PERIODIC TABLE

1. **The periodic table:** Earlier concepts of classifying elements

   (*i*) Doebereinier's law of Triads: Doebereinier classified the elements into the groups of three elements, each was called as 'triads.' The atomic weight of the middle element in each triad was found to be the average of the atomic weights of the two

Triad	I	II	III
Elements	Li	Na	K
At. wt.	7	23	39

At. wt. of the elements (Na)

$$= \frac{7+39}{2} = 23$$

This classification failed, as it could not classify all the known elements.

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(*ii*) Newlands' law of octaves : Newlands arranged the elements in the increasing order of atomic weights and found that the properties of eighth element resemble closely with the starting element. *e.g.*

Elements	Li	Be	B	C	N	O	F
At. wt.	7	9	11	12	14	16	19

This law could not be applied for heavier elements.

(*iii*) Mendeleef's periodic law and periodic table : In 1869 Mendeleef arranged 63 elements into a periodic table on the basis of his periodic law, which states that *physical and chemical properties of the elements are periodic function of their atomic weights.*

This table has 8 vertical columns known as groups and 7 horizontal rows known as periods. Properties of elements are repeated after every seventh elements. Elements in the same group show similar properties.

Merits of Mendelef's Periodic Table

I. Mendeleff predicted the existance of certain elements and left spaces in his

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periodic table, these elements were later on discovered.

II. Mendeleef correct the atomic weights of certain elements, such as Au and Pt.

III. Mendeleef corrected the valence of certain elements, like Be.

Demerits of Mendeleef's Periodic Table

I. Position of hydrogen was not clear.

II. No distinction was made between metals and non-metals.

III. No place was assigned to the isotopes of an element.

IV. Variable valances of the elements could not be explained.

V. Certain dissimilar elements were placed in the same group, while certain similar elements were placed in different groups.

VI. Some elements with higher atomic weights were placed before the elements with lower atomic weights.

VII. Elements of group VIII were placed in a period.

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2. **The modern periodic table**

Modern periodic law : It states that physical and chemical properties of the elements are periodic function of their atomic numbers. Hence,

(*i*) The elements were arranged in order of their increasing atomic numbers.

(*ii*) The elements resembling in their physical and chemical properties fall one below another.

(*iii*) There are 7 horizontal rows called as **periods** and 18 vertical columns called as **groups**.

Periods

Horizontal rows are known as periods. There are 7 periods. The number of period represents the number of orbits. Each period begins with an alkali metal and ends up with a noble gas. However, first period begin with hydrogen.

(*i*) The first period contains 2 elements, H_1 and He_2.

(*ii*) The second and third periods contain 8 elements each and are called as short periods. The elements are from lithium (Li_3)

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to neon (Ne_{10}) and from sodium (Na_{11}) to argon (Ar_{18}).

(*iii*) The fourth and fifth periods contain 18 elements each and are called as long periods. The elements are from potassium (K_{19}) to krypton (Kr_{36}) and from rubedium (Rb_{37}) to xenon (Xe_{54}).

(*iv*) Sixth period contains 32 elements and is called as very long period. The elements contained are from caesium (Cs_{55}) to radon (Rn_{86}).

(*v*) Seventh period contains 21 elements, from francium (F_{87}) to unnitseptium (Uns_{107}).

(*vi*) The 14 elements each and lanthanum and actinium belonging to 6th and 7th periods are placed in two separate rows at the bottom known as **lanthanids** (57-71) and **actinides** (89-103).

Groups

18 vertical columns are known as groups. Elements in a group have similar physical and chemical properties because of similar outer shell electronic configuration.

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(*i*) Elements of groups 1, 2, 13-18 are called as *normal, typical or representative elements.* They have their innermost orbit complete (except group 18) and outer electronic configurations as ns^1, ns^2, ns^2np^1, ns^2np^2, ns^2np^3, ns^2np^4, ns^2np^5 and ns^2np^6 repectively. Group 1 is known as *alkali metals group,* group 2 is called *alkaline earth metals group* and group 17 is known as *halogen group.* The elements of group 18 are *noble gases.*

(*ii*) Elements of group 3-12 are called as *transition elements* as their properties lie in between those of metals and non-metals. They have their outermost as well as penultimate shells incomplete. Their general electronic configuration is $(n-1)\,d^{1-10}ns^{0-2}$.

(*iii*) Inner transition metals are placed in two separate horizontal rows below seventh period known as Lanthanons and actinons.

3. Electronic structure and the periodic table

(*i*) s-block elements: Those elements in which the last electron enters into the

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outermost s-subshell are called a s-block elements. These are the elements of group 1 having outermost electronic configuration ns^1 and elements of group 2 having outermost electronic configurations ns^2.

(*ii*) **p-block elements:** Those elements in which the last electron enters into the p-orbitals of outermost shell are called as p-block elements. These are the elements of groups 13-18 (excluding He). The general outer electronic configuration varies from ns^2np^1 to ns^2np^2.

(*iii*) **d-block elements:** Those elements in which the last electron enters in (n–1) d orbitals are called as d-block elements. This block includes elements of groups 3-12. This block lies between s-block and p-block and hence its elements are called as transition elements. They have configuration $(n-1)\,s^2\,p^6\,d^{1-10}, ns^{1-2}$.

(*iv*) **f-block elements:** Those elements in which the last electron enters in (n–2) f

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orbitals are called as f-block elements. There are two series of f-block elements: *Lanthanides* having incomplete 4f-orbitals [from cerium (58) to lutetium (71)] and *Actinides* having incomplete 5 f-orbitals [from thorium (90) to lawrencium (103)].

4. **Periodic properties of the elements:** The cause of periodic properties of the elements is due to regular repetition of similar outer shell electronic configuration after each period.

Main periodic properties of elements are :

(*i*) Electronic configuration and valence

In periods: The elements in period have different electronic configurations and different number of valence electrons.

In groups: The elements of same group have similar outer shell electronic configuration and hence same valence.

(*ii*) Atomic size: The distance from the atom to the outermost shell of the electrons is called atomic radius.

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In periods: On moving from left to right in a period, atomic radius decreases.

In groups: Atomic size increases as we move down in a group.

(*iii*) Ionization energy: Minimum energy needed to remove the most loosely bound electron from an isolated gaseous atom or cation, is called as ionization energy.

In periods: The ionization energy of the elements increases as we move from left to right.

In groups : On moving down in a group, ionization energy decreases.

(*iv*) Electron affinity: The energy released when an electron is added to a neutral isolated gaseous atom is called electron affinity.

In periods: Electron affinity increases as we move across the period from left to right. Halogens have the highest electron affinity. Electron affinity of rare gases, half filled and completely filled orbitals is zero (due to extra stability).

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(*v*) Electronegativity : Power of an elements to attract shared pair of electrons of a covalent bond in a compound towards itself, is called its electronegativity.

In periods: It increases along a period from left to right.

In groups: it decreases down the groups.

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