CHAPTER NAME : CLASSIFICATION OF ELEMENTS AND   
 PERIODICITY IN PROPERTIES

MODULE NO : 03/03(PERIODICITY IN PROPERTIES)

SUBJECT : CHEMISTRY CLASS : XI

Periodic trends in physical properties continue…..  
3)Electron Gain Enthalpy(ΔegH) /Electron Affinity(EA):  
It is an atomic property which gives us an idea of the tendency of the element to accept the electron to form an anion

The amount of energy released when an electron is added to a neutral isolated gaseous atom of an element is called Electron Gain Enthalpy(Electron Affinity)

X(g) + e- ---> X- (g) + EA

X(g) + e- ---> X- (g) ΔegH =-Ve(Exothermic process)

II Electron Gain Enthalpy: When an electron is added to uni-negative ion, energy is absorbed to overcome the repulsive forces. This energy is called second electron affinity

X-(g) + e- ---> X(g)2- -EA

X-(g) + e- ---> X(g)2- ΔegH=+ve(Endothermic process)

Electron Gain Enthalpy is measured in eV/atom, Kcal/mol, KJ/mol

In groups:Electron Gain Enthalpy decrease from top to bottom as the atomic size increases

In periods: From left to right side Electron Gain Enthalpy increases due to decrease in size of atoms and increase in the nuclear charge   
Zero group elements have completely filled orbitals and hence the addition of any extra electron from out side to these atoms is not possible. Therefore they have practical zero Electron Gain Enthalpy

Chlorine has highest Electron Gain Enthalpy (i.e. -349KJ/mol)

4) Electronegativity(EN)(≅Non-metallic Nature)

The tendency of an atom to attract the shared electron pair towards itself in a molecule is called Electronegativity

It is property of an atom in a molecule

Electro Negativity is a relative property and has no units.

Different scales are used to calculate Electronegativity

The reference element taken by pauling for the determination of Electronegativity values of other element is Fluorine

Highest Electronegative value for Fluorine(F)(4.0)

Electronegativity decreases in group as atomic size increases

Electronegativity increases in period as atomic size decreases(or Effective nuclear charge increases)

Noble gas elements have zero EN due to octet configuration

As electronegativity increases, non-metallic character increases

EN values are used to know the nature of chemical bond

If EN difference is less than 1.7, the bond is covalent in nature

If EN difference is equals to 1.7 the bond is 50% ionic in nature

If EN difference is more than 1.7, the bond is ionic in nature

Periodic trends in chemical properties

->Periodicity of Valence or Oxidation States

-> Periodic Trends and Chemical Reactivity  
->Anomalous Properties of Second Period Elements

->Periodicity of Valence or Oxidation States:

Valency(valence) is defined as the combining capacity of an element.

The valency of an element is not always constant

Exhibition of more than one valency by an element is known as variable valency

Valency remains constant in group as number of valence electrons are fixed in that group

Ex. Valency of Group 1 elements is 1(as number of valence electrons is 1)

Lithium-2,1

Sodium-2,8,1

Potassium-2,8,18,1

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Valency varies in period

Based on old concept valency of an element is the number of H-atoms (or) double the number of oxygen atoms that can combine with one atom of the element

Valency with respect to hydrogen across the period increases up to 4 and then decreases to 1  
Ex. Period 3 elements : Na Mg Al Si P S Cl  
 Hydrides : NaH MgH2 AlH3 SiH4 PH3 H2S HCl

Valency : 1 2 3 4 3 2 1

Valency with respect to oxygen increases from 1 to 7 across the period

Ex. Period 3 elements : Na Mg Al Si P S Cl  
 Oxides : Na2O MgO Al2O3 SiO2 P2O5 SO3 Cl2O7

Valency : 1 2 3 4 5 6 7

Based on new concept valency for groups(1-2,13,14 and 15-18)is equal to either number of valence shell e- or 8 minus number of valence e-

Ex. Period 2 elements : Li Be B C N O F  
 Valence e-  : 1(2,1) 2(2,2) 3(2,3) 4(2,4) 5(2,5) 6(2,6) 7(2,7)

Valency : 1 2 3 4 3 2 1

Highest valency ever known is 8(OsO4,XeO4)

Most of the d and f block elements show variable valencies

Oxidation state

The possible charge with which an atom appears in a compound is called its oxidation state  
 OR  
A number assigned to an element in chemical combination which represents the number of electrons lost (or gained, if the number is negative), by an atom of that element in the compound

Ex. In HCl as chlorine is moreelctronegative than hydrogen oxidation state of Cl is -1 where as for Hydrogen is +1

Oxidation state may be positive or negative or zero or fraction where as valency is whole number only

-> Periodic Trends and Chemical Reactivity

Electropositive Nature: (≅Metallic nature) The tendency of an element to loose an electron is called electropositivity.  
As electropositivity increases, metallic character increases

Electropositivity increases down the group

Electropositivity decreases across the period

It is converse of electronegativity

Most electropositive element is Cs in periodic table

Acidic and Basic Nature of Oxides:

Based on the nature, oxides are classified into 4 types

Basic oxides or metal oxides: Generally metals form basic oxides,   
 Na2O,BaO,MgO….

Acidic oxides or Non-metal oxides: Generally non-metals form acidic   
 oxides,SO2,CO2,NO2….

Amphoteric oxides: Oxides of metalloids and some metallic oxides are   
 amphoteric(they form acids and bases in water),   
 As2O3,GeO2,ZnO,Al2O3….

Neutral oxides: Some non-metallic oxides are neutral, they don’t form acids or   
 bases in water CO,N2O,NO…

In groups basic nature of oxides increases(or acidic nature of oxides decreases)

In periods basic nature of oxides decreases(or acidic nature of oxides increases)

Diagonal Relationship:

In the periodic table the first element of a group has similar properties with the second element of the next group. This is called diagonal relationship

Group-↓ 1 2 13 14

2nd PERIOD: → Li Be B C

3rd PERIOD: → Na Mg Al Si

The diagonal relationship is due to similar sizes of atoms or ions and same electronegativities of the participating elements.

This is relation won’t be continue after 14th group

The elements present under diagonal relationship have very close properties

Ex. BeO amphoteric, Al2O3 amphoteric

->Anomalous Properties of Second Period Elements

The first element of each of group in ‘s’ and ‘p’ block except noble gases differe in many aspects from the other members of their respective group due to the following reasons:-

1. Small size
2. Large (charge/radius) ratio
3. High electronegativity
4. Absence of vacant orbitals

Ex. Lithium forms covalent compounds rest of the group members(Na,K,Rb…..) form ionic compounds.

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**REFERENCES:  
1. NCERT TEXT BOOK PART I  
2. NEW COURSE CHEMISTRY PART I**

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