.44 1.30 760	^{73}Ta 1.34 1.50 760	^{74}W 1.30 1.70 770	^{75}Re 1.28 1.90 711	^{76}Os 1.26 2.20 840	^{77}Ir 1.26 2.20 900	^{78}Pt 1.29 2.20 870	^{79}Au 1.34 2.20 889	^{80}Hg 1.44 1.90 1007	^{81}Tl 1.55 1.80 589	^{82}Pb 1.46 1.80 715	^{83}Bi 1.52 1.90 703	^{84}Po 1.46 2.00 813	^{85}At ---- 2.20 912	^{86}Rn ---- ----- 1037
7		^{87}Fr . 0.70	^{88}Ra . 0.90	^{89}Ac	^{104}Rf	^{105}Db	^{106}Sg	^{107}Bh	^{108}Hs	^{109}Mt	^{110}Uun	^{111}Uuu	^{112}Uub	-	^{114}Uuq				
						f- Block Inner Transition elements													
LANTHANIDES			^{58}Ce	^{59}Pr	^{60}Nd	^{61}Pm	^{62}Sm	^{68}Eu	^{54}Gd	^{65}Tb	^{66}Dy	^{67}Ho	^{68}Er	^{69}Tm	^{70}Yb	^{71}Lu			
ACTINIDES			^{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			

Modern Periodic Table or Long form of Periodic Table or Mosley's Periodic Table.

- Modern Periodic law:

The physical & Chemical properties of the elements are periodic functions of their atomic numbers.

- Features :-

(i) No. of vertical columns : 18

(ii) No. of Horizontal row : 7

(iii) Elements are arranged on the basis of their electronic configuration.

- Elements, having similar outer electronic configuration - same group.
- The period no. - outermost orbit.
- The number of elements, in each period, is decided by electronic configuration as:

Electronic Configuration	No. of elements in each Period	Period No.
$1s^2$	2	1
$2s^2p^6$	8	2
$3s^2p^6$	8	3
$4s^23d^{10}4p^6$	18	4
$5s^24d^{10}5p^6$	18	5
$6s^25d^{10}4f^{14}6p^6$	32	6
$7s^2$	incomplete	7

TYPES OF ELEMENTS:

1. Based on electronic Configuration:

- If last electron goes to s-orbital- S-block. e.g. Gr. 1 & 2.
- If last electron goes to p-orbital - p-block. e.g. Gr. 13 to 18
- If last electron goes to d-orbital- d-block. e.g. Gr. 3 & 12.
- If last electron goes to f-orbital-Lanthanides & Actinides.

TYPES OF ELEMENTS:

2. Based on Common name:

Name	Features	Elements
Alkali metals	Certain of their compounds are caustic & alkaline	Group 1
Alkaline earth metals	These elements are found in mineral & certain of their compounds are caustic.	Group 2
Chalcogens or Ore forming	Because many metal ores are oxides or sulphides	The first four elements of Gr.16
Halogens or salt producing	These are found in the salts present in sea water.	Elements of Group 17.

TYPES OF ELEMENTS:

2. Based on Common name:

Name	Features	Elements
Inert Gases or Noble Gases	Less reactive	Group 18
Transition elements	• Inner d-orbital is partially filled - $(n-1)d^{1-10}ns^{1-2}$. • Zn, Cd & Hg - $(n-1)d^{10}ns^{2}$ configuration and do not show the general properties of Transition elements • Metals • Variable valency due to small energy difference between (n-1)d & ns orbital. • Possess transitional properties of s- & p-block elements, so they are placed in between more reactive s- & less reactive p-block.	Group 3-12

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Contd------

Lanthanides	• Electronic onfiguration:$(n-2)f^{1-14}(n-1)d^{0-1}ns^2$ • Metals, $_{58}Ce$ – $_{71}Lu$. • Similarity in chemical properties among Lanthanoids	4f-block
Actinides	• Electronic onfiguration:$(n-2)f^{1-14}(n-1)d^{0-1}ns^2$ • Metals, $_{90}Th$ – $_{103}Lr$. • Similarity in chemical properties among Actinoids. • Radioactive so less stable. The elements coming after Uranium are man-made & called Transurenic elements.	5f-block

Metals	• s-block, d-block, f-block & very few of the p-block elements. • They are mostly on the left of the periodic table. • 75% of the total elements are Metals.
Non-Metals	• Most of the elements of p-block & they are at the top right hand side of the periodic table.
Metalloids or Semi-metals.	• They have properties of both metals & non-metals e.g. Ge , Si, As, Sb, Te.
Representative elements	• s- & p-block elements
Typical elements	• Elements of 3^{rd} period
Bridge elements	• Elements of 2^{nd} period

PERIODICITY

- Effective nuclear charge(Z*)
- Atomic size
- Ionization Energy or Ionization potential
- Electron affinity(Ea)
- Metallic character
- Hardness & cohesive energy
- Reactivity
- Strength of acid & base
- Thermal stability of oxosalts
- Lattice energy
- Solubilty

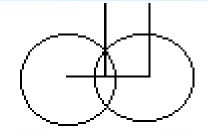
Effective nuclear charge(Z*)

- It is the net nuclear charge felt by any electron.
- $Z^* = Z - \sigma$ Z= Nuclear charge ; σ = Screening constant
- Approx. calculation of σ :
- Each electron of the outermost orbit (n) screens the nuclear charge by 0.35 unit , (n-1) electron shields by 0.85 unit & each electron of other orbit screens by 1 unit.
- Z* increases along the period and decreases down the group

Atomic size :

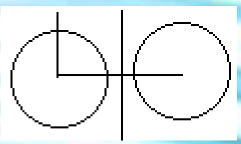
Types of Radii

(i) Covalent Radius:-Half of the distance between the nuclei of two like atoms covalent bond.



(ii) VanderWaal Radius:-

If the two atoms are identical and only weak vanderwaal force exist.



Metallic radius:- Half of the internuclear distance separating the metal ions in the metallic crystal

$$M^{+n}\text{----}ne\text{----}M^{+n}$$

- **Factors affecting atomic radius:**
- Z* Effective Nuclear Charge(ENC)
- Shielding power of orbitals
- Increase in orbit number
- The decreasing order of shielding power of different orbitals: s > P > d > d > f
- **Variation**

➢ Increases down the group due to increase in orbit no. and decrease in ENC.

➢ Decreases along the period due to increase in ENC

➢ As we remove electron, ENC increases and size decreases.

➢ As we add electron, ENC decreases and size increases

➢ For Isoelectronic (having same electrons) species size decreases with increase in atomic number.

- Atomic size of inert gas has largest value in their respective Period due to their Vanderwaal radius.

- Lanthanide contraction & their consequences

After La , electrons start filling 4f-orbital. f-Orbital has least shielding power i.e. it shields nuclear charge least. So as electron is added to the f-orbital, Z* increases and size decreases. This decrease in size is known as Lanthanide contraction.

As we go from Sc-Y-La, the size increases due to increase in orbit no.But after 3rd group the size increase from 3d to 4d series but there is hardly any increase in size from 4d to 5d.Because increase in size due to orbit no. is exactly compensated by decrease in size due to lanthanide contraction. Due to similarity in size, their chemical properties are similar, they co-exist in nature and their isolation is difficult.

Ionization Energy :

- **Definition** : Energy required to remove electron/electrons from the outermost orbit of an isolated gaseous atom per mole.
- **Factors affecting I. E**

- **The size of atom**

  Down the group Size increases and I.E. decreases.

  Along the period, size decreases and I.E. increases

- **Stability of Orbitals**

Full filled and half filled orbital are more stable. So, energy required to remove electron from their outermost orbit is high and as a result their I.E. is high.

(i) I.E. of inert gases is very high due to their full filled orbital.

(ii) I.E. of Nitrogen is greater than that of Oxygen due to half filled orbital of Nityrogen.

- **Nature of Orbital from which electron is to be removed**

Decreasing order of distance of orbitals of same orbit from the nucleus – f>d>p>s

I.E. Contd-----

Decreasing order of Energy required to remove electron from orbitals of given orbit:- s>p>d>f

I.E. of Beryllium is greater than that of Boron?

Ans: In case of Be electron has to be removed from full filled s-orbital whereas in case of B it has to be removed from p-orbital which is neither full filled nor half filled

Electron affinity(Ea) or Electron Gain Enthalpy

Definition: Energy released per mole when electron is added to the outermost orbit of an isolated gaseous atom.

$$M(g) + e \rightarrow M^{-}(g) ;$$

It may be exothermic or endothermic depending upon the nature of the element/ion. But in most of the cases the process is exothermic.

Factors affecting Ea:

Size & Z*

(a) Along the period, Z* increases, size decreases so Ea increases.

(b) Down the group, Z* decreases, size increases so Ea increases.

Stability of orbitals

Due to stable configuration of Be, N & Noble gases their Ea is positive.

Electron density of atom/ion

Ea of O & F is less than expected. Due to their smaller size,the electron density is more. It causes elecron-electron repulsion, so energy released is less. **Repulsion is less for S & & Cl , So their Ea value is greater. Cl has the highest Ea value.**

Electronegativity(χ chi) :

- It is tendency of the atom to attract the bonded pair of electron toward itself.
- **Mulliken' scale** to measure electronegativity

$$\chi = \frac{I.P + Ea}{2}$$

χ was 2.8 times greater than Pauling's scale. So mulliken scale was divided by 2.8 as:

$$\chi = I.P + Ea /5.6$$

Variation in Periodic table: It increases along the period & decreases down the group.

- **Metallic character** : Metals are electropositive because they have tendency to lose electrons. So metallic property i. e. electropositivity increases down the group and decreases along the period.
- **Ionic character of compound** : More electropositive the metal , greater the ionic character.
- **Basic strength** : Oxides & hydroxides of metal are bases.More electropositive the metal, more the ionic character and stronger the base. So basic strength increases down the group and decreases along the period for representative elements.

Weakly electropositive elements form amphoteric oxides i.e. theses oxides react both with acid & base.Oxides of non metals are acid.

- **Thermal stability of oxosalts** The thermal stability of oxosalts such as Carbonates, Bicarbonates , Sulphates etc increase with increase in electropositivity of metals. So the thermal stability of oxosalts increase down the group and decreases along the period.

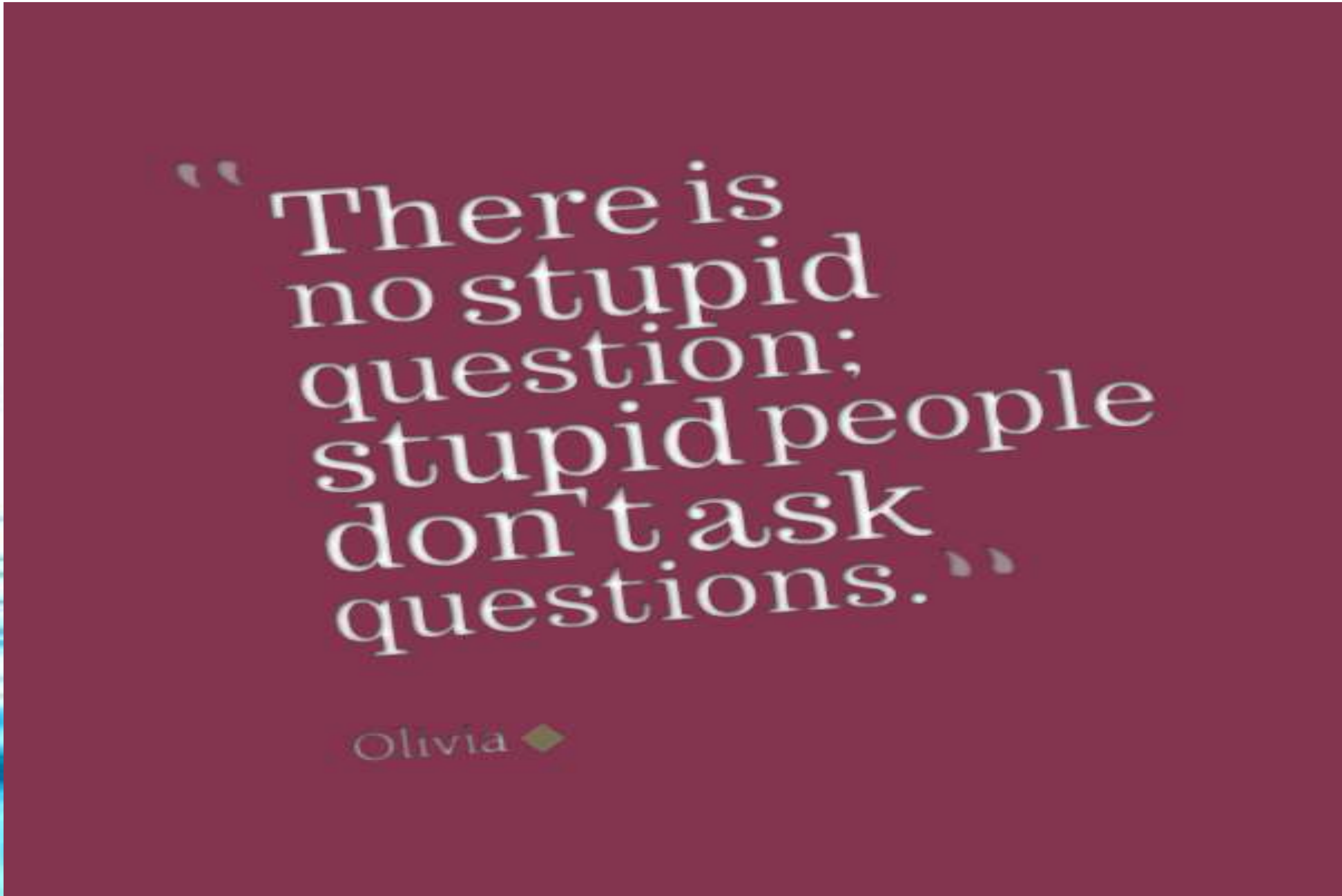
Inert pair effect : When the energy required to unpair the paired electron of s-orbital becomes greater than the energy released in bond formation , inert pair effect is observed. It is found in the bottom elements of 13th, 14th & 15th group.

Solubility of ionic compounds :

- For solubility, hydration energy must exceed the lattice energy. Down the group both hydration & Lattice energy decrease so solubility also decrease.
- The solubility of Fluoride & carbonate increase down the group for alkali metals & fluorides & hydroxides of alkaline earth metal, because the lattice E. decrease more rapidly than hydration E.

Diagonal relationship : Ions having same ionic potential value have similar chemical properties.

Li	Be	B	The diagonally related Li-Mg & Be-Mg have same ionic potential value so they show similarity in their chemical properties.
Na	Mg	Al	


"There is no stupid question; stupid people don't ask questions."
Olivia

THANK YOU