Classification of Elements and Periodicity In Properties

Periodic table is an arrangement of elements with similar properties placed together.

Groups: The 18 vertical columns are called groups. The elements belonging to a particular group is known as a family and is usually named after the first number. Apart from this some of the groups are given typical names as examplified beneath,

(1) Elements of group 1 are called **Alkali-Metals**.
(2) Elements of group 2 are called **Alkaline Earths**.
(3) Elements of group 3 are called **Pnicogens**.
(4) Elements of group 16 are called **Chalcogens**.
(5) Elements of group 17 are called **Halogens**.

(6) Elements of group 18 are called **Noble Gases or Aerogens**.
All the other groups are named after the first member of each group.

Periods: The horizontal rows are called periods. There are seven periods in the long form of the periodic table,
(1) Ist period $({}_{1}H \rightarrow {}_{2}He)$ contains 2 elements. It is the shortest period.
(2) 2nd period $({}_{3}Li \rightarrow {}_{10}Ne)$ and 3rd period $({}_{11}Na \rightarrow {}_{18}Ar)$ contains 8 elements each. These are short periods.
(3) 4th period $({}_{19}K \rightarrow {}_{36}Kr)$ and 5th period $({}_{37}Rb \rightarrow {}_{54}Xe)$ contains 18 elements each. These are long periods.
(4) 6th period $({}_{55}Cs \rightarrow {}_{86}Ra)$ consists of 32 elements and is the longest period.
(5) 7th period starting with ${}_{87}Fr$ is incomplete and consists of 19 elements.

The screening effect or shielding effect

A valence-electron in a multi-electron atom is attracted by the nucleus, and repelled by the electrons of inner-shells. The combined effect of this attractive and repulsive force acting on the valence-electron experiences less attraction from the nucleus. This is called ***shielding*** or ***screening effect***.

Effective nuclear charge

z^*. It is related to actual nuclear charge (Z) by the following formula,

$z^* = (Z - \sigma)$ where σ is screening constant.

It is observed that ***magnitude of effective nuclear charge increases in a period when we move from left to right.***

Variation of ionisation energy in periodic table

Ionisation energy decreases in a group as the atomic number increases. Ionisation energy increases along a period with increase in atomic number.

Electron affinity

"*the energy released when an extra electron is added to a neutral gaseous atom*".

Electronegativity

The tendency of an atom in a compound to attract a pair of bonded electrons towards itself is known as electronegativity of the atom.

In a period, electronegativity increases from left to right. This is due to decrease in size and increase in nuclear charge. Thus the alkali metals possess the lowest value,

while the halogens have the highest. Inert gases have zero electronegativity.

In a group, electronegativity decreases from top to bottom. This is due to increase in atomic size.

Mulliken's scale: Mulliken regarded electronegativity as the average value of ionization potential and electron affinity of an atom.

$$\text{Electroneg ativity} = \frac{\text{Ionization potential} + \text{Electron affinity}}{2}$$

***Pauling scale*:** Pauling scale of electronegativity is the most widely used. It is based on excess bond energies.

while $\Delta E =$ Actual bond energy $- \sqrt{(E_{A-A} \times E_{B-B})}$

Pauling and Mulliken values of electronegativities are related as below χ (Pauling) = 0.34χ (Mulliken) – 0.2

Some other periodic properties

Atomic volume: It is defined as the volume occupied by one gram atom of an element. Mathematically,

$$\text{Atomic volume} = \frac{\text{Gram atomic weight}}{\text{Density in solid state}}$$

Units of atomic volume are c.c./mole.

Density: The density of the elements in solid state varies periodically with their atomic numbers. At first, the density increases gradually in a period and becomes maximum somewhere for the central members and then starts decreasing afterwards gradually.

Melting and boiling points: The melting points of the elements exhibit some periodicity with rise of atomic number.

Oxidation state (Oxidation number, O.N.) : *Oxidation number of an element in a compound is the total number of electrons it appears to have gained or lost* (negative and positive oxidation states respectively) *during the formation of that particular compound.*

Magnetic properties: Magnetic properties of matter depend on the properties of the individual atoms.