NCERT Solutions for 11th Class Chemistry: Chapter 10-The s-Block Elements

NCERT Solutions for 11th Class Chemistry: Chapter 10-The s-Block Elements

Class 11: Chemistry Chapter 10 solutions. Complete Class 11 Chemistry Chapter 10 Notes.

NCERT Solutions for 11th Class Chemistry: Chapter 10-The s-Block Elements

NCERT 11th Chemistry Chapter 10, class 11 Chemistry Chapter 10 solutions

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

Answer: Physical properties of alkali metals:

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

Chemical properties of alkali metals:

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

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

Answer:

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

Question 3. Why are alkali metals not found in nature?

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

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

IndCareer

Answer: Let x be the oxidation state of Na in Na_2O_2 $2x + 2(-1) = 0$ $2x - 2 = 0$ $2x = 2$ $x = +1$.

Question 5. Explain why is sodium less reactive than potassium.

Answer: It is because ionization enthalpy ΔH_i of potassium = 419 kJ mol^{-1}.

Ionization enthalpy of sodium = 496 KJ mol. Since Ionization enthalpy of potassium is less than that of sodium, potassium is more reactive than sodium.

Question 6. Compare the alkali metals and alkaline earth metals with respect to (i) ionization enthalpy, (ii) basicity of oxides, (iii) solubility of hydroxides.

Answer: (i) Ionization enthalpy. Because of high nuclear charge the ionization enthalpy

of alkaline earth metals are higher than those of the corresponding alkali metals.

(ii) Basicity of oxides. Basicity of oxides of alkali metals are higher than that of alkaline earth metals.

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

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Question 7. In what ways lithium shows similarities to magnesium in its chemical behaviour?

Answer:

- Both react with nitrogen to form nitrides.
- Both react with 02 to form monoxides.
- Both the elements have the tendency to form covalent compounds.
- Both can form complex compounds.

Question 8. Explain why can alkali and alkaline earth metals not be obtained by chemical reduction method.

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

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

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

Question 10. When alkali metal dissolves in liquid ammonia, the solution can acquire different colours. Explain the reason for this type of colour change.

Answer: Alkali metals dissolve in liquid ammonia and give deep blue solutions which are conducting in nature because ammoniated

electrons absorb energy in the visible region of light and impart blue colour.

$$M + (x + y)\,NH_3 \longrightarrow [M(NH_3)_x]^+ + \underbrace{e^-(NH_3)_y}_{\text{Ammoniated electrons}}$$

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

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

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

Answer:

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

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

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

$$2\,NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + CO_2 + H_2O$$

$$Na_2CO_3 + 10\,H_2O \longrightarrow Na_2CO_3 \cdot 10\,H_2O$$

Question 13. Potassium carbonate cannot be prepared by Solvay process. Why?

IndCareer

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

Question 14. Why is Li_2CO_3 decomposed at a lower temperature whereas Na_2CO_3 at higher temperature?

Answer: Li_2CO_3 is a covalent compound whereas Na_2CO_3 is an ionic compound. Therefore, Lattice energy of Na_2CO_3 is higher than that of Li_2CO_3. Thus, $LiCO_3$ is decomposed at a lower temperature.

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

(a) Nitrates (b) Carbonates (c) Sulphates

Answer: (a) Nitrates of both group 1 and group 2 elements are soluble in water because hydration energy is more than the lattice energy.

Nitrates of both group 1 and group 2 elements are thermally unstable but they decompose differently except $LiCO_3$ e.g.

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

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

$$4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4\,NO_2 + O_2$$

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

(b) Carbonates of group 1 elements are soluble in water except Li_2CO_3 They are also thermally stable except Li_2CO_3

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

Group 2 carbonates are insoluble in water because their Lattice energy are higher than hydration energy.

Thermal stability of carbonates of group 2 increases down the group because Lattice energy goes no increasing due to increase in ionic character.

(c) Sulphates of group 1 are soluble in water except Li_2SO_4. They are thermally stable.

Solubility of sulphates of group 2 decreases down the group because Lattice energy dominates over hydration energy.

Sulphates of group 2 elements are thermally stable and increasing down the group due to increases in Lattice energy.

Question 16. Starting with sodium chloride how would you proceed to prepare.

(i) Sodium metal (ii) Sodium hydroxide

(iii) Sodium peroxide (iv) Sodium carbonate?

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

At cathode:

$Na^+ + e^- \text{——>} Na\ (l)$

At anode:

$2Cl^-$ (melt) ——-> Cl_2 (g) + $2e^-$.

(ii) Sodium hydroxide is manufactured by electrolysis of an aqueous solution of NaCl (brine) in Castner-Kellner cell.

At cathode:

$Na^+ + e^-$ ——> Na

2Na + Hg ——->Na – Hg + $2H_20$

2Na- Hg + $2H_20$——>2NaOH +H_2 +Hg

At anode:

$Cl^- – e^-$ ——->Cl

Cl + Cl———>Cl_2

(iii) Sodium peroxide:

4Na + 0_2 $2Na_2O$ + 0_2

(iv)Sodium carbonate is obtained by Solvay ammonia process.

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

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

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

Answer:

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

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

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

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

Question 18. Describe two important uses of each of the following: ,

(i) caustic soda (ii) sodium carbonate (iii) quick lime

Answer: (i) Caustic soda

(a) It is used in the manufacturing of soap paper, artificial silk etc.

(b) It is used in textile industries.

(ii) Sodium carbonate

(a) Used in the softening of water, for laundry and cleaning purposes.

(b) It is used in glass manufacturing.

(iii) Quick lime

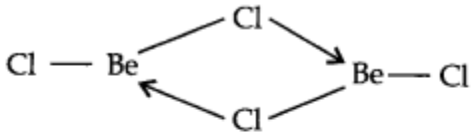
(a) It is used in the preparation of bleaching powder.

(b) Used in the purification of sugar and in the manufacturing of cement.

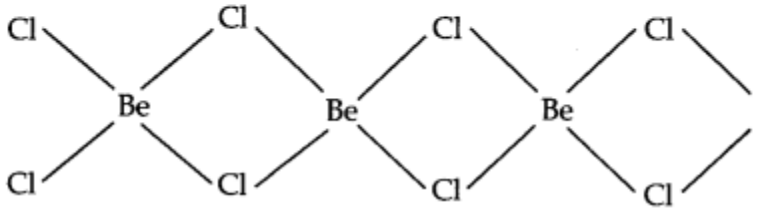
Question 19. Draw the structure of (i) $BeCl_2$ (vapour), (ii) $BeCl_2$ (solid).

Answer: $BeCl_2$ (vapour)

In the vapour state, it exists as a chlorobridged dimer.



$BeCl_2$ (solid)



Question 20. The hydroxides and carbonates of sodium and potassium are easily soluble in water while the corresponding salts of magnesium and calcium are sparingly soluble in water. Explain.

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

Question 21. Describe the importance of the following:

(i) Limestone (ii) Cement (iii) Plaster of Paris.

Answer: Limestone:

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

- Used as an antacid.

Cement:

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

Plaster of Paris:

- Used in plasters.
- In dentistry, in ornamental work for making statues.

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

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

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

Answer: It is due to high lattice energy of LiF as compared to LiCl.

LiCl is soluble in water because its hydration energy is higher than its lattice energy.

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

Answer: Sodium ions:

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

Potassium ions:

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

Magnesium ions:

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

Calcium:

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

Question 25. What happens when

(i) Sodium metal is dropped in water?

(ii) Sodium metal is heated in free supply of air?

(iii) Sodium peroxide dissolves in water?

Answer: (i) $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

(ii) $2Na + O_2 \longrightarrow Na_2O_2$

(iii) $Na_2O_2 + 2H20 \longrightarrow 2NaOH + H_2O_2$

Question 26. Comment 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) Ee for M^{2+} (aq) + $2e^-$ —> M(s) (where M = Ca, Sr, or Ba) is nearly constant.

Answer: (a) Smaller the size of the ion, more highly it is hydrated and hence greater is the mass of the hydrated ion and thus the ionic mobility become lesser. The extent of hydration decreases in the order.

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

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

(b) Due to its smaller size lithium can form nitride directly.

(c) It is because reduction potential depends upon sublimation energy, ionisation energy and hydration energy. Their resultant is almost constant for these ions.

Question 27. State as to why

(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 move useful than potassium?

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

$Na_2CO_3(s) + H_2O(l)———>2NaOH$

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

(c) Since potassium is move reactive than sodium and it is found in nature to a less extent than Na, sodium is found to be more useful.

Question 28.Write balanced equations for reactions between.

(a) Na_2O_2 and water

(b) KO_2 and water

(c) Na_2O and CO_2

Answer: (a) $Na_2O_2 + 2H_2O$ ——-> $2NaOH + H_2O_2$

(b) $2KO_2 + 2H_2O$ ———-> $2KOH + O_2 + H_2O_2$

(c) $Na_2O + CO_2$ ————>Na_2CO_3

Question 29. How would you explain the following observations?

(i) BeO is almost insoluble but $BeSO_4$ is soluble in water.

(ii) BaO is soluble but $BaSO_4$is insoluble in water.

(iii) Lil is more soluble than KI in ethanol.

Answer: (i) Lattice energy of BeO is compartively higher than the hydration energy. Therefore, it is almost insoluble in water. Whereas

$BeSO_4$ is ionic in nature and its hydration energy dominates the lattice energy.

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

(iii) Since the size of Li^+ ion is very small in comparison to K^+ ion, it polarises the electron cloud of I^- ion to a great extent. Thus Lil dissolves in ethanol more easily than the KI.

Question 30. Which of the alkali metal is having least melting point?

(a) Na (b) K (c) Rb (d) Cs

Answer: Size of Cs is the biggest thus, its melting point is the lowest, (d) is correct.

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

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

Answer: Li^+ is the smallest. Thus, it has the highest charge density and hence attracts the water molecules more strongly.

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

(a) $MgCO_3$ (b) $CaCO_3$ (c) $SrCO_3$ (d) $BaCO_3$

Answer: (d) $BaCO_3$

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Chapterwise NCERT Solutions for Class 11 Chemistry:

- Chapter 1-Some Basic Concepts
- Chapter 2-Structure of Atom
- Chapter 3-Classification of Elements and Periodicity in Properties
- Chapter 4-Chemical Bonding and Molecular Structure
- Chapter 5-States of Matter
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- Chapter 7-Equilibrium
- Chapter 8-Redox Reactions
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- Chapter 12-Organic Chemistry Some Basic Principles and Techniques
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