Crack CSIR-NET 2021
(Study Notes on Electron affinity)

Electron Affinity
It is the amount of energy released when an electron gets added to the neutral atom in gaseous state. This process results in the formation of a negative ion. This is known as the first electron affinity. When an electron is added further, the second electron gets added to gaseous anion due to which there is electron-electron repulsion. So, energy instead of being released will be supplied for the addition of electrons to an anion.

$$\underset{1mole}{A_{(g)}} + 1e^{-} \rightarrow A^{-}_{(g)}; \Delta_{eg}H = -x\,kj/mol$$

Successive electron affinity: When an electron is added to a neutral atom, release of energy takes place due to which the first electron affinity is negative. When an electron is added to a negative ion, there will be electron-electron repulsion due to which instead of energy being released, it must be supplied as a result, second electron affinity is positive. The first electron affinity is always negative, that is an exothermic process. While the second electron affinity will be positive, that is an endothermic process. There is no direct method to determine electron affinity. It can be predicted indirectly by using the Born-Haber cycle.

Factors affecting the magnitude of electron affinity:
i. Atomic size: Electron affinity is inversely related to atomic size. Larger the atomic size, smaller will be electron affinity or vice versa.

Electron affinity $\langle \dfrac{1}{\text{Atomic size}}$

ii. Effective nuclear charge: Electron affinity is directly related to nuclear charge because incoming electrons will be more attracted towards the nucleus due to which a large amount of energy will be released when an electron is added.
Electron affinity α Effective nuclear charge (Z_{eff})

iii. Screening or Shielding effect: Electron affinity is inversely related to shielding effect. On going from top to bottom, shielding effect increases, in other words, repulsion increases. As a result, attraction decreases on going from top to bottom.

Electron affinity $\langle \dfrac{1}{\text{Shielding effect}}$

(iv) Stability of half-filled and completely filled orbitals: It is difficult to add electrons in half-filled and fully-filled orbitals and as a result, lesser energy is released when an electron gets added, hence the electron affinity value will decrease. For e.g. He, Ne

Periodicity in electron affinity:
According to the general trend, along the period, electron affinity increases and down the group, it decreases. But there are some exceptions, and these are:
(a). For alkaline earth metals, the electron affinity value is zero.
(b). Electron affinity values of the nitrogen family are slightly negative due to slightly positive electron gain enthalpy due to stability of half-filled orbitals.
(c). The theoretical value of the electron affinity of zero group inert gas elements is zero because of stable s^2p^6 configuration.