Electron Affinity

1. The amount of energy released when an electron is added to a neutral isolated gaseous atom of an element is called EA. It is an exothermic process $X_{(g)} + e^- \rightarrow X_{(g)}^- + EA_1$ (Or) $X_{(g)} + e^- \rightarrow X_{(g)}^-$.

2. When an electron is added to uni-negative ion, energy is absorbed to overcome the repulsive forces. This energy is called second electron affinity. It is an Endothermic process.

   $X_{(g)}^- + e^- \rightarrow X_{(g)}^{2-}$

3. It is measured in eV/atom, Kcal/mole, KJ/mole for some Nonmetals it can be determined indirectly from Born - Haber Cycle.

4. Like IE, EA depends on size, effective nuclear charge, shielding effect and electronic configuration of an element.

5. 'O' group elements have practically zero EA due tocompletely filled orbitals i.e ns^2np^6.

6. EA values N, P are close to zeroas they have half filled orbitals.

7. First electron affinity (except for Be, Mg and N atoms) is negative for all elements.

8. In a group EA decreases from top to bottom as the atomic size increases. In IVA, VA, VIA and VIIA groups EA_1 of first element is less than corresponding second element due to their exceptionally small size and Strong inter electronic repulsions .

E.g.: IV A group EA of Si > EA of C, VA group EA of P > EA of N, VIA group EA of S > EA of O and In VII A group EA of Cl > EA of F

9, Among a) halogens the order of EA values is Cl > F > Br > I > At

b) Chalcogens is S > Se > Te > O.

10. In a period from left to right side EA increases as size of atoms decreases and the nuclear charge increases.

11. EA of a neutral atom is numerically equal to IE of its uninegative ion but opposite in sign.

Note: IE of a neutral atom = EA of its unipositive ion.

Among all the elements chlorine has the maximum EA.

Electro Negativity

1. It is the property of a bonded atom in a molecule, butnot an isolated atom.

2. EN is the tendency of an atom to attract the shared electron pair towards itself in a molecule. Behind a relative property E.N. has no units.

3. Pauling Scale: In this EN of elements are calculated from the values of bond energies (BE).

Pauling calculated the EN of other elements by using the formula

. $X_A - X_B = 0.208\sqrt{\Delta}$ When Δ is in K.Cal./mole.

(Or) $X_A - X_B = 0.1017\sqrt{\Delta}$, when Δ is in KJ/mole

Where X_A and X_B are the EN's of A & B $\Delta = E_{A-B} - 1/2\ [E_{A-A} + E_{B-B}]$. Δ Is called electro chemical constant it is a measure to the polarity of A-B bond.

4. The reference element taken by Pauling for the determination of E.N. Values of other elements is fluorine. Fluorine has Highest E.N. value (4.0).

5. **Mulliken scale:** According to Mulliken scale, EN of monovalent elements is the average of IE and EA.

a. $EN = \frac{IE + EA}{2}$

b. $EN = \frac{IE\ in\ eV + EA\ in\ eV}{5.6}$

c. $EN = \frac{(IE\ in\ kj/mole) + (EA\ in\ kj/mole)}{544}$

d. $EN = \frac{(IE\ in\ kcals/mole) + (EA\ in\ kcals/mole)}{129}$

6. Mulliken EN values are approximately 2.8 times greater than Pauling EN values.

7. Elements with same EN in Pauling's scale are

i.N=Cl=3.0 ii.C=S=I=2.5

iii. H=P=2.1 iv. Cs=Fr=0.7

8. **Allred - Rochow's Scale:** According to this scale electro negativity is a force which is exerted by the nucleus on the electron present in outermost orbit.

$EN = \frac{0.359 \times Z_{effective}}{r^2} + 0.744$, Wherer = constant radius,

$Z_{effective}$ = Effective nuclear charge.

9. E.N increases, as the oxidation number of an atom increases,

10. In groups from top to bottom EN decreases.

11. EN order of i. I A group Li > Na > K > Rb > Cs

ii. IIIA group is B> Ti> In> Ga> Al

iii.IVA group is C >Si=Ge=Sn=Pb

iv.VA group is N.P.As.Sb>Bi

v.VIA group is O>S>Se>Te>.Po

vi. VIIA group is F > Cl > Br > I

12. In periods from left to right EN increasesup to Halogens and becomes Zero for Inert gas. **Variation of EN in II period Li < Be < B < C < N < O < F**

13. In each period Halogen has high EN valueand Alkali metal has low EN value.

14. 1^{st} most EN element is F(4.0),most EN element is oxygen (3.5) and Least for Cesium (0.7)

15. ENof Noble gas elements are zero due to octet configuration.

16. i) EN values are useful in knowing the nature of chemical bond.

If EN difference between two bonded atoms is

a) < 1.7, the bond is covalent in nature.

b) = 1.7, the bond is 50% ionic in nature.

c) > 1.7, the bond is ionic in nature.

ii) E.N. values are useful in writing the formula of a compound.

17. E.N. values are a measure to Non metallic nature of an Element.

18. In Lanthanides from Ce t Lr electronegativity increase as size decreases.

Electro Positive Nature, Metallic and Non-Metallic Nature, Acidic and Basic Nature of Oxides

1. The tendency of an element to lose an electron is called electro positivity.
2. Electro positivity is a measure to metallic character. Higher the electro positivity, greater is the metallic character of Elements.
3. Electropositive nature increases with increase in sizeof Elements
4. Moving down the group electropositive nature increases as the size of the atom increases. And decreases across a period as the size of the atom decreases
5. In any period the electropositivity is hihest for alkali metal.
6. Elements of S-block are highly electropositive.
7. Electropositivity is hihest for Cs and lowest for Flourine in periodic table.
8. The ions of highly electropositive metal do not undergo hydrolysis.
9. **From Top to Bottom:** a) Non metallic nature decreases

   b) Metallic nature increases

   Left to right in a period: a) Metallic nature decreases

   b) Non metallic nature increases
10. Order of metallic nature –

Alkali Metals > Alkaline Earth Metals > d-block > p-block.

11. All metals are solids at room temperature except mercury (Hg).
12. Non-metals are usually solids or gases at room temperature with low melting and boiling point Boron and carbon are exceptions, have very high M.P's & B.P's due to polymeric structure.
13. Elements showing both metallic and non-metallic nature are called metalloids or semi metals

    E.g.: Silicon, Germanium, Arsenic, Antimony, and Tellurium

14. Based on the nature, oxides are clasified into 4 types

    1) Basic Oxides or Metal Oxides (Basic anhydrides)

    2) Acidic Oxides of Non-Metal Oxides (Acidic anhydrides)

    3) Amphoteric Oxides

    4) Neutral Oxides

15. Metal oxides are basic as they form hydroxides with water.

    E.g.: Na_2O, BaO, MgO, CaO

    IA, IIA group metal oxides are strong bases.

    E.g.: $Na_2O + H_2O \rightarrow 2NaOH$

16. Non metal oxides are acidic as they form acids with water. Examples: SO_2, P_2O_5, CO_2, P_2O_3, NO_2 .Oxides of halogens are highly acidic.

    E.g.: $SO_3 + H_2O \rightarrow H_2SO_4$

17. Oxides of metalloids are amphoteric.

    Eg: As_2O_3, $Sb_2\,O_3$, TeO_2, GeO_2

18. Some non-metallic oxides are neutral. They don't form acids or bases in water.

    Eg: CO, N_2O, NO etc.

    Some metallic Oxides are amphoteric.

    E.g.: BeO, ZnO, Al_2O_3, SnO_2 etc.

19. Top to bottom in a group acidic nature of oxides decreases and basic nature of oxides increases.

20. Left to right in a period basic nature of oxides decreases and acidic nature of oxides increases.

21. In second period $Li_2\,O$ is most basic, BeO is amphoteric and $N_2\,O_5$ is most acidic oxides.

22. In third period Na_2O is most basic, Al_2O_3 is amphoteric and Cl_2O_7 is most acidic oxides.

22. Cl_2O_7 is most acidic oxide and Cs_2O is most basic oxide in nature.

23. In oxides of same element acidic nature increases with increase in oxidation state.

E.g- acidic nature of $SO_3 > SO_2$