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Theme :- **Periodic properties**

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First sem

INTRODUCTION

- **In the modern periodic table total elements are 118.**
- **The periodic table is divided into four roughly rectangular areas called blocks.**
- **The rows of the table are called periods, and the columns are called groups.**
- **There are a total of 7 periods and 18 groups in the Modern Periodic Table.**

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- The trends of a similar outer electronic configuration at certain regular intervals is the cause of periodicity.
- The certain regular intervals are 2,8,8,18,32 and 32.
- “ The repetition of similar properties of elements after certain regular intervals when they are arranged in the order of increasing atomic number is called periodicity.”

Periodic properties:- Atomic radii, Ionic radii, ionization potential, electron affinity, electronegativity, Density, melting point, boiling point etc. are some important periodic properties of the elements.

Atomic Radii

"The atomic radii is defined as the distance between the center of nucleus and the electron in the valence shell".

- The physical properties such as density, melting point and boiling point etc are related to the atomic size.
- If atom is assumed to be a sphere then atomic or ionic radii corresponds to the radius of the sphere.

The absolute size of atom is difficult to define because

- **There is an uncertainty in exact position of electron.**
- **It is impossible to have isolated atom so that the measure of atomic is not possible.**
- **However the techniques such as x-ray diffraction, electron diffraction, NMR spectroscopy from which the internuclear distance the atom in the molecule can be determined.**
- **The atomic radii are sub-divided into three types**

1.Covalent radii 2. Van der waals radii. 3.Metallic radii

Periodic trends of Atomic radii

Along period

From left to right along the period atomic radii decrease

Reasons to decrease Atomic radii along period

- The nuclear charge increases and due to that valence electrons are attracted more towards the nucleus.
- The electrons are added in the last same shell and hence electron cloud is concentrated closer to the nucleus and therefore atomic radius decreases.

Valence Shell e-c	Li_3 $2s^1$	Be_4 $2s^2$	B_5 $2s^2 2p^1$	C_6 $2s^2 2p^2$	N_7 $2s^2 2p^3$
electron	1	2	3	4	5
Nuclear charge	+1	+2	+3	+4	+5
Same Shell (n)	2	2	2	2	2

Along Group

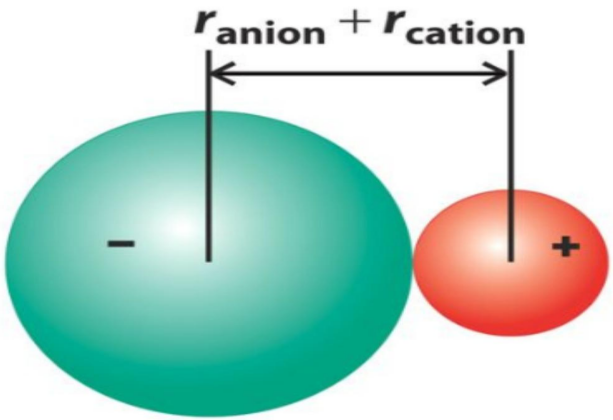
As we move from top to bottom in the group, atomic radii increase gradually because

- ➔ The nuclear charge increases but new orbitals are created to fill the electrons and the nucleus is shielded more.
- ➔ Due to the shielding effect, the effective nuclear charge decreases which causes increases in atomic radii.

Valence Shell e.c	Li_3 $2s^1$	Na_{11} $3s^1$	K_{19} $4s^1$
electron in outermost shell	1	1	1
Nuclear charge	+3	+11	+19
Shell	2	3	4

Ionic radii

- **“ Ionic radius is defined as the distance between the centre of nucleus of an ion up to which it has influence on its electron charge cloud”.**



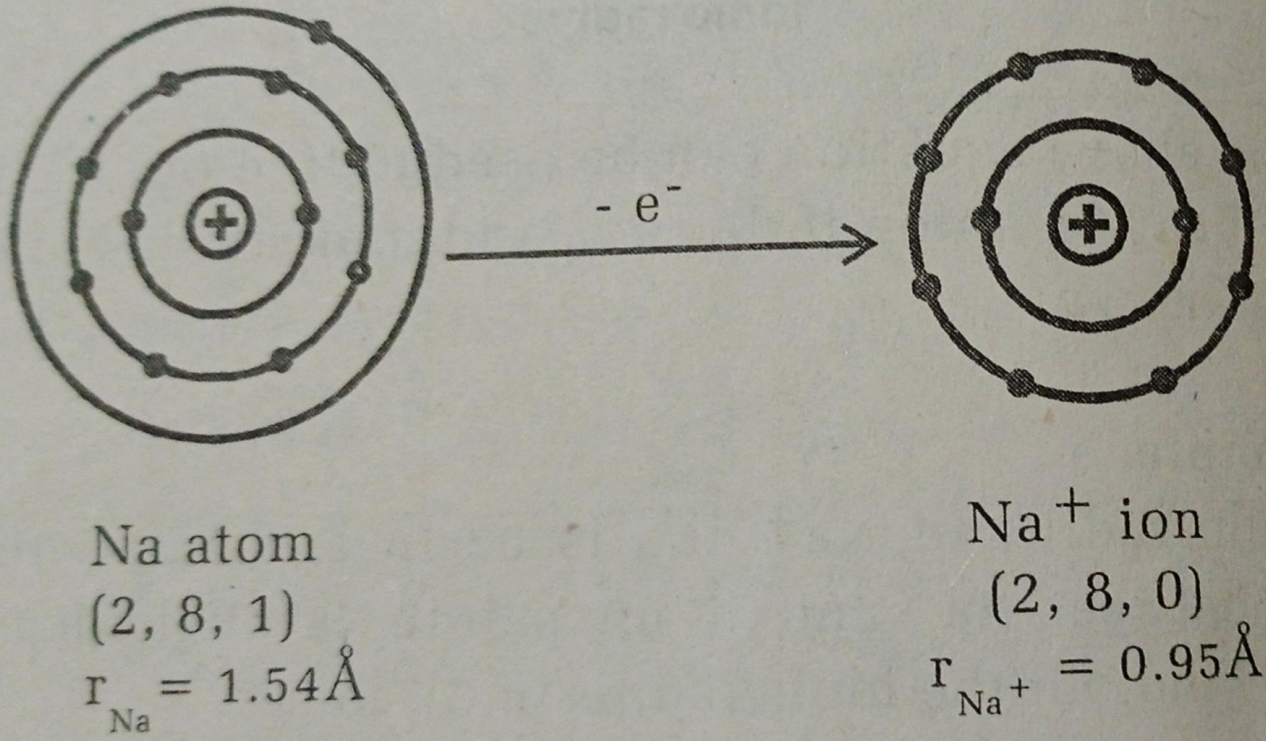
- Ions are formed when an atom loses or gains electrons.
- When an atom loses an electron it forms a cation and when it gains an electron it becomes an anion.
- The Ionic radius can be described as the distance between the nucleus of an ion and the outermost shell of the ion.

- **The atomic size of a cation will be smaller than that of the parent atom.**

- **An anion is relatively larger in size than its parent atom.**

- **The atomic size of a cation will be smaller than that of the parent atom.**

  - **Due to formation of positive ion, the outer most shell electron is generally removed completely.**
  - **Due to formation of cation number of electrons are decreases while the nuclear charge remains same.**
    The Effective nuclear charge per electron increases and electrons are therefore pulled more strongly towards the nucleus and hence the ionic radii decreases.



Radius of Na and Na^+

- **In sodium atom**

Number of protons = 11

Number of electrons = 11

- **But in Sodium action (Na^+)**

Number of protons = 11

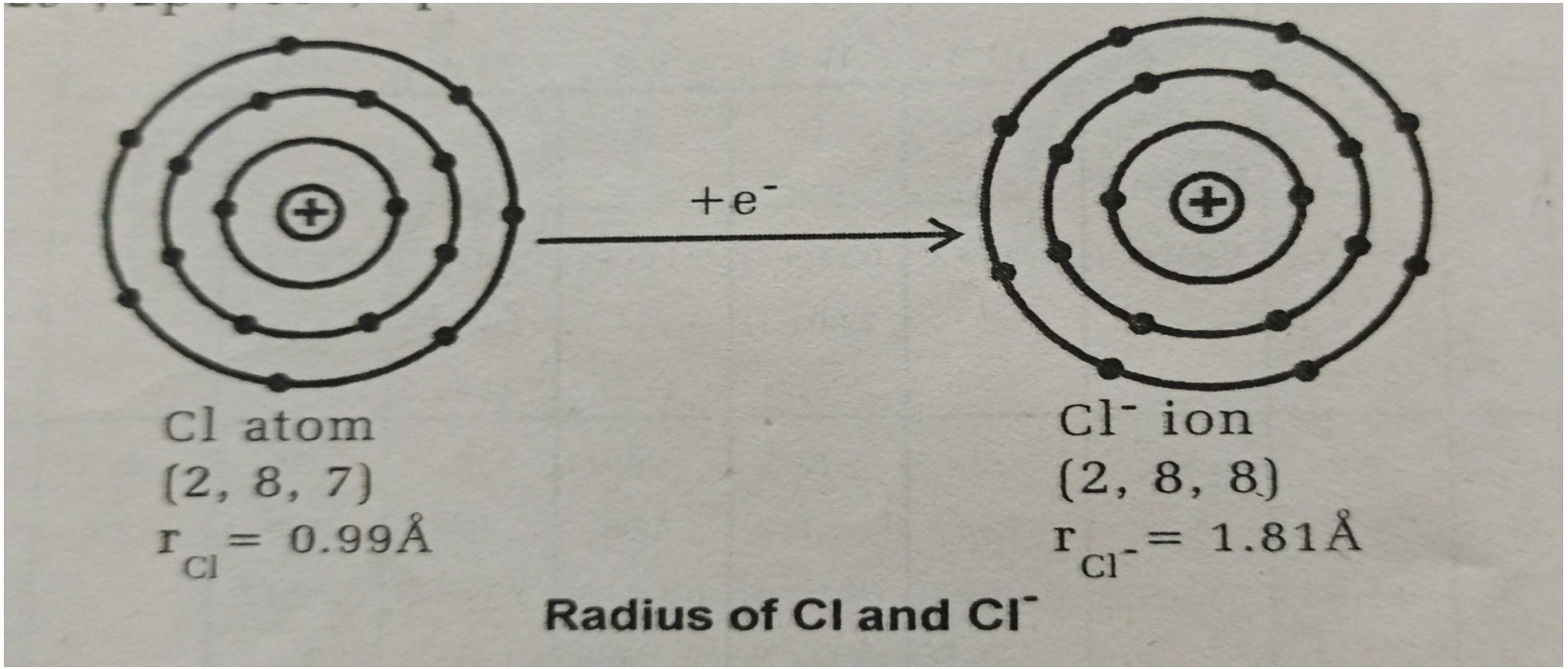
Number of electrons = 10

The effective nuclear charge per electron is more than the parent atom so it attracts the electrons from the valence shell more strongly towards

- **An anion is relatively larger in size than its parent atom.**

- **If one or more electrons are added in the valence shell of an atom then it possess negative charge.**
- **Due to addition of electrons the effective nuclear charge per electron decreases and electron cloud extends and ionic size increases.**

Ex. In chlorine



In chlorine atom

- Number of protons = 17
- Number of electrons = 17

In chlorine anions

- Number of protons = 17
- Number of electrons = 18

The effective nuclear charge per electron decreases and electrons are loosely bound towards the nucleus and due to this the ionic radius is more than the parent atom.

THANK YOU