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.

$$4BF_3 + 6H_2O \longrightarrow 3H_3O^+ + 3BF_4^- + B(OH)_3$$

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.

$$Al^{3+} > Ga^{3+} > In^{3+} > Tl^{3+}$$

$$\text{Most stable} \xrightarrow[\text{stability}]{} \text{lest stable}$$

$$Tl^{+} > In^{+} > Ga^{+} > Al^{+}$$

Ex. 3 If you have a mixture of CO and CO_2, how would you know about the relative proportions of the two gases in the given mixture ?

Sol. **(i)** Pass mixture through the $Ca(OH)_2$ solution; CO_2 is absorbed by $Ca(OH)_2$. The residual volume will be that of CO

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

(ii) Pass mixture through I_2O_5 ; CO reduces I_2O_5 to I_2.

$$5CO + I_2O_5 \longrightarrow I_2 + 5CO_2$$

I_2 thus liberated is determined by titration with $Na_2S_2O_3$.

$$2Na_2S_2O_3 + I_2 \longrightarrow 2NaI + Na_2S_4O_6$$

This is the quantitative method of estimation of CO.

Ex. 4 **True / False**

(a) BCl_3 in aqueous solution exists as B^{3+} and 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 H_2SO_4 and HNO_3.

(c) AlX_3 (X = Cl, Br) exists as dimer and retains dimer formula in non-polar solvents like ether, benzene etc.

(d) Be_2C is called acetylide because it reacts with water yielding ethyne.

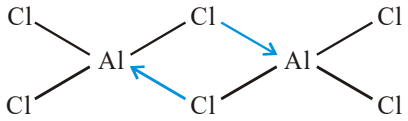
(e) Pb_3O_4 a double oxide, is obtained by heating lead (II) oxide in air.

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

Sol. **(a)** Statement is incorrect. BCl_3 hydrolyses in aqueous solution to give boric acid. Because it has large ionisation energies and to make the enthalpy of solution of BCl_3 negative, the enthalpy of hydration of B^{3+} should be very high (~ 600 g kJ) which is unlikely for the small B^{3+} cation.

(b) $2B + 6HNO_3\,(aq.) \longrightarrow 2H_3BO_3\,(aq.) + 6NO_2\,(g)$

(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.

$$Be_2C + 4H_2O \longrightarrow 2Be(OH)_2 + CH_4$$

(e) $3PbO + O_2 \xrightarrow{\Delta} Pb_3O_4$

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

(a) iodine is treated with $SnCl_2$.

(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.

Sol. **(d)** $Sn + 10HNO_3\,(\text{dilute}) \longrightarrow 4Sn(NO_3)_2 + NH_4NO_3 + 3H_2O$

(b) $NaCl + NH_4OH + CO_2 \longrightarrow NaHCO_3 + NH_4Cl$

(a) $2SnCl_2 + I_2 \longrightarrow 2SnCl_2I_2 \longrightarrow SnCl_4 + SnI_4$

(c) $Pb_3O_4 + 4HNO_3 \longrightarrow 2Pb(NO_3)_2 + PbO_2 + 2H_2O$

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

(a) The oxidation of HCl (aq) to Cl_2 (g) by PbO_2.

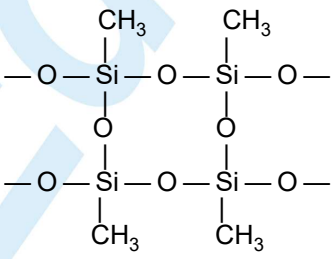
(b) The disproportionation of SnO to Sn and SnO_2.

Sol. **(a)** $PbO_2 + 4HCl \longrightarrow PbCl_2 + 2H_2O + Cl_2$

(b) $2SnO \longrightarrow Sn + SnO_2$

Ex. 7 What will happen if we take $Si(CH_3)Cl_3$ as a starting material for the preparation of commercial silicon polymer ?

Sol. With $Si(CH_3)Cl_3$ 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 :** PbO_2 is an oxidising agent and reduced to PbO.

Statement - 2 : Stability of Pb (II) > 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) B_2O_3 and 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 B_2H_5Cl.

(D) SiO_4^{4-} gets hydrolysed by acid or water and form $Si_2O_7^{6-}$.

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

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

$$B_2H_6 + 6Cl_2 \longrightarrow 2BCl_3 + 6HCl$$

Ex. 11 Match the following :

	Column - I		Column - II
(A)	Boron	**(p)**	Forms acidic oxides.
(B)	Carbon	**(q)**	Pure crystalline form is obtained by Van Arkel method.
(C)	Tin	**(r)**	Exists in allotropic forms.
(D)	Aluminium	**(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, B_2O_3 is acidic in nature.

$$2BI_3 \xrightarrow[\text{Van Arkel method}]{\text{red hot W}} 2B + 3I_2$$

(B) Exists in various allotropic forms like diamond, graphite etc. and its oxide CO_2 is acidic in nature.

(C) Exists in allotropic forms like grey tin (α-Sn) and white tin (β-Sn). Hydroxide is amphoteric in nature.

$$Sn(OH)_4 + 2OH^- \longrightarrow [Sn(OH)_6]^{2-}$$

$$Sn(OH)_4 + 4H^+ \longrightarrow Sn^{4+} + 4H_2O$$

(D) Hydroxide is amphoteric in nature.

$$Al(OH)_3 + OH^- \longrightarrow [Al(OH)_4]^-$$

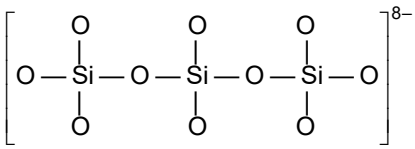
$$Al(OH)_3 + 3H^+ \longrightarrow Al^{3+} + 3H_2O$$

Ex. 12 The silicate anion in the mineral kionite is a chain of three SiO_4 tetrahedra that share corners with adjacent tetrahedra. The mineral also contains Ca^{2+} ions, 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 SiO_4 tetrahedra that share corners with adjacent tetrahedra thus silicate is Si_3O_{10}, hence it can be represented as with charge as = $3 \times 4n + 10 \times (-2) = -8$



(b) Ca^{2+}, Cu^{2+} and H_2O 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 Ca^{2+}, Cu^{2+} and H_2O thus, kinoite has formula $Ca_2Cu_2Si_3O_{10} \cdot 2H_2O$.

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

$$CH_4 > SiH_4 > GeH_4 > SnH_4 > PbH_4$$

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 alkalies ?

(A) Boron **(B)** Silicon **(C)** Aluminium **(D)** None of these

Ans. **(D)**

Sol. Boron dissolved in fused alkalies according to the following reaction.

$$2B + 6NaOH \xrightarrow{\text{fused}} 2Na_3BO_3 + 3H_2$$

Silicon and aluminium dissolved in both fused and aqueous alkalies.

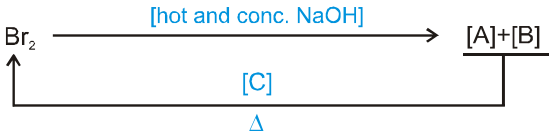
Ex. 15 What happens when CO_2 (g) is passed through sodium meta borate solution ?

Sol. $4NaBO_2 + CO_2 \longrightarrow Na_2B_4O_7 + Na_2CO_3$

Ex. 16 Why anhydrous HF liquid is not electrolysed alone to get 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^- ; [B] = BrO_3^- ; [C] = concentrated H_2SO_4

Sol. $3Br_2 + 6OH^- \rightarrow 5Br^- + BrO_3^- + 3H_2O$

$5Br^- + BrO_3^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$

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^+ and CN^-.

(b) Bright blue solution is formed which has been shown to have I_2^+ and I_3^+.

$$2\,I_2 + 6H_2SO_4.\,SO_3 \longrightarrow 2I_2^+ + 2HS_3O_{10}^- + 5H_2SO_4 + SO_2$$

$$3\,I_2 + 6H_2SO_4.\,SO_3 \longrightarrow 2I_3^+ + 2HS_3O_{10}^- + 5H_2SO_4 + SO_2.$$

(c) It is due to the presence of (I_3^+ and I_3^-) species produced by self ionisation of iodine $3I_2 \rightleftharpoons I_3^+ + I_3^-$

Ex. 19 Match the following .

Column - I	Column - II
(A) $ClO_2 \longrightarrow Cl_2O_3$	**(p)** Boiling with NaOH solution.
(B) $[Al(OH)_4]^- \longrightarrow Al(OH)_3\downarrow$	**(q)** On passing ozone.
(C) $P_4 \longrightarrow PH_3 + H_2PO_2^-$	**(r)** Reaction with hydrogen.
(D) $XeF_2 \longrightarrow Xe$	**(s)** On passing CO_2 gas.

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

(A) $2ClO_2 + 2O_3 \longrightarrow Cl_2O_6 + 2O_2$ oxidation by ozone.

(B) $CO_2 + H_2O \rightarrow H_2CO_3 \rightleftharpoons CO_3^{2-} + 2H^+$; $2Al^{3+} + 3CO_3^{2-} + 3H_2O \longrightarrow 2Al(OH)_3 + 3CO_2$

As acidic property of $Al(OH)_3$ is very weak.

(C) $P_4 + 3NaOH + 3H_2O \xrightarrow{\text{boil/warm}} PH_3 + 3NaH_2PO_2.$

Alkaline hydrolysis.

(D) $2XeF_2 + 4OH^- \longrightarrow 2Xe + 4F^- + 2H_2O + O_2$

Alkaline hydrolysis.

$XeF_2 + H_2 \longrightarrow 2Xe + 2HF$

Reduction by hydrogen.

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

$KBrO_3 + F_2 + KOH \longrightarrow$ product(s)

(A) $KBrO_4$ **(B)** KF **(C)** HOF **(D)** Br_2

Sol. $KBrO_3 + F_2 + 2KOH \longrightarrow KBrO_4 + 2KF + H_2O$. **Ans (A,B)**

Ex. 21 $Na_2S_2O_3$ may react with the compounds given in column (I). $Na_2S_2O_3$ 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)	**Column - II (type of property shown)**
(A) Chlorine (CI_2)	**(p)** Complexing reagent
(B) Silver bromide	**(q)** Disproportionation
(C) Hydrochloric acid	**(r)** Only as reductant
(D) Iodine (I_2)	**(s)** An-antichlor

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

Sol. **(A)** $Na_2\overset{+2}{S_2}O_3 + 4CI_2 + 5H_2O \longrightarrow 2NaH\overset{+6}{S}O_4 + 8HCI$

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

(B) $Ag^+ + 2S_2O_3^{2-} \rightarrow [Ag(S_2O_3)_2]^{3-}$ (soluble complex)

(C) $Na_2\overset{+2}{S_2}O_3 + 2HCI \rightarrow 2NaCI + \overset{+4}{S}O_2 + \overset{0}{S} + H_2O$

(D) $2Na_2\overset{+2}{S_2}O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$

Exercise # 1 [Single Correct Choice Type Questions]

1. Boric acid polymerizes due to –
(A) The presence of hydrogen bonds **(B)** Its acidic nature
(C) Its geometry **(D)** Its monobasic nautre

2. Aluminium is obtained by–
(A) Reduction of Al_2O_3 with coke
(B) Electrolysis of Al_2O_3 dissolved in Na_3AlF_6
(C) Reduction of Al_2O_3 with chromium
(D) Heating cryolite and alumina

3. In thermite welding, aluminium acts as –
(A) A solder **(B)** A flux **(C)** An oxidising agent **(D)** A reducing agent

4. 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

5. Which of the following can be detected by the borax-bead test ?
(A) Ni^{2+} **(B)** Co^{2+} **(C)** Pb^{+2} **(D)** Both **(A)** & **(B)**

6. The hydrides of boron are called
(A) Boron hydrogen compounds **(B)** Hydrogen borides
(C) Boranes **(D)** Hydroboric acids

7. Which one of the following mixed sulphates is not an alum ?
(A) $K_2SO_4.Al_2(SO_4)_3.24H_2O$ **(B)** $K_2SO_4.Cr_2(SO_4)_3.24H_2O$
(C) $Na_2SO_4.Fe(SO_4)_3.24H_2O$ **(D)** $CuSO_4.Al_2(SO_4)_3.24H_2O$

8. Higher percentage of carbon is found in –
(A) Anthracite **(B)** Lignite **(C)** Bituminous **(D)** Peat

9. From B_2H_6, all the following can be prepared except –
(A) B_2O_3 **(B)** H_3BO_3 **(C)** $B_2(CH_3)_6$ **(D)** $NaBH_4$

10. The product formed in the reaction,
$BCl_3 + H_2O \longrightarrow$ Product is –
(A) $H_3BO_3 + HCl$ **(B)** $B_2O_3 + HOCl$ **(C)** $B_2H_6 + HCl$ **(D)** No reaction

11. Silicones have the general formula –
(A) SiO_4^{4-} **(B)** $Si_2O_7^{6-}$ **(C)** $(R_2SiO)_n$ **(D)** $(SiO_3)_n^{2-}$

12. In which of the following there exists a $p\pi - d\pi$ bonding –
(A) Diamond **(B)** Graphite **(C)** Dimethylamine **(D)** Trisilylamines

13. Glass or silica soluble in –
(A) $HClO_4$ **(B)** HF **(C)** Aqua-regia **(D)** H_2SO_4

14. The species present in solution when CO_2 is dissolved in water are –
(A) $CO_2, H_2CO_3, HCO_3^-, CO_3^{2-}$ **(B)** H_2CO_3, CO_3^{2-}
(C) CO_3^{2-}, HCO_3^- **(D)** CO_2, H_2CO_3

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) Na_2S **(B)** Na_2SO_3 **(C)** Na_2SO_4 **(D)** $Na_2S_4O_6$

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-

ClOH(I) BrOH(II) IOH(III)

(A) I > II > III **(B)** II > I > III **(C)** III > II > I **(D)** I > III > II

38. Sea weed are important source of –

(A) Iron **(B)** Chlorine **(C)** Iodine **(D)** Bromine

39. Euchlorine is a mixture of –

(A) Cl_2 and SO_2 **(B)** Cl_2 and ClO_2 **(C)** Cl_2 and CO **(D)** None of these

40. BCl_3 does not exist as dimer but BH_3 exist as dimer (B_2H_6) because –

(A) Chlorine is more electronegative than hydrogen

(B) There is $p\pi - p\pi$ back bonding in BCl_3 but 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) $B(OH)_3$ **(B)** Mixutre of B_2O_3 and BN

(C) Only B_2O_3 **(D)** Only BN

42. Which of the following statements is correct ?

(A) BCl_3 and $AlCl_3$ are both Lewis acids and BCl_3 is stronger than $AlCl_3$

(B) BCl_3 and $AlCl_3$ both Lewis acids and $AlCl_3$ is stronger that BCl_3

(C) BCl_3 and $AlCl_3$ are both equally strong Lewis acids

(D) Both BCl_3 and $AlCl_3$ 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. $AlCl_3$ on hydrolysis gives –

(A) $Al_2O_3.H_2O$ **(B)** $Al(OH)_3$ **(C)** Al_2O_3 **(D)** $AlCl_3.6H_2O$

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) BF_3 **(B)** BCl_3 **(C)** BBr_3 **(D)** BH_3

47. Thermite is a mixture of –

(A) 3 Parts of powdered Al and 1 part of Fe_2O_3 **(B)** 1 part of powdered Al and 3 parts of Fe_2O_3

(C) 1 part of powdered Al and 1 part of Fe_2O_3 **(D)** 2 Parts of powdered Al and 1 part of Fe_2O_3

48. Borax is used as cleansing agent because on dissolving in water it gives –

(A) Alkaline solution **(B)** Acidic solution **(C)** Bleching solution **(D)** Colloidal solution

49. $SbCl_3$ and $BiCl_3$ on hydrolysis gives –

(A) Sb^{+3} and Bi^{+3} **(B)** $Sb(OH)_3$ and $Bi(OH)_3$

(C) SbOCl and 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) $SO_2 > CO_2 > CO > N_2O_5$ **(B)** $SO_2 > N_2O_5 > CO > CO_2$

(C) $N_2O_5 > SO_2 > CO > CO_2$ **(D)** $N_2O_5 > SO_2 > CO_2 > CO$

52. Trisilylamine [$\ddot{N}(SiH_3)_3$] has a –

(A) Planar geometry **(B)** Tetrahedral geometry

(C) Pyramidal geometry **(D)** None of these

53. The halide that is not hydrolysed is –

(A) $SiCl_4$ **(B)** SiF_4 **(C)** CCl_4 **(D)** $PbCl_4$

54. What is false about N_2O_5 ?

(A) It is anhydride of HNO_3 **(B)** It is a powerful oxidizing agent

(C) Solid N_2O_5 is called nitronium nitrate **(D)** Structure of N_2O_5 contains no [N→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) $Pb(NO_3)_2$ **(B)** NH_4NO_3 **(C)** $Cu(NO_3)_2$ **(D)** $NaNO_3$

58. By passing H_2S gas in acidified $KMnO_4$ solution, we get –

(A) K_2S **(B)** S **(C)** K_2SO_3 **(D)** MnO_2

59. Chloride of lime is –
(A) $CaOCl_2$ **(B)** $Ca(OCl)_2$ **(C)** $CaCl_2$ **(D)** $(CaO)_2Cl$

60. Which one of the following oxy acid of fluorine exists ?
(A) HOF **(B)** HFO_3 **(C)** HFO_4 **(D)** HFO_2

61. H_2SO_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) $ZnSO_4$ **(B)** $CaSO_4$ **(C)** $BaSO_4$ **(D)** $PbSO_4$

63. Which of the following does not react with AgCl –
(A) $Na_2S_2O_3$ **(B)** NH_4OH **(C)** $NaNO_3$ **(D)** NH_3

64. Chromyl chloride test is performed for the confirmation of the presence of the following in mixture –
(A) SO_4^{2-} **(B)** Cr^{+++} **(C)** Cl^- **(D)** Cr^{+++} and Cl^-

65. Iodine gas turns strach 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)** I_2

67. HI can be prepared by all the following methods except –
(A) $Pl_3 + H_2O$ **(B)** $KI + H_2SO_4$ **(C)** $H_2 + I_2 \longrightarrow$ **(D)** $I_2 + H_2S$

68. When I_2 is passed through KCl, KF, KBr solution –
(A) Cl_2 and Br_2 are evolved **(B)** Cl_2 is evolved
(C) Cl_2, Br_2, F_2 are evolved **(D)** None of these

69. Which two of the following salts are used for preparing iodized salt–
(i) KIO_3 (ii) KI (iii) I_2 (iv) 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) $Ca(ClO_2)_2$ **(B)** $CaCl_2$ **(C)** $CaOCl_2$ **(D)** $Ca(OCl_2)_2$

71. Iodine is formed when KI reacts with a solution of –
(A) $ZnSO_4$ **(B)** $CuSO_4$ **(C)** $FeSO_4$ **(D)** $(NH_4)_2SO_4$

72. Which amongst the following reactions cannot be used for the preparation of the halogen acid ?
(A) $2KBr + H_2SO_4(Conc.) \longrightarrow K_2SO_4 + 2HBr$
(B) $2NaCl + H_2SO_4(Conc.) \longrightarrow NaHSO_4 + HCl$
(C) $NaHSO_4 + NaCl \longrightarrow Na_2SO_4 + HCl$
(D) $CaF_2 + H_2SO_4(conc.) \longrightarrow CaSO_4 + 2HF$

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?

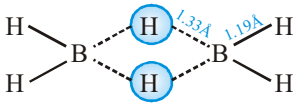
(A) It has two bridging hydrogens and four perpendicular to the rest.

(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°
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

80. Borax is actually made of two tetrahedral and two triangular units joined together and should be written as : $Na_2[B_4O_5(OH)_4] \cdot 8H_2O$.

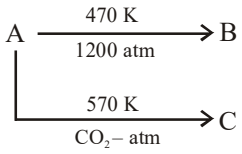
Consider the following statements about borax:

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 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) Mn_3O_4, MnO_2, $MnCl_2$ **(B)** Pb_3O_4, PbO_2, $PbCl_2$

(C) Fe_3O_4, Fe_2O_3, $FeCl_2$ **(D)** Fe_3O_4, Fe_2O_3, $FeCl_3$

83. Match List-I with List-II

List-I Chemical reaction	**List-II Name of process**
(1) $4NH_3 + 5O_2 \xrightarrow{800°C/Pt} 4NO + 6H_2O$	(a) Contact process
(2) $4HCl + O_2 \xrightarrow[450\text{-}500°/V_2O_5]{3230°C/CuCl_2} 2Cl_2 + 2H_2O$	(b) Ostwald's process
(3) $2SO_2 + O_2 \longrightarrow 2SO_3$	(c) Deacon's process
(4) $2N_2 + 3H_2 \xrightarrow{Fe+Mo} 2NH_3$	(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 α, β and γ is –

(A) SO_2 **(B)** SO_3 **(C)** CO_2 **(D)** NH_3

85. $HNO_3 + P_4O_{10} \longrightarrow HPO_3 + A$; The product A is –

(A) N_2O **(B)** N_2O_3 **(C)** NO_2 **(D)** N_2O_5

86. The solubility of anhydrous $AlCl_3$ and hydrous $AlCl_3$ 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 HNO_3 reacts with iodine to give –

(A) HI **(B)** HOI **(C)** $HOIO_2$ **(D)** $HOIO_3$

88. Conc. H_2SO_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. HNO_3 is yellow coloured liquid due to –

(A) Dissolution of NO in conc. HNO_3

(B) Dissolution of NO_2 in conc. HNO_3

(C) Dissolution of N_2O in conc. HNO_3

(D) Dissolution of N_2O_3 in conc. HNO_3

90. When chlorine gas is passed through an aqueous solution of a potassium halide in the presence of chloroform, a voilet colouration is obtained. On passing more of chlorine water, the voilet 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) NH_4NO_3, N_2O, H_2O, P_2O_5

(B) NH_4NO_2, N_2O, H_2O, P_2O_5

(C) $CaCO_3$, CaO, H_2O, $CaCl_2$

(D) $CaCO_3$, CaO, H_2O, $Ca(OH)_2$

92. CH_2(COOH)(COOH) $\xrightarrow{P_4O_{10},150^\circ C}$ X. Compound (X) is –

(A) Malonic acid **(B)** Carbon suboxide **(C)** Tartaric acid **(D)** Acetic acid

93. $H_3BO_3 \xrightarrow{T_2} X \xrightarrow{T_2} Y \xrightarrow{\text{red hot}} B_2O_2$ if $T_1 < T_2$ 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 $B(OH)_3$ only.

(B) Formation of 2 mol of $[B(OH)_4]^-$ only.

(C) Formation of 1 mol each of $B(OH)_3$ and $[B(OH)_4]^-$

(D) Formation of 2 mol each of $[B(OH)_4]^-$ and $B(OH)_3$, of which only $[B(OH)_4]^-$ 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.H_2SO_4 and MnO_2 the gas evolved is –

(A) HF **(B)** F_2 **(C)** SF_4 **(D)** None

Exercise # 2 Part # I [Multiple Correct Choice Type Questions]

1. Which species exist:
(A) $[BF_6]^{3-}$ **(B)** $[AlF_6]^{3-}$ **(C)** $[GaF_6]^{3-}$ **(D)** $[InF_6]^{3-}$

2. Borax bead test is given by:
(A) An aluminium salt **(B)** A cobalt salt **(C)** A copper salt **(D)** A nickel salt

3. Which of the following statement(s) is/are correct ?
(A) The oxide, B_2O_3 and $B(OH)_3$ are acidic
(B) The halides of B (except 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, $(AlH_3)_n$.

4. Which of the following statements about anhydrous aluminium chloride is/are incorrect ?
(A) It exists as $AlCl_3$ molecule in gaseous phase **(B)** It is a strong Lewis base
(C) It sublimes at 100°C under vacuum **(D)** It is not easily hydrolysed

5. 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) C_{60} is called as Buckminster fullerene

6. Carbon monoxide is prepared by :
(A) heating formic acid with conc. H_2SO_4 **(B)** heating potassium ferrocyanide with conc H_2SO_4
(C) heating malonic acid with P_4O_{10} **(D)** hydrolysis of Mg_2C_3

7. 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

8. Which is/are true in case of 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 NH_3

9. 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

10. 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. H_2SO_4.

11. Which of the following give(s) ethyne on reaction with water?
(A) $Al_2(C_2)_3$ **(B)** Al_4C_3 **(C)** SrC_2 **(D)** Mg_2C_3

12. A complex cross-linked polymer (silicone) is formed by
(A) hydrolysis of $(CH_3)_3SiCl$. **(B)** hydrolysis of a mixture of $(CH_3)_3SiCl$ and $(CH_3)_2SiCl_2$
(C) hydrolysis of CH_3SiCl_3 **(D)** hydrolysis of $SiCl_4$.

13. Consider the following statements and which of the folowing are correct ?
S_1 : $B_4O_7^{2-}$ on hydrolysis with acid / water yields $B(OH)_3$.
S_2 : SiO_4^{4-} on hydrolysis with acid / water yields $Si_2O_7^{6-}$.
S_3 : $MeSiCl_3$ on hydrolysis and then condensations gives a complex cross-linked polymer of silicones.
S_4 : Among CO_2, CuO, CaO and H_2O, CO_2 is most acidic oxide while CaO is most basic oxide.
(A) S_1 S_2 S_3 only **(B)** $S_1S_3S_4$ only **(C)** $S_1S_2S_3S_4$ **(D)** S_2 S_3 S_4 only

14. Which is / are the correct statement(s) ?
(A) BeF_2 readily coordinates two additional F^- ions forming the $[BeF_4]^{2-}$ complex.
(B) One mole of borax in aqueous solution reacts with two moles of acid.
(C) HCOONa as well as solid $K_3[Fe(CN)_6]$ both on heating with concentrated sulphuric acid evolve carbon monoxide gas.
(D) Carbon mono oxide when passed through a solution of iodine pentaoxide, I_2O_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 $(SiO_4)^{4-}$ units.
(D) Asbestos mineral is a double chain silicate and mica is a sheet silicate.

16. Boron can be obtained by :
(A) reduction of Br_2O_3 by C.
(B) reduction of BCl_3 with H_2 at 1270 K.
(C) thermal decomposition of boron halides at 1173 K.
(D) electrolytic reduction of KBF_4 in KF at 1073 K.

17. What products are expected from the reaction between colemanite powder and sodium carbonate solution, when they are heated ?
(A) $CaCO_3$ **(B)** $Na_2B_4O_7$ **(C)** $NaBO_2$ **(D)** 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)** Fullerences **(D)** Gas carbon.

20. Which is/are incorrect statement(s) ?
(A) Diamond is unaffected by conc acids but graphite reacts with hot conc HNO_3 forming mellitic acid.
(B) 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) $(Me)_2$ Si $(Cl)_2$ on hydrolysis followed by condensation, produces $(Me)_2$ Si $(OH)_2$.

21. Select the correct statement (s)

(A) CH_3SiCl_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 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)** NH_4Cl **(C)** N_2H_4 **(D)** HNO_2

23. As, Sb and Bi show little or no tendency to form negative ions of the type 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 NH_3 to BiH_3

(D) The reducting power increases in going from NH_3 to BiH_3

25. What is true for hydrogen peroxide and ozone ?

(A) H_2O_2 acts as a stronger reducing agent in alkaline medium than in acidic medium

(B) H_2O_2 and O_3 both are oxidising agents as well as bleaching agent

(C) H_2O_2 forms a hydrate, $H_2O_2.H_2O$

(D) Ozone is used in the manufacture of potassium permangnate 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 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) $SbH_3 > NH_3 > ASH_3 > PH_3$ (boiling point)

(B) $H_3PO_4 > H_3PO_3 > H_3PO_2$ (reducing character)

(C) $N_2O < NO < N_2O_3 < N_2O_5$ (oxidation state on nitrogen atom)

(D) $NH_3 > PH_3 > ASH_3 > SbH_3 \geq BiH_3$ (basicity)

29. Which of the following statements is (are) correct ?

(A) Antimony on reaction with conc. HNO_3 gives antimonic acid.

(B) Manganese on reaction with cold and dilute HNO_3 gives NO_2 gas.

(C) HNO_2 disproportionate to give HNO_3 and NO

(D) HNO_3 on reaction with P_4O_{10} gives N_2O_5

30. Which of the following is/are true for oxygen.

(A) $KMnO_4(s)$ on strong heating gives oxygen gas

(B) Oxygen mixed with helium is used for artificial respiration.

(C) It has two unpaired electrons in bonding π molecular orbitals.

(D) Brins process is used as industrial method for the preparation of oxygen gas.

31. Which among the following is/are peroxo acid (s) ?

(A) $H_2S_2O_3$ **(B)** H_2SO_5 **(C)** $H_2S_2O_7$ **(D)** $H_2S_2O_8$

32. Ammonium dichromate on heating liberates a gas. The same gas will be obtained by :

(A) heating $NaNO_2$ and NH_4Cl. **(B)** treating H_2O_2 with $NaNO_2$.

(C) passing ammonia gas over red hot CuO. **(D)** treating ammonia with $KMnO_4$ in neutral medium.

33. Nitrogen (I) oxide is produced by :

(A) thermal decomposition of ammonium nitrate. **(B)** disproportionation of N_2O_4.

(C) thermal decomposition of ammonium nitrite. **(D)** interaction of hydroxyl ammine and nitrous acid

34. Select the incorrect statements(s).

(A) Alkaline H_2O_2 reduces ClO_2 to ClO_2^-

(B) Ammonia reacts with excess of iodine to form an explosive, $NI_3.NH_3$

(C) The manufacture of HNO_3 is based upon catalytic oxidation of NH_3 by atmospheric oxygen.

(D) N_2O_3 with concentrated $HClO_4$ forms nitrosyl salt.

35. Which of the following is/are incorrect statement(s) for phosphine ?

(A) It is less basic then NH_3.

(B) It is less poisonous than NH_3.

(C) The solution of PH_3 in water does not decompose.

(D) Phosphine on heating at 150°C burns forming H_3PO_4.

36. What is/are not true about phosphine (PH_3) ?

(A) It turns red litmus blue.

(B) It reacts with HCl(aq.) to give PH_4Cl.

(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) NaI **(B)** Na_2SO_3 **(C)** $Na_2S_4O_6$ **(D)** Na_2SO_4

38. Cl_2 reacts with hot aqueous NaOH to give :

(A) NaCl **(B)** $NaClO_3$ **(C)** $NaClO_2$ **(D)** $NaClO_4$

39. Select the correct order of acidity :

(A) HI > HBr > HCl > HF
(B) $HClO_4 > HBrO_4 > HIO_4$
(C) HClO < HBrO > HlO
(D) $HClO_4 > HClO_3 > HClO_2 > HClO$

40. Which is / are true statement(s) ?

(A) Basic nature of X^- is in order $F^- > Cl^- > Br^- > I^-$
(B) HI is strongest acid of HF, HCl, HBr and HI
(C) The ionic character of M—X bond decreases in the order M—F > M—Cl > M—Br > M—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) Cl_2 **(B)** H_2 **(C)** NaOH **(D)** None

42. Which of the following salts will evolve halogen on treatment with conc. H_2SO_4 ?

(A) NaCl **(B)** KI **(C)** NaBr **(D)** none of these

43. Which of the following product(s) is/are obtained when Cl_2O_6 reacts with KOH ?

(A) KCl **(B)** $KClO_2$ **(C)** $KClO_3$ **(D)** $KClO_4$

44. Which of the following product(s) is/are obtained when Cl_2O reacts with NH_3 ?

(A) NO_2 **(B)** N_2 **(C)** NCl_3 **(D)** NH_4Cl

45. Select the incorrect order.

(A) He > Ar > Kr > Ne > Xe – (abundance in air).
(B) He < Ne < Ar < Kr < Xe – (boiling point).
(C) $XeF_6 > XeF_4 > XeF_2$ – (melting point).
(D) $XeF_6 < XeF_4 < XeF_2$ – (Xe – F bond length).

46. Which of the following statements(s) is /are true for XeF_6 ?

(A) Its partial hydrolysis gives $XeOF_4$.
(B) Its reaction with silica gives $XeOF_4$
(C) It is prepared by the reaction of XeF_4 and O_2F_2
(D) Its reaction with XeO_3 gives $XeOF_4$.

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, XeF_2 slowly and, XeF_4 and XeF_6 rapidly.
(B) All three fluorides are powerful oxidising agents.
(C) XeF_4 and 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) clatharate compoud(s) with quinol ?

(A) Helium **(B)** Xenon **(C)** Krypton **(D)** Neon

50. Which among the following statements is / are correct ?

(A) XeF_4 and 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.

51. Thermal decomposition product (s) of XeF_6 is /are :

(A) Xe **(B)** XeF_2 **(C)** XeF_4 **(D)** F_2

52. Select correct statement(s)

(A) ClO_2 and Cl_2O are used as bleaching agents for paper pulp and textiles.

(B) OCl^- disproportionates in alkaline medium.

(C) BrO_3^- liberates Br_2 with iodine in acidic medium.

(D) $HClO_2$ liberates iodine from KI.

53. What products are expected from disproportionation reaction of hypochlorous acid ?

(A) $HClO_3$ **(B)** $HClO_2$ **(C)** HCl **(D)** $HClO_4$

54. Select the correct order (s).

(A) HOCl > HOBr > HOI – Acid strength. **(B)** $HClO_4 < HClO_3 < HClO_2 \leq$ HClO – oxidising power

(C) $ClO_4^- < BrO_4^- < IO_4^-$ – oxidising power **(D)** $IO^- > BrO^- > ClO^-$ – ease of disproportionation.

55. Which of the following pair(s) will give chlorine gas most quickly, upon reaction ?

(A) HCl and $KMnO_4$ **(B)** NaCl and H_3PO_4 **(C)** NaCl and MnO_2 **(D)** $CaCl_2$ and Br_2

56. Iodine is liberated from sodium iodate by reacting with :

(A) dilute H_2SO_4 **(B)** $KMnO_4$ **(C)** $NaHSO_3$ **(D)** concentrated H_2SO_4 & NaI

57. HI can be prepared by all the following methods except :

(A) $Pl_3 + H_2O$ **(B)** $KI + H_2SO_4$ **(C)** $H_2 + I_2 \xrightarrow{Pt}$ **(D)** $I_2 + H_2S$

58. A solution of KI_3 in water contains :

(A) K^{3+} ions **(B)** I^- ions **(C)** K^+ ions **(D)** 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 $[AlF_6]^{3-}$ but B does not form $[BF_6]^{3-}$

Statement-2 : BF_3 on hydrolysis gives 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 :** $AlCl_3$ forms dimer Al_2Cl_6 in gaseous state but it dissolves in H_2O forming $[Al(H_2O)_6]^{3+}$ and $3Cl^-$ ions.
Statement-2 : Aqueous solution of $AlCl_3$ is acidic due to hydrolysis.

4. **Statement-1 :** $Al(OH)_3$ is insoluble in NH_4OH but soluble in NaOH
Statement-2 : 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, $B_3N_3H_6$

7. **Statement-1 :** Si–Si bonds are much weaker than Si–O bonds.
Statement-2 : Silicon forms double bonds with itself.

8. **Statement-1 :** Pb^{4+} can be reduced easily to Pb^{2+}.
Statement-2 : Pb^{2+} is paramagnetic.

9. **Statement-1 :** Al $(OH)_3$ is amphoteric in nature.
Statement-2 : Al–O and O–H bonds can be broken with equal ease in $Al(OH)_3$.

10. **Statement-1 :** $SnCl_2 . 2H_2O$ is soluble in water and its solution becomes milky on standing.
Statement-2 : $SnCl_2 . 2H_2O$ undergoes hydrolysis slowly forming $Sn(OH)_2$ and HCl.

11. **Statement-1 :** SiF_6^{2-} is known but $SiCl_6^{2-}$ 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 :** Buckminister 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 SiO_2 is taken in excess.
Statement-2 : Excess of SiO_2 prevents the formation of the carbide 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 $Na_2[B_4O_5(OH)_4].8H_2O$ 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 :** $AlCl_3$ ionises in solution.
Statement-2 : The hydration energy of $AlCl_3$ exceeds the ionization energy.

18. **Statement-1 :** $T●^{3+}$ acts as an oxidising agent
Statement-2 : $T●^{+}$ is more stable than $T●^{3+}$ due to inert pair effect.

19. **Statement-1 :** PbI_4 is a stable compound.
Statement-2 : 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 NX_3, the dipole moment is highest for NI_3 and lowest for NF_3.
Statement-2 : Nitrogen halides NX_3 , have trigonal pyramidal structure.

22. **Statement-1 :** Bismith 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 N_2O.
Statement-2 : The contaminant is NO which is removed by passing through ferrous sulphate solution.

24. **Statement-1 :** H_3PO_3 is a dibasic acid and shows reducing character.
Statement-2 : H_3PO_3 contains two OH^- groups and one hydrogen atom directly attached to P atom.

25. **Statement-1 :** Liquid NH_3 is used for refrigeration.
Statement-2 : Enthalpy of vaporisation of ammonia is very large.

26. **Statement-1 :** NaH_2PO_2 is an acid salt.
Statement-2 : It contains no ionisable protons.

27. **Statement-1 :** Both H_3PO_3 and H_3PO_4 have the same number of hydrogen atoms but H_3PO_4 is a tribasic acid and H_3PO_3 is a dibasic acid.
Statement-2 : 1 mol of H_3PO_3 is neutralised by 2 mol of NaOH while 1 mol of H_3PO_4 is neutralised by 3 mol of NaOH.

28. **Statement-1 :** HNO_3 is stronger acid than HNO_2.
Statement-2 : In HNO_3 there are two nitrogen to oxygen bonds where as in 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 Hg_2O 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 (O^{2-})
Statement-2 : Dinegative anion of oxygen (O^{2-}) is quite common but dinegative anion of sulphur (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 O = O molecule.

34. **Statement-1 :** Anhydrous BaO_2 is not used for preparing H_2O_2.
Statement-2 : H_2O_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.

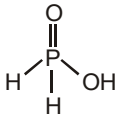
37. **Statement-1 :** Sulphur exhibits paramagnetic behaviour in vapour state.
Statement-2 : In vapour state sulphur partly exists as S_2 molecule which has two unpaired electrons in antibonding π orbitals.

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.

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 :** IO_3^- oxidises I^- to I_2 in acidic medium.
Statement-2 : HIO_3 is formed by oxidation of I_2 with concentrated HNO_3.

54. **Statement-1 :** Hydrolysis of XeF_6 represents a redox reaction.
Statement-2 : The products of hydrolysis are $XeOF_4$ and 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 (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 :** $HClO_4$ is a more stronger acid than $HClO_3$.
Statement-2 : Oxidation state of Cl in $HClO_4$ is +7 and in $HClO_3$ is +5.

58. **Statement-1 :** Fluorine is obtained by the interaction of K_2MnF_6 with lewis acid SbF_5.
Statement-2 : Stronger lewis acid SbF_5 displaces weaker acid MnF_4 from K_2MnF_6 and MnF_4 being unstable decomposes to give MnF_3 and 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) $BBr_3 + H_2 \longrightarrow B$	(p) Borax bead test
(B) $Na_2B_4O_7.10H_2O + CuSO_4 \rightarrow Cu(BO_2)_2$	(q) Reduction
(C) $AlCl_3 + H_2O \longrightarrow HCl$	(r) White fumes
(D) $Cr_2O_3 + Al \longrightarrow Cr$	(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) $Al_2(C_2)_3 + H_2O \longrightarrow$	(p) One of the products contains both σ and π bonds
(B) $CH_2(COOH)_2 + P_4O_{10} \longrightarrow$	(q) Hydrolysis
(C) $CH_3SiCl_3 + H_2O \longrightarrow$	(r) Dehydration
(D) $SnCl_2.2H_2O \xrightarrow[\text{standing}]{\text{on}}$	(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) $B_2O_3 + H_2O$	(p) H_3BO_3
(B) $B_2H_6 + H_2O$	(q) H_2
(C) $B_3N_3H_6 + H_2O$	(r) HCl
(D) $BCl_3 + H_2O$	(s) NH_3
	(t) 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 $(SiO_3)_n^{2n-}$
(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) Thorteveitite	(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) $PCl_5 \xrightarrow[\text{Air}]{\text{Moist}}$	(p) Hydrolysis
(B) $P_4 + NaOH\,(conc.) + H_2O \xrightarrow{\text{Warm}}$	(q) At least one of the products has tetrahedral hybridisation
(C) $H_3PO_3 \xrightarrow{\Delta}$	(r) Disproportionation
(D) $P_4O_6 + H_2O \xrightarrow{\Delta}$	(s) At least one of the products has $p\pi$–$d\pi$ bonding.

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

Column – I	Column – II
(A) $(NH_4)_2S_2O_8 + H_2O \xrightarrow{\text{Distillation}}$	**(p)** Hydrolysis
(B) $NaBO_2 + H_2O + H_2O_2 \xrightarrow{OH^-}$	**(q)** One of the product has peroxide linkage
(C) $Na_2SO_3 \xrightarrow[\text{temperature}]{\text{fusion}}$	**(r)** Disproportionation.
(D) 2–Ethyl anthraquinol + Air $\longrightarrow$	**(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 phosphoros)	Column II (Characteristic bonds)
(A) $H_4P_2O_7$	**(p)** P—P bond **(s)**
(B) $H_4P_2O_5$	**(q)** P—O—P bond **(s)**
(C) $H_4P_2O_6$	**(r)** P—H bond **(s)**
(D) $(HPO_3)_n$ (cyclic)	**(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
(A) $PbO_2 + HNO_3 \rightarrow$	**(p)** One of the products has bond order of two.
(B) $Cr_2O_7^{2-} + H^+ + H_2O_2 \rightarrow$	**(q)** One of the products has peroxide linkage**(s)**.
(C) $H_2O_2 + ClO_2 + OH^- \rightarrow$	**(r)** One of the products is a hydride and is liquid at room temperature.
(D) $XeF_2 + NaOH \rightarrow$	**(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
(A) $2NO_2 \xrightarrow{\text{Cool}}$	**(p)** One of the products is a mixed anhydride.
(B) $ClO_2 + O_3 \xrightarrow{H^+}$	**(q)** One of the products is an acidic oxide.
(C) $K_4[Fe(CN)_6] + H_2SO_4(\text{conc.}) + H_2O \xrightarrow{\Delta}$	**(r)** The oxidation state of the central atom of one of the products is + 6.
(D) $KOH + O_3 \longrightarrow$	**(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
(A) $Cl_2O_6 + H_2O \longrightarrow$	**(p)** ClO_2
(B) $NaClO_4$**(s)** + HCl(conc.) $\longrightarrow$	**(q)** $HClO_3$
(C) $KClO_3 + (COOH)_2 \longrightarrow$	**(r)** Cl_2O
(D) $HgO + Cl_2 \xrightarrow{573K}$	**(s)** $HClO_4$

12. Match the reaction products listed in column–I with the particulars listed in column-II

Column–I	Column–II
(A) $XeF_2 + H_2O \longrightarrow$	(p) Redox reaction
(B) $XeF_4 + H_2O \longrightarrow$	(q) Disproportionation
(C) $XeF_6 + H_2O \longrightarrow$	(r) O_2 formation
(D) $XeO_3 + NaOH \longrightarrow$	(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 (●)	(p) Oxidising agent
(B) Ozone	(q) Non-polar (i.e. $\mu = 0$)
(C) XeF_2	(r) Liberates iodine from the halide ion.
(D) 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) $Na_2CO_3\,(aq) + Br_2\,(●) \rightarrow$	(p) Disproportionation reaction
(B) $KClO_3 + H_2SO_4\,(conc.) \rightarrow$	(q) One of the products is a paramagnetic gas.
(C) $[HXeO_4]^- + OH^- \rightarrow$	(r) In one of the products, the central atom has oxidation state greater than + 6.
(D) $P_4 + NaOH + H_2O \rightarrow$	(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) $XeF_6 + SiO_2 \longrightarrow$	(p) One of the products has square pyramidal shape.
(B) P_4(white) + $SO_2Cl_2 \longrightarrow$	(q) One of the products has tetrahedral hybridisation
(C) $H_2SO_4 + P_2O_5 \longrightarrow$	(r) In one of the products there is $p\pi - d\pi$ type overlapping.
(D) $XeF_6 + H_2O \xrightarrow[\text{Hydrolysis}]{\text{Partial}}$	(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) XeF_2	(p) Undergoes hydrolysis with water.
(B) XeF_4	(q) Acts as oxidising agent.
(C) XeF_6	(r) Undergoes addition reaction.
(D) XeO_3	(s) Has lone pair**(s)** of electrons.
	(t) Gives disproportionation reaction with H_2O or OH^-.

Part # II [Comprehension Type Questions]

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.

1. 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.

2. 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)** Na_2HPO_4

3. 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 group1 and 2) form ionic carbides. They hydrolyse to liberate hydrocarbons. Most of them resembles with NaCl in crystal structure. Transition metals forms interstitial carbides.

1. Consider the following carbides :

CaC_2	Be_2C	MgC_2	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

2. What is the co-ordination number of Ca^{2+} in solid CaC_2 ?
(A) 4 **(B)** 6 **(C)** 8 **(D)** 12

3. Select the methanides from compounds give below :

Al_4C_3	Be_2C	MgC_2	CaC_2
I	II	III	IV

(A) I only **(B)** I & IV **(C)** I & II **(D)** I, II, III & IV

4. 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 BI_3 may be prepared by direct reaction between the elements. Boron trihalides consist of trigonal - planar BX_3 molecules. Unlike the halides of the other elements in the group they are monomeric in the gas, liquid and solid states, BF_3 and BCl_3 are gases, BBr_3 is a volatile liquid and BI_3 is a solid. Boron trihalides are Lewis acids because they form simple Lewis complexes with suitable bases, as in the reaction :

$$BF_3(g) + :NH_3(g) \longrightarrow F_3B - NH_3 \textbf{ (s)}$$

However, boron chlorides, bromides and iodides are susceptible (sensitive) to protolysis by mild proton sources such as water, alcohols and even amines; for example BCl_3 undergoes rapid hydrolysis:

$$BCl_3(g) + 3H_2O(\bullet) \longrightarrow B(OH)_3(aq) + 3HCl(aq)$$

It is supposed that the first step in the above reaction is the formation of the complex $Cl_3B \leftarrow OH_2$ which then eliminates HCl and reacts further with water.

1. Which of the following is the best order of Lewis acid strength of BF_3, BCl_3 and BBr_3 ?

(A) $BF_3 > BCl_3 > BBr_3$ (B) $BF_3 = BCl_3 = BBr_3$

(C) $BF_3 < BCl_3 < BBr_3$ (D) $BBr_3 > BF_3 > BCl_3$

2. Which of the following is the correct prediction about observed B–X bond length, in BX_3 molecules ?

(A) B–F bond length in 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

(B) BF_3 and $[BF_4]^-$ have equal B–F bond length

(C) The decrease in the B–F bond length in BF_3 is due to delocalised $p_\pi - p_\pi$ bonding between vacant '2p' orbital of B and filled '2p' orbital of F.

(D) The correct B–X bond length order is B–F > B–Cl > B–Br > B–I

3. Which is correct about the hydrolysis of BX_3 ?

(A) All BX_3 undergo hydrolysis to produce $B(OH)_3$ (aq) and HX(aq).

(B) BF_3 does not undergo complete hydrolysis due to formation of HBF_4.

(C) BBr_3 does not undergo hydrolysis at all because it cannot form H–bonds with water.

(D) All the above are correct

4. Which of the following reactions is incorrect ?

(A) $BF_3(g) + F^-(aq) \longrightarrow [BF_4]^-(aq)$

(B) $BCl_3(g) + 3EtOH(\bullet) \longrightarrow B(OEt)_3(\bullet) + 3HCl(g)$

(C) $BBr_3(\bullet) + F_3BN(CH_3)_3$ (s) $\longrightarrow BF_3(g) + Br_3BN(CH_3)_3$ (s)

(D) $BCl_3(g) + 2\,C_5H_5N(\bullet) \longrightarrow Cl_3B(C_5H_5N)_2$ (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.

1. Which of the following statement is incorrect ?

(A) PbI_4 does not exist.

(B) Boron shows only +3 oxidation state.

(C) $TlCl_3$ does not undergo disproportionation reaction.

(D) In thallium +3 oxidation state is more stable than +1.

2. The strongest reducing agent among the following is :

(A) Ge (II) chloride (B) Sn (II) chloride (C) Pb (II) chloride (D) None

3. The strongest oxidising agent among the following is :

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

Comprehension # 5

The small size and high charge of 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 forms 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 exists as monomer. In boron trihalides the extent of back bonding decreases with increase in size of halogens and thus lewis acid character increases. All BX_3 are hydrolysed by water but BF_3 shows a different behaviour.

1. The dimeric structure of aluminium chloride disappears when :

(A) it dissolves in water
(B) it reacts with donor molecules like R_3N
(C) it dissolves in benzene
(D) **(A)** & **(B)** both

2. 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

3. 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°C under vaccum.
(D) It is a strong lewis base.

4. Which of the following reaction is incorrect ?

(A) $BF_3(g) + F^-(aq) \longrightarrow BF_4^-$
(B) $BF_3(g) + 2H_2O \longrightarrow [BF_3OH]^- + H_3O^+$
(C) $BCl_3(g) + 3EtOH(\bullet) \longrightarrow B(Oet)_3(\bullet) + 3HCl$
(D) $BCl_3(g) + 2C_5H_5N(\bullet) \longrightarrow Cl_3B(C_5H_5N)_2$ **(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.

1. 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 P_2H_4.
(D) It can act as oxidising agent.

2. The compound **(C)** :

(A) has 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 breakble 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.

1. 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.

2. 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.

1. 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

2. 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.

3. 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.

1. The H – M – H bond angle of V group hydrides decrease from 107° to 90° for NH_3 to SbH_3 ; this is due to :
   (A) increase in strength of bases with molecular weight
   (B) use of pure p-orbital for M – H bonding in hydrides of higher molecular weight
   (C) bond energies of M – H bonds increase
   (D) bond pairs of electrons go closer to central atom

2. Reducing power of V-group hydrides are in order :
   (A) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$
   (B) $BiH_3 > SbH_3 > AsH_3 > PH_3 > NH_3$
   (C) $PH_3 > NH_3 > AsH_3 > SbH_3 > BiH_3$
   (D) $BiH_3 > SbH_3 > AsH_3 > NH_3 > PH_3$

3. The boiling points of the hydrides of V-group elements are in the order :
   (A) $NH_3 > PH_3 > AsH_3 > SbH_3$
   (B) $NH_3 > AsH_3 > SbH_3 > PH_3$
   (C) $SbH_3 > NH_3 > AsH_3 > PH_3$
   (D) $AsH_3 > SbH_3 > NH_3 > PH_3$

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.

1. CFC damages ozone layer by reactions :
   (A) $O_3 + h\nu \rightarrow O + O_2$ **(B)** $Cl + O_3 \rightarrow ClO + O_2$ **(C)** $ClO + O \rightarrow Cl + O_2$ **(D)** all of the above

2. Identify the incorrect statement with respect to ozone.
   (A) Ozone is formed in the upper atmosphere by a photochemical reaction involving dioxygen.
   (B) Ozone protects the earth's inhabitants by absorbing UV radiations.
   (C) Ozone can also be made by heating O_2 over 2500^0C and quenching
   (D) Chloride gas is preferred over ozone for the purification of drinking water and for water treatment in swimming pools.

3. Which of the following statement is correct ?
   (A) The dark blue colour of ozone is due to intense absorption of green light.
   (B) Oxides of nitrogen and the halogen cannot damage the O_3 layer.
   (C) Ozone oxidises dry iodine to I_2O_5 .
   (D) Ozone forms orange coloured compound 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.

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

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. H_2SO_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 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 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 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 π–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 F^- to F_2

(B) It on hydrolysis with alkali under goes disproportionation.

(C) It is obtained by the reaction of **(C)** with O_2F_2 at 118°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) sp^3d **(B)** sp^3d^2 **(C)** sp^3 **(D)** sp^3d^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 ns^2np^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 clatherate 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 XeF_2 .

(A) It is a colourless crystalline compound which sublimes at 298 K.

(B) BrO_3^- being good oxidising agent cannot be oxidised by XeF_2 to BrO_4^- .

(C) It undergoes hydrolysis more rapidly with alkali in comparision to water.

(D) XeF_2 can be prepared by heating Xenon with O_2F_2 at 118^0C.

Exercise # 4 [Subjective Type Questions]

1. How will you obtain ?

(A) Sodium peroxo borate from borax (in two steps only)

(B) Borazole from sodium borohydride (in three steps only)

(C) Borax from Boron (in two steps)

2. A certain salt x, gives the following results.

(i) Its aqueous solution is alkaline to litmus.

(ii) It swells up to a glassy material Y on strong heating.

(iii) When concentrated H_2SO_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.

3. What happens when :

(i) Borax is heated strongly.

(ii) Aluminium is heated with caustic soda solution.

(iii) A mixture of borax and cobalt oxide is heated in a flame.

(iv) Water is added to aluminium nitride.

(v) Aluminium reacts with HNO_3.

4. Give reason for the following :

Although aluminium is above hydrogen in the electrochemical series, it is stable in air and water.

5. Identify **A** and **B** in the following reactions :

Colemanite + **(A)** $\longrightarrow Na_2B_4O_7$

$Na_2B_4O_7$ + **(B)** $\longrightarrow H_3BO_3$

6. **(i)** A white precipitate **(B)** is formed when a mineral **(A)** is boiled with Na_2CO_3 solution.

(ii) The precipitate is filtered and filtrate contains two compounds **(C)** and **(D)**. The compound **(C)** is removed by crystallisation and when CO_2 is passed through the mother liquor left **(D)** changes to **(C)**.

(iii) The compound **(C)** on strong heating gives two compounds **(D)** and **(E)**.

(iv) **(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 relevent 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 : $C + HNO_3(conc.) \longrightarrow$

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.

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 most 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 tempt and 200ºC 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. $PbCl_4$ is less stable than $SnCl_4$. Explain.

32. $CaO + C \xrightarrow{\Delta}$ **(A)** + **(B)**

(A) + $N_2 \xrightarrow{\Delta}$ **(C)** + carbon

(C) + $H_2O \longrightarrow$ **(D)** + NH_3

Identify **(A)**, **(B)**, **(C)** and **(D)z**

33. Name two elements known for their semiconducting nature.

34. Write at least three uses of silicones.

35. During reduction of SiO_2 into Si, SiO_2 is taken in excess, why ?

36. Rationalise the given statements and give chemical reactions :

(i) Lead (II) chloride reacts with Cl_2 to give $PbCl_4$

(ii) Lead (IV) chloride is highly unstable towards heat.

(iii) lead is known not to form an iodide, PbI_4

37. Suggest a reason as to why CO is poisonous.

38. What happens when ?

(i) Ammonia reacts with $KMnO_4$ (neutral medium)

(ii) A mixture of NO and NO_2 is passed in Na_2CO_3 solution.

39. What happens when ?

(i) Aqueous solution of $NaNO_3$ is heated with zinc dust and caustic soda.

(ii) CaO in water reacts with white phosphorus.

40. Write down a reaction showing action of N_2O_4(●) as non-aqueous solvent.

41. What happens when:

(a) NH_4Cl & $NaNO_3$ is heated strongly. **(b)** $(NH_4)_2CO_3$ is heated. **(c)** NH_4NO_2 is heated.

(d) Mg_3N_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) H_3PO_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 P_4 and I_2(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 unplesant odour of rotten fish and is neutral towards litmus. When passed through $AgNO_3$ 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. H_2SO_4 + $K_2Cr_2O_7$ $\longrightarrow$ **(B)** Green Solution

(A) + dil. H_2SO_4 + **(C)** $\longrightarrow$ $MnSO_4$

(A) + O_2 $\xrightarrow{H_2O}$ **(D)**

(D) + $BaCl_2$ $\longrightarrow$ White ppt.

49. Complete the following equations

(i) $I_2 + O_3 + H_2O \rightarrow HIO_3 +$ ..... **(ii)** $CaS + H_2O + CO_2 \rightarrow$ .....+.....

50. Complete and balance the following :

(i) $P_4O_{10} + PCl_5 \longrightarrow$ **(ii)** $NH_3 + NaOCl \longrightarrow$

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 pentaoxide

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 phosporus 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 ?

59. Why does NO_2 dimerise ?

60. Complete and balance the following chemical equations :

(a) $HSO_3NH_2 + HNO_3\,(Conc.) \longrightarrow$

(b) $Ag_2N_2O_2 + HCl \xrightarrow{ether}$

(c) $HNO_3\,(50\%) + As_2O_3 + H_2O \longrightarrow$

(d) $AgNO_3 + Cl_2 \xrightarrow{60-90^\circ C}$

(e) $HPO_3 + H_3PO_4 \xrightarrow{100^\circ C}$ (taken in equimolar)

(f) $Ca_3(PO_4)_2 + SiO_2 + C \longrightarrow$

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 acified $K_2Cr_2O_7$ solution.

(ii) On boiling with H_2O_2 , cooling it and then adding an aqueous solution of $BaCl_2$, a precipitate insoluble in dilute HCl is obtained.

(iii) On passing H_2S 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 200^0C and beyond that it decreases why ?

66. How is the presence of 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. Exaplain it ?

Exercise # 5 Part # I [Previous Year Questions] [AIEEE/JEE-MAIN]

Group - 13th and 14th

1. The soldiers of Napolean army while at Alps during freezing winter suffered a serious problem as regards to the tin buttons of their uniforms. White metallic tin buttons got converted to grey powder. This transformation is related to **[AIEEE 2004]**

(1) a change in the crystalline structure of tin.

(2) an interaction with nitrogen of the air at very low to temperature.

(3) a change in the partial pressure of oxygen in the air.

(4) an interaction with water vapour contained in the humid air.

2. Aluminium chloride exists as dimer, Al_2Cl_6 in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives : **[AIEEE 2004]**

(1) $[Al(OH)_6]^{3-} + 3HCl$ **(2)** $[Al(H_2O)_6]^{3+} + 3Cl^-$

(3) $Al^{3+} + 3Cl^-$ **(4)** $Al_2O_3 + 6HCl$

3. In silicon dioxide : **[AIEEE 2005]**

(1) there are double bonds between silicon and oxygen atoms

(2) silicon atom is bonded to two oxygen atoms

(3) each silicon atom is surrounded by two oxygen atoms and each oxygen atom is bonded to two silicon atoms

(4) each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms

4. Heating an aqueous solution of aluminium chloride to dryness will give : **[AIEEE 2005]**

(1) $Al(OH)Cl_2$ **(2)** Al_2O_3 **(3)** Al_2Cl_6 **(4)** $AlCl_3$

5. The stability of dihalides of Si, Ge, Sn and Pb increases steadily in the sequence : **[AIEEE 2007]**

(1) $GeX_2 < SiX_2 < SnX_2 < PbX_2$ **(2)** $SiX_2 < GeX_2 < PbX_2 < SnX_2$

(3) $SiX_2 < GeX_2 < SnX_2 < PbX_2$ **(4)** $PbX_2 < SnX_2 < GeX_2 < SiX_2$

6. In context with the industrial preparation of hydrogen from water gas ($CO + H_2$), which of the following is the correct statement ? **[AIEEE 2008]**

(1) CO is removed by absorption in aqueous Cu_2Cl_2 Solution.

(2) H_2 is removed through occlusion with Pd.

(3) CO is oxidized to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali.

(4) CO and H_2 are fractionally separated using differences in their densities.

7. Among the following substituted silanes the one which will give rise to cross linked silicone polymer on hydrolysis is : **[AIEEE 2008]**

(1) $RSiCl_3$ **(2)** R_2SiCl_2 **(3)** R_3SiCl_2 **(4)** R_4Si

8. Which one of the following is the correct statement ? **[AIEEE 2008]**

(1) Beryllium exhibits coordination number of six.

(2) Chlorides of both beryllium and aluminium have bridged structures in vapour phase.

(3) $B_2H_6.2NH_3$ is known as 'inorganic benzene'.

(4) 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 200ºC consists mostly of S_8 rings.

(3) At 600ºC 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 200ºC consists mostly of S_8 rings.

(3) At 600ºC 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) NO_2 and NO (2) NO and N_2O (3) NO_2 and N_2O (4) N_2O and NO_2

9. The compound that does not produce nitrogen gas by the thermal decomposition is : [JEE(Mains) 2018]
(1) $(NH_4)_2Cr_2O_7$ (2) NH_4NO_2 (3) $(NH4)_2SO_4$ (4) $Ba(N_3)_2$

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 (H – X) is : [AIEEE 2005]
(1) HI > HBr > HCl > HF (2) HF > HCl > HBr > HI
(3) HCl < HF < HBr < HI (4) HI > HCl < HF < HBr

4. Which of the following statements is true? [AIEEE 2006]
(1) H_3PO_3 is a stronger acid than H_2SO_3 (2) In aqueous medium HF is a stronger acid than HCl
(3) $HClO_4$ is a weaker acid than $HClO_3$ (4) HNO_3 is a stronger acid than HNO_2

5. What products are expected from the disproportionation reaction of hypochlorous acid? [AIEEE 2006]
(1) $HClO_3$ and Cl_2O (2) $HClO_2$ and $HClO_4$ (3) HCl and Cl_2O (4) HCl and $HClO_3$

6. Identify the incorrect statement among the following. [AIEEE 2007]
(1) Cl_2 reacts with excess of NH_3 to give N_2 and HCl.
(2) Br_2 reacts with hot and strong NaOH solution to give NaBr, $NaBrO_4$ and H_2O.
(3) Ozone reacts with SO_2 to given SO_3.
(4) Silicon reacts with $NaOH_{(aq)}$ in the presence of air to give Na_2SiO_3 and H_2O.

7. Which one of the following reactions of Xenon compounds is not feasible ? [AIEEE 2009]
(1) $3XeF_4 + 6H_2O \rightarrow 2Xe + XeO_3 + 12HF + 1.5O_2$ (2) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$
(3) $XeF_6 + RbF \rightarrow Rb[XeF_7]$ (4) $XeO_3 + 6HF \rightarrow XeF_6 + 3H_2O$

8. The products obtained when chlorine gas reacts with cold and dilute aqueous NaOH are : [JEE Main 2017]
(1) ClO^- and ClO_3^- (2) ClO_2^- and ClO_3^- (3) Cl^- and ClO^- (4) Cl^- and ClO_2^-

Part # II [Previous Year Questions][IIT-JEE ADVANCED]

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 $[SiO_4]^{4-}$ 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, $2\mathbf{X} + B_2H_6 \longrightarrow [BH_2(\mathbf{X})_2]^+ [BH_4]^-$
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) teranuclea $[B_4O_5(OH)_4]2-$ unit
(B) all boron atoms in the sam 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. $(NH_4)_2 Cr_2O_7$ 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 –30ºC. **[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 a 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.

6. Among the following, the correct statement is : **[JEE 2008]**

(A) between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional.

(B) between NH_3 and PH_3, PH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional.

(C) between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional.

(D) between NH_3 and PH_3, 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 NaOH gives 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 P_4 with **X** leads selectively to P_4O_6. The **X** is : **[JEE 2009]**

(A) Dry O_2 **(B)** A mixture of O_2 and N_2

(C) Moist O_2 **(D)** O_2 in the presence of aqueous NaOH

9. Match each of the reactions given in **column I** with the corresponding products (s) given in **column II.** **[JEE 2009]**

	Column I		Column II
(A)	$Cu + dil\ HNO_3$	**(p)**	NO
(B)	$Cu + conc\ HNO_3$	**(q)**	NO_2
(C)	$Zn + dil\ HNO_3$	**(r)**	N_2O
(D)	$Zn + conc\ HNO_3$	**(s)**	$Cu(NO_3)_2$
		(t)	$Zn(NO_3)_2$

10. Extra pure N_2 can be obtained by heating **[JEE 2011]**

(A) NH_3 with CuO **(B)** NH_4NO_3 **(C)** $(NH_4)_2Cr_2O_7$ **(D)** $Ba(N_3)_2$

11. Among the following, the number of compounds that can react with PCl_5 to give $POCl_3$ is O_2, CO_2, SO_2, H_2O, H_2SO_4, P_4O_{10}. **[JEE 2011]**

12. Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen?

(A) HNO_3, NO, NH_4Cl, N_2 **(B)** HNO_3, NO, N_2, NH_4Cl **[JEE 2012]**

(C) HNO_3, NH_4Cl, NO, N_2 **(D)** NO, HNO_3, NH_4Cl, N_2

13. Which of the following oxoacids of sulphur has –O–O– linkage ? **[JEE 2004]**

(A) $H_2S_2O_3$ **(B)** $H_2S_2O_5$ **(C)** $H_2S_2O_6$ **(D)** $H_2S_2O_8$

14. Which of the following is not oxidised by O_3 ? **[JEE 2005]**

(A) KI **(B)** $KMnO_4$ **(C)** K_2MnO_4 **(D)** $FeSO_4$

15. Which gas is evolved when PbO_2 is treated with concentrated HNO_3 ? **[JEE 2005]**

(A) NO_2 **(B)** O_2 **(C)** N_2 **(D)** N_2O

16. Aqueous solution of $Na_2S_2O_3$ on reaction with Cl_2 gives : **[JEE 2008]**

(A) $Na_2S_4O_6$ **(B)** $NaHSO_4$ **(C)** NaCl **(D)** NaOH

17. The product formed in the reaction of $SOCl_2$ with white phosphorous is : **[JEE 2014]**

(A) PCl_3 **(B)** SO_2Cl_2 **(C)** SCl_2 **(D)** $POCl_3$

18. When O_2 is adsorbed on a metallic surface, electron transfer occurs from the metal to O_2. The TRUE statements(s) regarding this adsorption is (are) **[JEE 2015]**

(A) O_2 is physisorbed

(B) heat is released

(C) Occupancy of π^*_{2p} of O_2 is increased

(D) bond length of O_2 is increased

19. The nitrogen containing compound produced in the reactino of HNO_3 with P_4O_{10} **[JEE 2016]**

(A) can also be prepared by reaction of P_4 and 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 H_3PO_2, H_3PO_4, H_3PO_3, and $H_4P_2O_6$ is **[JEE 2017]**

(A) $H_3PO_4 > H_3PO_2 > H_3PO_3 > H_4P_2O_6$

(B) $H_3PO_2 > H_3PO_3 > H_4P_2O_6 > H_3PO_4$

(C) $H_3PO_3 > H_3PO_2 > H_3PO_4 > H_4P_2O_6$

(D) $H_3PO_4 > H_4P_2O_6 > H_3PO_3 > H_3PO_2$

Paragraph for Questions 21 & 22

Upon heating $KClO_3$ in the presence of catalytic amount of MnO_2, a gas W is formed. Excess amount of **W** reacts with white phosphorus to give **X**. The reaction of **X** with pure HNO_3 gives **Y** and **Z**. **[JEE(Advanced) 2017]**

21. Y and Z are, respectively

(A) N_2O_5 and HPO_3 **(B)** N_2O_3 and H_3PO_4 **(C)** N_2O_4 and H_3PO_3 **(D)** N_2O_4 and HPO_3

22. W and X are respectively

(A) O_2 and P_4O_6 **(B)** O_2 and P_4O_{10} **(C)** O_3 and P_4O_6 **(D)** O_3 and P_4O_{10}

23. Based on the compounds of group 15 elements, the correct statement (s) is (are) **[JEE(ADVANCED) 2018]**

(A) Bi_2O_5 is more basic than N_2O_5

(B) NF_3 is more covalent than BiF_3

(C) PH_3 boils at lower temperature than 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]**

N_2O_3, N_2O_5, P_4O_6, P_4O_7, $H_4P_2O_5$, $H_5P_3O_{10}$, $H_2S_2O_3$, $H_2S_2O_5$

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. XeF_4 reacts violently with water to give 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.

1. 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

2. The structure of XeO_3 is : **[JEE 2007]**

(A) linear **(B)** planar **(C)** pyramidal **(D)** T-shaped

3. XeF_4 and XeF_6 are expected to be : **[JEE 2007]**

(A) oxidizing **(B)** reducing **(C)** unreactive **(D)** strongly basic

4. 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	Column II
(A) $(CH_3)_2SiCl_2$	(p) Hydrogen halide formation
(B) XeF_4	(q) Redox reaction
(C) Cl_2	(r) Reacts with glass
(D) VCl_5	(s) Polymerization
	(t) O_2 formation

Paragraph for Questions 5 to 6

The reactions of Cl_2 gas with cold-dilute and hot-concentrated NaOH in water give sodium salts to two (different) oxoacids of chlorine, **P** and **Q**, respectively. The Cl_2 gas reacts with SO_2 gas, in presence of charcoal, to give a product **R. R** reacts with white phosphours to give a compound **S**. On hydrolysis, **S** gives an oxoacid of phosphours **T**.

5. **P** and **Q**, respectively, are the sodium salts of : **[JEE(Advanced) 2013]**

(A) hypochlorus and chloric acids

(B) hypochlorus and chlorus acids

(C) chloric and perchloric acids

(D) chloric and hypochlorus acids

6. **R**, **S** and **T**, respectively, are : **[JEE(Advanced) 2013]**

(A) SO_2Cl_2, PCl_5 and H_3PO_4

(B) SO_2Cl_2, PCl_3 and H_3PO_3

(C) $SOCl_2$, PCl_3 and H_3PO_2

(D) $SOCl_2$, PCl_5 and H_3PO_4

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

$$XeF_6 \xrightarrow[\text{Hydrolysis}]{\text{Complete}} P + \text{other product} \xrightarrow{OH^- / H_2O} Q \xrightarrow{\text{slow disproportionation in } OH^- / H_2O} \text{Products}$$

(A) 0 **(B)** 1 **(C)** 2 **(D)** 3

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

(A) BrF_5 **(B)** ClF_3 **(C)** XeF_4 **(D)** SF_4

9. The correct statement(s) about the oxoacids, $HClO_4$ and HClO, is(are) **[JEE(Advanced) 2017]**

(A) The central atom in both $HClO_4$ and HClO is sp^3 hybridized

(B) $HClO_4$ is formed in the reaction between Cl_2 and H_2O

(C) The conjugate base of $HClO_4$ is weaker base than H_2O

(D) $HClO_4$ is more acidic than HClO because of the resonance stabilization of its anion

MOCK TEST

SECTION - I : STRAIGHT OBJECTIVE TYPE

1. 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)**

2. $Mg_3B_2 \xrightarrow{HCl(aq)} [X] + MgCl_2$

$[X] + H_2O \xrightarrow{HCl(aq)} [Y] + H_2$

For [X] and [Y] the incorrect choice is:

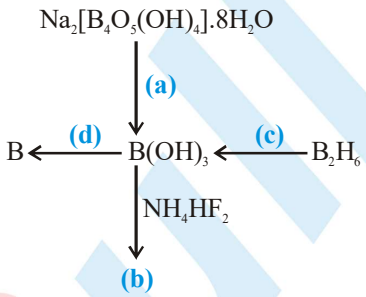
(A) [X] is BCl_3 and [Y] is H_3BO_3.

(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.

3. 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)	Acidc 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

4. Select the correct statement about elements of group 15^{th}

(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.

5. 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- reeducing agent

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

$NH_3 + O_2$ (from excess of air) $\xrightarrow[850°C]{(p)}$ NO $\xrightarrow[air]{(q)}$ (r) $\xrightarrow[(s)]{}$ HNO_3 + NO and table.

7. Which of the following is not oxidised by O3?

(A) KI **(B)** $FeSO_4$ **(C)** $KMnO_4$ **(D)** K_2MnO_4

8. Hot concentrated sulphuric acid dissolves sulphur froming:

(A) SO_3 **(B)** SO_2 **(C)** H_2SO_3 **(D)** $H_2S_2O_3$

9. Which of the following is incorrect for the oxides of 16th group elements?

(A) Reducing property of their dioxides decreases from SO_2 to 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°) gives a blue solid. The correct choice for blue liquid or solid is :

(A) It is referred to as a anhydride of nitric acid.

(B) It is an acidic oxide and hence dissolves in alkalies producing nitrites.

(C) It can also be prepared by the action of 50% HNO3 on arsenious oxide and then cooling to 250K.

(D) All of these.

11. $HCN + H_2O \longrightarrow [X] + NH_3$

$[X] \xrightarrow{\Delta} [Y] + H_2O$

(Unbalanced equations)

[Y] may be prepared by which one of the following methbods?

(A) By dehydration of malonic acid with P_2O_5

(B) By thermal decomposition of carbon sub-oxide in air.

(C) By heating potassium hexacyanoferrate (II) with conc. H_2SO_4.

(D) By the action of conc. HNO_3 on charcoal.

12. A gas 'X' is passed through water to form a saturated solution. the aquesou 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) CO_2, Cl_2 **(B)** Cl_2, CO_2 **(C)** Cl_2, H_2 **(D)** H_2, Cl_2

13. Which of the following can be reduced by HF?

(A) H_2SO_4 **(B)** $KMnO_4$ **(C)** $K_2Cr_2O_7$ **(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 meterological 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

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 KlO_3 to iodine in acidic medium

(C) It when passed through a solution of sodium sulphide, produces Na_2SO_3.

(D) It oxidises $SnCl_2$ to $SnCl_4$ in presence of HCl

SECTION - II : MULTIPLE CORRECT ANSWER TYPE

16. $Ca_2B_6O_{11} + Na_2CO_3 \xrightarrow{\Delta} [X] + CaCO_3 + NaBO_2$ (unbalanced equation)

Correct choice(s) for [X] is/are :

(A) structure of anion of crystalline [X] has one boron atom sp^3 hybridised and other three boron atom sp^2 hybridised.

(B) X with 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 HCl or H_2SO_4 yields a compound which on reaction with 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°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 pointof antimony is less than arsenic.

18. Which of the following order(s) is/are incorrect?

(A) $H_3PO_4 > H_3PO_3 > H_3PO_2$ (reducing character)

(B) $N_2O < NO < N_2O_3 < N_2O_5$ (oxidation state on nitrogen atom)

(C) $NH_3 > PH_3 < AsH_3 < SbH_3$ (basicity)

(D) $SbH_3 > NH_3 > AsH_3 > PH_3$ (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 H_2O_2 turn blue litmus red.

(C) When H_2O_2 behaves as a reducing agent, the O–O bond in its molecules is not broken down.

(D) Aqueous solution of H_2O_2 is stored in plastic bottles and some urea, phosphoric acid or glycerol is added to that solution.

20. The compound(s) which (have) peroxo linkage is (are) :

(A) $H_2S_2O_3$ **(B)** H_2SO_5 **(C)** $H_2S_2O_7$ **(D)** $H_2S_2O_8$

21. A solution containing Br^- ions is treated with each of the following. Which of these will not liberate bromine gas?

(A) Cl_2 **(B)** HI **(C)** I_2 **(D)** SO_3

22. Select the incorrect order(s) from the following :

(A) $ClO^- < BrO^- < IO^-$ – disproportionation

(B) $ClO_4^- < BrO_4^- < IO_4^-$ – oxidising power

(C) $HClO < HClO_2 < HClO_3 < HClO_4$ – acid strength

(D) $HClO < HClO_2 < HClO_3 < HClO_4$ – oxidising power

23. $XeF_4 + O_2F_2 \longrightarrow [X] + O_2$ (unbalanced equation)

Select the correct statement(s) for [X].

(A) Partial hydrolysis of [X] gives $XeOF_4$ as one of the product.

(B) [X] gives yellow liquid on melting

(C) [X] reacts with SiO_2 to form $XeOF_4$ and SiF_4

(D) [X] reacts with XeO_3 to form $XeOF_4$

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) Statemen-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 Fasle, Statement-2 is True.

25. **Statement - 1** : Reddish brown gas, NO_2 when passed through alkalies gives nitrite only.

Statement – 2 : 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) Statemen-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 Fasle, Statement-2 is True.

26. **Statement - 1** : Ammonium salts give yellow precipitates with both chloroplatinic acid and sodium cobaltinitrite

Statement – 2 : Ammonium salt containing SO_4^{2-} anion on heating quite readily decomposes to gtive N_2O.

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

(B) Statemen-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 Fasle, Statement-2 is True.

27. **Statement - 1** : 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) Statemen-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 Fasle, Statement-2 is True.

28. **Statement - 1** : Hydrolysis of XeF_6 represents a redox reaction.

Statement – 2 : The products of hydrolysis are $XeOF_4$ and XeO_2F_2.

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

(B) Statemen-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 Fasle, Statement-2 is True.

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) Statemen-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 Fasle, Statement-2 is True.

30. **Statement - 1** : Amongst the trihalides of nitrogen, NF_3, NCl_3, N Br_3 and NI_3, NF_3 is least basic.
Statement – 2 : In 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) Statemen-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 Fasle, Statement-2 is True.

31. **Statement - 1** : Zeolite, which is hydrated sodium aluminium silicate is used as water softner.
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) Statemen-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 Fasle, Statement-2 is True.

32. **Statement - 1** : HNO_3 oxidises sulphur to H_2SO_4 acid (S + VI) but only oxidises selenium to H_2SeO_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) Statemen-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 Fasle, 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 slowoly 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 organge coloured solid which is paramagnetic in nature. (A) reacts with IF_5, SbF_5, 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°C and 6 atm. pressure forms (A). The first ionization energy (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 I_2O_5.
(B) A fitter 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 brigtht 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 formes 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 otehr 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 eletctrons. 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 ($H_2S_2O_5$) the oxidation states of both the sulphur atoms are not same, they are +V and +III.

(C) Concn. 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) $H_2S > H_2Se < H_2T_3 < H_2O$ – reducting character

(D) $H_2O < H_2S < H_2Se < H_2Te$ – boiling point

38. In γ - 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 raction/characteristic(s) of the products mentioned in column-II.

Column - I	Column-II
(A) $H_3PO_2 \xrightarrow[\text{(ii) 435 K}]{\text{(i) 415 K}}$	(p) One of the products acts as reducing agent.
(B) $PCl_3 + H_2O \xrightarrow{435K}$	(q) One of the products is tribasic and non reducing
(C) $NO_2 + H_2O \longrightarrow$	(r) Dehydration
(D) $HNO_3 + P_4O_{10} \xrightarrow{\Delta}$	(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 raction/characteristic(s) of the products mentioned in column-II.

Column - I	Column-II
(A) $(NH_4)_2S_2O_8 + H_2O \xrightarrow{\text{distillation}}$	(p) Hydrolysis
(B) $NaBO_2 + H_2O + H_2O_2 \xrightarrow{OH^-}$	(q) One of the product has peroxide linkage
(C) $Na_2SO_3 \xrightarrow[\text{temperature}]{\text{fusion}}$	(r) Disproportionation
(D) 2-Ethyl anthraquinol + air	(s) In one of the products the central atom has 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)
(A) $Cl_2O_6 + OH^- \longrightarrow$	(p) sp^3 hybridisation
(B) $KClO_3 + H_2SO_4$ (conc.) $\xrightarrow{\Delta}$	(q) Chlorine dioxide and perchloric acid
(C) $H_2O_2 + HSO_3Cl \longrightarrow$	(r) Disproportionation
(D) $H_3PO_3 \xrightarrow{\Delta}$	(s) Peroxide Linkage
(5) $N_2O_5 + H_2O_2 \longrightarrow$	(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)
(A) HNO_2 (aq) $\longrightarrow$	(p) Oneof the product is a diamagnetic colourless gas.
(B) NH_4Cl (aq) + $NaNO_2$ (aq) $\longrightarrow$	(q) One of the product is a colourless paramagnetic gas
(C) $HN_3 + Li \longrightarrow$	(r) Redox reaction
(D) Mg + HNO_3 (cold and dilute) $\longrightarrow$	(s) One of the product gives brown ring test

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

Column - (I)	Column - (II)
(A) $XeF_4 + H_2O \longrightarrow$	(p) Disproport ionation
(B) $[HXeO_4]^- + 2OH^- \longrightarrow$	(q) One of the products is a gas which is paramagnetic
(C) $H_2O + F_2$ (2 : 2 by mole) $\longrightarrow$	(r) One of the products is used in light bulbs
(D) $NOCl + O_2 \longrightarrow$	(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 → q, B → p, C → r, s, D → q

2. A → p, q, B → p, r, C → q, s, D → q

3. A → p, B → p, q, C → p, q, s, D → p, r

4. A → p, q, r, s, B → p, q, r, s, C → p, q, D → p, q

5. A → r, B → q, C → p, D → s

6. A → p, q, s, B → p, q, r, s, C → q, r, s, D → p, q, r, s

7. A → p, q, s, B → p, q, s, C → r, s, D → q, s
8. A → q, s, B → q, r, C → p, s, D → q, s
9. A → p, r, s, B → q, r, s, C → p, r, s, D → p, r, s
10. A → p, q, B → p, q, r, s, C → r, D → s
11. A → q, s, B → s, C → p, D → r
12. A → p, q, r, s, t, B → p, q, r, s, t, C → t, D → p, q, r, s
13. A → p, q, r, s, B → p, r, C → p, q, r, D → p, q, r
14. A → p, B → p, q, r, C → p, r, D → p, s
15. A → p, q, r, s, B → r, s, C → q, r, s, D → p, q, r
16. A → p, q, r, s, B → p, q, r, s, t, C → p, q, r, s, D → 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 - 13th and 14th

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 - 15th and 16th

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 - 13th and 14th

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

5. (i) $3SiCl_4(vapour) + 4Al(molten) \longrightarrow 4AlCl_3 + 3Si$

(ii) (a) $3SiCl_4 + 4Al \longrightarrow 4AlCl_3 + 3Si$

(b) $Si + 2CH_3Cl \xrightarrow[570^oC]{Cu\ powder} (CH_3)_2SiCl_2$

(c) $(CH_3)_2SiCl_2 \xrightarrow[-2HCl]{2H_2O} HO-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{Si}}}}-OH$

(d) $nHO-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{Si}}}}-OH \xrightarrow[-nH_2O]{\Delta} HO-\left[\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{Si}}}}-O-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{Si}}}}-O\right]_n-$

linear silicone
(thermoplastic polymer)

(iii) (a) $SiCl_4 + 4H_2O \longrightarrow H_4SiO_4$ or $Si(OH)_4$ ortho silicic acid) + $4HCl$

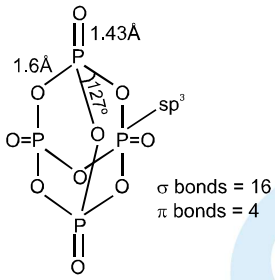
(b) $H_4SiO_4 \xrightarrow{\Delta} SiO_2 + 2H_2O$

(c) $SiO_2 + Na_2CO_3 \xrightarrow{1400^oC} Na_2SiO_3 + CO_2$

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

Group - 15th and 16th

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