CHEMISTRY STUDY MATERIALS FOR CLASS 10

(Based on: Periodic Classification of Elements)

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5. Electron Affinity/Electron Gain Enthalpy

Electron affinity is the amount of energy released when an electron is added to an isolated gaseous atom.

$$\text{Atom (g)} + \text{electron (g)} \longrightarrow \text{Anion (g)} + \text{energy}$$

Element	Electron affinity
Fluorine	3.62eV
Chlorine	3.79eV
Bromine	3.56eV
Iodine	3.28eV

Electron affinity is the ability of an atom to hold an additional electron. If the atom has more tendency to accept an electron then the energy released will be large and consequently the electron affinity will be high. Electron affinities can be positive or negative. It is taken as positive when an electron is added to an atom. It is expressed as electron volts per atom (eV per atom) or kilo joules per mole.

Electron affinity depends on:

1. Extent of nuclear charge 2. Size of the atom 3. Electronic configuration

As a result of the gain in electrons, the atom gains one negative charge. In the case of halogens, all the elements have a high electron affinity, as they need one electron to complete the octet of their outermost shell.

Electron Affinity of the Halogens

From chlorine to iodine, which ionize by accepting one electron there is a decrease in the electron affinity or the energy released. The lower electron

affinity of fluorine when compared to chlorine is not fully understood.

If the electron affinity is low, the electron is weakly bound; if the electron affinity is high, the electron is strongly bonded, e.g., electron affinity of chlorine is 3.79 which is higher than that of iodine i.e., 3.28. Hence, chlorine accepts the electrons more easily than iodine.

- Electron affinity increases from left to right across the period because of increase in nuclear charge and decrease in atomic size. This causes the incoming electron to experience a greater pull of the nucleus thus giving a higher electron affinity.
- Electron affinity decreases down the group because the number of shells increases i.e., the atomic size increases and the effective nuclear charge decreases. This causes the incoming electron not to experience much attraction of the nucleus thus giving a lower electron affinity.
- The electron affinity of completely filled atoms is almost zero. An atom does not accept an electron in its outermost shell if it already has a stable configuration i.e. a duplet or octet, as in the case of inert gases.

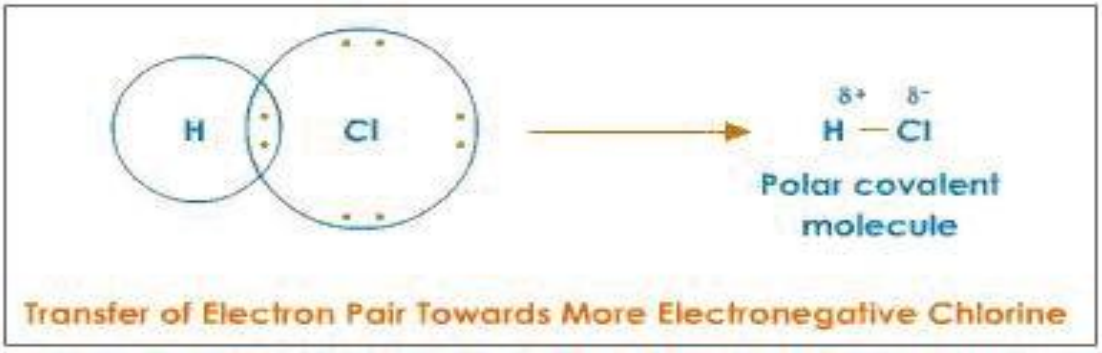
Electronegativity

Electronegativity is the tendency of an atom to attract bond pair of electrons towards itself in a molecule of a compound. The value of electronegativity of an element describes the ability of its atom to compete for electrons with the other atom to which it is bonded. Electronegativity is however not the property of an isolated atom.

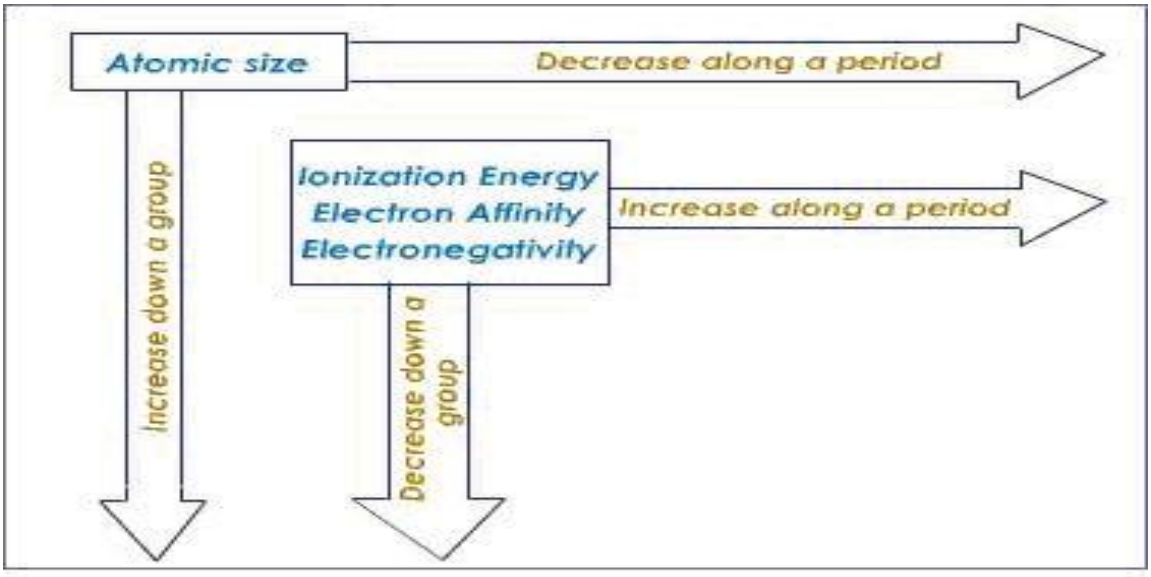
Electronegativity increases from left to right in each period ending at group 17.

In the 3^{rd} period, electronegativity increases from sodium to chlorine i.e., chlorine can accept electrons most easily in that period followed backwards by sulphur, phosphorus, silicon, aluminium, magnesium and sodium. All the atoms of the above mentioned elements have three shells but chlorine has the smallest atomic radii. Hence chlorine experiences more positive charge from the nucleus than all other atoms in that period. So, if one electron is available, chlorine can attract it most easily.

If the molecule is formed by sharing of electrons (covalent bond) the bonded pair of electrons shifts towards more electronegative atom resulting in the formation of polar molecule. In the example below, chlorine atom is more electronegative as compared to hydrogen atom, resulting in a covalent bond where the shared pair of electron shifts towards the more electronegative atom. This results in polar molecules. The electron pair is closer to the chlorine atom and so the molecule gets polarized i.e., the chlorine atom gets a negative charge while the hydrogen atom gets a positive charge.



A summary of periodic properties and their variation in groups and periods is given below:



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