CHAPTER 10

The s-Block Elements

1. KO_2 (potassium super oxide) is used in oxygen cylinders in space and submarines because it **[2002]**

(a) absorbs CO_2 and increases O_2 content
(b) eliminates moisture
(c) absorbs CO_2
(d) produces ozone.

2. The metallic sodium disolves in liquid ammonia to form a deep blue coloured solution. The deep blue colour is due to formation of: **[2002]**

(a) solvated electron, $e(NH_3)_x^-$
(b) solvated atomic sodium, $Na(NH_3)_y$
(c) $(Na^+ + Na^-)$
(d) $NaNH_2 + H_2$

3. A metal M readily forms its sulphate MSO_4 which is water-soluble. It forms its oxide MO which becomes inert on heating. It forms an insoluble hyroxide $M(OH)_2$ which is soluble in NaOH solution. Then M is **[2002]**

(a) Mg (b) Ba
(c) Ca (d) Be.

4. In curing cement plasters water is sprinkled from time to time. This helps in **[2003]**

(a) developing interlocking needle-like crystals of hydrated silicates
(b) hydrating sand and gravel mixed with cement
(c) converting sand into silicic acid
(d) keeping it cool

5. The substance **not** likely to contain $CaCO_3$ is

(a) calcined gypsum (b) sea shells **[2003]**
(c) dolomite (d) a marble statue

6. The solubilities of carbonates decrease down the magnesium group due to a decrease in **[2003]**

(a) hydration energies of cations
(b) inter-ionic attraction
(c) entropy of solution formation
(d) lattice energies of solids

7. Which one of the following processes will produce hard water ? **[2003]**

(a) Saturation of water with $MgCO_3$
(b) Saturation of water with $CaSO_4$
(c) Addition of Na_2SO_4 to water
(d) Saturation of water with $CaCO_3$

8. One mole of magnesium nitride on the reaction with an excess of water gives : **[2004]**

(a) two moles of ammonia
(b) one mole of nitric acid
(c) one mole of ammonia
(d) two moles of nitric acid

9. Based on lattice energy and other considerations which one of the following alkali metal chlorides is expected to have the highest melting point ? **[2005]**

(a) RbCl (b) KCl
(c) NaCl (d) LiCl

10. The ionic mobility of alkali metal ions in aqueous solution is maximum for **[2006]**

(a) Li^+ (b) Na^+
(c) K^+ (d) Rb^+

11. The products obtained on heating $LiNO_2$ will be : **[2011RS]**

(a) $Li_2O + NO_2 + O_2$ (b) $Li_3N + O_2$
(c) $Li_2O + NO + O_2$ (d) $LiNO_3 + O_2$

12. What is the best description of the change that occurs when $Na_2O(s)$ is dissolved in water ? **[2011RS]**

(a) Oxide ion accepts sharing in a pair of electrons

(b) Oxide ion donates a pair of electrons

(c) Oxidation number of oxygen increases

(d) Oxidation number of sodium decreases

13. Which of the following on thermal decomposition yields a basic as well as acidic oxide? **[2012]**

(a) $NaNO_3$ (b) $KClO_3$

(c) $CaCO_3$ (d) NH_4NO_3

14. The first ionisation potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be **[2013]**

(a) -2.55 eV (b) -5.1 eV

(c) -10.2 eV (d) $+2.55$ eV

15. Stability of the species Li_2, Li_2^- and Li_2^+ increases in the order of: **[2013]**

(a) $Li_2 < Li_2^+ < Li_2^-$ (b) $Li_2^- < Li_2^+ < Li_2$

(c) $Li_2 < Li_2^- < Li_2^+$ (d) $Li_2^- < Li_2 < Li_2^+$

16. Which one of the following alkaline earth metal sulphates has its hydration enthalpy greater than its lattice enthalpy? **[JEE M 2015]**

(a) $BaSO_4$ (b) $SrSO_4$

(c) $CaSO_4$ (d) $BeSO_4$

17. The main oxides formed on combustion of Li, Na and K in excess of air are, respectively: **[JEE M 2016]**

(a) Li_2O_2, Na_2O_2 and KO_2

(b) Li_2O, Na_2O_2 and KO_2

(c) Li_2O, Na_2O and KO_2

(d) LiO_2, Na_2O_2 and K_2O

18. Both lithium and magnesium display several similar properties due to the diagonal relationship; however, the one which is incorrect is: **[JEE M 2017]**

(a) Both form basic carbonates

(b) Both form soluble bicarbonates

(c) Both form nitrides

(d) Nitrates of both Li and Mg yield NO_2 and O_2 on heating

Answer Key														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
(a)	(a)	(d)	(a)	(a)	(a)	(b)	(a)	(c)	(d)	(a)	(b)	(c)	(b)	(b)
16	17	18												
(d)	(b)	(a)												

SOLUTIONS

1. **(a)** $2KO_2 + 2H_2O \rightarrow 2KOH + H_2O_2 + O_2$.
KO_2 is used as an oxidising agent. It is used as air purifier in space capsules. Submarines and breathing masks as it **produces oxygen** and **remove carbon dioxide**.

2. **(a)** The alkali metals dissolve in liquid ammonia without evolution of hydrogen. The metal loses electrons and combine with ammonia molecule.

$M \longrightarrow M^+$ (in liquid ammonia) $+ e^-$ (ammoniated)

$M + (x+y)NH_3 \rightarrow [M(NH_3)_x]^+ + e^-(NH_3)_y$

Solvated electron

It is ammoniated electron which is responsible for colour.

3. **(d)** Sulphate of alkaline earth metal are sparingly soluble or almost not soluble in water whereas $BeSO_4$ is soluble in water due to high degree of solvation. $Be(OH)_2$ is insoluble in water but soluble in NaOH.

$BeO + 2NaOH \longrightarrow Na_2BeO_2 + H_2O$

4. **(a)** Setting of cement is exothermic process which develops interlocking crystals of hydrated silicates

5. **(a)** Gypsum is $CaSO_4.2H_2O$

6. **(a)** As we move down the group, the lattice energies of carbonates remain approximately the same. However the hydration energies of the metal cation decreases from Be^{++} to Ba^{++}, hence the solubilities of carbonates of the alkaline earth metal decrease down the group mainly due to decreasing hydration energies of the cations from Be^{++} to Ba^{++}.

7. **(b)** Permanent hardness of water is due to chlorides and sulphates of calcium and magnesium i.e $CaCl_2$, $CaSO_4$, $MgCl_2$ and $MgSO_4$.

8. **(a)** $Mg_3N_2 + 6H_2O \rightleftharpoons 3Mg(OH)_2 + 2NH_3$

9. **(c)** LiCl has partly covalent character. Other halides are ionic in nature. Lattice energy decreases with increase of ionic radius of cation, anion being the same. Larger is the lattice energy, the higher will be m. pt. hence NaCl will have highest lattice energy.

10. **(d)** Smaller the size of cation higher is its hydration energy and greater is its ionic mobility hence the correct order is $Li^+ < Na^+ < K^+ < Rb^+$

11. **(a)** $4LiNO_3 \rightarrow 2Li_2O + 4NO_2 + O_2$

12. **(b)** $O^{2-}(\text{base}) + H_2O(\text{acid}) \rightarrow OH^-(\text{C.B.}) + OH^-(\text{C.A.})$

O^{2-} acts as Lewis base.

13. **(c)** Calcium carbonate on thermal decomposition gives CaO (Basic oxide) and CO_2 (Acidic oxide)

$$CaCO_3 \xrightarrow{\Delta} \underset{\text{Basic oxide}}{CaO} + \underset{\text{Acidic oxide}}{CO_2\uparrow}$$

14. **(b)** $\because$ For $Na \longrightarrow Na^+ + e^-$ $\quad IE_1 = 5.1$ eV

$\therefore$ For $Na^+ + e^- \longrightarrow Na$ $\quad EF = -5.1$ eV

(because the reaction is reverse)

15. **(b)** $Li_2 = \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2$

$\therefore$ Bond order $= \frac{1}{2}(4-2) = 1$

$Li_2^+ = \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^1$

$\text{B.O.} = \frac{1}{2}(3-2) = 0.5$

$Li_2^- = \sigma 1s^2\, \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^1$

$\text{B.O.} = \frac{1}{2}(4-3) = 0.5$

The bond order of Li_2^+ and Li_2^- is same but Li_2^+ is more stable than Li_2^- because Li_2^+ is smaller in size and has 2 electrons in antibonding orbitals whereas Li_2^- has 3 electrons in antibonding orbitals. Hence Li_2^+ is more stable than Li_2^-.

16. **(d)** In alkaline earth metals, ionic size increases down the group. The lattice energy remains constant because sulphate ion is so large, so that small change in cationic size does not make any difference. On moving down the group the degree of hydration of metal ions decreases very much leading to decrease in solubility.

17. **(b)** On heating with excess of air Li, Na and K forms following oxides

$4Li + O_2 \rightarrow 2Li_2O$	Lithium monoxide
$2Na + O_2 \rightarrow Na_2O_2$	Sodium peroxide
$K + O_2 \rightarrow KO_2$	Potassium superoxide

18. **(a)** Mg can form basic carbonate like

$3MgCO_3 . Mg(OH)_2 . 3H_2O\downarrow$

While Li can form only carbonate (Li_2CO_3) not basic carbonate.