The s-Block Elements and their Compounds (Group I & II)

SINGLE CORRECT CHOICE TYPE QUESTIONS

1. In the following reaction, which of the following compounds crystallize out first?

$$2Na_2CrO_4 + H_2SO_4 \rightarrow Na_2SO_4 + Na_2Cr_2O_7 + H_2O$$

(A) $Na_2Cr_2O_7$
(B) H_2O
(C) Na_2SO_4
(D) $Na_2Cr_2O_7$ and Na_2SO_4 equally

2. Choose the correct order of lattice enthalpy in the following.
(A) LiF > NaCl > NaF > LiCl
(B) LiF > LiCl > NaF > NaCl
(C) LiF > NaF > NaCl > LiCl
(D) LiCl > LiF > NaF > NaCl

3. Match the ions in Column I with their ionic radius (in Å) given in Column II and select the correct code.

Column I	Column II
(P) Mg^{2+}	(1) 1.37
(Q) K^+	(2) 1
(R) Li^+	(3) 0.76
(S) Ca^{2+}	(4) 0.72

Code:

	P	Q	R	S
(A)	2	1	3	4
(B)	1	2	3	4
(C)	4	3	1	2
(D)	4	1	3	2

4. Identify the correct order.
(A) CsCl < RbCl < KCl < NaCl < LiCl: Solubility in water
(B) CsCl < RbCl < KCl < NaCl < LiCl: Melting point
(C) CsCl > RbCl > KCl > NaCl > LiCl: % Ionic character
(D) CsCl > RbCl > KCl > NaCl > LiCl: Lattice energy

5. Aqueous solution of Na_2SO_4 is crystallized out above and below 32 °C. The respective products are
(A) Na_2SO_4 and $Na_2SO_4 \cdot 10H_2O$
(B) $Na_2SO_4 \cdot 10H_2O$ and Na_2SO_4
(C) Na_2SO_4 and Na_2SO_4
(D) $Na_2SO_4 \cdot 10H_2O$ and $Na_2SO_4 \cdot 10H_2O$

6. Which of the following compounds does not have similarity in structure with the other three compounds?
(A) $FeSO_4 \cdot 7H_2O$
(B) $Na_2CO_3 \cdot 7H_2O$
(C) $MgSO_4 \cdot 7H_2O$
(D) $ZnSO_4 \cdot 7H_2O$

7. The melting point of an eutectic mixture of Na_2CO_3 + K_2CO_3 is
(A) higher than that of Na_2CO_3.
(B) higher than that of K_2CO_3.
(C) lower than that of both Na_2CO_3 and K_2CO_3.
(D) lower than that K_2CO_3 only.

8. Which of the following statements is not correct?
(A) Common salt absorbs water because it is hygroscopic.
(B) Common salt is used to clear snow on the road.
(C) Anhydrous $MgCl_2$ can be prepared by heating a double salt of it, i.e. $MgCl_2 \cdot NH_4Cl \cdot 6H_2O$.
(D) $CaSO_4$ and $BaSO_4$ are reacted with coke to produce CaS and BaS respectively.

9. KOH is preferably used to absorb CO_2 because
(A) KOH is more soluble than NaOH in water.
(B) KOH is a stronger base than NaOH.
(C) $KHCO_3$ is soluble in water and $NaHCO_3$ is insoluble in water.
(D) KOH is cheaper than NaOH.

10. Ozonized oxygen is passed through dry powdered KOH. Which option is not correct regarding the product obtained in the above process?

(A) It is an orange coloured solid.
(B) It is paramagnetic in nature.
(C) It is used in submarines for oxygenating the air.
(D) It is also prepared by passing O_2 in blue solution of K in liquid NH_3

11. $A + H_2O \rightarrow NaOH$

$$A \xrightarrow{400^\circ C} B \xrightarrow[\text{at } 25^\circ C]{H_2O} NaOH + O_2$$

B is used for oxygenating in submarines. A and B are respectively:
(A) Na_2O_2 and Na_2O
(B) Na_2O and Na_2O_2
(C) Na_2O_2 and O_2
(D) Na_2O and O_2

12. Electrolysis of KH produces H_2
(A) at the cathode.
(B) at the anode.
(C) either at the cathode or at the anode.
(D) Cannot be predicted.

13. Which of the following is the most soluble in water?
(A) $CsClO_4$
(B) $NaClO_4$
(C) $KClO_4$
(D) $LiClO_4$

14. Which of the following statements is correct?
(A) $NaHCO_3$ and $KHCO_3$ have similar crystal structure.
(B) Li_2CO_3 decomposes to give Li_2O and CO_2.
(C) Li_2CO_3 is soluble in water.
(D) All are correct.

15. If Na^+ ion is larger than Mg^{2+} and S^{2-} ion is larger than Cl^- ion, which of the following will be least soluble in water?
(A) NaCl
(B) Na_2S
(C) $MgCl_2$
(D) MgS

16. In which of following cases is the value of x maximum?
(A) $CaSO_4 \cdot xH_2O$
(B) $BaSO_4 \cdot xH_2O$
(C) $MgSO_4 \cdot xH_2O$
(D) All have the same value of x.

17. Among LiCl, RbCl, $BeCl_2$, $MgCl_2$, the compounds with greatest and least ionic character respectively are
(A) LiCl and RbCl
(B) RbCl and $BeCl_2$
(C) RbCl and $MgCl_2$
(D) $MgCl_2$ and $BeCl_2$

18. Which of the following properties show a reverse trend of radius on moving from Mg to Ba within the group?
(A) Density
(B) Solubility of sulphate
(C) Solubility of oxalate
(D) Basicity of $M(OH)_2$

19. Compound M on heating leaves no residue and N_2 is also not obtained. Aqueous solution of M reacts with alkali and all the gases are evolved. The resulting solution is treated with Al in alkaline medium to liberate a gas that produces a deep blue solution with $Ni(NO_3)_2$ solution. M is
(A) NH_4NO_3
(B) NH_4NO_2
(C) NH_4Cl
(D) NH_4Br

MULTIPLE CORRECT CHOICE TYPE QUESTIONS

1. MgO can be used as refractory material because
(A) it has a very high melting point.
(B) it has a very low vapour pressure.
(C) it is a very good conductor of heat.
(D) it is chemically inert.

2. The temporary hardness of water is caused by which of the following compound(s).
(A) $CaCl_2$
(B) $Mg(HCO_3)_2$
(C) $Ca(HCO_3)_2$
(D) $MgSO_4$

3. When KO_2 reacts with water, the products are
(A) KOH
(B) H_2O_2
(C) K_2O_2
(D) O_2

4. KO_3 or Na_2O_2 is used in submarines or space capsules because
(A) it absorbs CO_2.
(B) it releases O_2.
(C) it produces corresponding carbonate on reaction with CO_2.
(D) None of these.

5. Na_2O can be prepared by
(A) $Na_2O_2 + CO \rightarrow$
(B) $Na + NaNO_3 \rightarrow$
(C) $Na + NaNO_2 \rightarrow$
(D) $Na_2O_2 + Na \rightarrow$

6. Which of the following properties are in the increasing order from top to bottom for metal ions in Group 1?
(A) Ionic radius
(B) Hydrated radius
(C) Ionic mobility
(D) Hydration number

7. Which of the following hydrides are electron deficient?
   (A) BeH_2
   (B) CaH_2
   (C) AlH_3
   (D) KH

8. In which of the following cases, does N_2 evolve as a gaseous product?
   (A) KNO_3 reacts with K on heating.
   (B) Na_2O_2 reacts with NH_3.
   (C) NH_3 reacts with bleaching powder.
   (D) None of these.

9. Which of the following elements liberate H_2 on reaction with NaOH?
   (A) Be
   (B) Al
   (C) B
   (D) None of these.

10. Which of the following statements are correct regarding the diagonal relationship between Al and Be?
   (A) BeO and Al_2O_3 are amphoteric in nature.
   (B) Carbides of both produce the same gas on hydrolysis.
   (C) Both can form complexes.
   (D) Hydrides of both the elements are covalent in nature.

*COMPREHENSION TYPE QUESTIONS

Passage 1: For Questions 1–3

Hard water contains dissolved salts such as magnesium and calcium chlorides, bicarbonates, or sulphates. There are two kinds of hardness of water, i.e. temporary hardness and permanent hardness.

1. Temporary hardness can be removed by
   (A) boiling hard water.
   (B) adding slaked lime.
   (C) adding dil. H_2SO_4.
   (D) adding milk of magnesia.

2. When Graham's salt (calgon) is used for removal of permanent hardness of water, Ca^{2+} and Mg^{2+} are sequestered in the form of
   (A) precipitate.
   (B) solution.
   (C) colloidal solution.
   (D) sedimentation.

3. Permanent hardness of water can be removed by
   (A) distillation.
   (B) passing it through ion-exchange resins.
   (C) adding various phosphates.
   (D) adding Na_2CO_3 solution.

Passage 2: For Questions 4–6

Several alkali metals and alkaline earth metals when dissolved in NH_3 produce a bright blue solution.

4. This bright blue solution is due to
   (A) solvated metal ion.
   (B) solvated electron.
   (C) high extent of hydration.
   (D) All of these.

5. The characteristic(s) of the resulting solution is/are:
   (A) It acts as a very good fuel.
   (B) It acts as a very good reducing agent.
   (C) It acts as a very good oxidizing agent.
   (D) It shows attraction towards magnetic field.

6. On addition of more metal to this solution which of the following characteristics get changed?
   (A) Electrical conductivity.
   (B) Colour.
   (C) Magnetic behaviour.
   (D) None of these.

Passage 3: For Questions 7–9

$$E + D\uparrow \xleftarrow{H_2O} (B) \xleftarrow{P} \underset{\text{Heat}}{Ca} \xrightarrow{N_2} (A) \xrightarrow{H_2O} C\uparrow + E$$

7. Which of the following characteristics are mainly different for gases C and D?
   (A) Colour
   (B) Smell
   (C) Burning characteristics in air
   (D) Hybridization

8. When gas C is passed through bleaching powder suspension, another gas F comes out, which can also be obtained by
   (A) heating NH_4NO_3.
   (B) heating NH_4NO_2.
   (C) heating $(NH_4)_2CrO_7$.
   (D) heating $Ba(N_3)_2$.

9. Gas D catches fire automatically when it comes in contact with the air and this is due to
   (A) presence of PH_3.
   (B) presence of O_2.
   (C) presence of P_2H_4.
   (D) presence of H_2.

ASSERTION–REASONING TYPE QUESTIONS

In the following set of questions, a Statement I is given and a corresponding Statement II is given below it. Mark the correct answer as:

(A) If both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.

(B) If both Statement I and Statement II are true but Statement II is not the correct explanation for Statement I.

(C) If Statement I is true but Statement II is false.

(D) If Statement I is false but Statement II is true.

1. **Statement I:** Be is amphoteric in nature.

   Statement II: The ionization energy of Be is the highest among the alkaline earth metals.

2. **Statement I:** For purification of CO_2 by Girbotol process ethanol amine is chosen for absorption of CO_2, not NaOH or KOH.

   Statement II: Ethanol amine absorbs CO_2 at 30 – 60 °C while it releases CO_2 at 100 – 150 °C.

3. **Statement I:** $BeH_2(s)$ and $CaH_2(s)$ have the same structure.

   Statement II: Be and Ca are both alkaline earth metal elements.

4. **Statement I:** $CaCl_2$ is formed as a by-product in the Solvay process for Na_2CO_3 preparation.

   Statement II: During the recovery of NH_3, $CaCl_2$ is obtained when $Ca(OH)_2$ is used to react with NH_4Cl.

5. **Statement I:** Na_2CO_3 solution is strongly alkaline in nature.

   Statement II: Hydrolysis of CO_3^{2-} ions produces undissociated H_2CO_3 and OH^- ions in solution.

6. **Statement I:** The hydration energy of Be^{2+} is much higher as compared to that of Li^+.

   Statement II: First ionization energy of Be is greater than that of Li.

7. **Statement I:** $BaSO_4$ is used in diagnosing stomach or duodenal ulcers.

   Statement II: $BaSO_4$ is insoluble in water and in several acids and is opaque to X-rays.

8. **Statement I:** When an electron is added to Na^+ ion, the size of the ion decreases.

   Statement II: In the process of $Na^+ \rightarrow Na$, the inter-electric repulsion increases.

9. **Statement I:** Na and K on reaction with H_2O, catch fire.

   Statement II: The reaction is highly exothermic, as a result of which the remaining solid metal melts and local heating is so high that the released H_2 catches fire.

10. **Statement I:** $NaOH + NH_4^+ - salt \rightarrow NH_3\uparrow + Na^+ + H_2O$

    Statement II: $H^+ + OH^- \rightarrow H_2O$; it is the strong acid–strong base reaction which releases more energy and shifts towards greater stability.

11. **Statement I:** Superoxides are stronger oxidizing agents than peroxides.

    Statement II: Superoxides accept electrons in the same energy level, i.e. π^* orbital while peroxides accept electrons in the higher energy σ^*_{2p} orbital.

INTEGER ANSWER TYPE QUESTIONS

The answer to each of the following questions is a non-negative integer.

1. The number of rings formed in $[Ca(EDTA)]^{2-}$ is _____.

2. The total number of electrons in one molecule of Mg_2C_3 is _____.

3. Among the following the number of pairs of compounds, for which the thermal stability order is correct is _____.
   (a) $BeCO_3 > SrCO_3$
   (b) $MgO > BaO$
   (c) $Li_2CO_3 < Cs_2CO_3$
   (d) $CaSO_4 < BaSO_4$
   (e) $Li_3N > Na_3N$
   (f) $LiClO_4 < KClO_4$

4. Among the following compounds, the number of compounds which do not produce acidic or basic solutions when dissolved in water is _____.
   NaCl, $BeCl_2$, $BaCl_2$, Li_2O, MgO, CaH_2, $CaSO_4$

5. Cl_2 gas is passed through a compound A and produces bleaching powder. The number of protons in A is _____.

6. The ratio of the number of water of crystallization in gypsum and that in plaster of Paris is _____.

7. Among the following elements, the number of elements that release H_2 on reaction with NaOH is _____.
   Be, Al, B, Mg, Ca, Zn, Sn

8. The number of bicarbonates that do not exist in solid form among the following is _____.

$LiHCO_3$, $NaHCO_3$, $Ca(HCO_3)_2$, $KHCO_3$,

NH_4HCO_3, $Ba(HCO_3)_2$ $Mg(HCO_3)_2$

9. The number of planes of symmetry in $[BeH_4]^{2-}$ is _____.

10. What is the number of ions among the following for which hydrated ion has higher ionic mobility than $Be^{2+}(aq)$?

$Li^+(aq)$, $Na^+(aq)$, $Mg^{2+}(aq)$, $Ca^{2+}(aq)$

11. The percentage water loss when gypsum is heated to get plaster of Paris is _____.

MATRIX–MATCH TYPE QUESTIONS

In each of the following questions, statements are given in two columns, which have to be matched. The statements in Column I are labelled as **(A)**, **(B)**, **(C)** and **(D)**, while those in Column II are labelled as **(P)**, **(Q)**, **(R)**, **(S)** and **(T)**. Any given statement in Column I can have correct matching with *one or more* statements in Column II.

1. Match the chemical properties with the compounds.

Column I	Column II
(A) Ca	(P) Produces H_2 on reaction with H_2O.
(B) CaH_2	(Q) Produces $Ca(OH)_2$ on reaction with H_2O.
(C) CaO	(R) The compound is ionic.
(D) CaC_2	(S) Can absorb N_2 under hot conditions.

2. Match the compounds with their characteristics.

Column I	Column II
(A) $BeCO_3$	(P) Least soluble in water.
(B) $MgCO_3$	(Q) Least thermally stable.
(C) $CaCO_3$	(R) Produces $MO + CO_2$ on heating with the help of bunsen burner.
	(S) Produces basic oxides on thermal decomposition.

3. Match the compounds with the properties.

Column I	Column II
(A) $CaSO_4 \cdot 2H_2O$	(P) Stored under kerosene.
(B) LiI	(Q) Most covalent alkali metal halide.
(C) Na	(R) Insoluble in water.
(D) KF	(S) Soluble in water without any reaction with water.

4. Match the compounds with their uses/properties.

Column I	Column II
(A) $NaCO_3 \cdot 10H_2O$	(P) Dessicating agent.
(B) $CaCl_2$ (anhydride)	(Q) Used for preparing freezing mixture.
(C) $CaSO_4$ (anhydride)	(R) Washing soda.
(D) NaCl	(S) Dead burnt.
	(T) Soluble in water.

ANSWERS

Single Correct Choice Type Questions

1. (C)	5. (A)	9. (C)	13. (D)	17. (B)
2. (B)	6. (B)	10. (D)	14. (B)	18. (B)
3. (D)	7. (C)	11. (B)	15. (D)	19. (A)
4. (C)	8. (A)	12. (B)	16. (C)	

Multiple Correct Choice Type Questions

1. (A), (B), (C), (D)	3. (A), (B), (D)	5. (B), (C), (D)	7. (A), (C)	9. (A), (B), (C)
2. (B), (C)	4. (A), (B)	6. (A), (C)	8. (A), (B), (C)	10. (A), (B), (C), (D)

Comprehension Type Questions

1. (A), (B)	3. (A), (B), (C), (D)	5. (B), (D)	7. (B), (C), (D)	9. (C)
2. (B)	4. (B)	6. (A), (B), (C)	8. (B), (C), (D)	

Assertion–Reasoning Type Questions

1. (B)	4. (A)	7. (A)	10. (A)
2. (A)	5. (A)	8. (D)	11. (A)
3. (D)	6. (B)	9. (A)	

Integer Answer Type Questions

1. 5	4. 3	7. 5	10. 4
2. 42	5. 38	8. 4	11. 75
3. 5	6. 4	9. 6	

Matrix–Match Type Questions

1. (A) → (P), (Q), (S)
   (B) → (P), (Q), (R)
   (C) → (Q), (R)
   (D) → (Q), (R), (S)

2. (A) → (Q), (R)
   (B) → (R), (S)
   (C) → (P), (S)

3. (A) → (R)
   (B) → (Q), (S)
   (C) → (P)
   (D) → (S)

4. (A) → (R), (T)
   (B) → (P), (T)
   (C) → (S)
   (D) → (Q), (T)