16

s-Block Elements

TOPIC 1

Group 1 Elements (Alkali Metals)

01 The following metal ion activates many enzymes, participates in the oxidation of glucose to produce ATP and with Na, is responsible for the transmission of nerve signals [NEET (Sep.) 2020]

(a)copper (c)potassium

(b) calcium n (d) iron

Ans. (c)

The ionic-gradients between two sides of a cell membrane, is operated by Na—K pump and consumes one-third of the ATP used by a resting animal. Potassium ion (K⁺) present in synapse helps transmission of nerve signals from one neuron to another.

02 Ionic mobility of which of the following alkali metal ions is lowest when aqueous solution of their salts are put under an electric field? [NEET 2017]
(a) Na (b) K
(c) Rb (d) Li

Ans. (d)

Key concept More the extent of hydration, lesser is the ionic mobility . In all the alkali metals, Li⁺ ion is smallest. Thus, extent of hydration is maximum in Li⁺ ion.

i.e. the dissolution of ${\rm Li}^+$ in water occurs and get hydrated. Smaller the size of a cation, greater is the extent of hydration and lesser is the ionic mobility.

03 The alkali metals form salt like hydrides by the direct synthesis at elevated temperature. The thermal stability of these hydrides decreases in which of the following orders? [CBSE AIPMT 2008] (a)CsH > RbH > KH > NaH > LiH (b)KH > NaH > LiH > CsH > RbH

(c)NaH > LiH > KH > RbH > CsH (d)LiH > NaH > KH > RbH > CsH Ans (d)

Ans. (d)

As the size of the alkali metal cation increases, thermal stability of their hydrides decreases. Hence, the correct order of thermal stability of alkali metal hydrides is LiH > NaH > KH > RbH > CsH

04 The sequence of ionic mobility in aqueous solution is [CBSE AIPMT 2008]

Ans. (b)

The smaller the size of the ion, the greater is the degree of hydration, thus degree of hydration is highest for Li^+ and lowest for Cs^+ . Thus, Li^+ holds more water molecules in its hydration sphere and becomes largest in size among alkali metals and Cs^+ . ion hold least number of water molecules.

Hence, ionic mobility is highest for Cs⁺. (due to its smallest size in aqueous solution) and lowest for Li⁺ Here the lowest is for Na⁺. Thus, the order of ionic mobility in aqueous solution is

 $Cs^+ > Rb^+ > K^+ > Na^+$

05 The correct order of the mobility of the alkali metal ions in aqueous solution is **[CBSE AIPMT 2006]** (a) $Li^+ > Na^+ > K^+ > Rb^+$ (b) $Na^+ > K^+ > Rb^+ > Li^+$ (c) $K^+ > Rb^+ > Na^+ > Li^+$ (d) $Rb^+ > K^+ > Na^+ > Li^+$

Ans. (d)

The correct order of the mobility of the alkali metal ions in aqueous solution is $Rb^+ > K^+ > Na^+ > Li^+$ due to following order of hydration energy of these ions $Li^+ > Na^+ > K^+ > Rb^+$ and as the hydration of ion increases, mobility decreases. Hydration enthalpy

1 Size of cation

- **06** Sodium is made by the electrolysis of a molten mixture of about 40% NaCl and 60% CaCl₂ because [CBSE AIPMT 1995]
 - (a) Ca²⁺ can reduce NaCl to Na
 - (b) Ca²⁺ can displace Na from NaCl
 - (c) CaCl₂ helps in conduction of electricity
 - (d) this mixture has a lower melting point than NaCl

Ans. (d)

The melting point of sodium chloride is high, so to reduce the melting point of NaCl some CaCl₂ is added to the electrolytic mixture.

07 A certain compound X when treated with copper sulphate solution yields a brown precipitate. On adding hypo solution, the precipitate turns white. The compound X is [CBSE AIPMT 1994]
(a) K₂CO₃ (b) KI

) K ₂ CO ₃	(b) KI	
) KBr	(d) K ₃ PO ₄	

Ans. (b)

(c

When potassium iodide is reacted with $CuSO_4$, it gives iodine gas which is brown colour. This iodine reacted with sodium thiosulphate and form white precipitate of sodium tetrathionate.

08 Which of the following is known as fusion mixture? [CBSE AIPMT 1994] (a) Mixture of $Na_2CO_3 + NaHCO_3$ (b) $Na_2CO_3 \cdot 10H_2O$ (c) Mixture of $K_2CO_3 + Na_2CO_3$ (d) $NaHCO_3$

Ans. (c)

A mixture of Na_2CO_3 and K_2CO_3 is used as a fusion mixture.

09 Which of the following elements is extracted commercially by the electrolysis of an aqueous solution of its compound?

(b)Br (c)Al (d)Na

Ans. (d)

(a)Cl

Sodium is prepared by electrolysis of molten NaCl as

 $2NaCI \xrightarrow{Electrolysis} 2Na + Cl_2$

At cathode : $2CI^{-} + 2e^{-} \longrightarrow CI_{2}$ At anode : $2Na \longrightarrow 2Na^{+} + 2e^{-}$

10 Which of the following has largest size? [CBSE AIPMT1993]

size? (a)Na

- (b)Na⁺
- (c)Na⁻

(d) Can't be predicted

Ans. (c)

Na⁻ has largest size because anion is always larger than neutral atom and cation is smaller than neutral atom. So the order is given as

Na⁻ > Na > Na⁺ Anion > Parental atom > Cation

11 Washing soda has formula [CBSE AIPMT 1990]

(a)Na₂CO₃·7H₂O (c)Na₂CO₃·3H₂O

Ans. (b)

Washing soda is chemicaly named as sodium carbonate decahydrate, so its formula is $Na_2CO_3 \cdot 10H_2O$.

12 Which one of the following properties of alkali metals increases in magnitude as the atomic number rises?

[CBSE AIPMT 1989]

(b)Na₂CO₃·10H₂O

(d)Na₂CO₃

- (a) lonic radius
- (b) Melting point
- (c) Electronegativity
- (d) First ionisation energy

Ans. (a)

The ionic radii of alkali metal increases as the atomic number increases when we move from top to bottom because on moving down the group, there is a increase in the number of shells and therefore, ionic radii increases.

TOPIC 2 Group 2 Elements (Alkaline Earth Metals)

13 Among the following alkaline earth metal halides, one which is covalent and soluble in organic solvents is **[NEET 2021]**

(a) calcium chloride

(b) strontium chloride

- (c) magnesium chloride
- (d) beryllium chloride

Ans. (d)

On moving down the group, the ionic size of alkaline earth metals increases. So, due to small size of Be^{2+} ion, Be has highest polarising power [ability to attract the electron cloud of anion (Cl⁻)].

∴ BeCl₂ is more covalent than other alkaline earth metal halides.

Organic molecules are covalent in nature. Rule for solubility is "Like dissolves like". So, BeCl₂ is soluble in organic solvents as both are covalent in nature.

14 The structures of beryllium chloride in solid state and vapour phase, are [NEET 2021]
(a) chain and dimer, respectively
(b) linear in both

(c) dimer and linear, respectively (d) chain in both

Ans. (a)

Beryllium chloride (BeCl₂) is an electron deficient compound. So, it does not exist in its monomer form.

In solid state and vapour phase, BeCl₂ exists in chain and dimer forms respectively.



15 HCl was passed through a solution of CaCl₂, MgCl₂ and NaCl. Which of the following compound(s)

crystallise(s)? [NEET (Sep.) 2020]

(a) Only NaCl (b) Only MgCl₂ (c) NaCl, MgCl₂ and CaCl₂

(d) Both MgCl₂ and CaCl₂

Ans. (a)

Let us explain the crystallisation process by a flow-sheet diagram.



16 What is the role of gypsum, CaSO₄ ·2H₂O is setting of cement? Identify the correct option from the following. **[NEET (Oct.) 2020]**

- (a) to fasten the setting process
- (b) to provide water molecules for
- hydration process
- (c) to help to remove water molecules
- (d) to slow down the setting process

Ans. (d)

 $\label{eq:Gypsum} \begin{array}{l} Gypsum(CaSO_4\cdot 2H_2O) \mbox{ is present in } \\ cement(Portland \mbox{ cement}) \mbox{ by a mass of } \\ 2\mbox{-}3\%. \end{array}$

Gypsum slow down the process of setting of cement so that it gets sufficiently hardened.

17 Which of the following is an amphoteric hydroxide?

(a)Ca(OH) ₂	(b)Mg(OH) ₂
(c)Be(OH) ₂	(d)Sr(OH) ₂

Ans. (c)

 ${\rm Be(OH)_2}$ is amphoteric in nature as it reacts with acid and alkali both as :

 $\begin{array}{l} \text{Be(OH)}_2 + 2\text{HCI} \longrightarrow \text{BeCI}_2 + 2\text{H}_2\text{O} \\ \text{Be(OH)}_2 + 2\text{NaOH} \longrightarrow \text{Na}_2[\text{Be(OH)}_4] \\ \text{This amphoteric nature of Be is due to} \\ \text{small size of Be. The other hydroxides of} \\ \text{alkaline earth metals are basic in nature.} \end{array}$

18 The product obtained as a result of a reaction of nitrogen with CaC₂ is **INEET 2016. Phase II**

	L
(a)CaCN	(b)CaCN ₃
(c)Ca ₂ CN	$(d) Ca(CN)_2$

Ans. (*)

When calcium carbide (CaC_2) reacts with nitrogen (N_2) under high temperature, it forms calcium cyanamide which is also called nitrolim.

High $CaC_2 + N_2 -$ CaCN₂ temperature Calcium cyanamide

+ C

Hence, option (d) should be CaCN₂ instead of Ca(CN)₂. Thus no option is correct.

- 19 Which of the following statements is false? [NEET 2016, Phase I]
 - (a) Ca²⁺ ions are important in blood clotting
 - (b) Ca²⁺ ions are not important in maintaining the regular beating of the heart
 - (c) Mg²⁺ ions are important in the green parts of plants

(d) Mg²⁺ ions form a complex with ATP

Ans. (b)

- Ca²⁺ ions are very important factor in blood clotting.
- Ca²⁺ ions are very important for maintaining the regular heart beating.
- Mg²⁺ ions is present in the green parts of plants i.e., chlorophyll.
- Mg²⁺ can form a complex with ATP.

20 In context with beryllium, which one of the following statements is incorrect? [NEET 2016, Phase II] (a) It is rendered passive by nitric acid

(b) It forms Be₂C

- (c) Its salts rarely hydrolyse
- (d) Its hydride is electron-deficient and polymeric

Ans. (c)

Beryllium salts are covalent in nature because of very small size of Be²⁺ ion and its high polarising power, so it is easily hydrolysed.

e.g. $BeCl_2 + 2H_2O \longrightarrow Be(OH)_2 + 2HCI$

21 Solubility of the alkaline earth's metal sulphates in water decreases in the sequence [CBSE AIPMT 2015]

(a) Mg> Ca> Sr> Ba (b)Ca>Sr>Ba>Mg (c)Sr>Ca>Mg>Ba (d)Ba>Mg>Sr>Ca

Ans. (a)

Solubility of the sulphates. The

sulphates becomes less soluble as you go down the group i.e.

Mg > Ca > Sr > Ba

The magnitude of the lattice energy remains almost constant as the size of the sulphate ion is so big that small increase in the size of the cation from Be to Ba does not make any difference. However, the hydration energy decreases from Be^{2+} to Ba^{2+} appreciably as the size of the cation increases down the group. The significantly high solubility of MgSO4 is due to high enthalpy of solvation of the smaller Mg²⁺ ions.

22 On heating which of the following releases CO₂ most easily? [CBSE AIPMT 2015] $(a)K_{a}CO_{-}$ (b)Na₂CO₃

(4)12003	
C)MUQUUz	
a / .	

Ans. (c)

Order of thermal stability is

 $K_2CO_3 > Na_2CO_3 > CaCO_3 > MgCO_3$ Hence, MgCO₃ releases CO₂ most easily $MgCO_3 \longrightarrow MgO + CO_2$

 $(d)CaCO_3$

23 Which one of the following is present as an active ingredient in bleaching powder for bleaching action? [CBSE AIPMT 2011] $(a)Ca(OCI)_2$ (b)CaO₂Cl₂

(d)CaOCl₂ (c)CaCl₂ Ans. (a)

 $Ca(OCI)_2$, calcium hypochlorite is the active ingredient in bleaching powder which releases chlorine.

24 Equimolar solutions of the following were prepared in water separately. Which one of the solutions will record the highest CRSF AIPMT 2008] nU2

pri:	LCDSE AIPINIT 2000
(a) SrCl ₂	(b)BaCl ₂
(c)MgCl ₂	(d)CaCl ₂

Ans. (b)

All salts are soluble in water and give strong acid and weak base

 $SrCl_2 + 2H_2O \longrightarrow Sr(OH)_2 + 2HCI$

 $BaCl_2 + 2H_2O \longrightarrow Ba(OH)_2 + 2HCI$

 $MgCl_2 + 2H_2O \longrightarrow Mg(OH)_2 + 2HCI$

 $CaCl_2 + 2H_2O \longrightarrow Ca(OH)_2 + 2HCI$

The basic nature of alkaline earth metals generally increases from Be to Ra. Thus, the order of basic nature of these hydroxides is

 $Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$ Hence, pH is highest for BaCl₂.(As pH increases with basic nature)

25 In which of the following the hydration energy is higher than the lattice energy? [CBSE AIPMT 2007] (a)BaS∩ (h)Maco

(c)RaSO ₄	(d)SrSO ₄
(a)BaSU ₄	(D)MgSU4

Ans. (b)

Hydration energy of sulphate decreases from top to bottom in II group. Mg²⁺ is smaller than other given ions of II group, so Mg^{2+} is readily hydrated. $MgSO_4$ has higher hydration energy than lattice energy.

26 The correct order of increasing thermal stability of K_2CO_3 , MgCO₃, $CaCO_3$ and $BeCO_3$ is

[CBSE AIPMT 2007]

(a) BeCO₃ < MgCO₃ < K_2CO_3 < CaCO₃ $(b)BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$ $(c)MgCO_3 < BeCO_3 < CaCO_3 < K_2CO_3$ $(d)K_2CO_3 < MgCO_3 < CaCO_3 < BeCO_3$

Ans. (b)

Thermal stability of carbonates increases in a group as we move from top to bottom and decreases in a period as we move from left to right, so the correct order of thermal stability of given carbonates is

 $BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$ Be, Mg and Ca are present in second group and K is present in first group.

- **27** Which one is the correct statement with reference to the solubility of MgSO₄ in water? [CBSE AIPMT 1996]
 - (a) SO_4^{2-} ions mainly contributes towards hydration energy
 - (b) Sizes of Mg^{2+} and SO_4^{2-} are similar
 - (c) Hydration energy of MgSO₄ is higher in comparison to its lattice energy
 - (d) Ionic potential (charge/radius ratio) of Mg²⁺ is very low

Ans. (c)

 ${\rm MgSO}_4$ is soluble in water because it have hydration energy more than lattice energy.

Mg²⁺ ions mainly contributes towards hydration energy

size of SO_4^{2-} ion is greation than Mg^{2+} ions

28 Identify the correct statement. [CBSE AIPMT 1995]

- (a) Gypsum is obtained by heating plaster of Paris
- (b) Plaster of Paris can be obtained by hydration of gypsum

- (c) Plaster of Paris is obtained by partial oxidation of gypsum
- (d) Gypsum contains a lower percentage of calcium than plaster of Paris

Ans. (d)

The formula of gypsum is $CaSO_4 \cdot 2H_2O$ and that of plaster of Paris is $(CaSO_{4})_{2} \cdot 2H_{2}O_{1}$ so the percentage of Ca in plaster of Paris is more than gypsum.

29 Which of the following statement is false? [CBSE AIPMT 1994]

- (a) Strontium decomposes water readily than beryllium
- (b) BaCO₂ melts at a higher temperature than CaCO₃
- Barium hydroxide is more soluble in (c) water than Mg(OH)₂
- Beryllium hydroxide is more basic (d) than barium hydroxide

Ans. (d)

The size of beryllium is very small and the hydroxide formed by it, are amphoteric in nature, so its hydroxide is less basic than barium hydroxide.

30 Which of the following metal ions play an important role in muscle

> contraction? [CBSE AIPMT 1994] (c)Mg²⁺ (d)Ca²⁺ (a)K⁺ (b)Na⁺ Ans. (d)

Calcium ion (Ca²⁺) play an important role in muscle contraction.

31 The formula for calcium chlorite is [CBSE AIPMT 1994]

 $(a)Ca(CIO_4)_2$ $(b)Ca(CIO_3)_2$ $(c)CaClO_2$ $(d)Ca(CIO_2)_2$

Ans. (d)

The formula of calcium chlorite is $Ca(CIO_2)_2$.

32 All the following substances react with water. The pair that gives the same gaseous product is [CBSE AIPMT 1994]

(a) K and CO₂ (b) Na and Na₂O₂ (c) Ca and CaH₂ (d) Ba and BaO₂

Ans. (c)

Ca and CaH₂ gives H₂ and calcium hydroxide when reacted with water.

> $\text{Ca} + \text{H}_2 \text{O} \longrightarrow \text{Ca}(\text{OH})_2 + \text{H}_2 \uparrow$ $CaH_2 + 2H_2O \longrightarrow Ca(OH)_2 + 2H_2\uparrow$

- **33** Which one of the following has minimum value of size of cation/anion ratio?
 - [CBSE AIPMT 1993] (b) KCI (a) NaCl (c)MgCl₂ $(d)CaF_2$

Ans. (c)

The size of Mg^{2+} is minimum among Na^{+} , Ca^{2+} , K^{+} and Mg^{2+} and size of CI^{-} is more than F⁻, so the ratio of size of cation and anion are minimum in MgCl₂.

34 When chlorine is passed over dry slaked lime at room temperature, the main reaction product is [CBSE AIPMT 1992]

(c)CaOCl₂

Ans. (c)

When chlorine gas is passed over dry slaked lime, it form bleaching powder i.e. CaOCl₂.

 $Ca(OH)_2 + CI_2 \longrightarrow CaOCI_2 + H_2O$

35 Compared with the alkaline earth metals, the alkali metals exhibit [CBSE AIPMT 1990]

(a) smaller ionic radii

(b) higher boiling points

(c) greater hardness

(d) lower ionisation energies

Ans. (d)

Alkali metals have the lowest ionisation enthalpy in each period because alkali metals are largest in their respective periods and therefore, the valency electrons are loosely held by the nucleus.

36 Which of the following metal evolves hydrogen on reacting with cold dilute HNO₃?

[CBSE AIPMT 1989]

(b)	AI
(d)	Cu

(c) Fe

Ans. (a)

(a) Mg

Magnesium react with cold and dilute nitric acid to form hydrogen.

 $Mg + 2HNO_3 \longrightarrow Mg(NO_3)_2 + H_2$

37 Which one of the following atoms will have the smallest size? [CBSE AIPMT 1989]

	LODOL AIL III	
a) Mg	(b)Na	
c)Be	(d)Li	

Ans. (c)

Atomic size increases down the group and decreases in period from left to right. So, Be is smallest in size in these elements.

Alkali Alkaline earth metal metal Group 1 Group 2



Size decreases

38 Bleaching powder is obtained by the action of chlorine gas and [CBSE AIPMT 1988]

(a) dilute solution of Ca(OH)₂ (b) concentrated solution of Ca(OH)₂ (c) dry CaO

(d) dry slaked lime

Ans. (d)

Bleaching powder is prepared by passing chlorine gas over dry slaked lime Ca(OH)₂ by Hesenclaver method or by Bachmann method.

 $Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$

$(a)Ca(CIO_2)_2$ (b)CaCl₂ $(d)Ca(OCI)_2$