Chapter 9. S Block Elements

Question-1

Which alkali metals form superoxides? Give reason.

Solution:

Potassium, Rubium and caesium form superoxides. Li and Na do not form superoxide. In KO_2 (potassium superoxide) larger anions are stabilized by bigger cation through lattice energy. Li^+ and Na^+ are small cations. They cannot stabilize too many oxide ions.

Question-2

Why LiOH is a weak base while CsOH is a strong base?

Solution:

Li^+ ion due to its small size, is able to attract valence electrons from OH^- ion to form an ionic bond containing covalency (Fajan's rule)

Being covalent, it is sparingly soluble and less basic.

For CsOH, size of Cs^+ ion is bigger. Hence, ionic bond strength is maximum and more soluble in water. Hence is a strong base.

Question-3

Why is lithium the strongest reducing agent in solution?

Solution:

Li^+ ion being smallest in size has large hydration energy. This energy stabilizes the formation of Li^+ ion in solution

Li ###ERROR###à $Li^+ + e^-$

$Li^+ + (H_2O)x$ ###ERROR###à $Li^+ (H_2O)x$ + Hydration energy. Hence Li is the strongest reducing agent.

Question-4

Why is LiF sparingly soluble in water while other halides of Li are soluble in organic solvents?

Solution:

This can be explained through covalency in ionic compounds. As per Fajan's rule (i) small size of cation (2) larger charge of cation (3) large size of anion causes more polarization in ionic bond of ionic crystals. For LiF, size of Li^+ is small. Hence covalency in the ionic bond is possible. As the size of Cl^-, Br^- and I^- are greater than that of F^-, polarization by Li^+ will be greater, leading to the increase of covalent nature in the bond. Thus LiCl, LiBr and LiI are soluble in organic solvents when compared to LiF.

Question-5

Why does $LiNO_3$ give Li_20, NO_2 and O_2 while $NaNO_3$ gives $NaNO_2$ and O_2?

Solution:

Li^+ polarizes the NO_3^- ion and attract valency electrons of NO_3^- towards it. Thus covalency in ionic bond between Li^+ and NO_3^- arises. Covalency causes less stability. On heating it gives $Li_2O + NO_2 + O_2$. But for $NaNO_3$ polarisation in the ionic bond is not much and hence bond between Na^+ NO_3^- is more ionic and stronger. On heating it gives $NaNO_2$ and O_2.

Question-6

Be and Mg salts do not give colour to the flame. Give reasons.

Solution:

The electrons of nS^2 orbital in Ca, Sr and Ba are excited to higher energy electrons and returns to their original energy level (s orbital). The absorbed energy is emitted back in the form of visible light by the S electrons. Hence salts of Ca, Sr, and Ba gives red, crimson and apple green colours respectively.

Be and Mg are made of atoms of small size. They have high ionisation energy. Hence, two paired electrons cannot be excited to higher energy level by the energy of the flame. Hence Be and Mg do not give colour to the flame.

Question-7

How is the solubility of ionic crystal depends on the lattice energy and hydration energy?

Solution:

Smaller the lattice energy more will be the solubility. Smaller the size of cation and anion, stronger will be the ionic bond, grater will be lattice energy, smaller will be a solubility. (E.g. LiF). KI is more soluble than F^-, Cl^- and Br^- of K. Greater the size of halides, lesser will be the bond strength, lesser will be lattice energy, more will be the solubility.

Smaller the size of cation greater will be a hydration energy, more will the solubility. When hydration energy exceeds the lattice energy, dissolution of the ionic compound takes place. When solvation / hydration energy is not enough to counteract the lattice energy, the substance remains insoluble (e.g. LiF).

Question-8

Stability of carbonates of alkaline earth metal increases on moving down the group. Give reason.

Solution:

Be CO_3 on heating gives BeO and CO_2. BeO is more stable as the size of Be^{2+} and O^{2-} are nearly same. As BeO is more stable than $BeCO_3$, $BeCO_3$ on heating it decomposes readily.

But $BaCO_3$ on heating gives BaO and CO_2. BaO is less stable due to the larger size of Ba^{2+}.

In short, it is the increasing size of the cation that destabilizes the oxides and hence does not favour the decomposition of the heavier alkaline earth metal carbonates.

Question-9

Although Li^+ ion is the smallest among the alkali metal ions, its conductivity in aqueous solution is less than that of Cs^+ ion. Give reasons.

Solution:

Smallest Li^+ ion forms biggest hydrated Li^+ ion. Cs^+ ion forms only smaller V hydrated ions than that of Li^+ ion. Hence, due to greater size of hydrated Li^+ ion, mobility will be small. Hence conductance will be small and less than that of Cs^+ ion in aqueous solution.

Question-10

Why doesn't sodium and potassium ion form complex ions?

Solution:

In order to form complex compounds, a metal should have following characteristics.

(a) Small size (b) High nuclear size (c) Tendency to accept pair of electrons (the presence of empty orbital).

Size of Na & K are not of small size, when compared to Li. Charge on the nucleus is also not very high. They do not have empty orbital.