SUBJECT - CHEMISTRY

CLASS - BSc (SUBHONEN) PART-I

GROUP - B

TOPIC - Ion polarisation (Fajan's rule)

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Ion polarisation: When a cation comes in close proximity of an anion, the cation attracts the electron of anion and at the same time, the nuclei of ions being positively charged undergo repulsion These two opposite forces cause ionic deformation. Ion deformation Increases if -

(i) Cationic Size is small (ii) anionic Size is large (iii) charge on the ion is high and (IV) cations have preferably 18-electron structure to 8-electron structure.

With the increase in ion deformation, Covalent character of the bond in molecules increases and so the volatality of Compounds increases but the Solubility in wates melting point of Compounds are decreased.

(a) The cationic charge in $AlCl_3$ and $MgCl_2$ is +3 and +2 respectively. Ion polarisation increases with the increase of cationic charge. Hence Al^{3+} ion is more polarised and Consequently $AlCl_3$ is more Covalent than $MgCl_2$

(b) Along this sequence, the polarising power of cations Na^+, Mg^+ and Al^{3+} increases. Since the positive charge on these cations also increases, therefore as we pass from NaCl to $AlCl_3$ through $MgCl_2$, the Covalent character of compounds increases and thus their melting points will decrease.

(c) The polarising power of cation to polarise an anion increases with decrease in size. The greatest magnitude of polarising power of Be^{2+} cation makes its salts to show covalent character, as is evident from their minimum m.p.s

(d) A cation with 18-electron structure has greater polarising power to polarise an anion than a cation, with 8-electron structure even if both cations have the same charge.

Na^+, K^+, Rb^+ — 8-electron structure

Cu^+, Ag^+, Au^+ — 18-electron structure

Na^+ and Cu^+ ions have identical charge but the former has 8-electron structure while the latter has 18-electron structure. Hence Cu^+ salts are more covalent i.e have lower m.p than NaCl.

(e) Because of the maximum value of ionic potential for Li^+ ion, it has greatest tendency to undergo hydration. Hence is why Li^+ salts are hydrated whereas the salts of other alkali metals are not hydrated.

(f) Larger the ionic potential for a cation, greater is its polarisation and greater is the covalent character of M-O bond and thus cation has greater tendency to form acidic oxide.

Ion	charge	Radius	Ionic potential
Na^+	+1	0.98 A°	1/0.98 = 1.05
Mg^{2+}	+2	0.65 A°	2/0.65 = 3.08

Hence Na_2O is more ionic than MgO. The increase in acidity is due to the increase in covalent character M-O bond and as such there would be difficulty in breaking the bond in aqueous solution.