Education that enlightens!

Periodic Classification of Elements

Early Attempts of Classification of Elements

Dobereiner's Triads

Law of Triads: When elements are arranged in the order of their increasing atomic masses, the atomic mass of the middle element was approximately the mean of the atomic masses of the other two elements.
For example:
Consider the triad of lithium, sodium and potassium. The atomic mass of sodium is the mean of the atomic masses of lithium and potassium.

Element	Atomic Mass
Lithium	6.9
Sodium	Atomic mass of Na = $\frac{6.9 + 39}{2} = 23$
Potassium	39

Newlands' Law of Octaves

- **Law of Octaves:** When elements are arranged in the increasing order of their atomic masses, the properties of every eighth element is similar to the first.

Limitations

- Newland could arrange elements only up to calcium, out of the total 56 elements known.
- After calcium, every eighth element did not possess properties similar to that of the first.
- Only 56 elements were known at the time of Newland, but later several new elements were discovered.
- In order to fit the existing element arrangement, Newland placed two elements in the same position which differed in their properties.
  For example: Iron, an element which resembles cobalt and nickel in its properties is placed far away from these elements.
- The periodic table did not include inert gases because they were not discovered then.

Mendeleev's Periodic Table

- **Mendeleev's Periodic Law**: The physical and chemical properties of elements are a periodic function of their atomic masses.

Features of Mendeleev's Periodic Table

- There are seven horizontal rows in the periodic table, numbered from 1 to 7. These seven rows are called periods.
- There are eight vertical columns numbered from I to VIII. These eight columns are called groups. Groups I to VII are further divided into sub groups A and B.
- The properties of elements in a particular period show regular gradation from left to right.

Merits of Mendeleev's Periodic Table

- Mendeleev kept some blank spaces in the periodic table for the elements which were yet to be discovered.

Predicted element	Actual element discovered later
Eka-boron	Scandium
Eka-aluminium	Gallium
Eka-silicon	Germanium

- He also predicted properties of some elements even before their discovery which were later found to be correct.

Property	Eka-aluminium	Gallium
Atomic mass	68	69.7
Formula of oxide	E_2O_3	Ga_2O_3
Formula of chloride	ECl_3	$GaCl_3$

- Mendeleev's periodic table could accommodate noble gases when they were discovered.

Demerits of Mendeleev's Periodic Table

- Hydrogen resembles alkali metals as well as halogens. So, a correct position could not be assigned to hydrogen in the periodic table.
- The position of isotopes could not be explained. Isotopes are atoms of the same element having similar chemical properties but different atomic masses. If the elements are arranged according to atomic masses, the isotopes should be placed in different groups of the periodic table.
- At certain places, an element of higher atomic mass was placed before an element of lower atomic mass.
  For example: Cobalt (Co = 58.93) was placed before nickel (Ni = 58.71).
- Some elements placed in the same sub group had different properties.
  For example: Manganese is placed with the halogens which are totally different in their properties.

Modern Periodic Table

- In 1913, Henry Moseley proved that the atomic number is the fundamental property rather than its atomic mass.
- **Modern Periodic Law**: Properties of elements are a periodic function of their atomic numbers.
- The periodic table, based on the Modern Periodic Law is called the Modern Periodic Table.

Position of Elements in the Periodic Table

Periods

- The horizontal rows in the Modern Periodic Table are called periods.
- The Modern Periodic Table consists of seven periods which are numbered from 1 to 7.
- In each period, a new shell starts filling up. The period number is also the number of shell which starts filling up.

Groups

- The vertical columns are called groups and consist of eighteen groups numbered from 1 to 18.
- Elements having the same number of valence electrons are present in the same group.
- Elements present in the same group show the same chemical properties.

Trends in the Modern Periodic Table

Valency

- The valency of an element is determined by the number of valence electrons present in its outermost shell.
- In a group, all the elements have the same number of valence electrons.
- On moving from left to right in each short period, the valency increases from 1 to 4 and then decreases to zero.

Atomic Size

- Atomic size refers to the radius of the atom.
- It is the distance between the centre of the nucleus and the outermost shell of an isolated atom.
- In a period, the atomic radius decreases from left to right. This is because electrons are added to the same shell and so they experience a greater pull from the nucleus.
- Moving in a group from top to bottom, the atomic radius increases as new shells are added, resulting in the outermost electrons being farther away from the nucleus.

Metallic & Non-metallic Properties

- Metals show a tendency to lose electrons and are said to be electropositive.
- Non-metals show a tendency to accept or share electrons and are said to be electronegative.
- Moving from left to right in a period, the metallic character decreases and the non-metallic character increases. The atomic size decreases and so electrons are not released easily.
- In a group, the metallic character increases from top to bottom and the non-metallic character decreases. This is because, as the atomic size increases the valence electrons can be easily removed.
- Elements on the left of the periodic table are all metals and on the right of the periodic table are all non-metals.
- A zigzag line in the periodic table separates the metals from non-metals. The borderline elements show intermediate properties and are called metalloids.