The s-Block Elements

10 Chapter

Exercise:

1. What are the common physical and chemical features of alkali metals?

Ans: Physical properties of alkali metals:

- Alkali metals have low ionization enthalpies.
- Alkali metals are highly electropositive in nature
- Alkali metals exhibit +1 oxidation states in their compounds.
- Alkali metals impart characteristic colours to the flame.

Chemical properties of alkali metals:

- Alkali metals are highly reactive in nature.
- Alkali metals hydroxides are highly basic in nature.
- Alkali metals dissolve in liquid ammonia to form blue and conducting solution.

2. Discuss the general characteristics and gradation in properties of alkaline earth metals.

Ans:

- Atomic size goes on increasing down the group.
- Ionization energy goes on decreasing down the group.
- They are harder than alkali metals.
- They are less electropositive than alkali metals.
- Electropositive character increases on going down the group.

3. Why are alkali metals not found in nature?

Ans: Alkali metals are highly reactive in nature. That's why they always exist in a combined state in nature.

4. Find out the oxidation state of sodium in Na_2O_2 .

Ans: let x be the oxidation of sodium in Na_2O_2

$$2x + 2(-1) = 0$$

$$2x - 2 = 0 \Rightarrow x = +1$$

5. Explain why sodium is less reactive than potassium.

Ans: it is because ionization enthalpy ΔH_i of potassium = 419 kJ/mol

Ionization enthalpy of sodium = 496 kJ/mol

Since, ionization enthalpy of potassium is less than that of sodium, potassium is more reactive than sodium

6. **Compare the alkali metals and alkaline earth metals with respect to**
   a. Ionization enthalpy

Ans: Because of high nuclear charge the ionization enthalpy of alkaline earth metals are higher than those of the corresponding alkali metals.

b. Basicity of oxides

Ans: Basicity of oxides of alkali metals are higher than that of alkaline earth metals.

c. Solubility of hydroxides

Ans: Solubility of hydroxides of alkali metals are higher than that of alkaline earth metals. Alkali metals due to lower ionization enthalpy are more electropositive than the corresponding group 2 elements.

7. **In what ways lithium shows similarities to magnesium in its chemical behavior?**

Ans:

- Both react with nitrogen to form nitrides
- Both react with O_2 to form monoxides.
- Both the elements have the tendency to form covalent compounds
- Both can form complex compounds

8. **Explain why alkali and alkaline earth metals can not be obta ined by chemical reduction methods.**

Ans: Alkali and alkaline earth metals are better reducing agents, and reducing agents better than alkali metals are not available. That is why these metals are not obtained by chemical reduction methods.

9. **Why are potassium and caesium, rather than lithium used in photoelectric cells?**

Ans: Potassium and caesium have much lower ionization enthalpy than that of lithium. As a result, these metals easily emit electrons on exposure to light. Due to this, K and Cs are used in photoelectric cells rather than lithium.

10. **When alkali metal dissolves in liquid ammonia, the solution can acquire different colors. Explain the reason for this type of color change.**

Ans: Alkali metals dissolve in liquid ammonia and give deep blue solutions which are conducting in nature because ammoniated electrons absorb energy in the visible region of light and impart blue colour.

$$M + (x+y)NH_3 \rightarrow [M(NH_3)_x]^+ + e^-(NH_3)_y$$
Ammoniated electrons

11. Beryllium and magnesium do not give colour to flame whereas other alkaline earth metals do so. Why?

Ans: Due to the small size, the ionization enthalpies of Be and Mg are much higher than those of other alkaline earth metals. Therefore, a large amount of energy is needed to excite their valence electrons, and that's why they do not impart colour to the flame.

12. Discuss the various reactions that occur in the Solvay process.

Ans:

$$CaCO_3(s) \xrightarrow{\text{Heat}} CaO + CO_2$$

$$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$$

$$NaCl + NH_4OH + CO_2 \rightarrow NaHCO_3 + NH_4Cl$$

$$2NaHCO_3(s) \xrightarrow{\text{heat}} Na_2CO_3 + CO_2 + H_2O$$

$$Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3.10H_2O$$

13. Potassium Carbonate cannot be prepared by solvay process. Why?

Ans: Potassium carbonate being more soluble than sodium bicarbonate does not get precipitated when CO_2 is passed through a concentrated solution of KCl saturated with ammonia.

14. Why is Li_2CO_3 decomposed at a lower temperature whereas Na_2Co_3 at high temperature?

Ans: Li_2CO_3 is a covalent compound whereas Na_2Co_3 is an ionic compound. Therefore, Lattice energy of Na_2Co_3 is higher than that of Li_2CO_3. Thus, Li_2CO_3 is decomposed at a lower temperature.

15. Compare the solubility and thermal stability of the following compounds of the alkali metals with those of the alkaline earth metals.a. Nitrates

Ans: Nitrates of both group 1 and group 2 elements are soluble in water because Hydration energy is more than the lattice energy.
Nitrates of both group 1 and group 2 elements are thermally unstable but they decompose differently except $LiCO_3$ e.g.

$$2NaNO_3 \xrightarrow{\text{heat}} 2NaNO_2 + O_2$$

$$2KNO_3 \xrightarrow{\Delta} 2KNO_2 + O_2$$

$$4LiNO_3 \xrightarrow{\Delta} 2LiO_2 + 4NO_2 + O_2$$
$$2Mg(NO_3)_2 \xrightarrow{\Delta} 2MgO + 4NO_2 + O_2$$

b. Carbonates

Ans: carbonates of group 1 elements are soluble in water except Li_2CO_3.

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

Group 2 carbonates are insoluble in water because their Lattice energy are higher than hydration energy.Thermal stability of carbonates of group 2 increases down the group because Lattice energy goes on increasing due to increase in ionic character.

c. Sulphates

Ans: Sulphates of group 1 are soluble in water except Li2SO4. They are thermally stable. Solubility of sulphates of group 2 decreases down the group because Lattice energy dominates over hydration energy. Sulphates of group 2 elements are thermally stable and increasing down the group due to increases in Lattice energy

16. Starting with sodium chloride how could you proceed to prepare

a. Sodium metal

Ans: sodium metal is manufactured by electrolysis of a fused mass of NaCl 40% and $CaCl_2$ 60% in Down's cell at 873K, using iron as cathode and graphite as anode. Na is liberated at the cathode.

At cathode: $Na^+ + e^- \rightarrow Na(l)$

At anode: $2Cl^-(melt) \rightarrow Cl_2(g) + 2e^-$

b. Sodium hydroxide

Ans: sodium hydroxide is manufactured by electrolysis of an aqueous solution of NaCl (brine) in Castner- Kellner cell

At cathode:

$$Na^+ + e^- \rightarrow Na$$
$$2Na + Hg \rightarrow Na - Hg + 2H_2O$$
$$2Na - Hg + 2H_2O \rightarrow 2NaOH + H_2 + Hg$$

At anode:

$$Cl^- - e^- \rightarrow Cl$$
$$Cl + Cl \rightarrow Cl_2$$

c. Sodium peroxide

Ans: $4Na + 2O_2 \rightarrow 2Na_2O + O_2$

d. Sodium carbonate

Ans: sodium carbonate is obtained by Solvay ammonia process

$$NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 \downarrow + NH_4Cl$$

$$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + CO_2 + H_2O$$

17. What happens when (i) magnesium is burnt in air, (ii) Quick lime is heated with silica (iii) chlorine reacts with slaked lime (iv) calcium nitrate is heated?

Ans:

a. $2Mg(s) + O_2(g) \xrightarrow{\Delta} 2MgO(s)$

b. $CaO(s) + SiO_2(s) \xrightarrow{\Delta} CaSiO_3(s)$

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

d. $2Ca(NO_3)_2(s) \xrightarrow{\Delta} 2CaO(s) + 4NO_2(g) + O_2(g)$

18. Describe the two important uses of the following.

a. Caustic soda

Ans:

i. It is used in the manufacturing of soap paper , artificial silk etc.

ii. It is used in the textile industries

b. Sodium carbonate

Ans:

i. Used in the softening of water, for laundry and cleaning purpos es.

ii. It is used in glass manufacturing

c. Quick lime

Ans:

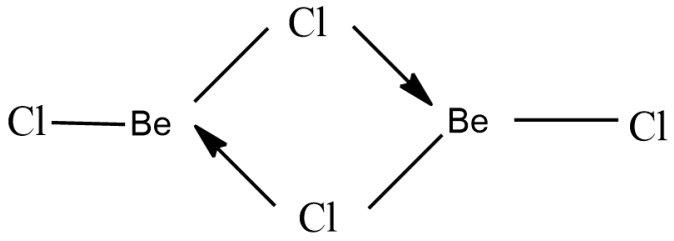
i. It is used in the preparation of bleaching powder

ii. Used in the purification of sugar and in the manufacturing of cement.

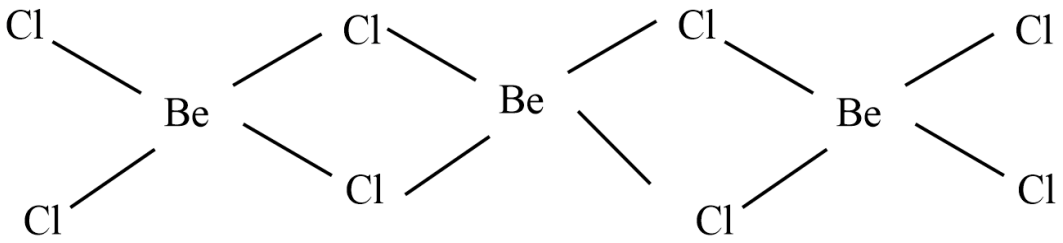
19. Draw the structure of the following:

a. $BeCl_2$(vapour)

Ans: in the vapor site , it exists as a chloro bridged dimer



b. $BeCl_2$(solid)



20. 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

Ans: Since group 1 hydroxides and carbonates due to large size contain higher hydration energy than the lattice energy so, they are easily soluble in water. Whereas, in magnesium and calcium due to small size, their lattice energy dominates over hydration energy. Hence they are sparingly soluble in water.

21. Describe the importance of the following.

a. Limestone

Ans:

- Extensively used in manufacturing of high quality paper
- Used in mild abrasive in toothpaste
- As a filler in cosmetics
- Used as an antacid

b. Cement

Ans:

- An important building material
- Used in concrete and reinforced cement

c. Plaster of Paris

Ans:

- Used in plasters
- In dentistry, in ornamental work for making status

22. Why are lithium salts commonly hydrated and those of the other alkali metal ions usually anhydrous?

Ans: Due to smallest size, Li^+ can polarize water molecules easily than the other alkali metal ions

23. Why is LiF almost insoluble in water whereas LiCl soluble not only in water but also in acetone?

Ans: It is due to high lattice energy of LiF as compared to LiCl.
LiCl is soluble in water because its hydration energy is higher than its lattice energy

24. Explain the significance of sodium, potassium, magnesium and calcium in biological fluids.

Ans:

Sodium ions:

- Na^+ ions participate in the transmission of nerve signals, in regulating the flow of water across cell membranes.
- In the transport of sugars and amino acids into cell

Potassium ions:

- They active many enzymes
- Participate in the oxidation of glucose to produce ATP.

Magnesium ions:

- All enzymes that utilize ATP in phosphate transfer require magnesium as a cofactor.
- Mg is the main pigment for the absorption of light in plants.

Calcium ions:

- Ca^{+2} ions are present in bones
- Plays important roles in neuromuscular function

25. What happens when

Sodium metal is dropped in water?

Ans: $2Na + 2H_2O \rightarrow 2NaOH + H_2$

Sodium metal is heated in a free supply of air?

Ans: $2Na + O_2 \rightarrow Na_2O_2$

Sodium peroxide dissolves in water?

Ans: $Na_2O_2 + 2H_2O \rightarrow 2NaOH + H_2O_2$

26. Comment on each of the following observation:

a. The mobility of the alkali metal ions in aqueous solutions are $Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$

Ans: Smaller the size of the ion, more highly it is hydrated and hence greater is the mass of the hydrated ion and thus the ionic mobility becomes lesser. The extent of hydration decreases in the order.

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

Thus, the mobility of Cs^+ will be the highest

b. Lithium is the only alkali metal to form a nitride directly.

Ans: due to its smaller size lithium can form nitride directly

xxx

c. E^{Θ} for $M^{+2}(aq) + 2e^{-} \rightarrow M(s)$ (where M= Ca, Sr, or Ba)

Ans: it is because reduction potential depends upon sublimation energy, ionization energy and hydration energy. Their resultant is almost constant for these ions.

27. State as to why

A solution of Na_2CO_3 is alkaline?

Ans: Na_2CO_3 is a salt of a weak acid, carbonic acid (H_2CO_3) and a strong base NaOH. Thus it undergoes hydrolysis to produce a strong base NaOH and its aqueous solution is alkaline in nature.

$$Na_2CO_3(s) + H_2O(l) \rightarrow 2NaOH$$

Alkali metals are prepared by electrolysis of their fused chlorides?

Ans: Because the discharge potential of alkali metals is much higher than that of hydrogen, therefore when the aqueous solution of any alkali metal chlorides is subjected to electrolysis, H_2 , instead of the alkali metal, is produced at the cathode. Therefore alkali metals are prepared by electrolysis of their fused chlorides.

Sodium is found to be more useful than potassium?

Ans: since potassium is more reactive than sodium and it is found in nature to a less extent than Na, sodium is found to be more useful.

28. Write balanced equations for reactions between.

Na_2O_2 and water

Ans: $Na_2O_2 + 2H_2O \rightarrow 2NaOH + H_2O_2$

KO_2 and water

Ans: $2KO_2 + 2H_2O \rightarrow 2KOH + O_2 + H_2O_2$

Na_2O and CO_2

Ans: $Na_2O + CO_2 \rightarrow Na_2CO_3$

29. How would you explain the following observations?

BeO is almost insoluble $BeSO_4$ is soluble in water.

Ans: Lattice energy of BeO is comparatively higher than the hydration energy. Therefore, it is almost insoluble in water. Whereas $BeSO_4$ is ionic in nature and its hydration energy dominates the lattice energy.

BaO is soluble but $BaSO_4$ is insoluble in water.

Ans: Both BaO and $BaSO_4$ are ionic compounds but the hydration energy of BaO is higher than the lattice energy therefore it is soluble in water.

LiI is more soluble than KI in ethanol.

Ans: Since the size of Li^+ ion is very small in comparison to K^+ ion, it polarizes the electron cloud I- ion to great extent. Thus LiI dissolves in ethanol more easily than the KI.

30. Which of the following alkali metals has the least melting point?

a. Na
b. K
c. Rb
d. Cs

Ans: size of Cs is the biggest thus, its melting point is the lowest. Option (d) is correct

31. Which one of the following alkali metals gives hydrated salts?

a. Li
b. Na
c. K
d. Cs

Ans: Li is the smallest. Thus it has the highest charge density and hence attracts the water molecules more strongly.

32. Which one of the following alkaline earth metal carbonates is thermally most stable?

a. $MgCO_3$
b. $CaCO_3$
c. $SrCO_3$
d. $BaCO_3$

Ans: $BaCO_3$

I. Very Short Answer Type Questions

1. Name the alkali metal which shows diagonal relationship with magnesium?

Ans: Lithium (Li)

2. Why alkali and alkaline earth metals cannot be obtained by chemical reduction method?

Ans: Because alkali and alkaline earth metals are themselves stronger reducing agents than the majority of other reducing agents.

3. Name the compounds used for the manufacture of washing soda by Solvay process.

Ans: $NaCl, CaCO_3 \& NH_3$

4. Which electrolyte is used to obtain sodium in Castner's process?

Ans: Fused NaOH

5. What happens when crystals of washing soda are exposed to air?

Ans: Monohydrate ($Na_2CO_3 - H_2O$) is formed as a result of efflorescence.

6. Name the alkaline earth metals whose salt do not impart colour to a non-luminous flame.

Ans: beryllium does not impart colour to a non-luminous flame.

7. What is dead burnt plaster?

Ans: it is anhydrous calcium sulphate ($CaSO_4$)

8. What is Quicklime? What happens when it is added to water?

Ans: CaO is quicklime. When it is added to water, $Ca(OH)_2$ is formed.

9. Arrange the following in the increasing order of solubility in water?
$MgCl_2, CaCl_2, SrCl_2, BaCl_2$

Ans: $BaCl_2 < SrCl_2 < CaCl_2 < MgCl_2$

10. Give the chemical formula of Epsom salt.

Ans: $MgSO_4.7H_2O$

11. How would you prepare sodium silicate from silica?

Ans: $Na_2CO_3 + SiO_2 \xrightarrow{\text{Fuse}} \underset{\text{Sod. Silicate}}{Na_2SiO_3} + CO_2$

12. What happens when sodium metal is heated in a free supply of air?

Ans: sodium peroxide is formed $2Na + O_2 \rightarrow Na_2O_2$

13. What is the general name for elements of group 1?

Ans: alkali metals

14. Why are alkali metals soft?

Ans: since the atoms of alkali metals have bigger kernels and smaller number of valence electrons, the metallic bonds in them are very weak and hence are soft.

15. What do you mean by diagonal relationship in periodic table?

Ans: The resemblance of the first element of the second period with diagonally situated elements of neighboring elements is called diagonal relationship.

16. Why is $BeCl_2$ soluble in organic solvent?

Ans: since, $BeCl_2$ is a covalent compound that is soluble in organic solvent.

17. Why do alkali metals give characteristic flame coloration?

Ans: Alkali metals due to low ionization energy absorb energy from the visible region to radiate complementary color.

18. Why is the solution of alkali metals in liquid ammonia conducting in nature?

Ans: Due to ammoniated electrons and cations.

19. Which is more basic NaOH or $Mg(OH)_2$?

Ans: NaOH is more basic

20. Which alkaline earth metals do not impart color to the flame?

Ans: Be and Mg

21. What is soda ash?

Ans: soda ash is anhydrous sodium carbonate (Na_2CO_3)

II.Short Answer Type Questions

1. Why are alkali metals always univalent? Which alkali metal ion forms the largest hydrated ion in aqueous solution?

Ans: they are always univalent because after losing one electron, they acquire the nearest inert gas configuration. Li^+ forms largest hydrated cations because it has the highest hydration energy.

2. What is the effect of heat on the following compounds (give equations for the reactions)

a. $CaCO_3$

Ans: $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

b. $CaSO_4.2H_2O$

Ans: $CaSO_4.2H_2O \xrightarrow{\Delta} \underset{\text{Dead burnt plaster}}{CaSO_4} + 2H_2O$

3. Explain the following:

i. Lithium iodide is more covalent than lithium fluoride

Ans: According to Fazan's rule, Li^+ ion can polarize I^- ion more than the F^- ion due to the bigger size of the anion. Thus LiI has more covalent character than LiF.

ii. Lattice enthalpy of LiF is maximum among all the alkali metal halides.

Ans: Smaller the size (internuclear distance), more is the value of Lattice enthalpy since internuclear distance is expected to be least in the LiF.

4. Write the chemical formula of the following compound s.

i. Chile saltpetre

Ans: $NaNO_3$

ii. Marble

Ans: $CaCO_3$

iii. Brine

Ans: NaCl

5. Explain the following:

a. Why is Cs considered as the most electropositive element?

Ans: Due to its lowest ionization energy, Cs is considered as the most electropositive element.

b. Lithium cannot be used in making photoelectric cells

Ans: lithium cannot be used in making photoelectric cells because out of all alkali metals it has highest ionization energy and thus cannot emit electrons when exposed to light.

c. Lithium does not form alums

Ans: due to small size, lithium does not form alums.

6. a. What makes lithium show properties uncommon to the rest of the alkali metals?

Ans: The unusual properties of lithium as compared to other al kali metals are due to its exceptionally small size of atom and its ion and its high polarizing power.

b. When is cation highly polarizing? Which alkali metal cation has the highest polarizing power?

Ans: A cation is highly polarizing if its charge/size ratio is very high. Li^+ ion has the highest polarizing power.

7. Why are only ionic hydrides of only alkali metals and alkaline earth metals known? Give two examples.

Ans: Alkali metals and alkaline earth metals are most electropositive due to low ionization enthalpy therefore they form ionic hydrides, e.g. NaH, KH and CaH_2 .

8. Why does the solution of alkali metals become blue in liquid ammonia? Give the chemical equation also

Ans: The blue colour of the solution is due to an ammoniated electron which absorbs energy in the visible region of light and imparts blue colour.

$$Na(am) + e^-(am) + NH_3(l) \rightarrow NaNH_2(am) + (-\frac{1}{2})H_2(g)$$

9. Give the important uses of the following:

i. $NaHCO_3$

Ans:

- It is used in fire extinguisher
- It is mild antiseptic for skin infections
- It is used as an antacid.

ii. NaOH

Ans:

- It is used in soap industry
- It is used in textile industry
- It is used as reagent in laboratory
- It is used in absorbing poisonous gases

10. What is the mixture of CaC_2 and N_2 called? How is it prepared?

Ans: it is called Nitro lime.

It is prepared by heating CaC_2 with N_2 at high temperature.

$$CaC_2 + N_2 \rightarrow CaCN_2 + C$$

III. Long Answer Type Questions

1. Compare

a) Compare four properties of alkali and alkaline earth metals

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) What happens when alkali metals are dissolved in ammonia?

Ans: they form a blue colored solution. The solution is paramagnetic in nature.

c) $MgCl_2$ is electrolyzed.

Ans: $MgCl_2 \xrightarrow{\text{electrolysis}} Mg^{+2} + 2Cl^-$

At cathode:

$Mg^{2+}(aq) + 2e^- \xrightarrow{\text{electrolysis}} Mg(s)$

At anode:

$2Cl^-(aq) - 2e^- \rightarrow Cl^2(g)$

2. State as to why

a) Alkali metals show only +1 oxidation state.

Ans: 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) Na and K impart colour to the flame but Mg does not.

Ans: 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 atoms have 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) Lithium on being heated in air mainly forms the monoxide and not the peroxide.

Ans: 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) Li is the best reducing agent in aqueous solution

Ans: Since, among alkali metals, lithium has the most negative electrode potential ($E^0 = -3.04V$) so, it is the strongest reducing agent in the aqueous solution.

IV. Multiple Choice Questions

1. **The reducing property of alkali metals follows that order**
   a) **$Na < K < Rb < Cs < Li$**
   b) **$K < Na < Rb < Cs < Li$**
   c) **$Li < Cs < Rb < K < Na$**
   d) **$Rb < Cs < K < Na < Li$**

Ans: a) $Na < K < Rb < Cs < Li$

2. **Which of the following is least thermally stable?**
   a) **$MgCO_3$**
   b) **$CaCO_3$**
   c) **$SrCO_3$**
   d) **$BeCO_3$**

Ans: d) $BeCO_3$

3. **When heated to 800^oC , $NaNO_3$ gives**
   a) **$Na + N_2 + O_2$**
   b) **$NaNO_2 + O_2$**
   c) **$Na_2O + O_2 + N_2$**
   d) **$NaN_3 + O_2$**

Ans: c) $Na_2O + O_2 + N_2$

4. **Lithium shows a diagonal relationship with**
   a) **Sodium**
   b) **Silicon**
   c) **Nitrogen**
   d) **Magnesium**

Ans: d) magnesium

5. **In the Solvay process**
   a) **An ammonical brine solution is bicarbonate with CO_2, forming $NaHCO_3$ which on decomposition at 150^0C produces Na_2CO_3**
   b) **A sodium amalgam reacts with water to produce NaOH which gives Na_2CO_3 on reacting with CO_2**
   c) **A brine solution is made react with $BaCO_3$ to produce Na_2CO_3**

d) All of the above

Ans: An ammonical brine solution is bicarbonate with CO_2, forming $NaHCO_3$ which on decomposition at 150^0C produces Na_2CO_3

6. Which oxide of the following is amphoteric?

a) Pb
b) Mg
c) Ca
d) Al

Ans: a) Pb and d) Al

7. Alkaline earth metals are

a) More reactive
b) Less reducing
c) More oxidizing
d) Less basic than alkali metals

Ans: b) less reducing and d) less basic than alkali metals

8. Which of the following is not peroxides?

a) KO_2
b) CrO_5
c) Na_2O_2
d) BaO_2

Ans: a) KO_2

9. Hydrides as well as halides of alkaline earth metals tend to polymerize

a) Sr
b) Ca
c) Be
d) Mg

Ans: c) Be

10. Which of the following is used in photovoltaic cells?

a) Na
b) K
c) Li
d) Cs

Ans: d) Cs

V. Hots Questions:

1. **Why are alkali metals soft and have low melting points?**

Ans: 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.

2. **Which out of the following can be used to store an alkali metal?**
H_2O, C_2H_5OH & C_6H_6

Ans: benzene can be used to store an alkali metal because other substances react with alkali metal as:

$$Na + H_2O \rightarrow NaOH + \frac{1}{2}H_2$$

$$Na + C_2H_5OH \rightarrow C_2H_5ONa + \frac{1}{2}H_2$$

3. **Potassium carbonate cannot be prepared by Solvay process. Why?**

Ans: This is due to the reason that potassium bicar bonate ($KHCO_3$) formed as an intermediate (when CO_2 gas is passed through an ammoniated solution of potassium chloride) is highly soluble in water and cannot be separated by filtration.

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.**

Ans: 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 to 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.

5. **Why is LiF almost insoluble in water whereas LiCl soluble not only in water but also in acetone?**

Ans: 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).