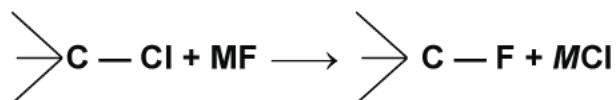


- Q1. When sodium carbonate is added to a solution of aluminium salt, aluminium hydroxide is precipitated. Why?
- Q2. NaCl in water forms a neutral solution whereas Na₂CO₃ in water gives alkaline solution? Why?

- Q3. Why does the following



Proceed better with KF than with NaF?

- Q4. Mention the general trends in Group I with increasing atomic number with respect to:
(a) density (b) melting (c) atomic size (d) ionization enthalpy
- Q5. Name the chief factor responsible for the anomalous behaviour of lithium.
- Q6. List three properties of lithium in which it differs from the rest of the alkali metals.
- Q7. Name the metal which floats on water without any apparent reaction with it.
- Q8. Name the alkali metals which form superoxides when heated in excess of air.
- Q9. The alkali metals follow the noble gases in their atomic structure. What properties of these metals can be predicted from this information?
- Q10. Write three general characteristics of the elements of alkali metals.
- Q11. Why do sodium and potassium not form complex ions?
- Q12. The addition of NaOH solution to a solution of ZnCl₂ produces a white precipitate which dissolves on further addition of NaOH. Why?
- Q13. NaCl is not hygroscopic but table salt on exposure to air damps up. Why?
- Q14. On exposure to air, sodium hydroxide becomes liquid and after some time it changes to white powder. Explain why?
- Q15. Calcium chloride or KCl is added to NaCl in the manufacture of sodium by electrolysis. Why?
- Q16. Aqueous solution of iodine becomes colourless on adding excess of sodium hydroxide solution. Why?
- Q17. Standard solution of NaOH cannot be prepared by direct weighing. Why?
- Q18. Alkali metals are paramagnetic but their salts are diamagnetic. Why?
- Q19. Why are alkali metals kept in paraffin or kerosene?
- Q20. Unlike Na₂CO₃, K₂CO₃ cannot be prepared by Solvay ammonia soda process. Why?

- Q21. Why does sodium form Na^+ ion and not Na^{2+} ion?
- Q22. Alkali metals are obtained by the electrolyte of their molten salts and not by the electrolysis of their aqueous salt solutions.
- Q23. Sodium is less reactive than potassium. Why?
- Q24. Why are alkali metals not found in nature?
- Q25. Why the bottle containing NaOH solution should not be closed by glass lid?
- Q26. Sodium metal can be used for drying diethyl ether but not for ethanol. Why?
- Q27. The softness of group I metals increases down the group with increasing atomic number. Why?
- Q28. Though placed in different groups of periodic table, lithium and magnesium resemble each other. Why?
- Q29. Lithium halides are covalent in nature. Why?
- Q30. Alkali metals are soft metals, explain.
- Q31. Cesium is most reactive among the alkali metals, explain.
- Q32. Why are K and Cs rather than Na and Li used in photoelectric cells?
- Q33. Why are alkali metals used in photoelectric cells?
- Q34. Why do alkali metals lose metallic lustre on exposure to air?
- Q35. Sodium fire in the laboratory should not be extinguished by water. Why?
- Q36. LiF is least reducing agent and thus converts nitrogen into nitrides.
- Q37. Lithium is the only alkali metal to form nitride directly. Explain.
- Q38. Explain the action of backing powder.
- Q39. Which out of Na and K has high m.pt and density?
- Q40. Why is colour of the flame imparted by sodium salt different from that potassium salts?
- Q41. Chemical reactivity of alkali metal increases from Li to Cs.
- Q42. Super oxides of alkali metals are coloured and paramagnetic in nature. Why?
- Q43. $\text{Al}(\text{OH})_3$ is insoluble in excess of NH_4OH but soluble in NaOH. Explain.
- Q44. NaCl and CsCl have same solid geometry or not.
- Q45. Astronauts use LiOH in their space journey, why?
- Q46. Although Li^+ ion is smaller in size than Cs^+ but the conducting power of Cs^+ is more. Explain.
- Q47. Lithium forms normal oxide, sodium forms peroxide and rest all alkali metals form superoxides. Explain.

- Q48. Among LiF and LiI which has more covalent nature and why?
- Q49. Lithium fluoride has lowest solubility in water among all the halides of alkali metals. Explain.
- Q50. Iodine is less soluble in water but fairly soluble in KI(aq).
- Q51. M.pt and b.pt of alkali metals decreases from Li to Cs. Explain.
- Q52. Give radioactive formation and decay of francium.
- Q53. Which hydride of alkali metal is used to fill meteorological balloons.
- Q54. How will you prepare lithium hydride. Give equations to show the formation. LiH contains two isoelectronic ions Li^+ and H^- , which ion is bigger and why?
- Q55. Why is potassium strongly electropositive element?
- Q56. When $\text{Cl}_2(g)$ is bubbled through aqueous potassium hydroxide; a firework explosive is formed along with KCl and H_2O . Write down balanced equation for it.
- Q57. NaCl is added during electrolyse of fused MgCl_2 , why?
- Q58. What are wrap around complex compounds of alkali metals?
- Q59. What happens when KNO_3 is fused with 'K' metal.
- Q60. LiF, LiCl, LiBr and LiI in increasing covalent character and explain the reason.
- Q61. Lithium salts have a greater degree of covalent character than other halides of the group. Explain.
- Q62. PbO_2 is soluble in NaOH and HCl both comments on it.
- Q63. Why Na and Mg are called bridge elements?
- Q64. What is the composition and action of baking powder?
- Q65. Salts of lithium having small anions are more stable than the salts having larger anions. Explain.
- Q66. Baking powder usually contains NaHCO_3 , $\text{Ca}(\text{H}_2\text{PO}_4)_2$, starch and $\text{NaAl}(\text{SO}_4)$. Point out the function of each component.
- Q67. Which indicator phenolphthalein or methyl orange can be used to detect end point in the titration of K_2CO_3 with strong acid.
- Q68. Sodium does not form sodium carbide (Na_2C_2) with carbon, however Na_2C_2 is known. How it can be obtained?
- Q69. In preparation of LiH by action of H_2 on heated Li, heating is discontinued after reaction has begin, why?
- Q70. LiH is stable to approximately 900° while NaH decomposes at 350°C why?
- Q71. LiClO_4 is much more soluble in H_2O than NaClO_4 , why?
- Q72. Reaction $\text{Li}^+ + \text{}_{-1}\text{e}^0 \longrightarrow \text{Li}$ does not occur, why?

- Q73. Alkali metal compounds are colourless, why?
- Q74. Arrange the following in order of increasing lattice energy.
(a) NaF, NaCl, NaBr, NaI (b) LiF, LiCl, LiBr, LiI
- Q75. Find the oxidation state of sodium in Na_2O_2 .
- Q76. Like lithium in group I, beryllium shows anomalous behaviour in group II. Write three such properties of beryllium which make it anomalous in the group.
- Q77. The hydroxides of aluminium and iron are insoluble in water. However, NaOH is used to separate one from the other. Why?
- Q78. Arrange MgO, SrO, K_2O , NiO, Cs_2O in their increasing order of basic nature.
- Q79. Between Na^+ and Ag^+ , which is a stronger Lewis acid and why?
- Q80. In water LiF is least soluble fluoride among fluorides of alkali metals, but its solubility increases as HF is added in aqueous solution, why?
- Q81. Explain why sodium is less reactive than potassium?
- Q82. Why are potassium and caesium, rather than lithium used in photoelectric cells?
- Q83. Why Li_2CO_3 decomposes at lower temperature whereas Na_2CO_3 at higher temperature?
- Q84. Lithium has the highest ionization enthalpy among alkali metals, yet it is the strongest reducing agent. Explain why?
- Q85. Which one of the following alkali metals gives hydrated salts?
(a) Li (b) Na (c) K (d) Cs
- Q86. Which of the alkali metal is having least melting point?
(a) Na (b) K (c) Rb (d) Cs
- Q87. 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.
- Q88. Why are lithium salts commonly hydrated and those of the other alkali metal ions usually anhydrous?
- Q89. Potassium carbonate cannot be prepared by Solvay process. Why?
- Q90. Alkali metals impart blue colour to ammonia solution. The solution also possesses strong reducing nature. Explain.
- Q91. Li_2SO_4 does not form alum. Explain.
- Q92. Alkali metal salts imparts colour to flame.
- Q93. Starting with sodium chloride how would you proceed to prepare (state the steps only).
(a) sodium metal (b) sodium hydroxide
(c) sodium peroxide (d) sodium carbonate.

Q94. Arrange the following in terms of increasing order of:

- (a) Li_2CO_3 , MgCO_3 , K_2CO_3 (thermal stability)
(b) Li_2O , Li_2CO_3 (stability)
(c) Na_2O , Na_2CO_3 (stability)

Q95. Arrange the following in increasing solubility of water:

- (a) LiOH , NaOH , KOH (b) Li_2CO_3 , Na_2CO_3 , K_2CO_3
(c) LiHCO_3 , NaHCO_3 , KHCO_3 (d) LiCl , NaCl , KCl

Q96. Arrange the following

- (a) LiCl , LiBr , LiI , LiF (Increasing ionic nature)
(b) LiCl , NaCl , KCl , RbCl and CsCl (Increasing ionic nature)
(c) LiF , NaF , KF , RbF and CsF (Increasing lattice energy)
(d) NaHCO_3 , KHCO_3 , $\text{Mg}(\text{HCO}_3)_2$, $\text{Ca}(\text{HCO}_3)_2$ (Increasing solubility in water)

Q97. What happens when:

- (a) Potassium carbonate is heated with milk of lime.
(b) Lithium nitrate is heated.

Give chemical equations for the reactions involved.

Q98. Explain why:

- (a) Potassium is more reactive than sodium
(b) Alkali metals do not form divalent ions.

Q99. Explain why:

- (a) Alkali metals are good reducing agents.
(b) Alkali metals are soft and can be cut with the help of a knife.

Q100 Why is LiF almost insoluble in water whereas LiCl soluble not only in water but also in acetone?

Q101 A white solid is either Na_2O or Na_2O_2 . A piece of red litmus paper turns white when it is dipped into a freshly made aqueous solution of the white solid.

- (a) Identify the substance and explain with balanced equation.
(b) Explain what would happen to the red litmus if the white solid were the other compound.

Q102 Explain why:

- (a) Lithium on being heated in air mainly forms the monoxide and not peroxide.
(b) K , Rb and Cs , on being heated in the presence of excess supply of air form superoxides in preference to oxides and peroxides.

Q103 Write balanced equations for reactions between:

- (a) Na_2O_2 and water (b) KO_2 and water (d) Na_2O and CO_2

Q104 Explain what happens when:

- (a) sodium hydrogen carbonate is heated. (b) sodium amalgam reacts with water.
(c) fused sodium metal reacts with ammonia.

Q105 On the basis of following reactions, identify (A), (B), (C) and (D) and write down their chemical formulae:

- (a) $(A)_{aq.} + \text{Zn} \xrightarrow{\text{Heat}} (B) \text{ gas}$ (b) $(A)_{aq.} + (C) \xrightarrow{\text{Heat}} \text{PH}_3$
(c) $(A)_{aq.} + \text{NH}_4\text{Cl} \xrightarrow{\text{Heat}} (D) \text{ gas}$

Q106What happens when

- (a) sodium metal is dropped in water?
- (b) sodium metal is heated in free supply of air?
- (c) sodium peroxide dissolves in water?

Q107Discuss the various reactions that occur in the Solvay ammonia process.

Q108An inorganic compound (A) loses water of crystallization on heating. It's aqueous solution:

- (a) Gives white turbidity with HCl.
- (b) Decolourizes I_2 in KI solution.
- (c) Gives white precipitate with $AgNO_3$ which turns black on standing..

Q109Give reasons for the following:

- (a) In aqueous solution, Li^+ ion has lowest ionic mobility among all the alkali metals
- (b) LiCl has lower melting point than NaCl.
- (c) NaCl has higher melting point than KCl.

Q110Comment on each of the following observations:

- (a) The mobilities of the alkali metal ions in aqueous solution are:
 $Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$
- (b) Lithium is the only alkali metal to form a nitride directly.
- (c) LiF is least soluble among the fluorides of alkali metals.

Q111Starting with sodium chloride how would you prepare (a) sodium metal (b) sodium hydroxide (c) sodium peroxide and (d) sodium carbonate.

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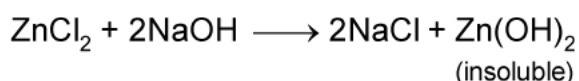
- S1.** $\text{Al}_2(\text{CO}_3)_3$ and $\text{Al}(\text{OH})_3$ are formed which are insoluble in water.
- S2.** NaCl is a salt of strong acid and strong base and thus, does not hydrolyse, whereas Na_2CO_3 , a salt of strong base and weak acid (H_2CO_3), gets hydrolysed.

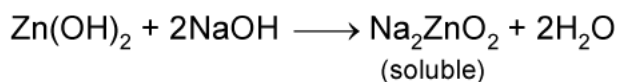


- S3.** KF is more ionic than NaF .
- S4.** (a) Decreases (b) Decreases (c) Increases (d) Decreases
- S5.** The charge/radius ratio is greatest for lithium.
- S6.** (a) It forms deliquescent salts.
(b) It is much harder than other alkali metals.
(c) It is less reactive but strongest reducing agent among all alkali metals.
- S7.** Lithium.
- S8.** K , Rb and Cs form superoxides as KO_2 , RbO_2 and CsO_2 respectively.
- S9.** Alkali metals lose one electron to attain the nearest noble gas configuration and thus show monovalent nature.
- S10.** (a) The ns^1 configuration
(b) High E°_{OP} values and thus strong reducing agent.
(c) Soluble in liquid NH_3 and give highly conducting blue coloured solution.
- S11.** In order to form complex ion, a metal should have,
(a) small size.
(b) high nuclear charge.
(c) tendency to accept electrons.

The atomic size increases and nuclear charge decreases from Li to Cs and thus tendency to form complex ion does not exist in Na or K . Only Li forms complex ion.

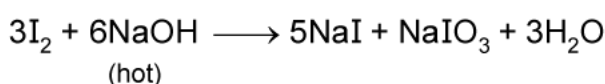
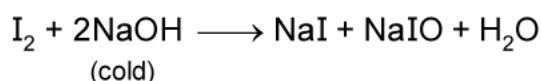
- S12.** ZnCl_2 reacts with NaOH to give a white precipitate of $\text{Zn}(\text{OH})_2$ which later dissolves in excess of NaOH and forms soluble sodium zincate.





- S13.** Pure NaCl is not hygroscopic. Commercial sample, however, absorbs water and damp due to the hygroscopic nature of impurities of MgCl₂, CaCl₂ etc., present in table salt.
- S14.** From air, sodium hydroxide continuously absorbs CO₂ and gets converted into Na₂CO₃. Crystals of Na₂CO₃ effloresce on standing in air and crumble to white powder.
- S15.** Pure NaCl melts at 1070 K but if KCl or CaCl₂ is added to it, the melting point is lowered to 870 K. Thus KCl or CaCl₂ are used to lower the m.pt. of NaCl in order to get better yield at low cost.

- S16.** Iodine present in solution reacts with NaOH and thus loses its colour.



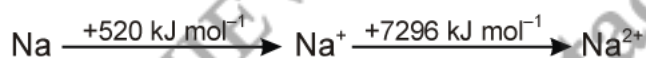
- S17.** NaOH on exposure during weighing or handling absorbs H₂O and CO₂ from atmosphere and gets partially converted to Na₂CO₃. Thus accurate weighing of NaOH cannot be made to prepare standard solution.

- S18.** Alkali metals have one unpaired electron (*ns*¹) and are paramagnetic. However, during the salt formation, the unpaired electron is lost by alkali metals to other atom forming anion. The salt has all paired electrons and shows diamagnetic nature.

- S19.** Alkali metals are highly sensitive towards air and water and so are kept in kerosene or paraffin oil.

- S20.** Unlike NaHCO₃, the intermediate KHCO₃ formed during reaction, is highly soluble in water and thus can not be taken out from solution to obtain K₂CO₃.

- S21.** Na⁺ ion acquires stable noble gas configuration after the removal of electron from 3s-orbital and removal of electron from 2p-orbital of stable Na⁺ require a lot of energy.



- S22.** On electrolysis of aqueous solution of alkali metal salts (containing metal cation, H⁺, OH⁻ and other anion), the alkali metal cations due to higher discharge potential than H⁺ do not discharge at cathode. On the contrary, it is the H⁺ ion which is discharged at cathode to give H₂.

However, the electrolysis of fused metal salts, liberates metal at cathode due to the discharge of metal cation at cathode.

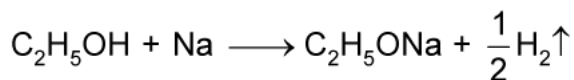
- S23.** IE₁ of potassium is less than sodium because of larger size or less effective nuclear charge. Thus, potassium is more reactive than sodium.

- S24.** Alkali metals are highly reactive because of low IE values and are thus found in nature only in the combined state.

- S25.** Glass reacts with NaOH to form sodium silicates and lid is sealed at the mouth of bottle.



S26. Sodium metal reacts with ethanol and cannot be used for drying it.



S27. The metallic bonding decreases with increase in atomic size and thus the tendency to show metallic bonding among alkali metals decreases from Li to Cs and the close packing of atoms in crystal lattice decreases from Li to Cs resulting in an increase in softness.

S28. Both Li and Mg have nearly same charge – size ratio and other closer periodic properties and thus resemble in many other properties (diagonal relationship).

S29. Li^+ ion due to its smaller size than other alkali metal cations exerts stronger polarizing power towards anion and therefore develops covalent character in the molecule (Fajan rule).

S30. Alkali metals have largest atomic radii in their periods. The degree of metallic bonding in alkali metals is lower as metallic bonding decreases with increase in atomic size.

S31. Due to lowest ionisation energy, it possesses more electropositive nature.

S32. Due to lower ionisation energies of K and Cs, the photoelectric emission of electron takes place easily.

S33. Due to lower ionisation energy, removal of photo-electrons takes place easily even in visible radiation.

S34. Alkali metals being very reactive are oxidized in air and form a film of their oxides. This tarnishes their surface.

S35. Sodium reacts violently with water and thus sodium fire should not be extinguished with water. CCl_4 (pyrene) may be used for this purpose.

S36. The small size of both Li^+ and F^- ion leads to very high value of lattice energy and thus crystal of LiF is very hard to break apart.

S37. Lithium being strongest reducing agent and thus converts nitrogen into nitrides.

S38. Baking powder is a mixture of potassium hydrogen tartarate and sodium bicarbonate. On heating, the bicarbonate gives CO_2 which causes the bread to swell up.

S39. (a) **m.pt.** — Na; As the atomic size increase, interparticle distance between atoms in crystal in crystal lattice increases and the interparticle forces operating in between them decreases. Thus, m.pt. decreases down the group.

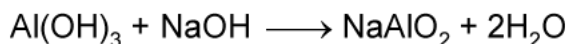
(b) **density** — Na.

S40. The excitation in Na occurs from 3rd shell, whereas in K from 4th shell.

S41. Ionisation energies decrease from Li to Cs showing highest reactivity.

S42. Super oxides contain a three electron bond which makes its paramagnetic and coloured.

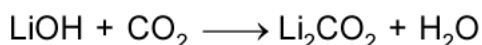
S43. NaOH is strong alkali than NH_4OH and $\text{Al}(\text{OH})_3$ being amphoteric dissolves in NaOH Because of formation of solution NaAlO_2 .



S44. No; NaCl — fcc structure

CsCl — bcc structure

S45. LiOH absorbs CO_2 .



S46. No doubt Li^+ ion is smaller in size but it has extensive property of hydration. It is the hydration of anion which influences the conductance of an ion. More is the tendency of an ion to get itself hydrated larger becomes its size of hydrated ion (*i.e.*, $\text{Li}_{\text{aq}}^+ > \text{Cs}_{\text{aq}}^+$) lesser is its conducting power.

S47. Lithium as well as the oxide ion, O^{2-} have small ionic radii and high charge densities. Hence these small ions pack together forming a very stable lattice of Li_2O . Similarly, formation of sodium peroxide, Na_2O_2 and superoxides of the larger alkali metals (*e.g.* potassium) superoxide, KO_2) can be explained on the basis of the stable lattice formed by the packing of bigger cations and bigger anions.

In short, the increasing stability of peroxides and superoxides of alkali metals from Li to Cs is due to the stabilisation of larger anions by larger cations through lattice energy.

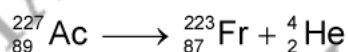
S48. F^- ion being smaller than I^- and thus not easily polarised. Thus LiI is more covalent (Fajan's rule).

S49. Li^+ and F^- are small cation and anion respectively and possess higher lattice energy.

S50. I_2 is non-polar and water is polar and thus solubility of I_2 in water is poor (like dissolves like theory). However, solubility of I_2 increase in KI as it reacts with KI solution to form water soluble complex KI_3 .

S51. The energy binding the atoms in crystal lattice decreases from Li to Cs due to decreasing tendency of metallic bonding and thus m.pt, b.pt decreases from Li to Cs.

S52. Francium is formed by α -radioactive decay of actinium 227. Francium

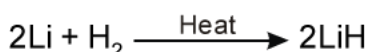


Itself is a radioactive alkali metal that decays by β -emission.



S53. **LiH:** $\text{LiH} + \text{H}_2\text{O} \longrightarrow \text{LiOH} + \text{H}_2\uparrow$

S54. Lithium hydride is made by action of H_2 on bright red hot Li metal.

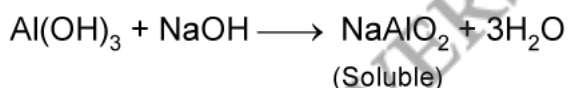


H^- is bigger because its nuclear charge is less.

- S69.** Since the heat of reaction is sufficient to maintain the temperature high enough for reaction to occur.
- S70.** Due to small size of Li^+ , LiH has higher lattice energy than NaH .
- S71.** Due to strong solvation of smaller Li^+ ion., much energy is released which makes LiClO_4 more soluble.
- S72.** E_{RP}° for the given reaction is most negative and so $\Delta G^\circ (= -nFE^\circ)$ is most positive, so reaction does not occur.
- S73.** Electronic transitions in alkali metals require high energy and wavelengths absorbed are in UV-region which is not sensitive to human eye.
- S74.** (a) $\text{NaF} < \text{NaCl} < \text{NaBr} < \text{NaI}$
- (b) $\text{LiF} < \text{LiCl} < \text{LiBr} < \text{LiI}$
- S75.** Let x be the oxidation state of Na in Na_2O_2 . Since Na_2O_2 contains a peroxide linkage in which O has an oxidation state of -1 , therefore,

$$x \quad -1 \\ \text{Na}_2\text{O}_2 \quad \text{or} \quad 2x + 2(-1) = 0 \quad \text{or} \quad x = +1.$$

- S76.** (a) Be does not show co-ordination number more than four.
- (b) The oxide and hydroxides of Be are amphoteric in nature.
- (c) BeCl_2 has bridged chloride structure in vapour phase.
- S77.** Aluminium hydroxide dissolves in NaOH forming soluble NaAlO_2 and can be separated from ferric hydroxide. The later has no reaction with NaOH .



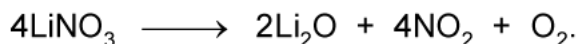
- S78.** $\text{NiO} < \text{MgO} < \text{SrO} < \text{K}_2\text{O} < \text{Cs}_2\text{O}$
- S79.** Ag^+ ; because Ag^+ has pseudo noble gas configuration which makes it more polarising and therefore stronger acid.
- S80.** In presence of HF , F^- is converted into bifluoride ion HF_2^- , allowing further dissolution of solid LiF .
- S81.** The ionization enthalpy of potassium is less than that of sodium and hence potassium is more reactive than sodium.
- S82.** Potassium and caesium have much lower ionization enthalpy than that of lithium. As a result, these metals on exposure to light, lose electrons much more easily than lithium. Hence, potassium and caesium rather than lithium are used in photoelectric cells.
- S83.** Potassium carbonate cannot be prepared by Solvay process because potassium bicarbonate being highly soluble in water does not get precipitated in carbonation tower when CO_2 is passed through a concentrated solution of KCl saturated with ammonia.

- S84.** Smaller the size of an ion, the more highly is it hydrated. Among the given alkali metals, Li is the smallest in size. Also, it has the highest charge density and highest polarising power. Hence, it attracts water molecules more strongly than the other alkali metals. As a result, it forms hydrated salts such as $\text{LiCl} \cdot 2\text{H}_2\text{O}$. The other alkali metals are larger than Li and have weaker charge densities. Hence, they usually do not form hydrated salts.
- S85.** Atomic size increases as we move down the alkali group. As a result, the binding energies of their atoms in the crystal lattice decrease. Also, the strength of metallic bonds decreases on moving down a group in the periodic table. This causes a decrease in the melting point. Among the given metals, Cs is the largest and has the least melting point.
- S86.** Lithium is the smallest in size among the alkali metals. Hence, Li^+ ion can polarize water molecules more easily than other alkali metals. As a result, water molecules get attached to lithium salts as water of crystallization. Hence, lithium salts such as trihydrated lithium chloride ($\text{LiCl} \cdot 3\text{H}_2\text{O}$) are commonly hydrated. As the size of the ions increases, their polarizing power decreases. Hence, other alkali metal ions usually form anhydrous salts.
- S87.** Li^+ ion is smaller in size. It forms more stable lattice with smaller anion oxide, O^{2-} than with CO_3^{2-} ion. Therefore, Li_2CO_3 decomposes into Li_2O at lower temperature on the other hand, Na^+ ion being larger in size forms more stable lattice with larger anion CO_3^{2-} than with O^{2-} ion. Therefore, Na_2CO_3 is quite stable and decomposes into Na_2O at very high temperature.
- S88.** The atomic size of sodium and potassium is larger than that of magnesium and calcium. Thus, the lattice energies of carbonates and hydroxides formed by calcium and magnesium are much more than those of sodium and potassium. Hence, carbonates and hydroxides of sodium and potassium dissolve readily in water whereas those of calcium and magnesium are only sparingly soluble.
- S89.** The strength of an element as reducing agent depends not only on ionization enthalpy but also an enthalpy of atomization and enthalpy of hydration of the ion formed. Li^+ ion has very high enthalpy of hydration due to its small size. This more than compensates for the higher value of ionization enthalpy of lithium. Hence, lithium behaves as the strongest reducing agent.
- S90.** The metal atom is converted into ammoniated metal ion *i.e.*, $M^+(\text{NH}_3)$ and the electron set free combines with NH_3 molecule to produce blue ammonia solvated electron.



It is the ammoniated electron which is responsible for blue colour, paramagnetic nature and reducing power of alkali metals in ammonia solution. However, the increased conductance nature of these metals in ammonia is due to presence of ammoniated cation and ammonia solvated electron.

- (b) Lithium nitrate decomposes to give a reddish brown gas, nitrogen dioxide.



S98. (a) Reactivity of metals depends on their ionization enthalpy; smaller the ionization enthalpy, greater is the reactivity. Potassium has lower ionization enthalpy than sodium and hence is more reactive.

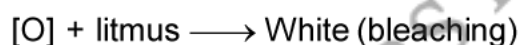
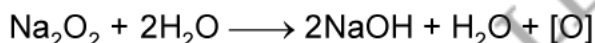
- (b) The second ionization enthalpy of alkali metals is very high because the M^+ ions have stable noble gas configuration. Hence, alkali metals do not form divalent (M^{2+}) ions.

S99. (a) Alkali metals have very low ionization enthalpies. Hence, they can lose their valence electron readily and can bring about reduction, and behave as strong reducing agents.

- (b) Due to their large atomic size and only one valence electron, alkali metals have weak metallic bond as interparticle forces. Because of weak metallic bond alkali metals are soft and can be cut with a knife.

S100 LiF is insoluble in water. On the contrary, LiCl is soluble not only in water, but also in acetone. This is mainly because of the greater ionic character of LiF as compared to LiCl. The solubility of a compound in water depends on the balance between lattice energy and hydration energy. Since fluoride ion is much smaller in size than chloride ion, the lattice energy of LiF is greater than that of LiCl. Also, there is not much difference between the hydration energies of fluoride ion and chloride ion. Thus, the net energy change during the dissolution of LiCl in water is more exothermic than that during the dissolution of LiF in water. Hence, low lattice energy and greater covalent character are the factors making LiCl soluble not only in water, but also in acetone.

S101(a) Na_2O_2 is powerful oxidant and bleaching agent and bleaches red litmus paper to white in aqueous solution state.



red

- (b) The other compound Na_2O will give NaOH on dissolution in water. The red litmus will turn to blue.

S102(a) Li^+ ions is smaller in size. It is stabilized more by smaller anion, oxide ion (O_2^-) as compared to larger anion peroxide (O_2^{2-}).

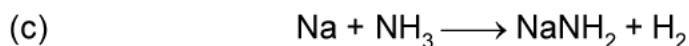
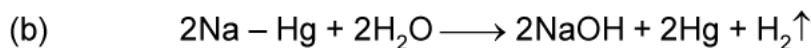
- (b) K^+ , Rb^+ and Cs^+ , are large cations. A large cation is more stabilized by large anions. Since superoxide ion, O_2^- is quite large, K, Rb and Cs, form superoxides in preference to oxides and peroxides.

S103(a) $2\text{Na}_2\text{O}_2 + 2\text{H}_2\text{O} \longrightarrow 4\text{NaOH} + \text{O}_2$

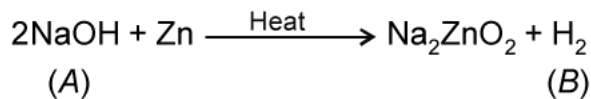
(b) $2\text{KO}_2 + 2\text{H}_2\text{O} \longrightarrow 2\text{KOH} + \text{H}_2\text{O}_2 + \text{O}_2$

(c) $\text{Na}_2\text{O} + \text{CO}_2 \longrightarrow \text{Na}_2\text{CO}_3$

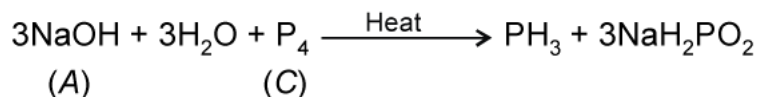
S104(a) $2\text{NaHCO}_2 \longrightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$



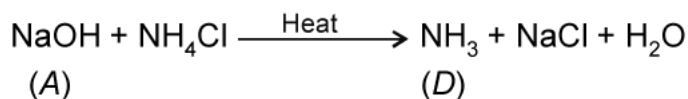
S105.(a) (A) is an alkali and the equation is,



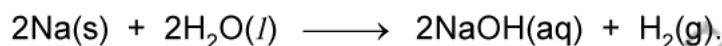
(b) (A) is NaOH and (C) is phosphorus. Thus equation will be,



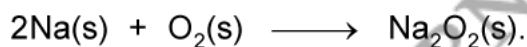
(c) (D) is NH_3 gas and (A) is NaOH. The equation will be,



S106.(a) When Na metal is dropped in water, it reacts violently to form sodium hydroxide and hydrogen gas. The chemical equation involved in the reaction is:



(b) On being heated in air, sodium reacts vigorously with oxygen to form sodium peroxide. The chemical equation involved in the reaction is:



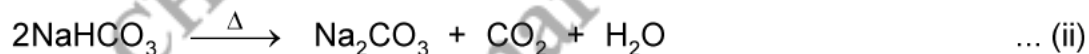
(c) When sodium peroxide is dissolved in water, it is readily hydrolysed to form sodium hydroxide and water. The chemical equation involved in the reaction is:



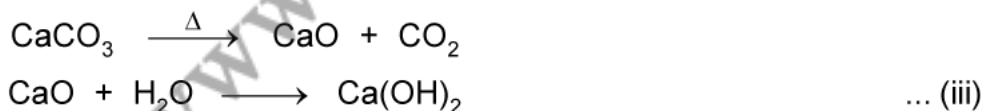
S107.In Solvay ammonia process, in the carbonation tower CO_2 is passed through brine, saturated with ammonia when sodium bicarbonate is formed which being sparingly soluble gets precipitated.



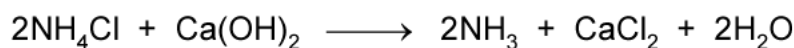
Sodium bicarbonate is separated which on heating gives sodium carbonate.



CO_2 needed for the reaction is prepared by heating limestone and the quick lime, CaO is treated with water to form slaked lime, $\text{Ca}(\text{OH})_2$

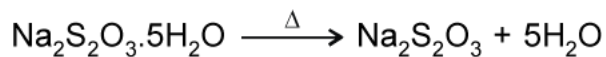


NH_3 is recovered from filtrate of reaction (i) by heating with $\text{Ca}(\text{OH})_2$

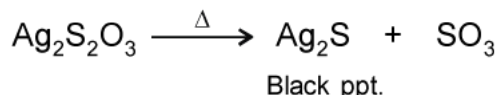
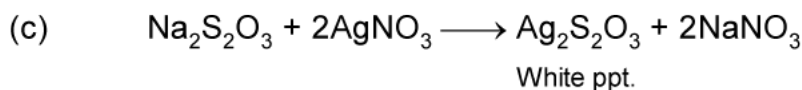
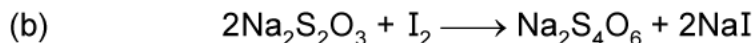
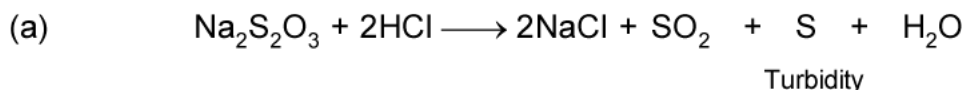


S108.Steps (a), (b) and (c) indicate that (A) is hypo $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$

Reactions:



(A)



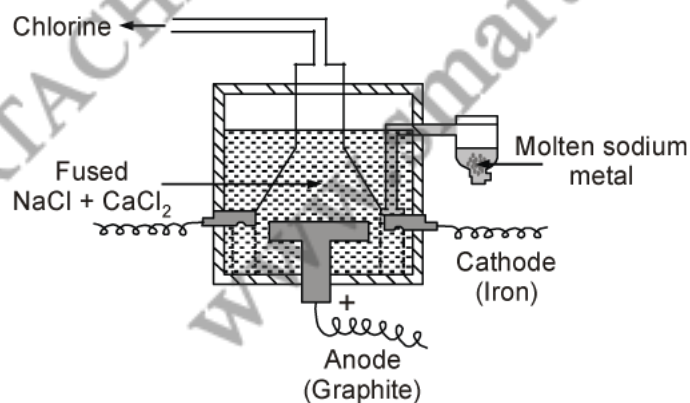
- S109**(a) Li^+ ion is maximum hydrated in aqueous solution and hence has lowest ionic mobility.
- (b) LiCl has more covalent character than NaCl and hence has lower melting point. NaCl is predominately ionic.
- (c) NaCl has higher melting point than KCl because NaCl has greater lattice enthalpy than KCl due to smaller size of Na^+ ion than K^+ ion.

- S110**(a) As the size of cation increases, its hydration decreases and thus hydrated ion size shows the order $\text{Cs}^+ < \text{Rb}^+ < \text{K}^+ < \text{Na}^+ < \text{Li}^+$.
- Thus, mobility of ion increases from Li^+ to Cs^+ .

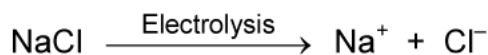
- (b) Li is strongest reducing agent.
- (c) The small size of both Li^+ and F^- ions leads to a very large lattice energy and thus, the crystal of LiF is very hard to break apart.

- S111**(a) Sodium can be extracted from sodium chloride by Downs process.

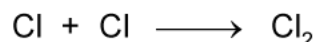
This process involves the electrolysis of fused NaCl (40%) and CaCl_2 (60%) at a temperature of 1123 K in Downs cell.



Steel is the cathode and a block of graphite acts as the anode. Metallic Na and Ca are formed at cathode. Molten sodium is taken out of the cell and collected over kerosene.

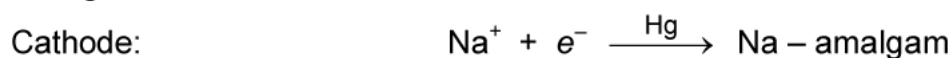


Molten



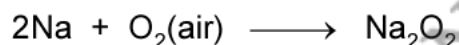
- (b) **Sodium hydroxide:** Sodium hydroxide can be prepared by the electrolysis of sodium chloride. This is called Castner-Kellner process. In this process, the brine solution is electrolysed using a carbon anode and a mercury cathode.

The sodium metal, which is discharged at cathode, combines with mercury to form an amalgam.

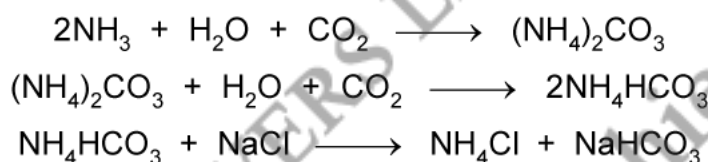


- (c) **Sodium peroxide:** First, NaCl is electrolysed to result in the formation of Na metal (Downs process).

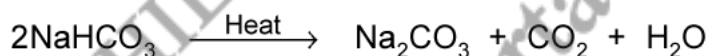
This sodium metal is then heated on aluminium trays in air (free of CO_2) to form its peroxide.



- (d) **Sodium carbonate:** Sodium carbonate is prepared by Solvay process. Sodium hydrogen carbonate is precipitated in a reaction of sodium chloride and ammonium hydrogen carbonate.



These sodium hydrogen carbonate crystals are heated to give sodium carbonate.



- Q1. $\text{Be}(\text{OH})_2$ is amphoteric but $\text{Mg}(\text{OH})_2$ is basic. Explain.
- Q2. Explain why $\text{Be}(\text{OH})_2$ is soluble in NaOH but $\text{Ba}(\text{OH})_2$ is insoluble in NaOH ?
- Q3. MgCO_3 is insoluble in water, why?
- Q4. BeCl_2 is soluble in ether but BaCl_2 is insoluble in ether. Explain.
- Q5. KOH is a stronger base than $\text{Ba}(\text{OH})_2$. Explain.
- Q6. The atomic radius of Mg is smaller than sodium. Why?
- Q7. Why do alkaline earth metals not form monovalent ions?
- Q8. IE_3 of Mg is very high as compared to its IE_2 value.
- Q9. Describe the importance of the following:
(a) Limestone, (b) Cement, (c) Plaster of Paris
- Q10. Mention the main constituents of Portland cement.
- Q11. What is milk of lime and for what purposes it is used?
- Q12. What is precipitated chalk?
- Q13. What is milk of magnesia and for what purposes it is used?
- Q14. Why are salts of alkaline earth metal diamagnetic in nature?
- Q15. Anhydrous calcium sulphate cannot be used as Plaster of Paris. Why?
- Q16. Anhydrous MgCl_2 is prepared by heating $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ in a current of HCl gas. Explain with reason.
- Q17. Alkaline earth metal salts are less soluble than the corresponding alkali metal salts.
- Q18. BeO and MgO have a high melting point, why?
- Q19. Beryllium halides fume in air, why?
- Q20. Name an element which is invariably bivalent and whose oxide is soluble in excess of NaOH and its dipositive ion has a noble gas core.
- Q21. NaCl is added to anhydrous MgCl_2 (fused) before electrolysis. Why?
- Q22. Alkaline earth metals have higher m.pt. than alkali metals. Why?
- Q23. Alkaline earth metals are weaker reducing agent than alkali metals.
- Q24. IE_1 of alkaline earth metals is very low as compared to their IE_2 . Why?
- Q25. $\text{Ba}(\text{OH})_2$ is much stronger base than $\text{Be}(\text{OH})_2$. Explain.

- Q26. Beryllium shows covalence whereas other alkaline earth metals show electrovalence. Explain.
- Q27. Solubility of hydroxides, fluorides or oxalate of alkaline earth metals increases from Be to Ba. Explain.
- Q28. The reaction between marble and dilute sulphate acid stops soon. Why?
- Q29. Anhydrous calcium sulphate is used as drying agent. Why?
- Q30. Be and Mg do not give flame colour whereas other alkaline earth metals do so. Why?
- Q31. Alkaline earth metal salts are less soluble than the corresponding alkali metal salts.
- Q32. The hydroxides of alkaline earth metals are weaker alkali than those of alkali than those of alkali metals. Explain.
- Q33. Be does not exhibit a covalency beyond 4.
- Q34. Alkali metals and alkaline earth metals are usually not obtained by chemical reduction methods, why?
- Q35. Why MgSO_4 is water soluble but BaSO_4 is not?
- Q36. The alkaline earth metals are found in nature as carbonates and sulphates whereas mercury and silver are found as sulphides.
- Q37. What is anhydrite and for what purposes it is used?
- Q38. BeCl_2 can be easily hydrated, why?
- Q39. Beryllium turns passive in presence of HNO_3 . Explain.
- Q40. $\text{Ca}(\text{HCO}_3)_2$ and $\text{Ca}(\text{OH})_2$ solutions can not be stored in one vessel. Why?
- Q41. Write down the chemistry of foam type fire extinguishers.
- Q42. BeCl_2 in aqueous solution exists as $[\text{Be}(\text{H}_2\text{O})]^{2+}$ rather than Be^{2+} and forms acidic solution. Explain.
- Q43. Like other halides, BeF_2 can not be prepared by action of HF on $\text{Be}(\text{OH})_2$, why?
- Q44. E° for $M_{(\text{aq})}^{2+} + 2e \longrightarrow M_{(\text{s})}$ (where) $M = \text{Ca}, \text{Sr}$ or Ba) is nearly constant. Explain
- Q45. Melting points of calcium halides decrease in the order:
 $\text{CaF}_2 > \text{CaCl}_2 > \text{CaBr}_2 > \text{CaI}_2$. Explain.
- Q46. Why anhydrite (anhydrous calcium sulphate) cannot be used as plaster of Paris?
- Q47. Why is reduction of CaO is not possible with carbon?
- Q48. Hydration energies of group second dication are 4-5 times higher than for group 1 cations, explain.
- Q49. Arrange the M^{2+} ($M =$ alkaline earth metal) in increasing order of affinity for RSO_3H type cation-exchange resins.
- Q50. Beryllium and magnesium do not give colour to flame whereas other alkaline earth metals do so, why?

- Q51.** The crystalline salts of alkaline earth metals contain more water of crystallization than the corresponding alkali metal salts. Why?
- Q52.** Chlorination of calcium hydroxide produces bleaching powder. Write its chemical equation.
- Q53.** When Mg metal is burnt in air, a white powder is left behind as ash. What is this white powder?
- Q54.** Lime water becomes turbid on passing CO_2 through it, but becomes clear when more CO_2 is passed. Why?
- Q55.** Magnesium metal burns in air to give a white ash. When this ash is treated with water, the odour of ammonia can be detected. What is the reason?
- Q56.** Solubility of the sulphates, chromates and carbonates of alkaline earth metals decreases from Be to Ba. Explain.
- Q57.** Which metal salt is present in tooth enamel. How is cavity developed in teeth and how it can be prevented.
- Q58.** Discuss preparation, structure and properties of beryllium borohydride.
- Q59.** How will the solutions of following compounds behave towards litmus?
(a) NaHSO_4 , (b) K_2CO_3 , (c) MgSO_4 , (d) CaCl_2 . (e) BaSO_4 .
- Q60.** How would you explain?
(a) BeO is insoluble but BeSO_4 soluble in water.
(b) BaO is soluble but BaSO_4 is insoluble in water.
(c) LiI is more soluble than KI in ethanol.
(d) NaHCO_3 is known in solid state but $\text{Ca}(\text{HCO}_3)_2$ is not isolated in solid state.
- Q61.** On moving down in group 2 solubility of fluorides and hydroxides increases while for other salts it decreases. Explain.
- Q62.** Discuss the shape of Beryllium oxide acetate.
- Q63.** Draw the structure of (a) BeCl_2 (vapour) (b) BeCl_2 (solid).
- Q64.** Which one of the alkaline earth metal carbonates is thermally the most stable?
(a) MgCO_3 (b) CaCO_3 (c) SrCO_3 (d) BaCO_3
- Q65.** Explain why:
(a) Magnesium metal is harder than sodium.
(b) Magnesium oxide is used as a refractory material.
- Q66.** What is quick lime, slaked lime and lime water? What happens when carbon dioxide gas is passed through lime water?
- Q67.** Account for the following:
(a) $\text{Be}(\text{OH})_2$ is insoluble but $\text{Ba}(\text{OH})_2$ is fairly soluble in water.
(b) $\text{Be}(\text{OH})_2$ is amphoteric while $\text{Mg}(\text{OH})_2$ is basic.
- Q68.** Explain the following phenomenon by means of balanced equation:
(a) When exhaling is made through a tube passing in lime water
(b) The turbidity of solution (a) eventually disappears when continued exhaling is made through it.
(c) When the solution (b) is heated, turbidity reappears.

Q69. Contrast the action of heat on the following and explain your answer:

- (a) Na_2CO_3 and CaCO_3 (b) $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ and $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$
(c) $\text{Ca}(\text{NO}_3)_2$ and NaNO_3

Q70. Complete the following equations for the reaction between :

- (a) $\text{Ca}(\text{OH})_2 + \text{Cl}_2$ (b) $\text{BeO} + \text{NaOH}$ (c) $\text{BaO}_2 + \text{H}_2\text{SO}_4$

Q71. What happens when:

- (a) magnesium is burnt in air? (b) quick lime is heated with silica?
(c) chlorine reacts with slaked lime? (d) calcium nitrate is heated?

Q72. Arrange the following properties as listed in the increasing order:

- (a) Lattice energy : $\text{BeCl}_2, \text{MgCl}_2, \text{CaCl}_2, \text{SrCl}_2$
(b) Solubility in H_2O : $\text{BeSO}_4, \text{MgSO}_4, \text{CaSO}_4, \text{SrSO}_4, \text{BaSO}_4$
(c) Thermal stability : $\text{BeCO}_3, \text{MgCO}_3, \text{CaCO}_3$
(d) Thermal stability : $\text{BeSO}_4, \text{MgSO}_4, \text{CaSO}_4$
(e) Polarising power : $\text{Be}^{2+}, \text{Mg}^{2+}, \text{Ca}^{2+}$

Q73. Arrange the following properties as listed in the increasing order:

- (a) Solubility in water : $\text{MgF}_2, \text{BaF}_2, \text{BeF}_2$
(b) Solubility in water : $\text{Be}, \text{Mg}, \text{Ca}, \text{Sr}$
(c) Refractory properties : $\text{BeO}, \text{MgO}, \text{CaO}$
(d) Stability : $\text{BeCl}_2, \text{BeF}_2, \text{BeBr}_2, \text{BeI}_2$

Q74. Compare the solubility and thermal stability of the following compounds of the alkali metals with those of alkaline earth metals (a) nitrates (b) carbonates (c) sulphates.

Q75. Arrange the following properties as listed in the increasing order:

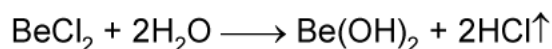
- (a) Solubility in H_2O : $\text{Be}(\text{OH})_2, \text{Mg}(\text{OH})_2, \text{Ca}(\text{OH})_2$
(b) Covalent nature : $\text{BeCl}_2, \text{MgCl}_2, \text{CaCl}_2$
(c) Hydrolysis nature : $\text{BeCl}_2, \text{MgCl}_2, \text{CaCl}_2$
(d) Lattice energy : $\text{CaF}_2, \text{MgF}_2, \text{BaF}_2$
(e) Hydration energy : $\text{Be}^{2+}, \text{Mg}^{2+}, \text{Ba}^{2+}$

- S1.** Be has smaller size, so it is less ionised to release OH^- due to more covalent character.
- S2.** $\text{Be}(\text{OH})_2$ is amphoteric whereas $\text{Ba}(\text{OH})_2$ is alkaline.
- S3.** Lattice energy of MgCO_3 is more than its hydration energy.
- S4.** BeCl_2 being non-polar covalent molecule and thus soluble in non-polar or weak polar solvents. BaCl_2 is ionic and soluble in water.
- S5.** The greater ionic radius and lower ionisation energy of potassium as compared to Ba result in stronger basic nature of KOH.
- S6.** An increase in atomic number along the period results in an increase in effective nuclear charge and thus valence shells in magnesium atom are pulled more effectively towards nucleus resulting to smaller size of magnesium atom.
- S7.** The alkaline earth metal ions possess smaller size and thus have high heat of hydration which is responsible for the formation of divalent nature. Also, divalent cations of alkaline metals attain inert gas configuration.
- S8.** Removal of electron from Mg^+ (requires IE_2) takes place from 3s subshell, whereas the removal of electron from Mg^{2+} occurs from 2p subshell and thus energy shell change during removal of electron is responsible for jump in IE values.
- S9.** (a) In preparation of quick lime, as building material and road aggregate.
(b) In plastering and preparation of buildings dams, bridges, RCC.
(c) In surgical bandages, castings, moulding and dentistry.
- S10.** Dicalcium silicate (Ca_2SiO_4), tricalcium silicate (Ca_3SiO_3) and tricalcium aluminate ($\text{Ca}_3\text{Al}_2\text{O}_6$).
- S11.** A solution-suspension of $\text{Ca}(\text{OH})_2$ in water, used for the white washing.
- S12.** The precipitate of CaCO_3 obtained during passage of CO_2 through lime water.
- $$\text{Ca}(\text{OH})_2 + \text{CO}_2 \longrightarrow \text{CaCO}_3 \uparrow + \text{H}_2\text{O}$$
- S13.** A suspension of $\text{Mg}(\text{OH})_2$ in water, used as antacid to remove acidity.
- S14.** Alkaline earth metal ions have no unpaired electron and thus are diamagnetic in nature.
- S15.** On moistening with water, anhydrous CaSO_4 does not set like Plaster of Paris.
- S16.** Presence of HCl gas checks up the hydrolysis of magnesium chloride by its own water of crystallization.

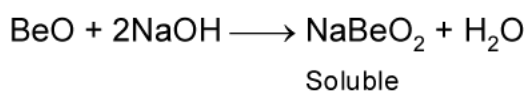
S17. Due to high charge-size ratio, lattice energy of alkaline earth metal salts are more than corresponding alkali metal salts.

S18. The lattice energy of BeO and MgO is appreciably higher due to their small size.

S19. Due to formation of halogen acids on hydrolysis.



S20. Be: $1s^2, 2s^2$



S21. The addition of NaCl to anhydrous MgCl_2 during its electrolysis is done to lower the fusion point of MgCl_2 as well as to increase the conducting power of fused mixture.

S22. Alkaline earth metals possess two valence electrons and are much strongly bonded in the solid state than the alkali metals which results in higher m.pt.

S23. Due to high sublimation energy and high ionisation energy, alkaline earth metals possess lower oxidation potential than alkali metals and thus they are less electropositive and weaker reducing agent than alkali metals.

S24. The much higher values of IE_2 for alkaline earth metals (just double to IE_1) are due to high heat of hydration of their cation in solution and high lattice energy in solid state.

S25. On moving from Be to Ba (*i.e.*, down the group) the size of metal ion increases, the ionisation energy decreases and hence the electropositive character increases which increases the polarity of the bond as well as the internuclear distance between oxygen of hydroxide and metal ion. Consequently ease of formation of ions increases and hence basic character increases.

S26. Be has the smallest size among all the alkaline earth metals and thus Be^{2+} ion shows more polarizing power towards anion leading to higher covalent nature in molecule.

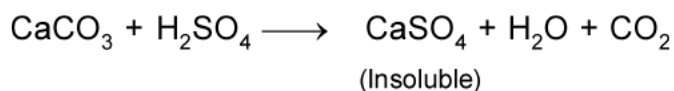
S27. The solubility of an ionic compound depends.

(a) lattice energy and

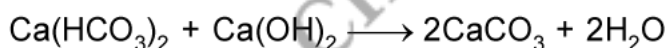
(b) hydration energy.

In the case of hydroxides, fluorides and oxalates the lattice energies are different *i.e.*, lattice energy decreases as the size of cation increases. This tends to increase the solubility as it overcomes the counter effect of decrease in hydration energy. Hence, the solubility of hydroxides, fluorides and oxalates increases from Ca to Ba.

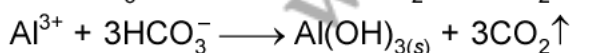
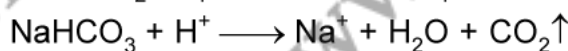
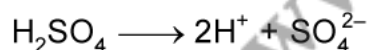
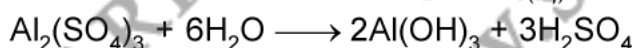
S28. The reaction between marble and dilute sulphuric acid gives insoluble CaSO_4 which covers the surface of marble and thus reaction ceases soon.



- S29.** Anhydrous CaSO_4 absorbs water and readily forms hydrated sulphate $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$.
- S30.** Be and Mg atoms being smaller in size, bind their *ns* electrons more strongly *i.e.*, their IE values are high. Hence, these possess high excitation energy and are not excited by the energy of the flame to higher energy level and thus de-excitation does not take. As a result no colour is produced in flame.
- S31.** Alkaline earth metal cations possess high lattice energy due to their smaller size.
- S32.** Alkaline earth metals are relatively less electropositive than alkaline metals and thus show less polarity in metal – oxygen bond as well as the less inter molecular distance in between oxygen of hydroxide and metal ion. Consequently ease of formation of ion decreases for alkaline earth metals which results in less basic character.
- S33.** The outermost energy shell in Be atom does not have ‘*d*’ subshell and therefore, it cannot accommodate more than 8 electrons in 2nd shell (valence shell).
- S34.** Alkali and alkaline earth metals are themselves strong reducing agents and can be reduced only by electrolytic reduction.
- S35.** Lattice energy of BaSO_4 predominates over its hydration energy while in MgSO_4 , Mg^{2+} being smaller in size and thus hydration energy predominates over lattice energy of MgSO_4 .
- S36.** The ions Ca^{2+} , Mg^{2+} , Ba^{2+} etc., are hard acids while SO_4^{2-} and CO_3^{2-} ions are also hard bases. Since compounds of hard acids and hard bases are stable, alkaline earth metals are found in nature as sulphates and carbonates. However, Hg^{2+} and Ag^+ ions are soft acids. They combine with soft bases such as S^{2-} to form stable compounds.
- S37.** Anhydronite is $\text{Mg}(\text{ClO}_4)_2$ or magnesium perchlorate. It is used as drying agent. It should not be used with organic materials as it is strong oxidising agent.
- S38.** Be^{2+} ion has high charge-size ratio. BeCl_2 on hydration forms $\text{BeCl}_2 \cdot 4\text{H}_2\text{O}$. The hydrated ion has the formula $[\text{Be}(\text{H}_2\text{O})_4]^{2+}$ which acts as Lewis acid as well as Bronsted acid.
- S39.** HNO_3 acts as an oxidising agent to oxidise surface of Be to BeO and forms a layer of BeO on Be surface which prevents further action of HNO_3 .
- S40.** $\text{Ca}(\text{HCO}_3)_2$ solution behaves as acid towards $\text{Ca}(\text{OH})_2$.



- S41.** Foam type fire extinguishers contains $\text{Al}_2(\text{SO}_4)_3(\text{aq})$ and $\text{NaHCO}_3(\text{aq})$

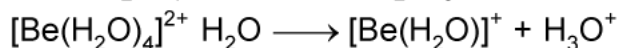


Foam which extinguishes fire

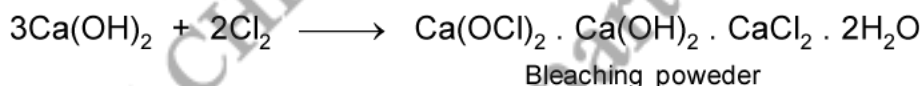
- S42.** $\text{BeCl}_2 + \text{H}_2\text{O} \longrightarrow [\text{Be}(\text{H}_2\text{O})_4]^{2+} + 2\text{Cl}^-$

Due to extensive hydration on account of its small size of Be^{2+} ion

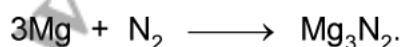
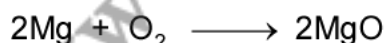
Hydrolysis of $[\text{Be}(\text{H}_2\text{O})_4]^{2+}$ gives $[\text{Be}(\text{H}_2\text{O})_3\text{OH}]^+$ and H_3O^+ to produce acidic nature.



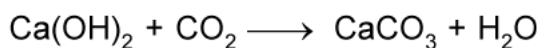
- S43.** Because crystalline $\text{BeF}_2 \cdot 4\text{H}_2\text{O}$ formed is readily hydrolysed during dehydration.
- S44.** Heating of atomisation and ionisation energy are complimentary to heat of hydration.
- S45.** Smaller is the anion, lesser is its polarizability by a cation and thus more is ionis and higher is the m.pt. The anion size increases from F to I and thus m.pt. and ionic character decreases from CaI_2 .
- S46.** Anhydrite (anhydrous CaSO_4) cannot be used as plaster of Paris because it does not set on the water and is known as 'dead burnt plaster'.
- S47.** Reduction of CaO is not possible with carbon because CaO is very reactive and reacts with carbon to produce carbides.
- S48.** Due to smaller size and higher charge, charge/mass ratio (or charge density) on M^{2+} is much higher than M^+ cations and i.e., why salts of alkaline earth metals are more hydrated than those of alkali metals.
- S49.** $\text{Be}^{2+} < \text{Mg}^{2+} < \text{Ca}^{2+} < \text{Sr}^{2+} < \text{Ba}^{2+}$.
- S50.** Due to the small size, the ionization enthalpies of Be and Mg are much higher than those of other alkaline earth metals. This means that the valence electrons in beryllium and magnesium are more tightly held by the nucleus. Therefore, they need large amount of energy for excitation of electrons to higher energy levels. Since such a large amount of energy is not available in bunsen flame, therefore, these metals do not impart any colour to the flame.
- S51.** Due to smaller size and higher nuclear charge, alkaline earth metals have a higher tendency than alkali metals to attract H_2O molecules and thus contain more water of crystallization than alkali metals. For example, $\text{LiCl} \cdot 2\text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$.
- S52.** Bleaching powder is obtained by passing Cl_2 into $\text{Ca}(\text{OH})_2$. Though bleaching powder is often written as $\text{Ca}(\text{OH})_2$ it is actually a mixture.



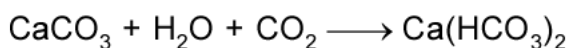
- S53.** Mg on burning in air reacts with oxygen and nitrogen resulting in the formation of magnesium oxide and magnesium nitride.



- S54.** On passing CO_2 in lime water, insoluble CaCO_3 is precipitated out which produces turbidity in water. However, on passage of enough CO_2 , CaCO_3 further reacts to form soluble bicarbonate and solution becomes clear.

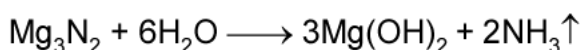
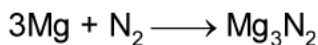
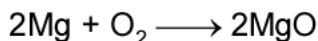


(Insoluble)



(Soluble)

S55. Mg Burns in air to form MgO and Mg₃N₂. It is the Mg₃N₂ which on hydrolysis gives NH₃.



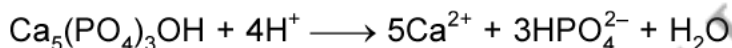
S56. The solubility of an ionic compound depends.

- (a) lattice energy and (ii) hydration energy.

These two factors oppose each other. If lattice energy is high, the ions will be tightly packed in the crystal, therefore, solubility will be low. If hydration energy is high, the ions will have greater tendency to be hydrated, therefore, the solubility will be high.

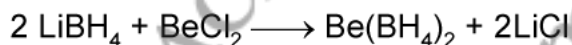
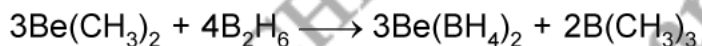
In the case of carbonates, sulphates and chromates the anions are larger in size and small changes in cation size do not alter the lattice energies *i.e.*, lattice energies are about the same. However, the hydration energies decrease from Ca²⁺ to B²⁺. Hence, the solubility of carbonates, sulphates and chromates decreases from calcium to barium.

S57. Ca₅(PO₄)₃OH, a calcium salt, known as hydroxy apatite, is the main constituent of tooth enamel. Excessive use of fatty acid and its long stay on tooth enamel decomposes this weak basic apatite coating to develop cavity.

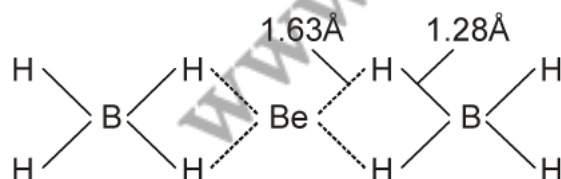


The formation of cavity can be prevented by cleaning teeth after taking food stuffs or by covering the hydroxy apatite by fluorapatite by getting pasting daily with fluoride salts such as MFP or sodium monofluorapatite, a main source of fluoride in our tooth paste.

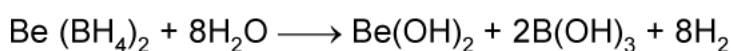
S58. Beryllium borohydride, Be(BH₄)₂ is made by action of diborane on dimethyl beryllium or by reaction between LiBH₄ and BeCl₂.



By electron diffraction its unsymmetrical bridge structure has been established.



It spontaneously burns in air and liberates H₂.



S59. (a) Acidic, (b) (Alkaline), (c) Acidic, (d) Neutral, (e) Neutral.

- S60.** (a) BeO is covalent, BeSO_4 is ionic.
 (b) In BaSO_4 lattice energy is more than its hydration energy. i.e. why it is insoluble in water.
 (c) LiI is more covalent. KI is ionic. 'Like dissolves like'.
 (d) Bicarbonates of alkaline earth metals are thermally unstable.

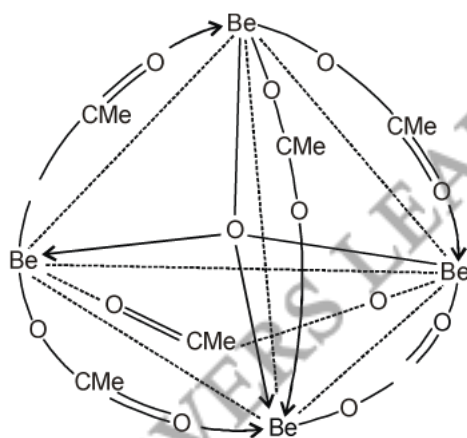
S61. Solubility of a salt depends upon two factors.

- (a) Lattice energy-higher lattice energy disfavours dissolution.
 (b) Hydration energy-higher hydration energy favours dissolution.

On descending down in a group, size of cation increases which results in decrease in lattice energy and hydration energy both. For fluorides and hydroxides, the decrease in lattice energy is more rapid than hydration energy so their solubility increases on moving down the group.

For other salts decrease in hydration energy is more rapid than lattice energy so solubility decreases.

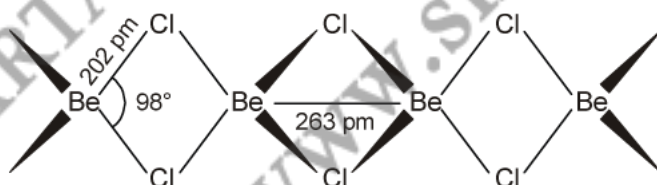
S62. The structure of beryllium oxide acetate is shown in figure given below. The molecule itself has tetrahedral symmetry, the central oxygen atom being surrounded tetrahedrally by four beryllium atoms and the six acetate groups are attached symmetrically to the six edges of the tetrahedron. The oxide acetate crystallizes in the cubic system.



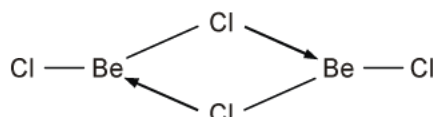
Structure of beryllium oxide acetate

S63. (a) Structure of BeCl_2 (solid)

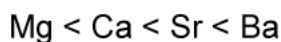
BeCl_2 exists as a polymer in condensed (solid) phase.



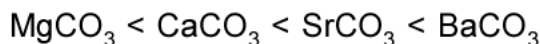
(b) In the vapour state, BeCl_2 exists as a monomer with a linear structure.



S64. Thermal stability increases with the increase in the size of the cation present in the carbonate. The increasing order of the cationic size of the given alkaline earth metals is



Hence, the increasing order of the thermal stability of the given alkaline earth metal carbonates is



S65. (a) Magnesium has stronger metallic bond than sodium due to its smaller atomic size and more number of valence electrons. Hence it is harder than sodium.

(b) Magnesium oxide has very high lattice enthalpy due to greater charge and smaller ionic size of Mg^{2+} and O^{2-} ions. As a result it has very high melting point and is used as a refractory material.

S66. Quick lime is calcium oxide, CaO .

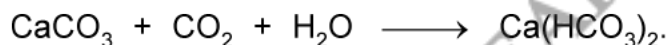
Slaked lime is calcium hydroxide Ca(OH)_2 .

Lime water is a clear solution of calcium hydroxide in water.

When carbon dioxide gas is passed through lime water, it becomes milky due to formation of calcium carbonate.

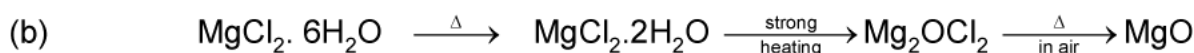
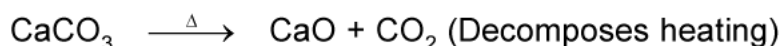
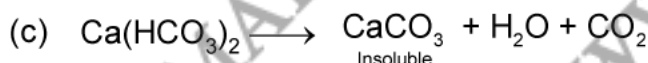
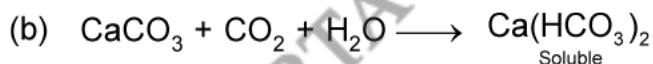


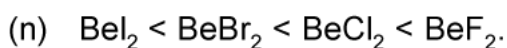
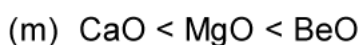
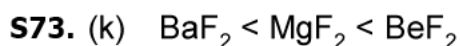
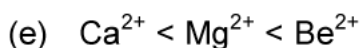
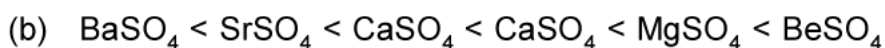
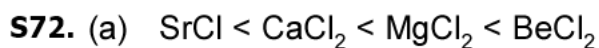
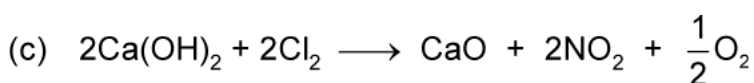
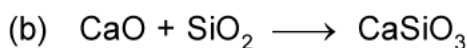
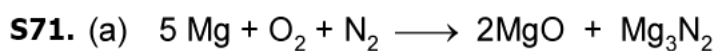
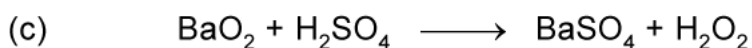
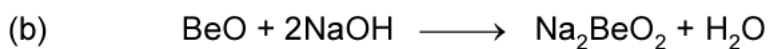
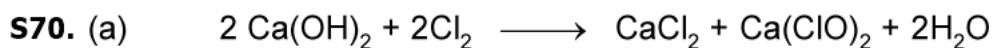
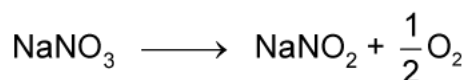
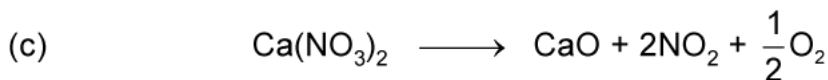
If carbon dioxide gas is passed in excess, the milkiness disappears due to formation of $\text{Ca(HCO}_3)_2$, which is soluble in water.



S67. (a) This is because with increase in size (from Be to Ba) the lattice enthalpy decreases significantly but hydration enthalpy remains almost constant.

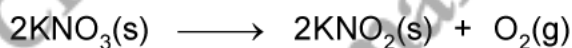
(b) Because of higher sum of $(\Delta_f H)_I$ and $(\Delta_f H)_{II}$ of Be than that of Mg, the M—OH bond can break less easily in Be(OH)_2 than in Mg(OH)_2 . In other words, Be(OH)_2 acts as a weak base even weaker than Mg(OH)_2 .



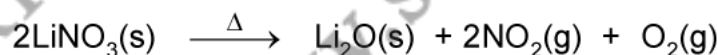


S74. (a) **Nitrates:**

Thermal stability: Nitrates of alkali metals, except LiNO_3 , decompose on strong heating to form nitrites.



LiNO_3 , on decomposition, gives oxide.



Similar to lithium nitrate, alkaline earth metal nitrates also decompose to give oxides.

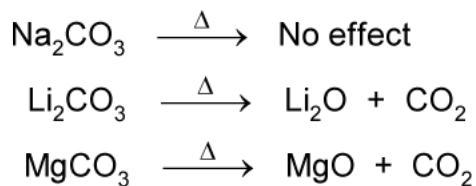


As we move down group 1 and group 2, the thermal stability of nitrate increases.

Solubility: Nitrates of both group 1 and group 2 metals are soluble in water.

(b) **Carbonates:**

Thermal stability: The carbonates of alkali metals are stable towards heat. However, carbonate of lithium, when heated, decomposes to form lithium oxide. The carbonates of alkaline earth metals also decompose on heating to form oxide and carbon dioxide.



Solubility: Carbonates of alkali metals are soluble in water with the exception of Li_2CO_3 . Also, the solubility increases as we move down the group.

Carbonates of alkaline earth metals are insoluble in water.

(c) **Sulphates:**

Thermal stability: Sulphates of both group 1 and group 2 metals are stable towards heat.

Solubility: Sulphates of alkali metals are soluble in water. However, sulphates of alkaline earth metals show varied trends.

BeSO_4 Fairly soluble

MgSO_4 Soluble

CaSO_4 Sparingly soluble

SrSO_4 Insoluble

BaSO_4 Insoluble

In other words, while moving down the alkaline earth metals, the solubility of their sulphates decreases.

S75. (a) $\text{Be}(\text{OH})_2 < \text{Mg}(\text{OH})_2 < \text{Ca}(\text{OH})_2$

(b) $\text{CaCl}_2 < \text{MgCl}_2 < \text{BeCl}_2$

(c) $\text{CaCl}_2 < \text{MgCl}_2 < \text{BeCl}_2$

(d) $\text{CaF}_2, \text{MgF}_2, \text{BaF}_2$

(e) $\text{Ba}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+}$

Name :

M.M.: 41

Time : 05:00

Date: 16/10/2021

- Q1. Explain why alkaline earth metals have higher first ionization enthalpies than the corresponding alkali metals. 1**
- Q2. The hydroxides and carbonates of sodium and potassium are easily soluble in water whereas that of magnesium and calcium are sparingly soluble in water. Explain. 1**
- Q3. Describe two important uses of each of the following: 1**
(a) caustic soda, (b) sodium carbonate, (c) quick lime
- Q4. Explain why alkali and alkaline earth metals cannot be obtained by chemical reduction methods? 1**
- Q5. Why do alkali metals impart characteristic colours to the flame of a Bunsen burner? What is the colour imparted to the flame by each of the following metals? Lithium, Sodium and Potassium. 1**
- Q6. Mg_3N_2 when reacted with water gives off NH_3 but HCl is not obtained from $MgCl_2$ on reaction with water at room temperature. 1**
- Q7. Compare the alkali metals and alkaline earth metals with respect to (a) ionization enthalpy (b) basicity of oxides and (c) solubility of hydroxides. 2**
- Q8. IE_1 of Be is greater than Li and B both. Explain. 2**
- Q9. In what ways does lithium show similarities to magnesium in its chemical behaviour? 2**
- Q10. Give the chemical formulae of the following: 2**
(a) Gypsum (b) Magnesite (c) Epsom salt (d) Plaster of Paris
- Q11. Explain why: 2**
(a) LiCl is predominantly covalent while NaCl is ionic.
(b) $Be(OH)_2$ is almost insoluble in water while $Ba(OH)_2$ is soluble.
- Q12. Explain why: 2**
(a) Pellets of potassium hydroxide become wet when exposed to air.
(b) During electrolysis of molten sodium chloride, calcium chloride or potassium chloride is added.
- Q13. Explain the following: 2**
(a) Sodium metal is stored under kerosene
(b) Sodium wire is used to dry benzene but cannot be used to dry ethanol.
- Q14. Explain why: 2**
(a) $BeCO_3$ is less stable than $MgCO_3$.
(b) K_2CO_3 cannot be prepared by Solvay's process.
- Q15. What happens when 2**
(a) Beryllium carbide reacts with water.
(b) Sodium sulphate solution is added to an aqueous solution of barium nitrate.

- Q16.** Addition of NaOH solution to a solution of ZnCl_2 produces a white precipitate which dissolves in excess of NaOH and forms soluble sodium zincate. Why? 2
- Q17.** State as to why 3
- (a) a solution of Na_2CO_3 is alkaline?
 - (b) alkali metals are prepared by electrolysis of their fused chlorides?
 - (c) sodium is found to be more useful than potassium?
- Q18.** Comment on each of the following observations: 3
- (a) The mobilities of the alkali metal ions in aqueous solution are $\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{Rb}^+ < \text{Cs}^+$.
 - (b) Lithium is the only alkali metal to form a nitride directly.
 - (c) (where M = Ca, Sr or Ba) is nearly constant.
- Q19.** Explain the significance of sodium, potassium, magnesium and calcium in biological fluids. 3
- Q20.** How would you explain the following observations? 3
- (a) BeO is almost insoluble but BeSO_4 is soluble in water,
 - (b) BaO is soluble but BaSO_4 is insoluble in water,
 - (c) LiI is more soluble than KI in ethanol.
- Q21.** How would you distinguish between: 3
- (a) Magnesium and calcium
 - (b) BeSO_4 and BaSO_4
 - (c) KNO_3 and LiNO_3

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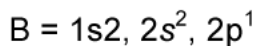
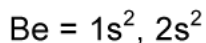
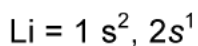
Total Marks = 41

Date: 16/10/2021

- S1.** Since the atoms of the alkaline earth metals have smaller size as compared to alkali metals, electrons in the outermost shells of the alkaline earth metals are tightly held. Moreover, alkali metals have relatively stable electronic configurations. Consequently, their ionization enthalpies are higher than those of alkali metals. **1**
- S2.** The hydroxides and carbonates of calcium and magnesium have quite high lattice enthalpy which is not compensated by hydration enthalpy. Hence, they are sparingly soluble in water. On the other hand, hydroxides and carbonates of sodium and potassium have smaller lattice enthalpy which is more than compensated by their hydration enthalpy. Hence, they are easily soluble in water. **1**
- S3.** (a) In soap industry, in petroleum industry. **1**
(b) In glass and soap industry, in paper making.
(c) As drying agent, As a constituent of mortar.
- S4.** Alkali and alkaline earth metals are themselves very strong reducing agents and reducing agents stronger than them are not easily available. Therefore, these metals cannot be obtained by chemical reduction methods. **1**
- S5.** When the alkali metal or any of its compounds is introduced into a flame, the electrons absorb energy from flame and get excited to higher energy levels. When these electrons come to ground state, the absorbed energy is given out in the form of radiations in the visible region. **1**
- Lithium imparts carmine red, sodium golden yellow and potassium pink violet colour to the flame.
- S6.** Mg_3N_2 is a salt of a strong base, $Mg(OH)_2$ and a weak acid (NH_3) and hence gets hydrolysed to give NH_3 . In contrast, $MgCl_2$ is a salt of a strong base, $Mg(OH)_2$ and a strong acid, HCl and hence does not undergo hydrolysis to give HCl. **1**
- S7.** (a) **Ionization enthalpy:** Because of higher nuclear charge and smaller atomic size, the ionization enthalpies of alkaline earth metals are higher than those of the corresponding alkali metals. **2**
(b) **Basicity of oxides:** Since the ionization enthalpy of alkali metals is less or the electropositive character of alkali metals is more than that of the corresponding alkaline earth metal, therefore, *alkali metal oxides are more basic than the corresponding alkaline earth metal oxides.*
(c) **Solubility of hydroxides:** Due to smaller size and higher ionic charge, the lattice enthalpies of alkaline earth metals hydroxides are much higher than those of alkali metals and hence the solubility of alkali metal hydroxides is more than that of alkaline earth metal hydroxides.

S8. Consider their electronic configuration.

2



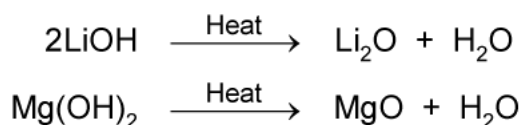
IE_1 of Be is greater than Li because completely filled $2s^2$ configuration is more stable than incompletely filled $2s^1$ configuration in Li. Also Be has higher nuclear charge.

In case of Boron, electron is removed from $2p^1$ and $2p$ being far away from nucleus shows easier removal of electron.

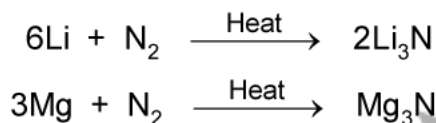
S9. Similarities between lithium and magnesium are as follows.

2

- (a) Both Li and Mg react slowly with cold water.
- (b) The oxides of both Li and Mg are much less soluble in water and their hydroxides decompose at high temperature.



- (c) Both Li and Mg react with N_2 to form nitrides.



- (d) Neither Li nor Mg form peroxides or superoxides.
- (e) The carbonates of both are covalent in nature. Also, these decompose on heating.



- (e) Li and Mg do not form solid bicarbonates.
- (f) Both LiCl and MgCl_2 are soluble in ethanol owing to their covalent nature.
- (g) Both LiCl and MgCl_2 are deliquescent in nature. They crystallize from aqueous solutions as hydrates, for example, $\text{LiCl} \cdot 2\text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 8\text{H}_2\text{O}$.

S10. (a) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (b) MgCO_3 (c) $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ (d) $(\text{CaSO}_4)_2 \cdot \text{H}_2\text{O}$ 2

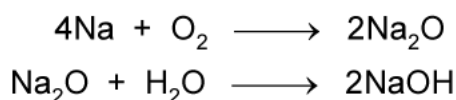
S11. (a) Lithium ion, due to its smaller size, has greater polarizing power than sodium ion. Hence, LiCl predominantly is covalent while NaCl is ionic. 2

- (b) Due to small size and high charge density beryllium ion has high polarizing power. Hence, Be(OH)_2 is covalent in character and is almost insoluble in water. On the other hand, Ba^{2+} ion is larger in size and has small polarizing power. Therefore, Ba(OH)_2 is ionic in character and is soluble in water.

S12. (a) Potassium hydroxide is highly deliquescent. It absorbs moisture from air and changes into solution. Thus, when potassium hydroxide pallets are exposed to air their surface becomes wet. **2**

(b) Pure sodium chloride melts at 815°C which is close to the boiling point of sodium. Moreover, chlorine gas has corrosive action on the cell at high temperature. To lower the fusion temperature of sodium chloride to about 600°C, some calcium chloride or potassium chloride is added to it.

S13. (a) Because of its reactivity with moisture and oxygen present in the air, sodium metal is stored under kerosene. **2**



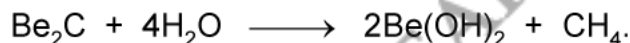
(b) Sodium metal removes moisture from benzene by reacting with water. However, ethanol cannot be dried by using sodium because it reacts with sodium.



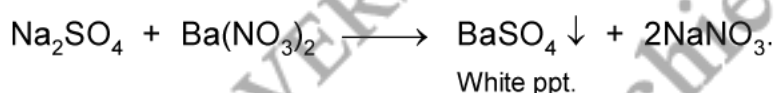
S14. (a) Be^{2+} ion is smaller in size than Mg^{2+} ion. Be^{2+} ion does not form a stable lattice with carbonate ion, which is quite large in size. Mg^{2+} ion, being larger, forms relatively stable lattice with carbonate ion. **2**

(b) K_2CO_3 cannot be prepared by Solvay's process because KHCO_3 being more soluble would not be precipitated in carbonation tower.

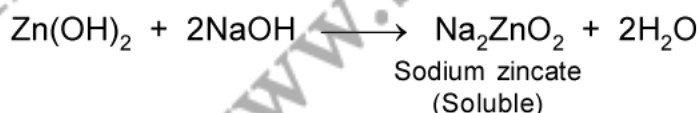
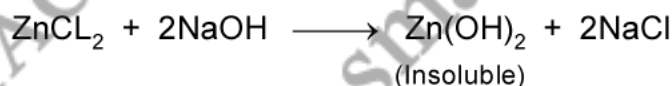
S15. (a) Beryllium carbide on reaction with water undergoes hydrolysis and liberates methane gas **2**



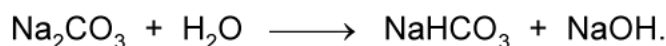
(b) Sodium sulphate reacts with barium nitrate solution and a white precipitate of barium sulphate is formed.



S16. ZnCl_2 reacts with NaOH to give a white precipitate of $\text{Zn}(\text{OH})_2$ which later dissolves in excess of NaOH and forms soluble sodium zincate. **2**



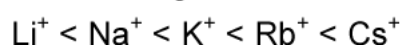
S17. (a) When sodium carbonate is added to water, it hydrolyses to give sodium bicarbonate and sodium hydroxide (a strong base). As a result, the solution becomes alkaline. **3**



- (b) It is not possible to prepare alkali metals by the chemical reduction of their oxides as they themselves are very strong reducing agents. They cannot be prepared by displacement reactions either (wherein one element is displaced by another). This is because these elements are highly electropositive. Neither can electrolysis of aqueous solutions be used to extract these elements. This is because the liberated metals react with water. Hence, to overcome these difficulties, alkali metals are usually prepared by the electrolysis of their fused chlorides.
- (c) Blood plasma and the interstitial fluids surrounding the cells are the regions where sodium ions are primarily found. Potassium ions are located within the cell fluids. Sodium ions are involved in the transmission of nerve signals, in regulating the flow of water across the cell membranes, and in transporting sugars and amino acids into the cells. Hence, sodium is found to be more useful than potassium.

S18. (a) On moving down the alkali group, the ionic and atomic sizes of the metals increase. **3**

The given alkali metal ions can be arranged in the increasing order of their ionic sizes as:



Smaller the size of an ion, the more highly is it hydrated. Since Li^+ is the smallest, it gets heavily hydrated in an aqueous solution. On the other hand, Cs^+ is the largest and so it is the least hydrated. The given alkali metal ions can be arranged in the decreasing order of their hydrations as:



Greater the mass of a hydrated ion, the lower is its ionic mobility. Therefore, hydrated Li^+ is the least mobile and hydrated Cs^+ is the most mobile. Thus, the given alkali metal ions can be arranged in the increasing order of their mobilities as:



- (b) Unlike the other elements of group 1, Li reacts directly with nitrogen to form lithium nitride. This is because Li^+ is very small in size and so its size is the most compatible with the N^{3-} ion. Hence, the lattice energy released is very high. This energy also overcomes the high amount of energy required for the formation of the N^{3-} ion.
- (c) Electrode potential (E°) of any M^{2+}/M electrode depends upon three factors:
- (i) Ionisation enthalpy (ii) Enthalpy of hydration (iii) Enthalpy of vaporisation
- The combined effect of these factors is approximately the same for Ca, Sr, and Ba. Hence, their electrode potentials are nearly constant.

S19. Importance of sodium, potassium, magnesium, and calcium in biological fluids: **3**

- (a) **Sodium (Na):** Sodium ions are found primarily in the blood plasma. They are also found in the interstitial fluids surrounding the cells.
- (i) Sodium ions help in the transmission of nerve signals.
- (ii) They help in regulating the flow of water across the cell membranes.
- (iii) They also help in transporting sugars and amino acids into the cells.
- (b) **Potassium (K):** Potassium ions are found in the highest quantity within the cell fluids.
- (i) K ions help in activating many enzymes.

(ii) They also participate in oxidising glucose to produce ATP.

(iii) They also help in transmitting nerve signals.

(c) **Magnesium (Mg) and calcium (Ca):** Magnesium and calcium are referred to as macro-minerals. This term indicates their higher abundance in the human body system.

(i) Mg helps in relaxing nerves and muscles.

(ii) Mg helps in building and strengthening bones.

(iii) Mg maintains normal blood circulation in the human body system.

(iv) Ca helps in the coagulation of blood

(v) Ca also helps in maintaining homeostasis.

S20. (a) BeO is almost insoluble in water and BeSO_4 is soluble in water. Be^{2+} is a small cation with a high polarising power and O^{2-} is a small anion. The size compatibility of Be^{2+} and O^{2-} is high. Therefore, the lattice energy released during their formation is also very high. When BeO is dissolved in water, the hydration energy of its ions is not sufficient to overcome the high lattice energy. Therefore, BeO is insoluble in water. On the other hand, ion is a large anion. Hence, Be^{2+} can easily polarise ions, making BeSO_4 unstable. Thus, the lattice energy of BeSO_4 is not very high and so it is soluble in water. **3**

(b) BaO is soluble in water, but BaSO_4 is not. Ba^{2+} is a large cation and O^{2-} is a small anion. The size compatibility of Ba^{2+} and O^{2-} is not high. As a result, BaO is unstable. The lattice energy released during its formation is also not very large. It can easily be overcome by the hydration energy of the ions. Therefore, BaO is soluble in water. In BaSO_4 , Ba^{2+} and are both large-sized. The lattice energy released is high. Hence, it is not soluble in water.

(c) LiI is more soluble than KI in ethanol. As a result of its small size, the lithium ion has a higher polarising power than the potassium ion. It polarises the electron cloud of the iodide ion to a much greater extent than the potassium ion. This causes a greater covalent character in LiI than in KI. Hence, LiI is more soluble in ethanol.

S21. (a) Magnesium when heated in a flame does not impart any characteristic colour to the flame whereas calcium imparts brick red colour to the flame. **3**

(b) BeSO_4 is soluble in water whereas BaSO_4 is insoluble in water.

(c) LiNO_3 on heating gives reddish brown fumes of NO_2 whereas KNO_3 on decomposition gives colourless O_2 gas.