Short Answer Type Questions – II

Q. 1. What is diagonal relationship? In what ways lithium shows similarities to magnesium in its chemical behavior?

Ans. Some elements of certain groups in the second period resemble with the certain elements of the next higher group in the third period. This is called **diagonal relationship.**

Similarities between lithium and magnesium:

(i) Both Li and Mg form a nitride Li_3N and Mg_3N_2 by direct combination with nitrogen.

(ii) The oxides, Li_2O and MgO do not combine with excess oxygen to form any superoxide.

Q. 2. (i) Explain why lithium salts are commonly hydrated and those of the other alkali metal ions usually anhydrous? [KVS, 2014-15]

(ii) Write any two differences between lithium and other alkali metals.

Ans. (i) Lithium is the smallest in size among all the elements of the alkali metals groups. Hence, lithium ion can polarize water molecules more easily than other alkali metals. As a result, water molecules get attached to lithium salts as water of commonly hydrated. As the ionic size increases, their polarizing power decreases. So, other alkali metal ions are usually anhydrous.

(ii) (a) Lithium is least reactive but the strongest reducing agent among all the alkali metals.

(b) Lithium nitrates decompose to give the corresponding nitrite.

$$4LiNO_3 \rightarrow 2Li_2O + 4NO_2 + O_2$$

$$2NaNO_3 \rightarrow 2NaNO_2 + O_2$$

Q. 3. (i) Why does the solubility of alkaline earth metal hydroxides in water down the group?

(ii) Why does the solubility of alkaline earth metal carbonates and sulphates in water decrease down the group? [DDE, 2017-18]

Ans. (i) Among alkaline earth metal hydroxides, the anion being common the cationic radius will influence the lattice enthalpy.

Since lattice enthalpy decreases much more than the hydration enthalpy with increasing ionic size, the solubility of alkaline earth metal hydroxides in water increases down the group.

(ii) The size of anions being much larger compared to cations the lattice enthalpy will remain almost constant with in a particular group.

Since the hydration enthalpies decrease down the group, so, solubility of alkaline earth metal carbonates and sulphates in water decrease down the group.

Q. 4. What happens when:-

(i) Mg is burnt in air

(ii) Quick lime is heated with silica

(iii) Chlorine is heated with slaked lime **[DDE, 2017-18]**

Ans. (i) Mg burns with dazzling brilliance in air to form magnesium oxide.

$$2Mg + O_2 \xrightarrow{\Delta} 2MgO$$

(ii) Quick lime is heated with silica to form calcium silicate.

$$CaO + SiO_2 \rightarrow CaSiO_3$$

(iii) Chlorine is heated with slaked lime to form calcium hypochlorite, a constituent of bleaching powder.

$$2Ca(OH)_2 + 2Cl_2 \rightarrow CaCl_2 + Ca(OCl)_2 + 2H_2O$$

Bleaching powder

Q. 5. Arrange the following in order of property mentioned against each:

(i) $BaCl_2, MgCl_2, BeCl_2, CaCl_2$ (Increasing ionic character)

(ii) $Mg(OH)_2, Sr(OH)_2, Ba(OH)_2, Ca(OH)_2$ (Increasing solubility in water)

(iii) BeO, MgO, BaO, CaO (increasing basic strength) **[DDE, 2017-18]**

Ans. (i) Increasing order of ionic character is-

$$BeCl_2 < MgCl_2 < CaCl_2 < BaCl_2$$

(ii) Increasing order of solubility in water-

$$Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$$

(iii) Increasing order of basic strength-

$$BeO < MgO < CaO < BaO$$

Q. 6. (i) Why alkaline earth metals, can not be obtained by reduction of their oxides?

(ii) Why the elements of group 2 are known as alkaline earth metals? [DDE, 2017-18]

Ans. (i) The alkaline earth metals can not be obtained by reduction of their formation because the enthalpies of formation of these oxides are quite high and consequently they are very stable to heat.

(ii) The elements of group 2 are known as alkaline earth metals because their oxides and hydroxides are alkaline in nature and these metal oxides are found in the earth's crust.

Q. 7. Give reasons for the following:

(i) Beryllium and magnesium do not give specific colour to flame whereas other alkaline earth metals do so. Why?

(ii) Why are potassium and caesium used in photoelectric cells?

(iii) Why Li_2CO_3 decomposes at lower temperature whereas Na_2CO_3 at higher temperature? [KVS, Agra Region, 2016-17, 2015-16]

Ans. (i) Beryllium and magnesium atoms are smaller in size and their electron are strongly bound to the nucleus. They need large amount of energy levels which is not available in the Bunsen flame. So they do not impart colour to the flame.

(ii) Due to low ionization energies, alkali metals, specially potassium and caseium, eject electrons when exposed to light, therefore, photoelectric cells.

(iii) As we move down the alkali metal group, the electropositive character increases. This causes an increase in the stability of alkali carbonates. However, lithium carbonate is not so stable to heat. This is because lithium carbonate is covalent. Lithium a large carbonate ion, leading to the formation of more stable lithium oxide.

$$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$$

Therefore, lithium carbonate decomposes at a low temperature while a stable sodium carbonate decomposes at a high temperature.

Q. 8. Comment on each of the following:

(i) the mobilities of alkali metal ions in aqueous solution are:

$$Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$$

(ii) Lithium is the only metal to form nitride directly.

(iii) BaO is soluble but $BaSO_4$ is insoluble in water. [MSE, 2008; NCT, 2009]

Ans. (i) Small size ∝ Hydrations energy

$$\propto \frac{1}{\text{ionic mobility}}$$

(ii) Lithium on account of its small size, shows anomalous behavior.

(iii) BaO is soluble but $BaSO_4$ is insoluble on account of higher lattice energy of $BaSO_4$ than its hydration energy.

Q. 9. (i) LiI is covalent in nature. Why?

(ii) Li is kept wrapped in paraffin wax and not stored in kerosene. Why?

(iii) Why $BeCl_2$ in aqueous solution exists as $[\mathbf{BE(H_2O)_4}]^{2+}$

Ans. (i) Because of the small size and higher polarizing power, lithium halides except LiF are predominantly covalent.

(ii) Lithium cannot be stored in kerosene because of its low density. Therefore, lithium is generally kept wrapped in paraffin wax.

(iii) Due to small size and high ionization enthalpy, be forms coordination compound.

$$BeCl_2 + H_2O \rightarrow [Be(H_2O)]^{2+} + 2Cl^-$$