III. Long Answer Type Questions

Question 1. (a) Compare four properties of alkali metals and alkaline earth metals.
(b) What happens when alkali metals are dissolved in ammonia?
(c) $MgCl_2$ is electrolysed.
Answer: (a)

Alkali metals	*Alkaline earth metals*
(*i*) They are soft metals.	(*i*) They are harder than alkali metals.
(*ii*) Alkali metals show +1 oxidation state.	(*ii*) Alkaline earth metals show +2 oxidation state.
(*iii*) Their carbonates are soluble in water except Li_2CO_3.	(*iii*) Their carbonates are insoluble in water.
(*iv*) Except Li, alkali metals do not form complex compounds.	(*iv*) They can form complex compounds.

(*b*) They form blue coloured solution. The solution is paramagnetic in nature.

(*c*) $MgCl_2 \xrightarrow{\text{electrolysis}} Mg^{2+} + 2Cl^-$

At cathode:
$Mg_2^+(aq) + 2e^- \rightarrow Mg(s)$
At anode:
$2Cl^-(aq) - 2e^- \rightarrow Cl_2(g)$

Question 2. State as to why
(a) Alkali metals show only +1 oxidation state.
(b) Na and K impart colour to the flame but Mg does not.
(c) Lithium on being heated in air mainly forms the monoxide and not the peroxide.
(d) Li is the best reducing agent in aqueous solution.
Answer:
(a) Alkali metals have low ionization enthalpies. They have a strong tendency to lose 1 electron to form unipositive ions. Thus they show an oxidation state of +1 and are strongly electropositive.
(b) Valence electrons of alkali metals like Na and K easily absorb energy from the flame and are excited to higher energy levels. When these electrons return to the ground state, the energy is emitted in the form of light.
Magnesium atom has small size so electrons are strongly bound to the nucleus. [Thus they need large amount of energy for excitation of electrons to higher energy levels which is not possible in bunsen flame.
(c) Due to the small size of Li+ it has a strong positive field which attracts the negative charge so strongly that it does not permit the oxide ion, 02- to combine with another oxygen atom to form peroxide ion.
(d) Since, among alkali metals, lithium has the most negative electrode potential (E° = -3.04 V) so, it is the strongest reducing agent in the aqueous solution.

IV. Multiple Choice Questions

Question 1. The reducing property of alkali metals follows the order
(a) Na < K < Rb < Cs < Li
(b) K < Na < Rb < Cs < Li
(c) Li < Cs < Rb < K < Na
(d) Rb < Cs < K < Na < Li
Question 2. Which of the following is the least thermally stable?

(a) $MgCO_3$
(b) $CaCO_3$
(c) $SrCO_3$
(d) $BeCO_3$
Question 3. When heated to 800°C, NaN03 gives
(a) $Na + N_2 + O_2$
(b) $NaNO_2 + O_2$
(c) $Na_2O + O_2 + N_2$
(d) $NaN_3 + O_2$
Question 4. Lithium shows a diagonal relationship with
(a) sodium
(b) silicon
(c) nitrogen
(d) magnesium
Question 5. In the Solvay process
(a) an ammoniacal brine solution is carbonated with CO_2, forming $NaHCO_3$ which on decomposition at 150°C produces Na_2CO_3
(b) a sodium amalgum reacts with water to produce NaOH which gives Na_2CO_3 on reacting with CO_2
(c) A brine solution is made to react with $BaCO_3$ to produce Na_2CO_3
(d) all of the above
Question 6. The oxide of which of the following metals is amphoteric?
(a) Pb (b) Mg (c) Ca (d) Al
Question 7. Alkaline earth metals are
(a) more reactive
(b) less reducing
(c) more oxidizing
(d) less basic than alkali metals
Question 8. Which of the following is not a peroxide?
(a) KO_2
(b) CrO_5
(c) Na_2O_2
(d) BaO_2
Question 9. Hydrides as well as halides of alkaline earth metals tend to polymerize
(a) Sr (b) Ca (c) Be (d) Mg
Question 10. Which of the following is used in photoelectric cells?
(a) Na (b) K (c) Li (d) Cs
Answer:
1. (a)
2. (d)
3. (c)
4. (d)
5. (a)
6. (a) and (d)
7. (b) and (d)
8. (a)
9. (c)
10. (d)

V. Hots Questions

Question 1. Why are alkali metals soft and have low melting points?
Answer: Alkali metals have only one valence electron per metal atom. As a result, the binding energy of alkali metal ions in the close-packed metal lattices are weak. Therefore, these are soft and have low melting point.

Question 2. Which out of the following can be used to store an alkali metal?
H_2O, C_2H_5OH and Benzene
Answer: Benzene can be used to store an alkali metal because

other substances react with alkali metal as:
$Na + H_2O \rightarrow NaOH + 1/2H_2$
$Na + C_2H_5OH \rightarrow C_2H_5ONa + ½ H_2$

Question 3. Potassium carbonate cannot be prepared by Solvay process. Why?
Answer: This is due to the reason that potassium bicarbonate ($KHCO_3$) formed as an intermediate (when CO_2 gas is passed through ammoniated solution of potassium chloride) is highly soluble in water and cannot be separated by filtration.

Question 4. The hydroxides and carbonates of sodium and potassium are easily soluble in water while the corresponding salts of magnesium and calcium are sparingly soluble in water. Explain.
Answer: All the compounds are crystalline solids and their solubility in water is guided by both lattice enthalpy and hydration enthalpy. In case of sodium and potassium compounds, the magnitude of lattice enthalpy is quite small as compared of sodium and potassium that are mentioned, readily dissolve in water. However, in case of corresponding magnesium and calcium compounds, the cations have smaller sizes and more magnitude of positive charge. This means that their lattice enthalpies are more as compared to the compounds of sodium and potassium. Therefore, the hydroxides and carbonates of these metals are only sparingly soluble in water.

Question 5. Why is LiF almost insoluble in water whereas LiCl soluble not only in water but also in acetone?
Answer: The low solubility of LiF in water is due to its very high lattice enthalpy (F^- ion is very small in size). On the other hand, in lithium chloride (LiCl) the lattice enthalpy is comparatively very small. This means that the magnitude of hydration enthalpy is quite large. Therefore lithium chloride dissolves in water. It is also soluble in acetone due to dipolar attraction. (Acetone is polar in nature).

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