

# CHEMISTRY STUDY MATERIALS FOR CLASS 10 (NCERT Based Revision Notes of Chapter - 05)

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## Periodic Classification of Elements

### Mendeleev's Periodic Table

In 1869, Mendeleev classified the then known 63 elements on the basis of their physical and chemical properties( formation of hydride and oxide) in the increasing order of the atomic masses, in the form of a table. Mendeleev had observed that properties of the elements orderly recur in a cyclic fashion. He found that the elements with similar properties recur at regular intervals when the elements are arranged in the order of their increasing atomic masses. He concluded that 'the physical and chemical properties of the elements are periodic functions of their atomic masses'. This came to be known as the law of chemical periodicity and stated: that the physical and chemical properties of elements are periodic function of their atomic weights.

Based on this law all the known elements were arranged in the form of a table called the 'Periodic Table'. Elements with similar properties recurred at regular intervals and fell in certain groups or families. The elements in each group were similar to each other in many properties. The elements with dissimilar properties from one another were separated. Mendeleev's periodic table contains eight vertical columns of elements called 'groups' and seven horizontal rows called 'periods', Each group has two sub-groups A and B. The properties of elements of a sub-group resemble each other more markedly than the properties of those between the elements of the two sub-groups.

### **In other words**

Mendeleev believed that the atomic mass of an element was the most fundamental property in classifying elements.

Mendeleev arranged elements in the increasing order of their atomic masses and observed that the elements showed repetition after certain intervals in their physical and chemical properties.

He arranged the known elements in the increasing order of their atomic masses in horizontal rows, till he encountered an element which had properties similar to the first element.

Mendeleev placed the element below the first element and started the second row of elements.

Proceeding in this way, he created the first periodic table containing 63 elements, arranged according to their properties.

**Mendeleev's Periodic Law:** The physical and chemical properties of elements are a periodic function of their atomic masses.

SERIES	GROUPS OF ELEMENTS											
	0	I	II	III	IV	V	VI	VII	VIII			
1	-	Hydrogen H 1.008	-	-	-	-	-	-	-			
2	Helium He 4.0	Lithium Li 7.03	Beryllium Be 9.1	Boron B 11.0	Carbon C 12.0	Nitrogen N 14.04	Oxygen O 16.00	Fluorine F 19.0	-			
3	Neon Ne 19.9	Sodium Na 23.5	Magnesium Mg 24.3	Aluminium Al 27.0	Silicon Si 28.4	Phosphorus P 31.0	Sulphur S 32.06	Chlorine Cl 35.45	-			
4	Argon Ar 38	Potassium K 39.1	Calcium Ca 40.1	Scandium Sc 44.1	Titanium Ti 48.1	Vanadium V 51.4	Chromium Cr 52.1	Manganese Mn 55.0	Iron Fe 55.9	Cobalt Co 59	Nickel Ni 59	(Cu)
5	-	Copper Cu 63.6	Zinc Zn 65.4	Gallium Ga 70.0	Germanium Ge 72.3	Arsenic As 75	Selenium Se 79	Bromine Br 79.95	-	-	-	-
6	Krypton Kr 81.8	Rubidium Rb 85.4	Strontium Sr 87.6	Yttrium Y 89.0	Zirconium Zr 90.6	Niobium Nb 94.0	Molybdenum Mo 96.0	-	Ruthenium Ru 101.7	Rhodium Rh 103.0	Palladium Pd 106.5	(Ag)
7	-	Silver Ag 107.9	Cadmium Cd 112.4	Indium In 114.0	Tin Sn 119.0	Antimony Sb 120.0	Tellurium Te 127.6	Iodine I 126.9	-	-	-	-
8	Xenon Xe 128	Caesium Cs 132.9	Barium Ba 137.4	Lanthanum La 139	Cerium Ce 140	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	Ytterbium Yb 173	-	Tantalum Ta 183	Tungsten W 184	-	Osmium Os 191	Iridium Ir 193	Platinum Pt 194.9	(Au)
11	-	Gold Au 197.2	Mercury Hg 200.0	Thallium Tl 204.1	Lead Pb 206.9	Bismuth Bi 208	-	-	-	-	-	-
12	-	-	Radium Ra 224	-	Thorium Th 232	-	Uranium U 239	-	-	-	-	-
	R	R <sub>2</sub> O	RO	R <sub>2</sub> O <sub>3</sub>	HIGHER SALINE OXIDES RO <sub>2</sub> R <sub>2</sub> O <sub>5</sub> RO <sub>3</sub> R <sub>2</sub> O <sub>7</sub>				RO <sub>4</sub>			
					HIGHER GASEOUS HYDROGEN COMPOUNDS RH <sub>4</sub> RH <sub>3</sub> RH <sub>2</sub> RH							

## ACHIEVEMENTS OF MENDELEEV'S PERIODIC TABLE

Mendeleev's periodic table was one of the greatest achievements in chemistry with some of its important contributions as follows:

### Systematic Study of Elements

Mendeleev's Periodic table simplified the study of elements. As the arrangements of elements showing similar properties were classified into groups, it was very useful in studying and remembering the properties of a large number of elements in a systematic way.

### Prediction of New Elements

Based on the positions in the periodic table, Mendeleev could predict the properties of some undiscovered elements. He left three blanks for elements that were not discovered at that time. He was able to predict the properties of these unknown elements more or less accurately. He named them eka-boron, eka-aluminium and eka-silicon. He named them so, as they were just below boron, aluminium and silicon in the respective sub-groups. Eka-boron was later named as scandium, eka-aluminium as gallium and eka-silicon as germanium. A Comparative Study of the Properties of Elements Predicted and later Discovered

Property	Eka-boron	Scandium
Atomic weight	44	43.79
Oxide	$\text{Eb}_2\text{O}_3$	$\text{Sc}_2\text{O}_3$
Specific gravity	3.5	3.864
Sulphate	$\text{Eb}_2(\text{SO}_4)_3$	$\text{Sc}_2(\text{SO}_4)_3$
Property	Eka-aluminium	Gallium
Atomic weight	68	69.9
Specific gravity	5.9	5.94
Melting point	Low	$303.15^\circ\text{K}$
Formula of oxide	$\text{Ea}_2\text{O}_3$	$\text{Ga}_2\text{O}_3$
Solubility in acid and alkali	Dissolves slowly in both acid and alkali	Dissolves slowly in both acid and alkali

## Correction of Atomic Masses

Mendeleev's periodic table helped in correcting the atomic masses of some of the elements, based on their positions in the periodic table. For example, atomic mass of beryllium was corrected from 13.5 to 9.0. Atomic masses of indium, gold and platinum were also corrected.

### DEMERITS OF MENDELEEV'S PERIODIC TABLE

1. Hydrogen resembles alkali metals as well as halogens. So, **a correct position could not be assigned to hydrogen in the periodic table.**
2. **The position of isotopes could not be explained.** Isotopes are atoms of the same element having similar chemical properties but different atomic masses. If the elements are arranged according to atomic masses, the isotopes should be placed in different groups of the periodic table. For e.g., there are three isotopes of hydrogen with atomic mass 1, 2, and 3. According to Mendeleev's periodic table these should be placed at three separate places.
3. **Anomalous Pair:- At certain places, an element of higher atomic mass was placed before an element of lower atomic mass.** In certain pairs of elements like, Ar (40) and K (39); Co (58.9) and Ni (58.6); Te (127.6) and I (126.9) the arrangement was not justified. For example, argon was placed before potassium whereas its atomic mass is more than potassium.
4. **Some elements placed in the same sub group had different properties.**  
For example: Manganese is placed with the halogens which are totally different in their properties.

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