

10.THE S-BLOCK ELEMENTS

The diagonal relationship within s-block elements

	Group 1	Group 2	Group 13	Group 14
Second period	Li	Be	B	C
Third period	Na	Mg	Al	Si

Ramanujan School of Mathematics and Physics

Theory + NCERT MCQs + Topic Wise Practice
MCQs + NEET PYQs

Physical Properties

- Atomic radii/ionic radii: increase with increase in atomic no. & decreases down the group.
- Ionization energy: decreases down the group.
- Density increases down the group.

- General electronic configuration: (Noble gas) ns^1
- Belong to group 1 of the periodic table

- Flame colour:
 - Li: Crimson red
 - Na: Yellow
 - K: Violet
 - Rb: Red violet
 - Cs: Blue
 - Fr: Red violet
- Low M.P. and B.P.
- Forms ionic compounds

Anomalous behaviour of Li is due to:

- Exceptionally small size of Li^+ ion and low hydration enthalpy.
- Absence of d orbitals.
- High ionization enthalpy.

Biological importance of Na and K

- Sodium ions participate in neuronal signal transmission. Regular flow of Na^+ ions across cell membrane is essential for generation and conduction of action potential.
- ATP.

USES

- Li is used to make alloys.
- NaCl is used as fertilizer.
- CS is used in drying photographic film.
- Li is used in nuclear reactors.

Alkali Metals

Li	Na	K	Rb	Cs	Fr
3	11	19	37	55	87

Sodium Chloride (NaCl)

- Obtained from sea water.
- Used for the preparation of $NaOH$ and Na_2CO_3 .

Importance of Sodium Compounds

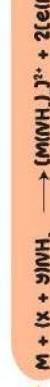


Alkaline Earth Metals

Be	Mg	Ca	Sr	Ba	Ra
4	12	20	38	56	88

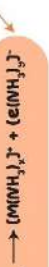
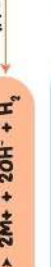
Chemical Properties

Be & Mg are kinetically inert to O & H₂O.



(X = F, Cl, Br, I)

Chemical Properties



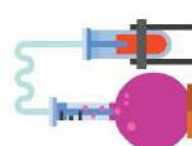
Physical Properties

- Atomic & ionic radii: smaller than the corresponding alkali group, increases with increase in atomic number.
- Density: increases down the group.

- Density: increases from Be to Ca & decreases from Ca to Ra.
- General electronic configuration: (Noble gas) ns^2
- Belong to group 2 of the periodic table.

- Flame colour:
 - Ca: Brick red
 - Sr: Crimson
 - Ba: Apple green
 - Ra: Red
- Higher M.P. & B.P. than corresponding alkali metals.

Forms ionic compounds except Be



Uses

- Be is used to manufacture alloys.
- Ca is used in extraction of metals.
- Mg-Al alloys are used in aircraft construction.
- Ra is used in radio therapy.

Importance of Calcium Compounds



THE S-BLOCK ELEMENTS

Introduction

In the previous chapter we have discussed about The Hydrogen but in this chapter we will study the general characteristics of the alkali and alkaline earth metals and their compounds. We will also study the compounds of s-block elements, their uses and importance, commercially and industrially. The biological significance of sodium, potassium, calcium and magnesium will also be discussed in this chapter.

The s-Block Elements

The s-block elements of the Periodic Table are those in which the last electron enters the outermost s-orbital. As the s-orbital can accommodate only two electrons, two groups (1 & 2) belong to the s-block of the Periodic Table.

Group-1 of periodic table contains

Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Caesium (Cs) and Francium (Fr). Together these elements are called alkali metals because they form hydroxides on reaction with water, which are strongly alkaline in nature.

The group-2

Includes Beryllium (Be), Magnesium (Mg), Calcium (Ca), Strontium (Sr), Barium (Ba) and Radium (Ra). Except Beryllium, rest of the elements of group-2 are called the alkaline earth metals. These are called so because their oxides and hydroxides are alkaline in nature and these metal oxides are found in the earth crust.

Group-1 Elements : Alkali Metals

1. Electronic Configuration

Electronic Configuration of elements of group-1 is ns^1 , where n represents the valence shell. The alkali metals have one valence electron, outside the noble gas core.

Element	Symbol	Electronic configuration
Lithium	Li	$1s^2 2s^1$
Sodium	Na	$1s^2 2s^2 2p^6 3s^1$
Potassium	K	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
Rubidium	Rb	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^1$
Caesium	Cs	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$ $4p^6 4d^{10} 5s^2 5p^6 6s^1$ or [Xe] $6s^1$
Francium	Fr	[Rn] $7s^1$

2. Atomic and ionic radii

The atoms of alkali metals have the largest size in their respective periods. The atomic radius increases on moving down the group because on moving down the group there is a progressive addition of new energy shells.

3. Ionization enthalpy

The ionization enthalpies of the alkali metals are generally low and decrease down the group from Li to Cs. This is because on moving down the group is due to increase in size of the atoms of alkali metals and increase in the magnitude of screening effect.

4. Hydration enthalpy

The alkali metal ions are extensively hydrated in aqueous solutions. The hydration enthalpies of alkali metal ions decrease with increase in ionic size $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+$.

5. Physical properties

- Alkali metals are silvery white in colour and are generally soft and light metals.
- The densities of alkali metals are low and increase down the group. Alkali metals have low melting and boiling point.
- When alkali are heated metals they impart characteristic colours to the flame.
- When the excited electron comes back to the ground state, there is emission of radiation in the visible region.

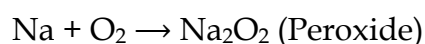
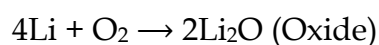
6. Chemical Properties

The alkali metals are highly reactive elements. The cause for their high chemical reactivity is:

- Low value of first ionisation enthalpy
- Large size

iii. low heat of atomisation.

- i. **Reaction with Air:** Alkali metals burn very fast in oxygen and form different kind of oxides like monoxides, peroxides and superoxides. In all the compounds formed by alkali metals with oxygen, their oxidation state is +1.

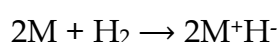


- ii. **Reaction with Water:** The alkali metals on reaction with water form their respective hydroxide and dihydrogen.



(M = an alkali metal)

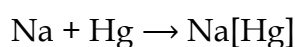
- iii. **Reaction with Dihydrogen:** Alkali metal react with dry di-hydrogen at about 673K (lithium at 1073K) to form crystalline hydrides which are ionic in nature and have high melting points.



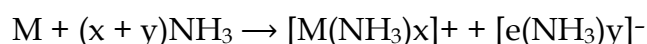
- iv. **Reaction with Halogens:** The alkali metals react vigorously with halogens and form halides which are ionic in nature, M^+X^- . But the halides of lithium are a bit covalent in nature.

- v. **Reaction with Mercury:** The alkali metals have strong tendency to get oxidised, that is why they act as strong reducing agents, among these lithium is the strongest and sodium is the least powerful reducing agent.

- vi. **Reducing Nature:** Alkali metals combine with mercury to form amalgams. The reaction is highly exothermic in nature.



- vii. **Solutions in liquid Ammonia:** All alkali metals dissolve in liquid ammonia and give deep blue colour solution which are conducting in nature. These solutions contain ammoniated cations and ammoniated electrons as shown below:



Uses of Alkali Metals

1. Lithium is used as a metal in a number of alloys. Its alloys with aluminium to make aircraft parts.
2. Lithium hydroxides is used in the ventilation systems of space crafts and submarines to absorb carbondioxide.
3. Lithium aluminium hydride (LiAlH_4) is a powerful reducing agent which is

commonly used in organic synthesis.

4. Liquid sodium or its alloys with potassium is used as a coolant in nuclear reactors.
5. Sodium-lead alloy is used for the preparation of tetraethyl lead, $\text{Pb}(\text{C}_2\text{H}_5)_4$, which is used as an antiknocking agent in petrol.
6. Sodium is used in the production of sodium vapour lamps.
7. Potassium chloride is used as fertilizer.
8. Potassium hydroxide is used in the manufacture of soft soaps and also as absorbent of carbon dioxide.
9. Potassium ions play a vital role in biological systems.
10. Caesium is used in photoelectric cells.

Anomalous Properties of Lithium

Lithium shows properties which are very different from the other members of its group. This is due to the:

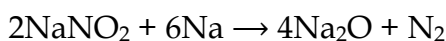
1. Exceptionally small size of its atom and ion.
2. Greater polarizing power of lithium ion.
3. As compared to other alkali metals, lithium is harder and its melting point and boiling point are higher.
4. Among all the alkali metals lithium is least reactive but the strongest reducing agent.

Some important Compounds of Sodium

Sodium is highly reactive and always found in combined state. The isotope of sodium (Na) is used in detection of leukemia. The compound of sodium are given below:

1. Sodium Oxide (Na_2O)

Preparation:



Properties:

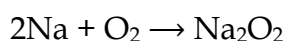
1. Sodium oxide is a colourless ionic solid.

2. Aqueous solution of sodium oxide is strongly basic.
3. Sodium oxide on reaction with liquid ammonia forms sodamide.
4. At low temperature, when sodium peroxide is reacted with water or acids, H_2O_2 is formed.

2. Sodium Peroxide (Na_2O_2)

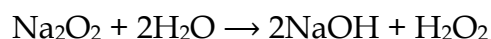
Preparation:

Sodium when heated in excess of air or when heated in excess of pure oxygen gives sodium peroxide.



Properties:

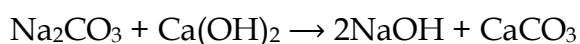
1. Sodium peroxide is a pale yellow diamagnetic compound.
2. Sodium peroxide is a powerful oxidising agent.
3. Sodium peroxide combines with CO and CO_2 to give carbonate.
4. At low temperature, when sodium peroxide is reacted with water or acids, H_2O_2 is formed.



3. Sodium Hydroxide (Caustic Soda) (NaOH)

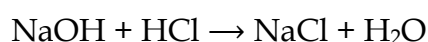
Preparation:

When sodium carbonate is treated with calcium hydroxide it gives calcium carbonate along with sodium hydroxide. Also known as lime caustic soda process. It is a reversible reaction.



Properties

1. Sodium hydroxide is a white crystalline deliquescent solid.
2. Sodium hydroxide is corrosive in nature.
3. Sodium hydroxide is highly soluble in water.
4. Sodium hydroxide reacts with acid forming corresponding salts.



Uses:

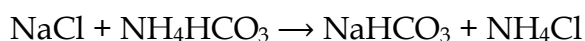
It is used in the manufacture of soap, paper, artificial silk and a number of chemicals,

1. In petroleum refining.
2. In the purification of bauxite.

3. In the textile industries for mercerising cotton fabrics.
4. For the preparation of pure fats and oils.
5. As a laboratory reagent.

4. Sodium Carbonate (Na_2CO_3)

Preparation:

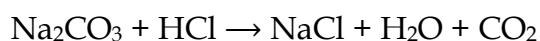


Properties:

1. Sodium carbonate is a white crystalline solid.
2. $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ is known as washing soda.
3. Sodium carbonate reacts with acids to give carbon dioxide.

Uses:

1. It is used in water softening, laundering and cleaning.
2. It is used in the manufacture of glass, soap, borax and caustic soda.
3. It is used in paper, paints and textile industries.
4. It is an important laboratory reagent both in qualitative and quantitative analysis.



Properties:

On heating sodium bicarbonate loses CO_2 and H_2O forming Na_2CO_3 .



5. Sodium Chloride (NaCl)

Manufacture of sodium chloride is done from sea water. Sea water is allowed to dry up under summer heat in small tanks and solid crust so formed is collected.

Properties:

1. Sodium chloride is a white crystalline solid.
2. It is slightly hygroscopic.
3. It is soluble in water and insoluble in alcohol.

Uses:

1. It is used as a common salt or table salt for domestic purpose.

2. It is used for the preparation of Na_2O_2 , NaOH and Na_2CO_3 .

6. Sodium Bicarbonate (Baking Soda) (NaHCO_3)

Preparation:

When NaOH is treated with CO_2 in presence of H_2O it gives sodium bicarbonate.



Properties:

On heating sodium bicarbonate loses CO_2 and H_2O forming Na_2CO_3 .



Group-2 Elements : Alkaline Earth Metals

The elements of group-2 are Beryllium (Be), Magnesium (Mg), Calcium (Ca), Strontium (Sr), Barium (Ba) and Radium (Ra). Except for Be, rest are known as alkaline earth metals, because they were alkaline in nature and existed in the earth.

1. Electronic Configuration

The alkaline earth metals have 2 electrons in the s-orbital of the valence shell. Their general electronic configuration [Noble gas] ns^2

Element	Symbol	Electronic configuration
Beryllium	Be	$1s^2 2s^2$
Magnesium	Mg	$1s^2 2s^2 2p^6 3s^2$
Calcium	Ca	$1s^2 2s^2 2p^6 3s^2 3p^4 s^2$
Strontium	Sr	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2$
Barium	Ba	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6 6s^2$ or [Xe] $6s^2$
Radium	Ra	[Rn] $7s^2$

2. Atomic and Ionic Radii

The atomic radii as well as ionic radii of the members of the family are smaller than the corresponding members of alkali metals. Within the group, the atomic and ionic radii increase with increase in atomic number.

3. Ionization Enthalpies

The alkaline earth metals owing to their large size of atoms have fairly low values of ionization enthalpies. Within the group, the ionization enthalpy decreases as the atomic number increases.

4. Hydration Enthalpies

The hydration enthalpies of alkaline earth metal ions are larger than those of alkali metal ions. Therefore, compounds of alkaline earth metals are more extensively hydrated, for example, magnesium chloride and calcium chloride exist. the hydration enthalpies of alkaline earth metal ions decrease with increase in ionic size down the group. $\text{Be}^{2+} > \text{Mg}^{2+} > \text{Ca}^{2+} > \text{Sr}^{2+} > \text{Ba}^{2+}$

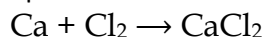
5. Physical Properties

The alkaline earth metals are silvery white, lustrous and relatively soft but harder than the alkali metals. The melting and boiling points of these metals are higher than the corresponding alkali metals. The electropositive character increases down the group from Be to Ba, Calcium, strontium and barium impart characteristic brick red, crimson and apple green colours respectively to the flame. The alkaline earth metals just like those of alkali metals have high electrical and thermal conductivities.

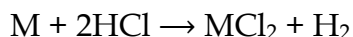
6. Chemical Properties

As compared to alkali metals, alkaline earth metals are less reactive due to their relatively higher ionization enthalpies. The reactivity of alkaline earth metals increases on going down the group.

- i. **Reaction with water:** Ca, Sr, and Ba have reduction potentials similar to those of corresponding group 1st metals and are quite high in the electrochemical series. They react with cold water readily, liberating hydrogen forming metal hydroxides.
$$\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$$
- ii. **Reaction with Air:** Except Be these metals are easily tarnished in air as a layer of oxide is formed on their surface. Ba in powdered form bursts into flame on exposure to air.
- iii. **Reaction with hydrogen:** The elements Mg, Ca, Sr and Ba all react with hydrogen to form hydrides MH_2 .
- iv. **Reaction with oxygen:** Except Ba and Ra the elements when burnt in oxygen form oxides of the type MO .
- v. **Reaction with halogens:** When heated with halogens the alkaline earth metals directly combine with them and form the halides of the type MX_2 .



vi. **Reaction with acids:** The alkaline earth metals readily react with acids liberating dihydrogen.



Uses of alkaline earth metals:

1. Beryllium is used in the manufacture of alloys. Cooper-Beryllium alloys are used in the making of high strength springs.
2. Metallic beryllium is used for making windows of X-rays tubes.
3. Magnesium, being a light metal, forms many light alloys with aluminum, zinc, manganese and tin.
4. Magnesium is used in flash powders and bulbs, incendiary bombs and signals.
5. Magnesium-aluminium alloys are used in aircraft construction.
6. Magnesium is used as sacrificial anode for the prevention of corrosion of iron.
7. A suspension of magnesium hydroxide in water (called milk of magnesia) is used as an ant-acid to control excess acidity in stomach.
8. Magnesium carbonate is an ingredient of tooth-paste.
9. Calcium is used in the extraction of metals from oxides which are difficult to reduce with carbon.
10. Calcium and barium metals are used to remove air from vacuum tubes, due to their tendency to react with oxygen and nitrogen at high temperature.
11. Radium salts are used for radio therapy of cancer.

Anomalous Behaviour of Beryllium

Beryllium shows different behaviour from the rest members of its group and shows diagonal relationship to aluminium due to reasons discussed below.

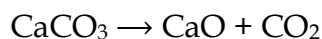
1. Beryllium has exceptionally small atomic and ionic sizes and therefore does not compare well with other members of the group, because of high ionisation enthalpy and small size it forms compounds which are largely covalent and get easily hydrolysed.
2. Beryllium does not exhibit coordination number more than four as in its valence shell, there are only four orbitals. The remaining members of the group can have a coordination number of six by making use of d-orbitals.
3. The oxides and hydroxide of beryllium unlike the hydroxide of other elements in the group, are amphoteric in nature.

Compounds of Calcium

1. **Calcium Oxide (CaO)**

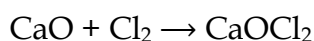
Preparation:

Calcium carbonate when decomposed at 800°C gives calcium oxide.

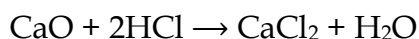


Properties:

1. Calcium oxide is also known as 'Quick lime' or 'Burnt lime', is white amorphous substance.
2. When water is added to lime a hissing sound is produced along with clouds of steam. The lime forms slaked lime $[\text{Ca}(\text{OH})_2]$.
3. Calcium oxide reacts with moist chlorine to form bleaching powder.



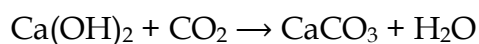
4. Calcium oxide on reaction with moist HCl gas forms CaCl_2 .



2. Calcium Carbonate (CaCO_3)

Preparation:

Carbon dioxide when passed through lime water gives calcium carbonate.



Properties:

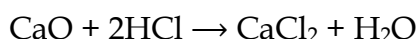
1. Calcium carbonate is a white powder insoluble in water.
2. Calcium carbonate dissolves in water in presence of CO_2 due to formation of calcium bicarbonate.



3. Calcium Chloride (CaCl_2)

Preparation:

Calcium oxide, calcium hydroxide or calcium carbonate when treated with HCl gives calcium chloride.



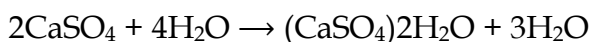
Properties:

1. Calcium chloride is a colourless deliquescent crystalline substance which is soluble in water as well as in alcohol.
2. Crystals of calcium chloride when strongly heated gives off water of crystallizations.

4. Calcium sulphate (Plaster of Paris)

Preparation:

When Gypsum is heated at about 120° - 130°C, Plaster of Paris is formed.

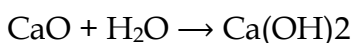


Properties:

1. It is a white crystalline solid. It is sparingly soluble in water.
2. It becomes anhydrous at about 200°C. Anhydrous form is known as dead burnt plaster.

5. Calcium hydroxide $\text{Ca}(\text{OH})_2$

Preparation:



Properties:

1. It gives CaCO_3 and $\text{Ca}(\text{HCO}_3)_2$ with CO_2
$$\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$$
2. On prolong treatment with CO_2 milkiness disappears due to formation of $\text{Ca}(\text{HCO}_3)_2$
$$\text{CaCO}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{Ca}(\text{HCO}_3)_2$$

Summary-

1. **s-block elements:** The elements in which last electron enters into s-orbital are called s-block elements.
2. **Alkali metals:** The elements of group 1 whose hydroxide are strong alkali.
3. **Alkaline earth metal:** The elements of group 2, and their oxides and hydroxides are alkaline in nature and their oxides are found in the Earth's crust.
4. **Diagonal relationship:** The resemblance in properties of elements of second period with elements of third period present diagonally on the right hand side.
5. Monovalent sodium and potassium ions and divalent magnesium and calcium ions are found in large proportions in biological fluids. These ions perform important biological functions such as maintenance of ion balance and nerve impulse conduction.

NCERT LINE BY LINE QUESTIONS

- (1.) Some statements are given below regarding Lithium metal. [Page: 296] I. The b.p. and m.p. of lithium are higher than the other alkali metals. II. Lithium hydrogen carbonate is obtained in solid form. III. Lithium forms ethynide on reaction with ethyne. IV. Lithium nitrate when heated gives lithium oxide. Which of the following statements are correct .
- (a.) I and II (b.) II and III
(c.) II and IV (d.) I and IV
- (2.) Lithium is alloyed with which metal to make white metal) [Page: 294]
- (a.) Lead (b.) Aluminium
(c.) Magnesium (d.) Silicon
- (3.) On passing excess of carbon dioxide in CaCO_3 , the precipitate dissolves to form [Page: 303]
- (a.) calcium hydrogen carbonate (b.) bleaching powder
(c.) limestone (d.) milk of lime

- (4.) On heating which of the following releases CO_2 most easily? [Re-AIPMT-2015, Page: 301]
- (a.) MgCO_3 (b.) CaCO_3
(c.) K_2CO_3 (d.) Na_2CO_3
- (5.) Which of the alkaline earth metals used salts in radiotherapy for the treatment of cancer [Page: 302]
- (a.) Radium (b.) Barium
(c.) Strontium (d.) Calcium
- (6.) The formula of washing soda is [Page: 296]
- (a.) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ (b.) $\text{Na}_2\text{CO}_3 \cdot 2\text{H}_2\text{O}$
(c.) $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ (d.) Na_2CO_3
- (7.) What is the chemical formula of dead burnt plaster ?. [Page: 303]
- (a.) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (b.) $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
(c.) CaSO_4 (d.) $\text{CaSO}_4 \cdot 5\text{H}_2\text{O}$
- (8.) Lithium, sodium, potassium, rubidium, caesium and francium are collectively known as the alkali metals, because [Page: 292]
- (a.) they form hydroxides on reaction with water which are strongly alkaline in nature. (b.) they form oxides on reaction with water which are weakly basic in nature.
(c.) they form hydrides on reaction with water which are acidic in nature. (d.) they form oxides and hydroxides on reaction with water which are acidic in nature.
- (9.) Which of the following alkali metals cannot form superoxide (O_2^-) ion) [Page: 293]
- (a.) K (b.) Rb
(c.) Cs (d.) Li
- (10.) Some statements regarding sodium are given below. [Page: 298] (I) Sodium ions are found primarily on the outside of cells. (II) Sodium ions are located in blood plasma and in the interstitial fluid which surrounds the cells. (III) Sodium ions participate in the transmission of nerve signals. (IV) Sodium ions regulate the flow of water across cell membrane. Choose the correct statements.
- (a.) II and III only (b.) I and IV only
(c.) I, II and III only (d.) I, II, III and IV
- (11.) Identify the pair of species which are readily soluble in water. [Page: 301]
- (a.) CaSO_4 and BaSO_4 (b.) BaSO_4 and BeSO_4
(c.) CaSO_4 and BeSO_4 (d.) BeSO_4 and MgSO_4

(12.) Which of the following elements requires as the co-factor in enzymes that utilize ATP in phosphate transfer ? [Page: 304]

- (a.) Mg (b.) Na
(c.) Be (d.) Ca

(13.) Match List I with List II and choose the correct option. [Page: 303]

List I Compound	List II Common name
(P) CaCO_3	(i) Slaked lime
(Q) CaO	(ii) A constituent of bleaching powder
(R) $\text{Ca}(\text{OCl})_2$	(iii) Limestone
(S) $\text{Ca}(\text{OH})_2$	(iv) Quick lime

- (a.) P-(i), Q-(ii), R-(iii), S-(iv) (b.) P-(iv), Q-(iii), R-(ii), S-(i)
(c.) P-(ii)2 Q-(i), R-(iv), S-(iii) (d.) P-(iii), Q-(iv), R-(ii), S-(i)

(14.) Which among the following alkali metals has strong reducing agent ?. [Page: 294]

- (a.) K (b.) Na
(c.) Rb (d.) Li

(15.) Which of the following metal hydroxides is most basic in nature? [NCERT Exemplar Modified, Page: 301]

- (a.) $\text{Be}(\text{OH})_2$ (b.) $\text{Mg}(\text{OH})_2$
(c.) $\text{Ca}(\text{OH})_2$ (d.) $\text{Ba}(\text{OH})_2$

(16.) Which of the following composition correctly indicates the average composition of portland cement ? [Page: 304]

- (a.) $\text{CaO}, 50-60\%, \text{SiO}_2, 20-25\%, \text{Al}_2\text{O}_3, 5-10\%$ (b.) $\text{CaO}, 20-25\%, \text{SiO}_2, 50-60\%, \text{Al}_2\text{O}_3, 5-10\%$
(c.) $\text{CaO}, 5-10\%, \text{SiO}_2, 20-25\%, \text{Al}_2\text{O}_3, 50-60\%$ (d.) $\text{CaO}, 50-60\%, \text{SiO}_2, 5-10\%, \text{Al}_2\text{O}_3, 20-25\%$

(17.) Which of the following is also known as soda ash [Page: 297]

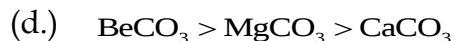
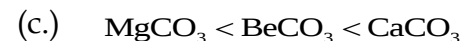
- (a.) $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ (b.) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
(c.) $\text{Na}_2\text{CO}_3 \cdot 5\text{H}_2\text{O}$ (d.) Na_2CO_3

(18.) Which of the following elements is kinetically inert to oxygen and water [Page: 29s]

- (a.) Ca (b.) Sr
(c.) Ba (d.) Be

- (19.) General electronic configuration of alkali metal is $[\text{Noble gas}]ns^1$. Which of the following noble gas and number for 'n' belongs to the element Caesium? **[Page: 292]**
- (a.) Noble gas=Xe, n=4 (b.) Noble gas=Xe, M=6
(c.) Noble gas=Rn, n=5 (d.) Noble gas=Rn, n=6
- (20.) Which of the following gas evolved when alkaline earth metals react with HCl. **[Page: 301]**
- (a.) Cl_2 (b.) O_2
(c.) H_2O_2 (d.) H_2
- (21.) The low solubility of LiF in water is due to **[Page: 294]**
- (a.) its high hydration enthalpy. (b.) its low hydration enthalpy.
(c.) its high lattice enthalpy. (d.) its low lattice enthalpy.
- (22.) Beryllium shows diagonal relationship from which metal in the periodic table) **[page: 302]**
- (a.) P (b.) Al
(c.) C (d.) Li
- (23.) Which of the following statements regarding lithium, magnesium and their compounds is incorrect) **[Page: 296]**
- (a.) Both lithium and magnesium are harder. (b.) The oxides Li_2O and MgO do not combine with excess oxygen to give any superoxide
(c.) Both LiCl and MgCl_2 are soluble in ethanol. (d.) Lithium and magnesium react vigorously with water.
- (24.) Assertion: Solubility of NaCl is 36.0 g in 100 g of water at 273 K. Reason: The solubility of NaCl increases with increasing temperature. **[Page: 297]**
- (a.) Both A and R are true and R is the correct explanation of A. (b.) Both A and R are true but R is not the correct explanation of A.
(c.) A is true but R is false. (d.) Both A and R are false.
- (25.) When magnesium reacts with oxygen and nitrogen, which of the following compounds respectively will form? **[Page: 301]**
- (a.) $\text{MgO}_2, \text{Mg}_3\text{N}_2$ (b.) MgO, MgN_2
(c.) $\text{MgO}, \text{Mg}_3\text{N}_2$ (d.) $\text{Mg}_2\text{O}_3, \text{Mg}_3\text{N}$
- (26.) Which of the following metal halides is soluble in organic solvents) **[NCERT Exemplar Modified, HOT, Page: 304]**
- (a.) BeCl_2 (b.) MgCl_2
(c.) CaCl_2 (d.) SrCl_2
- (27.) Which of the following is an amphoteric hydroxide **[NEET-2017, Page: 301]**

- (a.) $\text{Sr}(\text{OH})_2$ (b.) $\text{Ca}(\text{OH})_2$
 (c.) $\text{Mg}(\text{OH})_2$ (d.) $\text{Be}(\text{OH})_2$
- (28.)** Slaked lime is prepared by adding (i) to (ii) . Identify (i) and (ii). **[Page: 303]**
 (a.) CO_2 , quick lime (b.) H_2O , quick lime
 (c.) HCl , limestone (d.) quick lime, limestone
- (29.)** $2\text{NH}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{x}$ **[Page: 296]** $\text{x} + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{g}$ $\text{y} + \text{NaCl} \rightarrow \text{NH}_4\text{Cl} + \text{z}$ Identify x,y and z.
 (a.) $\text{x} = (\text{NH}_4)_2\text{CO}_3, \text{g} = \text{NaHCO}_3, \text{z} = \text{NH}_4\text{HCO}_3$ (b.) $\text{x} = (\text{NH}_4)_2\text{CO}_3, \text{y} = \text{NH}_4\text{HCO}_3, \text{z} = \text{NaHCO}_3$
 (c.) $\text{x} = \text{NH}_4\text{HCO}_3, \text{y} = (\text{NH}_4)_2\text{CO}_3, \text{z} = \text{NaHCO}_3$ (d.) $\text{x} = \text{NaHCO}_3, \text{y} = \text{NH}_4\text{HCO}_3, \text{z} = (\text{NH}_4)_2\text{CO}_3$
- (30.)** Which of the following alkaline earth metal oxides is amphoteric in nature **[Page: 301]**
 (a.) MgO (b.) CaO
 (c.) BeO (d.) SrO
- (31.)** What is the purpose of adding gypsum in the cement? **[Page: 304]**
 (a.) Slow down the process of setting of cement. (b.) Faster the process of setting of cement.
 (c.) Reduce the hardness of the cement. (d.) None of these.
- (32.)** Which of the following sets of atomic numbers belongs to the group two elements? **[Page: 299]**
 (a.) 20, 38, 88 (b.) 18, 38, 56
 (c.) 88, 20, 14 (d.) 38, 12, 90
- (33.)** Which of the following sets of elements does not impart colour to the flame) **[page: 299]**
 (a.) Ca and Sr (b.) Sr and Ba
 (c.) Be and Mg (d.) Be and Ca
- (34.)** 35. Assertion: Lithium ion has highest hydration enthalpy. Reason: Lithium has high negative E° value and also has high reducing power. **[Page: 294]**
 (a.) Both A and R are true and R is the correct explanation of A. (b.) Both A and R are true but R is not the correct explanation of A.
 (c.) A is true but R is false. (d.) Both A and R are false.
- (35.)** Which of the following factors is responsible for the lowest solubility of lithium fluoride in water) **[Page: 296]**
 (a.) High lattice enthalpy (b.) Low lattice enthalpy
 (c.) High ionic nature of LiF (d.) Low ionic nature of LiF
- (36.)** Which of the following is the correct order regarding thermal stability of the alkaline earth metal carbonate) **[Page: 301]**
 (a.) $\text{BeCO}_3 < \text{MgCO}_3 < \text{CaCO}_3$ (b.) $\text{CaCO}_3 > \text{MgCO}_3 > \text{BeCO}_3$



(37.) Some properties of beryllium and aluminium are given below. Identify the correct statements. [Page: 302] (I) Both Be and Al have Cl^- bridge chloride structure in vapour phase. (II) Chlorides of both Be and Al are soluble in organic solvents. (III) Chlorides of both Be and Al are strong Lewis bases. (IV) They are used as Friedel-Crafts catalysts.

(a.) I and IV only

(b.) I, III and IV only

(c.) I, II and IV only

(d.) All of these

(38.) The stability of the carbonates and hydrogen carbonates down the group [Page: 295]

(a.) increases.

(b.) decreases.

(c.) remains constant.

(d.) firstly increases and then decreases.

(39.) Which of the following oxides is most acidic in nature [NEET-201S, Page: 301]

(a.) MgO (b.) BeO (c.) BaO (d.) CaO

(40.) Which of the following colours gives alkali metals when it dissolves in liquid ammonia. [Page: 292]

(a.) Blue

(b.) Red

(c.) Orange

(d.) Black

(41.) $2\text{NaNO}_3 \xrightarrow{\Delta} 2x + y$ [Page: 297] Identify x and y .

(a.) $x = \text{NaNO}_2, y = \text{N}_2$ (b.) $x = \text{NaNO}_2, y = \text{O}_2$ (c.) $x = \text{NaO}, y = \text{NO}_2$ (d.) $x = \text{NaO}, y = \text{NO}$

(42.) Which of the alkali metal chloride (MCl) forms its dihydrate salt ($\text{MCl} \cdot 2\text{H}_2\text{O}$) easily [Odisha, NEET-2019]

(a.) LiCl (b.) CsCl (c.) RbCl (d.) KCl

(43.) Reactions of calcium oxide with water and carbon dioxide are given below. [Page: 303]
 $\text{CaO} + \text{H}_2\text{O} \rightarrow x$ $\text{CaO} + \text{CO}_2 \rightarrow y$ x and y respectively are

(a.) $\text{Ca}(\text{OH})_2$ and CaCO_3 (b.) CaCO_3 and $\text{Ca}(\text{OH})_2$ (c.) $\text{Ca}(\text{OH})_2$ and $\text{Ca}(\text{OH})_2$ (d.) CaCO_3 and CaCO_3

(44.) Among the given elements, which one has maximum in the adult human body [Page: 304]

(a.) Mg (b.) Fe (c.) Cu (d.) Ca

(45.) Choose the incorrect statements. [Page: 302] (I) Alkali metals are strong reducing agent. (II) Alkaline earth metals have much strong reducing power corresponding to alkali metals. (III) Beryllium has more negative value compared to other alkaline earth metals.

- (a.) (I) and (II) only (b.) (II) and (III) only
(c.) (I) and (III) only (d.) I, II and III
- (46.) Which of the following compounds is obtained as a by-product in the manufacture of sodium carbonate in Solvay process) [Page: 296]
(a.) Ammonium chloride (b.) Calcium chloride
(c.) Sodium hydrogen carbonate (d.) Ammonia
- (47.) Which of the following gases will evolve when magnesium nitrate decomposes [Page: 301]
(a.) O_2 (b.) N_2
(c.) Both (a) and (b) (d.) None of these
- (48.) Which of the following compounds are also known as slaked lime and quick lime respectively . [Page: 303]
(a.) CaO and $Ca(OH)_2$ (b.) $Ca(OH)_2$ and CaO
(c.) $CaCO_3$ and $Ca(OH)_2$ (d.) CaO and $CaCO_3$
- (49.) Which of the following properties of Lithium compounds is responsible for their solubility in organic solvents [page: 296]
(a.) Covalent character (b.) Ionic character
(c.) Hydrogen bonding (d.) Low boiling points
- (50.) At elevated temperature, when beryllium oxide reacts with chlorine in the presence of carbon, which of the following product is obtained apart from $BeCl_2$ [Page: 301]
(a.) CO_2 (b.) CO
(c.) $HClO_4$ (d.) H_2CO_3

TOPIC WISE PRACTICE QUESTIONS

TOPIC 1: Preparation and Properties of Alkali Metals and their Compounds

1. Which of the following alkali metal is highly radioactive?
 1) Rubidium 2) Caesium 3) Francium 4) Both 1) and 3)
2. Which compound will show the highest lattice energy ?
 1) RbF 2) CsF 3) NaF 4) KF
3. Strongest bond is in between
 1) CsF 2) NaCl 3) LiBr 4) None of above
4. In crystals which one of the following ionic compounds would you expect maximum distance between centres of cations and anions?
 1) LiF 2) CsF 3) CsI 4) LiI
5. Which one of the alkali metals, forms only, the normal oxide, M_2O on heating in air ?
 1) Rb 2) K 3) Li 4) Na
6. The ionic mobility of alkali metal ions in aqueous solution is maximum for
 1) Li^+ 2) Na^+ 3) K^+ 4) Rb^+
7. Which of the following pairs of substances would give same gaseous product on reaction with water?
 1) Na and Na_2O_2 2) Ca and CaH_2 3) Ca and CaO 4) Ba and BaO_2
8. Which of the following statements is incorrect?
 1) Alkali metal hydroxide are hygroscopic.
 2) Dissolution of Alkali metal hydroxide is endothermic.
 3) Aqueous solution of alkali metal hydroxides are strongly basic.
 4) Alkali metal hydroxides form ionic crystals.
9. Which is most basic in character ?
 1) CsOH 2) KOH 3) NaOH 4) LiOH
10. An inorganic compound which on heating first melts, then solidifies and liberates O_2 gas, the inorganic compound is
 1) Al_2O_3 2) $KMnO_4$ 3) MnO_2 4) $KClO_3$
11. The element which on burning in air gives peroxide is
 1) lithium 2) sodium 3) rubidium 4) cesium
12. Which of the following is known as fusion mixture ?
 1) Mixture of $Na_2CO_3 + NaHCO_3$ 2) $Na_2CO_3 \cdot 10H_2O$
 3) Mixture of $K_2CO_3 + Na_2CO_3$ 4) $NaHCO_3$
13. Which of the following has density greater than water?
 1) Li 2) Na 3) K 4) Rb
14. Among LiI, NaI, KI, the one which is more ionic and more soluble in water is :
 1) KI 2) NaI 3) LiI 4) None of these
15. Which of the following metal is used along with lithium to make the alloy named 'white metal' ?
 1) Nickel 2) Aluminium 3) Silver 4) Lead
16. The correct order of radii is –
 1) $Li < Be < Mg$ 2) $H^+ < Li^+ < H^-$ 3) $Mn^{3+} < Mn^{2+} < Mn^{7+}$ 4) $K^+ > Cl^- > S^{2-}$
17. The melting point of lithium (181 °C) is just double the melting point of sodium (98 °C) because –
 1) down the group, the hydration energy decreases.

- 2) down the group, the ionization energy decreases.
 3) down the group the cohesive energy decreases.
 4) none of these.
18. Suppose an element is kept in air chamber, than air content was evaluated after sometime , oxygen and nitrogen content was found to be low comparitively. The given element will be
 1) Li 2) Rb 3) Na 4) K
19. Why lithium react less vigorously with water than other alkali metals?
 1) Lithium has most negative E^- value
 2) Lithium has small size and very high hydration energy.
 3) Lithium has least negative E^- value
 4) Both 1) and 2)
20. Fires , that result from the combustion of alkali metals can be extinguished by
 1) CCl_4 2) sand 3) water 4) kerosene
21. In the replacement reaction

$$\text{>CI} + \text{MF} \longrightarrow \text{>CF} + \text{MI}$$
 The reaction will be most favourable if M happens to be :
 1) Na 2) K 3) Rb 4) Li
22. Magnitude of which of the following property of alkali metals increases with the increase of atomic number
 1) Electronegativity 2) Ionic radius
 3) First ionization energy 4) Melting point
23. Alkali metals form peroxides and superoxides except
 1) Na 2) Rb 3) Li 4) Cs
24. Which of the following is used as a source of oxygen in space capsules, submarines and breathing masks ?
 1) Li_2O 2) Na_2O_2 3) KO_2 4) K_2O_2
25. Which is an ore of potassium?
 1) Carnellite 2) Cryolite 3) Bauxite 4) Dolomite
26. Which of the following statements is correct for CsBr_3 ?
 1) It is a covalent compound. 2) It contains Cs^{3+} and Br^- ions.
 3) It contains Cs^+ and Br_3^- ions 4) It contains Cs^+ , and Br^- and lattice Br_2 molecule.
27. When potassium dichromate crystal are heated with conc. HCl
 1) O_2 is evolved 2) Chromyl chloride vapours are evolved
 3) Cl_2 is evolved 4) No reaction takes place
28. An alloy of which pair of metals is liquid at ordinary temperature and is used in special thermometers used for finding temperatures above the boiling point of mercury.
 1) Na and Hg 2) K and Hg 3) Na and K 4) None of these
29. An alkaline metal oxide which is soluble in NaOH has
 1) NaCl structure 2) wurzite structure 3) CsCl structure 4) rutile structure
30. The alkali metals which form normal oxide, peroxide as well as a super oxides are
 1) Na, Li 2) K, Li 3) Li, Cs 4) K, Rb
31. Which of the following compounds are paramagnetic in nature?
 1) KO_2 2) K_2O_2 3) Na_2O_2 4) Rb_2O_2

TOPIC 2: Some Important Compounds of Sodium

32. When sulphur is heated with NaOH (aq)? The compounds formed are
 1) $\text{Na}_2\text{S} + \text{H}_2\text{O}$ 2) $\text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$ 3) $\text{Na}_2\text{S} + \text{Na}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$ 4) $\text{Na}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$
33. Sodium carbonate is manufactured by Solvay process. The products which can be recycled are
 1) CO_2 and NH_3 2) CO_2 and NH_4Cl 3) NaCl and CaO 4) CaCl_2 and CaO .
34. An aqueous solution of salt 'R' when treated with dil. HCl, a colourless gas is given out. The gas so evolved when passed through acidified KMnO_4 decolourises KMnO_4 solution. The salt 'R' is
 1) Na_2CO_3 2) NaClO_3 3) NaNO_2 4) Na_2SO_3
35. How NH_3 is recovered in Solvay process?
 1) By reaction of NH_4Cl and $\text{Ca}(\text{OH})_2$ 2) By reaction of NH_4HCO_3 and NaCl
 3) By reaction of $(\text{NH}_4)_2\text{CO}_3$ with H_2O 4) By any of the above
36. Baking powder contains :
 1) NaHCO_3 , $\text{Ca}(\text{H}_2\text{PO}_2)_2$ and starch 2) NaHCO_3 , $\text{Ca}(\text{H}_2\text{PO}_2)_2$
 3) NaHCO_3 , starch 4) NaHCO_3
37. Sodium thiosulphate, $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ is used in photography to
 1) reduce the silver bromide grains to metallic silver.
 2) convert the metallic silver to silver salt.
 3) remove undecomposed AgBr as soluble silver thiosulphate complex. 4) remove reduced silver.
38. Sodium carbonate solution in water is alkaline due to
 1) hydrolysis of Na^+ 2) hydrolysis of CO_3^{2-}
 3) hydrolysis of both Na^+ and CO_3^{2-} ions 4) none of these
39. Which of the following statements is incorrect?
 1) Pure sodium metal dissolves in liquid ammonia to give blue solution.
 2) NaOH reacts with glass to give sodium silicate.
 3) Aluminium reacts with excess NaOH to give $\text{Al}(\text{OH})_3$
 4) NaHCO_3 on heating gives Na_2CO_3
40. Fire extinguishers contain H_2SO_4 and which one of the following?
 1) NaHCO_3 and Na_2CO_3 2) Na_2CO_3 3) NaHCO_3 4) CaCO_3
41. In Castner-Kellner cell for production of sodium hydroxide:
 1) Brine is electrolyzed with Pt electrodes 2) Brine is electrolyzed using graphite electrodes
 3) Molten sodium chloride is electrolysed 4) Sodium amalgam is formed at mercury cathode
42. Sodium cobaltinitrite is used in the detection of
 1) K 2) Ca 3) Sr 4) Ba

TOPIC 3: Preparation and Properties of Alkaline Earth Metals and their Compounds

43. Of the metals Be, Mg, Ca and Sr of group II A. In the periodic table the least ionic chloride would be formed by
 1) Be 2) Mg 3) Ca 4) Sr
44. Which one is known as barytes?
 1) BaSO_4 2) $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ 3) BaO 4) BaCO_3
45. Which of the following will precipitate first when aqueous solution containing sulphate ions are added?
 1) Mg^{2+} 2) Ca^{2+} 3) Sr^{2+} 4) Ba^{2+}
46. Which of the following compounds is used in preparation of green fire ?
 1) K_2SO_4 2) NaNO_3 3) $\text{Ba}(\text{NO}_3)_2$ 4) None of these
47. Lithopone is
 1) $\text{BaO} + \text{ZnSO}_4$ 2) $\text{BaS} + \text{ZnSO}_4$ 3) $\text{ZnS} + \text{BaSO}_4$ 4) $\text{ZnO} + \text{BaSO}_4$

48. Mixture of MgCl_2 and MgO is called :
 1) portland cement 2) sorel's cement 3) double salt 4) none of these
49. Which of the following statement(s) is/are correct regarding Al and Be ?
 (i) Both of these react with alkali.
 (ii) There is diagonal relationship among these elements.
 1) Both (i) and (ii) 2) Only (i) 3) Only (ii) 4) Neither (i) nor (ii)
50. Philosopher's wool on heating with BaO at 1100°C produces:
 1) $\text{Ba} + \text{ZnCl}_2$ 2) BaCdO_2 3) BaZnO_2 4) $\text{BaO}_2 + \text{Zn}$
51. Arrange the following compounds in order of increasing solubility
 (i) MgF_2 (ii) CaF_2 (iii) BaF_2
 1) (i) < (ii) < (iii) 2) (ii) < (i) < (iii) 3) (ii) < (iii) < (i) 4) (iii) < (ii) < (i)
52. The first ionization potential of Mg is
 1) less than Al 2) more than Al 3) equal to Al 4) can be less or more than Al
53. Calcium is obtained by the
 1) electrolysis of solution of calcium chloride in water
 2) electrolysis of molten anhydrous calcium chloride or fused calcium chloride
 3) roasting of limestone
 4) reduction of calcium chloride with carbon
54. BaO_2 and ozone reacts to produce
 1) Ba 2) Ba_2O_3 3) BaO 4) $\text{Ba}(\text{OH})_3$

TOPIC 4: Some Important Compounds of Calcium

55. Which one of the following is flourspar?
 1) CaF_2 2) CaO 3) H_2F_2 4) CaCO_3
56. Gypsum on heating at $120 - 130^\circ\text{C}$ gives :
 1) anhydrous salt 2) hemihydrate 3) monohydrate 4) dihydrate
57. Melting point of calcium halides decreases in the order
 1) $\text{CaF}_2 > \text{CaCl}_2 > \text{CaBr}_2 > \text{CaI}_2$ 2) $\text{CaI}_2 > \text{CaBr}_2 > \text{CaCl}_2 > \text{CaF}_2$
 3) $\text{CaBr}_2 > \text{CaI}_2 > \text{CaF}_2 > \text{CaCl}_2$ 4) $\text{CaCl}_2 > \text{CaBr}_2 > \text{CaI}_2 > \text{CaF}_2$
58. The substance not likely to contain CaCO_3 is
 1) gypsum 2) sea shells 3) dolomite 4) a marble statue
59. Bone ash contains
 1) CaO 2) CaSO_4 3) $\text{Ca}_3(\text{PO}_4)_2$ 4) $\text{Ca}(\text{H}_2\text{PO}_4)_2$
60. Oxygen is obtained from bleaching powder by
 1) the action of dilute acid 4) the action of alkali
 3) heating it with lime 4) heating it with cobalt salt

NEET PREVIOUS YEARS QUESTIONS

1. Which of the following oxides is most acidic in nature? [2018]
 1) MgO 2) BeO 3) CaO 4) BaO
2. Among CaH_2 , BeH_2 , BaH_2 , the order of ionic character is [2018]
 1) $\text{BeH}_2 < \text{CaH}_2 < \text{BaH}_2$ 2) $\text{CaH}_2 < \text{BeH}_2 < \text{BaH}_2$
 3) $\text{BaH}_2 < \text{BeH}_2 < \text{CaH}_2$ 4) $\text{BeH}_2 < \text{BaH}_2 < \text{CaH}_2$

3. Ionic mobility of which of the following alkali metal ions is lowest when aqueous solution of their salts are put under an electric field? [2017]
 1) K 2) Rb 3) Li 4) Na
4. Which of the following statements is false ? [2016]
 1) Mg^{2+} ions form a complex with ATP
 2) Ca^{2+} ions are important in blood clotting
 3) Ca^{2+} ions are not important in maintaining the regular beating of the heart.
 4) Mg^{2+} ions are important in the green parts of plants.
5. On heating which of the following releases CO_2 most easily? [2015]
 1) K_2CO_3 2) Na_2CO_3 3) MgCO_3 4) CaCO_3
6. Solubility of the alkaline earth metal sulphates in water decreases in the sequence :- [2015]
 1) $\text{Ca} > \text{Sr} > \text{Ba} > \text{Mg}$ 2) $\text{Sr} > \text{Ca} > \text{Mg} > \text{Ba}$ 3) $\text{Ba} > \text{Mg} > \text{Sr} > \text{Ca}$ 4) $\text{Mg} > \text{Ca} > \text{Sr} > \text{Ba}$
7. The function of "Sodium pump" is a biological process operating in each and every cell of all animals. Which of the following biologically important ions is also a constituent of this pump :- [2015]
 1) Mg^{2+} 2) K^+ 3) Fe^{2+} 4) Ca^{2+}
8. Which of the following is an amphoteric hydroxide? [2019]
 (1) $\text{Sr}(\text{OH})_2$ (2) $\text{Ca}(\text{OH})_2$ (3) $\text{Mg}(\text{OH})_2$ (4) $\text{Be}(\text{OH})_2$
9. Enzymes that utilize ATP in phosphate transfer require an alkaline earth metal (M) as the cofactor. M is [2019]
 (1) Be (2) Mg (3) Ca (4) Sr
10. Identify the correct statement from the following. [2020-COVID-19]
 (1) The order of hydration enthalpies of alkaline earth cations $\text{Be}^{2+} < \text{Mg}^{2+} < \text{Ca}^{2+} < \text{Sr}^{2+} < \text{Ba}^{2+}$
 (2) Lithium and Magnesium show some similarities in their physical properties as they are diagonally placed in periodic table.
 (3) Lithium is softer among all alkali metals.
 (4) Lithium chloride is deliquescent and crystallises as a hydrate, $\text{LiCl} \cdot \text{H}_2\text{O}$
11. What is the role of gypsum, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ in setting of cement ? Identify the correct option from the following : [2020-COVID-19]
 (1) to fasten the setting process (2) to provide water molecules for hydration process
 (3) to help to remove water molecules (4) to slow down the setting process
12. Among the following alkaline earth metal halides, one which is covalent and soluble in organic solvents is [NEET-2021]
 1) Strontium chloride 2) Magnesium chloride
 3) Beryllium chloride 4) Calcium chloride
13. The structures of beryllium chloride in solid state and vapour phase, are: [NEET-2021]
 1) Linear in both 2) Dimer and linear respectively
 3) Chain in both 4) Chain and dimer, respectively
14. Identify the incorrect statement from the following [NEET-2022]
 1) Alkali metals react with water to form their hydroxides
 2) The oxidation number of K in KO_2 is + 4
 3) Ionisation enthalpy of alkali metals decreases from top to bottom in the group
 4) Lithium is the strongest reducing agent among the alkali metals
15. Match List-I with List-II [NEET-2022]
 List-I List-II
 (a) Li (i) absorbent for carbon dioxide

- (b) Na (ii) electrochemical cells
 (c) KOH (iii) coolant in fast breeder reactor
 (d) Cs (iv) photoelectric cell

Choose the correct answer from the options given below

- 1) (a) – (iv), (b) – (i), (c) – (iii), (d) – (ii)
 2) (a) – (iii), (b) – (iv), (c) – (ii), (d) – (i)
 3) (a) – (i), (b) – (iii), (c) – (iv), (d) – (ii)
 4) (a) – (ii), (b) – (iii), (c) – (i), (d) – (iv)

NCERT LINE BY LINE QUESTIONS – ANSWERS

(1.)	d	(2.)	a	(3.)	a	(4.)	a	(5.)	a
(6.)	a	(7.)	c	(8.)	a	(9.)	d	(10.)	d
(11.)	d	(12.)	a	(13.)	d	(14.)	d	(15.)	d
(16.)	a	(17.)	d	(18.)	d	(19.)	b	(20.)	d
(21.)	c	(22.)	b	(23.)	d	(24.)	c	(25.)	c
(26.)	a	(27.)	d	(28.)	b	(29.)	b	(30.)	c
(31.)	a	(32.)	a	(33.)	c	(34.)	a	(35.)	a
(36.)	a	(37.)	c	(38.)	a	(39.)	b	(40.)	a
(41.)	b	(42.)	a	(43.)	b	(44.)	d	(45.)	b
(46.)	b	(47.)	a	(48.)	b	(49.)	a	(50.)	b

TOPIC WISE PRACTICE QUESTIONS - ANSWERS

1) 3	2) 3	3) 1	4) 3	5) 3	6) 4	7) 2	8) 2	9) 1	10) 4
11) 2	12) 3	13) 4	14) 1	15) 4	16) 2	17) 3	18) 1	19) 2	20) 1
21) 3	22) 2	23) 3	24) 3	25) 1	26) 3	27) 3	28) 3	29) 2	30) 4
31) 1	32) 3	33) 1	34) 4	35) 1	36) 1	37) 3	38) 2	39) 3	40) 1
41) 4	42) 1	43) 1	44) 1	45) 4	46) 3	47) 3	48) 2	49) 1	50) 3
51) 1	52) 2	53) 2	54) 3	55) 1	56) 2	57) 1	58) 1	59) 3	60) 1

NEET PREVIOUS YEARS QUESTIONS-ANSWERS

1) 2	2) 1	3) 3	4) 3	5) 3	6) 4	7) 2	8) 4	9) 2	10) 2
11) 4	12) 3	13) 4	14) 2	15) 4					

NCERT LINE BY LINE QUESTIONS – SOLUTIONS

- (1.) (d) The b.p. and m.p. of lithium are higher than the other alkali metals. Lithium hydrogen carbonate is not obtained in the solid form. Lithium unlike other alkali metals forms no ethynide on reaction with ethyne. Lithium nitrate when heated gives lithium oxide, Li_2O .
- (2.) (a) Alloy of lithium with lead make white metal.
- (3.) (a) On passing excess of carbon dioxide in calcium Carbonate, the precipitate dissolves to form calcium hydrogen carbonate. $\text{CaCO}_3 + \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{HCO}_3)_2$
- (4.) (a) Thermal stability order, $\text{K}_2\text{CO}_3 > \text{Na}_2\text{CO}_3 > \text{CaCO}_3 > \text{MgCO}_3$ Hence, MgCO_3 releases CO_2 most easily. $\text{MgCO}_3 \xrightarrow{\Delta} \text{MgO} + \text{CO}_2$
- (5.) (a) Radium salts are used in radiotherapy in the treatment of cancer.

- (6.) (a) Sodium carbonate is a white crystalline solid which exists as a decahydrate, $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$. This is also called washing soda.
- (7.) (c) Dead burnt plaster: CaSO_4 (anhydrous)
- (8.) (a) Li, Na, K, Rb, Cs and Fr are collectively known as the alkali metals, because they form hydroxides on reaction with water which are strongly alkaline in nature.
- (9.) (d) Alkali metals burn vigorously in oxygen forming oxides. Li forms monoxide, Na forms peroxide, the other metals form superoxides (O_2^-) ion.
- (10.) (d) All the given statements regarding sodium ions are correct.
- (11.) (d) BeSO_4 and MgSO_4 are readily soluble in water, the solubility decreases from CaSO_4 to BaSO_4 .
- (12.) (a) All enzymes that utilize ATP in phosphate transfer require magnesium as the cofactor.
- (13.) (d) CaCO_3 : Lime stone CaO : Quick lime $\text{Ca}(\text{OH})_2$: Slaked lime $\text{Ca}(\text{OCl})_2$: A constituent of bleaching powder
- (14.) (d) The alkali metals are strong reducing agent. Among the given alkali metals lithium is the most and sodium the least powerful reducing agent.
- (15.) (d) The basic character of alkaline earth metal hydroxides increase with increasing atomic number from $\text{Mg}(\text{OH})_2$ to $\text{Ba}(\text{OH})_2$.
- (16.) (a) The average composition of Portland cement is: CaO , 50–60%; SiO_2 , 20–25%; Al_2O_3 , 5–10%; MgO , 2–3%; Fe_2O_3 , 1–2% and SO_3 , 1–2%
- (17.) (d) Na_2CO_3
- (18.) (d) Be and Mg are kinetically inert to oxygen and water because of the formation of an oxide film on their surface.
- (19.) (b) General electronic configuration of caesium is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6 6s^1$ or $[\text{Xe}]6s^1$.
- (20.) (d) The alkaline earth metals readily react with acids liberating dihydrogen.
 $\text{M} + 2\text{HCl} \rightarrow \text{MCl}_2 + \text{H}_2$
- (21.) (c) The low solubility of LiF in water is due to its high lattice enthalpy.
- (22.) (b) Beryllium shows diagonal relationship with aluminium.
- (23.) (d) Lithium and magnesium react slowly with water.
- (24.) (c) NaCl melts at 1081 K and it has a solubility of 36.0 g in 100 g of water at 273 K. The solubility does not increase appreciably with increase in temperature.
- (25.) (c) MgO and Mg_3N_2
- (26.) (a) Beryllium halides are essentially covalent and soluble in organic solvents.
- (27.) (d) Among the given hydroxides, $\text{B}(\text{OH})_3$ is amphoteric hydroxide.
- (28.) (b) Calcium hydroxide (slaked lime) is prepared by adding water [o quick lime, CaO .
- (29.) (b) The given reactions belong to the Solvay process and the equations for the complete process may be written as:
- $$2\text{NH}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow (\text{NH}_4)_2\text{CO}_3 \quad (\text{x})$$
- $$(\text{NH}_4)_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2 (\text{x}) \rightarrow 2\text{NH}_4\text{HCO}_3 \quad (\text{y})$$
- $$\text{NH}_4\text{HCO}_3 + \text{NaCl} (\text{y}) \rightarrow \text{NH}_4\text{Cl} + \text{NaHCO}_3 \quad (\text{z})$$
- (30.) (c) BeO is amphoteric in nature.

- (31.) (a) The purpose of adding gypsum in the cement is to slow down the process of setting of cement.
- (32.) (a) Atomic numbers 20, 38 and 88 belong to the elements calcium, strontium and radium respectively. These elements lie in group two of the periodic table.
- (33.) (c) The electrons in Be and Mg are too strongly bound to get excited by flame. Therefore, these elements do not impart any colour to the flame.
- (34.) (a) Due to small size of lithium ion, it has highest hydration enthalpy which accounts for its high negative E° value and its high reducing power.
- (35.) (a) High lattice enthalpy is responsible for the lithium fluoride to lowest solubility in water.
- (36.) (a) The thermal stability of the alkaline earth metal carbonates increases with increasing cationic size.
- (37.) (c) Chlorides of both Be and Al are strong Lewis acids.
- (38.) (a) As the electropositive character increases down the group, the stability of the carbonates and hydrogen carbonates increases.
- (39.) (b) In case of metal oxides, metallic character increases down the group. Therefore, basic nature increases down the group. Among the given metal oxides, BeO is most acidic in nature.
- (40.) (a) The alkali metals dissolve in liquid ammonia to give deep blue solution.
- (41.) (b) $2\text{NaNO}_3 \xrightarrow{\Delta} 2\text{NaNO}_2 + \text{O}_2$
(x) (y)
- (42.) (a) Li^+ having maximum hydrate tendency. LiCl forms dihydrated salt $\text{LiCl} \cdot 2\text{H}_2\text{O}$ in IA group. Assertion-Reason Type questions
- (43.) (b) $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$ $\text{CaO} + \text{CO}_2 \rightarrow \text{CaCO}_3$
- (44.) (d) An adult body contains about 25 g of Mg, 1200 g of Ca, 5g of Fe and 0.06 g of Cu.
- (45.) (b) Alkali and alkaline earth metals are strong reducing agents. However, alkaline earth metals' reducing power is less than those of their corresponding alkali metals. Beryllium has less negative value compared to other alkaline earth metals.
- (46.) (b) Calcium chloride, CaCl_2 , is obtained as a by-product in the manufacture of Na_2CO_3 in the Solvay process.
- (47.) (a) Oxygen gas will evolve when magnesium nitrate decomposes.
 $2\text{Mg}(\text{NO}_3)_2 \xrightarrow{\Delta} 2\text{MgO} + 4\text{NO}_2 + \text{O}_2$
- (48.) (b) Quick lime: CaO Slaked lime: $\text{Ca}(\text{OH})_2$
- (49.) (a) Covalent character of lithium compounds is responsible for their solubility in organic solvents.
- (50.) (b) $\text{BeO} + \text{C} + \text{Cl}_2 \xrightarrow{600-800\text{K}} \text{BeCl}_2 + \text{CO}$

TOPIC WISE PRACTICE QUESTIONS – SOLUTIONS

- (3) Francium is highly radioactive.
- (3) With the same anion, smaller the size of the cation, higher is the lattice energy. The correct order of size of cations is –
 $\text{Na}^+ < \text{K}^+ < \text{Rb}^+ < \text{Cs}^+$
Hence, the lattice energy of NaF will be maximum. i.e., NaF.
- (1) According to Fajan rules, ionic character increases with increase in size of the cation and decrease in size of the anion. Thus, CsF has higher ionic character than NaCl and LiBr, hence bond in CsF is stronger than in NaCl and LiBr.
- (3) As Cs^+ ion has larger size than Li^+ and I^- has larger size than F^- , therefore maximum distance between centres of cations and anions is in CsI.

5. (3) All the alkali metals when heated with oxygen form different types of oxides for example lithium forms lithium oxide (Li_2O), sodium forms sodium peroxide (Na_2O_2), while K, Rb and Cs form their respective superoxides.
- $$2\text{Li} + \frac{1}{2}\text{O}_2 \rightarrow \text{Li}_2\text{O}$$
6. 4) Smaller the size of cation higher is its hydration energy and lesser is its ionic mobility hence the correct order is $\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{Rb}^+$
7. 2) Both Ca and CaH_2 produce H_2 gas with water.
- $$\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2 \uparrow$$
- $$\text{CaH}_2 + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + 2\text{H}_2 \uparrow$$
8. 2) During the dissolution of alkali metal hydrides energy is released in large amount, i.e., it is exothermic in nature.
9. (1) Since the ionization energies of alkali metals decrease down the group, the ionic character and consequently basic property of their hydroxides increases in the same order, i.e. from LiOH to CsOH .
- $$\underset{\text{solid}}{2\text{KClO}_3} \xrightarrow[\text{melts}]{\text{heat}} \underset{\text{solid}}{2\text{KCl}} + 3\text{O}_2$$
10. 4)
11. (2) Sodium metal on burning in air gives sodium peroxide.
12. (3) Mixture of K_2CO_3 and Na_2CO_3 is called fusion mixture.
13. (4) Li, Na, K are lighter than water but Rb is heavier than water.
14. (1) Larger cation (K^+) develops less polarisation in anion and thus KI has more ionic nature and more soluble in water.
15. (4) Lithium with lead is used to make white metal.
16. (2) H^+ cation is smaller than parent H-atom. H^- and Li^+ are isoelectronic species so Li^+ with higher nuclear charge (i.e. 3) will be smaller than H^- having smaller nuclear charge (i.e. 1).
17. (3) The atom becomes larger on descending the group, so the bonds become weaker (metallic bond), the cohesive force/energy decreases and accordingly melting point also decreases.
18. (1) All the given elements react with oxygen to form oxides but only Li also reacts with nitrogen to form Li_3N .
19. (2) Lithium although has most negative $E^\ominus$ value reacts less vigorously with water than other alkali metals due to its small size and very high hydration energy.
20. (1) In contrast, CCl_4 is a low boiling highly non inflammable heavy liquid. Its vapours surround the fire thereby cutting off air supply.
21. (3) Tertiary halide can show ionic reaction with MF so, MF should be most ionic for reaction to proceed forward. Hence 'M' should be 'Rb'.
22. (2) As the atomic no. increases, the no. of shells increases hence, atomic radius increases.
23. 3) Li^+ does not allow its O^{2-} ion to combine with other O atom(s) to form peroxides and superoxides
24. 3) Because KO_2 not only provides O_2 but also removes CO_2 as follows
- $$4\text{KO}_2 + 2\text{CO}_2 \rightarrow 2\text{K}_2\text{CO}_3 + 3\text{O}_2$$
- $$4\text{KO}_2 + 4\text{CO}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{KHCO}_3 + 3\text{O}_2$$
25. 1) Carnallite – $\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
26. 3) CsBr_3 may be represented as Cs^+Br_3^-
27. 3)
28. 3) An alloy of Na and K is liquid at ordinary temperature and is used in special thermometers used for finding temperature above boiling point of mercury.
29. 2)
30. 4)
31. 1)
32. 3) $4\text{S} + 6\text{NaOH} \rightarrow \text{Na}_2\text{S}_2\text{O}_3 + 2\text{Na}_2\text{S} + 3\text{H}_2\text{O}$
33. 1) CO_2 and NH_3 formed are reused (see Solvay process)
34. 4) Since 'R' gives a colourless gas on reaction with dil. HCl, so it contains CO_3^{2-} or SO_3^{2-} as anion (i.e., CO_2 or SO_2 is evolved)

Since the gas decolourises acidified KMnO_4 solution so it is SO_2 and thus the anion present is SO_3^{2-} i.e., the salt 'R' is Na_2SO_3 .

35. 1) NH_3 is recovered when the solution containing NH_4Cl is treated with $\text{Ca}(\text{OH})_2$
36. 1) Baking power has starch, NaHCO_3 and $\text{Ca}(\text{H}_2\text{PO}_2)_2$
37. 3) The unreacted AgBr is removed by soluble complex formation

$$\text{AgBr} + 2\text{Na}_2\text{S}_2\text{O}_3 \rightarrow \text{Na}_3[\text{Ag}(\text{S}_2\text{O}_3)_2] + \text{NaBr}$$
38. 2) Due to anionic hydrolysis

$$\text{CO}_3^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^- + ^-\text{OH}$$
39. 3) $2\text{Al}(\text{s}) + 2\text{NaOH}(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NaAlO}_2 + 3\text{H}_2$
 Sod. Meta aluminate
40. 1) Fire extinguishers contain a mixture of Na_2CO_3 , NaHCO_3 and H_2SO_4
41. (4) In castner cell, sodium amalgam is formed at mercury cathode.
42. (1)
43. (1) Because of small atomic size and high I.E. Be forms covalent chloride.
44. (1)
45. (4) Down the group solubility of sulphate decreases. Thus Ba^{2+} ions will precipitate out most easily.
46. (3) $\text{Ba}(\text{NO}_3)_2$ is used in preparation of green fire.
47. (3) $\text{ZnS} + \text{BaSO}_4$ is lithopone. It is used as white pigment.
48. (2) Mixture of MgO and MgCl_2 is called Sorel's cement. It is used for making magnesia cement.
49. (1)
50. 3) Philosopher's wool is ZnO

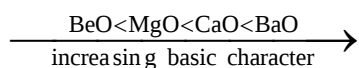
$$\text{ZnO} + \text{BaO} \xrightarrow{1100^\circ\text{C}} \text{BaZnO}_2$$
51. 1)
52. 2) Mg has more IE_1 than Al since the electron has to be removed from completely filled s-valence shell of Mg.
53. (2) Calcium is obtained by electrolysis of a fused mass consisting six parts calcium chloride and one part calcium fluoride at about 700°C in an electrolytic cell.
 (At. Nos. Mn = 25, Fe = 26, Co = 27, Ni = 28)
54. (3) Ozone reduces peroxides to oxides and in turn gets reduced to oxygen.

$$\text{BaO}_2 + \text{O}_3 \rightarrow \text{BaO} + 2\text{O}_2$$
55. 1)
56. 2) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O} \xrightarrow{120^\circ\text{C}} \text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
 Plaster of Paris is hemihydrate.
57. (1) As the size of the anion increases, the covalent character increases and hence the m.p. decrease.
58. (1) Gypsum is $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
59. 3)
60. 1) $2\text{CaOCl}_2 + \text{dil. H}_2\text{SO}_4 \rightarrow \text{CaCl}_2 + \text{CaSO}_4 + 2\text{HClO}$

$$\text{HClO} \rightarrow \text{HCl} + \text{O}$$

NEET PREVIOUS YEARS QUESTIONS-EXPLANATIONS

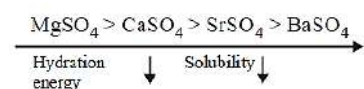
1. (2) In metals moving down the group metallic character increases, so basic nature increases hence most acidic will be BeO .



2. (1) $\text{BeH}_2 < \text{CaH}_2 < \text{BaH}_2$

Smaller the size of cation, more will be its polarising power. Hence BeH_2 will be least ionic.

3. (3) Li^+ being smallest, has maximum charge density. Li^+ is most heavily hydrated among all alkali metal ions. Effective size of Li^+ in aqueous solution is therefore, largest. So, moves slowest under electric field.
4. (3)
5. (3) Carbonates becomes more thermally stable down the group, therefore MgCO_3 will leave CO_2 easily.
6. (4) Solubility of alkaline earth metal sulphates decreases down the group due to decrease in hydration energy.



7. (2) K^+ ion is a constituent of sodium pump.
8. 4) $\text{Be}(\text{OH})_2$ is an amphoteric hydroxide rest all are basic hydroxides
9. 2) All enzymes that utilize ATP in phosphate transfer required magnesium as the cofactor.
10. 2) Li & Mg shows diagonal relationship that's why they show similarity in their physical properties.
11. 4) The purpose of adding gypsum is only to slow down the process of setting of cement so that it gets sufficiently hardened
12. 3) Except for beryllium chloride all other chloride of alkaline earth metals are ionic in nature.
Due to small size of Be, Beryllium chloride is essentially covalent and soluble in organic solvents.
13. 4) Solid state $\rightarrow$ chain

Gaseous state $\rightarrow$ dimer

14. Alkali metals always show only +1 oxidation state
15. (a) – (ii), (b) – (iii), (c) – (i), (d) – (iv)