

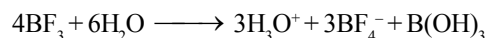
## SOLVED EXAMPLES

**Ex. 1** What will happen if borontrifluoride is kept in moist air ?

- (A) It will strongly fumes.  
 (B) It will partially hydrolysed.  
 (C) It will completely hydrolysed.  
 (D) None of these

**Ans.** (A)

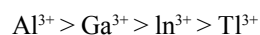
**Sol.** In moist air it strongly fumes :but it is partially hydrolysed by excess of water.



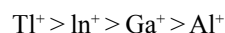
$\text{BF}_3$  is a colourless gas.

**Ex. 2** Al and Ga are trivalent in their compounds but monovalent compounds are the most stable down the 13th group. Why ?

**Sol.** Down the group (13th), the stability of +3 state decreases and that of +1 state increases due to the prominent "inert pair" effect.

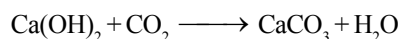


Most stable  $\xrightarrow{\text{stability}}$  least stable

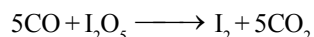


**Ex. 3** If you have a mixture of CO and  $\text{CO}_2$ , how would you know about the relative proportions of the two gases in the given mixture ?

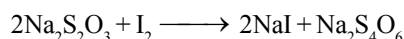
**Sol.** (i) Pass mixture through the  $\text{Ca}(\text{OH})_2$  solution;  $\text{CO}_2$  is absorbed by  $\text{Ca}(\text{OH})_2$ . The residual volume will be that of CO



(ii) Pass mixture through  $\text{I}_2\text{O}_5$ ; CO reduces  $\text{I}_2\text{O}_5$  to  $\text{I}_2$ .



$\text{I}_2$  thus liberated is determined by titration with  $\text{Na}_2\text{S}_2\text{O}_3$ .



This is the quantitative method of estimation of CO.

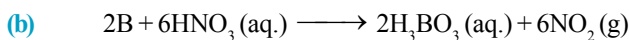
**Ex. 4** True / False

- (a)  $\text{BCl}_3$  in aqueous solution exists as  $\text{B}^{3+}$  and  $\text{Cl}^-$ .  
 (b) Pure crystalline boron is very unreactive and it is attacked only at high temperatures by strong oxidising agents such as a mixture of hot concentrated  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ .  
 (c)  $\text{AlX}_3$  ( $\text{X} = \text{Cl}, \text{Br}$ ) exists as dimer and retains dimer formula in non-polar solvents like ether, benzene etc.  
 (d)  $\text{Be}_2\text{C}$  is called acetylide because it reacts with water yielding ethyne.  
 (e)  $\text{Pb}_3\text{O}_4$  a double oxide, is obtained by heating lead (II) oxide in air.

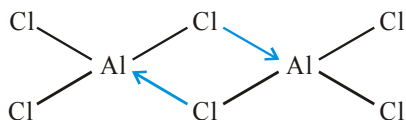
**Ans.** (a) False      (b) True      (c) True      (d) False      (e) True

## CHEMISTRY FOR JEE MAIN & ADVANCED

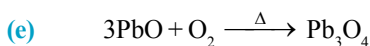
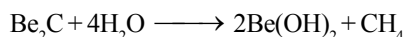
**Sol.** (a) Statement is incorrect.  $\text{BCl}_3$  hydrolyses in aqueous solution to give boric acid. Because it has large ionisation energies and to make the enthalpy of solution of  $\text{BCl}_3$  negative, the enthalpy of hydration of  $\text{B}^{3+}$  should be very high ( $\sim 600$  kJ) which is unlikely for the small  $\text{B}^{3+}$  cation.



(c) Statement is correct and its dimer structure is as follows. It acquires this structure for attaining an octet of electrons. Dimer formula retains in non-polar solvent like ether, benzene



(d) Statement is incorrect as it is methanide because it gives methane on reaction with water.



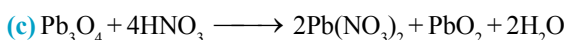
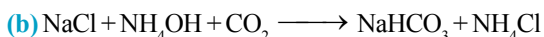
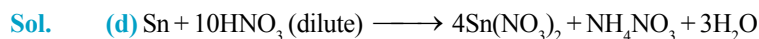
**Ex. 5** What happens when : (write only chemical reactions)

(a) iodine is treated with  $\text{SnCl}_2$ .

(b) carbondioxide is passed through a concentrated aqueous solution of sodium chloride saturated with ammonia.

(c) red lead is treated with nitric acid.

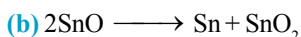
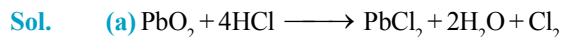
(d) dilute nitric acid is slowly reacted with tin.



**Ex. 6** Write the chemical equations to represent the following reactions.

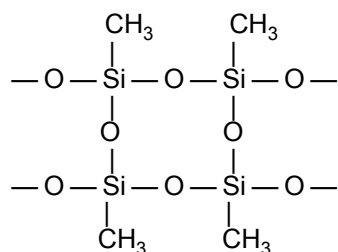
(a) The oxidation of  $\text{HCl}(\text{aq})$  to  $\text{Cl}_2(\text{g})$  by  $\text{PbO}_2$ .

(b) The disproportionation of  $\text{SnO}$  to  $\text{Sn}$  and  $\text{SnO}_2$ .



**Ex. 7** What will happen if we take  $\text{Si}(\text{CH}_3)\text{Cl}_3$  as a starting material for the preparation of commercial silicon polymer ?

**Sol.** With  $\text{Si}(\text{CH}_3)\text{Cl}_3$  the chain will grow in three places and we will get cross-linked silicon polymer as shown below :



**Ex. 8** Give three properties of diamond.

**Sol.** Diamond is very hard, high melting solid. It is an electrical insulator.

**Ex. 9** **Statement - 1 :**  $\text{PbO}_2$  is an oxidising agent and reduced to  $\text{PbO}$ .

**Statement - 2 :** Stability of  $\text{Pb (II)} > \text{Pb (IV)}$  on account of inert pair effect.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

**Ans.** (A)

**Sol.** Both are correct statements and statement-2 is the correct explanation of statement-1.

**Ex. 10** Which of the following statement(s) is/are correct ?

(A)  $\text{B}_2\text{O}_3$  and  $\text{SiO}_2$  are acidic in nature and are important constituents of glass.

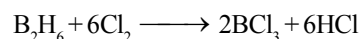
(B) Borides and silicide are hydrolysed by water forming boranes and silanes respectively.

(C) Diborane on reaction with chlorine (g) forms  $\text{B}_2\text{H}_5\text{Cl}$ .

(D)  $\text{SiO}_4^{4-}$  gets hydrolysed by acid or water and form  $\text{Si}_2\text{O}_7^{6-}$ .

**Ans.** (A), (B) and (D)

**Sol.** (A), (B) and (D) are correct statements but (C) is incorrect.



**Ex. 11** Match the following :

**Column - I**

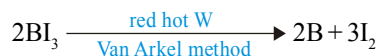
- (A) Boron  
(B) Carbon  
(C) Tin  
(D) Aluminium

**Column - II**

- (p) Forms acidic oxides.  
(q) Pure crystalline form is obtained by Van Arkel method.  
(r) Exists in allotropic forms.  
(s) Hydroxide is amphoteric in nature.

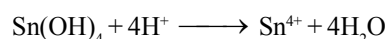
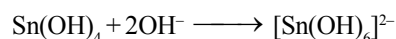
**Ans..** (A - p,q,r); (B - p,r); (C - r,s); (D - s)

**Sol.** (A) Exists in various allotropic forms and its oxide,  $\text{B}_2\text{O}_3$  is acidic in nature.

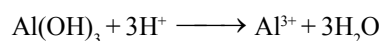
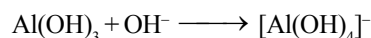


(B) Exists in various allotropic forms like diamond, graphite etc. and its oxide  $\text{CO}_2$  is acidic in nature.

(C) Exists in allotropic forms like grey tin ( $\alpha$ -Sn) and white tin ( $\beta$ -Sn). Hydroxide is amphoteric in nature.



(D) Hydroxide is amphoteric in nature.



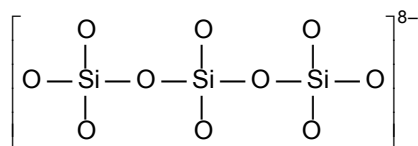
## CHEMISTRY FOR JEE MAIN & ADVANCED

**Ex. 12** The silicate anion in the mineral kionite is a chain of three  $\text{SiO}_4$  tetrahedra that share corners with adjacent tetrahedra. The mineral also contains  $\text{Ca}^{2+}$  ions,  $\text{Cu}^{2+}$  ions, and water molecules in a 1 : 1 : 1 ratio.

(a) Give the formula and charge of the silicate anion.

(b) Given the complete formula for the mineral.

**Sol.** (a) The silicate anion has three  $\text{SiO}_4$  tetrahedra that share corners with adjacent tetrahedra thus silicate is  $\text{Si}_3\text{O}_{10}^{8-}$ , hence it can be represented as with charge as  $= 3 \times 4n + 10 \times (-2) = -8$



(b)  $\text{Ca}^{2+}$ ,  $\text{Cu}^{2+}$  and  $\text{H}_2\text{O}$  are in the ratio of 1 : 1 : 1 and to balance  $(-8)$  charge of silicate as ion,  $(+8)$  charge is required thus there are two units each of  $\text{Ca}^{2+}$ ,  $\text{Cu}^{2+}$  and  $\text{H}_2\text{O}$  thus, kionoite has formula  $\text{Ca}_2\text{Cu}_2\text{Si}_3\text{O}_{10} \cdot 2\text{H}_2\text{O}$ .

**Ex. 13** **Statement - 1 :** The thermal stability of hydrides of carbon family is in order :



**Statement - 2 :** E—H bond dissociation enthalpies of the hydrides of carbon family decrease down the group with increasing atomic size.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

**Ans.** (A)

**Sol.** Both are correct statements and statement-2 is the correct explanation of statement-1. Down the group the size of atom increases and thus bond length increases.

**Ex. 14** Which one of the following element does not dissolve in fused or aqueous alkalis ?

(A) Boron

(B) Silicon

(C) Aluminium

(D) None of these

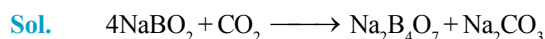
**Ans.** (D)

**Sol.** Boron dissolved in fused alkalis according to the following reaction.



Silicon and aluminium dissolved in both fused and aqueous alkalis.

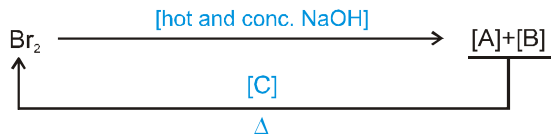
**Ex. 15** What happens when  $\text{CO}_2$  (g) is passed through sodium meta borate solution ?



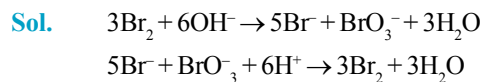
**Ex. 16** Why anhydrous HF liquid is not electrolysed alone to get  $\text{F}_2$ ?

**Sol.** Anhydrous HF is only slightly ionized and is, therefore a poor conductor of electricity Thus a mixture of KF and HF is electrolysed to increase the conductivity.

**Ex. 17** Identify [A] [B] and [C] and gives the complete chemical reactions involved.



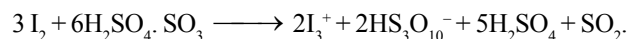
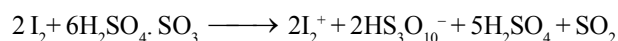
**Ans.** [A] = Br<sup>-</sup>; [B] = BrO<sub>3</sub><sup>-</sup>; [C] = concentrated H<sub>2</sub>SO<sub>4</sub>



**Ex. 18** Comment on the following.

- (a) Electrolysis of ICN in pyridine solution.  
 (b) Iodine dissolves in oleum.  
 (c) Electrical conductivity of molten iodine.

**Sol.** (a) Iodine is liberated at cathode indicating the ionisation of ICN into I<sup>+</sup> and CN<sup>-</sup>.  
 (b) Bright blue solution is formed which has been shown to have I<sub>2</sub><sup>+</sup> and I<sub>3</sub><sup>+</sup>.

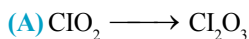


(c) It is due to the presence of (I<sub>3</sub><sup>+</sup> and I<sub>3</sub><sup>-</sup>) species produced by self ionisation of iodine  $3\text{I}_2 \rightleftharpoons \text{I}_3^+ + \text{I}_3^-$

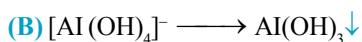
**Ex. 19** Match the following .

## Column - I

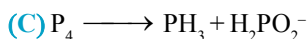
## Column - II



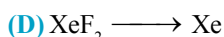
(p) Boiling with NaOH solution.



(q) On passing ozone.

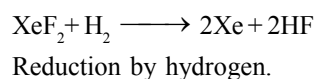
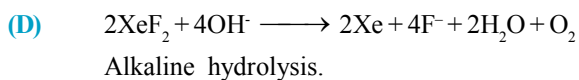
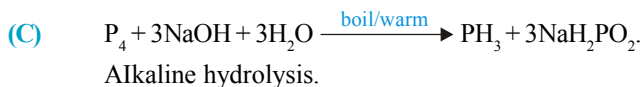
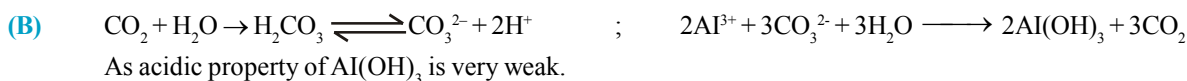
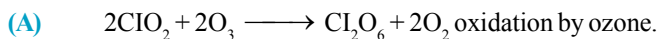


(r) Reaction with hydrogen.



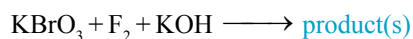
(s) On passing CO<sub>2</sub> gas.

**Sol.** (A - q); (B - s); (C - p); (D - p,r)



## CHEMISTRY FOR JEE MAIN & ADVANCED

**Ex. 20** Which of the following product(s) is/are obtained in the following reaction



(A)  $\text{KBrO}_4$                       (B)  $\text{KF}$                       (C)  $\text{HOF}$                       (D)  $\text{Br}_2$

**Sol.**  $\text{KBrO}_3 + \text{F}_2 + 2\text{KOH} \longrightarrow \text{KBrO}_4 + 2\text{KF} + \text{H}_2\text{O}$ .      **Ans (A,B)**

**Ex. 21**  $\text{Na}_2\text{S}_2\text{O}_3$  may react with the compounds given in column (I).  $\text{Na}_2\text{S}_2\text{O}_3$  exhibits the properties of the type given in the column (II), match the reactants given in column (I) with the type of property/properties given in column (II)

**Column - I**

**(reactant)**

(A) Chlorine ( $\text{Cl}_2$ )

(B) Silver bromide

(C) Hydrochloric acid

(D) Iodine ( $\text{I}_2$ )

**Column - II**

**(type of property shown)**

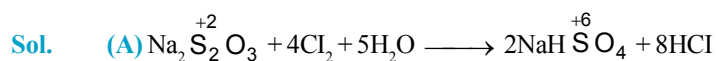
(p) Complexing reagent

(q) Disproportionation

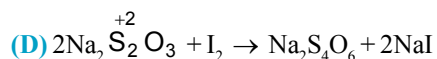
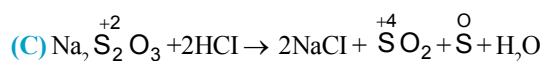
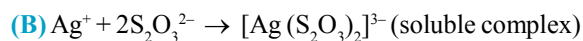
(r) Only as reductant

(s) An-antichlor

**Ans.** (A - r, s) ; (B - p) ; (C - q) ; (D - r)



It destroys any excess of chlorine on fabric in bleaching industry. Thus it acts as antichlor.



## Exercise # 1

## [Single Correct Choice Type Questions]

- Boric acid polymerizes due to –  
 (A) The presence of hydrogen bonds  
 (B) Its acidic nature  
 (C) Its geometry  
 (D) Its monobasic nature
- Aluminium is obtained by–  
 (A) Reduction of  $\text{Al}_2\text{O}_3$  with coke  
 (B) Electrolysis of  $\text{Al}_2\text{O}_3$  dissolved in  $\text{Na}_3\text{AlF}_6$   
 (C) Reduction of  $\text{Al}_2\text{O}_3$  with chromium  
 (D) Heating cryolite and alumina
- In thermite welding, aluminium acts as –  
 (A) A solder  
 (B) A flux  
 (C) An oxidising agent  
 (D) A reducing agent
- The final product obtained when boric acid is heated to red heat is –  
 (A) Metaboric acid  
 (B) Tetraboric acid  
 (C) Boron oxide  
 (D) Pyroboric acid
- Which of the following can be detected by the borax-bead test ?  
 (A)  $\text{Ni}^{2+}$   
 (B)  $\text{Co}^{2+}$   
 (C)  $\text{Pb}^{2+}$   
 (D) Both (A) & (B)
- The hydrides of boron are called  
 (A) Boron hydrogen compounds  
 (B) Hydrogen borides  
 (C) Boranes  
 (D) Hydroboric acids
- Which one of the following mixed sulphates is not an alum ?  
 (A)  $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$   
 (B)  $\text{K}_2\text{SO}_4 \cdot \text{Cr}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$   
 (C)  $\text{Na}_2\text{SO}_4 \cdot \text{Fe}(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$   
 (D)  $\text{CuSO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$
- Higher percentage of carbon is found in –  
 (A) Anthracite  
 (B) Lignite  
 (C) Bituminous  
 (D) Peat
- From  $\text{B}_2\text{H}_6$ , all the following can be prepared except –  
 (A)  $\text{B}_2\text{O}_3$   
 (B)  $\text{H}_3\text{BO}_3$   
 (C)  $\text{B}_2(\text{CH}_3)_6$   
 (D)  $\text{NaBH}_4$
- The product formed in the reaction,  
 $\text{BCl}_3 + \text{H}_2\text{O} \longrightarrow$  Product is –  
 (A)  $\text{H}_3\text{BO}_3 + \text{HCl}$   
 (B)  $\text{B}_2\text{O}_3 + \text{HOCl}$   
 (C)  $\text{B}_2\text{H}_6 + \text{HCl}$   
 (D) No reaction
- Silicones have the general formula –  
 (A)  $\text{SiO}_4^{4-}$   
 (B)  $\text{Si}_2\text{O}_7^{6-}$   
 (C)  $(\text{R}_2\text{SiO})_n$   
 (D)  $(\text{SiO}_3)_n^{2-}$
- In which of the following there exists a  $p\pi - d\pi$  bonding –  
 (A) Diamond  
 (B) Graphite  
 (C) Dimethylamine  
 (D) Trisilylamines
- Glass or silica soluble in –  
 (A)  $\text{HClO}_4$   
 (B)  $\text{HF}$   
 (C) Aqua-regia  
 (D)  $\text{H}_2\text{SO}_4$
- The species present in solution when  $\text{CO}_2$  is dissolved in water are –  
 (A)  $\text{CO}_2, \text{H}_2\text{CO}_3, \text{HCO}_3^-, \text{CO}_3^{2-}$   
 (B)  $\text{H}_2\text{CO}_3, \text{CO}_3^{2-}$   
 (C)  $\text{CO}_3^{2-}, \text{HCO}_3^-$   
 (D)  $\text{CO}_2, \text{H}_2\text{CO}_3$

## CHEMISTRY FOR JEE MAIN & ADVANCED

15.  $P_2O_5$  is used extensively as a –  
 (A) Dehydrating agent      (B) Catalytic agent      (C) Reducing agent      (D) Preservative
16. The number of molecules of water needed to convert one molecules of  $P_2O_5$  into orthophosphoric acid is –  
 (A) 2      (B) 3      (C) 4      (D) 5
17. Producer gas is a mixture of –  
 (A) CO and  $N_2$       (B)  $CO_2$  and  $H_2$       (C) CO and  $H_2$       (D)  $CO_2$  and  $N_2$
18. Which variety of glass is used for manufacture of optical glasses ?  
 (A) Sodium glass      (B) Flint glass      (C) Ground glass      (D) Quartz
19. The colour imparted by Co(II) compounds to glass is –  
 (A) Green      (B) Deep-Blue      (C) Yellow      (D) Red
20. In warfare smoke screens are prepared from –  
 (A)  $PH_3$       (B)  $CaC_2$       (C)  $P_2O_5$       (D)  $COCl_2$
21. In Haber's process for the manufacture of ammonia, the catalyst used is –  
 (A) Finely divided nickel      (B) Finely divided molybdenum  
 (C) Finely divided iron      (D) Finely divided platinum
22. Which one of the following nitrogen oxides is the anhydride of nitrous acid ?  
 (A)  $N_2O$       (B)  $N_2O_3$       (C)  $N_2O_4$       (D) NO
23. A metal X on heating in nitrogen gas gives Y. Y on treatment with  $H_2O$  gives a colourless gas which when passed through  $CuSO_4$  solution gives a blue colour. Y is –  
 (A)  $Mg(NO_3)_2$       (B)  $Mg_3N_2$       (C)  $NH_3$       (D) MgO
24. Oil of vitriol is –  
 (A)  $H_2SO_4$       (B)  $H_2SO_3$       (C)  $H_2S_2O_9$       (D)  $H_2S_2O_8$
25. The compound which gives off oxygen on moderate heating is –  
 (A) Cupric oxide      (B) Mercuric oxide      (C) Zinc oxide      (D) Aluminium oxide
26. Which acts both an oxidising as well as reducing agent –  
 (A)  $HNO_3$       (B)  $HNO_2$       (C)  $H_2SO_4$       (D) HCl
27.  $NO_2$  is released by heating –  
 (A)  $Pb(NO_3)_2$       (B)  $KNO_3$       (C)  $NaNO_2$       (D)  $NaNO_3$
28. A deep brown gas is formed by mixing two colourless gases which are –  
 (A)  $NO_2$  and  $O_2$       (B)  $N_2O$  and NO      (C) NO and  $O_2$       (D)  $NH_3$  and HCl
29. When conc.  $H_2SO_4$  comes in contact with sugar, it becomes black due to –  
 (A) Hydrolysis      (B) Hydration      (C) Decolourisation      (D) Dehydration
30. Which one of the following reacts with conc.  $H_2SO_4$  ?  
 (A) Au      (B) Ag      (C) Pt      (D) All
31.  $HCOOH$  reacts with conc.  $H_2SO_4$  to produce –  
 (A) CO      (B)  $CO_2$       (C) NO      (D)  $NO_2$
32. Which of the following represents the correct order of increasing  $pK_a$  values of the given acids –  
 (A)  $HClO_4 < HNO_3 < H_2CO_3 < B(OH)_3$       (B)  $HNO_3 < HClO_4 < B(OH)_3 < H_2CO_3$   
 (C)  $B(OH)_3 < H_2CO_3 < HClO_4 < HNO_3$       (D)  $HClO_4 < HNO_3 < B(OH)_3 < H_2CO_3$
33. The word Argon means –  
 (A) Noble      (B) Now      (C) Strange      (D) Lazy



34. Iodine and hypo react to produce –  
(A)  $\text{Na}_2\text{S}$  (B)  $\text{Na}_2\text{SO}_3$  (C)  $\text{Na}_2\text{SO}_4$  (D)  $\text{Na}_2\text{S}_4\text{O}_6$
35. Chlorine is manufactured by –  
(A) Brikland and Eyde's process (B) Deacon's process  
(C) Bosch process (D) Solvey's process
36. When chlorine water is kept in sunlight oxygen is evolved therefore –  
(A) Affinity of hydrogen for oxygen is less (B) Affinity of hydrogen for oxygen is more  
(C) Affinity of hydrogen for chlorine is more (D) Hydrogen is a reducing agent
37. The following acids have been arranged in the order of decreasing acid strength. Identify the correct order-  
 $\text{ClOH(I)}$                        $\text{BrOH(II)}$                        $\text{IOH(III)}$   
(A)  $\text{I} > \text{II} > \text{III}$  (B)  $\text{II} > \text{I} > \text{III}$  (C)  $\text{III} > \text{II} > \text{I}$  (D)  $\text{I} > \text{III} > \text{II}$
38. Sea weed are important source of –  
(A) Iron (B) Chlorine (C) Iodine (D) Bromine
39. Euchlorine is a mixture of –  
(A)  $\text{Cl}_2$  and  $\text{SO}_2$  (B)  $\text{Cl}_2$  and  $\text{ClO}_2$  (C)  $\text{Cl}_2$  and  $\text{CO}$  (D) None of these
40.  $\text{BCl}_3$  does not exist as dimer but  $\text{BH}_3$  exist as dimer ( $\text{B}_2\text{H}_6$ ) because –  
(A) Chlorine is more electronegative than hydrogen  
(B) There is  $\text{p}\pi - \text{p}\pi$  back bonding in  $\text{BCl}_3$  but  $\text{BH}_3$  does not contain such multiple bonding  
(C) Large sized chlorine atoms do not fit in between the small boron atoms whereas small sized hydrogen atoms get fitted in between boron atoms  
(D) None of the above
41. Amorphous boron on burning in air forms –  
(A)  $\text{B(OH)}_3$  (B) Mixutre of  $\text{B}_2\text{O}_3$  and  $\text{BN}$   
(C) Only  $\text{B}_2\text{O}_3$  (D) Only  $\text{BN}$
42. Which of the following statements is correct ?  
(A)  $\text{BCl}_3$  and  $\text{AlCl}_3$  are both Lewis acids and  $\text{BCl}_3$  is stronger than  $\text{AlCl}_3$   
(B)  $\text{BCl}_3$  and  $\text{AlCl}_3$  both Lewis acids and  $\text{AlCl}_3$  is stronger that  $\text{BCl}_3$   
(C)  $\text{BCl}_3$  and  $\text{AlCl}_3$  are both equally strong Lewis acids  
(D) Both  $\text{BCl}_3$  and  $\text{AlCl}_3$  are not Lewis acids.
43. A mixutre of boric acid with ehtyl alcohol burns with green edged flame due to the formation of –  
(A) Ethyl borax (B) Ethyl borate (C) Methyl borax (D) Methyl borate
44.  $\text{AlCl}_3$  on hydrolysis gives –  
(A)  $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (B)  $\text{Al(OH)}_3$  (C)  $\text{Al}_2\text{O}_3$  (D)  $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$

## CHEMISTRY FOR JEE MAIN & ADVANCED

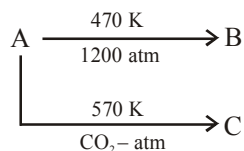
45. When a solution of sodium hydroxides is added in excess to the solution of potash alum, we obtain –  
(A) A white precipitate (B) Bluish white precipitate  
(C) A clear solution (D) A crystalline mass
46. Which one of the following does not exist in the free form ?  
(A)  $\text{BF}_3$  (B)  $\text{BCl}_3$  (C)  $\text{BBr}_3$  (D)  $\text{BH}_3$
47. Thermite is a mixture of –  
(A) 3 Parts of powdered Al and 1 part of  $\text{Fe}_2\text{O}_3$  (B) 1 part of powdered Al and 3 parts of  $\text{Fe}_2\text{O}_3$   
(C) 1 part of powdered Al and 1 part of  $\text{Fe}_2\text{O}_3$  (D) 2 Parts of powdered Al and 1 part of  $\text{Fe}_2\text{O}_3$
48. Borax is used as cleansing agent because on dissolving in water it gives –  
(A) Alkaline solution (B) Acidic solution (C) Bleaching solution (D) Colloidal solution
49.  $\text{SbCl}_3$  and  $\text{BiCl}_3$  on hydrolysis gives –  
(A)  $\text{Sb}^{+3}$  and  $\text{Bi}^{+3}$  (B)  $\text{Sb}(\text{OH})_3$  and  $\text{Bi}(\text{OH})_3$   
(C)  $\text{SbOCl}$  and  $\text{BiOCl}$  (D) None
50. The percentage of nitrogen in urea is about –  
(A) 70 (B) 63 (C) 47 (D) 28
51. Sequence of acidic character is –  
(A)  $\text{SO}_2 > \text{CO}_2 > \text{CO} > \text{N}_2\text{O}_5$  (B)  $\text{SO}_2 > \text{N}_2\text{O}_5 > \text{CO} > \text{CO}_2$   
(C)  $\text{N}_2\text{O}_5 > \text{SO}_2 > \text{CO} > \text{CO}_2$  (D)  $\text{N}_2\text{O}_5 > \text{SO}_2 > \text{CO}_2 > \text{CO}$
52. Trisilylamine  $[\ddot{\text{N}}(\text{SiH}_3)_3]$  has a –  
(A) Planar geometry (B) Tetrahedral geometry  
(C) Pyramidal geometry (D) None of these
53. The halide that is not hydrolysed is –  
(A)  $\text{SiCl}_4$  (B)  $\text{SiF}_4$  (C)  $\text{CCl}_4$  (D)  $\text{PbCl}_4$
54. What is false about  $\text{N}_2\text{O}_5$  ?  
(A) It is anhydride of  $\text{HNO}_3$  (B) It is a powerful oxidizing agent  
(C) Solid  $\text{N}_2\text{O}_5$  is called nitronium nitrate (D) Structure of  $\text{N}_2\text{O}_5$  contains no  $[\text{N} \rightarrow \text{O}]$  bond
55. Tip of saftymatch stick are made up of –  
(A) Sulphur and potassium (B) Sulphur  
(C) Sulphur, dichromate and phosphorus (D) Sulphur, dichromate and potassium
56. Of the following, which has three electron bond in its structure ?  
(A) Nitrous oxide (B) Nitric oxide  
(C) Dinitrogen trioxide (D) Nitrogen pentoxide
57. Which of the following leaves no residue on heating ?  
(A)  $\text{Pb}(\text{NO}_3)_2$  (B)  $\text{NH}_4\text{NO}_3$  (C)  $\text{Cu}(\text{NO}_3)_2$  (D)  $\text{NaNO}_3$
58. By passing  $\text{H}_2\text{S}$  gas in acidified  $\text{KMnO}_4$  solution, we get –  
(A)  $\text{K}_2\text{S}$  (B) S (C)  $\text{K}_2\text{SO}_3$  (D)  $\text{MnO}_2$

59. Chloride of lime is –  
 (A)  $\text{CaOCl}_2$  (B)  $\text{Ca}(\text{OCl})_2$  (C)  $\text{CaCl}_2$  (D)  $(\text{CaO})_2\text{Cl}$
60. Which one of the following oxy acid of fluorine exists ?  
 (A)  $\text{HOF}$  (B)  $\text{HFO}_3$  (C)  $\text{HFO}_4$  (D)  $\text{HFO}_2$
61.  $\text{H}_2\text{SO}_4$  has very high corrosive action on skin because –  
 (A) it reacts with proteins  
 (B) it acts as an oxidising agent  
 (C) it acts as a dehydrating agent  
 (D) it acts as dehydrating agent and absorption of water is highly exothermic
62. A black sulphide when treated with ozone becomes white. The white compound is –  
 (A)  $\text{ZnSO}_4$  (B)  $\text{CaSO}_4$  (C)  $\text{BaSO}_4$  (D)  $\text{PbSO}_4$
63. Which of the following does not react with  $\text{AgCl}$  –  
 (A)  $\text{Na}_2\text{S}_2\text{O}_3$  (B)  $\text{NH}_4\text{OH}$  (C)  $\text{NaNO}_3$  (D)  $\text{NH}_3$
64. Chromyl chloride test is performed for the confirmation of the presence of the following in mixture –  
 (A)  $\text{SO}_4^{2-}$  (B)  $\text{Cr}^{+++}$  (C)  $\text{Cl}^-$  (D)  $\text{Cr}^{+++}$  and  $\text{Cl}^-$
65. Iodine gas turns starch iodide paper –  
 (A) Blue (B) Red (C) Colourless (D) Yellow
66. Essential trace element involved in physiology of thyroid glands –  
 (A) K (B) Mg (C) Ni (D)  $\text{I}_2$
67.  $\text{HI}$  can be prepared by all the following methods except –  
 (A)  $\text{PI}_3 + \text{H}_2\text{O}$  (B)  $\text{KI} + \text{H}_2\text{SO}_4$  (C)  $\text{H}_2 + \text{I}_2 \longrightarrow$  (D)  $\text{I}_2 + \text{H}_2\text{S}$
68. When  $\text{I}_2$  is passed through  $\text{KCl}$ ,  $\text{KF}$ ,  $\text{KBr}$  solution –  
 (A)  $\text{Cl}_2$  and  $\text{Br}_2$  are evolved (B)  $\text{Cl}_2$  is evolved  
 (C)  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{F}_2$  are evolved (D) None of these
69. Which two of the following salts are used for preparing iodized salt–  
 (i)  $\text{KIO}_3$  (ii)  $\text{KI}$  (iii)  $\text{I}_2$  (iv)  $\text{HI}$   
 (A) (i) and (ii) (B) (i) and (iii) (C) (ii) and (iv) (D) (iii) and (iv)
70. When chlorine is passed over dry slaked lime at room temperature, the main reaction product is –  
 (A)  $\text{Ca}(\text{ClO}_2)_2$  (B)  $\text{CaCl}_2$  (C)  $\text{CaOCl}_2$  (D)  $\text{Ca}(\text{OCl}_2)_2$
71. Iodine is formed when  $\text{KI}$  reacts with a solution of –  
 (A)  $\text{ZnSO}_4$  (B)  $\text{CuSO}_4$  (C)  $\text{FeSO}_4$  (D)  $(\text{NH}_4)_2\text{SO}_4$
72. Which amongst the following reactions cannot be used for the preparation of the halogen acid ?  
 (A)  $2\text{KBr} + \text{H}_2\text{SO}_4(\text{Conc.}) \longrightarrow \text{K}_2\text{SO}_4 + 2\text{HBr}$   
 (B)  $2\text{NaCl} + \text{H}_2\text{SO}_4(\text{Conc.}) \longrightarrow \text{NaHSO}_4 + \text{HCl}$   
 (C)  $\text{NaHSO}_4 + \text{NaCl} \longrightarrow \text{Na}_2\text{SO}_4 + \text{HCl}$   
 (D)  $\text{CaF}_2 + \text{H}_2\text{SO}_4(\text{conc.}) \longrightarrow \text{CaSO}_4 + 2\text{HF}$

## CHEMISTRY FOR JEE MAIN & ADVANCED

73. Helium is obtained from which of the following?  
 (A) Natural gases trapped under rock formations. (B) Liquid air  
 (C) Radioactive decay (D) Gasoline
74. The statement, which prompted Neil Bartlett to prepare the first noble gas compound was –  
 (A) Xe-F bond has high bond energy  
 (B)  $F_2$  has exceptionally low bond energy  
 (C)  $PtF_6$  is a strong oxidant  
 (D)  $O_2$  molecule and Xe atom have very similar ionization energies.
75. Pick out the correct statement for  $XeF_6$   
 (A)  $XeF_6$  is hydrolysed partially to form  $XeOF_4$   
 (B) It react with  $SiO_2$  to form  $XeOF_4$   
 (C) On complete hydrolysis, it forms  $XeO_3$   
 (D) All
76. One mole of calcium phosphide on reaction with excess of water gives –  
 (A) One mole of phosphine (B) Two moles of phosphoric acid  
 (C) Two moles of phosphine (D) One mole of phosphorus penta-oxide
77.  $Ca + C_2 \longrightarrow CaC_2 \xrightarrow{N_2} A$   
 Compound (A) is used as a/an –  
 (A) Fertilizer (B) Dehydrating agent (C) Oxidising agent (D) Reducing agent
78. Which one of the following statements is not true regarding diborane?  
 (A) It has two bridging hydrogens and four perpendicular to the rest.  
 (B) When methylated, the product is  $Me_4B_2H_2$   
 (C) The bridging hydrogens are in a plane perpendicular to the rest.  
 (D) All the B–H bond distances are equal.
79. The molecular shapes of diborane is shown:  
 Consider the following statements for diborane  
 1. Boron is approximately  $sp^3$  hybridised  
 2. B-H-B angle is  $180^\circ$   
 3. There are two terminal B-H bonds for each boron atom  
 4. There are only 12 bonding electrons available  
 Of these statements –  
 (A) 1, 3 and 4 are correct (B) 1, 2 and 3 are correct  
 (C) 2, 3 and 4 are correct (D) 1, 2 and 4 are correct
- The diagram shows the structure of diborane (B<sub>2</sub>H<sub>6</sub>). Two boron atoms are connected by a dashed line representing a B-B bond with a length of 1.33 Å. Each boron atom is also bonded to two terminal hydrogen atoms (solid lines) and shares one hydrogen atom with the other boron atom (dashed line). The B-H bond length is 1.19 Å. The bridging hydrogens are positioned above and below the B-B bond.
80. Borax is actually made of two tetrahedral and two triangular units joined together and should be written as :  
 $Na_2 [B_4O_5(OH)_4] \cdot 8H_2O$ .  
 Consider the following statements about borax:  
 1. Each boron atom has four B-O bonds  
 2. Each boron atom has three B-O bonds  
 3. Two boron atoms have four B-O bonds while other two have three B-O bonds  
 4. Each boron atom has one-OH groups  
 Select correct statement(s) –  
 (A) 1, 2 (B) 2, 3 (C) 3, 4 (D) 1, 3

81. Three allotropes (A), (B) and (C) of phosphorous in the following change are respectively –



- (A) White, black, red      (B) Black, white, red      (C) Red, black, white      (D) Red, violet, black
82. A red coloured mixed oxide (X) on treatment with concentrate  $\text{HNO}_3$  gives a compound (Y). (Y) with HCl, produces a chloride compound (Z) which can also be produced by treating (X) with concentrate HCl. Compounds (X), (Y) and (Z) will be –
- (A)  $\text{Mn}_3\text{O}_4$ ,  $\text{MnO}_2$ ,  $\text{MnCl}_2$       (B)  $\text{Pb}_3\text{O}_4$ ,  $\text{PbO}_2$ ,  $\text{PbCl}_2$   
 (C)  $\text{Fe}_3\text{O}_4$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{FeCl}_2$       (D)  $\text{Fe}_3\text{O}_4$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{FeCl}_3$
83. Match List-I with List-II
- | List-I Chemical reaction   | List-II Name of process |
|--|-------------------------|
| (1) $4\text{NH}_3 + 5\text{O}_2 \xrightarrow{800^\circ\text{C}/\text{Pt}} 4\text{NO} + 6\text{H}_2\text{O}$  | (a) Contact process     |
| (2) $4\text{HCl} + \text{O}_2 \xrightarrow[450-500^\circ/\text{V}_2\text{O}_5]{3230^\circ\text{C}/\text{CuCl}_2} 2\text{Cl}_2 + 2\text{H}_2\text{O}$ | (b) Ostwald's process   |
| (3) $2\text{SO}_2 + \text{O}_2 \longrightarrow 2\text{SO}_3$   | (c) Deacon's process    |
| (4) $2\text{N}_2 + 3\text{H}_2 \xrightarrow{\text{Fe+Mo}} 2\text{NH}_3$  | (d) Haber's process     |
- (A) 1-a, 2-b, 3-d, 4-c      (B) 1-b, 2-c, 3-a, 4-d      (C) 1-a, 2-d, 3-c, 4-b      (D) 1-a, 2-c, 3-b, 4-d
84. A gas which exists in three allotropic forms  $\alpha$ ,  $\beta$  and  $\gamma$  is –
- (A)  $\text{SO}_2$       (B)  $\text{SO}_3$       (C)  $\text{CO}_2$       (D)  $\text{NH}_3$
85.  $\text{HNO}_3 + \text{P}_4\text{O}_{10} \longrightarrow \text{HPO}_3 + \text{A}$ ; The product A is –
- (A)  $\text{N}_2\text{O}$       (B)  $\text{N}_2\text{O}_3$       (C)  $\text{NO}_2$       (D)  $\text{N}_2\text{O}_5$
86. The solubility of anhydrous  $\text{AlCl}_3$  and hydrous  $\text{AlCl}_3$  in diethyl ether are  $S_1$  and  $S_2$  respectively. Then –
- (A)  $S_1 = S_2$       (B)  $S_1 > S_2$       (C)  $S_1 < S_2$       (D)  $S_1 < S_1$  but not  $S_1 = S_2$
87. Concentrated  $\text{HNO}_3$  reacts with iodine to give –
- (A) HI      (B) HOI      (C)  $\text{HOIO}_2$       (D)  $\text{HOIO}_3$
88. Conc.  $\text{H}_2\text{SO}_4$  cannot be used to prepare HBr from NaBr because it –
- (A) Reacts slowly with NaBr      (B) Oxidises HBr  
 (C) Reduces HBr      (D) Disproportionates HBr
89. Conc.  $\text{HNO}_3$  is yellow coloured liquid due to –
- (A) Dissolution of NO in conc.  $\text{HNO}_3$   
 (B) Dissolution of  $\text{NO}_2$  in conc.  $\text{HNO}_3$   
 (C) Dissolution of  $\text{N}_2\text{O}$  in conc.  $\text{HNO}_3$   
 (D) Dissolution of  $\text{N}_2\text{O}_3$  in conc.  $\text{HNO}_3$

## CHEMISTRY FOR JEE MAIN & ADVANCED

90. When chlorine gas is passed through an aqueous solution of a potassium halide in the presence of chloroform, a violet colouration is obtained. On passing more of chlorine water, the violet colour is disappeared and solution becomes colourless. This test confirms the presence of ..... in aqueous solution. –  
 (A) Chlorine (B) Fluorine (C) Bromine (D) Iodine
91. An inorganic salt (A) is decomposed at about 523 K to give products (B) and (C). compound (C) is a liquid at room temperature and is neutral to litmus paper while oxide (B) on burning with white phosphorous, given a dehydrating agent (D). compounds (A), (B), (C) and (D) will be identified as –  
 (A)  $\text{NH}_4\text{NO}_3, \text{N}_2\text{O}, \text{H}_2\text{O}, \text{P}_2\text{O}_5$   
 (B)  $\text{NH}_4\text{NO}_2, \text{N}_2\text{O}, \text{H}_2\text{O}, \text{P}_2\text{O}_5$   
 (C)  $\text{CaCO}_3, \text{CaO}, \text{H}_2\text{O}, \text{CaCl}_2$   
 (D)  $\text{CaCO}_3, \text{CaO}, \text{H}_2\text{O}, \text{Ca}(\text{OH})_2$
92. 
$$\text{CH}_2 \begin{array}{l} \nearrow \text{COOH} \\ \searrow \text{COOH} \end{array} \xrightarrow{\text{P}_4\text{O}_{10}, 150^\circ\text{C}} \text{X. Compound (X) is -}$$
  
 (A) Malonic acid (B) Carbon suboxide (C) Tartaric acid (D) Acetic acid
93.  $\text{H}_3\text{BO}_3 \xrightarrow{\text{T}_2} \text{X} \xrightarrow{\text{T}_2} \text{Y} \xrightarrow{\text{redhot}} \text{B}_2\text{O}_3$  if  $\text{T}_1 < \text{T}_2$  then X and Y respectively are –  
 (A) X = Metaboric acid and Y = Tetraboric acid  
 (B) X = Tetraboric acid and Y = Metaboric acid  
 (C) X = Borax and Y = Metaboric acid  
 (D) X = Tetraboric acid and Y = Borax
94. In a molecule of phosphorus (V) oxide, there are –  
 (A) 4P – P, 10P – O and 4P = O bonds (B) 12P – O and 4P = O bonds  
 (C) 2P – O and 4P = P bonds (D) 6P – P, 12P – O and 4P = P bonds
95. Aqueous solution of borax reacts with 2 mol of acids. This is because of –  
 (A) Formation of 2 mol of  $\text{B}(\text{OH})_3$  only.  
 (B) Formation of 2 mol of  $[\text{B}(\text{OH})_4]^-$  only.  
 (C) Formation of 1 mol each of  $\text{B}(\text{OH})_3$  and  $[\text{B}(\text{OH})_4]^-$   
 (D) Formation of 2 mol each of  $[\text{B}(\text{OH})_4]^-$  and  $\text{B}(\text{OH})_3$ , of which only  $[\text{B}(\text{OH})_4]^-$  reacts with acid
96. Borax is used as a buffer since –  
 (A) Its aqueous solution contains equal amount of weak acid and its salt  
 (B) It is easily available  
 (C) Its aqueous solution contains equal amount of strong acid and its salt  
 (D) Statement that borax is a buffer, is wrong.
97. When fluoride is heated with conc.  $\text{H}_2\text{SO}_4$  and  $\text{MnO}_2$  the gas evolved is –  
 (A) HF (B)  $\text{F}_2$  (C)  $\text{SF}_4$  (D) None

## Exercise # 2

## Part # I

## [Multiple Correct Choice Type Questions]

- Which species exist:  
 (A)  $[\text{BF}_6]^{3-}$                       (B)  $[\text{AlF}_6]^{3-}$                       (C)  $[\text{GaF}_6]^{3-}$                       (D)  $[\text{InF}_6]^{3-}$
- Borax bead test is given by:  
 (A) An aluminium salt      (B) A cobalt salt                      (C) A copper salt                      (D) A nickel salt
- Which of the following statement(s) is/are correct ?  
 (A) The oxide,  $\text{B}_2\text{O}_3$  and  $\text{B}(\text{OH})_3$  are acidic  
 (B) The halides of B (except  $\text{BF}_3$ ) and Si are readily hydrolysed.  
 (C) The hydrides of B and Si are volatile, spontaneously flammable and readily hydrolysed.  
 (D) Aluminium hydride is a polymer,  $(\text{AlH}_3)_n$ .
- Which of the following statements about anhydrous aluminium chloride is/are incorrect ?  
 (A) It exists as  $\text{AlCl}_3$  molecule in gaseous phase      (B) It is a strong Lewis base  
 (C) It sublimates at  $100^\circ\text{C}$  under vacuum                      (D) It is not easily hydrolysed
- Select the correct statement(s) .  
 (A) The graphite is diamagnetic and diamond is paramagnetic in nature.  
 (B) Graphite acts as a metallic conductor along the layers of carbon atoms and as semi-conductor perpendicular to the layers of the carbon atoms.  
 (C) Graphite is less denser than diamond  
 (D)  $\text{C}_{60}$  is called as Buckminster fullerene
- Carbon monoxide is prepared by :  
 (A) heating formic acid with conc.  $\text{H}_2\text{SO}_4$                       (B) heating potassium ferrocyanide with conc  $\text{H}_2\text{SO}_4$   
 (C) heating malonic acid with  $\text{P}_4\text{O}_{10}$                       (D) hydrolysis of  $\text{Mg}_2\text{C}_3$
- Boric acid is used :  
 (A) as an antiseptic                      (B) as a flux in soldering  
 (C) in making optical glasses                      (D) in making enamels and pottery glazes
- Which is/are true in case of  $\text{BF}_3$  ?  
 (A) It is volatile liquid even at room temperature      (B) It is Lewis acid  
 (C) It has planar geometry                      (D) It forms adduct with  $\text{NH}_3$
- Which statement(s) is/are correct ?  
 (A) Al acts as a reducing agent  
 (B) Al does not react with steam even at higher temperature  
 (C) Al forms a number of alloys with other metals  
 (D) Al is ionic in all its compounds
- Which of the following statement(s) is/are false for soluble bicarbonates?  
 (A) They give pink colour with phenolphthalein.  
 (B) They do not liberate carbondioxide with phenol.  
 (C) They give white precipitate with magnesium nitrate in cold.  
 (D) They liberate carbondioxide on reaction with dil.  $\text{H}_2\text{SO}_4$ .

## CHEMISTRY FOR JEE MAIN & ADVANCED

11. Which of the following give(s) ethyne on reaction with water?  
 (A)  $\text{Al}_2(\text{C}_2)_3$                       (B)  $\text{Al}_4\text{C}_3$                       (C)  $\text{SrC}_2$                       (D)  $\text{Mg}_2\text{C}_3$
12. A complex cross-linked polymer (silicone) is formed by  
 (A) hydrolysis of  $(\text{CH}_3)_3\text{SiCl}$ .                      (B) hydrolysis of a mixture of  $(\text{CH}_3)_3\text{SiCl}$  and  $(\text{CH}_3)_2\text{SiCl}_2$   
 (C) hydrolysis of  $\text{CH}_3\text{SiCl}_3$                       (D) hydrolysis of  $\text{SiCl}_4$ .
13. Consider the following statements and which of the following are correct ?  
 $\text{S}_1$  :  $\text{B}_4\text{O}_7^{2-}$  on hydrolysis with acid / water yields  $\text{B}(\text{OH})_3$  .  
 $\text{S}_2$  :  $\text{SiO}_4^{4-}$  on hydrolysis with acid / water yields  $\text{Si}_2\text{O}_7^{6-}$  .  
 $\text{S}_3$  :  $\text{MeSiCl}_3$  on hydrolysis and then condensations gives a complex cross-linked polymer of silicones.  
 $\text{S}_4$  : Among  $\text{CO}_2$ ,  $\text{CuO}$ ,  $\text{CaO}$  and  $\text{H}_2\text{O}$ ,  $\text{CO}_2$  is most acidic oxide while  $\text{CaO}$  is most basic oxide.  
 (A)  $\text{S}_1\text{S}_2\text{S}_3$  only                      (B)  $\text{S}_1\text{S}_3\text{S}_4$  only                      (C)  $\text{S}_1\text{S}_2\text{S}_3\text{S}_4$                       (D)  $\text{S}_2\text{S}_3\text{S}_4$  only
14. Which is / are the correct statement(s) ?  
 (A)  $\text{BeF}_2$  readily coordinates two additional  $\text{F}^-$  ions forming the  $[\text{BeF}_4]^{2-}$  complex.  
 (B) One mole of borax in aqueous solution reacts with two moles of acid.  
 (C)  $\text{HCOONa}$  as well as solid  $\text{K}_3[\text{Fe}(\text{CN})_6]$  both on heating with concentrated sulphuric acid evolve carbon monoxide gas.  
 (D) Carbon mono oxide when passed through a solution of iodine pentaoxide,  $\text{I}_2\text{O}_5$  liberates iodine and carbon dioxide gases.
15. Select the correct statement(s)  
 (A) Double chain silicates are known as amphiboles.  
 (B) In cyclic silicates two oxygen atoms per tetrahedron are shared.  
 (C) Orthosilicates contain discrete  $(\text{SiO}_4)^{4-}$  units.  
 (D) Asbestos mineral is a double chain silicate and mica is a sheet silicate.
16. Boron can be obtained by :  
 (A) reduction of  $\text{Br}_2\text{O}_3$  by C.  
 (B) reduction of  $\text{BCl}_3$  with  $\text{H}_2$  at 1270 K.  
 (C) thermal decomposition of boron halides at 1173 K.  
 (D) electrolytic reduction of  $\text{KBF}_4$  in  $\text{KF}$  at 1073 K.
17. What products are expected from the reaction between colemanite powder and sodium carbonate solution, when they are heated ?  
 (A)  $\text{CaCO}_3$                       (B)  $\text{Na}_2\text{B}_4\text{O}_7$                       (C)  $\text{NaBO}_2$                       (D)  $\text{CaO}$
18. Diborane undergoes unsymmetrical cleavage reactions with :  
 (A) dimethylamine                      (B) ammonia at low temperature  
 (C) methylamine                      (D) carbon dioxide
19. Which of the following allotropic form(s) of carbon is/are good conductor of electricity ?  
 (A) Diamond                      (B) Graphite                      (C) Fullerenes                      (D) Gas carbon.
20. Which is/are incorrect statement(s) ?  
 (A) Diamond is unaffected by conc acids but graphite reacts with hot conc  $\text{HNO}_3$  forming mellitic acid.  
 (B)  $\text{CO}$  is toxic because it forms a complex with haemoglobin in the blood cells.  
 (C) Carbon sub oxide is prepared by the dehydration of succinic acid with phosphorus penta oxide  
 (D)  $(\text{Me})_2\text{Si}(\text{Cl})_2$  on hydrolysis followed by condensation, produces  $(\text{Me})_2\text{Si}(\text{OH})_2$ .



21. Select the correct statement (s)
- (A)  $\text{CH}_3\text{SiCl}_3$  under goes hydrolysis followed by inter molecular elimination of water to form a complex cross-linked polymer (i.e silicone)
  - (B) Silicone fluids are thermally stable.
  - (C) In two dimensional sheet silicate, three oxygen atoms of each tetrahedral are shared with adjacent  $\text{SiO}_4^{4-}$  tetrahedrals.
  - (D) Silica is attacked by HF and NaOH.
22. Ammonia, on reaction with hypochlorite anion, can form : [JEE 1999]
- (A) NO
  - (B)  $\text{NH}_4\text{Cl}$
  - (C)  $\text{N}_2\text{H}_4$
  - (D)  $\text{HNO}_2$
23. As, Sb and Bi show little or no tendency to form negative ions of the type  $\text{M}^{3-}$ . This is because
- (A) these elements are less electronegative
  - (B) their atoms have larger size
  - (C) they are unable to hold the added electrons due to inert pair effect
  - (D) they do not posses half filled np subshells
24. Which of the following statements is (are) correct ?
- (A) The hydrides of group 15 elements act as oxidising agents
  - (B) The hydrides of group 15 elements act as reducing agents
  - (C) The oxidising power increases in going from  $\text{NH}_3$  to  $\text{BiH}_3$
  - (D) The reducing power increases in going from  $\text{NH}_3$  to  $\text{BiH}_3$
25. What is true for hydrogen peroxide and ozone ?
- (A)  $\text{H}_2\text{O}_2$  acts as a stronger reducing agent in alkaline medium than in acidic medium
  - (B)  $\text{H}_2\text{O}_2$  and  $\text{O}_3$  both are oxidising agents as well as bleaching agent
  - (C)  $\text{H}_2\text{O}_2$  forms a hydrate,  $\text{H}_2\text{O}_2 \cdot \text{H}_2\text{O}$
  - (D) Ozone is used in the manufacture of potassium permanganate from pyrolusite.
26. Sulphuric acid acts as
- (A) hygroscopic agent
  - (B) sulphonating agent
  - (C) reducing agent
  - (D) oxidising agent.
27. Which of the following statement (s) is/are true for sodium thiosulphate ?
- (A) it acts as an antichlor
  - (B) it is used as an reducing agent in iodometric titration.
  - (C) it reacts with hydrochloric acid to form  $\text{SO}_2$  and sulphur.
  - (D) it is used in photography as hypo to dissolves excess of AgBr as soluble complex.
28. Which of the following statement(s) is/are incorrect ?
- (A)  $\text{SbH}_3 > \text{NH}_3 > \text{AsH}_3 > \text{PH}_3$  (boiling point)
  - (B)  $\text{H}_3\text{PO}_4 > \text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_2$  (reducing character)
  - (C)  $\text{N}_2\text{O} < \text{NO} < \text{N}_2\text{O}_3 < \text{N}_2\text{O}_5$  (oxidation state on nitrogen atom)
  - (D)  $\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3 \geq \text{BiH}_3$  (basicity)

## CHEMISTRY FOR JEE MAIN & ADVANCED

29. Which of the following statements is (are) correct ?  
(A) Antimony on reaction with conc.  $\text{HNO}_3$  gives antimonic acid.  
(B) Manganese on reaction with cold and dilute  $\text{HNO}_3$  gives  $\text{NO}_2$  gas.  
(C)  $\text{HNO}_2$  disproportionate to give  $\text{HNO}_3$  and  $\text{NO}$   
(D)  $\text{HNO}_3$  on reaction with  $\text{P}_4\text{O}_{10}$  gives  $\text{N}_2\text{O}_5$
30. Which of the following is/are true for oxygen.  
(A)  $\text{KMnO}_4(\text{s})$  on strong heating gives oxygen gas  
(B) Oxygen mixed with helium is used for artificial respiration.  
(C) It has two unpaired electrons in bonding  $\pi$  molecular orbitals.  
(D) Brins process is used as industrial method for the preparation of oxygen gas.
31. Which among the following is/are peroxy acid (s) ?  
(A)  $\text{H}_2\text{S}_2\text{O}_3$                       (B)  $\text{H}_2\text{SO}_5$                       (C)  $\text{H}_2\text{S}_2\text{O}_7$                       (D)  $\text{H}_2\text{S}_2\text{O}_8$
32. Ammonium dichromate on heating liberates a gas. The same gas will be obtained by :  
(A) heating  $\text{NaNO}_2$  and  $\text{NH}_4\text{Cl}$ .                      (B) treating  $\text{H}_2\text{O}_2$  with  $\text{NaNO}_2$  .  
(C) passing ammonia gas over red hot  $\text{CuO}$ .                      (D) treating ammonia with  $\text{KMnO}_4$  in neutral medium.
33. Nitrogen (I) oxide is produced by :  
(A) thermal decomposition of ammonium nitrate.                      (B) disproportionation of  $\text{N}_2\text{O}_4$ .  
(C) thermal decomposition of ammonium nitrite.                      (D) interaction of hydroxyl ammine and nitrous acid
34. Select the incorrect statements(s).  
(A) Alkaline  $\text{H}_2\text{O}_2$  reduces  $\text{ClO}_2$  to  $\text{ClO}_2^-$   
(B) Ammonia reacts with excess of iodine to form an explosive,  $\text{NI}_3 \cdot \text{NH}_3$   
(C) The manufacture of  $\text{HNO}_3$  is based upon catalytic oxidation of  $\text{NH}_3$  by atmospheric oxygen.  
(D)  $\text{N}_2\text{O}_3$  with concentrated  $\text{HClO}_4$  forms nitrosyl salt.
35. Which of the following is/are incorrect statement(s) for phosphine ?  
(A) It is less basic than  $\text{NH}_3$ .  
(B) It is less poisonous than  $\text{NH}_3$ .  
(C) The solution of  $\text{PH}_3$  in water does not decompose.  
(D) Phosphine on heating at  $150^\circ\text{C}$  burns forming  $\text{H}_3\text{PO}_4$ .
36. What is/are not true about phosphine ( $\text{PH}_3$ ) ?  
(A) It turns red litmus blue.  
(B) It reacts with  $\text{HCl}(\text{aq.})$  to give  $\text{PH}_4\text{Cl}$ .  
(C) Phosphonium compounds are obtained when anhydrous phosphine reacts with anhydrous halogen acids.  
(D) It is prepared by hydrolysis of metal phosphides with acids.
37. Iodine reacts with hypo to give :  
(A)  $\text{NaI}$                       (B)  $\text{Na}_2\text{SO}_3$                       (C)  $\text{Na}_2\text{S}_4\text{O}_6$                       (D)  $\text{Na}_2\text{SO}_4$
38.  $\text{Cl}_2$  reacts with hot aqueous  $\text{NaOH}$  to give :  
(A)  $\text{NaCl}$                       (B)  $\text{NaClO}_3$                       (C)  $\text{NaClO}_2$                       (D)  $\text{NaClO}_4$

39. Select the correct order of acidity :  
 (A)  $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$  (B)  $\text{HClO}_4 > \text{HBrO}_4 > \text{HIO}_4$   
 (C)  $\text{HClO} < \text{HBrO} > \text{HIO}$  (D)  $\text{HClO}_4 > \text{HClO}_3 > \text{HClO}_2 > \text{HClO}$
40. Which is / are true statement(s) ?  
 (A) Basic nature of  $\text{X}^-$  is in order  $\text{F}^- > \text{Cl}^- > \text{Br}^- > \text{I}^-$   
 (B) HI is strongest acid of HF, HCl, HBr and HI  
 (C) The ionic character of  $\text{M}-\text{X}$  bond decreases in the order  $\text{M}-\text{F} > \text{M}-\text{Cl} > \text{M}-\text{Br} > \text{M}-\text{I}$   
 (D) Among F, Cl, Br and I, F has the highest enthalpy of hydration.
41. Electrolysis of aqueous solution of Brine (NaCl) gives :  
 (A)  $\text{Cl}_2$  (B)  $\text{H}_2$  (C) NaOH (D) None
42. Which of the following salts will evolve halogen on treatment with conc.  $\text{H}_2\text{SO}_4$  ?  
 (A) NaCl (B) KI (C) NaBr (D) none of these
43. Which of the following product(s) is/are obtained when  $\text{Cl}_2\text{O}_6$  reacts with KOH ?  
 (A) KCl (B)  $\text{KClO}_2$  (C)  $\text{KClO}_3$  (D)  $\text{KClO}_4$
44. Which of the following product(s) is/are obtained when  $\text{Cl}_2\text{O}$  reacts with  $\text{NH}_3$  ?  
 (A)  $\text{NO}_2$  (B)  $\text{N}_2$  (C)  $\text{NCl}_3$  (D)  $\text{NH}_4\text{Cl}$
45. Select the incorrect order.  
 (A)  $\text{He} > \text{Ar} > \text{Kr} > \text{Ne} > \text{Xe}$  – (abundance in air). (B)  $\text{He} < \text{Ne} < \text{Ar} < \text{Kr} < \text{Xe}$  – (boiling point).  
 (C)  $\text{XeF}_6 > \text{XeF}_4 > \text{XeF}_2$  – (melting point). (D)  $\text{XeF}_6 < \text{XeF}_4 < \text{XeF}_2$  – (Xe – F bond length).
46. Which of the following statements(s) is /are true for  $\text{XeF}_6$  ?  
 (A) Its partial hydrolysis gives  $\text{XeOF}_4$ .  
 (B) Its reaction with silica gives  $\text{XeOF}_4$   
 (C) It is prepared by the reaction of  $\text{XeF}_4$  and  $\text{O}_2\text{F}_2$   
 (D) Its reaction with  $\text{XeO}_3$  gives  $\text{XeOF}_4$ .
47. Which of the following is/are properties of helium?  
 (A) It is chemically inert. (B) It has very high thermal conductivity.  
 (C) It has extremely low boiling point. (D) It has very low viscosity.
48. Select the correct statement(s) regarding the fluorides of xenon.  
 (A) All three fluorides are decomposed by water,  $\text{XeF}_2$  slowly and,  $\text{XeF}_4$  and  $\text{XeF}_6$  rapidly.  
 (B) All three fluorides are powerful oxidising agents.  
 (C)  $\text{XeF}_4$  and  $\text{XeF}_6$  can act as fluoride ion acceptors as well as fluoride ion donors.  
 (D) All three fluorides are volatile, readily subliming at room temperature (298 K).
49. Which of the following inert gas(es) form(s) clathrate compound(s) with quinol ?  
 (A) Helium (B) Xenon (C) Krypton (D) Neon
50. Which among the following statements is / are correct ?  
 (A)  $\text{XeF}_4$  and  $\text{SbF}_5$  combine to form salt.  
 (B) He and Ne do not form clathrate.  
 (C) He diffuses through rubber and polyvinyl chloride.  
 (D) He has lowest boiling point in its group.

## CHEMISTRY FOR JEE MAIN & ADVANCED

51. Thermal decomposition product (s) of  $\text{XeF}_6$  is /are :  
 (A) Xe (B)  $\text{XeF}_2$  (C)  $\text{XeF}_4$  (D)  $\text{F}_2$
52. Select correct statement(s)  
 (A)  $\text{ClO}_2$  and  $\text{Cl}_2\text{O}$  are used as bleaching agents for paper pulp and textiles.  
 (B)  $\text{OCl}^-$  disproportionates in alkaline medium.  
 (C)  $\text{BrO}_3^-$  liberates  $\text{Br}_2$  with iodine in acidic medium.  
 (D)  $\text{HClO}_2$  liberates iodine from KI.
53. What products are expected from disproportionation reaction of hypochlorous acid ?  
 (A)  $\text{HClO}_3$  (B)  $\text{HClO}_2$  (C)  $\text{HCl}$  (D)  $\text{HClO}_4$
54. Select the correct order (s).  
 (A)  $\text{HOCl} > \text{HOBr} > \text{HOI}$  – Acid strength. (B)  $\text{HClO}_4 < \text{HClO}_3 < \text{HClO}_2 \leq \text{HClO}$  – oxidising power  
 (C)  $\text{ClO}_4^- < \text{BrO}_4^- < \text{IO}_4^-$  – oxidising power (D)  $\text{IO}^- > \text{BrO}^- > \text{ClO}^-$  – ease of disproportionation.
55. Which of the following pair(s) will give chlorine gas most quickly, upon reaction ?  
 (A)  $\text{HCl}$  and  $\text{KMnO}_4$  (B)  $\text{NaCl}$  and  $\text{H}_3\text{PO}_4$  (C)  $\text{NaCl}$  and  $\text{MnO}_2$  (D)  $\text{CaCl}_2$  and  $\text{Br}_2$
56. Iodine is liberated from sodium iodate by reacting with :  
 (A) dilute  $\text{H}_2\text{SO}_4$  (B)  $\text{KMnO}_4$  (C)  $\text{NaHSO}_3$  (D) concentrated  $\text{H}_2\text{SO}_4$  &  $\text{NaI}$
57.  $\text{HI}$  can be prepared by all the following methods except :  
 (A)  $\text{PI}_3 + \text{H}_2\text{O}$  (B)  $\text{KI} + \text{H}_2\text{SO}_4$  (C)  $\text{H}_2 + \text{I}_2 \xrightarrow{\text{Pt}}$  (D)  $\text{I}_2 + \text{H}_2\text{S}$
58. A solution of  $\text{KI}_3$  in water contains :  
 (A)  $\text{K}^{3+}$  ions (B)  $\text{I}^-$  ions (C)  $\text{K}^+$  ions (D)  $\text{I}_3^-$  ions
59. Which of the following statement (s) is/are incorrect for noble gases ?  
 (A) Argon is used in higher temperature metallurgical process because of their inert nature.  
 (B) Krypton and xenon form clathrate compounds with quinol having chemical formula not exact but approximately 3 quinol molecules : 1 gas molecule.  
 (C) All the noble gases are monoatomic.  
 (D) Noble gases are completely soluble in water.

Part # II

[Assertion & Reason Type Questions]

**Each question has 5 choices (A), (B), (C), (D) and (E) out of which only one is correct.**

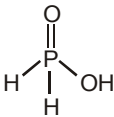
- (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
 (C) Statement-1 is True, Statement-2 is False.  
 (D) Statement-1 is False, Statement-2 is True.  
 (E) Statement-1 and Statement-2 both are False.

1. **Statement-1** : Al forms  $[\text{AlF}_6]^{3-}$  but B does not form  $[\text{BF}_6]^{3-}$   
**Statement-2** :  $\text{BF}_3$  on hydrolysis gives  $\text{HBF}_4$ .

2. **Statement-1** : Boron forms only covalent compounds.  
**Statement-2** : Due to small size of boron, the sum of its first three ionisation enthalpies very high.
3. **Statement-1** :  $\text{AlCl}_3$  forms dimer  $\text{Al}_2\text{Cl}_6$  in gaseous state but it dissolves in  $\text{H}_2\text{O}$  forming  $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$  and  $3\text{Cl}^-$  ions.  
**Statement-2** : Aqueous solution of  $\text{AlCl}_3$  is acidic due to hydrolysis.
4. **Statement-1** :  $\text{Al}(\text{OH})_3$  is insoluble in  $\text{NH}_4\text{OH}$  but soluble in  $\text{NaOH}$   
**Statement-2** :  $\text{NaOH}$  is a stronger base.
5. **Statement-1** : Boron has unusually high melting point.  
**Statement-2** : Boron shows non-metallic character.
6. **Statement-1** : Benzene is reactive while inorganic benzene is unreactive compound  
**Statement-2** : Inorganic benzene is borazine,  $\text{B}_3\text{N}_3\text{H}_6$
7. **Statement-1** : Si–Si bonds are much weaker than Si–O bonds.  
**Statement-2** : Silicon forms double bonds with itself.
8. **Statement-1** :  $\text{Pb}^{4+}$  can be reduced easily to  $\text{Pb}^{2+}$ .  
**Statement-2** :  $\text{Pb}^{2+}$  is paramagnetic.
9. **Statement-1** :  $\text{Al}(\text{OH})_3$  is amphoteric in nature.  
**Statement-2** : Al–O and O–H bonds can be broken with equal ease in  $\text{Al}(\text{OH})_3$ .
10. **Statement-1** :  $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$  is soluble in water and its solution becomes milky on standing.  
**Statement-2** :  $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$  undergoes hydrolysis slowly forming  $\text{Sn}(\text{OH})_2$  and  $\text{HCl}$ .
11. **Statement-1** :  $\text{SiF}_6^{2-}$  is known but  $\text{SiCl}_6^{2-}$  is not.  
**Statement-2** : Size of fluorine is small and its lone pair of electrons interacts with d-orbitals of Si strongly.
12. **Statement-1** : Buckminster fullerene is the purest isomeric form of carbon.  
**Statement-2** : Graphite is thermodynamically most stable allotrope of carbon.
13. **Statement-1** : In the extraction of silicone, by reduction with high purity coke, the  $\text{SiO}_2$  is taken in excess.  
**Statement-2** : Excess of  $\text{SiO}_2$  prevents the formation of the carbide  $\text{SiC}$ .
14. **Statement-1** : Silicones are resistant to heat, oxidation and most chemicals.  
**Statement-2** : The silicones(a) have stable silica-like six electron owing to high bond energy of Si – O bond and (b) have high strength of Si – C
15. **Statement-1** : The borax  $\text{Na}_2[\text{B}_4\text{O}_5(\text{OH})_4] \cdot 8\text{H}_2\text{O}$  is a useful primary standard for titrating against acids.  
**Statement-2** : Aqueous solution of borax contains equal amounts of weak acid and its salt.
16. **Statement-1** : Borazine is more reactive than benzene.  
**Statement-2** : Borazine is polar while benzene is non-polar in nature.
17. **Statement-1** :  $\text{AlCl}_3$  ionises in solution.  
**Statement-2** : The hydration energy of  $\text{AlCl}_3$  exceeds the ionization energy.
18. **Statement-1** :  $\text{Tl}^{3+}$  acts as an oxidising agent  
**Statement-2** :  $\text{Tl}^+$  is more stable than  $\text{Tl}^{3+}$  due to inert pair effect.

## CHEMISTRY FOR JEE MAIN & ADVANCED

19. **Statement-1** :  $\text{PbI}_4$  is a stable compound.  
**Statement-2** :  $\text{Pb}^{2+}$  ions with concentrated solution of KI forms a soluble complex.
20. **Statement-1** : Nitrates are not wide spread in the earth's crust.  
**Statement-2** : Nitrate are all very soluble in water.
21. **Statement-1** : Among nitrogen halides  $\text{NX}_3$ , the dipole moment is highest for  $\text{NI}_3$  and lowest for  $\text{NF}_3$ .  
**Statement-2** : Nitrogen halides  $\text{NX}_3$ , have trigonal pyramidal structure.
22. **Statement-1** : Bismuth does not form a pentoxide.  
**Statement-2** : The stability of the highest oxidation states decreases on descending the group due to inert pair effect.
23. **Statement-1** : Ammonium nitrate on heating gives  $\text{N}_2\text{O}$ .  
**Statement-2** : The contaminant is NO which is removed by passing through ferrous sulphate solution.
24. **Statement-1** :  $\text{H}_3\text{PO}_3$  is a dibasic acid and shows reducing character.  
**Statement-2** :  $\text{H}_3\text{PO}_3$  contains two  $\text{OH}^-$  groups and one hydrogen atom directly attached to P atom.
25. **Statement-1** : Liquid  $\text{NH}_3$  is used for refrigeration.  
**Statement-2** : Enthalpy of vaporisation of ammonia is very large.
26. **Statement-1** :  $\text{NaH}_2\text{PO}_2$  is an acid salt.  
**Statement-2** : It contains no ionisable protons.
27. **Statement-1** : Both  $\text{H}_3\text{PO}_3$  and  $\text{H}_3\text{PO}_4$  have the same number of hydrogen atoms but  $\text{H}_3\text{PO}_4$  is a tribasic acid and  $\text{H}_3\text{PO}_3$  is a dibasic acid.  
**Statement-2** : 1 mol of  $\text{H}_3\text{PO}_3$  is neutralised by 2 mol of NaOH while 1 mol of  $\text{H}_3\text{PO}_4$  is neutralised by 3 mol of NaOH.
28. **Statement-1** :  $\text{HNO}_3$  is stronger acid than  $\text{HNO}_2$ .  
**Statement-2** : In  $\text{HNO}_3$  there are two nitrogen to oxygen bonds where as in  $\text{HNO}_2$  there is only one
29. **Statement-1** : Mobility of mercury (Hg) decreases and its starts sticking to glass when it brought in contact with ozone.  
**Statement-2** : Ozone oxidises mercury to  $\text{Hg}_2\text{O}$  which dissolves in mercury.
30. **Statement-1** : Sulphuric acid is less viscous than water due to intermolecular hydrogen bonding.  
**Statement-2** : Concentrated sulphuric acid is used as dehydrating agent.
31. **Statement-1** : In caro's acid the oxidation state of sulphur is +5.  
**Statement-2** : In caro's acid, there is one peroxolinkage. ( - O - O - )
32. **Statement-1** : Electrovalency of oxygen is two ( $\text{O}^{2-}$ )  
**Statement-2** : Dinegative anion of oxygen ( $\text{O}^{2-}$ ) is quite common but dinegative anion of sulphur ( $\text{S}^{2-}$ ) is less common.
33. **Statement-1** : At room temperature oxygen exists as a diatomic gas, where as sulphur exists as solid.  
**Statement-2** : The catenated - O - O - O - chains are less stable as compared to  $\text{O}=\text{O}$  molecule.
34. **Statement-1** : Anhydrous  $\text{BaO}_2$  is not used for preparing  $\text{H}_2\text{O}_2$ .  
**Statement-2** :  $\text{H}_2\text{O}_2$  is prepared on large scale by air oxidation of 2-Ethyl anthraquinol.

35. **Statement-1** : A pink coloured solution of acidified potassium permanganate turns green on passing  $O_3$  through it.  
**Statement-2** :  $K_2MnO_4$  is oxidised by  $O_3$  to  $KMnO_4$
36. **Statement-1** :  $H_2O_2$  is stored in wax-lined glass.  
**Statement-2** : Presence of traces of alkali metal ions in the glass catalyse the decomposition of  $H_2O_2$ .
37. **Statement-1** : Sulphur exhibits paramagnetic behaviour in vapour state.  
**Statement-2** : In vapour state sulphur partly exists as  $S_2$  molecule which has two unpaired electrons in antibonding  $\pi$  orbitals.
38. **Statement-1** : Ozone is a stronger oxidising agent in acidic medium.  
**Statement-2** :  $O_3 + 2H^+ + 2e^- \rightarrow O_2 + H_2O$  ; SRP = + 2.07V  
 $O_3 + H_2O + 2e^- \rightarrow O_2 + 2OH^-$  ; SRP = + 1.24V
39. **Statement-1** : Hydrolysis of  $NCl_3$  gives  $NH_4OH$  and  $HOCl$ , while  $PCl_3$  on hydrolysis gives  $H_3PO_3$  and  $HCl$ .  
**Statement-2** : The difference is due to the change in polarity of  $P^{\delta+}-Cl^{\delta-}$  bond in  $PCl_3$  in contrast to  $N^{\delta-}-Cl^{\delta+}$  bond in  $NCl_3$ .
40. **Statement-1** :  $Na_2HPO_3$  is not an acid salt.  
**Statement-2** :  $Na_2HPO_3$  on heating decomposes to give phosphine gas and a mixture of phosphates.
41. **Statement-1** :  $NO_2$  and  $ClO_2$  both being odd electron molecules dimerise.  
**Statement-2** : On dimerisation,  $NO_2$  is converted to stable  $N_2O_4$  molecule with even number of electrons.
42. **Statement-1** :  $H_3PO_2$  is a weak monobasic acid and is also strong reducing in nature.  
**Statement-2** : 
43. **Statement-1** : Ozone is a powerful oxidising agent in comparison to  $O_2$ .  
**Statement-2** :  $O_3$  molecule is diamagnetic but  $O_3^-$  is paramagnetic.
44. **Statement-1** : Sodium thiosulphate is not prepared by boiling  $Na_2SO_3$  with S in acidic medium.  
**Statement-2** :  $Na_2S_2O_3 + H^+ \longrightarrow 2Na^+ + H_2SO_3 + S \downarrow$  (colloidal).
45. **Statement-1** : Most of the reactions of fluorine are exothermic.  
**Statement-2** : Fluorine atom is smaller in size and forms strong bonds with other elements and has low dissociation energy of the F—F bond.
46. **Statement-1** : Halogens are more reactive than interhalogens.  
**Statement-2** : Bond in the interhalogens (X—Y) is weaker than X—X bond in the halogens.
47. **Statement-1** : Chlorine bleaches vegetable or organic substances in the presence of moisture. .  
**Statement-2** :  $Cl_2 + H_2O \longrightarrow 2HCl + [O]$ .
48. **Statement-1** : Helium and beryllium both are chemically inert.  
**Statement-2** : Helium and beryllium have similar outer electronic configuration of the type  $ns^2$ .
49. **Statement-1** : Xenon forms fluorides.  
**Statement-2** : 5 d-orbitals are available in xenon for valence shell expansion.

## CHEMISTRY FOR JEE MAIN & ADVANCED

50. **Statement-1** : Noble gases have very low boiling points.  
**Statement-2** : Noble gases being monoatomic have weak dispersion interatomic forces.
51. **Statement-1** : Chlorine and sulphur dioxide both are bleaching agents.  
**Statement-2** : The bleaching action of chlorine and sulphur dioxide is performed through the process of oxidation.
52. **Statement-1** : Fluorine is a stronger oxidising agent than chlorine because  
**Statement-2** : It has (i) low enthalpy of dissociation of F – F bond and (ii) high hydration energy.
53. **Statement-1** :  $\text{IO}_3^-$  oxidises  $\text{I}^-$  to  $\text{I}_2$  in acidic medium.  
**Statement-2** :  $\text{HIO}_3$  is formed by oxidation of  $\text{I}_2$  with concentrated  $\text{HNO}_3$ .
54. **Statement-1** : Hydrolysis of  $\text{XeF}_6$  represents a redox reaction.  
**Statement-2** : The products of hydrolysis are  $\text{XeOF}_4$  and  $\text{XeO}_3$  where the oxidation states of all the elements remain the same as it was in the reacting state.
55. **Statement-1** : Hypochlorous acid ( $\text{HClO}$ ) acts as a powerful oxidising and bleaching agent.  
**Statement-2** : Sodium hypochlorite in solution undergoes disproportionation reaction.
56. **Statement-1** : All interhalogens are paramagnetic.  
**Statement-2** : AB type of interhalogen undergoes hydrolysis giving a halide ion derived from the smaller halogen and a hypohalite ion derived from the larger halogen.
57. **Statement-1** :  $\text{HClO}_4$  is a more stronger acid than  $\text{HClO}_3$ .  
**Statement-2** : Oxidation state of Cl in  $\text{HClO}_4$  is +7 and in  $\text{HClO}_3$  is +5.
58. **Statement-1** : Fluorine is obtained by the interaction of  $\text{K}_2\text{MnF}_6$  with lewis acid  $\text{SbF}_5$ .  
**Statement-2** : Stronger lewis acid  $\text{SbF}_5$  displaces weaker acid  $\text{MnF}_4$  from  $\text{K}_2\text{MnF}_6$  and  $\text{MnF}_4$  being unstable decomposes to give  $\text{MnF}_3$  and  $\text{F}_2$ .
59. **Statement-1** : Fluorine with sodium hydroxide solution does not undergo disproportionation reaction.  
**Statement-2** : Fluorine has the highest SRP value, therefore, it is completely reduced only.
60. **Statement-1** : Xenon hexafluoride is kept in silica-lined vessel.  
**Statement-2** : Xenon hexafluoride is not kept in silica-lined vessel.
61. **Statement-1** : Argon is used in the laboratory for handling substances that are air-sensitive.  
**Statement-2** : Argon is inert towards chemical reactivity due to the completely filled valence shell electronic configuration, high ionization enthalpy and more positive electron gain enthalpy.



## Exercise # 3

## Part # I

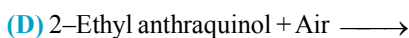
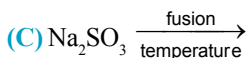
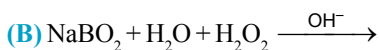
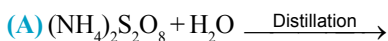
## [Matrix Match Type Questions]

1. Match the reactions listed in column-I with characteristic(s) / type of reactions listed in column-II.
- | Column-I   | Column-II           |
|--|---------------------|
| (A) $\text{BBr}_3 + \text{H}_2 \longrightarrow \text{B}$   | (p) Borax bead test |
| (B) $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10 \text{H}_2\text{O} + \text{CuSO}_4 \rightarrow \text{Cu}(\text{BO}_2)_2$ | (q) Reduction       |
| (C) $\text{AlCl}_3 + \text{H}_2\text{O} \longrightarrow \text{HCl}$  | (r) White fumes     |
| (D) $\text{Cr}_2\text{O}_3 + \text{Al} \longrightarrow \text{Cr}$  | (s) Hydrolysis      |
2. Match the reactions listed in column-I with characteristic(s) / type of reactions listed in column-II.
- | Column-I   | Column-II  |
|--|--|
| (A) $\text{Al}_2(\text{C}_2)_3 + \text{H}_2\text{O} \longrightarrow$                   | (p) One of the products contains both $\sigma$ and $\pi$ bonds |
| (B) $\text{CH}_2(\text{COOH})_2 + \text{P}_4\text{O}_{10} \longrightarrow$             | (q) Hydrolysis   |
| (C) $\text{CH}_3\text{SiCl}_3 + \text{H}_2\text{O} \longrightarrow$                    | (r) Dehydration  |
| (D) $\text{SnCl}_2 \cdot 2\text{H}_2\text{O} \xrightarrow[\text{standing}]{\text{on}}$ | (s) complex crosslinked polymer                                |
3. Match the reactions listed in column-I with the product(s) listed in column-II.
- | Column-I  | Column-II                   |
|---|-----------------------------|
| (A) $\text{B}_2\text{O}_3 + \text{H}_2\text{O}$           | (p) $\text{H}_3\text{BO}_3$ |
| (B) $\text{B}_2\text{H}_6 + \text{H}_2\text{O}$           | (q) $\text{H}_2$            |
| (C) $\text{B}_3\text{N}_3\text{H}_6 + \text{H}_2\text{O}$ | (r) $\text{HCl}$            |
| (D) $\text{BCl}_3 + \text{H}_2\text{O}$                   | (s) $\text{NH}_3$           |
|   | (t) $\text{N}_2$            |
4. Match the type of silicates listed in column-I with characteristic(s) listed in column-II.
- | Column-I                              | Column-II  |
|---------------------------------------|--|
| (A) Cyclic silicates                  | (p) Tetrahedral hybridisation.                   |
| (B) Single chain silicates            | (q) Si-O bonds are 50% ionic and 50% covalent.   |
| (C) Pyro silicates                    | (r) General formula is $(\text{SiO}_3)_n^{2n-}$  |
| (D) Sheet silicates (two dimensional) | (s) Two oxygen atoms per tetrahedron are shared. |
5. Match the materials listed in column-I with type of silicates listed in column-II.
- | Column-I         | Column-II                              |
|------------------|--|
| (A) Spondumene   | (p) Two dimensional sheet silicates    |
| (B) Thortveitite | (q) Pyrosilicates                      |
| (C) Kaolin       | (r) Chain silicates                    |
| (D) Quartz       | (s) Three dimensional sheet silicates. |
6. Match the reactions listed in column-I with characteristic(s) / type of reactions listed in column-II.
- | Column-I  | Column-II  |
|---|--|
| (A) $\text{PCl}_5 \xrightarrow[\text{Air}]{\text{Moist}}$                                   | (p) Hydrolysis   |
| (B) $\text{P}_4 + \text{NaOH}(\text{conc.}) + \text{H}_2\text{O} \xrightarrow{\text{Warm}}$ | (q) At least one of the products has tetrahedral hybridisation |
| (C) $\text{H}_3\text{PO}_3 \xrightarrow{\Delta}$  | (r) Disproportionation   |
| (D) $\text{P}_4\text{O}_6 + \text{H}_2\text{O} \xrightarrow{\Delta}$                        | (s) At least one of the products has $p\pi-d\pi$ bonding.      |

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7. Match the reactions listed in column-I with characteristic(s) / type of reactions listed in column-II.

**Column – I**



**Column – II**

(p) Hydrolysis

(q) One of the product has peroxide linkage

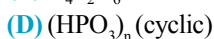
(r) Disproportionation.

(s) In one of the products the central atom has  $sp^3$  hybridisation.

8. Match the oxy-acids of phosphorus listed in column-I with type of bond(s) listed in column-II.

**Column I**

(Oxy acids of phosphorus)



**Column II**

(Characteristic bonds)

(p) P—P bond (s)

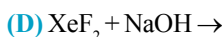
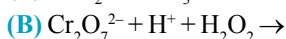
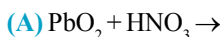
(q) P—O—P bond (s)

(r) P—H bond (s)

(s) Three or four P—OH bonds

9. Match the reactions listed in column-I with characteristic(s) listed in column-II.

**Column I**



**Column II**

(p) One of the products has bond order of two.

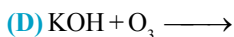
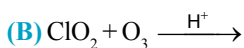
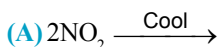
(q) One of the products has peroxide linkage(s).

(r) One of the products is a hydride and is liquid at room temperature.

(s) One of the products has bent shape with two lone pairs of electrons on central atom.

10. Match the reactions listed in column-I with characteristic(s) listed in column-II.

**Column I**



**Column II**

(p) One of the products is a mixed anhydride.

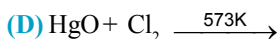
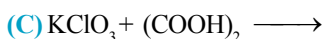
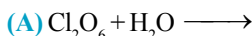
(q) One of the products is an acidic oxide.

(r) The oxidation state of the central atom of one of the products is + 6.

(s) One of the products is a colourless paramagnetic gas.

11. Match the reactions listed in column-I with the product(s) listed in column-II.

**Column - I**



**Column - II**

(p)  $\text{ClO}_2$

(q)  $\text{HClO}_3$

(r)  $\text{Cl}_2\text{O}$

(s)  $\text{HClO}_4$

12. Match the reaction products listed in column-I with the particulars listed in column-II
- | Column-I  | Column-II                  |
|---|----------------------------|
| (A) $\text{XeF}_2 + \text{H}_2\text{O} \longrightarrow$ | (p) Redox reaction         |
| (B) $\text{XeF}_4 + \text{H}_2\text{O} \longrightarrow$ | (q) Disproportionation     |
| (C) $\text{XeF}_6 + \text{H}_2\text{O} \longrightarrow$ | (r) $\text{O}_2$ formation |
| (D) $\text{XeO}_3 + \text{NaOH} \longrightarrow$        | (s) Xe formation           |
|   | (t) Etching glass          |
13. Match the compounds listed in column-I with characteristic(s)/type of reactions listed in column-II.
- | Column I               | Column II                                     |
|------------------------|---|
| (A) Bromine ( $\ell$ ) | (p) Oxidising agent                           |
| (B) Ozone              | (q) Non-polar (i.e. $\mu = 0$ )               |
| (C) $\text{XeF}_2$     | (r) Liberates iodine from the halide ion.     |
| (D) $\text{SO}_3$      | (s) Undergoes disproportionation with alkali. |
14. Match the reactions listed in column-I with characteristic(s)/type of reactions listed in column-II.
- | Column I  | Column II  |
|---|--|
| (A) $\text{Na}_2\text{CO}_3(\text{aq}) + \text{Br}_2(\ell) \rightarrow$ | (p) Disproportionation reaction  |
| (B) $\text{KClO}_3 + \text{H}_2\text{SO}_4(\text{conc.}) \rightarrow$   | (q) One of the products is a paramagnetic gas.                                     |
| (C) $[\text{HXeO}_4]^- + \text{OH}^- \rightarrow$                       | (r) In one of the products, the central atom has oxidation state greater than + 6. |
| (D) $\text{P}_4 + \text{NaOH} + \text{H}_2\text{O} \rightarrow$         | (s) One of the products is used in Holme's signal.                                 |
15. Match the reactions listed in column-I with characteristic(s) listed in column-II.
- | Column I  | Column - II   |
|---|---|
| (A) $\text{XeF}_6 + \text{SiO}_2 \longrightarrow$                                       | (p) One of the products has square pyramidal shape.                 |
| (B) $\text{P}_4(\text{white}) + \text{SO}_2\text{Cl}_2 \longrightarrow$                 | (q) One of the products has tetrahedral hybridisation               |
| (C) $\text{H}_2\text{SO}_4 + \text{P}_2\text{O}_5 \longrightarrow$                      | (r) In one of the products there is $p\pi - d\pi$ type overlapping. |
| (D) $\text{XeF}_6 + \text{H}_2\text{O} \xrightarrow[\text{Hydrolysis}]{\text{Partial}}$ | (s) One of the products has zero dipole moment.                     |
16. Match the compounds listed in column-I with characteristic(s) / type of reaction(s) listed in column-II.
- | Column I           | Column-II  |
|--------------------|--|
| (A) $\text{XeF}_2$ | (p) Undergoes hydrolysis with water.   |
| (B) $\text{XeF}_4$ | (q) Acts as oxidising agent.   |
| (C) $\text{XeF}_6$ | (r) Undergoes addition reaction.   |
| (D) $\text{XeO}_3$ | (s) Has lone pair(s) of electrons.   |
|                    | (t) Gives disproportionation reaction with $\text{H}_2\text{O}$ or $\text{OH}^-$ . |

## Comprehension # 1

Compound (A) on reaction with iodine in the solvent diglyme gives a hydride (B) and hydrogen gas. The product (B) is instantly hydrolysed by water or aqueous alkali forming compound (C) and liberating hydrogen gas. The compound (C) in aqueous solution behaves as a weak mono basic acid. But in presence of certain organic polyhydroxy compound behaves as a strong monobasic acid. The hydride (B) in air catches fire spontaneously forming oxide which gives coloured beads with transition metal compounds.

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- Which of the following statement is correct for the product (C) ?  
(A) It is an odd electron molecule. (B) It in water acts as proton donor.  
(C) It in solid state have hydrogen bonding. (D) It is a useful primary standard for titrating against acids.
- Aqueous solution of product (C) can be titrated against sodium hydroxide using phenolphthalein indicator only in presence of :  
(A) cis-1, 2 diol (B) trans-1, 2 diol (C) borax (D)  $\text{Na}_2\text{HPO}_4$
- Which of the following statement is correct for hydride (B) ?  
(A) One mole of it react with two moles of HCl.  
(B) It reacts with excess of ammonia at low temperature to form an ionic compound.  
(C) One mole of it reacts with one mole of trimethylamine.  
(D) It reacts with methyl alcohol to form a trimethyl compound liberating oxygen gas.

### Comprehension # 2

The term carbide is generally applied to compounds in which carbon is bonded to the elements of lower or approximately same electronegativity. This definition excludes the compounds in which oxygen, sulphur, phosphorus, nitrogen and halogens are united with carbon. Reactive metals (i.e., of group 1 and 2) form ionic carbides. They hydrolyse to liberate hydrocarbons. Most of them resembles with NaCl in crystal structure. Transition metals forms interstitial carbides.

- Consider the following carbides :  

$\text{CaC}_2$	$\text{Be}_2\text{C}$	$\text{MgC}_2$	$\text{SrC}_2$
I	II	III	IV

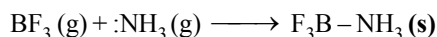
Select the carbide which gives different product on hydrolysis, than other carbides :  
(A) I (B) II (C) III (D) IV
- What is the co-ordination number of  $\text{Ca}^{2+}$  in solid  $\text{CaC}_2$  ?  
(A) 4 (B) 6 (C) 8 (D) 12
- Select the methanides from compounds give below :  

$\text{Al}_4\text{C}_3$	$\text{Be}_2\text{C}$	$\text{MgC}_2$	$\text{CaC}_2$
I	II	III	IV

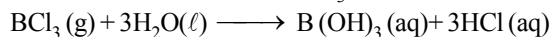
(A) I only (B) I & IV (C) I & II (D) I, II, III & IV
- The conductance of transition metal is not much affected when it forms interstitial carbide because :  
(A) The carbide anion helps in conduction.  
(B) The carbon atoms occupy octahedral holes and so does not affect electrical conductivity.  
(C) The carbon atoms react with metal and liberate electrons.  
(D) The conduction is due to holes.

### Comprehension # 3

All the boron trihalides except  $\text{BI}_3$  may be prepared by direct reaction between the elements. Boron trihalides consist of trigonal - planar  $\text{BX}_3$  molecules. Unlike the halides of the other elements in the group they are monomeric in the gas, liquid and solid states,  $\text{BF}_3$  and  $\text{BCl}_3$  are gases,  $\text{BBr}_3$  is a volatile liquid and  $\text{BI}_3$  is a solid. Boron trihalides are Lewis acids because they form simple Lewis complexes with suitable bases, as in the reaction :



However, boron chlorides, bromides and iodides are susceptible (sensitive) to protolysis by mild proton sources such as water, alcohols and even amines; for example  $\text{BCl}_3$  undergoes rapid hydrolysis:



It is supposed that the first step in the above reaction is the formation of the complex  $\text{Cl}_3\text{B} \leftarrow \text{OH}_2$  which then eliminates HCl and reacts further with water.

- Which of the following is the best order of Lewis acid strength of  $\text{BF}_3$ ,  $\text{BCl}_3$  and  $\text{BBr}_3$  ?
  - $\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3$
  - $\text{BF}_3 = \text{BCl}_3 = \text{BBr}_3$
  - $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3$
  - $\text{BBr}_3 > \text{BF}_3 > \text{BCl}_3$
- Which of the following is the correct prediction about observed B–X bond length, in  $\text{BX}_3$  molecules ?
  - B–F bond length in  $\text{BF}_3$  is found to be less than theoretical value because the electronegativity values of B(2.04) and F(4.0) suggest the bond to be ionic and hence the attraction between oppositely charged ions must decrease the bond length
  - $\text{BF}_3$  and  $[\text{BF}_4]^-$  have equal B–F bond length
  - The decrease in the B–F bond length in  $\text{BF}_3$  is due to delocalised  $p_\pi - p_\pi$  bonding between vacant '2p' orbital of B and filled '2p' orbital of F.
  - The correct B–X bond length order is  $\text{B–F} > \text{B–Cl} > \text{B–Br} > \text{B–I}$
- Which is correct about the hydrolysis of  $\text{BX}_3$  ?
  - All  $\text{BX}_3$  undergo hydrolysis to produce  $\text{B}(\text{OH})_3$  (aq) and  $\text{HX}$ (aq).
  - $\text{BF}_3$  does not undergo complete hydrolysis due to formation of  $\text{HBF}_4$ .
  - $\text{BBr}_3$  does not undergo hydrolysis at all because it cannot form H–bonds with water.
  - All the above are correct
- Which of the following reactions is incorrect ?
  - $\text{BF}_3(\text{g}) + \text{F}^-(\text{aq}) \longrightarrow [\text{BF}_4]^- (\text{aq})$
  - $\text{BCl}_3(\text{g}) + 3\text{EtOH}(\ell) \longrightarrow \text{B}(\text{OEt})_3(\ell) + 3\text{HCl}(\text{g})$
  - $\text{BBr}_3(\ell) + \text{F}_3\text{BN}(\text{CH}_3)_3(\text{s}) \longrightarrow \text{BF}_3(\text{g}) + \text{Br}_3\text{BN}(\text{CH}_3)_3(\text{s})$
  - $\text{BCl}_3(\text{g}) + 2 \text{C}_5\text{H}_5\text{N}(\ell) \longrightarrow \text{Cl}_3\text{B}(\text{C}_5\text{H}_5\text{N})_2(\text{s})$   
(excess)

### Comprehension # 4

The highest oxidation state of p–block element is equal to the group number minus 10. Moving down the group, the oxidation state two less than the highest group oxidation state becomes more stable in groups 13 to 16 due to inert pair effect.

- Which of the following statement is incorrect ?
  - $\text{PbI}_4$  does not exist.
  - Boron shows only +3 oxidation state.
  - $\text{TlCl}_3$  does not undergo disproportionation reaction.
  - In thallium +3 oxidation state is more stable than +1.
- The strongest reducing agent among the following is :
 

(A) Ge (II) chloride	(B) Sn (II) chloride	(C) Pb (II) chloride	(D) None
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- The strongest oxidising agent among the following is :
 

(A) Pb (IV) oxide	(B) Si (II) oxide	(C) Sn (II) oxide	(D) Ge (II) oxide
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Comprehension # 5

The small size and high charge of  $\text{Al}^{3+}$  ion gives it a high charge density which is responsible for its tendency to show (a) covalency in its compounds in the gaseous state (b) high hydration energy which stabilizes its compounds in solution, and (c) high lattice energy of its compounds in the solid state. Thus aluminium can form both covalent and ionic bond.

Like halides of boron, halides of aluminium do not show back bonding because of increase in size of aluminium. Actually aluminium atoms complete their octets by forming dimers. Thus chloride and bromide of aluminium exist as dimers, both in the vapour state and in polar-solvents like benzene while the corresponding boron halides exist as monomer. In boron trihalides the extent of back bonding decreases with increase in size of halogens and thus Lewis acid character increases. All  $\text{BX}_3$  are hydrolysed by water but  $\text{BF}_3$  shows a different behaviour.

- The dimeric structure of aluminium chloride disappears when :  
 (A) it dissolves in water (B) it reacts with donor molecules like  $\text{R}_3\text{N}$   
 (C) it dissolves in benzene (D) (A) & (B) both
- Which one of the following statements is correct ?  
 (A) All boron trihalides are hydrolysed to boric acid.  
 (B) Anhydrous aluminium chloride is an ionic compound  
 (C) Aluminium halides make up the electron deficiency by bridging with halide or alkyl groups  
 (D) None of these
- Which of the following statements about anhydrous aluminium chloride is correct?  
 (A) It is an ionic compound. (B) It is not easily hydrolysed.  
 (C) It sublimes at  $100^\circ\text{C}$  under vacuum. (D) It is a strong Lewis base.
- Which of the following reaction is incorrect ?  
 (A)  $\text{BF}_3(\text{g}) + \text{F}^-(\text{aq}) \longrightarrow \text{BF}_4^-$   
 (B)  $\text{BF}_3(\text{g}) + 2\text{H}_2\text{O} \longrightarrow [\text{BF}_3\text{OH}]^- + \text{H}_3\text{O}^+$   
 (C)  $\text{BCl}_3(\text{g}) + 3\text{EtOH}(\ell) \longrightarrow \text{B}(\text{OEt})_3(\ell) + 3\text{HCl}$   
 (D)  $\text{BCl}_3(\text{g}) + 2\text{C}_5\text{H}_5\text{N}(\ell) \longrightarrow \text{Cl}_3\text{B}(\text{C}_5\text{H}_5\text{N})_2(\text{s})$

Comprehension # 6

An inorganic iodide (A) on heating with a solution of KOH gives a gas (B) and a solution of a compound. The gas (B) on ignition in air gives a compound (C) and water. Copper sulphate is finally reduced to the metal on passing (B) through its solution.

- Select the correct statement from the following for the gas (B).  
 (A) Its solution in water does not decompose in presence of light.  
 (B) It can be prepared by the alkaline hydrolysis of white phosphorus.  
 (C) It is non-inflammable owing to the presence of  $\text{P}_2\text{H}_4$ .  
 (D) It can act as oxidising agent.
- The compound (C) :  
 (A) has  $\text{sp}^3$  hybridisation of central atom(s) (B) has sixteen sigma bonds.  
 (C) is used as a dehydrating agent (D) all of these

3. What is true about gas (B) and compound (C) ?
- (A) The oxidation number of central atom of gas (B) is + IV
- (B) The gas (B) produces a black precipitate of metallic silver with silver nitrate solution.
- (C) Compound (C) dissolves in water forming an acid which with sodium hydroxide forms three series of salts.
- (D) (B) and (C) both

### Comprehension # 7

Nitrogen forms the largest number of oxides as it is capable of forming stable multiple bonds with oxygen. They range from  $N_2O$  (O.S of nitrogen +1) through  $NO$ ,  $N_2O_3$ ,  $NO_2$ ,  $N_2O_4$  to  $N_2O_5$  (O.S of nitrogen +5). Following points are important regarding the study of oxides of nitrogen.

- (a) All oxides of nitrogen except  $N_2O_5$  are endothermic as a large amount of energy is required to dissociate the stable molecule of oxygen and nitrogen.
- (b) The small electronegativity difference between oxygen and nitrogen make N–O bond easily breakable to give oxygen and hence oxides of nitrogen are said to be better oxidising agents.
- (c) Except  $N_2O_5$ , all are gases at ordinary temperature.  $N_2O_3$  is stable only at lower temperature (253 K).
- (d) Except  $N_2O$  and  $NO$  which are neutral oxides, all are acidic oxides which dissolve in water forming corresponding oxy acids.
- (e) They are also good example for illustrating the concept of resonance.
1. The gas which is acidic in nature is :
- (A)  $NO$                       (B)  $N_2O$                       (C)  $NO_2$                       (D) both (A) and (C)

2. Which of the following statements is correct for the oxides of nitrogen ?
- (A) Dinitrogen trioxide dissolves in potassium hydroxide forming potassium nitrate.
- (B) Aqueous solution of nitrogen dioxide behaves both as a reducing agent and as an oxidising agent.
- (C) Nitrous oxide is fairly soluble in cold water and turns blue litmus red.
- (D) Nitrogen dioxide is not acidic oxide.

### Comprehension # 8

The property of hydrides of p–block elements mostly depends on :

- (i) electronegativity difference between central atom and hydrogen
- (ii) size of central atom
- (iii) number of valence electrons in central atom

Some undergo hydrolysis in which central atom is less electronegative, react with  $OH^-$  to give hydrogen. While acidic property of hydride in a period depends on electronegativity of central atoms, i.e. more electronegative is the atom, more acidic is hydride. In a group, acidic property is proportional to size of central atom. Some electron deficient hydride behaves as Lewis acid while only one hydride of an element in p–block behaves as Lewis base with lone pair of electrons. Hydrides in which central atom's electronegativity is close to hydrogen has no reaction with water.

1. Which one is the weakest acid among the following ?
- (A)  $HF$                       (B)  $HCl$                       (C)  $HBr$                       (D)  $HI$
2. Which hydride has no reaction with water ?
- (A)  $NH_3$                       (B)  $CH_4$                       (C)  $PH_3$                       (D)  $NaH$
3. Which one is strongest base ?
- (A)  $OH^-$                       (B)  $HS^-$                       (C)  $HSe^-$                       (D)  $HTe^-$

Comprehension # 9

Oxygen differs from the other elements of the group. Compounds of oxygen with metals are more ionic in nature and hydrogen bonding is more important for oxygen compounds. Oxygen is never more than divalent because when it has formed two covalent bonds, there are no low energy orbitals which can be used to form further bonds. However, the elements S, Se, Te and Po have empty d-orbitals which may be used for bonding, and they can form four or six bonds by unpairing electrons. The higher oxidation states become less stable on descending the group.

The bond between S and O, or Se and O, are much shorter than might be expected for a single bond owing to  $p\pi - d\pi$  interaction between the p-orbital of oxygen and d-orbital of S or Se.

- Which of the following statement is incorrect ?
  - (A) Oxo-anions of sulphur have little tendency to polymerise compared with the phosphates and silicates.
  - (B) In pyrosulphurous acid ( $H_2S_2O_5$ ), the oxidation states of both the sulphur atoms are not same, they are +V and +III
  - (C) Concentrated  $HNO_3$  oxidises both sulphur and selenium to  $H_2SO_4$  (+VI) and  $H_2SeO_4$  (+VI) respectively.
  - (D) Most metal oxides are ionic and basic in nature while non-metallic oxides are usually covalent and acidic in nature.
- Which one of the following orders represents the correct order for the properties indicated against them ?
  - (A)  $H_2O < H_2S < H_2Se < H_2Te$  – acidic character
  - (B)  $H_2O < H_2S < H_2Se < H_2Te$  – thermal stability
  - (C)  $H_2S > H_2Se < H_2Te < H_2O$  – reducing character
  - (D)  $H_2S < H_2Se < H_2O < H_2Te$  – boiling point

Comprehension # 10

An orange solid (A) on heating gives a green residue (B), a colourless gas (C) and water vapours. The dry gas (C) on passing over heated Mg gave a white solid (D). (D) on reaction with water gave a gas (E) which formed black precipitate with mercurous nitrate solution.

- Select the incorrect statement.
  - (A) The central atom (s) of the anion of solid (A) has  $sp^3$  hybridisation.
  - (B) The orange solid (A) is diamagnetic in nature.
  - (C) The anion of orange solid (A) is oxidising in nature.
  - (D) None
- Which of the following is true for the gas (E) ?
  - (A) It gives a deep blue colouration with  $CuSO_4$  solution.
  - (B) It is oxidised to a colourless gas (neutral oxide) at 1200 K in presence of a catalyst Pt/Rh in air.
  - (C) It gives the same gas (C) with potassium permanganate solution.
  - (D) All of these.
- The green residue (B) is :
  - (A) amphoteric in nature.
  - (B) used as green pigment.
  - (C) used in fire crackers to impart the red colour.
  - (D) (A) and (B) both.

Comprehension # 11

Fifth group elements form hydrides of type  $AH_3$ . The hydrides have a lone pair of electrons. The hydrides are reducing in nature and the reducing power is related to the stability of A – H bonds. The hydrides are covalent and low boiling. Their boiling points depends on their ability to form hydrogen bond and their molecular size which decide the intermolecular forces in the hydrides.



- The H – M – H bond angle of V group hydrides decrease from  $107^\circ$  to  $90^\circ$  for  $\text{NH}_3$  to  $\text{SbH}_3$ ; this is due to :
  - increase in strength of bases with molecular weight
  - use of pure p-orbital for M – H bonding in hydrides of higher molecular weight
  - bond energies of M – H bonds increase
  - bond pairs of electrons go closer to central atom
- Reducing power of V-group hydrides are in order :
 

(A) $\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3 > \text{BiH}_3$	(B) $\text{BiH}_3 > \text{SbH}_3 > \text{AsH}_3 > \text{PH}_3 > \text{NH}_3$
(C) $\text{PH}_3 > \text{NH}_3 > \text{AsH}_3 > \text{SbH}_3 > \text{BiH}_3$	(D) $\text{BiH}_3 > \text{SbH}_3 > \text{AsH}_3 > \text{NH}_3 > \text{PH}_3$
- The boiling points of the hydrides of V-group elements are in the order :
 

(A) $\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3$	(B) $\text{NH}_3 > \text{AsH}_3 > \text{SbH}_3 > \text{PH}_3$
(C) $\text{SbH}_3 > \text{NH}_3 > \text{AsH}_3 > \text{PH}_3$	(D) $\text{AsH}_3 > \text{SbH}_3 > \text{NH}_3 > \text{PH}_3$

### Comprehension # 12

Ozone is an unstable, dark blue diamagnetic gas. It absorbs strongly the UV radiation, thus protecting the people on the earth from the harmful UV radiation from the sun. The use of chlorofluorocarbon (CFC) in aerosols and refrigerators, and their subsequent escape into the atmosphere, is blamed for making holes in the ozone layer over the Antarctic, and Arctic.

Ozone acts as a strong oxidising agent in acidic and alkaline medium. For this property ozone is used as a germicide and disinfectant for sterilising water and improving the atmosphere of crowded places.

- CFC damages ozone layer by reactions :
 

(A) $\text{O}_3 + h\nu \rightarrow \text{O} + \text{O}_2$	(B) $\text{Cl} + \text{O}_3 \rightarrow \text{ClO} + \text{O}_2$	(C) $\text{ClO} + \text{O} \rightarrow \text{Cl} + \text{O}_2$	(D) all of the above
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- Identify the incorrect statement with respect to ozone.
  - Ozone is formed in the upper atmosphere by a photochemical reaction involving dioxygen.
  - Ozone protects the earth's inhabitants by absorbing UV radiations.
  - Ozone can also be made by heating  $\text{O}_2$  over  $2500^\circ\text{C}$  and quenching
  - Chloride gas is preferred over ozone for the purification of drinking water and for water treatment in swimming pools.
- Which of the following statement is correct ?
  - The dark blue colour of ozone is due to intense absorption of green light.
  - Oxides of nitrogen and the halogen cannot damage the  $\text{O}_3$  layer.
  - Ozone oxidises dry iodine to  $\text{I}_2\text{O}_5$ .
  - Ozone forms orange coloured compound  $\text{KO}_3$  with potassium hydroxide.

### Comprehension # 13

A red liquid (A) when treated with sodium carbonate gives a mixture of two salts (B) and (C) in the solution. The mixture then on acidification with sulphuric acid and distillation produces the red liquid (A) again.

- Select the correct statement for the liquid (A).
  - It acts as an oxidising agent,
  - It is sparingly soluble in water
  - It converts the yellow-dye stuff fluorescein (I) into red colour compound
  - All of these

## CHEMISTRY FOR JEE MAIN & ADVANCED

2. Which of the following statement is false for salt **(B)** ?
- (A) Its solution in water gives pale yellow precipitate with silver nitrate solution
  - (B) Its solution in water gives white precipitate with lead nitrate solution
  - (C) Its acidified solution (with conc.  $\text{H}_2\text{SO}_4$ ) liberates a coloured gas which produces orange red spots on starch paper
  - (D) None
3. Which of the following statement is correct ?
- (A) Liquid **(A)** undergoes disproportionation reaction in aqueous solution of sodium carbonate
  - (B) The anion of compound **(C)** has  $\text{sp}^3$  hybridisation and is trigonal pyramidal in shape
  - (C) **(A)** and **(B)** both
  - (D) None of these

### Comprehension # 14

White crystalline solid **(A)** reacts with  $\text{H}_2$  to form a highly associated liquid **(B)** and a monoatomic, colorless gas **(C)**. The liquid **(B)** is used for etching glass. Compound **(A)** undergoes hydrolysis slowly to form **(C)**, **(B)** and a diatomic gas **(D)** whose IE is almost similar to that of **(C)**. **(B)** forms an addition compound with  $\text{KF}$  to form **(E)** which is electrolysed in the molten state to form a most reactive gas **(F)** which combines with **(C)** in 2:1 ratio to produce **(A)**.

1. According to Molecular Orbital Theory, which of the following is correct about the molecule **D** ?
- (A) its bond order is 2.0
  - (B) it has two unpaired electrons in  $\pi$ -bonding M.O.
  - (C) both the above are correct
  - (D) none of these is correct
2. Which of the following is correct for the white crystalline solid **(A)** ?
- (A) It oxidises  $\text{F}^-$  to  $\text{F}_2$
  - (B) It on hydrolysis with alkali under goes disproportionation.
  - (C) It is obtained by the reaction of **(C)** with  $\text{O}_2\text{F}_2$  at  $118^\circ\text{C}$ .
  - (D) None of these.
3. The compound 'A' reacts with sulphur to form a compound in which hybridisation state of sulphur atom is
- (A)  $\text{sp}^3\text{d}$
  - (B)  $\text{sp}^3\text{d}^2$
  - (C)  $\text{sp}^3$
  - (D)  $\text{sp}^3\text{d}^3$

### Comprehension # 15

Read the following comprehension carefully and answer the following questions.

All the noble gases are colourless and tasteless monoatomic gases. In general, noble gases are least reactive and their inertness to chemical reactivity is attributed to the following reasons.

- (i) Except helium, all have completely filled  $\text{ns}^2\text{np}^6$  electronic configuration in their valence shells.
- (ii) All have high ionisation enthalpy and more positive electron gain enthalpy.

However, a number of xenon compounds mainly with most electronegative elements like fluorine and oxygen have been synthesized under different conditions and fluorides of xenon have been used as an oxidising agent and a fluorinating agent in many of the chemical reactions.

1. Noble gases have very low melting and boiling points because,
- (A) they have high ionisation enthalpy.
  - (B) they have more positive electron gain enthalpy.
  - (C) the type of interatomic interaction is weak metallic bonds.
  - (D) the type of interatomic interaction is weak dispersion forces.

2. The correct order of the abundance of various noble gases in air is :
- (A) He > Ar > Kr > Ne > Xe                      (B) Ar > Ne > Kr > He > Xe  
(C) Ar > He > Ne > Kr > Xe                      (D) Ar > Xe > He > Ne > Kr.
3. Select the correct statement.
- (A) Neon does not form clathrate compound with para-quinol.  
(B) Noble gases are sparingly soluble in water.  
(C) Helium is a non-inflammable and light gas, therefore, it is used in filling balloons for meteorological observations.  
(D) All of these.
4. Identify the incorrect statement with respect to  $\text{XeF}_2$ .
- (A) It is a colourless crystalline compound which sublimates at 298 K.  
(B)  $\text{BrO}_3^-$  being good oxidising agent cannot be oxidised by  $\text{XeF}_2$  to  $\text{BrO}_4^-$ .  
(C) It undergoes hydrolysis more rapidly with alkali in comparison to water.  
(D)  $\text{XeF}_2$  can be prepared by heating Xenon with  $\text{O}_2\text{F}_2$  at 118°C.

## Exercise # 4

## [Subjective Type Questions]

- How will you obtain ?
  - Sodium peroxo borate from borax (in two steps only)
  - Borazole from sodium borohydride (in three steps only)
  - Borax from Boron (in two steps)
- A certain salt x, gives the following results.
  - Its aqueous solution is alkaline to litmus.
  - It swells up to a glassy material Y on strong heating.
  - When concentrated  $\text{H}_2\text{SO}_4$  is added to a hot solution of X, white crystal of an acid Z separates out.

Write equations for all the above reactions and identify X, Y, and Z.
- What happens when :
  - Borax is heated strongly.
  - Aluminium is heated with caustic soda solution.
  - A mixture of borax and cobalt oxide is heated in a flame.
  - Water is added to aluminium nitride.
  - Aluminium reacts with  $\text{HNO}_3$ .
- Give reason for the following :  
Although aluminium is above hydrogen in the electrochemical series, it is stable in air and water.
- Identify **A** and **B** in the following reactions :
 
$$\text{Colemanite} + (\mathbf{A}) \longrightarrow \text{Na}_2\text{B}_4\text{O}_7$$

$$\text{Na}_2\text{B}_4\text{O}_7 + (\mathbf{B}) \longrightarrow \text{H}_3\text{BO}_3$$
- A white precipitate (**B**) is formed when a mineral (**A**) is boiled with  $\text{Na}_2\text{CO}_3$  solution.
  - The precipitate is filtered and filtrate contains two compounds (**C**) and (**D**). The compound (**C**) is removed by crystallisation and when  $\text{CO}_2$  is passed through the mother liquor left (**D**) changes to (**C**).
  - The compound (**C**) on strong heating gives two compounds (**D**) and (**E**).
  - (**E**) on heating with cobalt oxide produces blue coloured substances (**F**).

Identify (**A**) to (**F**) and gives chemical equations for the reactions at steps (i) to (iv).

7. Explain the following with relevant reason.
- (i) Aluminium metal is frequently used as reducing agent for the extraction of metals such as Cr, Mn, Fe, etc.
  - (ii) Why boron does not form  $B^{3+}$  ion ?
8. Why does not silicon form an analogue of graphite?
9. Dilute HCl is preferred over dilute  $H_2SO_4$  for the preparation of  $CO_2$  from lime stone. Explain.
10. How carbonates and bicarbonates can be differentiated from one another ?
11. Complete the following reaction :  $C + HNO_3(\text{conc.}) \longrightarrow$
12. Like CO why its analogue of SiO is not stable ?
13. What is the importance of ultra pure elemental silicon ? How is it obtained ?
14. Give reactions to show that  $CO_2$  is an acidic oxide and  $SnO_2$  is an amphoteric oxide.
15. To which category do the following carbides belong ?
- (i) SiC
  - (ii) VC
  - (iii) WC
  - (iv)  $Al_4C_3$
16. What are silicates ? How are they classified ?
17. What are silicones ? How are they manufactured ?
18. Why  $PbO$ , is not completely dissolved in HCl and  $H_2SO_4$  but dissolves in  $HNO_3$  ?
19. Write balanced equations for the following reactions :
- (A) SnO is treated with dilute  $HNO_3$
  - (B) Tin is treated with an excess of chlorine gas.
  - (C) Lead sulphide is heated in air.
20. Write down hydrolysis of :
- (i) alkyl substituted chlorosilane
  - (ii) trialkyl chlorosilane
21. What happens when,
- (a) Mixture of  $R_2-SiCl_2$  and  $R_3-SiCl$  is subjected to hydrolysis.
  - (b) Malonic acid is heated in presence of  $P_4O_{10}$ .
  - (c) Tin (IV) Chloride is exposed to moist air.

## CHEMISTRY FOR JEE MAIN & ADVANCED

22. An aqueous solution of borax is alkaline. Explain ?
23. Borazine or borazole is more reactive than benzene. Explain ?
24. How many types of bonds are present in  $B_2H_6$  ?
25. Why it is difficult to produce crystalline boron ?
26. What happens when  $NaOH$  (aq) is added drop wise to a solution of  $GaCl_3$  in water ?
27. A certain salt (X) gives the following tests :
- (i) Its aqueous solution is alkaline to litmus.
  - (ii) On strongly heating it swells to give glassy material.
  - (iii) When concentrated  $H_2SO_4$  is added to hot concentrated solution of (X), white crystals of a weak acid separate out. Identify (X) and write down the chemical equations for reaction at steps (i), (ii), (iii)
28. An inorganic Lewis acid (X) shows the following reactions :
- (i) It fumes in moist air. (ii) The intensity of fumes increases when a rod dipped in  $NH_4OH$  is brought near it.
  - (iii) An acidic solution of (X) on addition of  $NH_4Cl$  and  $NH_4OH$  gives a precipitate which dissolves in  $NaOH$  solution. (iv) An acidic solution of (X) does not give precipitate with  $H_2S$ . Identify (X) and give chemical equations for reactions at steps (i) to (iii).
29. Write balanced equation for
- (i)  $BF_3 + LiH \rightarrow$
  - (ii)  $B_2H_6 + H_2O \rightarrow$
  - (iii)  $NaH + B_2H_6 \rightarrow$
  - (iv)  $Al + NaOH \rightarrow$
  - (v)  $B_2H_6 + NH_3 \rightarrow$  (Low temp and  $200^\circ C$  in 1 : 2 ratio)
30. Complete the following reactions :
- (i)  $K_4 [Fe(CN)_6] + H_2SO_4 + H_2O \longrightarrow$
  - (ii)  $CS_2 + NO \longrightarrow$
  - (iii)  $Pb_3O_4 + HNO_3 \longrightarrow$
  - (iv)  $CaF_2 + SiO_2 + H_2SO_4 \longrightarrow$
  - (v)  $Pb^{+2} + H_2S + 2Cl^-$  (from saturated salt. of  $KCl$ )  $\longrightarrow$

31.  $\text{PbCl}_4$  is less stable than  $\text{SnCl}_4$ . Explain.
32.  $\text{CaO} + \text{C} \xrightarrow{\Delta} (\text{A}) + (\text{B})$   
 $(\text{A}) + \text{N}_2 \xrightarrow{\Delta} (\text{C}) + \text{carbon}$   
 $(\text{C}) + \text{H}_2\text{O} \longrightarrow (\text{D}) + \text{NH}_3$   
Identify (A), (B), (C) and (D).
33. Name two elements known for their semiconducting nature.
34. Write at least three uses of silicones.
35. During reduction of  $\text{SiO}_2$  into Si,  $\text{SiO}_2$  is taken in excess, why?
36. Rationalise the given statements and give chemical reactions :  
(i) Lead (II) chloride reacts with  $\text{Cl}_2$  to give  $\text{PbCl}_4$   
(ii) Lead (IV) chloride is highly unstable towards heat.  
(iii) Lead is known not to form an iodide,  $\text{PbI}_4$
37. Suggest a reason as to why CO is poisonous.
38. What happens when ?  
(i) Ammonia reacts with  $\text{KMnO}_4$  (neutral medium)  
(ii) A mixture of NO and  $\text{NO}_2$  is passed in  $\text{Na}_2\text{CO}_3$  solution.
39. What happens when ?  
(i) Aqueous solution of  $\text{NaNO}_3$  is heated with zinc dust and caustic soda.  
(ii) CaO in water reacts with white phosphorus.
40. Write down a reaction showing action of  $\text{N}_2\text{O}_4(\ell)$  as non-aqueous solvent.
41. What happens when:  
(a)  $\text{NH}_4\text{Cl}$  &  $\text{NaNO}_3$  is heated strongly.      (b)  $(\text{NH}_4)_2\text{CO}_3$  is heated.      (c)  $\text{NH}_4\text{NO}_2$  is heated.  
(d)  $\text{Mg}_3\text{N}_2$  reacts with water.      (e) Mg is burnt in air and the product is treated with water.

42. How will you obtain :
- (A) Ammonia from quick lime (in three steps)
- (B)  $\text{H}_3\text{PO}_4$  from phosphorite (in two steps only)
43. An orange solid (A) on heating gives a green residue (B), a colourless gas (C) and water vapour. The dry gas (C) on passing over heated Mg gave a white solid (D). (D) on reaction with water gave a gas (E) which formed dense white fumes with HCl. Identify (A) to (E) giving reactions.
44. Give the equations for preparation of :
- (A) Nitrolim. (B) Phosphine by  $\text{P}_4$  and  $\text{I}_2(\text{aq})$ .
45. A waxy crystalline solid (A) with a garlic odour is obtained by burning white P in a stream of air and nitrogen. (A) reacts vigorously with hot water forming a gas (B) and an acid (C). Gas (B) has unpleasant odour of rotten fish and is neutral towards litmus. When passed through  $\text{AgNO}_3$  solution, gas (B) produces a black precipitate (D). What are (A) to (D) ? Give chemical equations of the reactions.
46. (i) An organic iodide (A) on heating with a solution of KOH gives a gas (B) and the solution of compound (C).  
 (ii) The gas (B) on ignition in air gives a compound (D) and water.  
 (iii) Copper sulphate is finally reduced to the metal on passing (B) through its solution.  
 (iv) Precipitate of compound (E) is formed on reaction of (C) with copper sulphate solution. Identify (A) to (E) and give chemical equations for steps (i) to (iv).
47. What do you understand by tailing of mercury ?
48. From the reactions given below, identify (A), (B), (C) and (D) and write their formulae.
- (A) + dil.  $\text{H}_2\text{SO}_4$  +  $\text{K}_2\text{Cr}_2\text{O}_7 \longrightarrow$  (B) Green Solution
- (A) + dil.  $\text{H}_2\text{SO}_4$  + (C)  $\longrightarrow \text{MnSO}_4$
- (A) +  $\text{O}_2 \xrightarrow{\text{H}_2\text{O}}$  (D)
- (D) +  $\text{BaCl}_2 \longrightarrow$  White ppt.
49. Complete the following equations
- (i)  $\text{I}_2 + \text{O}_3 + \text{H}_2\text{O} \rightarrow \text{HIO}_3 + \dots\dots\dots$  (ii)  $\text{CaS} + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \dots\dots\dots + \dots\dots\dots$
50. Complete and balance the following :
- (i)  $\text{P}_4\text{O}_{10} + \text{PCl}_5 \longrightarrow$  (ii)  $\text{NH}_3 + \text{NaOCl} \longrightarrow$



51. In the following reaction,  $A + 2B + H_2O \longrightarrow C + 2D$   
( $A = HNO_2$ ,  $B = H_2SO_3$ ,  $C = NH_2OH$ ). Identify D.  
Draw the structures of A, B, C and D.
52. What happens when :
- (a)  $K_2Cr_2O_7$  is strongly heated
  - (b) Silent electric discharge is passed through pure and dry  $O_2$
  - (c) Ozone reacts with dry iodine
  - (d) 2-Ethyl anthraquinol undergoes air oxidation
  - (e)  $H_2S$  and  $SO_2$  react in presence of moisture
  - (f) Burning magnesium is kept in the atmosphere of  $SO_2$
  - (g) Acidified iodates react with  $SO_2$
  - (h) Conc.  $H_2SO_4$  is made to react with phosphorus pentoxide
53. What happens when
- (i) Hydrogen sulphide is bubbled through an aqueous solution of sulphur dioxide .
  - (ii) Hydrogen sulphide is passed through acidified ferric chloride.
54. Draw the structure of following acids.
- (a) Marshall's acid
  - (b) Dithionic acid
  - (c) Caro's acid
  - (d) Thiosulphuric acid
55. Give reason for the following:
- (a) Formation of  $NH_3$  from its elements at constant pressure is accompanied by a decrease in volume.
  - (b) Nitric oxide turns brown in air.
  - (c) Copper dissolves in  $HNO_3$  but not in HCl.
  - (d)  $Pb(NO_3)_2$  on heating produces a pale yellow gas which on strong heating produces brown gas.
56. What happens when :
- (i) Red phosphorus is treated with  $I_2$  and water.
  - (ii) Give balance equation : Cu reacts with  $HNO_3$  to produce NO and  $NO_2$  in the ratio 2 : 1
57. In  $P_4O_{10}$ , the number of oxygen atoms bonded to each phosphorus atom is .....
58. Nitrogen cannot be stored as liquid in sealed containers but ammonia can be, why ?

## CHEMISTRY FOR JEE MAIN & ADVANCED

59. Why does  $\text{NO}_2$  dimerise ?
60. Complete and balance the following chemical equations :
- (a)  $\text{HSO}_3\text{NH}_2 + \text{HNO}_3 (\text{Conc.}) \longrightarrow$       (b)  $\text{Ag}_2\text{N}_2\text{O}_2 + \text{HCl} \xrightarrow{\text{ether}}$
- (c)  $\text{HNO}_3 (50\%) + \text{As}_2\text{O}_3 + \text{H}_2\text{O} \longrightarrow$       (d)  $\text{AgNO}_3 + \text{Cl}_2 \xrightarrow{60-90^\circ\text{C}}$
- (e)  $\text{HPO}_3 + \text{H}_3\text{PO}_4 \xrightarrow{100^\circ\text{C}}$       (f)  $\text{Ca}_3(\text{PO}_4)_2 + \text{SiO}_2 + \text{C} \longrightarrow$   
(taken in equimolar)
61. Write the names of substances which have higher oxidation potential than ozone.
62. Why sulphur is able to show oxidation state of +4 and +6 with fluorine and oxygen ?
63. Why is dioxygen a gas but sulphur a solid ?
64. An aqueous solution of a gas (X) gives the following reactions :
- (i) It decolourizes an acidified  $\text{K}_2\text{Cr}_2\text{O}_7$  solution.
- (ii) On boiling with  $\text{H}_2\text{O}_2$ , cooling it and then adding an aqueous solution of  $\text{BaCl}_2$ , a precipitate insoluble in dilute  $\text{HCl}$  is obtained.
- (iii) On passing  $\text{H}_2\text{S}$  gas in the solution, white turbidity is obtained. Identify (X) and give equations for steps (i), (ii) and (iii).
65. On heating rhombic sulphur it melts but viscosity of liquid increases upto  $200^\circ\text{C}$  and beyond that it decreases why ?
66. How is the presence of  $\text{SO}_2$  detected ?
67. Which aerosols deplete ozone ?
68. Oxygen almost invariably exhibits an oxidation state of -2 but other members of the family exhibit negative as well as positive oxidation state of +2, +4 and +6. Explain it ?

## Exercise # 5

Part # I &gt; [Previous Year Questions] [AIEEE/JEE-MAIN]

## Group - 13th and 14th

- The soldiers of Napoleon 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 [AIEEE 2004]
  - a change in the crystalline structure of tin.
  - an interaction with nitrogen of the air at very low to temperature.
  - a change in the partial pressure of oxygen in the air.
  - an interaction with water vapour contained in the humid air.
- Aluminium chloride exists as dimer,  $\text{Al}_2\text{Cl}_6$  in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives : [AIEEE 2004]
  - $[\text{Al}(\text{OH})_6]^{3-} + 3\text{HCl}$
  - $[\text{Al}(\text{H}_2\text{O})_6]^{3+} + 3\text{Cl}^-$
  - $\text{Al}^{3+} + 3\text{Cl}^-$
  - $\text{Al}_2\text{O}_3 + 6\text{HCl}$
- In silicon dioxide : [AIEEE 2005]
  - there are double bonds between silicon and oxygen atoms
  - silicon atom is bonded to two oxygen atoms
  - each silicon atom is surrounded by two oxygen atoms and each oxygen atom is bonded to two silicon atoms
  - each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms
- Heating an aqueous solution of aluminium chloride to dryness will give : [AIEEE 2005]
  - $\text{Al}(\text{OH})\text{Cl}_2$
  - $\text{Al}_2\text{O}_3$
  - $\text{Al}_2\text{Cl}_6$
  - $\text{AlCl}_3$
- The stability of dihalides of Si, Ge, Sn and Pb increases steadily in the sequence : [AIEEE 2007]
  - $\text{GeX}_2 < \text{SiX}_2 < \text{SnX}_2 < \text{PbX}_2$
  - $\text{SiX}_2 < \text{GeX}_2 < \text{PbX}_2 < \text{SnX}_2$
  - $\text{SiX}_2 < \text{GeX}_2 < \text{SnX}_2 < \text{PbX}_2$
  - $\text{PbX}_2 < \text{SnX}_2 < \text{GeX}_2 < \text{SiX}_2$
- In context with the industrial preparation of hydrogen from water gas ( $\text{CO} + \text{H}_2$ ), which of the following is the correct statement ? [AIEEE 2008]
  - $\text{CO}$  is removed by absorption in aqueous  $\text{Cu}_2\text{Cl}_2$  Solution.
  - $\text{H}_2$  is removed through occlusion with Pd.
  - $\text{CO}$  is oxidized to  $\text{CO}_2$  with steam in the presence of a catalyst followed by absorption of  $\text{CO}_2$  in alkali.
  - $\text{CO}$  and  $\text{H}_2$  are fractionally separated using differences in their densities.
- Among the following substituted silanes the one which will give rise to cross linked silicone polymer on hydrolysis is : [AIEEE 2008]
  - $\text{RSiCl}_3$
  - $\text{R}_2\text{SiCl}_2$
  - $\text{R}_3\text{SiCl}_2$
  - $\text{R}_4\text{Si}$
- Which one of the following is the correct statement ? [AIEEE 2008]
  - Beryllium exhibits coordination number of six.
  - Chlorides of both beryllium and aluminium have bridged structures in vapour phase.
  - $\text{B}_2\text{H}_6 \cdot 2\text{NH}_3$  is known as 'inorganic benzene'.
  - Boric acid is a protonic acid.

9. Which of the following statements regarding sulphur is **incorrect** ? [AIEEE 2011]  
 (1)  $S_2$  molecule is paramagnetic.  
 (2) The vapour at  $200^\circ\text{C}$  consists mostly of  $S_8$  rings.  
 (3) At  $600^\circ\text{C}$  the gas mainly consists of  $S_2$  molecules.  
 (4) The oxidation state of sulphur is never less than +4 in its compounds.
10. Boron cannot form which one of the following anions? [AIEEE 2011]  
 (1)  $BF_6^{3-}$                       (2)  $BH_4^-$                       (3)  $B(OH)_4^-$                       (4)  $BO_2^-$
11. Which of the following is the wrong statement ? [JEE(Main) 2013]  
 (1)  $ONCl$  and  $ONO^-$  are not isoelectronic.                      (2)  $O_3$  molecule is bent  
 (3) Ozone is violet-black in solid state                      (4) Ozone is diamagnetic gas.
12. Which of the following are Lewis acids ? [JEE(Main) 2018]  
 (1)  $AlCl_3$  and  $SiCl_4$                       (2)  $PH_3$  and  $SiCl_4$                       (3)  $BCl_3$  and  $AlCl_3$                       (4)  $PH_3$  and  $BCl_3$

### Group - 15th and 16th

1. The number of hydrogen atom (s) attached to phosphorus atom in hypophosphorus acid is : [AIEEE 2005]  
 (1) zero                      (2) two                      (3) one                      (4) three
2. Which of the following chemical reactions depicts the oxidizing behaviour of  $H_2SO_4$ ? [AIEEE 2006]  
 (1)  $2HI + H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O$                       (2)  $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$   
 (3)  $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$                       (4)  $2PCl_5 + H_2SO_4 \rightarrow 2POCl_3 + 2HCl + SO_2Cl_2$
3. Regular use of which of the following fertilizers increases the acidity of soil? [AIEEE 2007]  
 (1) Superphosphate of lime                      (2) Ammonium sulphate  
 (3) Potassium nitrate                      (4) Urea
4. Which of the following statement is wrong? [AIEEE 2011]  
 (1) The stability of hydrides increase from  $NH_3$  to  $BiH_3$  in group 15 of the periodic table :  
 (2) Nitrogen cannot form  $d\pi-p\pi$  bond.  
 (3) Single N–N bond is weaker than the single P–P bond.  
 (4)  $N_2O_4$  has two resonance structure
5. Which of the following statements regarding sulphur is **incorrect** ? [AIEEE 2011]  
 (1)  $S_2$  molecule is paramagnetic.  
 (2) The vapour at  $200^\circ\text{C}$  consists mostly of  $S_8$  rings.  
 (3) At  $600^\circ\text{C}$  the gas mainly consists of  $S_2$  molecules.  
 (4) The oxidation state of sulphur is never less than +4 in its compounds.
6. Which of the following is the wrong statement ? [JEE(Mains) 2013]  
 (1)  $ONCl$  and  $ONO^-$  are not isoelectronic.                      (2)  $O_3$  molecule is bent  
 (3) Ozone is violet-black in solid state                      (4) Ozone is diamagnetic gas.
7. The pair in which phosphorous atoms have a formal oxidation state of +3 is :

- (1) Pyrophosphorous and hypophosphoric acids  
 (2) Orthophosphorous and hypophosphoric acids  
 (3) Pyrophosphorous and pyrophosphoric acids  
 (4) Orthophosphorous and pyrophosphorous acids
8. The reaction of zinc with dilute and concentrated nitric acid, respectively, produces:  
 (1)  $\text{NO}_2$  and  $\text{NO}$                       (2)  $\text{NO}$  and  $\text{N}_2\text{O}$                       (3)  $\text{NO}_2$  and  $\text{N}_2\text{O}$                       (4)  $\text{N}_2\text{O}$  and  $\text{NO}_2$
9. The compound that does not produce nitrogen gas by the thermal decomposition is : **[JEE(Mains) 2018]**  
 (1)  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$                       (2)  $\text{NH}_4\text{NO}_2$                       (3)  $(\text{NH}_4)_2\text{SO}_4$                       (4)  $\text{Ba}(\text{N}_3)_2$

### Group - Halogen and Noble Gases

1. Which one of the following statements regarding helium is incorrect ? **[AIEEE 2004]**  
 (1) It is used to produce and sustain powerful superconducting magnets  
 (2) It is used as a cryogenic agent for carrying out experiments at low temperatures  
 (3) It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable  
 (4) It is used in gas-cooled nuclear reactors
2. Which among the following factors is the most important in making fluorine the strongest oxidizing halogen? **[AIEEE-2004]**  
 (1) Hydration enthalpy                      (2) Ionization enthalpy  
 (3) Electron affinity                      (4) Bond dissociation energy
3. The correct order of the thermal stability of hydrogen halides ( $\text{H}-\text{X}$ ) is : **[AIEEE 2005]**  
 (1)  $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$                       (2)  $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$   
 (3)  $\text{HCl} < \text{HF} < \text{HBr} < \text{HI}$                       (4)  $\text{HI} > \text{HCl} < \text{HF} < \text{HBr}$
4. Which of the following statements is true? **[AIEEE 2006]**  
 (1)  $\text{H}_3\text{PO}_3$  is a stronger acid than  $\text{H}_2\text{SO}_3$                       (2) In aqueous medium  $\text{HF}$  is a stronger acid than  $\text{HCl}$   
 (3)  $\text{HClO}_4$  is a weaker acid than  $\text{HClO}_3$                       (4)  $\text{HNO}_3$  is a stronger acid than  $\text{HNO}_2$
5. What products are expected from the disproportionation reaction of hypochlorous acid? **[AIEEE 2006]**  
 (1)  $\text{HClO}_3$  and  $\text{Cl}_2\text{O}$                       (2)  $\text{HClO}_2$  and  $\text{HClO}_4$                       (3)  $\text{HCl}$  and  $\text{Cl}_2\text{O}$                       (4)  $\text{HCl}$  and  $\text{HClO}_3$
6. Identify the incorrect statement among the following. **[AIEEE 2007]**  
 (1)  $\text{Cl}_2$  reacts with excess of  $\text{NH}_3$  to give  $\text{N}_2$  and  $\text{HCl}$ .  
 (2)  $\text{Br}_2$  reacts with hot and strong  $\text{NaOH}$  solution to give  $\text{NaBr}$ ,  $\text{NaBrO}_4$  and  $\text{H}_2\text{O}$ .  
 (3) Ozone reacts with  $\text{SO}_2$  to give  $\text{SO}_3$ .  
 (4) Silicon reacts with  $\text{NaOH}_{(\text{aq})}$  in the presence of air to give  $\text{Na}_2\text{SiO}_3$  and  $\text{H}_2\text{O}$ .
7. Which one of the following reactions of Xenon compounds is not feasible ? **[AIEEE 2009]**  
 (1)  $3\text{XeF}_4 + 6\text{H}_2\text{O} \rightarrow 2\text{Xe} + \text{XeO}_3 + 12\text{HF} + 1.5\text{O}_2$                       (2)  $2\text{XeF}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{Xe} + 4\text{HF} + \text{O}_2$   
 (3)  $\text{XeF}_6 + \text{RbF} \rightarrow \text{Rb}[\text{XeF}_7]$                       (4)  $\text{XeO}_3 + 6\text{HF} \rightarrow \text{XeF}_6 + 3\text{H}_2\text{O}$
8. The products obtained when chlorine gas reacts with cold and dilute aqueous  $\text{NaOH}$  are : **[JEE Main 2017]**  
 (1)  $\text{ClO}^-$  and  $\text{ClO}_3^-$                       (2)  $\text{ClO}_2^-$  and  $\text{ClO}_3^-$                       (3)  $\text{Cl}^-$  and  $\text{ClO}^-$                       (4)  $\text{Cl}^-$  and  $\text{ClO}_2^-$

## Group- 13th and 14th

1.  $B(OH)_3 + NaOH \longrightarrow Na[B(OH)_4](aq)$ .  
Then addition of which of the following proceeds the reaction in the forward direction. [JEE 2006]  
(A) cis-1, 2 diol (B) Trans 1, 2 diol (C) Borax (D)  $Na_2HPO_4$
2. Match the reactions in Column-I with nature of the reactions in column-II. [JEE 2006]
- | Column-I                                  | Column-II             |
|---|-----------------------|
| (A) $Bi^{3+} \rightarrow (BiO)^+$         | (p) Heat              |
| (B) $[AlO_2]^- \rightarrow Al(OH)_3$      | (q) Hydrolysis        |
| (C) $SiO_4^{4-} \rightarrow Si_2O_7^{6-}$ | (r) Acidification     |
| (D) $(B_4O_7^{2-}) \rightarrow [B(OH)_3]$ | (s) Dilution by water |
3. **Statement-1** : In water, orthoboric acid behaves as a weak monobasic acid, **because**  
**Statement-2** : In water, orthoboric acid acts as a proton donor. [JEE 2007]  
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1  
(C) Statement-1 is True, Statement-2 is False  
(D) Statement-1 is False, Statement-2 is True
4. The Coordination number of Al in the crystalline state of  $AlCl_3$  is ? [JEE 2009]
5. Starting from  $SiCl_4$ , prepare the following in steps not exceeding the number given in parenthesis (give reactions only) : [JEE 2001]  
(i) Silicon (1) (ii) Linear silicone containing methyl groups (4) (iii)  $Na_2SiO_3$  (3)
6.  $(Me)_2SiCl_2$  on hydrolysis will produce : [JEE 2003]  
(A)  $(Me)_2Si(OH)_2$  (B)  $(Me)_2Si=O$   
(C)  $[-O-(Me)_2Si-O-]_n-$  (D)  $Me_2SiCl(OH)$
7. Which of the following silicate is formed when three oxygen atoms of  $[SiO_4]^+$  tetrahedral units are shared ? [JEE 2005]  
(A) Sheet silicate (B) Pyrosilicate  
(C) Three dimensional silicate (D) linear chain silicate
8. **Statement-1** :  $Pb^{+4}$  compounds are stronger oxidizing agents than  $Sn^{+4}$  compounds.  
**Statement-2** : The higher oxidation states for the group 14 elements are more stable for the heavier members of the group due to 'inert pair effect'. [JEE 2008]  
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1  
(C) Statement-1 is True, Statement-2 is False  
(D) Statement-1 is False, Statement-2 is True

9. In the reaction,  $2X + B_2H_6 \longrightarrow [BH_2(X)_2]^+ [BH_4]^-$   
the amine(s) X is(are) : [JEE 2009]  
(A)  $NH_3$                       (B)  $CH_3NH_2$                       (C)  $(CH_3)_2NH$                       (D)  $(CH_3)_3N$
10. The value of n in the molecular formula  $Be_nAl_2Si_6O_{18}$  is : [JEE 2010]
11. Three moles of  $B_2H_6$  are completely reacted with methanol. The number of moles of boron containing product formed is. [JEE 2015]
12. The crystalline form of borax has [JEE(Advanced) 2016]  
(A) tetranuclea  $[B_4O_5(OH)_4]^{2-}$  unit  
(B) all boron atoms in the same plane  
(C) equal number of  $sp^2$  and  $sp^3$  hybridized boron atoms  
(D) one terminal hydroxide per boron atom
13. Among the following the correct statement(s) is(are) [JEE(Advanced) 2017]  
(A)  $Al(CH_3)_3$  has the three-centre two-electron bonds in its dimeric structure  
(B)  $BH_3$  has the three-centre two-electron bonds in its dimeric structure  
(C) The Lewis acidity of  $BCl_3$  is greater than that of  $AlCl_3$   
(D)  $AlCl_3$  has the three-centre two-electron bonds in its dimeric structure

### Group - 15th and 16th

1.  $(NH_4)_2Cr_2O_7$  on heating gives a gas which is also given by : [JEE 2004]  
(A) heating  $NH_4NO_2$                       (B) heating  $NH_4NO_3$   
(C) treating  $Mg_3N_2$  with  $H_2O$                       (D) treating Na(compound) with  $H_2O_2$
2. A pale blue liquid is obtained by equimolar mixture of two gases at  $-30^\circ C$ . [JEE 2005]  
(A)  $N_2O$                       (B)  $N_2O_3$                       (C)  $N_2O_4$                       (D)  $N_2O_5$
3. Thermodynamically most stable allotrope of phosphorus is : [JEE 2005]  
(A) Red                      (B) White                      (C) Black                      (D) Yellow
4. (a) What amount of CaO in grams is required to neutralise 852 g of  $P_4O_{10}$ . [JEE 2005]  
(b) Write the structure of  $P_4O_{10}$ .

### Paragraph for Question Nos. 5 to 7

There are some deposits of nitrates and phosphates in earth's crust. Nitrates are more soluble in water. Nitrates are difficult to reduce under the laboratory conditions but microbes do it easily. Ammonia forms large number of complexes with transition metal ions. Hybridization easily explains the ease of sigma donation capability of  $NH_3$  and  $PH_3$ . Phosphine is a flammable gas and is prepared from white phosphorous.

5. Among the following, the correct statement is : [JEE 2008]  
(A) phosphates have no biological significance in humans.  
(B) between nitrates and phosphates, phosphates are less abundant in earth's crust.  
(C) between nitrates and phosphates, nitrates are less abundant in earth's crust.  
(D) oxidation of nitrates is possible in soil.

## CHEMISTRY FOR JEE MAIN & ADVANCED

6. Among the following, the correct statement is : [JEE 2008]  
 (A) between  $\text{NH}_3$  and  $\text{PH}_3$ ,  $\text{NH}_3$  is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional.  
 (B) between  $\text{NH}_3$  and  $\text{PH}_3$ ,  $\text{PH}_3$  is a better electron donor because the lone pair of electrons occupies  $\text{sp}^3$  orbital and is more directional.  
 (C) between  $\text{NH}_3$  and  $\text{PH}_3$ ,  $\text{NH}_3$  is a better electron donor because the lone pair of electrons occupies  $\text{sp}^3$  orbital and is more directional.  
 (D) between  $\text{NH}_3$  and  $\text{PH}_3$ ,  $\text{PH}_3$  is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional.
7. White phosphorus on reaction with  $\text{NaOH}$  gives  $\text{PH}_3$  as one of the products. This is a : [JEE 2008]  
 (A) dimerization reaction (B) disproportionation reaction  
 (C) condensation reaction (D) precipitation reaction
8. The reaction of  $\text{P}_4$  with **X** leads selectively to  $\text{P}_4\text{O}_6$ . The **X** is : [JEE 2009]  
 (A) Dry  $\text{O}_2$  (B) A mixture of  $\text{O}_2$  and  $\text{N}_2$   
 (C) Moist  $\text{O}_2$  (D)  $\text{O}_2$  in the presence of aqueous  $\text{NaOH}$
9. Match each of the reactions given in **column I** with the corresponding products (s) given in **column II**. [JEE 2009]
- | <b>Column I</b>                     | <b>Column II</b>               |
|-------------------------------------|--------------------------------|
| (A) $\text{Cu} + \text{dil HNO}_3$  | (p) $\text{NO}$                |
| (B) $\text{Cu} + \text{conc HNO}_3$ | (q) $\text{NO}_2$              |
| (C) $\text{Zn} + \text{dil HNO}_3$  | (r) $\text{N}_2\text{O}$       |
| (D) $\text{Zn} + \text{conc HNO}_3$ | (s) $\text{Cu}(\text{NO}_3)_2$ |
|                                     | (t) $\text{Zn}(\text{NO}_3)_2$ |
10. Extra pure  $\text{N}_2$  can be obtained by heating [JEE 2011]  
 (A)  $\text{NH}_3$  with  $\text{CuO}$  (B)  $\text{NH}_4\text{NO}_3$  (C)  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$  (D)  $\text{Ba}(\text{N}_3)_2$
11. Among the following, the number of compounds that can react with  $\text{PCl}_5$  to give  $\text{POCl}_3$  is  $\text{O}_2$ ,  $\text{CO}_2$ ,  $\text{SO}_2$ ,  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{P}_4\text{O}_{10}$ . [JEE 2011]
12. Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen? [JEE 2012]  
 (A)  $\text{HNO}_3$ ,  $\text{NO}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{N}_2$  (B)  $\text{HNO}_3$ ,  $\text{NO}$ ,  $\text{N}_2$ ,  $\text{NH}_4\text{Cl}$   
 (C)  $\text{HNO}_3$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{NO}$ ,  $\text{N}_2$  (D)  $\text{NO}$ ,  $\text{HNO}_3$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{N}_2$
13. Which of the following oxoacids of sulphur has  $-\text{O}-\text{O}-$  linkage ? [JEE 2004]  
 (A)  $\text{H}_2\text{S}_2\text{O}_3$  (B)  $\text{H}_2\text{S}_2\text{O}_5$  (C)  $\text{H}_2\text{S}_2\text{O}_6$  (D)  $\text{H}_2\text{S}_2\text{O}_8$
14. Which of the following is not oxidised by  $\text{O}_3$  ? [JEE 2005]  
 (A)  $\text{KI}$  (B)  $\text{KMnO}_4$  (C)  $\text{K}_2\text{MnO}_4$  (D)  $\text{FeSO}_4$
15. Which gas is evolved when  $\text{PbO}_2$  is treated with concentrated  $\text{HNO}_3$  ? [JEE 2005]  
 (A)  $\text{NO}_2$  (B)  $\text{O}_2$  (C)  $\text{N}_2$  (D)  $\text{N}_2\text{O}$
16. Aqueous solution of  $\text{Na}_2\text{S}_2\text{O}_3$  on reaction with  $\text{Cl}_2$  gives : [JEE 2008]  
 (A)  $\text{Na}_2\text{S}_4\text{O}_6$  (B)  $\text{NaHSO}_4$  (C)  $\text{NaCl}$  (D)  $\text{NaOH}$



17. The product formed in the reaction of  $\text{SOCl}_2$  with white phosphorous is : [JEE 2014]  
 (A)  $\text{PCl}_3$  (B)  $\text{SO}_2\text{Cl}_2$  (C)  $\text{SCL}_2$  (D)  $\text{POCl}_3$
18. When  $\text{O}_2$  is adsorbed on a metallic surface, electron transfer occurs from the metal to  $\text{O}_2$ . The TRUE statements(s) regarding this adsorption is (are) [JEE 2015]  
 (A)  $\text{O}_2$  is physisorbed  
 (B) heat is released  
 (C) Occupancy of  $\pi^*_{2p}$  of  $\text{O}_2$  is increased  
 (D) bond length of  $\text{O}_2$  is increased
19. The nitrogen containing compound produced in the reactino of  $\text{HNO}_3$  with  $\text{P}_4\text{O}_{10}$  [JEE 2016]  
 (A) can also be prepared by reaction of  $\text{P}_4$  and  $\text{HNO}_3$   
 (B) is diamagnetic  
 (C) contains one N-N bond  
 (D) reacts with Na metal producing a brown gas
20. The order of the oxidation state of the phosphorus atom in  $\text{H}_3\text{PO}_2$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{H}_3\text{PO}_3$ , and  $\text{H}_4\text{P}_2\text{O}_6$  is [JEE 2017]  
 (A)  $\text{H}_3\text{PO}_4 > \text{H}_3\text{PO}_2 > \text{H}_3\text{PO}_3 > \text{H}_4\text{P}_2\text{O}_6$   
 (B)  $\text{H}_3\text{PO}_2 > \text{H}_3\text{PO}_3 > \text{H}_4\text{P}_2\text{O}_6 > \text{H}_3\text{PO}_4$   
 (C)  $\text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_2 > \text{H}_3\text{PO}_4 > \text{H}_4\text{P}_2\text{O}_6$   
 (D)  $\text{H}_3\text{PO}_4 > \text{H}_4\text{P}_2\text{O}_6 > \text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_2$

### Paragraph for Questions 21 & 22

Upon heating  $\text{KClO}_3$  in the presence of catalytic amount of  $\text{MnO}_2$ , a gas W is formed. Excess amount of W reacts with white phosphorus to give X. The reaction of X with pure  $\text{HNO}_3$  gives Y and Z. [JEE(Advanced) 2017]

21. Y and Z are, respectively  
 (A)  $\text{N}_2\text{O}_5$  and  $\text{HPO}_3$  (B)  $\text{N}_2\text{O}_3$  and  $\text{H}_3\text{PO}_4$  (C)  $\text{N}_2\text{O}_4$  and  $\text{H}_3\text{PO}_3$  (D)  $\text{N}_2\text{O}_4$  and  $\text{HPO}_3$
22. W and X are respectively  
 (A)  $\text{O}_2$  and  $\text{P}_4\text{O}_6$  (B)  $\text{O}_2$  and  $\text{P}_4\text{O}_{10}$  (C)  $\text{O}_3$  and  $\text{P}_4\text{O}_6$  (D)  $\text{O}_3$  and  $\text{P}_4\text{O}_{10}$
23. Based on the compounds of group 15 elements, the correct statement (s) is (are ) [JEE(ADVANCED) 2018]  
 (A)  $\text{Bi}_2\text{O}_5$  is more basic than  $\text{N}_2\text{O}_5$   
 (B)  $\text{NF}_3$  is more covalent than  $\text{BiF}_3$   
 (C)  $\text{PH}_3$  boils at lower temperature than  $\text{NH}_3$   
 (D) The N-N single bond is stronger than the P-P single bond
24. The total number of compounds having at least one binding oxo group among the molecules given below is \_\_\_\_\_ [JEE Advanced 2018]  
 $\text{N}_2\text{O}_3, \text{N}_2\text{O}_5, \text{P}_4\text{O}_6, \text{P}_4\text{O}_7, \text{H}_4\text{P}_2\text{O}_5, \text{H}_5\text{P}_3\text{O}_{10}, \text{H}_2\text{S}_2\text{O}_3, \text{H}_2\text{S}_2\text{O}_5$

## Group - Halogen and Noble Gases

## Paragraph for Question Nos. 1 to 3

The noble gases have closed-shell electronic configuration and are monoatomic gases under normal conditions. The low boiling points of the lighter noble gases are due to weak dispersion forces between the atoms and the absence of other interatomic interactions.

The direct reaction of xenon with fluorine leads to a series of compounds with oxidation numbers +2, +4 and +6.  $\text{XeF}_4$  reacts violently with water to give  $\text{XeO}_3$ . The compounds of xenon exhibit rich stereochemistry and their geometries can be deduced considering the total number of electron pairs in the valence shell.

- Argon is used in arc welding because of its : [JEE 2007]  
 (A) low reactivity with metal (B) ability to lower the melting point of metal  
 (C) flammability (D) high calorific value
- The structure of  $\text{XeO}_3$  is : [JEE 2007]  
 (A) linear (B) planar (C) pyramidal (D) T-shaped
- $\text{XeF}_4$  and  $\text{XeF}_6$  are expected to be : [JEE 2007]  
 (A) oxidizing (B) reducing (C) unreactive (D) strongly basic
- All the compounds listed in **Column-I** react with water. Match the result of the respective reactions with the appropriate options listed in **Column-II**. [JEE 2010]

**Column I**

- (A)  $(\text{CH}_3)_2\text{SiCl}_2$   
 (B)  $\text{XeF}_4$   
 (C)  $\text{Cl}_2$   
 (D)  $\text{VCl}_5$

**Column II**

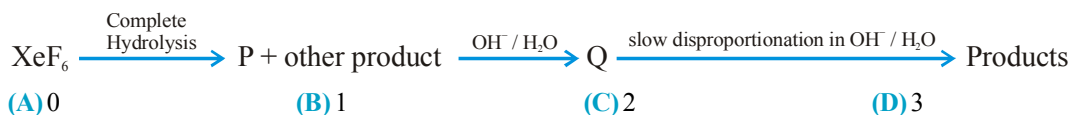
- (p) Hydrogen halide formation  
 (q) Redox reaction  
 (r) Reacts with glass  
 (s) Polymerization  
 (t)  $\text{O}_2$  formation

## Paragraph for Questions 5 to 6

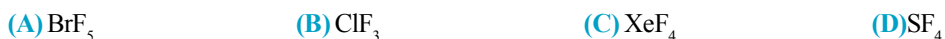
The reactions of  $\text{Cl}_2$  gas with cold-dilute and hot-concentrated  $\text{NaOH}$  in water give sodium salts to two (different) oxoacids of chlorine, **P** and **Q**, respectively. The  $\text{Cl}_2$  gas reacts with  $\text{SO}_2$  gas, in presence of charcoal, to give a product **R**. **R** reacts with white phosphorus to give a compound **S**. On hydrolysis, **S** gives an oxoacid of phosphorus **T**.

- P** and **Q**, respectively, are the sodium salts of : [JEE(Advanced) 2013]  
 (A) hypochlorous and chloric acids  
 (B) hypochlorous and chlorous acids  
 (C) chloric and perchloric acids  
 (D) chloric and hypochlorous acids
- R**, **S** and **T**, respectively, are : [JEE(Advanced) 2013]  
 (A)  $\text{SO}_2\text{Cl}_2$ ,  $\text{PCl}_5$  and  $\text{H}_3\text{PO}_4$   
 (B)  $\text{SO}_2\text{Cl}_2$ ,  $\text{PCl}_3$  and  $\text{H}_3\text{PO}_3$   
 (C)  $\text{SOCl}_2$ ,  $\text{PCl}_3$  and  $\text{H}_3\text{PO}_2$   
 (D)  $\text{SOCl}_2$ ,  $\text{PCl}_5$  and  $\text{H}_3\text{PO}_4$

7. Under ambient conditions, the total number of gases released as products in the final step of the reaction scheme shown below is :



8. The compound(s) with TWO lone pairs of electrons on the central atom is (are) [JEE(Advanced) 2016]



9. The correct statement(s) about the oxoacids,  $\text{HClO}_4$  and  $\text{HClO}$ , is(are) [JEE(Advanced) 2017]

- (A) The central atom in both  $\text{HClO}_4$  and  $\text{HClO}$  is  $sp^3$  hybridized  
(B)  $\text{HClO}_4$  is formed in the reaction between  $\text{Cl}_2$  and  $\text{H}_2\text{O}$   
(C) The conjugate base of  $\text{HClO}_4$  is weaker base than  $\text{H}_2\text{O}$   
(D)  $\text{HClO}_4$  is more acidic than  $\text{HClO}$  because of the resonance stabilization of its anion

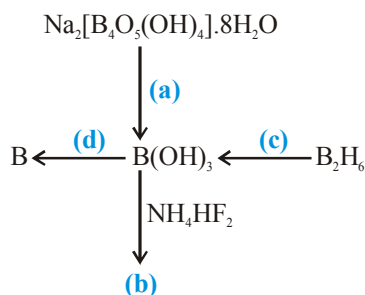
MOCK TEST

SECTION - I: STRAIGHT OBJECTIVE TYPE

- Aqueous solution of orthoboric acid can be titrated against sodium hydroxide using phenolphthalein indicator only in the presence of :

(A) trans-glycerol      (B) catechol      (C) cis-glycerol      (D) both (B) and (C)
- $Mg_3B_2 \xrightarrow{HCl(aq)} [X] + MgCl_2$   
 $[X] + H_2O \xrightarrow{HCl(aq)} [Y] + H_2$   
 For [X] and [Y] the incorrect choice is:

(A) [X] is  $BCl_3$  and [Y] is  $H_3BO_3$ .  
 (B) [X] is  $B_2H_6$  and [Y] is  $H_3BO_3$ .  
 (C) [X] with air and [Y] on strong heating (red heat) give same compound.  
 (D) In [Y], B completes its octet by removing  $OH^-$  from water molecule.
- For the following flow diagram.



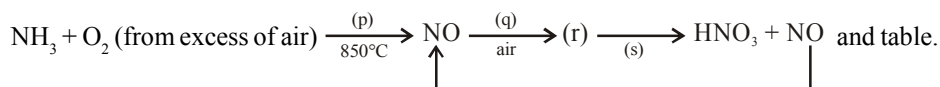
which of the following option correctly describes the reagents, products and the reaction conditions given in parentheses as small alphabets?

- | Option | (a)                 | (b)                   | (c)        | (d)                             |
|--------|---------------------|-----------------------|------------|---------------------------------|
| (A)    | Acidic hydrolysis   | $NH_3$ and $NH_4BF_4$ | Hydrolysis | Heating only                    |
| (B)    | Acidic hydrolysis   | $NH_4BF_4$            | Hydrolysis | Heating in presence of Mg or Fe |
| (C)    | Alkaline hydrolysis | $NH_4BF_4$            | Hydrolysis | Heating only                    |
| (D)    | Alkaline hydrolysis | $N_2 + BF_3$          | Hydrolysis | Heating in presence of Mg or Fe |
- Select the correct statement about elements of group 15<sup>th</sup>

(A) The order of stability of oxidation state for +3 is  $Bi^{+3} > Sb^{+3} > As^{+3}$  and for +5 is  $Bi^{+5} < Sb^{+5} < As^{+5}$   
 (B) In case of nitrogen, all oxidation states from +1 to +4 tend to disproportionate in acid solution.  
 (C) There is a considerable increase in covalent radius from N to P but also from As to Bi only a small increase in covalent radius is observed.  
 (D) All of the above.
  - For  $H_3PO_3$  and  $H_3PO_4$  the correct choice is :

(A)  $H_3PO_3$  is dibasic and reducing agent  
 (B)  $H_3PO_3$  is a dibasic and a non-reducing agent  
 (C)  $H_3PO_4$  is a tribasic and a reducing agent  
 (D)  $H_3PO_3$  is tribasic and a non-reducing agent

6. The following flow diagram represents the industrial preparation of nitric acid from ammonia.



7. Which of the following is not oxidised by  $\text{O}_3$ ?
- (A) KI                      (B)  $\text{FeSO}_4$                       (C)  $\text{KMnO}_4$                       (D)  $\text{K}_2\text{MnO}_4$
8. Hot concentrated sulphuric acid dissolves sulphur forming:
- (A)  $\text{SO}_3$                       (B)  $\text{SO}_2$                       (C)  $\text{H}_2\text{SO}_3$                       (D)  $\text{H}_2\text{S}_2\text{O}_3$
9. Which of the following is incorrect for the oxides of 16th group elements?
- (A) Reducing property of their dioxides decreases from  $\text{SO}_2$  to  $\text{TeO}_2$   
 (B) Basic character of their dioxides increases down the group i.e acidic character decreases down the group.  
 (C) (A) and (B) Both.  
 (D) None of the above.
10. A brown coloured mixture of two gases is obtained by the reduction of 6N nitric acid with metallic copper. This mixture on cooling condenses to a blue liquid which on freezing ( $-30^\circ$ ) gives a blue solid. The correct choice for blue liquid or solid is :
- (A) It is referred to as an anhydride of nitric acid.  
 (B) It is an acidic oxide and hence dissolves in alkalis producing nitrites.  
 (C) It can also be prepared by the action of 50%  $\text{HNO}_3$  on arsenious oxide and then cooling to 250K.  
 (D) All of these.
11.  $\text{HCN} + \text{H}_2\text{O} \longrightarrow [\text{X}] + \text{NH}_3$   
 $[\text{X}] \xrightarrow{\Delta} [\text{Y}] + \text{H}_2\text{O}$   
 (Unbalanced equations)  
 [Y] may be prepared by which one of the following methods?
- (A) By dehydration of malonic acid with  $\text{P}_2\text{O}_5$   
 (B) By thermal decomposition of carbon sub-oxide in air.  
 (C) By heating potassium hexacyanoferrate (II) with conc.  $\text{H}_2\text{SO}_4$ .  
 (D) By the action of conc.  $\text{HNO}_3$  on charcoal.
12. A gas 'X' is passed through water to form a saturated solution. The aqueous solution of treatment with silver nitrate gives a white precipitate. The saturated aqueous solution also dissolves magnesium ribbon with evolution of colourless gas 'Y'. 'X' and 'Y' are respectively :
- (A)  $\text{CO}_2, \text{Cl}_2$                       (B)  $\text{Cl}_2, \text{CO}_2$                       (C)  $\text{Cl}_2, \text{H}_2$                       (D)  $\text{H}_2, \text{Cl}_2$
13. Which of the following can be reduced by HF?
- (A)  $\text{H}_2\text{SO}_4$                       (B)  $\text{KMnO}_4$                       (C)  $\text{K}_2\text{Cr}_2\text{O}_7$                       (D) None of these
14. Which one of the following statements regarding helium is incorrect?
- (A) It is used to produce and sustain powerful superconducting magnets.  
 (B) It is used as a cryogenic agent for carrying out experiments at low temperatures.  
 (C) It is used in filling balloons for meteorological observations because it is lighter and non-inflammable.  
 (D) It is used as diluent for oxygen in modern diving apparatus because of its high solubility in blood

## CHEMISTRY FOR JEE MAIN & ADVANCED

15. Which of the following statement(s) is/are false for sulphurdioxide?
- (A) It reacts with dry chlorine in presence of charcoal to form sulphuryl chloride.  
(B) It reduces  $\text{KIO}_3$  to iodine in acidic medium  
(C) It when passed through a solution of sodium sulphide, produces  $\text{Na}_2\text{SO}_3$ .  
(D) It oxidises  $\text{SnCl}_2$  to  $\text{SnCl}_4$  in presence of  $\text{HCl}$

### SECTION - II : MULTIPLE CORRECT ANSWER TYPE

16.  $\text{Ca}_2\text{B}_6\text{O}_{11} + \text{Na}_2\text{CO}_3 \xrightarrow{\Delta} [\text{X}] + \text{CaCO}_3 + \text{NaBO}_2$  (unbalanced equation)  
Correct choice(s) for [X] is/are :
- (A) structure of anion of crystalline [X] has one boron atom  $\text{sp}^3$  hybridised and other three boron atom  $\text{sp}^2$  hybridised.  
(B) X with  $\text{NaOH}$  (aq.) gives a compound which on reaction with hydrogen peroxide in alkaline medium yields a compound used as brightner in soaps.  
(C) hydrolysis of [X] with  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  yields a compound which on reaction with  $\text{HF}$  gives fluoroboric acid.  
(D) [X] on heating with chromium salts in oxidising flame gives green coloured bead.
17. Which of the following statement(s) is/are true?
- (A) Boiling point of ammonia is greater than stibine  
(B) Calcium carbide reacts with nitrogen gas at  $1100^\circ\text{C}$  to form a fertilizer, nitrolin.  
(C) Nearly all intermediate oxidation states of phosphorus disproportionate in to +5 and -3 both in alkali and acid  
(D) The melting point of antimony is less than arsenic.
18. Which of the following order(s) is/are incorrect?
- (A)  $\text{H}_3\text{PO}_4 > \text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_2$  (reducing character)  
(B)  $\text{N}_2\text{O} < \text{NO} < \text{N}_2\text{O}_3 < \text{N}_2\text{O}_5$  (oxidation state on nitrogen atom)  
(C)  $\text{NH}_3 > \text{PH}_3 < \text{AsH}_3 < \text{SbH}_3$  (basicity)  
(D)  $\text{SbH}_3 > \text{NH}_3 > \text{AsH}_3 > \text{PH}_3$  (reducing character)
19. Which of the following statements regarding hydrogen peroxide is(are) incorrect?
- (A) The two hydroxy groups in hydrogen peroxide lie in the same plane  
(B) Aqueous solution of  $\text{H}_2\text{O}_2$  turn blue litmus red.  
(C) When  $\text{H}_2\text{O}_2$  behaves as a reducing agent, the O-O bond in its molecules is not broken down.  
(D) Aqueous solution of  $\text{H}_2\text{O}_2$  is stored in plastic bottles and some urea, phosphoric acid or glycerol is added to that solution.
20. The compound(s) which (have) peroxy linkage is (are) :
- (A)  $\text{H}_2\text{S}_2\text{O}_3$                       (B)  $\text{H}_2\text{SO}_5$                       (C)  $\text{H}_2\text{S}_2\text{O}_7$                       (D)  $\text{H}_2\text{S}_2\text{O}_8$
21. A solution containing  $\text{Br}^-$  ions is treated with each of the following. Which of these will not liberate bromine gas?
- (A)  $\text{Cl}_2$                       (B)  $\text{HI}$                       (C)  $\text{I}_2$                       (D)  $\text{SO}_3$
22. Select the incorrect order(s) from the following :
- (A)  $\text{ClO}^- < \text{BrO}^- < \text{IO}^-$  – disproportionation  
(B)  $\text{ClO}_4^- < \text{BrO}_4^- < \text{IO}_4^-$  – oxidising power  
(C)  $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$  – acid strength  
(D)  $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$  – oxidising power

23.  $\text{XeF}_4 + \text{O}_2\text{F}_2 \longrightarrow [\text{X}] + \text{O}_2$  (unbalanced equation)  
 Select the correct statement(s) for [X].  
 (A) Partial hydrolysis of [X] gives  $\text{XeOF}_4$  as one of the product.  
 (B) [X] gives yellow liquid on melting  
 (C) [X] reacts with  $\text{SiO}_2$  to form  $\text{XeOF}_4$  and  $\text{SiF}_4$   
 (D) [X] reacts with  $\text{XeO}_3$  to form  $\text{XeOF}_4$

### SECTION - III : ASSERTION AND REASON TYPE

24. **Statement - 1** : Mercury in contact with ozone loses its mobility and starts sticking to the glass surface.  
**Statement - 2** : This is known as tailing of mercury.  
 (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
 (C) Statement-1 is True, Statement-2 is False.  
 (D) Statement-1 is False, Statement-2 is True.
25. **Statement - 1** : Reddish brown gas,  $\text{NO}_2$  when passed through alkalis gives nitrite only.  
**Statement - 2** :  $\text{NO}_2$  is acidic in nature and is a mixed anhydride of nitric and nitrous acids.  
 (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
 (C) Statement-1 is True, Statement-2 is False.  
 (D) Statement-1 is False, Statement-2 is True.
26. **Statement - 1** : Ammonium salts give yellow precipitates with both chloroplatinic acid and sodium cobaltinitrite  
**Statement - 2** : Ammonium salt containing  $\text{SO}_4^{2-}$  anion on heating quite readily decomposes to give  $\text{N}_2\text{O}$ .  
 (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
 (C) Statement-1 is True, Statement-2 is False.  
 (D) Statement-1 is False, Statement-2 is True.
27. **Statement - 1** :  $\text{SF}_6$  is used as a gaseous insulator in high voltage generators.  
**Statement - 2** : It is inert and has good dielectric properties.  
 (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
 (C) Statement-1 is True, Statement-2 is False.  
 (D) Statement-1 is False, Statement-2 is True.
28. **Statement - 1** : Hydrolysis of  $\text{XeF}_6$  represents a redox reaction.  
**Statement - 2** : The products of hydrolysis are  $\text{XeOF}_4$  and  $\text{XeO}_2\text{F}_2$ .  
 (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
 (C) Statement-1 is True, Statement-2 is False.  
 (D) Statement-1 is False, Statement-2 is True.

## CHEMISTRY FOR JEE MAIN & ADVANCED

29. **Statement - 1**: Finally divided iron does not form ferric chloride with hydrochloric acid.  
**Statement - 2**: Hydrochloric acid produces hydrogen gas with iron.  
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
(C) Statement-1 is True, Statement-2 is False.  
(D) Statement-1 is False, Statement-2 is True.
30. **Statement - 1**: Amongst the trihalides of nitrogen,  $\text{NF}_3$ ,  $\text{NCl}_3$ ,  $\text{NBr}_3$  and  $\text{NI}_3$ ,  $\text{NF}_3$  is least basic.  
**Statement - 2**: In  $\text{NF}_3$ , the fluorine has the highest value of electronegativity and thus the lone pair of electrons on N-atom is strongly bound.  
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
(C) Statement-1 is True, Statement-2 is False.  
(D) Statement-1 is False, Statement-2 is True.
31. **Statement - 1**: Zeolite, which is hydrated sodium aluminium silicate is used as water softener.  
**Statement - 2**: The sodium ions of zeolite are exchanged with calcium and magnesium ions when hard water is passed through it.  
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
(C) Statement-1 is True, Statement-2 is False.  
(D) Statement-1 is False, Statement-2 is True.
32. **Statement - 1**:  $\text{HNO}_3$  oxidises sulphur to  $\text{H}_2\text{SO}_4$  acid (S + VI) but only oxidises selenium to  $\text{H}_2\text{SeO}_3$  (Se + IV).  
**Statement - 2**: In selenium atoms, the electrons are more tightly held by the nucleus on account of increases nuclear charge.  
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
(C) Statement-1 is True, Statement-2 is False.  
(D) Statement-1 is False, Statement-2 is True.

### SECTION - IV : COMPREHENSION TYPE

Read the following comprehensions carefully and answer the questions.

#### Comprehension # 1

A crystalline solid (A) reacts with hydrogen gas to form a monoatomic gas (B) and a highly associated liquid (C). (A) is soluble in water and undergoes hydrolysis slowly to form (B), (C) and a diatomic gas (D). When pure and dry (D) is subjected to a silent electric discharge and another pale blue gas (E) is produced which like (A) also acts as a strong oxidising agent. (E) dissolves in potassium hydroxide forming an orange coloured solid which is paramagnetic in nature. (A) reacts with  $\text{IF}_5$ ,  $\text{SbF}_5$ ,  $\text{PF}_5$  etc to form the addition compounds. (C) forms an addition compound (F) with KF which when electrolysed in molten state forms a most reactive gas (G). (B) and (G) (taken in 2 : 1 ratio) when heated in nickel tube at  $400^\circ\text{C}$  and 6 atm. pressure forms (A). The first ionization energy ( $\text{IE}_1$ ) of (B) is fairly close to (D).

33. Which is correct choice for (D) and (E).  
(A) (E) reacts with dry iodine to form  $\text{I}_2\text{O}_5$ .  
(B) A filter paper soaked in alcoholic benzidine becomes brown when brought in contact with (E).  
(C) (D) is prepared by Brin's process.  
(D) (B) and (C) both



34. Which of the following statement is true?  
 (A) Gas (G) reacts with conc NaOH to form  $OF_2$   
 (B) Pale blue gas (E) oxidises alkaline KI to  $KIO_3$  and  $KIO_4$ .  
 (C) Pale blue gas (E) in acidic medium reacts with  $K_2Cr_2O_7$  to form a bright blue coloured compound ( $CrO_5$ )  
 (D) (B) and (C) both

### Comprehension # 2

Compound (A) on reduction with  $LiAlH_4$  gives a hydride (P) containing 21.72% hydrogen along with other products. The one mole of hydride (P) and 2 mole of ammonia at higher temperature gives a compound (Q) which is known as inorganic benzene. (A) hydrolysis incompletely and forms a compound (R) and  $H_3BO_3$ .

35. Which of the following statement is incorrect for the compound (A)?  
 (A)  $sp^2$                                       (B)  $sp^3$                                       (C)  $sp$                                       (D)  $sp^3d$

### Comprehension # 3

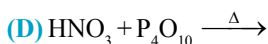
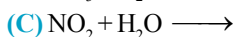
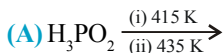
Oxygen differs from the other elements of the group. Compounds of oxygen with metals are more ionic in nature and hydrogen bonding is more important for oxygen compounds. Oxygen is never more than divalent because when it has formed two covalent bonds, there are no low energy orbitals which can be used to form further bonds. However, the elements S, Se, Te and Po have empty d-orbitals which may be used for bonding and they can form four or six bonds by unpairing electrons. However, the higher oxidation states becomes less stable on descending the group. The bond between S and O or Se and O, are much shorter than might be expected for a single bond owing to  $p\pi - d\pi$  interaction between the p-orbital of oxygen and d-orbital of S or Se.

36. Which of the following statement is incorrect?  
 (A) Oxoanions of sulphur have little tendency to polymerise compared with the phosphates and silicates.  
 (B) In pyrosulphurous acid ( $H_2S_2O_3$ ) the oxidation states of both the sulphur atoms are not same, they are +V and +III.  
 (C) Conc.  $HNO_3$  oxidises both sulphur and selenium to  $H_2SO_4$  (+VI) and  $H_2SeO_4$  (+VI) respectively.  
 (D) Most metal oxides are ionic and basic in nature while non-metallic oxides are usually covalent and acidic in nature.
37. Which one of the following orders represents the correct order for the properties indicated against them?  
 (A)  $H_2O < H_2S < H_2Se < H_2Te$  – acidic character  
 (B)  $H_2O < H_2S < H_2Se < H_2Te$  – thermal stability  
 (C)  $H_2S > H_2Se < H_2T_3 < H_2O$  – reducing character  
 (D)  $H_2O < H_2S < H_2Se < H_2Te$  – boiling point
38. In  $\gamma - SO_3(s)$  which exists as  $(SO_3)_3$ ,  
 (A) all S – O bond lengths are shorter and identical due to  $p\pi - d\pi$  interaction between sulphur and oxygen  
 (B) all sulphur atoms are tetrahedrally surrounded by three oxygen and one sulphur atoms.  
 (C) there are six  $p\pi - d\pi$  bonds.  
 (D) there are S–S linkages.

SECTION - V : MATRIX - MATCH TYPE

39. Match the reactions mentioned in column-I with the nature of the reaction/characteristic(s) of the products mentioned in column-II.

Column - I



Column-II

(p) One of the products acts as reducing agent.

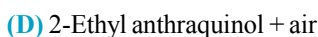
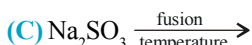
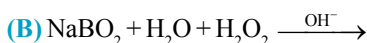
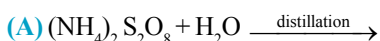
(q) One of the products is tribasic and non reducing

(r) Dehydration

(s) In one of the products the central atom is in +5 oxidation state.

40. Match the reactions mentioned in column-I with the nature of the reaction/characteristic(s) of the products mentioned in column-II.

Column - I



Column-II

(p) Hydrolysis

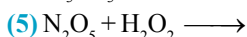
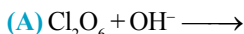
(q) One of the product has peroxide linkage

(r) Disproportionation

(s) In one of the products the central atom has  $\text{sp}^3$  hybridisation.

41. Match the reactions mentioned in column-I with the nature of reaction/product(s) formed/characteristic(s) of the products mentioned in Column-II.

Column - (I)



Column - (II)

(p)  $\text{sp}^3$  hybridisation

(q) Chlorine dioxide and perchloric acid

(r) Disproportionation

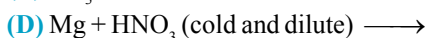
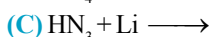
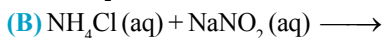
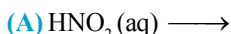
(s) Peroxide Linkage

(t) Caro's acid

(u) Chlorate and perchlorate

42. Match the reactions mentioned in column-I with the nature of reaction / characteristic(s) of the products mentioned in column-II.

Column - (I)



Column - (II)

(p) One of the product is a diamagnetic colourless gas.

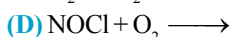
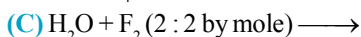
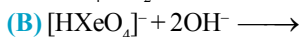
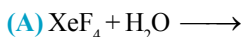
(q) One of the product is a colourless paramagnetic gas

(r) Redox reaction

(s) One of the product gives brown ring test

43. Match the reactions mentioned in column-I with the nature of reaction/characteristic(s) of the products mentioned in column-II.

Column - (I)



Column - (II)

(p) Disproportionation

(q) One of the products is a gas which is paramagnetic

(r) One of the products is used in light bulbs

(s) One of the products is corrosive to glass and is stored in wax-lined bottles.

## ANSWER KEY

## EXERCISE - 1

1. A 2. B 3. D 4. C 5. D 6. C 7. D 8. A 9. C 10. A 11. C 12. D 13. B  
 14. A 15. A 16. B 17. A 18. B 19. B 20. A 21. C 22. B 23. B 24. A 25. B 26. B  
 27. A 28. C 29. D 30. B 31. A 32. A 33. D 34. D 35. B 36. C 37. A 38. C 39. B  
 40. C 41. B 42. A 43. B 44. B 45. C 46. D 47. B 48. A 49. C 50. C 51. D 52. A  
 53. C 54. D 55. C 56. B 57. B 58. B 59. A 60. A 61. D 62. D 63. C 64. C 65. A  
 66. D 67. B 68. D 69. A 70. C 71. B 72. A 73. A,C 74. D 75. D 76. C 77. A 78. D  
 79. A 80. C 81. A 82. B 83. B 84. B 85. D 86. B 87. C 88. B 89. B 90. D 91. A  
 92. B 93. A 94. B 95. D 96. A 97. A

## EXERCISE - 2 : PART # I

1. B,C,D 2. B,C 3. A,B,C,D 4. A,B,D 5. B,C,D 6. A,B 7. A,C,D  
 8. B,C,D 9. A,B,C 10. A,C 11. A,C 12. C 13. C 14. A,B,C,D  
 15. A,B,C,D 16. B,C,D 17. A,B,C 18. A,B,C 19. B,D 20. C,D 21. A,B,C,D  
 22. C 23. A,B 24. B,D 25. A,B,C,D 26. A,B,D 27. A,B,C,D  
 28. B 29. A,C,D 30. A,B,D 31. B 32. A,C,D 33. A,D 34. A,B,C,D  
 35. B,C 36. A,B 37. A,C 38. A,B 39. A,B,D 40. B,C 41. A,B,C  
 42. B,C 43. C,D 44. B,D 45. A,C 46. A,B,C,D 47. A,B,C,D  
 48. A,B,C,D 49. B,C 50. A,B,C,D 51. B,C,D 52. A,B,C,D 53. A,C 54. A,B,D  
 55. A 56. C,D 57. B 58. C,D 59. D

## PART # II

1. B 2. A 3. B 4. B 5. B 6. D 7. C 8. C 9. A 10. A 11. A 12. B 13. A  
 14. A 15. A 16. A 17. A 18. A 19. D 20. A 21. B 22. A 23. B 24. A 25. A 26. D  
 27. B 28. C 29. A 30. D 31. D 32. B 33. B 34. B 35. D 36. A 37. A 38. A 39. A  
 40. B 41. D 42. A 43. B 44. A 45. A 46. D 47. A 48. D 49. B 50. A 51. C 52. A  
 53. B 54. D 55. B 56. D 57. B 58. A 59. A 60. D 61. A

## EXERCISE - 3 : PART # I

1.  $A \rightarrow q, B \rightarrow p, C \rightarrow r, s, D \rightarrow q$  2.  $A \rightarrow p, q, B \rightarrow p, r, C \rightarrow q, s, D \rightarrow q$   
 3.  $A \rightarrow p, B \rightarrow p, q, C \rightarrow p, q, s, D \rightarrow p, r$  4.  $A \rightarrow p, q, r, s, B \rightarrow p, q, r, s, C \rightarrow p, q, D \rightarrow p, q$   
 5.  $A \rightarrow r, B \rightarrow q, C \rightarrow p, D \rightarrow s$  6.  $A \rightarrow p, q, s, B \rightarrow p, q, r, s, C \rightarrow q, r, s, D \rightarrow p, q, r, s$

## CHEMISTRY FOR JEE MAIN & ADVANCED

7.  $A \rightarrow p, q, s, B \rightarrow p, q, s, C \rightarrow r, s, D \rightarrow q, s$       8.  $A \rightarrow q, s, B \rightarrow q, r, C \rightarrow p, s, D \rightarrow q, s$   
9.  $A \rightarrow p, r, s, B \rightarrow q, r, s, C \rightarrow p, r, s, D \rightarrow p, r, s$       10.  $A \rightarrow p, q, B \rightarrow p, q, r, s, C \rightarrow r, D \rightarrow s$   
11.  $A \rightarrow q, s, B \rightarrow s, C \rightarrow p, D \rightarrow r$       12.  $A \rightarrow p, q, r, s, t, B \rightarrow p, q, r, s, t, C \rightarrow t, D \rightarrow p, q, r, s$   
13.  $A \rightarrow p, q, r, s, B \rightarrow p, r, C \rightarrow p, q, r, D \rightarrow p, q, r$       14.  $A \rightarrow p, B \rightarrow p, q, r, C \rightarrow p, r, D \rightarrow p, s$   
15.  $A \rightarrow p, q, r, s, B \rightarrow r, s, C \rightarrow q, r, s, D \rightarrow p, q, r$   
16.  $A \rightarrow p, q, r, s, B \rightarrow p, q, r, s, t, C \rightarrow p, q, r, s, D \rightarrow q, s, t$

### PART # II

- Comprehension # 1:    1. C    2. A    3. B  
Comprehension # 2:    1. B    2. B    3. C    4. B  
Comprehension # 3:    1. C    2. C    3. B    4. D  
Comprehension # 4:    1. D    2. A    3. A  
Comprehension # 5:    1. D    2. C    3. C    4. D  
Comprehension # 6:    1. B    2. D    3. D  
Comprehension # 7:    1. C    2. B  
Comprehension # 8:    1. A    2. B    3. A  
Comprehension # 9:    1. C    2. A  
Comprehension # 10:    1. D    2. D    3. D  
Comprehension # 11:    1. B    2. B    3. C  
Comprehension # 12:    1. D    2. D    3. D  
Comprehension # 13:    1. D    2. D    3. C  
Comprehension # 14:    1. A    2. C    3. B  
Comprehension # 15:    1. D    2. B    3. D    4. B

### EXERCISE - 5 : PART # I

#### Group - 13<sup>th</sup> and 14<sup>th</sup>

1. 1    2. 2    3. 4    4. 2    5. 3    6. 3    7. 1    8. 2    9. 4    10. 1  
11. All statement are correct there is no answer.    12. 3

#### Group - 15<sup>th</sup> and 16<sup>th</sup>

1. 2    2. 1    3. 2    4. 1,4    5. 4    6. All statement are correct there is no answer.    7. 4    8. 4    9. 3

#### Group - Halogen and Noble Gases

1. 3    2. 4    3. 2    4. 4    5. 4    6. 2    7. 4    8. 3

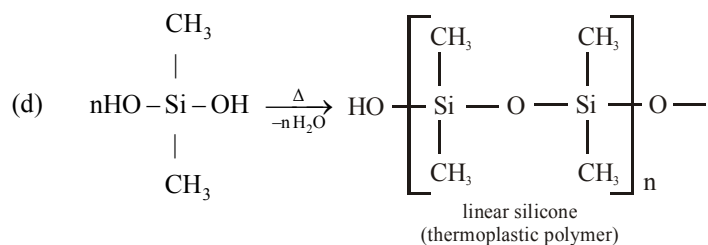
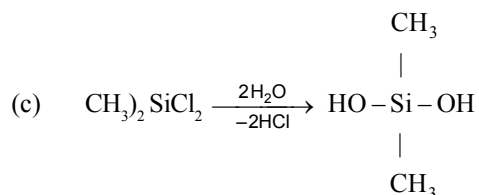
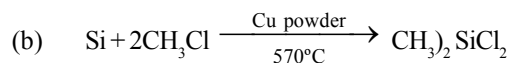
## PART # II

Group - 13<sup>th</sup> and 14<sup>th</sup>

1. A 2. A - q,s ; B - r ; C - q,r,s ; D - q,r. 3. C 4. 6

5. (i)  $3\text{SiCl}_4(\text{vapour}) + 4\text{Al}(\text{molten}) \longrightarrow 4\text{AlCl}_3 + 3\text{Si}$

(ii) (a)  $3\text{SiCl}_4 + 4\text{Al} \longrightarrow 4\text{AlCl}_3 + 3\text{Si}$



(iii) (a)  $\text{SiCl}_4 + 4\text{H}_2\text{O} \longrightarrow \text{H}_4\text{SiO}_4$  or  $\text{Si}(\text{OH})_4$  (ortho silicic acid) +  $4\text{HCl}$

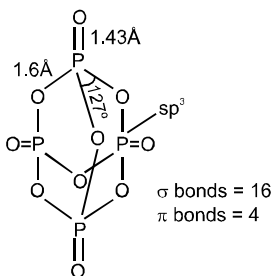
(b)  $\text{H}_4\text{SiO}_4 \xrightarrow{\Delta} \text{SiO}_2 + 2\text{H}_2\text{O}$

(c)  $\text{SiO}_2 + \text{Na}_2\text{CO}_3 \xrightarrow{1400^\circ\text{C}} \text{Na}_2\text{SiO}_3 + \text{CO}_2$

6. C 7. A 8. C 9. ABC 10. 3 11. 6 12. ABC 13. ABC

Group - 15<sup>th</sup> and 16<sup>th</sup>

1. A 2. B 3. C 4. a) 1008 g b) Structure of  $P_4O_{10}$ ,



5. C 6. C 7. B 8. B 9. A-p,s; B-q,s; C-r,t; D-q,t 10. D 11. 4 12. B 13. D 14. B  
15. B 16. B 17. A 18. B,C,D 19. B,D 20. D 21. A 22. B 23. A,B,C 24. 6

Group - Halogen and Noble Gases

1. A 2. C 3. A 4. A → p,s; B → p,q,r,t; C → p,q; D → p 5. A 6. A 7. C 8. B,C 9. A,D

MOCK TEST

1. D 2. A 3. B 4. D 5. A 6. A 7. C 8. B 9. D 10. D 11. C 12. C 13. D  
14. D 15. C 16. B,C,D 17. B,C,D 18. A,D 19. A,B 20. B,D 21. B,C 22. B,D  
23. A,B,C,D 24. B 25. D 26. D 27. A 28. D 29. A 30. A 31. A 32. A 33. D 34. B  
35. D 36. C 37. A 38. C  
39. A → p, q, s; B → p, q, s; C → p, s; D → r, s 40. A → p, q, s; B → p, q, s; C → r, s; D → q, s  
41. A → p, r, u; B → q, r; C → p, t, s; D → p, r; E → s 42. A → q, r, s; B → p, r; C → p, r; D → p, r, s  
43. A → p, q, r, s; B → p, q, r; C → q, s; D → q

