CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

MODERN PERIODIC LAW & PRESENT FORM OF PERIODIC TABLE

Mendeleef's Periodic Table

(a) **Mendeleef's periodic law:** The physical and chemical properties of elements are the periodic function of their atomic weight

Group	I	II	III	IV	V	VI	VII	VIII
Oxide : Hydride:	R_2O RH	RO RH_4	R_2O_3 RH_4	RO_2 RH_4	R_2O_5 RH_3	RO_3 RH_2	R_2O_7 RH	RO_4
Periods	A B	A B	A B	A B	A B	A B	A B	Transition series
1	H 1.008							
2	Li 6.939	Be 9.012	B 10.81	C 12.011	N 14.007	O 15.999	F 18.998	
3	Na 22.99	Mg 22.99	Al 24.31	Si 28.09	P 30.974	S 32.06	Cl 35.453	
4 First series Second series	K 39.102 Cu 63.54	Ca 40.08 Zn 65.54	Sc 44.96 Ga 69.72	Ti 47.90 Ge 72.59	V 50.94 As 74.92	Cr 50.20 Se 78.96	Mn 54.94 Br 79.909	Fe Co Ni 55.85 58.93 58.71
5 First series Second series	Rb 85.47 Ag 107.87	Sr 87.62 Cd 112.40	Y 88.91 In 114.82	Zr 91.22 Sn 118.69	Nb 92.91 Sb 121.60	Mo 95.94 Te 127.60	Tc 99 I 126.90	Ru Rh Pd 101.07 102.91 106.4
6 First series Second series	Cs 132.90 Au 196.97	Ba 137.34 Hg 200.59	La 138.91 Tl 204.37	Hf 178.40 Pb 207.19	Ta 180.95 Bi 208.98	W 183.85		Ru Rh Pd 190.2 192.2 195.09

(b) Characteristic of Mendeleef's periodic table

(I) It is based on atomic weight

(II) 63 elements were known; noble gases were not discovered.

(III) He was the first scientist to classify the elements in a systematic manner i.e., in horizontal rows and in vertical columns.

(IV) Horizontal rows are called periods and there were 7 periods in Mendeleev's Periodic table.

(V) Vertical columns are called groups and there were 8 groups in Mendeleev's Periodic table.

(VI) Each group up to VIIth is divided into A & B subgroups. 'A' sub groups element are called normal elements and 'B' sub groups elements are called transition elements.

(VII) The VIIIth group was consists of 9 elements in three rows (Transitional metals group).

(VIII) The elements belonging to same group exhibit similar properties.

(c) Merits or advantages of Mendeleef's periodic table

(I) **Study of elements:** First time all known elements were classified in groups according to their similar properties. So study of the properties of elements become easier.

(II) **Prediction of new elements:** It gave encouragement to the discovery of new elements as some gaps were left in it.

Sc (Scandium) Ga (Gallium) Ge (Germanium) Tc (Technetium)

These were the elements for whom position and properties were well defined by Mendeleev even before their discoveries and he left the blank spaces for them in his table.

Ex. Blank space at atomic weight 72 in silicon group was called Eka silicon (means properties like silicon) and element discovered later was named Germanium.

Similarly other elements discovered after mendeleef periodic table were.

Eka aluminium – Galium(Ga)	Eka Boron – Scandium (Sc)
Eka Silicon – Germanium (Ge)	Eka Mangense – Technetium (Tc)

(III) **Correction of doubtful atomic weights:** Correction were done in atomic weight of some elements.

Atomic weight = Valency × Equivalent weight.

Initially, it was found that equivalent weight of Be is 4.5 and it is trivalent (V = 3), so the weight of Be was 13.5 and there is no space in Mendeleev's table for this element. So, after correction, it was found that Be is actually divalent (V = 2). So, the weight of Be became 2 × 4.5 = 9 and there was a space between Li and B for this element in Mendeleev's table.

Corrections were done in atomic weight of elements are – U, Be, In, Au, Pt.

(d) Defects of Mendeleef's Periodic Table

(I) Position of hydrogen is uncertain. It has been placed in lA and VII A groups because of its resemblance with both the groups.

(II) No separate positions were given to isotopes.

(III) It is not clear whether the lanthanides and actinides are related to IIA or IIB group.

(IV) Although there is no resemblance except valency of subgroups A and B, they have been put in the same group.

(V) Order of increasing atomic weights is not strictly followed in the arrangement of elements in the periodic table. For e.g. – Co (At. wt. 58.9) is placed before I (127) and Ar (39.9) before K (39).

LONG FORM OF THE PERIODIC TABLE OR MOSELEY'S PERIODIC TABLE

MODERN PERIODIC TABLE (MODIFIED MENDELEEF PERIODIC TABLE)

(a) It was proposed by Moseley.

(b) Modern periodic table is based on atomic number.

(c) Moseley did an experiment in which he bombarded high speed electron on different metal surfaces and obtained X-rays.

He found out that where ν = frequency of X-rays, Z = atomic number.

(d) **Modern periodic law:** The physical & chemical properties of elements are the periodic function of their atomic number.

CHARACTERISTICS OF MODERN PERIODIC TABLE

(a) 9 vertical columns called groups.

(b) I^{st} to VIII group + 0 group of inert gases.

(c) Inert gases were introduced in periodic table by Ramsay.

(d) 7 horizontal series called periods.

He studied (1909) the frequency of the X-ray produced by the bombardment of a strong beam of electrons on 'metal target. He found that the square root of the frequency of X-rays ( ) is directly proportional to number of effective nuclear charge (z) of metal i.e. to atomic number and not to atomic mass of the atom of that metal. (as nuclear charge of metal atom is equal to atomic number)

i.e. ($\sqrt{\nu}$) = a (z - b)

Where 'a' is the proportionality constant and 'b' is a constant for all the lines in a given series of X-rays. Therefore, he, concluded that atomic number was a better fundamental property of an element than its atomic weight He suggested that the atomic number (z) instead of atomic weight should be basis of the classification of the elements.

Modern Periodic Law (Moseley's Periodic Law)

Physical and chemical properties of elements are the periodic functions of their atomic number. lf the elements are arranged in order of their increasing atomic number, after a regular interval, element with similar properties are repeated.

Periodicity

The repetition of the properties of elements after regular intervals when the elements are arranged in the order of increasing atomic number is called periodicity.

Cause of Periodicity:

The periodic repetition of the properties of the elements is due to the recurrence of similar valence shell electronic configuration after certain regular intervals. For example, alkail metals have same electronic configuration ns^1, therefore, have similar properties.

LONG FORM / PRESENT FORM OF MODERN PERIODIC TABLE

(It is also called as 'Bohr, Bury & Rang, Werner Periodic Table)

(a) It is based on the Bohr-Bury electronic configuration concept and atomic number.

(b) This model is proposed by Rang & Werner

(c) 7 periods and 18 vertical columns (groups)

(d) According to I. U. P. A. C. 18 vertical columns are named as I^{st} to 18^{th} group.

(e) Elements belonging to same group having same number of electrons in the outermost shell so their properties are similar.

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The long form of periodic table is the contribution of Range, Werner, Bohr and Bury

This table is also referred to as Bohr's table since it follows Bohr's scheme of the arrangements of elements into four types based on electronic configuration of elements

The modern periodic table consist of horizontal rows (periods) and vertical column (groups)

Periods:

There are seven periods numbered as 1, 2,3,4,5,6 and 7.

(i) Each period consists of a series of elements ha Ving same valence shell.

(ii) Each period corresponds to a particular principal quantum number of the valence shell present in it.

(iii) Each period starts with an alkali metal having outermost electronic configuration ns^1.

(iv) Each period ends with a noble gas with outermost electronic configuration ns^2np^6 except helium having outermost electronic configuration $1s^2$.

(v) Each period starts with the filling of new energy level.

(vi) The number of elements in each period is twice the number of atomic orbitals available in energy level that is being filled. To illustrate

1^{st} period shortest period having only two elements. Filling of electron takes place in the first energy shell, for which,

$n = 1$, $\lambda. = 0$ (s-subshell) and $m = 0$.

Only one orbital (1s) is available and thus it contains only two elements.

3^{rd} period short period having only eight elements. Filling of electrons takes place in the third energy level. For which,

$n = 3$, $\lambda. = 0$, 1,2 and no. of orbitals $m = 0$, 3, 5

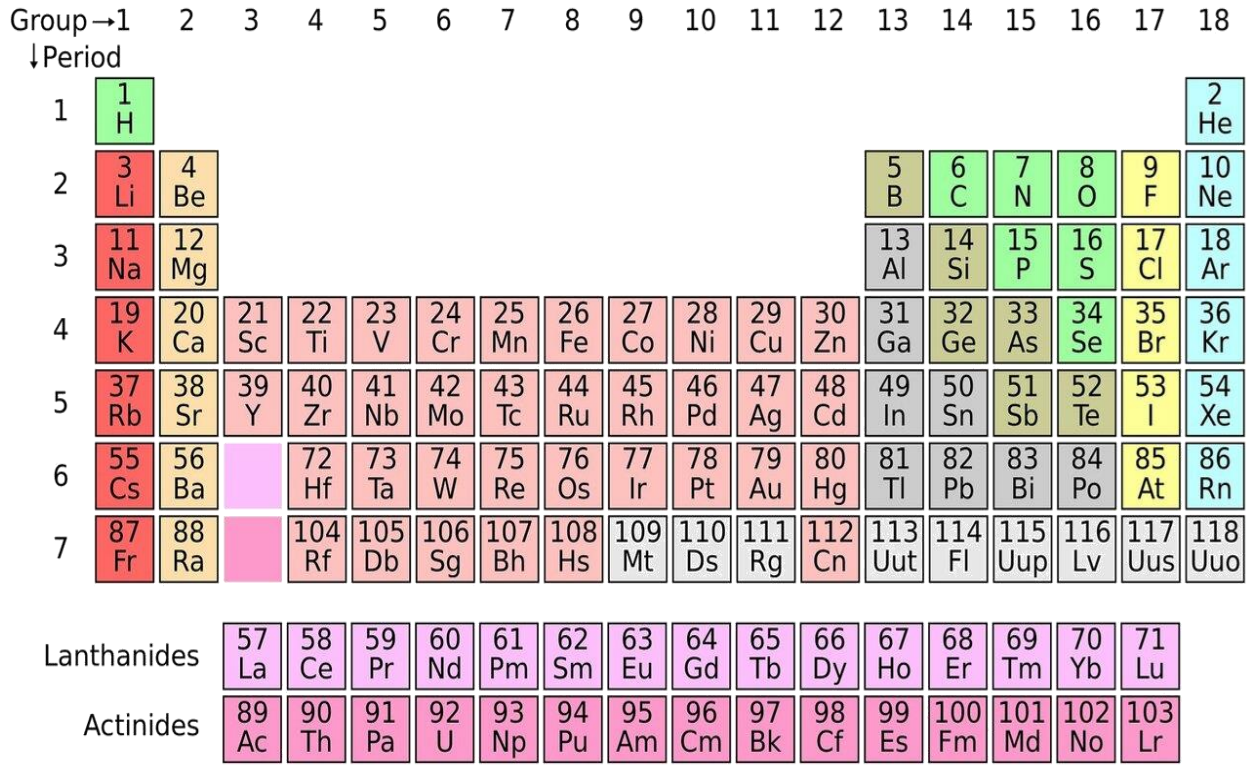
no. of orbitals	1	3	5
	(3s)	(3p)	(3d)
Total no. of orbitals	9		

But the energy of 3d orbitals are higher than 4s orbitals. Therefore, four orbitals (one 3s and three 3p orbitals) corresponding to n = 3 are filled before filling in 4s orbital (next energy elevel). Hence 3rd period contains eight elements not eighteen elements.

Groups:

There are eighteen groups numbered as 1,2,3,4,5, ... 13, 14, 15, 16, 17, 18.

Group consists of a series of elements having similar valence shell electronic configuration.



Description of periods

Period n	Sub shell	No. of elements	Element	Name of Period
1. 1	1s	2	$_1H$, $_2He$	Shortest
2. 2	2s, 2p	8	$_3Li$ – $_{10}Ne$	Short
3. 3	3s, 3p	8	$_{11}Na$ – $_{18}Ar$	Short
4. 4	4s, 3d, 4p	18	$_{19}K$ – $_{36}Kr$	Long

5.	5	5s, 4d, 5p	18	$_{37}Rb$ – $_{58}Xe$	Long
6.	6	6s, 4f, 5d, 6p	32	$_{55}Cs$ – $_{86}Rn$	Longest
7.	7	7s, 5f, 6d,	26	$_{87}Fr$ – $_{112}Uub$	Incomplete