PERIODIC TRENDS IN CHEMICAL PROPERTIES :-

Some of them are
- Diagonal relationship
- Inert pair effect
- Effect of Lanthanoid Contraction
- Periodicity of Valence or oxidation state
- Anomalous properties of second period elements.

(a) Periodicity of Valence or oxidation state :-

- The valence is the most charachterstic property of the elements and can be understood in the terms of their electronic configuration
- The Valence of representative elements is usually equal to the number of electrons in outermost orbitals and/or equal to eight minus the number of outermost electrons.

for ex.

Grp	1	2	13	14	15	16	17	18
Number of Valence e^-s	1	2	3	4	5	6	7	8
Valence	1	2	3	4	3,5	2,6	1,7	0,8

- Nowadays the term oxidation state is frequently used for Valence.

for eg 'O' present in two compounds

OF_2 & Na_2O

EN F > O > Na

'F' more EN
∴ O.S. of F is -1
each atom of Fluorine shares one electron with 'O' ∴ O.S. of 'O' is +2
F $(2s^2 2p^5)$ O $(2s^2 2p^4)$

'O' → More EN
Na $(3s^1)$ => loses one electron
'O' $(2s^2 2p^4)$ => gain one electron from each 'Na'
∴ Na → OS = +1
O → OS = -2

Thus, the oxidation state of an element in a particular compound can be defined as the charge Acquired by its atom on the basis of E.N. consideration from other atoms in the molecule.

- Some periodic trends observed in the Valence of elements (hydrides and oxides)...

Table 3.9 Periodic Trends in Valence of Elements as shown by the Formulas of Their Compounds

Group	1	2	13	14	15	16	17
Formula of hydride	LiH NaH KH	CaH_2	B_2H_6 AlH_3	CH_4 SiH_4 GeH_4 SnH_4	NH_3 PH_3 AsH_3 SbH_3	H_2O H_2S H_2Se H_2Te	HF HCl HBr HI
Formula of oxide	Li_2O Na_2O K_2O	MgO CaO SrO BaO	B_2O_3 Al_2O_3 Ga_2O_3 In_2O_3	CO_2 SiO_2 GeO_2 SnO_2 PbO	N_2O_5 N_2O_3 P_2O_5 P_2O_3 As_2O_5 As_2O_3 Sb_2O_5 Sb_2O_3 Bi_2O_3	SO_3 SeO_3 TeO_3	– Cl_2O_7 – –

- There are many elements which exhibit variable Valence. This is particularly characteristic of transition elements and actinoids.

(b) Anomalous Properties of second period elements :-

- The first element of each group 1 (Lithium) and 2 (beryllium) and group 3-17 (Boron to fluorine) differ in many respects from the other members of their respective group.
- for example, lithium unlike other alkali metals, and beryllium unlike other alkaline earth metals, form compounds with pronounced covalent character. The other members of these groups predominantly form ionic compounds.
- In fact the behaviour of Li & Be is more similar with the second element of the following group i.e. mg & Al, respectively. This sort of similarity is commonly known as "diagonal relationship" in the periodic properties.
- The anomalous behaviour of 1st member of of a group of s-p block elements is attributed to their small size, large charge/radius ratio and high EN of the elements.
- covalency => The maximum covalency of II period elements is four while other members may show higher covalency also.

for eg. BF_4^- and $[AlF_6]^{3-}$ exist but $[BF_6]^{3-}$ ✗

Similarly OF_2 → known OF_4, OF_6 ✗
SF_4 & SF_6 are known

'N' is never pentavalent, PCl_5 is known

Reason :- • In III period and onwards, Valence shell contain empty d-orbitals also.
• In II period only four valence orbitals are available for bonding.

Pπ-Pπ bonding :- first member of p-block elements display greater ability to form pπ-pπ multiple bonds to itself

for eg. C=C, C≡C
N=N, N≡N

and other second period elements

for eg C=O, C=N, C≡N, N=O

compared to subsequent members of the same group.

Reason :- smaller size & high E.N.