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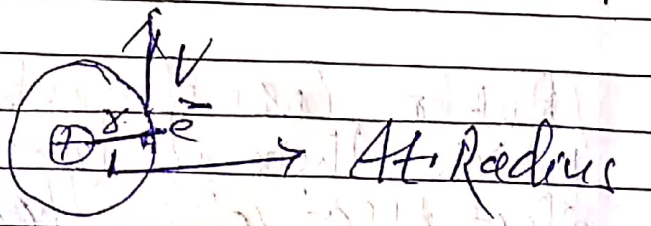
Deg-I (H/S) Inorganic.

Chapter - Periodic Properties.

Topics — Atomic Radius

Definition — It is defined as the distance b/w the centre of the nucleus & outermost orbit where electrons are present.



Remember — The absolute value of Atomic Radius measurement is very difficult due to following reason.

(i) The atom does not have sharp boundry. The probability of finding the electrons at far distance from the nucleus is not zero.

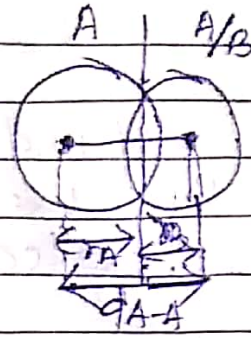
(ii) It is not possible to get isolated atom because the electron density around an atom is affected by the presence of neighbouring atoms thus their size distorted.

(iii) The size of atom is very small in order of about 1.2×10^{-10} m.

Thus at. Radius can be calculated only in their combining state.

There are three type of Radius —

(1) Covalent-Radius :- It is defined as the half of distance b/w the nuclei of two bonded (like or dislike) atoms by a single covalent bond



d_{A-A} = Diameter
r_A = Radius

For homo-nuclear atoms

$d_{A-A} = 2r_A$

$\therefore r_A = \frac{d_{A-A}}{2}$

For hetero-nuclear

$d_{A-B} = r_A + r_B$

But in case of hetero-diatomic molecule in which there is large difference in the electronegativity they will have some ionic-character & their bond-length becomes shorter as expected.

For such cases the Radius determined by adopting the expression

$$d_{A-B} = r_A + r_B - 0.09(X_A - X_B)$$

Where X_A & X_B is the electronegativity of atom A & B.

(2) Crystal Radius :- It is defined as the half of the distance b/w nuclei of the adjacent metal-atom in the metallic close packed crystal-having very high coordination number of that metal.

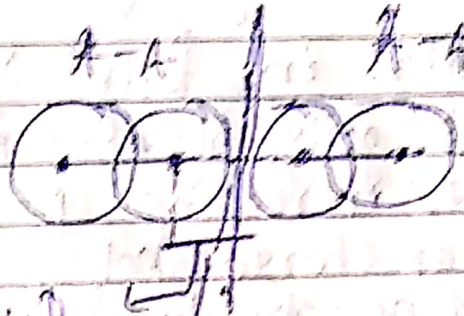
Crystal Radius is always higher than covalent-Radius.

Example Radius in Angstrom ($1A^\circ = 10^{-10}m$)

Metal	Covalent Radius	Crystal Radius
Na	1.54	1.86
K	2.03	2.31
Cu	1.17	1.28
Al	1.20	1.43

(3) Vanderwaal Radius :—

It is defined as the half of distance b/w the nuclei of two non-bonded neighbouring atoms of two adjacent molecules in the solid-state.



Remarks — Vanderwaal Radius > Crystal Radius > Covalent Radius

Ionic Radius :—

It is related for ions in Crystalline or Ionic solid.

$AB \longrightarrow A^{\oplus} + B^{\ominus}$

Crystalline solid Column Anions.

Def :- It is defined as the distance b/w the nucleus & outermost shell of an ion (Electron cloud)

Note :- Atomic Radius > Covalent Radius
Atomic Radius > Atomic Radius

Example. r_{Na} (1.86 A°) > r_{Na^+} (0.99 A°)
r_{Cl} (1.81 A°) > r_{Cl^-} (0.99 A°)

For Isoelectronic Species:

(a) Cationic Radius decrease by Increasing charge of Cation

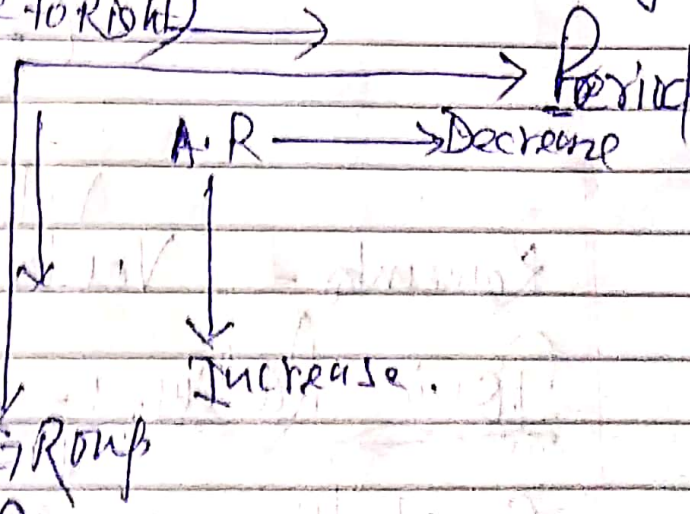
→ r_{Na^+} > $r_{Mg^{+2}}$ > $r_{Al^{+3}}$ > $r_{Si^{+4}}$
(in A°) 0.99 > 0.65 > 0.50 > 0.38

(b) Anionic Radius increase by increasing charge.

C^{+4} (2.60) > N^{-3} (1.71) > O^{-2} (1.40) > F^{-1} (1.36)

Variation of Radius in Periodic Table -

Variation in Period :- It decrease along Period (going from left to Right) due to increasing Nuclear charge which give rise of attraction towards nucleus & it's size decr.



Variation in a Group:-

It increase in a group (moving from left to Right) by increasing atomic number.

It is due to opening of new shell, However their valence electrons remain same. The effect of increase in the size of electron cloud is more favourable than the effect of increased nuclear charge.