PERIODIC CLASSIFICATION OF ELEMENTS

- **All the elements have been divided into a few groups in such a way that elements in the same group have similar properties.**

DOBEREINER'S TRAIDS

When elements are arranged in the order of increasing atomic masses, groups of three elements (known as triads), having similar chemical properties are obtained. The atomic mass of the middle element of the triad being equal to the arithmetic mean of the atomic masses of the other two elements.

1. The Alkali Metal Group. The elements lithium, sodium and potassium have similar chemical properties and form a triad.

2. The Alkaline Earth Metal Group. The elements calcium, strontium and barium have similar chemical properties and form a triad.

3. The Halogen Group. The elements chlorine, bromine and iodine have similar chemical properties and form a triad.

- **The limitation of Dobereiner's classification was that it failed to arrange all the then known elements in the form of triads of elements having similar chemical properties. Dobereiner could identify only three triads from the elements known at that time. So, his classification of elements was not much successful.**

Newlands' law of octaves.

- **When elements are arranged in the order of increasing atomic masses, the properties of the *eighth* element (starting from a given element) are a repetition of the properties of the *first* element.**

- **Newlands' classification of elements based on his law of octaves, however, gave a very important conclusion that there is some systematic relationship between the order of atomic masses and repetition of properties of elements.**

- **All the three elements, lithium, sodium and potassium possess similar chemical properties.**

- **All the three elements, beryllium, magnesium and calcium possess similar chemical properties.**

- **Dobereiner's triads also exist in the columns of Newlands' classification of elements based on the law of octaves.**

- **limitations :**

1. **Newlands' law of octaves was applicable to the classification of elements up to calcium only.**

2. **Newlands assumed that only 56 elements existed in nature and no more elements would be discovered in the future. But later on, several new elements were discovered whose properties did not fit into Newlands'.**

3. **Iron element (Fe) which resembles cobalt and nickel elements in properties, was placed far away from these elements.**

4. **In order to fit elements into his table, Newlands put even two elements together in one slot and that too in the column of unlike elements having very different properties. Example Ni, Co.**

MENDELEEV'S PERIODIC TABLE

- **when elements are arranged in the order of increasing atomic masses, the elements with similar properties occur at regular intervals.**

- **The periodic table is a chart of elements prepared in such a way that the elements having similar properties occur in the same vertical column or group.**

- **A periodic table consists of horizontal rows of elements called periods and vertical columns called groups.**

- **The properties of elements are a periodic function of their atomic masses.**

- **There were seven periods (horizontal rows) and eight groups (vertical columns) in the original periodic table of Mendeleev.**

- **In order to make sure that the elements having similar properties fell in the same vertical column or group, Mendeleev left some gaps in his periodic table.**

- **Again, in order to make sure that the elements having similar properties fell in the same vertical column (or group), Mendeleev placed a few elements in the wrong order of their atomic masses by keeping the element with higher atomic mass first and the element with lower atomic mass later.**

Merits of Mendeleev's Classification of Elements

1. Mendeleev's periodic law predicted the existence of some elements that had not been discovered at that time.

2. Mendeleev's periodic table could predict the properties of several elements on the basis of their positions in the periodic table.

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

Anomalies (or Limitations) of Mendeleev's Classification of Elements

1. The position of isotopes could not be explained.

2. Wrong order of atomic masses of some elements could not be explained.

3. A correct position could not be assigned to hydrogen in the periodic table.

PRESENT BASIS FOR THE CLASSIFICATION OF ELEMENTS

- **The present basis for the classification of elements is the atomic number of elements.**
- **The significance of atomic number in the classification of elements is that being equal to the number of electrons in an atom, it helps in arranging the elements according to their electronic configurations.**
- **The present basis for the classification of elements is their electronic configuration.**
- **It was the discovery of atomic number which led to a change in Mendeleev's periodic law which was based on atomic mass.**

Explanation of the Anomalies of Mendeleev's Classification of Elements

- **Since all the isotopes of an element have the same atomic number, they can be put at one place in the same group of the periodic table.**

- **cobalt with lower atomic number (27) should come first and nickel with higher atomic number (28) should come later, even if their atomic masses are in the wrong order.**

- **The properties of elements are a periodic function of their atomic numbers.**

- **when elements are arranged according to increasing atomic numbers, there is a periodicity in the electronic configurations of elements. The periodicity in electronic configurations of elements leads to the periodicity in their chemical properties.**

- **When the elements are arranged according to increasing atomic numbers, then the elements having same number of valence electrons occur at regular intervals (or periods).**

- **The real significance of the modern periodic classification based on atomic numbers is that it relates the periodicity in the properties of elements to the periodicity in their electronic configurations.**

- **the arrangement of elements in the modern (long form) periodic table is based on their electronic configurations.**

- **The elements in a period have consecutive (continuous) atomic numbers.**

- **The number of elements in a period is fixed by the maximum number of electrons which can be accommodated in the various shells of an atom.**

- **The elements in a group do not have consecutive atomic numbers.**

- **All the elements in a group have similar electronic configurations and show similar properties.**

- **the valence shells of all the noble gases are completely filled with electrons.**

- **In the periodic table, metals have been separated from non-metals by some elements called 'metalloids' which are placed diagonally in the periodic table.**

- **In this class we have to study only the normal elements of the eight groups in detail**

1 valence electron group 1, 2 valence electrons group 2, 3 valence electrons group 13, 4 valence electrons group 14, 5 valence electrons group 15, 6 valence electrons group 16, 7 valence electrons group 17, 8 valence electrons group 18.

CHARACTERISTICS OF PERIODS AND GROUPS

- **CHARACTERISTICS OF PERIODS**

1. Valence Electrons (or Outermost Electrons)

On moving from left to right in a period, the number of valence electrons in elements increases from 1 to 8.

2. Valency

On moving from left to right in each short period, the valency of elements increases from 1 to 4 and then decreases to 0 (zero).

3. Size of Atoms (or Atomic size)

On moving from left to right in a period of the periodic table, the size of atoms decreases (or atomic size decreases).

4. Metallic Character

On moving from left to right in a period, the metallic character of elements decreases (but the nonmetallic character increases).

5. Chemical Reactivity

On moving from left to right in a period, the chemical reactivity of elements first decreases and then increases.

6. Nature of Oxides

On moving from left to right in a period, the basic nature of oxides decreases and the acidic nature of oxides increases.

- **CHARACTERISTICS OF GROUPS**

1. Valence Electrons (or Outermost Electrons)

All the elements of a group of the periodic table have the same number of valence electrons.

2. Valency

all the elements in a group have the same valency.

3. Size of Atoms (or Atomic size)

On going down in a group of the periodic table, the size of atoms increases (or atomic size increases).

4. Metallic Character

On going down in a group of the periodic table, the metallic character of elements increases.

5. Chemical Reactivity

(*i*) **The chemical reactivity of metals increases on going down in a group of the periodic table.**

(*ii*) **The chemical reactivity of nonmetals decreases on going down in a group of the periodic table.**

6. Nature of Oxides

On going down in a group of the periodic table, there is no change in the nature of oxides of elements.

Merits of the Modern Periodic Table

1. The modern periodic table is based on the atomic numbers of elements which is the most fundamental property of elements.

2. The modern periodic table helps us understand why elements in a group show similar properties but elements in different groups show different properties.

3. The modern periodic table explains the reasons for the periodicity in properties of elements.

4. The modern periodic table tells us why the properties of elements are repeated after 2, 8, 18 and 32 elements.

Advantages of the Periodic Table

1. The periodic table has made the study of chemistry systematic and easy. It acts as an aid to memory.

2. It is easier to remember the properties of an element if its position in the periodic table is known.

3. The type of compounds formed by an element can be predicted by knowing its position in the periodic table.

4. A periodic table chart is used as a teaching-aid in chemistry in schools and colleges.