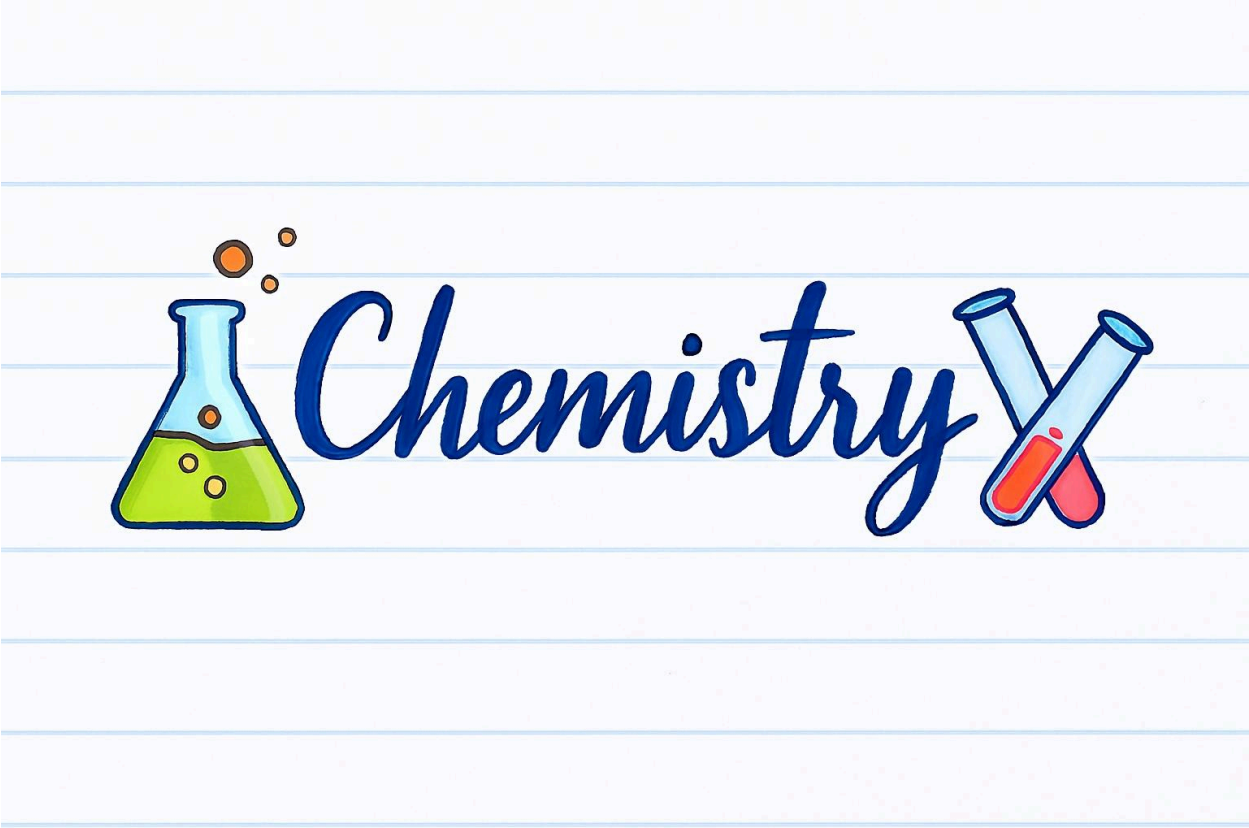

Class: 12th

Subject: Chemistry

Chapter 2: S-BLOCK ELEMENTS

🩸 Important MCQs – Alkali & Alkaline Earth Metals: Key Points

1. The elements of Group IA (except hydrogen) are called:

(a) Transition metals

(b) Alkali metals ✅

(c) Halogens

(d) Noble gases

2. The elements of Group IIA are known as:

(a) Alkaline earth metals ✅

(b) Halogens

(c) Transition metals

(d) Noble gases

3. Alkali metals have how many electrons in the s-orbital of their valence shell?

(a) Two

(b) One ✅

(c) Three

(d) Four

4. When alkali metals lose one electron, they form:

(a) Negative ions

(b) Divalent ions

(c) Monovalent positive ions ✅

(d) Covalent bonds

5. Alkaline earth metals form which type of ions?

(a) M^{+}

(b) M^{2+} ✅

(c) M^{3+}

(d) M^{-}

6. Which of the following is a mineral of alkali metals?

(a) Barite

(b) Dolomite

(c) Sylvite ✅

(d) Beryl

7. Which of the following is an important mineral of alkaline earth metals?

(a) Magnesite ✅

(b) Borax

(c) Halite

(d) Alunite

8. Lithium differs from other alkali metals because it:

(a) Forms only normal oxide ✅

(b) Does not form compounds

(c) Is non-metallic

(d) Is liquid at room temperature

9. Which element of Group II reacts with alkalies to give hydrogen?

(a) Magnesium

(b) Beryllium ✅

(c) Calcium

(d) Strontium

10. When gypsum is heated above 100°C, it forms:

(a) Dead burnt plaster

(b) Lime

(c) Plaster of Paris ✅

(d) Epsom salt

🩸 Important MCQs:

1. The s-block elements belong to which groups of the periodic table?

(a) Group IIIA and IVA

(b) Group IA and IIA ✅

(c) Group VA and VIA

(d) Group IIA and IIIA

2. The name “alkali” came from which language?

(a) Greek

(b) Latin

(c) Arabic ✅

(d) Persian

3. Alkali metals are called so because they form:

(a) Acidic oxides

(b) Alkaline solutions with water ✅

(c) Neutral compounds

(d) Covalent bonds

4. The alkali metals include all except:

(a) Lithium

(b) Sodium

(c) Calcium ✅

(d) Potassium

5. Which of the following is not an alkaline earth metal?

(a) Magnesium

(b) Beryllium

(c) Potassium ✅

(d) Barium

6. Alkali metals show which oxidation state?

(a) +2

(b) 0

(c) +1 ✅

(d) −1

7. Alkaline earth metals generally show which oxidation state?

(a) +1

(b) +2 ✅

(c) +3

(d) +4

8. Why are alkali metals not found free in nature?

(a) They are gases

(b) They are unstable in solid form

(c) They are highly reactive ✅

(d) They dissolve in air

9. The most abundant alkali metals in the earth's crust are:

(a) Sodium and Potassium ✅

(b) Lithium and Sodium

(c) Potassium and Rubidium

(d) Sodium and Calcium

10. Which alkali metal is artificially prepared and radioactive?

(a) Rubidium

(b) Cesium

(c) Francium ✅

(d) Lithium

11. Magnesium is an essential component of which biological compound?

(a) Hemoglobin

(b) Chlorophyll ✅

(c) Keratin

(d) Enzyme ATPase

12. Calcium is mainly found in which part of living organisms?

(a) Blood plasma

(b) Muscles

(c) Bones and shells ✅

(d) Nerves

13. Lithium differs from other alkali metals mainly due to:

(a) Large atomic size

(b) Small atomic size and high charge density ✅

(c) High electropositivity

(d) High melting point only

14. Which of the following compounds of lithium is less soluble in water?

(a) LiOH

(b) LiF

(c) Li_2CO_3

(d) All of these ✅

15. Which alkali metal reacts slowly with water?

(a) Sodium

(b) Potassium

(c) Lithium ✅

(d) Cesium

16. Which compound is formed when lithium burns in air?

(a) Lithium peroxide

(b) Lithium oxide ✅

(c) Lithium superoxide

(d) Lithium carbonate

17. Which alkali metal forms nitride directly with nitrogen?

(a) Sodium

(b) Potassium

(c) Lithium ✅

(d) Cesium

18. Beryllium differs from other alkaline earth metals because:

(a) It is liquid at room temperature

(b) It has small atomic size and high electronegativity ✅

(c) It is radioactive

(d) It forms colored compounds

19. Which of the following alkaline earth metals reacts with alkalis to give hydrogen gas?

(a) Calcium

(b) Strontium

(c) Barium

(d) Beryllium ✅

20. Which statement about beryllium is correct?

(a) It reacts vigorously with water

(b) It is softer than sodium

(c) It is almost as hard as iron ✅

(d) It forms superoxides

21. The reducing property of an element depends upon:

(a) Atomic radius

(b) Ionization energy ✅

(c) Atomic mass

(d) Density

22. Alkali metals are strong reducing agents because they have:

(a) High electronegativity

(b) Low ionization energy ✅

(c) Small atomic radii

(d) High melting points

23. Alkali metals generally show which oxidation state?

(a) +1 ✅

(b) +2

(c) 0

(d) −1

24. The salts of alkali metals are mostly:

(a) Insoluble in water

(b) Soluble and completely dissociated in water ✅

(c) Slightly soluble

(d) Covalent in nature

25. Which alkali metal burns in air to form a normal oxide?

(a) Sodium

(b) Potassium

(c) Lithium ✅

(d) Rubidium

26. Sodium in excess of oxygen forms:

(a) Sodium oxide

(b) Sodium peroxide ✅

(c) Sodium carbonate

(d) Sodium hydroxide

27. Potassium reacts with oxygen to form:

(a) Potassium oxide

(b) Potassium peroxide

(c) Potassium superoxide ✅

(d) Potassium carbonate

28. The reactivity of alkali metals with water increases from:

(a) Li < Na < K < Rb < Cs ✅

(b) Cs < Rb < K < Na < Li

(c) Na < Li < Cs < K < Rb

(d) K < Na < Rb < Li < Cs

29. Alkali metals form hydrides by reacting with:

(a) Nitrogen

(b) Hydrogen ✅

(c) Carbon

(d) Oxygen

30. Lithium is the only alkali metal that reacts directly with:

(a) Nitrogen and carbon ✅

(b) Sulphur and oxygen

(c) Phosphorus and chlorine

(d) Hydrogen and bromine

31. Which of the following is formed when sodium reacts with chlorine?

(a) Sodium oxide

(b) Sodium carbonate

(c) Sodium chloride ✅

(d) Sodium hydroxide

32. Which of the following alkaline earth metals forms a peroxide with oxygen?

(a) Calcium

(b) Strontium

(c) Barium ✅

(d) Magnesium

33. When magnesium burns in air, it forms:

(a) Only magnesium oxide

(b) Magnesium oxide and magnesium nitride ✅

(c) Magnesium peroxide

(d) Magnesium hydroxide

34. Which alkaline earth metal reacts rapidly with steam to produce hydrogen?

(a) Beryllium

(b) Magnesium ✅

(c) Calcium

(d) Barium

35. The solubility and basic character of oxides of alkaline earth metals:

(a) Decrease down the group

(b) Increase down the group ✅

(c) Remain constant

(d) First increase then decrease

36. BeO is amphoteric because it reacts with:

(a) Only acids

(b) Only bases

(c) Both acids and bases ✅

(d) Neither acids nor bases

37. The product formed when BeO reacts with NaOH is:

(a) Sodium oxide

(b) Sodium beryllate ✅

(c) Sodium carbonate

(d) Sodium hydroxide

38. Which of the following hydroxides is slightly soluble in water?

(a) NaOH

(b) KOH

(c) LiOH ✅

(d) $Ba(OH)_2$

39. The solubility of alkaline earth metal hydroxides in water:

(a) Decreases down the group

(b) Increases down the group ✅

(c) Remains constant

(d) First increases then decreases

40. Which of the following hydroxides decomposes on heating?

(a) NaOH

(b) KOH

(c) LiOH

(d) $Mg(OH)_2$ ✅

41. The suspension of $Mg(OH)_2$ in water is called:

(a) Lime water

(b) Washing soda

(c) Milk of magnesia ✅

(d) Bleaching powder

42. Sodium carbonate crystallizes as $Na_2CO_3 \cdot 10H_2O$ below:

(a) 20°C

(b) 25°C

(c) 35.2°C ✅

(d) 45°C

43. The solution of Na_2CO_3 in water is:

(a) Neutral

(b) Basic ✅

(c) Acidic

(d) Amphoteric

44. Upon heating, $CaCO_3$ decomposes into:

(a) CaO and CO_2 ✅

(b) Ca and CO

(c) $Ca(OH)_2$ and CO_2

(d) CaO and CO

45. Which of the following sulphates is almost insoluble in water?

(a) $MgSO_4$

(b) $CaSO_4$

(c) $SrSO_4$ ✅

(d) $BeSO_4$

46. Sodium metal is commercially prepared by:

(a) Castner–Kellner process

(b) Hall–Héroult process

(c) Downs cell process ✅

(d) Solvay process

47. Calcium chloride is added in Downs cell to:

(a) Increase the conductivity of NaCl

(b) Lower the melting point of NaCl ✅

(c) Remove impurities

(d) Form an alloy with sodium

48. The operating temperature of the Downs cell is about:

(a) 400°C

(b) 500°C

(c) 600°C ✅

(d) 801°C

49. In the Downs cell, the anode is made of:

(a) Copper

(b) Iron

(c) Graphite ✅

(d) Platinum

50. In the Downs cell, sodium is liberated at:

(a) Anode

(b) Cathode ✅

(c) Both electrodes

(d) Diaphragm

51. During electrolysis in Downs cell, chlorine gas is formed at:

(a) Cathode

(b) Anode ✅

(c) Both electrodes

(d) None of these

52. Sodium hydroxide is prepared commercially by electrolysis of:

(a) Fused NaCl

(b) Aqueous NaCl solution ✅

(c) Sodium carbonate

(d) Sodium nitrate

53. In the diaphragm cell, the diaphragm is made of:

(a) Iron gauze

(b) Copper plate

(c) Asbestos ✅

(d) Zinc sheet

54. The function of asbestos diaphragm in the cell is to:

(a) Prevent passage of sodium ions

(b) Separate chlorine and hydroxide ions ✅

(c) Increase conductivity

(d) Collect sodium hydroxide

55. The solution obtained from the cathode compartment of diaphragm cell contains about:

(a) 11% NaOH and 16% NaCl ✅

(b) 50% NaOH and 1% NaCl

(c) 16% NaOH and 11% NaCl

(d) 25% NaOH and 5% NaCl

56. Chemically, gypsum is:

(a) Calcium carbonate

(b) Hydrated calcium sulphate ✅

(c) Calcium oxide

(d) Calcium silicate

57. The main elements supplied by gypsum to soil are:

(a) Calcium and carbon

(b) Sulphur and hydrogen

(c) Calcium and sulphur ✅

(d) Calcium and nitrogen

58. The deficiency of sulphur in plants causes:

(a) Yellow flowers

(b) Pale green leaves ✅

(c) Stunted roots

(d) Early flowering

59. Gypsum helps to improve crop yield mainly by:

(a) Increasing acidity of soil

(b) Providing calcium and sulphur ✅

(c) Reducing phosphorus content

(d) Increasing alkalinity of soil

60. When gypsum is heated, it loses three-quarters of its water of crystallization to form:

(a) Dead burnt plaster

(b) Cement

(c) Plaster of Paris ✅

(d) Lime

61. If gypsum is heated too strongly, it forms:

(a) Cement

(b) Anhydrous salt called dead burnt plaster ✅

(c) Lime

(d) Calcium chloride

62. Plaster of Paris sets into a hard mass within:

(a) 5–10 minutes

(b) 10–15 minutes ✅

(c) 30–40 minutes

(d) 1 hour

63. The expansion of Plaster of Paris during setting is about:

(a) 0.5%

(b) 1% ✅

(c) 2%

(d) 5%

64. Plaster of Paris is used in surgery for:

(a) Healing wounds

(b) Reducing pain

(c) Holding fractured bones in place ✅

(d) Cleaning bones

65. The addition of gypsum in Portland cement helps to:

(a) Harden cement rapidly

(b) Prevent the cement from setting too quickly ✅

(c) Make cement more white

(d) Remove moisture

66. Lime (CaO) is obtained by heating:

(a) $CaSO_4$

(b) $CaCO_3$ ✅

(c) $Ca(OH)_2$

(d) $CaCl_2$

67. The process of forming $Ca(OH)_2$ from CaO is called:

(a) Calcination

(b) Slaking of lime ✅

(c) Crystallization

(d) Carbonation

68. Lime is used in agriculture to:

(a) Increase soil acidity

(b) Neutralize acidic soils ✅

(c) Reduce soil calcium

(d) Decrease soil phosphorus

69. Lime reacts with sand at high temperature to form:

(a) Calcium silicate ✅

(b) Calcium carbonate

(c) Calcium sulphate

(d) Sodium silicate

70. A mixture of NaOH and $Ca(OH)_2$ is known as:

(a) Lime water

(b) Milk of lime

(c) Soda lime ✅

(d) Slaked lime

🩸 Important short questions– Alkali & Alkaline Earth Metals: Key Points

1. What are alkali metals and alkaline earth metals?

Answer:

👉 The elements of Group IA (except hydrogen) are called alkali metals, while those of Group IIA are called alkaline earth metals.

2. How many electrons are present in the valence shell of alkali metals?

Answer:

👉 Alkali metals have one electron in the s-orbital of their valence shell.

3. How do alkali metals form positive ions?

Answer:

👉 Alkali metals lose one electron and form monovalent positive ions (M^+).

4. How do alkaline earth metals form positive ions?

Answer:

👉 Alkaline earth metals lose two electrons and form dipositive ions (M^{2+}).

5. Name any four common minerals of alkali metals.

Answer:

👉 Spodumene, trona, borax, and sylvite are common minerals of alkali metals.

6. Name any four important minerals of alkaline earth metals.

Answer:

👉 Beryl, dolomite, gypsum, and barite are important minerals of alkaline earth metals.

7. Which metal behaves differently from other alkali metals?

Answer:

👉 Lithium behaves differently from other alkali metals.

8. Which metal of Group II reacts with alkalies to give hydrogen?

Answer:

👉 Beryllium is the only member of Group II that reacts with alkalies to give hydrogen.

9. What is Plaster of Paris and how is it obtained?

Answer:

👉 When gypsum is heated above 100°C, it forms $CaSO_4 \cdot \frac{1}{2}H_2O$ which is called Plaster of Paris.

10. How is sodium prepared commercially?

Answer:

👉 Sodium is prepared by the electrolysis of molten sodium chloride in Down's cell.

🩸 Important Short Questions:

1. Which elements are called s-block elements?

Answer:

👉 The metals in Group IA and Group IIA of the periodic table are called s-block elements because their outermost electrons enter the s-orbital.

2. What are alkali metals and alkaline earth metals?

Answer:

👉 Group IA elements (except hydrogen) are alkali metals, while Group IIA elements are alkaline earth metals.

3. Why are Group IA metals called alkali metals?

Answer:

👉 Because they form strong alkaline solutions when they react with water.

4. What is the meaning of the word alkali and from which language is it derived?

Answer:

👉 The word “alkali” comes from Arabic, meaning “The Ashes,” as early Arabs found that plant ashes contained sodium and potassium compounds.

5. Why do alkali and alkaline earth metals not occur in free state in nature?

Answer:

👉 Because they are highly reactive and occur in combined forms such as silicates, carbonates, and sulphates.

6. Name two important alkali metals and their abundance in the earth’s crust.

Answer:

👉 Sodium and potassium are abundant alkali metals, each making up about 2.4% of the earth’s crust.

7. Why is lithium different from other alkali metals?

Answer:

👉 Lithium differs due to its small atomic size, high charge density, and less electropositive nature.

8. How does lithium react with water compared to other alkali metals?

Answer:

👉 Lithium reacts slowly with water, whereas other alkali metals react violently.

9. Which Group II element reacts with alkalies to give hydrogen gas?

Answer:

👉 Beryllium is the only Group II element that reacts with alkalies to produce hydrogen gas.

10. Why is beryllium resistant to acids and oxidation?

Answer:

👉 Because it forms a protective coating of insoluble beryllium oxide (BeO) on its surface.

11. Why are alkali metals strong reducing agents?

Answer:

👉 Because they have low ionization energies and can easily lose electrons to form positive ions.

12. Why do alkali metals show only +1 oxidation state?

Answer:

👉 Their second ionization energies are very high, so they can lose only one electron.

13. What happens when alkali metals react with oxygen?

Answer:

👉 Lithium forms normal oxide (Li_2O), sodium forms peroxide (Na_2O_2), while potassium, rubidium, and caesium form superoxides (MO_2).

14. Write a chemical equation for the reaction of sodium with water.

Answer:

👉 $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

15. Which alkali metal reacts with nitrogen and carbon to form nitride and carbide?

Answer:

👉 Lithium reacts with nitrogen to form lithium nitride (Li_3N) and with carbon to form lithium carbide (Li_2C_2).

16. What happens when magnesium burns in air?

Answer:

👉 Magnesium forms magnesium oxide (MgO) and a small amount of magnesium nitride (Mg_3N_2).

17. Write an equation showing the reaction of magnesium with steam.

Answer:

👉 $Mg(s) + H_2O(g) \rightarrow MgO(s) + H_2(g)$

18. What is the use of potassium superoxide (KO_2)?

Answer:

👉 Potassium superoxide is used in breathing equipment for mountaineers and spacecraft because it absorbs carbon dioxide and releases oxygen.

19. Why is BeO amphoteric in nature?

Answer:

👉 Because it reacts with both acids and bases to form salts such as beryllium sulphate and sodium beryllate.

20. Write two chemical equations showing the amphoteric behaviour of BeO.

Answer:

👉 $BeO + H_2SO_4 \longrightarrow BeSO_4 + H_2O$

👉 $BeO + 2NaOH \longrightarrow Na_2BeO_2 + H_2O$

21. Why are alkali metal hydroxides strong bases?

Answer:

👉 Because they are highly soluble in water and completely ionize to give hydroxide ions (OH^-), except LiOH which is slightly soluble.

22. How does the solubility of alkaline earth metal hydroxides vary down the group?

Answer:

👉 The solubility increases down the group due to the decrease in lattice energy as ionic size increases.

23. What is the difference between lime water and milk of magnesia?

Answer:

👉 Lime water is a saturated solution of $Ca(OH)_2$ used to test CO_2,

while milk of magnesia is a suspension of $Mg(OH)_2$ used for treating acidity in the stomach.

24. What happens when lithium carbonate (Li_2CO_3) is heated?

Answer:

👉 It decomposes to form lithium oxide and carbon dioxide:

$Li_2CO_3 \longrightarrow Li_2O + CO_2$

25. Why are alkali metal carbonates more stable than alkaline earth metal carbonates?

Answer:

👉 Because larger alkali metal ions have lower lattice energy, making their carbonates more stable and less likely to decompose on heating.

26. What is the principle used in the Downs Cell for preparing sodium metal?

Answer:

👉 Sodium metal is produced by the electrolysis of fused sodium chloride (NaCl) mixed with calcium chloride ($CaCl_2$) to lower its melting point.

27. Why is calcium chloride added in the Downs Cell?

Answer:

👉 Calcium chloride is added to lower the melting point of sodium chloride from 801°C to about 600°C, making the electrolysis process more efficient.

28. Write the electrode reactions in the Downs Cell.

Answer:

👉 At cathode: $Na^+ + e^- \longrightarrow Na$

👉 At anode: $2Cl^- \longrightarrow Cl_2 + 2e^-$

29. What are the advantages of the Downs process?

Answer:

👉 (a) Metallic fog is not produced.

👉 (b) Liquid sodium can be easily collected at 600°C.

👉 (c) The cell material is not attacked by the products formed.

30. What is the function of the asbestos diaphragm in the Diaphragm Cell?

Answer:

👉 It separates the anode and cathode compartments, allowing Na^+ ions to pass but preventing chlorine and hydroxide ions from mixing, thus avoiding side reactions.

31. What is gypsum and how is it useful in agriculture?

Answer:

👉 Gypsum is hydrated calcium sulphate ($CaSO_4 \cdot 2H_2O$). It provides calcium and sulphur to the soil, improving crop growth and root development.

32. Why is sulphur important for plant growth?

Answer:

👉 Sulphur helps in chlorophyll formation and is a part of plant proteins. Deficiency of sulphur causes pale green leaves and poor growth.

33. What happens when gypsum is heated under controlled conditions?

Answer:

👉 It loses three-quarters of its water of crystallization and forms Plaster of Paris ($CaSO_4 \cdot \frac{1}{2}H_2O$).

34. What is "Dead Burnt Plaster"?

Answer:

👉 When gypsum is overheated and completely loses its water of crystallization, it becomes anhydrous and absorbs water slowly — this form is called Dead Burnt Plaster.

35. What are the uses of Plaster of Paris?

Answer:

👉 It is used for making plaster walls, surgical bandages, casts, statues, coins, and decorative molds.

36. What is the function of gypsum in cement manufacture?

Answer:

👉 About 2% gypsum is added to cement to slow down its hardening process and increase its setting time.

37. How is lime obtained?

Answer:

👉 Lime (CaO) is obtained by heating calcium carbonate ($CaCO_3$) strongly, which decomposes into calcium oxide and carbon dioxide.

38. How is slaked lime prepared?

Answer:

👉 When lime (CaO) reacts with water, it forms calcium hydroxide ($Ca(OH)_2$). This process is called slaking of lime.

39. Mention any three industrial uses of lime.

Answer:

👉 (a) Used in paper, cement, and leather industries.

👉 (b) Used in refining of metals and sugar.

👉 (c) Used in manufacturing of bleaching powder and glass.

40. What is milk of lime and how is it used?

Answer:

👉 A suspension of calcium hydroxide in water is called milk of lime. It is used for whitewashing walls.

🩸 EXERCISE:

Q1. Fill in the blanks:

(i) Alkali metals are _____ reactive than alkaline-earth metals.

Answer: more ✅

(ii) Alkali metals decompose water vigorously producing _____ and _____.

Answer: hydrogen, metal hydroxides ✅

(iii) When heated in a current of dry hydrogen, alkaline earth metals form white crystalline _____ of the type MH_2.

Answer: hydrides ✅

(iv) The beryllium hydroxide, like the hydroxide of aluminium, is amphoteric, while the hydroxides of the other members of group IIA are _____.

Answer: basic ✅

(v) The elements of the group IA are termed as alkali metals, because their _____ are alkaline.

Answer: oxides and hydroxides ✅

(vi) Spodumene is an ore of _____ metal.

Answer: lithium ✅

(vii) Alkali metal nitrates on heating give the corresponding _____ and _____.

Answer: nitrites, oxygen ✅

(viii) $Na_2CO_3 \cdot 10H_2O$ is the chemical formula of a mineral of sodium which is known as _____.

Answer: washing soda ✅

(ix) Metallic bicarbonates are decomposed on heating into their carbonates, along with _____ and _____.

Answer: carbon dioxide, water ✅

(x) Metal nitrates other than the alkali metals on heating decompose into the corresponding _____ and along with the evolution of _____ and _____.

Answer: metal oxides, nitrogen dioxide, oxygen ✅

Q2. Indicate True or False:

(i) Group IA elements are called alkali metals because their chlorides are alkaline in nature.

Answer: _____ (False)

(ii) Alkali metals are very good conductors of electricity.

Answer: _____ (True)

(iii) The hydroxides of alkali metals and alkaline-earth metals are soluble in water.

Answer: _____ (True)

(iv) Plaster of Paris is a hemihydrate.

Answer: _____ (True)

(v) Alkali metals have low melting and boiling points as compared to those of alkaline earth metals.

Answer: _____ (True)

(vi) Lithium carbonate is decomposed to its oxide, but the carbonates of the other alkali metals are stable towards heat.

Answer: _____ (True)

(vii) All alkali metal sulphates are insoluble in water.

Answer: _____ (False)

(viii) Lithium combines with nitrogen to form lithium nitride but other alkali metals do not react with nitrogen.

Answer: _____ (True)

(ix) Trona is a mineral of lithium.

Answer: _____ (False)

(x) Alkaline earth metals are stronger reducing agents than alkali metals.

Answer: _____ (False)

🌟 **Q4 (a): Give the names, electronic configurations and occurrence of s-block elements.**

❖ **Answer:**

1. Introduction

- The elements in which the last electron enters the s-orbital of the outermost shell are called s-block elements.
- They include the elements of Group IA (1) and Group IIA (2) in the modern periodic table.
- These are also known as alkali metals and alkaline earth metals respectively.

2. Names of s-block Elements

(i) Group IA (Alkali Metals):

- Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs), and Francium (Fr).
- They are called **alkali metals** because their hydroxides are strongly alkaline in nature.

(ii) Group IIA (Alkaline Earth Metals):

- Beryllium (Be), Magnesium (Mg), Calcium (Ca), Strontium (Sr), Barium (Ba), and Radium (Ra).
- These are called **alkaline earth** metals because their oxides are basic and occur in the earth's crust.

3. Electronic Configurations

👉 All s-block elements have their outermost electrons in the s-orbital.

- Alkali metals have one electron (ns^1) in their outermost shell.

Example: Sodium (Na) ⟶ $1s^2\ 2s^2\ 2p^6\ 3s^1$

- Alkaline earth metals have two electrons (ns^2) in their outermost shell.

Example: Magnesium (Mg) ⟶ $1s^2\ 2s^2\ 2p^6\ 3s^2$

The presence of one or two electrons in the s-orbital gives these elements their characteristic chemical properties.

4. Occurrence of s-block Elements

(a) Alkali Metals:

- Lithium is found in minerals such as spodumene and petalite.
- Sodium occurs in rock salt (NaCl), soda ash (Na_2CO_3) and Glauber's salt ($Na_2SO_4 \cdot 10H_2O$).
- Potassium occurs as carnallite ($KCl \cdot MgCl_2 \cdot 6H_2O$) and sylvite (KCl).

(b) Alkaline Earth Metals:

- Beryllium occurs in beryl ($Be_3Al_2(SiO_3)_6$) and phenacite (Be_2SiO_4).

- Magnesium is found in magnesite ($MgCO_3$) and dolomite ($CaCO_3 \cdot MgCO_3$).
- Calcium occurs in limestone ($CaCO_3$), gypsum ($CaSO_4 \cdot 2H_2O$) and fluorite (CaF_2).

🌟 **Q4 (b): Discuss the peculiar behaviour of lithium with respect to the other members of alkali metals.**

❖ **Answer:**

1. Introduction

👉 Lithium, being the first element of Group IA, shows several distinct properties that make it different from other alkali metals.

- This **difference** is mainly due to its small atomic size, high ionization energy, and high polarizing power.

2. Reasons for Peculiar Behaviour

(i) Small Atomic and Ionic Size:

- Lithium has the smallest atomic and ionic radius among alkali metals, which increases its charge density.

(ii) High Polarizing Power:

- The Li^+ ion strongly attracts negative ions, causing covalent character in its compounds.

(iii) High Ionization Energy:

- Because of its small size, lithium holds its outermost electron tightly, making it less reactive than other alkali metals.

(iv) Absence of d-orbitals:

- Lithium has no vacant d-orbitals, while heavier alkali metals can use d-orbitals in bonding.

3. Peculiar Properties of Lithium

- **(a)** Lithium reacts slowly with water, while other alkali metals react violently.

- **(b)** Lithium forms only normal oxide (Li_2O), while others form peroxides and superoxides.
- **(c)** Lithium carbonate (Li_2CO_3) decomposes easily on heating, whereas other alkali metal carbonates are stable.
- **(d)** Lithium nitrate ($LiNO_3$) on heating gives lithium oxide (Li_2O), nitrogen dioxide (NO_2) and oxygen (O_2), while other alkali nitrates form nitrites and oxygen.
- **(e)** Lithium reacts directly with nitrogen to form lithium nitride (Li_3N), while others do not.
- **(f)** Lithium chloride (LiCl) is covalent and soluble in alcohol, but chlorides of other alkali metals are ionic and soluble in water.

4. Diagonal Relationship

👉 Lithium shows a diagonal relationship with magnesium (Mg) of Group IIA.

Both elements resemble each other in several ways:

- Both form covalent compounds.
- Both form carbonates and nitrates that decompose easily on heating.
- Both react with nitrogen to form nitrides.

- Both have chlorides that dissolve in alcohol.

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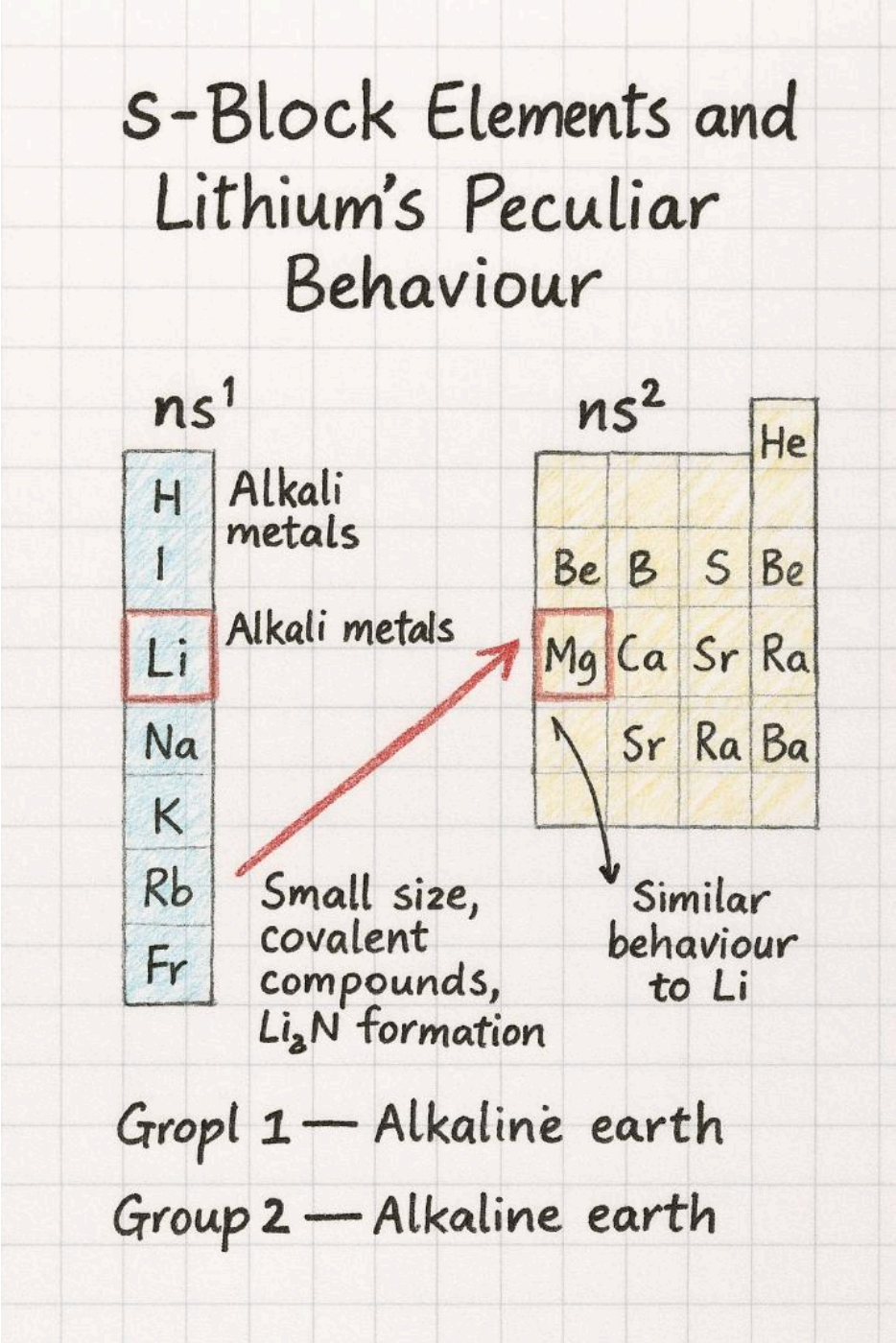

✦ **Summary:**

✅ The s-block elements include alkali metals (Group 1) and alkaline earth metals (Group 2) with general electronic configurations of ns^1 and ns^2 respectively.

✅ They are highly reactive and occur naturally in the form of minerals and salts.

✅ Lithium shows peculiar behavior compared to other alkali metals due to its small size, high ionization energy, and strong covalent character.

✅ It also resembles magnesium, showing a clear diagonal relationship between Group 1 and Group 2 elements.

🌟 **Q5: Discuss the trends in chemical properties of compounds like oxides, hydroxides, carbonates, nitrates and sulphates of IA and IIA group elements.**

❖ **Answer:**

1. Introduction

👉 The elements of Group IA (Alkali metals) and Group IIA (Alkaline earth metals) form a variety of compounds such as oxides, hydroxides, carbonates, nitrates, and sulphates.

The properties of these compounds show systematic trends when we move down the group due to the increase in atomic size, decrease in ionization energy, and difference in lattice energies.

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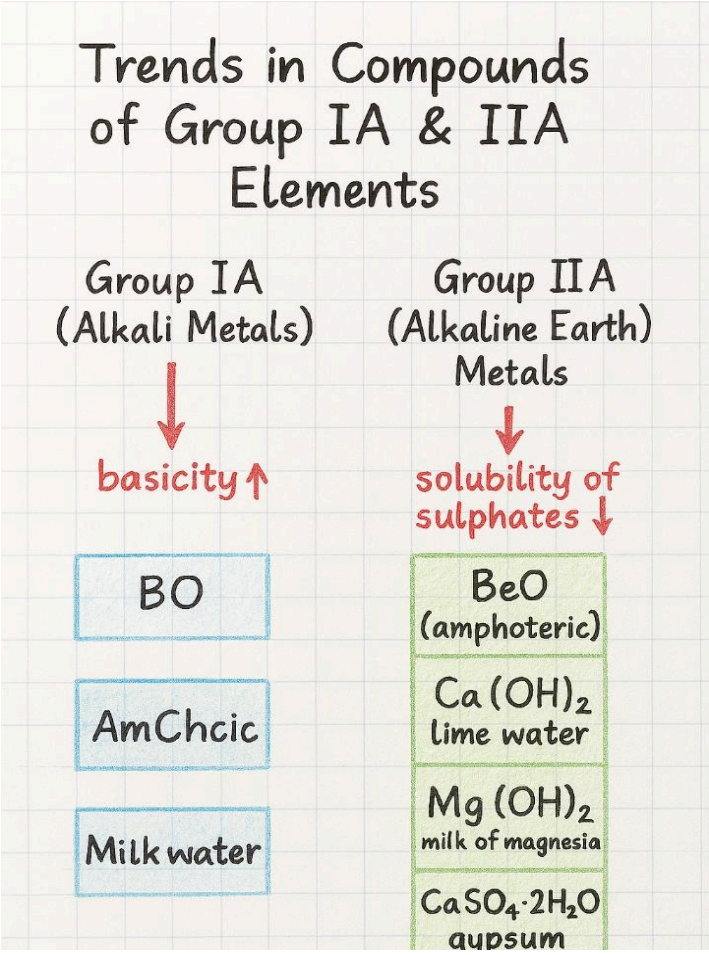

2. Trends in Chemical Properties

(a) Oxides

Alkali Metal Oxides:

- **Alkali metals** form three types of oxides depending on the size of the cation:

👉 Normal oxide (M_2O) — formed by Li

👉 Peroxide (M_2O_2) — formed by Na

👉 Superoxide (MO_2) — formed by K, Rb, Cs

The basic character of oxides increases down the group.

Example: $Li_2O < Na_2O < K_2O < Rb_2O < Cs_2O$

Alkaline Earth Metal Oxides:

- All elements of Group IIA form monoxides (MO).

Example: BeO, MgO, CaO, SrO, BaO

- **BeO** is amphoteric (reacts with both acids and bases).
- Basic nature increases down the group because of increasing ionic size.

Example: BeO < MgO < CaO < SrO < BaO

Reactions:

$BeO + 2NaOH \longrightarrow Na_2BeO_2 + H_2O$

$BeO + H_2SO_4 \longrightarrow BeSO_4 + H_2O$

(b) Hydroxides

Alkali Metal Hydroxides:

- All alkali metal hydroxides are strong bases and very soluble in water, except LiOH (slightly soluble).
- Their basic strength increases down the group due to decreasing lattice energy.

Example: LiOH < NaOH < KOH < RbOH < CsOH

Alkaline Earth Metal Hydroxides:

- Solubility and basicity increase down the group because lattice energy decreases.
- **Example**: $Be(OH)_2$ (insoluble) < $Mg(OH)_2$ (sparingly soluble) < $Ca(OH)_2$ (soluble) < $Ba(OH)_2$ (most soluble).
- $Be(OH)_2$ is amphoteric in nature.

Important Compounds:

- $Ca(OH)_2$ (Lime water) — used to test CO_2.
- $Mg(OH)_2$ (Milk of magnesia) — used as an antacid.

(c) Carbonates

Alkali Metal Carbonates:

- All are soluble in water and thermally stable, except Li_2CO_3.
- Li_2CO_3 decomposes on heating:

$Li_2CO_3 \longrightarrow Li_2O + CO_2$

Alkaline Earth Metal Carbonates:

- All are sparingly soluble in water, and solubility decreases down the group.
- On heating, they decompose to oxides and CO_2:

$CaCO_3 \longrightarrow CaO + CO_2$

(d) Nitrates

Alkali Metal Nitrates:

- All are soluble in water.
- On heating:

$LiNO_3 \longrightarrow Li_2O + NO_2 + O_2$

$NaNO_3$ and $KNO_3 \longrightarrow MNO_2 + O_2$

Alkaline Earth Metal Nitrates:

- All are soluble and decompose on heating to give metal oxide, nitrogen dioxide, and oxygen.

Example:

$2Ca(NO_3)_2 \longrightarrow 2CaO + 4NO_2 + O_2$

(e) Sulphates

Alkali Metal Sulphates:

- All are soluble in water and thermally stable.
- **Example**: Na_2SO_4, K_2SO_4 are completely soluble.

Alkaline Earth Metal Sulphates:

- Solubility decreases down the group due to increasing ionic size and lattice energy.
- **Example**: $BeSO_4$ and $MgSO_4$ (soluble), $CaSO_4$ (sparingly soluble), $SrSO_4$ and $BaSO_4$ (insoluble).
- Gypsum ($CaSO_4 \cdot 2H_2O$) and Plaster of Paris ($CaSO_4 \cdot \frac{1}{2}H_2O$) are important compounds.

4. Overall Explanation

👉 The difference in properties between the compounds of Group IA and IIA arises mainly from:

- Ionic charge difference (+1 vs +2)
- Variation in ionic size
- Polarizing power
- Lattice energy changes
- As we move down each group:
- Metallic character increases
- Ionic size increases
- Lattice energy decreases
- Solubility and basicity generally increase

✦ **Summary:**

✅ **Oxides:** Become more basic down the group.

✅ **Hydroxides:** Solubility and basic strength increase down the group.

✅ **Carbonates:** Solubility decreases in IIA; Li_2CO_3 decomposes easily.

✅ **Nitrates:** All are soluble; heating gives different products for IA and IIA.

✅ **Sulphates:** Solubility decreases down the group in IIA metals.

In short, alkali metals form highly soluble and strongly basic compounds, whereas alkaline earth metals form less soluble and moderately basic compounds.

🌟 **Q6. Compare the chemical behaviour of lithium with magnesium.**

❖ **Answer:**

Although lithium belongs to Group IA (alkali metals) and magnesium belongs to Group IIA (alkaline earth metals), they show a number of similarities in their chemical behaviour. This similarity is due to their similar ionic sizes and polarizing power — a phenomenon known as diagonal relationship in the periodic table.

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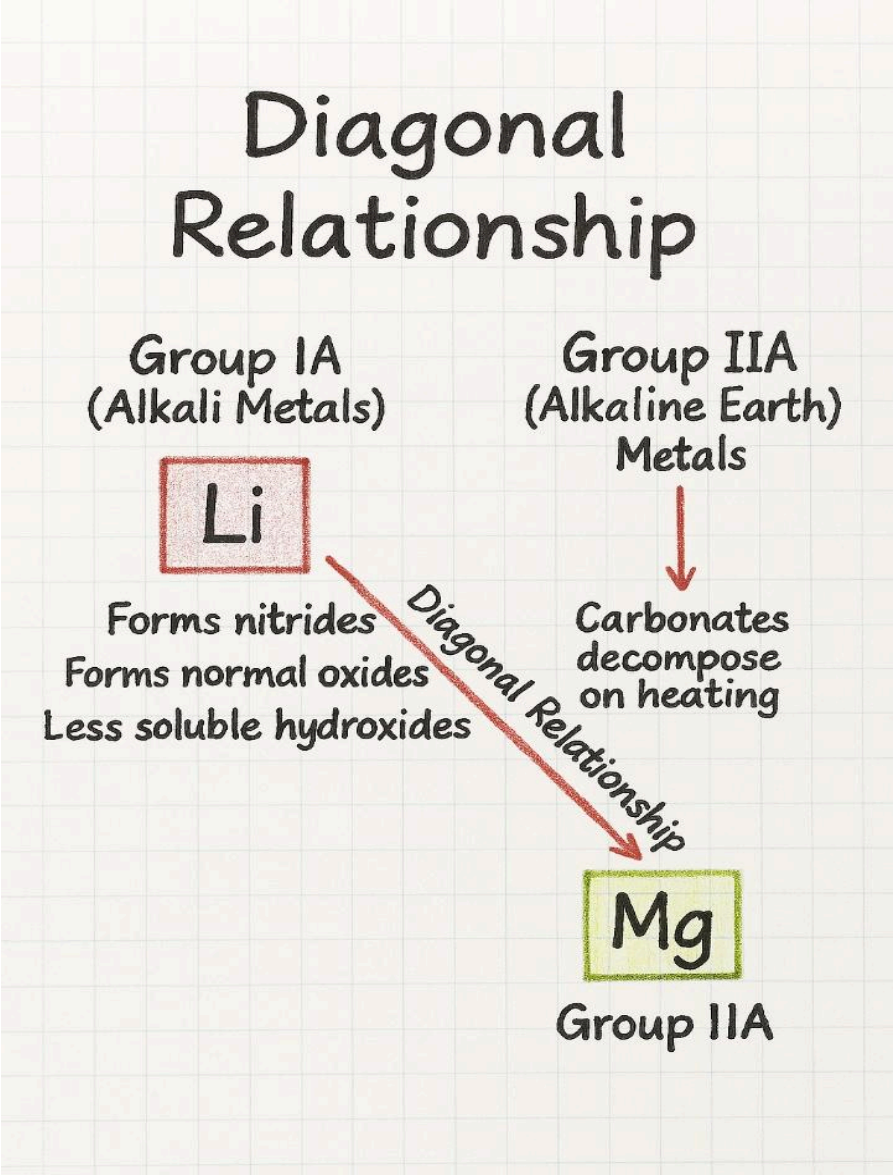

1. Formation of Normal Oxides

👉 Both lithium and magnesium form only normal oxides when heated in air.

- Lithium forms Li_2O

- Magnesium forms MgO

Both oxides are white, stable, and sparingly soluble in water, forming weakly basic hydroxides.

2. Reaction with Nitrogen

👉 Both lithium and magnesium react directly with nitrogen to form nitrides.

$6Li + N_2 \longrightarrow 2Li_3N$

$3Mg + N_2 \longrightarrow Mg_3N_2$

This property is not shown by other members of their respective groups.

3. Formation of Carbonates

👉 Both lithium carbonate (Li_2CO_3) and magnesium carbonate ($MgCO_3$) are unstable on heating and decompose to give oxide and carbon dioxide.

$Li_2CO_3 \longrightarrow Li_2O + CO_2$

$MgCO_3 \longrightarrow MgO + CO_2$

Other alkali and alkaline earth metal carbonates are thermally more stable.

4. Formation of Hydroxides

👉 Both LiOH and $Mg(OH)_2$ are sparingly soluble in water and less basic compared to other members of their respective groups.

5. Formation of Chlorides

👉 Both LiCl and $MgCl_2$ are soluble in alcohol, delinquent (absorb moisture), and crystallize from aqueous solutions as hydrated salts — $LiCl{\cdot}2H_2O$ and $MgCl_2{\cdot}6H_2O$.

6. Nitrates and Sulphates

👉 Both $LiNO_3$ and $Mg(NO_3)_2$ decompose on heating to give metal oxide, nitrogen dioxide, and oxygen.

Similarly, their sulphates (Li_2SO_4 and $MgSO_4$) are soluble in water and show similar crystalline structures.

7. Polarizing Power

👉 Both Li^+ and Mg^{2+} ions have small ionic sizes and high charge density, which gives them strong polarizing power.

Hence, their compounds (like LiCl, $MgCl_2$) have more covalent character than those of other metals in their respective groups.

✦ **Summary:**

- Lithium and magnesium exhibit similar chemical properties due to their diagonal relationship.
- Both form normal oxides, nitrides, less soluble hydroxides, and unstable carbonates.
- Their compounds have higher covalent character because of high polarizing power.

🌟 **Q7 (a) Mention the properties of beryllium in which it does not resemble with its own family.**

❖ **Answer:**

Beryllium (Be) belongs to Group IIA (alkaline earth metals), which also includes Mg, Ca, Sr, and Ba.

However, beryllium shows anomalous (peculiar) behaviour as compared to other elements of its family.

The reason for this difference is its small atomic and ionic size, high ionization energy, and high charge density (polarizing power).

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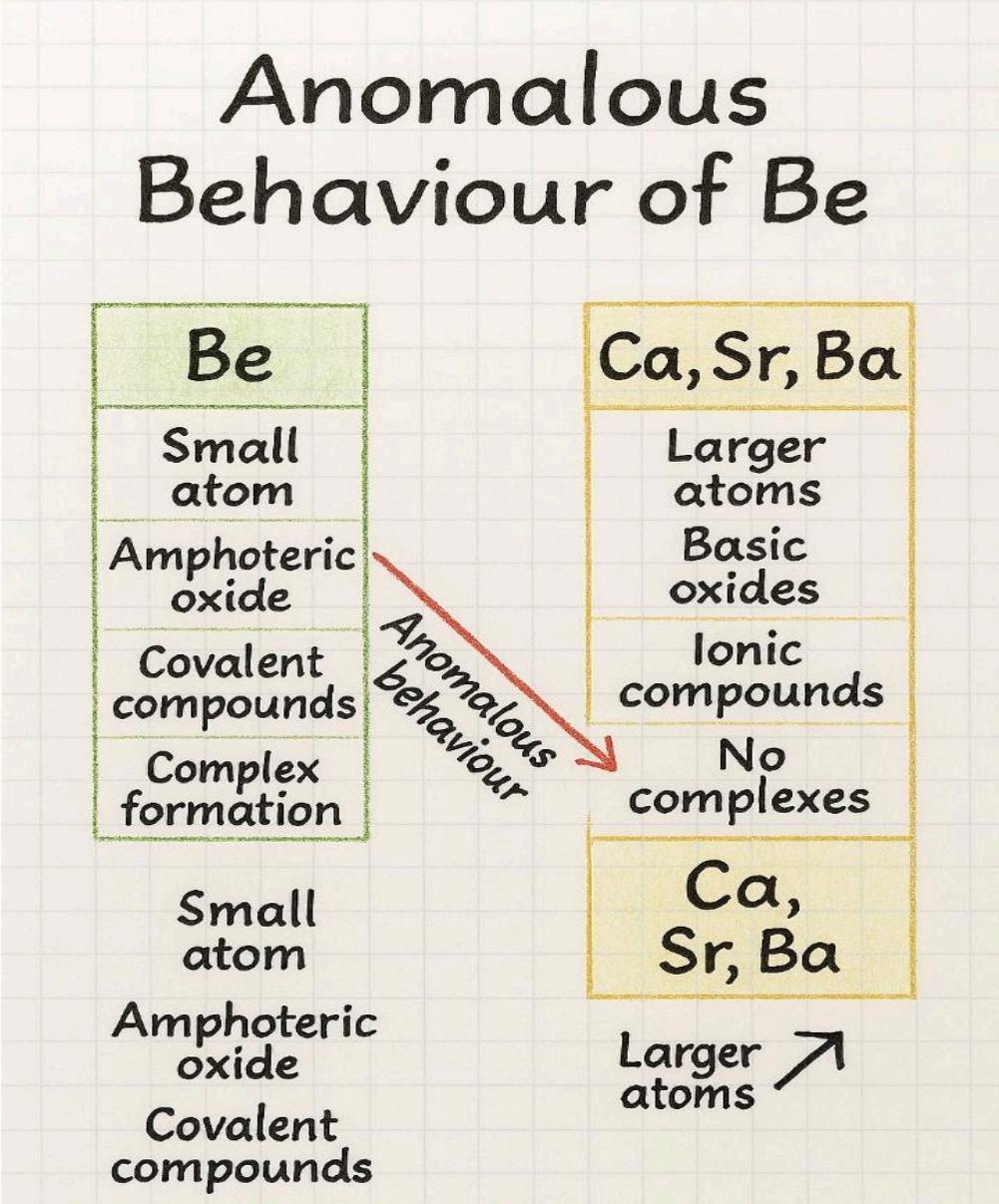

1. Nature of Oxide and Hydroxide

👉 Beryllium oxide (BeO) and beryllium hydroxide [$Be(OH)_2$] are amphoteric in nature,

that is, they react both with acids and bases to form salts.

Equations:

With acid:

$BeO + 2HCl \longrightarrow BeCl_2 + H_2O$

With base:

$BeO + 2NaOH + H_2O \longrightarrow Na_2[Be(OH)_4]$

Other alkaline earth metals (like Ca, Sr, Ba) form basic oxides and hydroxides only, not amphoteric ones.

2. Solubility of Hydroxide

👉 $Be(OH)_2$ is insoluble in water,

- whereas hydroxides of other members, such as $Ca(OH)_2$, $Sr(OH)_2$, and $Ba(OH)_2$, are soluble and strongly basic.

3. Reaction with Water

👉 Beryllium does not react with water,

- even at high temperature, due to the formation of a thin oxide layer on its surface.

Other metals (Ca, Sr, Ba) react readily:

$Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$ ⬆️

4. Nature of Compounds

👉 Beryllium forms mainly covalent compounds,

- while other members form ionic compounds.

Reason: Be^{2+} has very high polarizing power, which distorts the anions and makes the bond covalent.

Example:

- $BeCl_2 \longrightarrow$ {Covalent compound (polymeric structure)}
- $CaCl_2 \longrightarrow$ {Ionic compound}

5. Complex Formation

👉 Beryllium has a strong tendency to form complex compounds because of its small size and high charge.

Examples:

[BeF4]^2−, [Be(H2O)4]^2+

Other alkaline earth metals rarely form complexes.

6. Reaction with Ammonia (NH_3)

👉 When $BeCl_2$ reacts with ammonia, it forms a complex compound:

$BeCl_2 + 2NH_3 \longrightarrow BeCl_2 \cdot 2NH_3$

Other **metal chlorides** (like $CaCl_2$, $BaCl_2$) form only simple ammoniates, not complexes.

7. Structure of Chlorides

👉 $BeCl_2$ is covalent and polymeric in solid state,

while other members like $CaCl_2$ are ionic and crystalline.

✦ **Summary:**

- BeO and $Be(OH)_2$ are amphoteric, not basic.
- $Be(OH)_2$ is insoluble in water.
- Be forms covalent and complex compounds.
- Be does not react with water.

The anomalous behavior is due to small size, high ionization energy, and high polarizing power.

🌟 **Q7 (b) Why is the aqueous solution of Na_2CO_3 alkaline in nature?**

❖ **Answer:**

👉 Sodium carbonate (Na_2CO_3) is a salt of a strong base (NaOH) and a weak acid (H_2CO_3).

When it dissolves in water, it undergoes complete ionization and hydrolysis, producing OH^- ions — which makes the solution alkaline.

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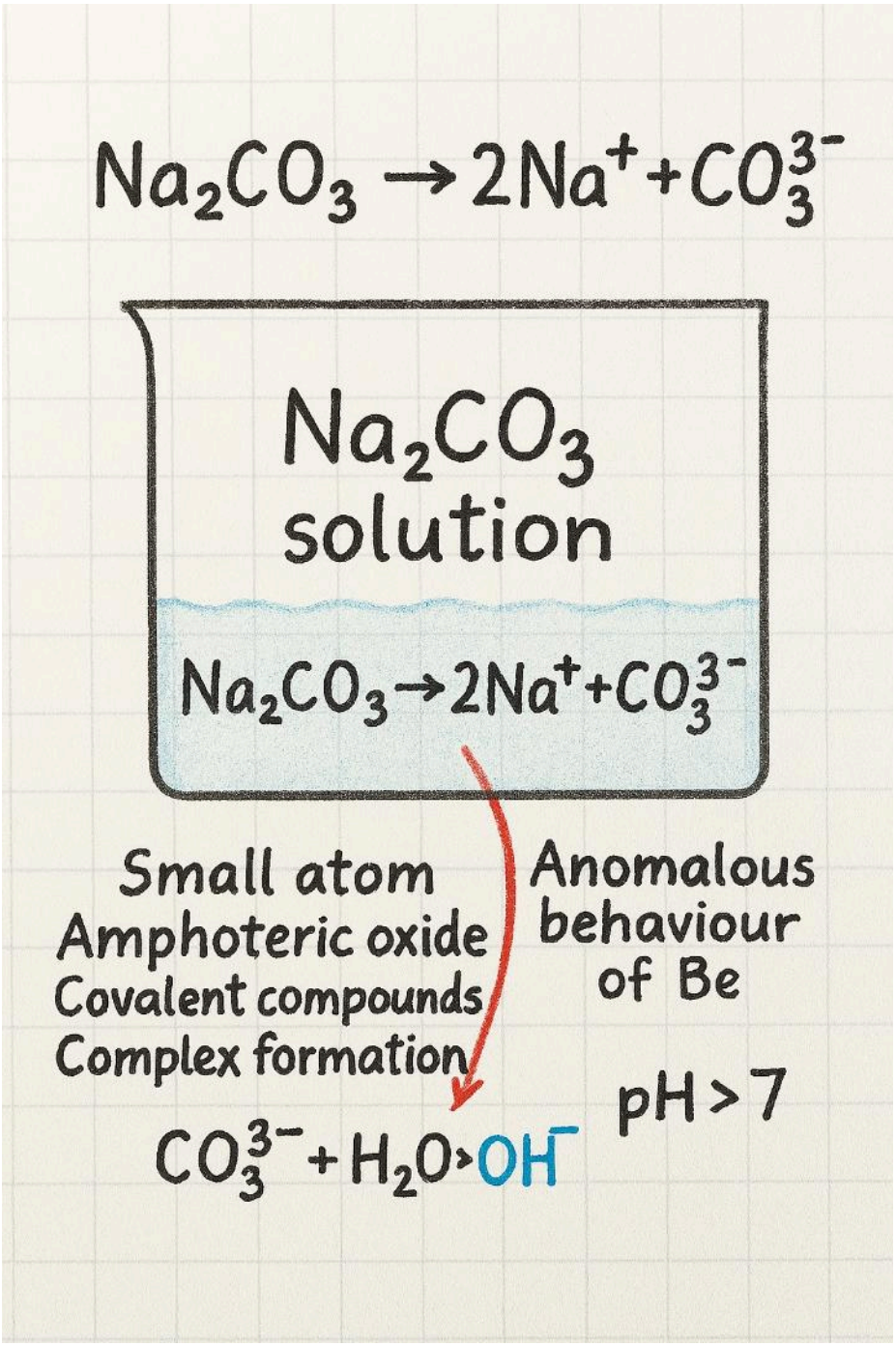

Step 1: Ionization of Sodium Carbonate

$Na_2CO_3 \longrightarrow 2Na^+ + CO_3^{2-}$

Step 2: Hydrolysis of Carbonate Ions

$CO_3^{2-} + H_2O \rightleftharpoons HCO_3^- + OH^-$

In this reaction, hydroxide ions (OH^-) are produced.

Step 3: Presence of OH^- Ions $\longrightarrow$ Alkaline Nature

Due to the production of OH^- ions, the solution becomes basic (alkaline) and turns red litmus blue.

Explanation:

- The strong base (NaOH) fully neutralizes the weak acid (H_2CO_3) during salt formation.
- When this salt dissolves in water, the anion (CO_3^{2-}) reacts with water to regenerate a small amount of base (NaOH equivalent).
- **This increases** OH^- ion concentration, raising the pH above 7, indicating alkalinity.

Final Equation (Overall Process):

$Na_2CO_3 + H_2O \rightleftharpoons 2Na^+ + HCO_3^- + OH^-$

✦ **Summary:**

- Na_2CO_3 is a salt of strong base and weak acid.
- It undergoes hydrolysis, forming OH^- ions.
- These hydroxide ions make the solution alkaline in nature.

🌟 **Q8 (a) Describe with diagram the manufacture of sodium by Down's Cell.**

❖ **Answer:**

👉 Sodium metal is obtained commercially by the electrolysis of fused sodium chloride (NaCl) using a specially designed electrolytic apparatus known as the Down's Cell.

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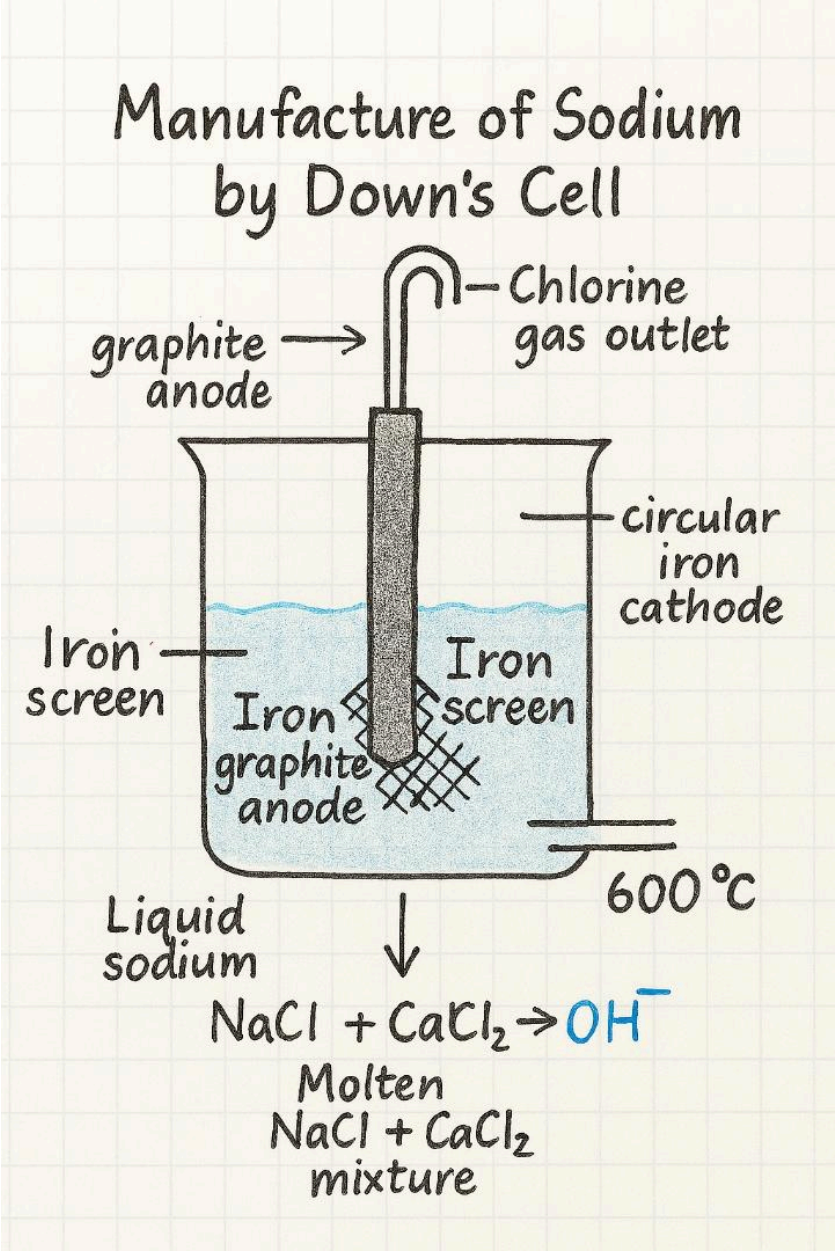

1. Principle of the Process

- The process is based on the electrolysis of fused NaCl (not aqueous solution) because if water were present, it would decompose instead of NaCl.

- To lower the melting point of NaCl (801°C), calcium chloride ($CaCl_2$) is added.

This mixture melts at about 600°C, making the process more economical.

2. Construction of Down's Cell

The Down's cell is made of iron and is lined inside with a refractory material to resist heat.

Main parts of the cell:

- **Anode:** A large graphite rod placed vertically at the centre.
- **Cathode:** A circular ring of iron surrounding the anode.

Iron gauze/screen: Placed between the anode and cathode to prevent sodium and chlorine from coming into contact after being liberated.

Outlet:

- One for molten sodium (at cathode side).

- One for chlorine gas (at anode side).

3. Working of Down's Cell

- The fused mixture of NaCl and $CaCl_2$ is heated to about 600°C and then electrolyzed.

During electrolysis, the following reactions occur:

At Cathode (Reduction):

$Na^+ + e^- \longrightarrow Na$

It rises to the surface and is collected in a special receiver.

At Anode (Oxidation):

$2Cl^- \longrightarrow Cl_2 + 2e^-$

4. Overall Reaction:

$2NaCl(l) \longrightarrow 2Na(l) + Cl_2(g)$

5. Precautions:

- The anode and cathode compartments are separated by an iron screen to prevent the recombination of Na and Cl_2.
- The temperature is carefully maintained at 600°C.
- The cell material is chosen to resist corrosion by molten salts.

6. Products Obtained:

- Sodium metal (Na) — 99.9% pure
- Dry chlorine gas (Cl_2) — collected as a valuable by-product

Summary of the Process:

- **Process**: Electrolysis of fused NaCl (with $CaCl_2$)
- **Temperature**: ≈ 600°C
- **Products**: Na (metal) and Cl_2 (gas)
- **Cell type:** Down's Cell

🌟 Q8 (b) Point out the three advantages of this process.

❖ **Answer:**

The Down's process has the following three important advantages:

1. No metallic fog is produced:

- Sodium is obtained in pure molten form, not as a mist or vapor.

2. Easy collection of liquid sodium:

- Since the process operates at 600°C, sodium remains liquid and can be easily collected.

3. Cell material is not attacked:

- The iron and graphite materials of the cell are resistant to the chemical attack of molten salts and gases.

✦ **Summary:**

- Sodium is manufactured by electrolysis of fused NaCl in Down's Cell.

- The process gives 99.9% pure sodium and dry chlorine gas.

It is an efficient, safe, and economical industrial method.

🌟 **Q9 (a) Compare the physical and chemical properties of alkali metals with those of alkaline-earth metals.**

❖ **Answer:**

Alkali metals (Group IA: Li, Na, K, Rb, Cs, Fr) and alkaline-earth metals (Group IIA: Be, Mg, Ca, Sr, Ba, Ra) both belong to the s-block, but they differ greatly in their physical and chemical behavior.

1️⃣ Electronic Configuration

- Alkali metals → ns^1 (one valence electron)
- Alkaline-earth metals → ns^2 (two valence electrons)
- Alkali metals lose one electron easily; therefore, they are more reactive than alkaline-earth metals which must lose two.

2️⃣ Atomic and Ionic Size

- Alkali metals have larger atomic and ionic radii than alkaline-earth metals in the same period.

Example: Na > Mg

3️⃣ Melting and Boiling Points

- Alkali metals have low melting and boiling points,
- while alkaline-earth metals have higher melting and boiling points.

Example: Lithium (181 °C) vs Magnesium (650 °C)

4️⃣ Hardness

- Alkali metals are soft (can be cut with a knife).
- Alkaline-earth metals are harder and denser.

5️⃣ Ionization Energy

- Alkali metals have low ionization energy, so they lose electrons easily and act as strong reducing agents.

- Alkaline-earth metals have higher ionization energy, making them less reactive.

6️⃣ Reactivity

- Alkali metals are more reactive than alkaline-earth metals.
- They react vigorously with water and air, while alkaline-earth metals react slowly.

7️⃣ Reaction with Oxygen

Alkali metals:

- $4Na + O_2 \longrightarrow 2Na_2O$
- $2K + O_2 \longrightarrow K_2O_2$
- $Cs + O_2 \longrightarrow CsO_2$

Alkaline-earth metals:

- $2Mg + O_2 \longrightarrow 2MgO$
- $2Ca + O_2 \longrightarrow 2CaO$

Alkali metals form oxides, peroxides, or superoxides depending on size;

alkaline-earth metals form only simple oxides.

8️⃣Reaction with Water

Alkali metals:

$2Na + 2H_2O \longrightarrow 2NaOH + H_2$⬆️

Alkaline-earth metals:

$Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$⬆️

Alkali metals react violently with water;

alkaline-earth metals react slowly.

9️⃣Hydroxides

Alkali metals:

- $Na_2O + H_2O \longrightarrow 2NaOH$

Alkaline-earth metals:

- $CaO + H_2O \longrightarrow Ca(OH)_2$

Alkali-metal hydroxides are strong bases,

whereas **alkaline-earth** hydroxides are less soluble and therefore weaker bases.

Beryllium hydroxide [$Be(OH)_2$] is amphoteric (reacts with both acids and bases).

🔟 Carbonates

Alkali metals:

- $Li_2CO_3 \longrightarrow Li_2O + CO_2$⬆️ (on heating)

Alkaline-earth metals:

- $CaCO_3 \longrightarrow CaO + CO_2$⬆️ (on heating)

Except for **lithium carbonate**, **alkali-metal** carbonates are heat-stable.

All **alkaline-earth** carbonates decompose when heated.

11. Nitrates

Alkali metals:

- $2NaNO_3 \longrightarrow 2NaNO_2 + O_2\uparrow$

Alkaline-earth metals:

- $2Ca(NO_3)_2 \longrightarrow 2CaO + 4NO_2\uparrow + O_2\uparrow$

Alkali nitrates give nitrites and oxygen,

while alkaline-earth nitrates give oxides, nitrogen dioxide, and oxygen.

12. Sulphates

- All alkali-metal sulphates are soluble in water.

- **In contrast,** the solubility of alkaline-earth sulphates decreases as we move down the group.

($BeSO_4$ > $MgSO_4$ > $CaSO_4$ > $BaSO_4$)

✦ **Summary:**

- Alkali metals are softer, lighter, and more reactive.
- Alkaline-earth metals are harder, denser, and less reactive.

Both groups form basic oxides and hydroxides, but alkali-metal compounds are more soluble and more strongly basic.

🌟 **Q9 (b): What happens when:**

(i) Lithium carbonate is heated

$Li_2CO_3 \longrightarrow Li_2O + CO_2$⬆️ (on heating)

- When lithium carbonate is heated, it decomposes to form lithium oxide and carbon dioxide gas.
- This happens because lithium ion (Li^+) is small in size and polarizes the carbonate ion strongly, weakening the C–O bonds and causing decomposition.

(ii) Lithium hydroxide is heated to red hot

$2LiOH \longrightarrow Li_2O + H_2O\uparrow$ (on heating)

- On strong heating, lithium hydroxide decomposes into lithium oxide and water vapor.
- This behavior is exceptional because other alkali metal hydroxides like NaOH and KOH are stable to heat.

(iii) Beryllium is treated with sodium hydroxide

$Be + 2NaOH + 2H_2O \longrightarrow Na_2[Be(OH)_4] + H_2\uparrow$

- When beryllium reacts with sodium hydroxide in the presence of water, it produces sodium beryllate and hydrogen gas.
- This shows that beryllium is amphoteric, meaning it reacts with both acids and bases.

(iv) Lithium hydride is treated with water

$LiH + H_2O \longrightarrow LiOH + H_2\uparrow$

- When lithium hydride reacts with water, lithium hydroxide and hydrogen gas are formed.

This reaction is highly exothermic and vigorous.

Hydrogen gas has evolved rapidly.

✦ **Summary:**

1. Lithium carbonate decomposes into lithium oxide and carbon dioxide on heating.

2. Lithium hydroxide decomposes into lithium oxide and water at red heat.

3. Beryllium reacts with NaOH forming sodium beryllate and hydrogen gas, showing its amphoteric nature.

4. Lithium hydride reacts with water forming lithium hydroxide and hydrogen gas.

🌟 **Q10. Give formulas of the following minerals.**

❖ **Answer:**

(a) Dolomite ⟶ $CaCO_3 \cdot MgCO_3$

👉 It is a double carbonate of calcium and magnesium.

(b) Asbestos ⟶ $CaMg_3(SiO_3)_4$

👉 It is a hydrated silicate mineral containing calcium and magnesium.

(c) Halite ⟶ NaCl

👉 It is commonly known as rock salt or common salt.

(d) Natron → $Na_2CO_3 \cdot 10H_2O$

👉 It is a hydrated sodium carbonate mineral.

(e) Beryl → $3BeO \cdot Al_2O_3 \cdot 6SiO_2$

👉 It is a natural source of beryllium, a silicate of aluminium and beryllium.

(f) Sylvite → KCl

👉 It is a natural potassium chloride mineral.

(g) Phosphorite → $Ca_3(PO_4)_2$

👉 It is a mineral form of calcium phosphate used in fertilizer production.

(h) Chile Saltpetre → $NaNO_3$

👉 It is a natural sodium nitrate mineral found in Chile and Peru.

✦ **Summary:**

These minerals are important natural sources of alkali and alkaline-earth metals such as sodium, potassium, calcium, magnesium, and beryllium — used in industry, fertilizers, and chemical manufacturing.

🌟 **Q.11. Answer the following questions briefly**

❖ **Answer:**

(a) Why alkali and alkaline earth metals are among the reactive elements of the periodic table?

👉 Alkali (Group IA) and Alkaline Earth (Group IIA) metals are highly reactive because they have one or two electrons in their outermost shell, which they easily lose to form positive ions.

They have low ionization energy and large atomic size, making it easier for them to take part in chemical reactions.

(b) Why lime water turns milky with CO_2 but becomes clear with excess CO_2?

👉 When carbon dioxide is passed through lime water (calcium hydroxide), it turns milky due to formation of insoluble calcium carbonate.

Equation 1:

$$Ca(OH)2 + CO2 \longrightarrow CaCO3 + H2O$$

👉 When excess CO_2 is passed, the milkiness disappears because calcium carbonate reacts with more CO_2 and water to form soluble calcium bicarbonate.

Equation 2:

$$CaCO3 + CO2 + H2O \longrightarrow Ca(HCO3)2$$

(c) How is gypsum converted into plaster of Paris?

👉 When gypsum ($CaSO4 \cdot 2H2O$) is gently heated up to about 100°C, it loses three-fourths of its water of crystallization and forms plaster of Paris ($CaSO4 \cdot ½H2O$).

Equation:

$2CaSO_4 \cdot 2H_2O \longrightarrow (CaSO_4)_2 \cdot H_2O + 3H_2O$

(d) Why 2% gypsum is added in the cement?

👉 About 2% gypsum is added to Portland cement to control the setting time.

- Without gypsum, cement sets very quickly when mixed with water.
- Gypsum slows down the hardening process and allows enough time for mixing and application.

(e) Why is lime added to an acidic soil?

👉 Acidic soils have extra hydrogen ions (H^+) which reduce fertility.

Lime (CaO) or slaked lime ($Ca(OH)_2$) neutralizes acidity and improves soil pH.

Equation:

$2H^+ + CaCO_3 \longrightarrow Ca^{2+} + CO_2 + H_2O$

(f) How lime and sand are used to make glass?

👉 When lime (CaO) reacts with sand (SiO2) at high temperature, it forms calcium silicate (CaSiO3), an important compound used in glass making.

Equation:

$$CaO + SiO_2 \longrightarrow CaSiO_3$$

(g) How lime mortar is prepared?

👉 Lime mortar is prepared by mixing slaked lime [Ca(OH)2], sand, and water into a thick paste.

When applied between bricks, it hardens by absorbing CO2 from air and forms calcium carbonate, which binds the bricks together.

Equation 1:

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

✦ Summary:

Alkali and alkaline earth metals are very reactive due to their easy electron loss.

Gypsum and lime are useful in many industries:

- Gypsum ⟶ Plaster of Paris and cement control
- Lime ⟶ Soil neutralizer, glass making, mortar and construction materials

Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

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Purpose: To contribute to education by offering insightful, valuable content that enhances learning and understanding.