



Complete
CHEMISTRY

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CLASS 11 & 12th



Learning Inquiry
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CLASS 11th

**Classification of
Elements & Periodicity
in Properties**

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01. Need for Classification:

It is very difficult to study individually the chemistry of all the elements and millions of their compounds, hence to simplify and systematize the study of chemistry of the elements and their compounds, they are classified into groups and periods. Early attempt to classify the elements:

02. Dobereiner's Law of Triads:

It was first attempt towards classification. He arranged similar elements in a group of three elements called triad and the atomic mass of the middle elements of the triad is approximately the arithmetic mean of the other two.

e.g. Ca^{40} $\text{Sr}^{87.5}$ Ba^{137}

$$\text{At. wt. of Sr} = \frac{137+40}{2} = 88.5$$

88.5 is nearly similar to 87.5 of atomic wt. of Sr.

Such a group of elements is called **Dobereiner's triad**.

| Triad of atoms | | | Means of first and last element |
|----------------|----|----|---------------------------------|
| Li | Na | K | $\frac{7+39}{2} = 23$ |
| 7 | 23 | 39 | |
| Be | Mg | Ca | $\frac{8+40}{2} = 24$ |
| 8 | 24 | 40 | |

Dobereiner could arrange only a few elements as triads and there are some such elements present in a triad, whose atomic weights are approximately equal, e.g.

Fe Co Ni
Ru Rh Pd

Therefore, this hypothesis was not acceptable for all elements.

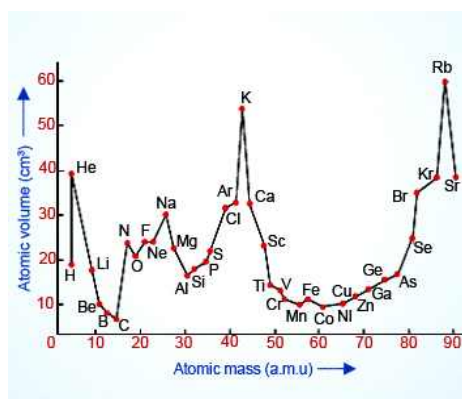
03. Newland's Law of Octaves:

When the lighter elements are arranged in order of their increasing atomic weights, then every eighth element is similar to the first element in its properties, similarly as the eighth note of a musical scale is similar to 1st one. e.g. Na 8th element resembles in their properties with Li. Similarly K the 8th element with Na and so on.

| | | | | | | | |
|-----------------|----|----|----|----|----|----|------|
| Name of element | Li | Be | B | C | N | O | F |
| | 7 | 9 | 11 | 12 | 14 | 16 | 19 |
| Name of element | Na | Mg | Al | Si | P | S | Cl |
| | 23 | 24 | 27 | 28 | 31 | 32 | 35.5 |

- It is clear from the above table that sodium is the eighth element from lithium, whose properties resemble that of lithium.
- This type of classification was limited up to only 20 elements.
- Inert gas element were not discovered till then.

04. Lothar Mayer Arrangement:



- The graphs plotting the atomic volumes against atomic weights are known as Lothar Mayer volume curves.
- The alkali metals have highest atomic volumes.
- Alkaline earth metals (Be, Mg, Ca, Sr, Ba, etc.) which are relatively a little less electropositive. Occupy positions on the descending part of the curve.
- Halogens and the noble gases (except helium) occupy positions on the ascending part of the curve.
- Transition elements have very small volumes and therefore these are present at the bottoms of the curve.

05. Mendeleev's Periodic Law

Mendeleev's Periodic Law

The physical and chemical properties of elements are the periodic function of their atomic weight.

06. Characteristic of Mendeleev's Periodic Table

- It is based on atomic weight
- 63 elements were known, noble gases were not discovered.
- 12 Horizontal rows are called periods.
- Vertical columns are called groups and there were 8 groups in Mendeleev's Periodic table.
- 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.
- The VIIIth group was consists of 9 elements in three rows (Transition metals group).
- The elements belonging to same group exhibit similar properties.

07. Modified Mendeleev's Periodic Table of Elements

| Reihen | Gruppe I. — R ² O | Gruppe II. — RO | Gruppe III. — R ² O ³ | Gruppe IV. RH ⁴ RO ² | Gruppe V. RH ³ R ² O ³ | Gruppe VI. RH ² RO ³ | Gruppe VII. RH R ² O ⁷ | Gruppe VIII. — RO ⁴ |
|--------|------------------------------------|-----------------------|---|--|---|--|--|--------------------------------------|
| 1 | H=1 | | | | | | | |
| 2 | Li=7 | Be=9.4 | B=11 | C=12 | N=14 | O=16 | F=19 | |
| 3 | Na=23 | Mg=24 | Al=27.3 | Si=28 | P=31 | S=32 | Cl=35.5 | |
| 4 | K=39 | Ca=40 | —=44 | Ti=48 | V=51 | Cr=52 | Mn=55 | Fe=56, Co=59, Ni=59, Cu=63. |
| 5 | (Cu=63) | Zn=65 | —=68 | —=72 | As=75 | Se=78 | Br=80 | |
| 6 | Rb=85 | Sr=87 | ?Yt=88 | Zr=90 | Nb=94 | Mo=96 | —=100 | Ru=104, Rh=104, Pd=106, Ag=108. |
| 7 | (Ag=108) | Cd=112 | In=113 | Sn=118 | Sb=122 | Te=125 | J=127 | |
| 8 | Cs=133 | Ba=137 | ?Di=138 | ?Ce=140 | — | — | — | — |
| 9 | (—) | — | — | — | — | — | — | — |
| 10 | — | — | ?Er=178 | ?La=180 | Ta=182 | W=184 | — | Os=195, Ir=197, Pt=198, Au=199. |
| 11 | (Au=199) | Hg=200 | Tl=204 | Pb=207 | Bi=208 | — | — | — |
| 12 | — | — | — | Th=231 | — | U=240 | — | — |

08. Merits of Advantages of Mendeleev's Periodic Table

(a) Study of elements

First time all known elements were classified in groups according to their similar properties. So study of the properties become easier of elements.

(b) 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), Te(Technetium) were the elements for whom position and properties were defined by Mendeleev even before their discoveries and he left the blank spaces for them in his table.