Electron Affinity.

Those atoms whose nuclear forces are not completely screened by electronic shells, offer attraction for electrons. Such atoms capture electrons if these are available within their effective fields to neutralize the electrostatic forces of the nucleus. Energy is always liberated whenever there is a force of attraction offered by an atom or ion, and this energy is called electron affinity. This may be defined as, "**the energy released when an extra electron is added to a neutral gaseous atom**".

This is first electron affinity. Similarly, second electron affinity will be the energy released (absorbed) when a second electron is added. $X(g) + e^{-1} \rightarrow X^{-}(g) + E_1$ (Exoenergic) ;

$X^{-}(g) + e^{-1} \rightarrow X^{-2}(g) + E_2$

But the third electron affinity corresponds to energy absorbed instead of energy evolved in the process.

$X^{-2}(g) + e^{-1} \rightarrow X^{-3}$ (Endoenergic)

For example, chlorine atom readily accepts one electron and 86.5 Kcal/gm energy is released.

$Cl + e^{-1} \rightarrow Cl^{-}$ + 86.5 Kcal/gm

Thus, higher the energy released in the process of taking up an extra electron, the higher will be the electron affinity. Higher the value of electron affinity of an atom, the more is its tendency to change into anion. It is very difficult to determine the electron affinity experimentally. The values have been calculated on the basis of thermodynamic concepts. It is expressed in electron volts. The values of inert gases are assumed to be zero because they have stable ns^2p^6 configuration and unable to accept any electron. The values for alkali metals are between zero and one.

Electron Affinity of Elements (For one electron only at 25° C)

Li 0.54	Be 0	B 0.3	C 1.13	N 0.20	O 1.48	F 3.62	Ne 0
Na 0.74	Mg 0	Al 0.4	Si 1.9	P 0.80	S 2.07	Cl 3.79	Ar 0

The electron affinities of Be, Mg and zero since they have complete ns^2 configuration which cannot accommodate extra electron. Similarly, the values for N and P are very low because they also have completely half–filled p orbitals (ns^2p^3) and are more stable.

(1) **Factors affecting the value of electron affinity**

(i) **Atomic size:**The value of electron affinity decreases with the increase in the size of atom since the nuclear attraction decreases down a group as the atomic number increases. Its value increases as we move along a period since the size of atoms decreases along a period. The lower value of F than Cl is due to the very small size of F in which negative charge is highly concentrated and repels the incoming electron thereby reducing the force of attraction of the nucleus towards the adding electron and hence decreasing the electron affinity. Thus, chlorine has a highest value of electron affinity.

(ii) **Nuclear charge:** The value of electron affinity increases with increasing nuclear charge. Thus, its value increases with increase in nuclear charge along a period.

(iii) **Screening or shielding effect:** The value of electron affinity increases with the decrease in shielding effect of inner electrons. Besides, the value of electron affinity also depends to some extent upon the type of orbital in which electron is added. The value is greater when electron enters 's' orbital and decreases successively for p, d and f orbitals.

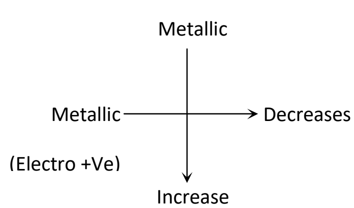
(2) **Importance of electron affinity:**Certain properties of the elements are predicted on the basis of values of electron affinity.

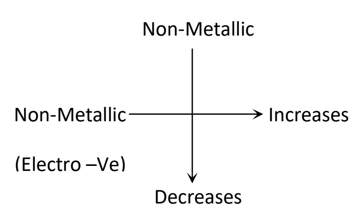
(i) The elements having high value high values of electron affinity are capable of accepting electron easily. They form anions and electrovalent compounds. These elements are electronegative in nature.

(ii) The elements having high values of electron affinity act as strong oxidizing agents, for example, $F, Cl, Br, O, S,$ etc.

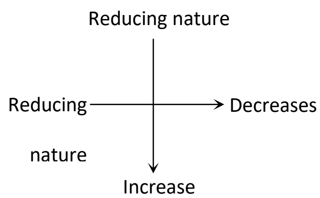
On the basis of the general trend of ionization potential and electron affinity, the following properties can be predicted,

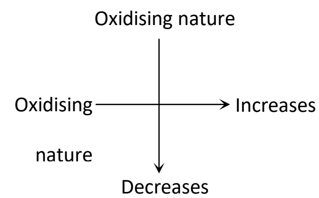
(a) Metallic nature decreases in a period while nonmetallic nature increases. Metallic nature increases in a group while non-metallic nature decreases. The arrow $(\downarrow)$ represents a group and $(\rightarrow)$ represents a period.



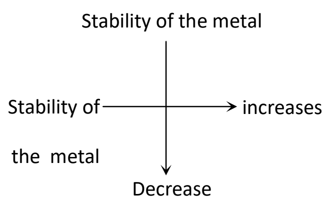


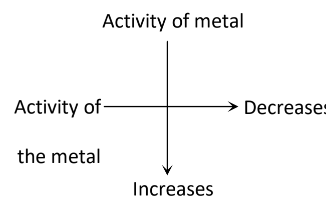
(b) Reducing nature decreases in a period while oxidizing nature increases. The reducing nature increases in a group while oxidizing nature decreases.





(c) Stability of metal increases while activity of the metal decreases in a period and in a group stability decreases while activity increases.





This trend is observed especially in IA, IIA and IIIA elements.

(d) The basic nature of the oxides decreases in a period while acidic nature increases. In a group, basic nature increases while acidic nature decrases.