5.Periodic Classification of Elements

1. Classification means identifying similar species and grouping them together.

2. Lavoisier divided elements into two main types known as metals and non-metals.

3. Doberiner's Law of Triads:

According to this law, "in certain triads (grout) of three elements) the atomic mass of the central element was the arithmetic mean of the atomic masses of the other two elements." But in some triads all the threc elements possessed nearly the same atomic masses, therefore the law was rejected.

e.g., atomic masses of Li, Na and K are respectively 7, 23 and 39, thus the mean of atomic masses of I St and 3rd element is

Limitations of Doberiner's Triads: He could identify only a few such triads and so the law could not gain importance. In the triad ofFe, Co, Ni, all the three elements have a nearly equal atomic mass and thus does not follow the above law

4. Newland's Law of Octaves:

According to this law "the elements are arranged in such a way that the eighth element starting from a given one has properties which are a repetition of those of the first if arranged in order of increasing atomic weight like the. eight note of musical scale."

Drawback of Newland's law of Octaves:

(i) According to Newland only 56 elements exists in nature and no more elements would be discovered in the future. But later on several new element were discovered whose properties did not fit into law of octaves.

(ii) In order to fit new elements into his table Newland adjust two elements in the same column, but put some unlike elements under the same column.

Thus, Newland's classification was not accepted.

Mendeleev's Periodic Table :

Mendeleev arranged 63 elements known at that time in the periodic table. According to Mendeleev "the properties of the elements are a periodic function of their atomic masses." The table consists of eight vertical column called 'groups' and horizontal rows called 'periods'.

Merits of Mendeleev's Periodic Table:

(i) At some places the order of atomic weight was changed in order to justify the chemical and physical nature.

(ii) Mendeleev left some gap for new elements which were not discovered at that time.

(iii) One of the strengths of Mendeleev's periodic table was that, when inert gases were discovered they could be placed in a new group without disturbing the existing order.

Characteristics of the periodic table : Its main characteristics are :

(i) In the periodic table, the elements are arranged in vertical rows called groups and horizontal rows called periods.

(ii) There are eight groups indicated by Roman Numerals I, II, III, IV, V, VI, VII, VIII. The elements belonging to first seven groups have been divided into sub-groups designated as A and B on the basis of similarities. The elements that are present on the left hand side in each group constitute sub-group A while those on the right hand side form sub-group B. Group VIII consists of nine elements arranged in three triads.

(iii) There are six periods (numbered 1, 2, 3, 4, 5 and 6). In order to accomodate more elements, the periods 4, 5, 6 are divided into two halves. The first half ofthe elements are placed in the upper left corners and the second half occupy lower right corners in each box.

Achievements of mendeleev's periodic table

(i) The arrangement of elements in groups and periods made the study of elements quite systematic in the sense that if properties of one element in a particular group are known, those of the others can be easily predicted.

(ii) Prediction of new elements and their properties : Many gaps were left in this table for undiscovered elements. However, properties of these elements could be predicted in advance from their expected position. This helped in the discovery of these elements. The elements silicon, gallium and germanium were discovered in this manner.

(iii) Correction of doubtful atomic masses :

Mendeleev corrected the atomic masses of certain elements with the help of their expected positions and properties.

Limitations of mendeleev's classification :

(i) He could not assign a correct position of hydrogen in his periodic table, as the properties of hydrogen resembles both with alkali metals as well as with halogens.

(ii) The isotopes of the same element will be given different position if atomic number is taken as basis, which will disturb the symmetry of the periodic table.

(iii) The atomic masses do not increases in a regular manner in going from one elements to the next.

So it was not possible to predict how many elements could be discovered between two elements.

6. Modern Periodic Law : This law was given by Henry Moseley in 1913. it states, "Properties of the elements are the periodic function of their atomic numbers".

Cause of periodicity : Periodicity may be defined as the repetition of the similar properties of the elements placed in a group and separated by certain definite gap of atomic numbers.

The cause of periodicity is the resemblance in properties of the elements is the repetition of the same valence shell electronic configuration.

7. Modern Periodic Table

Moseley proposed this modern periodic table and according to which "the physical and chemical properties of elements are periodic function of their atomic number and not the horizontal rows called "periods". The groups have been numbered 1, 2, 3 …. 18 from left to right.

(ii) The elements belonging to a particular group make a family and usually named after the first member. In a group all the elements contain the same number of valence electrons.

(iii) In a period all the elements contain the same number of shells, but as we move from left to right the number of valence shell electrons increases by one unit.

The maximum number of electrons that can be accommodated in a shell can be calculated by the formula 2n2 where n is the number of the given shell from the nucleus.

8. Trends in Modern Periodic Table : The trends observed in some important properties of the elements in moving down the group (from top to bottom of the table) and across a period (from left to right in a period) are discussed below :

(i) Valency : Valency may be defined as the combining capacity of the atom of an element with atoms of other elements in order to acquire the stable configuration (i.e. 8 electron in valence shell. In some special cases it is 2 electrons).

(ii) Atomic size : It refers to the distance between the centre of nucleus of an isolated atom to its outermost shell containing electrons.

The atomic radius decreases on moving from left to right along a period. This is due to an increase in nuclear charge which tends to pull the electrons closer to the nucleus and reduces the size of the atom.

In a group atomic size decreases from top to bottom due to increase in number of shells.

(iii) Metallic and non-metallic properties : In a period from left to right metallic nature decreases while non-metallic character increases.

In a group metallic character increases from top to bottom while non-metallic character decrease.

(iv) Electronegativity : The relative tendency of an atom to attract the shared electron pair of electrons towards itself is called electronegativity.

In a period from left to right, the value of electronegativity increases while in a group from top to bottom the value of electronegativity decreases.