

Unit

10

THE s -BLOCK ELEMENTS

I. Multiple Choice Questions (Type-I)

1. The alkali metals are low melting. Which of the following alkali metal is expected to melt if the room temperature rises to 30°C?
 - (i) Na
 - (ii) K
 - (iii) Rb
 - (iv) Cs
2. Alkali metals react with water vigorously to form hydroxides and dihydrogen. Which of the following alkali metals reacts with water least vigorously?
 - (i) Li
 - (ii) Na
 - (iii) K
 - (iv) Cs
3. The reducing power of a metal depends on various factors. Suggest the factor which makes Li, the strongest reducing agent in aqueous solution.
 - (i) Sublimation enthalpy
 - (ii) Ionisation enthalpy
 - (iii) Hydration enthalpy
 - (iv) Electron-gain enthalpy
4. Metal carbonates decompose on heating to give metal oxide and carbon dioxide. Which of the metal carbonates is most stable thermally?
 - (i) MgCO_3
 - (ii) CaCO_3
 - (iii) SrCO_3
 - (iv) BaCO_3

5. Which of the carbonates given below is unstable in air and is kept in CO_2 atmosphere to avoid decomposition.
- (i) BeCO_3
 - (ii) MgCO_3
 - (iii) CaCO_3
 - (iv) BaCO_3
6. Metals form basic hydroxides. Which of the following metal hydroxide is the least basic?
- (i) Mg(OH)_2
 - (ii) Ca(OH)_2
 - (iii) Sr(OH)_2
 - (iv) Ba(OH)_2
7. Some of the Group 2 metal halides are covalent and soluble in organic solvents. Among the following metal halides, the one which is soluble in ethanol is
- (i) BeCl_2
 - (ii) MgCl_2
 - (iii) CaCl_2
 - (iv) SrCl_2
8. The order of decreasing ionisation enthalpy in alkali metals is
- (i) $\text{Na} > \text{Li} > \text{K} > \text{Rb}$
 - (ii) $\text{Rb} < \text{Na} < \text{K} < \text{Li}$
 - (iii) $\text{Li} > \text{Na} > \text{K} > \text{Rb}$
 - (iv) $\text{K} < \text{Li} < \text{Na} < \text{Rb}$
9. The solubility of metal halides depends on their nature, lattice enthalpy and hydration enthalpy of the individual ions. Amongst fluorides of alkali metals, the lowest solubility of LiF in water is due to
- (i) Ionic nature of lithium fluoride
 - (ii) High lattice enthalpy
 - (iii) High hydration enthalpy for lithium ion.
 - (iv) Low ionisation enthalpy of lithium atom
10. Amphoteric hydroxides react with both alkalies and acids. Which of the following Group 2 metal hydroxides is soluble in sodium hydroxide?
- (i) Be(OH)_2
 - (ii) Mg(OH)_2
 - (iii) Ca(OH)_2
 - (iv) Ba(OH)_2

11. In the synthesis of sodium carbonate, the recovery of ammonia is done by treating NH_4Cl with $\text{Ca}(\text{OH})_2$. The by-product obtained in this process is
- CaCl_2
 - NaCl
 - NaOH
 - NaHCO_3
12. When sodium is dissolved in liquid ammonia, a solution of deep blue colour is obtained. The colour of the solution is due to
- ammoniated electron
 - sodium ion
 - sodium amide
 - ammoniated sodium ion
13. By adding gypsum to cement
- setting time of cement becomes less.
 - setting time of cement increases.
 - colour of cement becomes light.
 - shining surface is obtained.
14. Dead burnt plaster is
- CaSO_4
 - $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$
 - $\text{CaSO}_4 \cdot \text{H}_2\text{O}$
 - $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
15. Suspension of slaked lime in water is known as
- lime water
 - quick lime
 - milk of lime
 - aqueous solution of slaked lime
16. Which of the following elements does not form hydride by direct heating with dihydrogen?
- Be
 - Mg
 - Sr
 - Ba

17. The formula of soda ash is
- (i) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
 - (ii) $\text{Na}_2\text{CO}_3 \cdot 2\text{H}_2\text{O}$
 - (iii) $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
 - (iv) Na_2CO_3
18. A substance which gives brick red flame and breaks down on heating to give oxygen and a brown gas is
- (i) Magnesium nitrate
 - (ii) Calcium nitrate
 - (iii) Barium nitrate
 - (iv) Strontium nitrate
19. Which of the following statements is true about $\text{Ca}(\text{OH})_2$?
- (i) It is used in the preparation of bleaching powder
 - (ii) It is a light blue solid
 - (iii) It does not possess disinfectant property.
 - (iv) It is used in the manufacture of cement.
20. A chemical **A** is used for the preparation of washing soda to recover ammonia. When CO_2 is bubbled through an aqueous solution of **A**, the solution turns milky. It is used in white washing due to disinfectant nature. What is the chemical formula of **A**?
- (i) $\text{Ca}(\text{HCO}_3)_2$
 - (ii) CaO
 - (iii) $\text{Ca}(\text{OH})_2$
 - (iv) CaCO_3
21. Dehydration of hydrates of halides of calcium, barium and strontium i.e., $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$, $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$, $\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$, can be achieved by heating. These become wet on keeping in air. Which of the following statements is correct about these halides?
- (i) act as dehydrating agent
 - (ii) can absorb moisture from air
 - (iii) Tendency to form hydrate decreases from calcium to barium
 - (iv) All of the above

II. Multiple Choice Questions (Type-II)

In the following questions two or more options may be correct.

22. Metallic elements are described by their standard electrode potential, fusion enthalpy, atomic size, etc. The alkali metals are characterised by which of the following properties?

- (i) High boiling point
 - (ii) High negative standard electrode potential
 - (iii) High density
 - (iv) Large atomic size
23. Several sodium compounds find use in industries. Which of the following compounds are used for textile industry?
- (i) Na_2CO_3
 - (ii) NaHCO_3
 - (iii) NaOH
 - (iv) NaCl
24. Which of the following compounds are readily soluble in water?
- (i) BeSO_4
 - (ii) MgSO_4
 - (iii) BaSO_4
 - (iv) SrSO_4
25. When Zeolite, which is hydrated sodium aluminium silicate is treated with hard water, the sodium ions are exchanged with which of the following ion(s)?
- (i) H^+ ions
 - (ii) Mg^{2+} ions
 - (iii) Ca^{2+} ions
 - (iv) SO_4^{2-} ions
26. Identify the correct formula of halides of alkaline earth metals from the following.
- (i) $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
 - (ii) $\text{BaCl}_2 \cdot 4\text{H}_2\text{O}$
 - (iii) $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$
 - (iv) $\text{SrCl}_2 \cdot 4\text{H}_2\text{O}$
27. Choose the correct statements from the following.
- (i) Beryllium is not readily attacked by acids because of the presence of an oxide film on the surface of the metal.
 - (ii) Beryllium sulphate is readily soluble in water as the greater hydration enthalpy of Be^{2+} overcomes the lattice enthalpy factor.
 - (iii) Beryllium exhibits coordination number more than four.
 - (iv) Beryllium oxide is purely acidic in nature.
28. Which of the following are the correct reasons for anomalous behaviour of lithium?
- (i) Exceptionally small size of its atom
 - (ii) Its high polarising power
 - (iii) It has high degree of hydration
 - (iv) Exceptionally low ionisation enthalpy

III. Short Answer Type

29. How do you account for the strong reducing power of lithium in aqueous solution?
30. When heated in air, the alkali metals form various oxides. Mention the oxides formed by Li, Na and K.
31. Complete the following reactions
(i) $\text{O}_2^{2-} + \text{H}_2\text{O} \longrightarrow$ (ii) $\text{O}_2^- + \text{H}_2\text{O} \longrightarrow$
32. Lithium resembles magnesium in some of its properties. Mention two such properties and give reasons for this resemblance.
33. Name an element from Group 2 which forms an amphoteric oxide and a water soluble sulphate.
34. Discuss the trend of the following:
(i) Thermal stability of carbonates of Group 2 elements.
(ii) The solubility and the nature of oxides of Group 2 elements.
35. Why are BeSO_4 and MgSO_4 readily soluble in water while CaSO_4 , SrSO_4 and BaSO_4 are insoluble?
36. All compounds of alkali metals are easily soluble in water but lithium compounds are more soluble in organic solvents. Explain.
37. In the Solvay process, can we obtain sodium carbonate directly by treating the solution containing $(\text{NH}_4)_2\text{CO}_3$ with sodium chloride? Explain.
38. Write Lewis structure of O_2^- ion and find out oxidation state of each oxygen atom? What is the average oxidation state of oxygen in this ion?
39. Why do beryllium and magnesium not impart colour to the flame in the flame test?
40. What is the structure of BeCl_2 molecule in gaseous and solid state?

IV. Matching Type

In the following questions more than one option of column I and II may be correlated.

41. Match the elements given in Column I with the properties mentioned in Column II.

Column I

- (i) Li
- (ii) Na
- (iii) Ca
- (iv) Ba

Column II

- (a) Insoluble sulphate
- (b) Strongest monoacidic base
- (c) Most negative $E^\ominus$ value among alkali metals.
- (d) Insoluble oxalate
- (e) $6s^2$ outer electronic configuration

42. Match the compounds given in Column I with their uses mentioned in Column II.

Column I	Column II
(i) CaCO_3	(a) Dentistry, ornamental work
(ii) Ca(OH)_2	(b) Manufacture of sodium carbonate from caustic soda
(iii) CaO	(c) Manufacture of high quality paper
(iv) CaSO_4	(d) Used in white washing

43. Match the elements given in Column I with the colour they impart to the flame given in Column II.

Column I	Column II
(i) Cs	(a) Apple green
(ii) Na	(b) Violet
(iii) K	(c) Brick red
(iv) Ca	(d) Yellow
(v) Sr	(e) Crimson red
(vi) Ba	(f) Blue

V. Assertion and Reason Type

In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

44. **Assertion (A):** The carbonate of lithium decomposes easily on heating to form lithium oxide and CO_2 .

Reason (R) : Lithium being very small in size polarises large carbonate ion leading to the formation of more stable Li_2O and CO_2 .

- (i) Both A and R are correct and R is the correct explanation of A.
- (ii) Both A and R are correct but R is not the correct explanation of A.
- (iii) Both A and R are not correct
- (iv) A is not correct but R is correct.

45. **Assertion (A):** Beryllium carbonate is kept in the atmosphere of carbon dioxide.

Reason (R) : Beryllium carbonate is unstable and decomposes to give beryllium oxide and carbon dioxide.

- (i) Both A and R are correct and R is the correct explanation of A.
- (ii) Both A and R are correct but R is not the correct explanation of A.
- (iii) Both A and R are not correct.
- (iv) A is not correct but R is correct.

VI. Long Answer Type

46. The s-block elements are characterised by their larger atomic sizes, lower ionisation enthalpies, invariable +1 oxidation state and solubilities of their oxosalts. In the light of these features describe the nature of their oxides, halides and oxosalts.
47. Present a comparative account of the alkali and alkaline earth metals with respect to the following characteristics:
- Tendency to form ionic / covalent compounds
 - Nature of oxides and their solubility in water
 - Formation of oxosalts
 - Solubility of oxosalts
 - Thermal stability of oxosalts
48. When a metal of group 1 was dissolved in liquid ammonia, the following observations were obtained:
- Blue solution was obtained initially.
 - On concentrating the solution, blue colour changed to bronze colour.
- How do you account for the blue colour of the solution? Give the name of the product formed on keeping the solution for some time.
49. The stability of peroxide and superoxide of alkali metals increase as we go down the group. Explain giving reason.
50. When water is added to compound (A) of calcium, solution of compound (B) is formed. When carbon dioxide is passed into the solution, it turns milky due to the formation of compound (C). If excess of carbon dioxide is passed into the solution milky disappears due to the formation of compound (D). Identify the compounds A, B, C and D. Explain why the milky disappears in the last step.
51. Lithium hydride can be used to prepare other useful hydrides. Beryllium hydride is one of them. Suggest a route for the preparation of beryllium hydride starting from lithium hydride. Write chemical equations involved in the process.
52. An element of group 2 forms covalent oxide which is amphoteric in nature and dissolves in water to give an amphoteric hydroxide. Identify the element and write chemical reactions of the hydroxide of the element with an alkali and an acid.
53. Ions of an element of group 1 participate in the transmission of nerve signals and transport of sugars and amino acids into cells. This element imparts yellow colour to the flame in flame test and forms an oxide and a peroxide with oxygen. Identify the element and write chemical reaction to show the formation of its peroxide. Why does the element impart colour to the flame?

ANSWERS

I. Multiple Choice Questions (Type-I)

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|----------|-----------|-----------|---------|----------|----------|
| 1. (iv) | 2. (i) | 3. (iii) | 4. (iv) | 5. (i) | 6. (i) |
| 7. (i) | 8. (iii) | 9. (ii) | 10. (i) | 11. (i) | 12. (i) |
| 13. (ii) | 14. (i) | 15. (iii) | 16. (i) | 17. (iv) | 18. (ii) |
| 19. (i) | 20. (iii) | 21. (iv) | | | |

II. Multiple Choice Questions (Type-II)

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|----------------|----------------|---------------|-----------------|
| 22. (ii), (iv) | 23. (i), (iii) | 24. (i), (ii) | 25. (ii), (iii) |
| 26. (i), (iii) | 27. (i), (ii) | 28. (i), (ii) | |

III. Short Answer Type

31. (i) $\text{O}_2^{2-} + 2\text{H}_2\text{O} \longrightarrow 2\text{OH}^- + \text{H}_2\text{O}_2$
(ii) $2\text{O}_2^- + 2\text{H}_2\text{O} \longrightarrow 2\text{OH}^- + \text{H}_2\text{O}_2 + \text{O}_2$

IV. Matching Type

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|--------------|-----------|------------|---------------|
| 41. (i)→(c), | (ii)→(b), | (iii)→(d), | (iv)→(a), (e) |
| 42. (i)→(c), | (ii)→(d), | (iii)→(b), | (iv)→(a) |
| 43. (i)→(f), | (ii)→(d), | (iii)→(b), | (iv)→(c) |
| (v)→(e), | (vi)→(a) | | |

V. Assertion and Reason Type

44. (i) 45. (i)

VI. Long Answer Type

50. Compound : A : CaO; B : Ca(OH)₂; C : CaCO₃; D : Ca(HCO₃)₂
Ca(HCO₃)₂ is soluble in water. Hence, milky solution disappears on passing excess carbon dioxide into the solution of compound B.
51. $8\text{LiH} + \text{Al}_2\text{Cl}_6 \longrightarrow 2\text{LiAlH}_4 + 6\text{LiCl}$
 $\text{LiAlH}_4 + 2\text{BeCl}_2 \longrightarrow 2\text{BeH}_2 + \text{LiCl} + \text{AlCl}_3$
52. The element is beryllium
53. The element is sodium.