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THE p-BLOCK ELEMENTS (GROUPS 13 AND 14)

MCQs with One Correct Answer

1. H_3BO_3 on heating up to 373 K yields
(a) boric anhydride
(b) orthoboric acid
(c) metaboric acid
(d) tetraboric acid

2. Aluminium chloride exists as dimer, (Al_2Cl_6) in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives
(a) $[Al(OH)_6]^{3-} + 3HCl$
(b) $[Al(H_2O)_6]^{3+} + 3Cl^-$
(c) $Al^{3+} + 3Cl^-$
(d) $Al_2O_3 + 6HCl$

3. In reaction
$BF_3 + 3LiBH_4 \rightarrow 3LiF + X$; X is
(a) B_4H_{10} (b) B_2H_6
(c) BH_3 (d) B_3H_8

4. The role of fluorspar (CaF_2) which is added in small quantities in the electrolytic reduction of alumina dissolved in fused cryolite (Na_3AlF_6) is
(a) as a catalyst
(b) to make the fused mixture very conducting
(c) to increase the temperature of the melt.
(d) to decrease the rate of oxidation of carbon at the anode.

5. The dissolution of $Al(OH)_3$ by a solution of NaOH results in the formation of
(a) $[Al(H_2O)_4(OH)]^{2+}$
(b) $[Al(H_2O)_2(OH)_4]^-$
(c) $[Al(H_2O)_3(OH)_3]$
(d) $[Al(H_2O)_6(OH)_3]$

6. $BX_3 + NH_3 \xrightarrow{R.T.} BX_3.NH_3$ + Heat of adduct formation (ΔH)
The numerical value of ΔH is found to be maximum for :
(a) BF_3
(b) BCl_3
(c) BBr_3
(d) BI_3

7. When aluminium is heated in atomoshere of nitrogen it forms :
   (a) AlN (b) Al_2N
   (c) Al_3N (d) Al_2N_3

8. Diborane is prepared on large scale by
   (a) $2BF_3(g) + 6LiH(s) \xrightarrow{450\ K} B_2H_6(g) + 6LiF(s)$
   (b) $2BCl_3(g) + 6LiH(s) \xrightarrow{450\ K} B_2H_6(g) + 6LiCl(s)$
   (c) $2BF_3(g) + 6NaH \xrightarrow{450\ K} B_2H_6 + 6NaF$
   (d) $2BCl_3 + 6NaH \xrightarrow{450\ K} B_2H_6 + 6NaCl$

9. Silicon dioxide is formed by the reaction of
   (a) $SiCl_4 + H_2O$
   (b) $SiO_2 + HF$
   (c) $SiO_2 + NaOH$
   (d) $SiCl_4 + NaOH$

10. SiF_4 gets hydrolysed giving.....
   (a) SiO_2 (b) $Si(OH)_2F_2$
   (c) H_2SiF_6 (d) $Si(OH)_4$

11. Soldiers of Napolean army while at alps during freezing winter suffered a serious problem as regards to the tin buttons of their uniforms. White metallic tin buttons got converted to grey powder. This transformation is related to
   (a) a change in the partial pressure of oxygen in the air
   (b) a change in the crystalline structure of tin
   (c) an interaction with nitrogen of the air at very low temperatures
   (d) an interaction with water vapours contained in the humid air

12. The tendency of X in BX_3 (X = F, Cl, OMe, NMe) to form a π - bond with boron follows the order
   (a) $BCl_3 < BF_3 < B(OMe)_3 < B(NMe_2)_3$
   (b) $BF_3 < BCl_3 < B(OMe)_3 < B(NMe_2)_3$
   (c) $BCl_3 < B(NMe_2)_3 < B(OMe)_3 < BF_3$
   (d) $BCl_3 < BF_3 < B(NMe_2)_3 < B(OMe)_3$

13. PbO_2 is obtained from
   (a) the reaction of PbO with HCl
   (b) thermal decomposition of $Pb(NO_3)_2$ at 200 °C
   (c) the reaction of Pb_3O_4 with HNO_3
   (d) the reaction of Pb with air at room temperature

14. An allotrope of carbon which exhibits only two types of C – C bond distance of 143.5 pm and 138.3 pm, is
   (a) charcoal (b) graphite
   (c) diamond (d) fullerene

15. A solid element (symbol Y) conducts electricity and forms two chlorides YCl_n (colourless volatile liquid) and YCl_{n-2} (a colourless solid). To which one of the following groups of the periodic table does Y belong?
   (a) 13 (b) 14
   (c) 15 (d) 16

16. The reducing power of divalent species decreases in the order
   (a) Ge > Sn > Pb
   (b) Sn > Ge > Pb
   (c) Pb > Sn > Ge
   (d) None of these

17. The gas evolved on heating CaF_2 and SiO_2 with concentrated H_2SO_4, on hydrolysis gives a white gelatinous precipitate. The precipitate is
   (a) hydrofluorosilicic acid
   (b) silica gel
   (c) silicic acid
   (d) calciumfluorosilicate

18. On heating $Pb(NO_3)_2$, the products formed are:
   (a) PbO, N_2, O_2 (b) Pb $(NO_2)_2$, O_2
   (c) PbO, NO_2, O_2 (d) Pb, N_2, O_2

19. The product of the following reaction are:
   $SiO_2 + C \xrightarrow{\Delta}$ Products
   (a) SiC and CO_2 (b) SiO and CO
   (c) SiC and CO (d) Si and CO

20. What is not correct about carbon monoxide ?

(a) Carbon in CO is sp hybridised and is linear molecule

(b) CO is a ligand because it has a lone pair of electrons on the carbon atom

(c) CO is the reducing agent in metallurgy of iron

(d) CO has the structure C = O

Numeric Value Answer

21. In aluminates, the coordination number of Al is

22. How many oxides of the following are non-amphoteric in nature?

CO_2, SiO_2, SnO_2 and CaO

23. How many orbitals of boron are involved in hybridisation in B_2H_6?

24. In a molecule of C_{60} Buckminsterfullerene, what is the sum of six-membered and five-membered rings?

25. What is the sum for the molecular masses of constituents of producer gas?

ANSWER KEY																	
1	(c)	**4**	(b)	**7**	(a)	**10**	(d)	**13**	(c)	**16**	(a)	**19**	(c)	**22**	(3)	**25**	(56)
2	(b)	**5**	(b)	**8**	(a)	**11**	(b)	**14**	(d)	**17**	(d)	**20**	(d)	**23**	(4)		
3	(b)	**6**	(d)	**9**	(a)	**12**	(a)	**15**	(b)	**18**	(c)	**21**	(6)	**24**	(32)		

Hints & Solutions

CHAPTER 11

The p-Block Elements (Groups 13 and 14)

1. **(c)** H_3BO_3 on heating at 373K yields metaboric acid (HBO_2)

$$H_3BO_3 \xrightarrow[\Delta]{373K} \underset{\substack{\text{metaboric acid}\\(\text{orthorombic form})}}{HBO_2} + H_2O$$

2. **(b)** $Al_2Cl_6 + 12H_2O \rightleftharpoons 2[Al(H_2O)_6]^{3+} + 6Cl^-$

3. **(b)**

4. **(b)** CaF_2 when added to fused cryolite, lowers the m.p. and increases the conductivity.

5. **(b)** $Al(OH)_3 + OH^- \rightarrow [Al(OH)_4]^-$

$$\xrightarrow{2H_2O} [Al(OH)_4(H_2O)_2]^-$$

6. **(d)** Lewis acidic strength : $BF_3 < BCl_3 < BBr_3 < BI_3$
As BI_3 is strongest lewis acid among all boron halides therefore, heat of adduct formation will the maximum numerically, for BI_3.

7. **(a)** $2Al + N_2 \xrightarrow{\Delta} 2AlN$

8. **(a)**

9. **(a)**

$$SiCl_4(s) + 2H_2O(l) \xrightarrow[-4HCl]{\Delta} \underset{\text{Silicic acid}}{Si(OH)_4(aq)} \xrightarrow{\Delta} \underset{\text{Silica gel}}{SiO_2.xH_2O(s)}$$

10. **(d)** It is hydrolysed with water to form a $Si(OH)_4$.

11. **(b)** $\underset{\substack{\text{(Grey)}\\\text{(most common and stable)}}}{\alpha\text{-tin}} \overset{15.2°C}{\rightleftharpoons} \underset{\text{(White)}}{\beta\text{-Sn}} \overset{164°C}{\rightleftharpoons} \underset{\substack{\text{(Brittle)}\\\text{(Rhombic)}}}{\gamma\text{-Sn}} \overset{232°C}{\rightleftharpoons} \text{Liquid tin}$

Although transitions of white to grey tin occurs at any temperature below 15.2°C, it becomes rapid only at –50°C, unless a catalyst is present. During the conversion of white tin to grey tin (in cold countries) volume increases. Grey Sn is very brittle easily crumbles down to powder. This phenomenon is called tin diseases, tin past or tin plague.

12. **(a)** Lesser electronegativity of *X* and similar size of valence shell of *X* and *B* favours back bonding.
Cl and F are more electronegative than OMe and NMe group and Cl have large size of 3*p*-orbital.
Among $B(OMe)_3$ and $B(NMe_2)_3$, N in NMe is less electronegative than O in OMe group. Thus, the tendency to form π-bond with boron follows the order.
$BCl_3 < BF_3 < B(OMe)_3 < B(NMe_2)_3$.

13. **(c)** $Pb_3O_4 + 4HNO_3 \rightarrow 2Pb(NO_3)_2 + PbO_2 + 2H_2O$

14. **(d)** Fullerene contains both single and double bond with C-C at a distance of 143.5 pm and 138.3 pm.

15. **(b)** $SnCl_4$ is colourless volatile liquid and $SnCl_2$ is colourless solid Sn conducts electricity and it belongs to 14 group.

16. **(a)** The stability of +2O.S. follows the order
$Pb^{2+} > Sn^{2+} > Ge^{2+}$
Hence reducing power $Ge > Sn > Pb$

17. **(d)** $2CaF_2 + SiO_2 + H_2SO_4 \longrightarrow$

$$SiF_4 + H_2O + CaSO_4 \xrightarrow{\text{hydrolysis}} CaSiF_6$$

18. **(c)** $Pb(NO_3)_2 \xrightarrow{\Delta} PbO + 2NO_2 + \frac{1}{2}O_2$

19. **(c)** $SiO_2 + 3C \longrightarrow SiC + 2CO$

20. **(d)** CO molecule is linear ($C \overleftarrow{=} O$) and it is supposed that carbon atom in it is sp-hybridised. CO is electron deficient molecule and has π acceptor properties. Due to presence of pair of electrons, it acts as ligand or Lewis base. In metallurgy it is used as reducing agent.

21. **(6)** In aqueous solution the probable aluminate species is $[Al(H_2O)_2(OH)_4]$, hence, co-ordination number of Al is 6.

22. **(3)** CO_2, SiO_2 acidic CaO basic and SnO_2 amphoteric.

23. **(4)** Boron in B_2H_6 is sp^3 hybridised and hence four orbitals are involved.

24. **(32)** It contains 20 six-membered rings and 12 five-membered rings.

Total no. of rings = 20 + 12 = 32

25. **(56)** Producer gas is $CO + N_2$.

Sum of molecular mass = (16 + 12) + (14 + 14)

= 56