

PROBLEMS

1. Why caesium can be used in photoelectric cell, While lithium can not be?
2. Explain why
 - (i) Lithium on being heated in air mainly forms the monoxide and not peroxide.
 - (ii) An aqueous solution of sodium carbonate gives alkaline tests.
3. Which alkali metal ion has the maximum polarizing power and why?
4. Na_2SO_4 is soluble in water where as BaSO_4 is insoluble. Why?
5. Why potassium carbonate can not be prepared by solvay process?
6. when Mg metal is burnt in air; a white powder is left, leaving behind the ash. What is the white powder?
7. In aqueous solution K^+ ion has the lowest mobility. Why?
8. Explain, why lithium is kept rapped in paraffin wax and not stored in kerosene oil?
9. Statues coated with white lead on long exposure to atmosphere turns black and the original colour can be restored on treatment with H_2O_2 . Why?
10. Which isotope of hydrogen is used as a traces in organic reaction?

OBJECTIVE

1. A solution of sodium in liquid ammonia is strongly reducing due to the presence of
 - (A) sodium atoms
 - (B) sodium hydride
 - (C) sodium amide
 - (D) solvated electrons
2. The solubility in water of sulphates down the group is $\text{Be} > \text{Mg} > \text{Sr} > \text{Ba}$. This is due to
 - (A) increase in melting point
 - (B) high ionization energy
 - (C) high hydration energy
 - (D) all of these
3. Which of the following on heating do not decompose?
 - (A) Li_2CO_3
 - (B) BeCO_3
 - (C) Na_2CO_3
 - (D) none
4. The oxidation state of the most electronegative element in the product of the reaction, BaO_2 with dil. H_2SO_4 are
 - (A) 0 and -1
 - (B) -2 only
 - (C) -2 and 0
 - (D) -2 and -1
5. Among KO_2 , AlO_2^- and NO^2 . Unpaired electron is present in
 - (A) NO^+_2 and BaO_2
 - (B) KO_2 and AlO_2^-
 - (C) KO_2 only
 - (D) BaO_2 only
6. The compound insoluble in acetic is
 - (A) calcium oxide
 - (B) calcium carbonate
 - (C) calcium oxalate
 - (D) calcium hydroxide
7. Solubilities of carbonates decreases down the magnesium group due to decrease in
 - (A) entropy of solution formation
 - (B) lattice energies of solids
 - (C) hydration energy of cations
 - (D) inter-ionic attraction
8. CaSO_4 on strong heating give
 - (A) SO_2 and O_2
 - (B) CaO
 - (C) SO_2 and CaO
 - (D) CaO , O_2 and SO_2 gas
9. Which of the following substances can be used for drying gas?
 - (A) calcium carbonate
 - (B) sodium carbonate
 - (C) sodium bicarbonate
 - (D) calcium oxide
10. KO_2 (potassium superoxide) is used in oxygen cylinders in space and submariners because it
 - (A) absorbs CO_2 and increases O_2 content
 - (B) eliminates moisture

- (C) absorbs CO_2
 (D) produces ozone
11. HCl is added to the following oxides. Which one would give H_2O_2 ?
 (A) MnO_2 (B) PbO_2 (C) BaO (D) none of the above
12. Which of the following can not be oxidized by H_2O_2 ?
 (A) $\text{KI} + \text{HCl}$ (B) O_3 (C) PbS (D) Na_2SO_3
13. The reaction $\text{Ag}_2\text{O} + \text{H}_2\text{O}_2 \longrightarrow 2\text{Ag} + \text{H}_2\text{O} + \text{O}_2$ takes place in
 (A) basic medium (B) bleaching agent (C) neutral medium
 (D) both in acidic and basic medium
14. Which of the following compounds turns white on treatment with H_2O_2 .
 (A) HgS (B) PbS (C) NiS (D) CuS

ASSIGNMENTS

SECTION – I

PART-A

(Level-I)

- The solubility of the hydroxides of the alkaline earth metals in water increases from Be to Ba. Why?
- Lithium has the lowest mobility in aqueous solution in an electric field. Explain.
- Why alkali metals impart colour to the flame?
- Why BeCO_3 is kept only in an atmosphere of CO_2 ?
- Why Be and Mg do not give characteristic colour to the flame whereas other alkaline earth metals do give?
- (A) Name the blue compound formed in the reaction of H_2O_2 with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ in ether?
 (B) What is the principle in the bleaching action of H_2O_2 ?
- Lithium shows a diagonal relationship with beryllium. [True/False]
- In hydrogen peroxide both the hydroxyl groups lie in the same plane. [True/False]
- Sodium dissolves in liquid ammonia to give a coloured solution which is a conductor of electricity because it contains
- Potassium reacts vigorously with water as compared to sodium because it is

Level-II

- Chlorination of calcium hydroxide produces bleaching powder. Write its chemical equation.
- What is the difference between milk of lime and lime water?
- Explain the stability of oxides of alkali metals.
- Why superoxides of alkali metals are paramagnetic while normal oxides are diamagnetic?
- What happens when KO_2 reacts with water? Write the balanced chemical equation for the reaction.
- Li is extracted by electrolysis of a fused mixture of LiCl & KCl . Why is KCl added?
- Why is an alkaline earth metal more electropositive than divalent ions in spite of the fact that $IE_2 > IE_1$ of alkaline earth metals?
- Give reason for decreasing order of conductivity of following.
 Conductivity of $\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{Rb}^+ < \text{Cs}^+$
- Why is calcium preferred over sodium to remove last traces of moisture from alcohol?
- A white solid is either Na_2O or Na_2O_2 . A piece of litmus paper turns white when it is dipped into a freshly made aqueous solution of the white solid.
- State any reason for alkaline earth metals having a greater tendency to form complex than alkali metals.
- Mg_3N_2 when reacted with water gives off NH_3 but HCl is not obtained from MgCl_2 on reaction with water at room temperature.

13. The crystalline salts of alkaline earth metals contain more water of crystallization than the corresponding alkali metals salts why?
14. Magnesium metals burns in air to give a white ash. When this ash is treated with water, the odors of ammonia can be detected? Explain.
15. While moving from top to bottom solubilities of hydroxides for alkaline earth metals increases while for their sulphates decreases. Explain.

PART-B

Multiple choice Questions (Single Option Correct)

1. The solution of alkali metals as in liquid ammonia is used for reduction of ethylenic double bond, acetylenic triple bonds to double bonds and aromatic compounds under the name Birch reduction, the alkali metal will be
 (A) Li (B) Na (C) K (D) all of them
2. Which of the following carbide is known by the name hydrolith?
 (A) MgH_2 (B) CaH_2 (C) SrH_2 (D) BeH_2
3. Sodium reacts with water more vigorously than lithium because it
 (A) has higher atomic weight (B) is a metal
 (C) has low melting point (D) more electronegative
4. The hydration energy of Mg^{2+} is greater than
 (A) Al^{3+} (B) Na^+ (C) Be^{2+} (D) All of these
5. Property of alkaline earth metals that increase with this atomic number is
 (A) Ionization energy (B) solubility of their hydroxides
 (C) solubility of their sulphates (D) electronegativity
6. Which of the following is most covalent in nature?
 (A) $BaCl_2$ (B) $MgCl_2$ (C) $CaCl_2$ (D) $BeCl_2$
7. The correct order of solubility of sulphates of alkaline earth metals are
 (A) $BeSO_4 > MgSO_4 > SrSO_4 > CaSO_4$
 (B) $BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4$
 (C) $BeSO_4 > MgSO_4 < CaSO_4 < SrSO_4$
 (D) $MgSO_4 < CaSO_4 < SrSO_4 > BeSO_4$
8. The decomposition of hydrogen peroxide $2H_2O_2 \longrightarrow 2H_2O + O_2$ is a
 (A) zero order reaction (B) first order reaction
 (C) second order reaction (D) third order reaction
9. The drying agent – which absorbs carbon dioxide and reacts violently with water is
 (A) sodium carbonate (B) alcohol (C) conc. H_2SO_4
 (D) calcium oxide
10. The compounds of alkaline earth metals have the following magnetic nature
 (A) diamagnetic (B) paramagnetic (C) ferromagnetic
 (D) anti ferromagnetic
11. Which of the following alkali metals halides has the lowest lattice energy?
 (A) LiF (B) NaCl (C) KBr (D) CsI
12. Which of the following alkali metals ions has the lowest mobility in aqueous solution?
 (A) Li^+ (B) Na^+ (C) K^+ (D) Cs^+
13. Which has minimum hydration energy?
 (A) K^+ (B) Li^+ (C) Ca^+ (D) Al^{+3}
14. Alcohol can dissolve.....in it.
 (A) KCl (B) NaCl (C) RbCl (D) LiCl

15. LiNO_3 on heating give
 (A) O_2 (B) NO_2 (C) $\text{O}_2 + \text{NO}_2$ (D) none of the above
16. A compound of sodium which when heated give CO_2 is
 (A) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ (B) NaHCO_3 (C) $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
 (D) $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
17. Which of the following carbonate decompose on heating evolve CO_2 ?
 (A) Na_2CO_3 (B) Li_2CO_3 (C) K_2CO_3 (D) Rb_2CO_3
18. Which of the following metal ions has more polarizing power?
 (A) Na^+ (B) Ca^{2+} (C) K^+ (D) Be^{2+}
19. An aqueous solution of sodium sulphate is electrolysed using inert electrodes. The products at the cathode and anode are respectively
 (A) H_2, O_2 (B) O_2, H_2 (C) O_2, Na (D) O_2, SO_2
20. In the preparation of sodium carbonate (Na_2CO_3). Which of the following is used?
 (A) slaked lime (B) quick lime (C) lime stone
 (D) sodium hydroxide

Multiple Choice Question (Multiple Options Correct)

1. Which of the following statement/s is /are correct regarding saline hydrides.
 (A) In the molten states they conduct electricity
 (B) They dissolve in water giving off hydrogen
 (C) They are used as reducing agent
 (D) They are covalent in nature
2. Which of the following can decompose on heating?
 (A) Li_2CO_3 (B) BaCO_3 (C) Na_2CO_3 (D) MgCO_3
3. Which of the following can illustrate/s the anomalous properties of Li?
 (A) The m. pt. and b. pt. of Li are comparatively high.
 (B) Li forms a nitride Li_3N unlike group metals.
 (C) Li is much softer than the other group I metals.
 (D) Li^+ ion and its compounds are more heavily hydrated than those of the rest of the group.
4. A solution of Li in liq. NH_3 is:
 (A) strongly reducing and paramagnetic
 (B) Typically blue coloured which survive for long at low temperature but decomposes slowly to give sodamide and $\text{H}_{2(g)}$
 (C) Having Li^+ ion and solvated electron
 (D) It gives cis product with but-2-yne

Numerical Based

1. Number of water molecules attached with a single molecule through H-bonding in liquid state is
 2. How many type of gaseous product are formed when LiNO_3 is strongly heated?
 3. Number of unpaired electron present in KO_2 is

SECTION-II

Multiple Choice Question (Single Option Correct)

1. Acidified solution of chromic acid on treatment with H_2O_2 yield
 (A) $\text{CrO}_3 + \text{H}_2\text{O} + \text{O}_2$ (B) $\text{Cr}_2\text{O}_3 + \text{H}_2\text{O} + \text{O}_2$ (C) $\text{CrO}_5 + \text{H}_2\text{O}$
 (D) $\text{H}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O} + \text{O}_2$
2. On heating sodium metals in a current of dry ammonia, the compound formed is

- (A) sodium amide (B) sodium azide (C) sodium nitride
(D) sodium hydride
3. Anhydrous mixture of KF and HF contains which type of ions
(A) K^+ , H^+ , F^- (B) $(KF^+)(HF^-)$ (C) KH^+ , F^- (D) K^+ , HF^{2-}
4. The alkali metal that reacts with nitrogen directly to form nitride is
(A) Li (B) Na (C) K (D) Rb
5. When K_2O is added to water, the solution is basic because it contains a significant concentration of
(A) O_2^{2-} (B) O^{3-} (C) OH^- (D) K^+
6. The heat of hydration is maximum for
(A) Be^{+2} (B) Mg^{2+} (C) Ca^{2+} (D) Sr^{+2}
7. Which of the following is used in producing neutrons?
(A) Rb (B) Ba (C) Cr (D) Be
8. Reduction of $BaSO_4$ with carbon gives
(A) $BaSO_3$ (B) BaS (C) BaS_2O_3 (D) Ba
9. Nitrolim which is used as fertilizer has the composition
(A) $CaCN_2$ (B) $CaCn_2+C$ (C) Ca_3N_2 (D) $Ca(CN)_2$
10. Magnesium keeps as burning in
(A) N_2 (B) CO_2 (C) NO_2 (D) N_2 as well as CO_2
11. Which of the following are arranged in increasing order of solubilities?
(A) $CaCO_3 < KHCO_3 < NaHCO_3$
(B) $NaCO_3 < KHCO_3 < CaHCO_3$
(C) $KHCO_3 < NaCO_3 < CaHCO_3$
(D) $CaCO_3 < NaHCO_3 < KHCO_3$
12. The thermal stability of alkaline earth metal carbonates decreases in the order
(A) $BaCO_3 > SrCO_3 > CaCO_3 > MgCO_3$
(B) $BaCO_3 > SrCO_3 > MgCO_3 > CaCO_3$
(C) $CaCO_3 > SrCO_3 > MgCO_3 > BaCO_3$
(D) $MgCO_3 > CaCO_3 > SrCO_3 > BaCO_3$
13. The stability of the following alkali metal chlorides follows the order
(A) $LiCl > KCl > NaCl > CsCl$
(B) $CsCl > KCl > NaCl > LiCl$
(C) $NaCl > KCl > LiCl > CsCl$
(D) $KCl > CsCl > NaCl > LiCl$
14. With excess of oxygen the oxide formed by Na is
(A) Na_2O (B) Na_2O_2 (C) NaO_2 (D) none
15. The correct order of ionic character is
(A) $BeCl_2 < MgCl_2 < CaCl_2 < BaCl_2$
(B) $BeCl_2 < MgCl_2 < BaCl_2 < CaCl_2$
(C) $BeCl_2 < BaCl_2 < MgCl_2 < CaCl_2$
(D) $BeCl_2 < CaCl_2 < MgCl_2 < BaCl_2$

Comprehension Type

Read the paragraph carefully and answer the following question

The lattice energy is the energy change when one mole of a crystal is formed from its component ions in the gaseous state. A measure of how strongly ions are attracted by water molecules is the hydration energy. When a crystal is made up of small high charged ions the lattice energy is usually very high so the hydration energy of the ions are not large enough to overcome the lattice energy.

The interaction of ions with solvent molecules is responsible for the lattice enthalpy of MX and hydration of ions. There is a correlation of enthalpy of solution of a salt and the difference in hydration of two ions. If the cation has a larger hydration enthalpy than anion, then the dissolution of salt is exothermic.

The lattice energy is inversely proportional to the distance between ions whereas hydration enthalpy is inversely proportional to the sum of individual ion contributions.

1. Which of the following statement is correct?

- (i) Compound containing large sized cation and anion are generally soluble in water
- (ii) compound that contain ions with large difference in generally soluble in water
- (iii) The least water soluble salts are those of ions with similar radii
- (iv) compound having low solubility product are soluble in water

- (A) (ii), (iii)
- (B) (i), (ii)
- (C) (i), (ii), (iii)
- (D) (i), (ii), (iii)

2. Which of the following properties of the elements of group II (alkaline earth metals) increases with increasing atomic number?

- (i) Solubility of number
- (ii) Ionization energy
- (iii) Reactivity with water
- (iv) Solubility of carbonates

- (A) (i), (iv)
- (B) (iii), only
- (C) (i), (ii), (iv)
- (D) (i), (iii)

3. Which of the following is least insoluble when dissolved in water?

- (A) LiI
- (B) CsF
- (C) LiF
- (D) CsI

Match the following

Column-1

- (A) Microcosmis salt
- (B) Washing sods
- (C) Baking soda
- (D) Hypo

Column-II

- (p) NaHCO_3
- (q) $\text{Na}_2\text{S}_2\text{O}_3$
- (r) $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7 \cdot 4\text{H}_2\text{O}$
- (s) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
- (t) $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$