Classification of Elements & Periodicity in Properties

EARLIER ATTEMPTS OF PERIODIC CLASSIFICATION OF ELEMENTS Section - 1

Certain groups of elements have similar chemical properties ; we classify elements as members of the same chemical family. Such similarity in the properties of elements has led scientists to classify them in such a form where one can study them in an organized manner. Such an arrangement is called as Periodic Table. Some of significant earlier attempts are discussed below.

Dobereiner's Triads

In 1829, J. Dobereiner made an important first step towards a systematic classification by arranging elements into groups of three (triads). He observed that the atomic weight of the middle element of the group was midway between the atomic weights of the other two. He also concluded that the same midpoint relation held true for the physical properties of these elements.

Some of his triads were :

Li, Na, K Cl, Br, I Ca, Sr, Ba

Newland's law of Octaves

In 1865, Newland proposed that if the elements are arranged according to the increasing atomic weights (beginning with lightest element, excluding Hydrogen), the chemical and physical properties of a particular element would be similar to those of the elements seven places before and seven places after it (like the eight note in an octave of music). This led to the idea of periodicity for the first time in true sense.

For example, Li, the second element in Newland's list, had properties similar to Na, the ninth element in the list and K, the sixteenth element. Thus these were similar elements represented by numbers 2, 9, 16 that show interval of seven.

Mendeleev's Periodic law and Classification

In 1869, the Russian Chemist Mendeleev was successful in arranging the elements in the form a *periodic table*, in such a way that the elements having similar properties were placed in same vertical columns, called groups.

Mendeleev organized the elements according to the increase in the atomic weight. He thus obtained a pattern where similar chemical properties for elements recurred periodically. In fact his observations were based on a periodic law stating :

" *The physical and chemical properties of the elements are periodic functions of their respective Atomic weights.*"

His proposal was even backed by the predictions for the undiscovered elements. He took a bold step to leave the blank places for such elements. He in fact predicted the properties of these elements and called some of them as *eka*-sillicon (Germanium), *eka*-aluminum (Gallium) and *eka*-boron (Scandium). Later on when these elements were discovered, Mendeleev's predictions were found to be amazingly accurate.

Modern Periodic Table

With the establishment of atomic theory in the first quarter of 20th century and work of physicist Henry Moseley, the chemical behavior of an atom is known to be dependent on its electrical characteristics signified by its *Atomic number* (Z). So Mendeleev's periodic table was modified to include the later developments in so called *Long-form of periodic table*. It is based on modern Periodic Law stated as :

"*The physical and chemical properties of the elements are periodic functions of their respective Atomic numbers*".

In the long form of periodic, the elements having the same electronic configuration in their outer shell were grouped together. The electrons in the outer shell are termed as valence electrons. Valence electrons determine the properties and chemical reactivity of the elements and participate in chemical bonding (discussed later in the chapter).

Hence a major modification in the long form of periodic table, is the arrangement of elements in order of increasing Atomic numbers rather than increasing Atomic weights.

MODERN PERIODIC TABLE Section - 2

In modern periodic table, elements are arranged in horizontal rows (*periods*) and vertical columns (*groups*). In all there are seven periods and eighteen groups. The groups were divided into two categories according to old convention. Now the groups are numbered from 1 to 18. In old convention group nos. were IA, IIA, ...VIIA, IB, IIB .....VIIIB

IA, IIA, IIIA ..... VIIIA : now written as 1, 2, 13, 14, 15, 16, 17, 18

IIIB ..... VIIB : now written as 3, 4, 5, 6, 7

VIII B corresponds to 8, 9, 10 and IB, IIB correspond to11, 12 respectively.

Periods :

Ist Period contains only two elements namely Hydrogen (H), Helium (He). It is called as *shortest period*.

IInd period starts with Lithium (Li) and contains eight elements.

Li, Be, B, C, N, O, F, Ne.

IIIrd period starts with Sodium (Na) and contains eight elements.

Na, Mg, Al, Si, P, S, Cl, Ar.

Note : II and III periods are called as *short-periods*.

IVth period contains eighteen elements starting with Potassium (K).

K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Kr.

Vth period contains eighteen elements starting from Rubidium (Rb).

Rb, ……..., Xe (Xenon).

Note : IV and Vperiods are called as *long-periods*.