Class-XI

Subject - Chemistry

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Causes of Periodicity: The occurrence of similar properties of the elements after certain regular intervals when they are arranged in the order of increasing atomic numbers is called Periodicity.

The causes of periodicity of properties of the elements is the repetition of similar electronic configuration of their atoms in the outermost energy shell (or valence shell) after certain regular intervals.

Periodic trends in the properties of elements:-

(I) **Valency:**

(i) **Variation in a group:** When move from top to bottom in a group, the valency of all elements are same.

Let us consider Gp-1 elements

$_3Li \Rightarrow K=2, L=1$ (valency = 1)
$_{11}Na \Rightarrow K=2, L=8, M=1$ (valency = 1)
$_{19}K \Rightarrow K=2, L=8, M=8, N=1$ (valency = 1)

} Valency = No. of valence shell electrons

(Valency = No. of valence shell electrons
or
Valency = 8 - [No. of valence shell electrons])

(ii) **Variation in a period:** When we move from left to right in a period, the valency will increase from 1 to 4 then decreases to 0.

Let us consider 2nd Period elements:

$_3Li \Rightarrow K=2, L=1$ (valency = 1)
$_4Be \Rightarrow K=2, L=2$ (valency = 2)
$_5B \Rightarrow K=2, L=3$ (valency = 3)
$_6C \Rightarrow K=2, L=4$ (valency = 4)

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$_7N$ ⇒ K=2, L=5 (valency = 8-5=3)

$_8O$ ⇒ K=2, L=6 (valency = 8-6=2)

$_9F$ ⇒ K=2, L=7 (valency = 8-7=1)

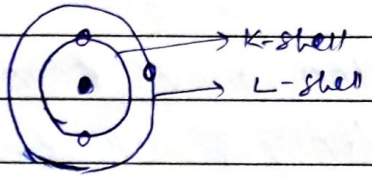
$_{10}Ne$ ⇒ K=2, L=8 (valency = 8-8=0)

(2) **Atomic radius:** The distance between centre of nucleus and valence shell of electrons is called atomic radius.

(i) Variation in a group: When we move from top to bottom in a group, the atomic radius will increase due to the addition of new shell.

for example: Let us consider 1st-1 elements.

$_3Li$ ⇒ K=2, L=1 { valence shell = L-shell }



$_{11}Na$ ⇒ K=2, L=8, M=1 (valence shell = M-shell)

(ii) Variation in a period: When we move from left to right in a period, the atomic radius will decrease due to increase in nuclear charge. (Nuclear charge depends upon the number of protons present in the nucleus not on neutrons)

Let us consider 2nd period.

$_3Li$ ⇒ No. of protons = 3

$_4Be$ ⇒ No. of protons = 4

$_5B$ ⇒ No. of protons = 5

$_6C$ ⇒ No. of protons = 6

$_7N$ ⇒ No. of protons = 7

$_8O$ ⇒ No. of protons = 8

$_9F$ ⇒ No. of protons = 9

$_{10}Ne$ ⇒ No. of protons = 10

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(3) Ionic radius: The effective distance from the centre of the nucleus of the ion upto which it has an influence in the ionic bond.

(i) The radius of the cation (positive ion) is always smaller than that of the parent atom.

$Na \xrightarrow{-e^-} Na^+$

	Atom	Cation
Electrons	11	10
Nuclear charge	+11	+11
Size	186 pm	95 pm

In cation same nuclear charge acts on less number of electrons. The effective nuclear charge per electron increases and the electrons are strongly pulled towards nucleus. This cause decrease in size of the cation.

(ii) The negative ion is always larger than that of the corresponding atom.

$Cl \xrightarrow{+e^-} Cl^-$

	Atom	Anion
Electrons	17	18
Nuclear charge	+17	+17
Size	99 pm	181 pm

The effective nuclear charge per electron is reduced and the electron cloud is held less tightly by the nucleus. This causes increase in size of the ion.

Variation of Size in an Isoelectronic ions

Isoelectronic ions are the ions of different elements which have same number of electrons but differs from one another in magnitude of nuclear charge. Greater the nuclear charge, lesser is the size of ion.

$Al^{3+} < Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$

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