Self Practice Paper (SPP)

1. Which of the following has maximum ionisation energy ?
(1) $Ba \longrightarrow Ba^{+} + e^{-}$ (2) $Be \longrightarrow Be^{+} + e^{-}$
(3) $Ca \longrightarrow Ca^{2+} + 2e^{-}$ (4) $Mg \longrightarrow Mg^{2+} + 2e^{-}$

2. Which of the following increases in magnitude as the atomic number of alkali metals increases?
(1) Electronegativity (2) First ionisation potential
(3) Ionic radius (4) Melting point

3. Alkali metals give colour in Bunsen flame due to :
(1) Low electronegativeity (2) One electron in outer most orbit
(3) Smaller atomic radii (4) Low ionisation energy

4. Which of the following statements about solution of alkali metals in liquid ammonia is correct ?
(1) The solutions have strong oxidizing properties.
(2) Both the dilute solution as well as concentrated solution are paramagntic in nature.
(3) Colour of the solution is attributed to charge transfer spectrum.
(4) None of these.

5. Select the incorrect statement :
(1) Solutions of alkali metals in liquid ammonia are a good reducing agents because they contain free or solvated electrons.
(2) The crystalline salts of alkaline earth metals contain more water of crystallisation than the corresponding alkali metal salts.
(3) Atoms of alkaline earth metals have smaller size and more nuclear charge than alkali metal atoms of same period.
(4) All alkali metal halides form hydrates.

6. Consider the following statements ;
S_1 : Among alkali metal halides lithium iodide is the most covalent in nature.
S_2 : Potassium has greater photoelectric work function than sodium.
S_3 : The blue solution of alkali metals in liquid ammonia is stable at room temperature, where ammonia is still a liquid, in the presence of Fe.
S_4 : The melting and boiling points of alkali metal halides always follow the trend : chloride > fluoride > bromide > iodide.
and arrange in the order of true/false.
(1) T F F F (2) T T F F (3) T F T T (4) T T T F

7. Which of the following has the highest reactivity towards water ?
(1) Na (2) Rb (3) Li (4) K

8. Sodium burns in dry air to largely give :
(1) Na_2O (2) Na_2O_2 (3) NaO_2 (4) Na_3N

9. Alkali metals are not characterised by :
(1) good conductor of heat and electricity (2) high oxidation potentials
(3) high melting points (4) solubility in liquid ammonia

10. In view of their ionisation energies, the alkali metals are :
(1) weak oxidising agents (2) strong reducing agents
(3) strong oxidising agents (4) weak reducing agents

11. Which of the following is incorrect statement :
(1) Solubilities of alkaline earth metal fluorides and hydroxides generally increase down the group.
(2) Hydration energies of alkali metal halides decrease down the group with increase in size of cations.
(3) Mg^{2+} ion is bigger than Li^{+}.
(4) $BeCl_2$ is easily hydrolysed in water.

12. A metal (M) burns with dazzling brilliance in air above 1000ºC to give a white powder. The white powder reacts with water to form a white precipitate (P) and a colourless gas (G) with a characteristic smell. The metal (M) dissolves in conc. NaOH to liberate another gas(H). (H) may also be obtained on heating (G). Then:
(1) M = Mg (2) M = Be (3) P = $Ca(OH)_2$ (4) G = O_3

13. Carbon can be oxidised to CO_2 while heating its powder with :
(1) SO_2 (2) KNO_3 (3) K_2CO_3 (4) FeS_2

14. What happens when sodium metal is heated in excess of dry air containing carbon dioxide gas ?
(1) Na_2O_2 is formed. (2) Na_2O is formed. (3) Na_2CO_3 is formed. (4) Na_3N is formed.

15. Solution of K_2O in water is basic, because it contains a significant concentration of :
(1) O_2^{2-} (2) O_2^{-} (3) OH^{-} (4) K^{+}

16. Which of the following oxides is formed when potassium metal is burnt in excess air ?
(1) KO_3 (2) K_2O (3) K_2O_2 (4) KO_2

17. On commercial scale, sodium hydroxide is prepared by :
(1) Dow's process (2) Solvay process (3) Castner-Kellner cell (4) Hall-Heroult process

18. Which of the following gives sodium hydroxide along with hydrogen gas on reaction with water ?
(1) Sodium oxide (2) Sodium amalgam (3) Sodium peroxide (4) Sodium carbonate.

19. Which of the following can exist in aqueous solution?
(1) Na_2O (2) Na_2O_2 (3) KO_2 (4) K_2CO_3

20. Which of the following salts are composed of isoelectronic cation and anion
(I) NaCl (II) $BaCl_2$ (III) MgF_2 (IV) CaS
(1) I and II (2) II and III (3) III & IV (4) None of these

21. Which of the following liberates H_2 with cold water ?
(1) H_2O_2 (2) NaH (3) NaOH (4) Mg

22. When ionic nitrides react with water, the products are :
(1) acidic solution and hydrogen gas. (2) acidic solution and ammonia gas.
(3) basic solution and ammonia gas. (4) basic solution and hydrogen gas.

23. Low solubility of CsI in water is due to :
(1) smaller hydration enthalpy of Cs^{+}. (2) smaller hydration enthalpy of I^{-}.
(3) lower lattice enthalpy of its two ions. (4) (1) and (2) both.

24. Select the correct statement.
(1) Among the alkali metals, only lithium reacts with nitrogen directly at room temperature to form nitride.
(2) Among the alkali metal carbonates, Li_2CO_3 has the lowest thermal stability.
(3) Among the alkali metal hydroxide, CsOH has the highest solubility in water.
(4) All of these.

25. $NaNO_3$ is not used as gun powder because it is :
(1) hygroscopic (2) very costly (3) amorphous (4) soluble in water

26. A doctor by mistake administers a dilute $Ba(NO_3)_2$ solution to a patient for radiagraphic investigations. Which of the following should be the best to prevent the absorption of soluble Barium and subsequent Barium poisoning.
(1) NaCl (2) Na_2SO_4 (3) Na_2CO_3 (4) NH_4Cl

27. Baking powder used to make cake is a mixture of starch, $NaHCO_3$ and $Ca(H_2PO_4)_2$. The function of $Ca(H_2PO_4)_2$ is :
(1) to slow down the release of CO_2 gas
(2) it has acidic hydrogen and gives CO_2 when moistened with $NaHCO_3$
(3) to act as a filler
(4) None of these

28. Which salt hydrolyses to a minimum extent ?
(1) $Mg(NO_3)_2$ (2) $Be(NO_3)_2$ (3) $Ca(NO_3)_2$ (4) $Ba(NO_3)_2$.

29. Methanides are :
(1) Mg_2C_3 , Be_2C, Al_4C_3 and CaC_2 (2) Mg_2C_3 , Be_2C and Al_4C_3
(3) Be_2C, Al_4C_3 and CaC_2 (4) Be_2C and Al_4C_3

30. Select correct statement :
(1) Interstitial carbides are formed by metalloids like Si and B
(2) SiC and B_4C are covalent carbides.
(3) B_4C on hydrolysis gives methane.
(4) VC, WC are ionic carbides.

31. Which of the following is correct order ionization energies of alkali metals.
(1) Li < Na < K < Rb < Cs (2) Li > Na > K > Rb > Cs
(3) Na < Li < K < Rb < Cs (4) Cs < Na < K < Rb < Li

32. Which of the following is correct density order of alkali metals.
(1) Li < Na < K < Rb < Cs (2) Li > Na > K > Rb > Cs
(3) Li > K > Na > Rb > Cs (4) Rb < Li < Na < K < Cs

33. Which of the following is least reducing among alkali metals in aqueous medium.
(1) Sodium (2) Potassium (3) Cesium (4) Rubidium

34. Which of the following is strong reducing among alkali metals in aqueous medium.
(1) Sodium (2) Potassium (3) Cesium (4) Lithium

35. Which of the following is strong reducing among alkali metals in gaseous medium.
(1) Sodium (2) Potassium (3) Cesium (4) Lithium

36. Which of the following alkali metal has maximum hydration in aqueous medium.
(1) Sodium (2) Lithium (3) Cesium (4) Potassium

37. Which of the following alkali metal has minimum hydration in aqueous medium.
(1) Sodium (2) Lithium (3) Cesium (4) Potassium

38. Which does not impart in flame test ?
(1) Li (2) Na (3) K (4) Be

39. Which has maximum reducing nature in gaseous phase?
(1) Li (2) Rb (3) Cs (4) NG

40. Which is least reducing in aq. medium ?
(1) Li (2) Na (3) Cs (4) Rb

41. Which is not correctly matched ?
(1) Basic strength of oxides $Cs_2O<Rb_2O< K_2O < Na_2O < Li_2O$
(2) Stability of peroxides $Na_2O_2 < K_2O_2 < Rb_2O_2 < Cs_2O_2$
(3) Stability of bicarbonates $LiHCO_3 < NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$
(4) Melting point NaF < NaCl < NaBr < NaI
(1) 1 and 4 (2) 1 and 3 (3) 1 and 2 (4) 2 and 3

42. When CO_2 is bubbled through NaOH, it initially gives :
(1) CO (2) Na_2CO_3
(3) $NaHCO_3$ (4) Both Na_2CO_3 and $NaHCO_3$ in equimolar ratio

43. In context with the highly pure dilute solution of sodium in liquid ammonia, which of the following is the incorrect statement ?
(1) In dilute solution the main species are metal ions (Na^+) and electrons, which are solvated (i.e. ammoniated)
(2) It is paramagnetic, with approximately one unpaired electron per metal atom.
(3) It acts as powerful oxidising agent.
(4) It shows blue colour and exhibits electrical conductivity.

44. Which of the following statements is correct ?
(1) Pure sodium metal can be produced by the electrolysis of an aqueous solution of NaCl.
(2) CsOH has the maximum basicity and least solubility among all alkali metal hydroxides.
(3) Sodium carbonate and potassium carbonate both can be manufactured by Solvay's process.
(4) The hydrated radii of alkaline earth metal ions decreases on moving down the group.

45. Berylium chloride exist as monomer, dimer and polymeric solid form . When it dissolve in water it gives :
(1) $[Be(OH)_4]^{-2} + 2HCl$ (2) $[Be(H_2O)_4]^{+2} + 2Cl^-$
(3) $Be^{+2} + 2Cl^-$ (4) BeO +2HCl

SPP Answers

1.	(4)	**2.**	(3)	**3.**	(4)	**4.**	(4)	**5.**	(4)	**6.**	(1)	**7.**	(2)
8.	(2)	**9.**	(3)	**10.**	(2)	**11.**	(3)	**12.**	(2)	**13.**	(2)	**14.**	(3)
15.	(3)	**16.**	(4)	**17.**	(3)	**18.**	(2)	**19.**	(4)	**20.**	(3)	**21.**	(2)
22.	(3)	**23.**	(4)	**24.**	(4)	**25.**	(1)	**26.**	(2)	**27.**	(2)	**28.**	(4)
29.	(4)	**30.**	(2)	**31.**	(2)	**32.**	(3)	**33.**	(1)	**34.**	(4)	**35.**	(3)
36.	(2)	**37.**	(3)	**38.**	(4)	**39.**	(3)	**40.**	(2)	**41.**	(1)	**42.**	(2)
43.	(3)	**44.**	(4)	**45.**	(2)								

SPP Solutions

1. Down the group size increases and therefore, attraction between valence shell electron and nucleus decreases and thus ionisation energy decreases.

2. (1) Down the group, the atomic size increases with increasing atomic number and so attraction for shared pair of electrons decreases. Hence electronegativity decreases.
(2) Down the group, the atomic size increases with increasing atomic number and so attraction between valence electron and nuclear decreases. Hence ionization energy decreases.
(3) Down the group atomic size increases with increase in number of atomic shells while effective nuclear charge remains constant.
(4) Down the group atomic size increases with increase in number of atomic shells and therefore, the strength of metallic bond decreases. So melting point decreases.

3. Alkali metals have low ionisation energy.

4. All are wrong. The solution has strong reducing nature and coloured due to ammoniated electron. Dilute solution is paramagnetic whereas concentrated solution is diamagnetic.

5. (2) Smaller cation and higher charge attracts more numbers of water molecules.
(3) Periodic property
(4) Except Li^+, due to bigger size of ions they have low hydration enthalpies. Hence except lithium, all alkali metal halides do not form hydrates.

6. **S_1 :** Li^+ being smaller have high polarising power and I^- being larger have high polarisability. So it is most covelent among alkali metal halides according to Fajan's rule.
S_2 : The IE1 of potussium atom is less then sodium atom.
S_3 : The presence of transition metals like iron and other impurities catalyses the decompositon of deep blue solution forming amide and liberating H_2.
S_4 : Two opposing tendencies exists. With greater charge and smaller size of cation, lattice energy increases which tends to increase the melting point ; while increase in covalent character causes a decrease in melting point. Hence, no unique generalised trend may be stated for melting points. (Students need not worry about or memorise such experimental data).

7. The reaction of alkali metals with water becomes increasingly violent on descending the group on account of their decreasing ionisation energies with increasing atomic size. So, the order of reactivity is :
Li < Na < K < Rb.

8. $2Na + O_2 \longrightarrow Na_2O_2$

9. They have weak metallic bond because of one valence electron per atom. So they have low melting points.

10. They easily lose valence shell electron because of their low ionisation energies, on account of their bigger atomic sizes. So they behave as strong reducing agents.

11. (1) Factual

(2) Hydration energy $\propto \frac{1}{\text{size of cation}}$.

(3) Both are diagonally related ; because of more positive charge on Mg, Mg^{2+} is smaller than Li^+.
Li^+ = 76 pm, Mg^{2+} = 72 pm.
(4) Salt of weak base and strong acid, thus easily hydrolysed in water giving acidic solution.

12. $Be + Air \xrightarrow{T>1000^\circ C} BeO + Be_3N_2$ (white powder)
$Be_3N_2 + 6H_2O \longrightarrow 3Be(OH)_2$ (white precipitate) $+ 2NH_3$ (Colourless gas)

13. $KNO_3 \xrightarrow{Heat} KNO_2 + \frac{1}{2}O_2$
$C + O_2 \longrightarrow CO_2$

14. $2Na + O_2 \xrightarrow{Heat} Na_2O_2$; $2Na_2O_2 + 2CO_2 \longrightarrow 2Na_2CO_3 + O_2$.

15. $K_2O + H_2O \longrightarrow 2\,KOH \longrightarrow K^+ + OH^-$.
The resulting solution is basic due to the presence of OH^-.

16. $K + O_2 \xrightarrow{burning} KO_2$.

17. Sodium hydroxide is manufactured by the electrolysis of brine using Castner-Kellner cell.

18. (1) $Na_2O + H_2O \longrightarrow 2\,NaOH$
(2) $2\,Na/Hg + 2\,H_2O$ (Castner-Kellner cell) $\longrightarrow 2NaOH + 2\,Hg + H_2$.
(3) $Na_2O_2 + 2H_2O \longrightarrow 2\,NaOH + H_2O_2$
(4) $Na_2CO_3 + 2H_2O \rightleftharpoons 2NaOH + H_2CO_3$

19. (1) , (2) & (3) reacts with water being more basic than water.

20. Isoelectronic species have same number of electrons.

21. All alkali metal hydrides are ionic in nature and react with water according to the reaction ;
$NaH + H_2O \longrightarrow NaOH + H_2$.

22. $Mg_3N_2 + 6H_2O \longrightarrow 3\,Mg(OH)_2 + 2NH_3$

23. True statement. The CsI, because of bigger cation (Cs^+) and bigger anion (I^-), has smaller hydration enthalpy. As a result, it does not exceed its lattice energy ; so CsI is insoluble in water.

24. (1) Lithium show exceptional behavior in reaction directly with nitrogen of air to form the nitride, Li_3N.
(2) Smaller cation (Li^+) polarises bigger anion (CO_3^{2-}) liberating CO_2 gas. So it has the lowest thermal stability.
(3) The solubility of the alkali metal hydroxides increases down the group from Li to Cs. This is because of the fact that down the group with increasing size of cation, the lattice energy as well as hydration energy also decreases but the change in lattice energy is more as compare to that of hydration energy.

25. $NaNO_3$ is not used as gun powder because it is hygroscopic in nature and becomes wet by absorbing water molecules from the atmosphere. Therefore, (1) option is correct.

27. Baking powder used to make cake is a mixture of starch, $NaHCO_3$ and $Ca(H_2PO_4)_2$. The function of $Ca(H_2PO_4)_2$ is being acidic in nature and gives CO_2 when moistened with $NaHCO_3$.

28. $Ba(NO_3)_2$ results a neutral solution as it is the salt of strong acid, HNO_3 and strong base, $Ba(OH)_2$.

29. Methanides give CH_4 on reaction with H_2O.
$Al_4C_3 + 12H_2O \longrightarrow 4Al(OH)_3 + 3CH_4$; $Be_2C + 4H_2O \longrightarrow 2Be(OH)_2 + CH_4$

43. Solution of sodium in liquid ammonia acts as powerful reducing agent.
$O_2 + e^- \longrightarrow O_2^-$
$[Ni(CN)_4]^{2-} + 2e^- \longrightarrow [Ni(CN)_4]^{4-}$

44. (1) Pure sodium metal can be produced by the electrolysis of molten NaCl.
(2) CsOH has the maximum basicity and maximum solubility among all alkali metal hydroxides.
(3) Potassium carbonate can not be prepared because $KHCO_3$ is more soluble than $NaHCO_3$.

45. $BeCl_2 + 4H_2O \rightleftharpoons [Be(H_2O)_4]^{+2} + 2Cl^-$