Chapter 21. p-Block Elements (Group 15 to 18)

1. Match the interhalogen compounds of column-I with the geometry in column-II and assign the correct code.

Column I	Column II
(A) XX'	(i) T-shape
(B) XX'_3	(ii) Pentagonal bipyramidal
(C) XX'_5	(iii) Linear
(D) XX'_7	(iv) Square pyramidal
	(v) Tetrahedral

Code :

	A	B	C	D
(a)	(iii)	(i)	(iv)	(ii)
(b)	(v)	(iv)	(iii)	(ii)
(c)	(iv)	(iii)	(ii)	(i)
(d)	(iii)	(iv)	(i)	(ii)

(NEET 2017)

2. In which pair of ions both the species contain S — S bond?

(a) $S_4O_6^{2-}$, $S_2O_3^{2-}$ (b) $S_2O_7^{2-}$, $S_2O_8^{2-}$

(c) $S_4O_6^{2-}$, $S_2O_7^{2-}$ (d) $S_2O_7^{2-}$, $S_2O_3^{2-}$

(NEET 2017)

3. Match the compounds given in column I with the hybridisation and shape given in column II and mark the correct option.

Column I	Column II
(A) XeF_6	(i) distorted octahedral
(B) XeO_3	(ii) square planar
(C) $XeOF_4$	(iii) pyramidal
(D) XeF_4	(iv) square pyramidal

Code :

	A	B	C	D
(a)	(iv)	(iii)	(i)	(ii)
(b)	(iv)	(i)	(ii)	(iii)
(c)	(i)	(iii)	(iv)	(ii)
(d)	(i)	(ii)	(iv)	(iii)

(NEET-I 2016)

4. Which is the correct statement for the given acids?

(a) Phosphinic acid is a monoprotic acid while phosphonic acid is a diprotic acid.

(b) Phosphinic acid is a diprotic acid while phosphonic acid is a monoprotic acid.

(c) Both are diprotic acids.

(d) Both are triprotic acids. *(NEET-I 2016)*

5. Which one of the following orders is correct for the bond dissociation enthalpy of halogen molecules?

(a) $Br_2 > I_2 > F_2 > Cl_2$ (b) $F_2 > Cl_2 > Br_2 > I_2$

(c) $I_2 > Br_2 > Cl_2 > F_2$ (d) $Cl_2 > Br_2 > F_2 > I_2$

(NEET-I 2016)

6. When copper is heated with conc. HNO_3 it produces

(a) $Cu(NO_3)_2$, NO and NO_2

(b) $Cu(NO_3)_2$ and N_2O

(c) $Cu(NO_3)_2$ and NO_2

(d) $Cu(NO_3)_2$ and NO *(NEET-I 2016)*

7. Among the following, the correct order of acidity is

(a) $HClO_2 < HClO < HClO_3 < HClO_4$

(b) $HClO_4 < HClO_2 < HClO < HClO_3$

(c) $HClO_3 < HClO_4 < HClO_2 < HClO$

(d) $HClO < HClO_2 < HClO_3 < HClO_4$

(NEET-I 2016)

8. Strong reducing behaviour of H_3PO_2 is due to

(a) high electron gain enthalpy of phosphorus

(b) high oxidation state of phosphorus

(c) presence of two –OH groups and one P—H bond

(d) presence of one –OH group and two P—H bonds. *(2015)*

9. The variation of the boiling points of the hydrogen halides is in the order $HF > HI > HBr > HCl$.

What explains the higher boiling point of hydrogen fluoride?

(a) There is strong hydrogen bonding between HF molecules.
(b) The bond energy of HF molecules is greater than in other hydrogen halides.
(c) The effect of nuclear shielding is much reduced in fluorine which polarises the HF molecule.
(d) The electronegativity of fluorine is much higher than for other elements in the group.
(2015)

10. Which of the statements given below is incorrect?
(a) O_3 molecule is bent.
(b) ONF is isoelectronic with O_2N^-.
(c) OF_2 is an oxide of fluorine.
(d) Cl_2O_7 is an anhydride of perchloric acid.
(2015)

11. The formation of the oxide ion, $O^{2-}_{(g)}$ from oxygen atom requires first an exothermic and then an endothermic step as shown below :
$O_{(g)} + e^- \rightarrow O^-_{(g)}$; $\Delta_f H° = -141$ kJ mol^{-1}
$O^-_{(g)} + e^- \rightarrow O^{2-}_{(g)}$; $\Delta_f H° = +780$ kJ mol^{-1}
Thus, process of formation of O^{2-} in gas phase is unfavourable even though O^{2-} is isoelectronic with neon. It is due to the fact that,
(a) O^- ion has comparatively smaller size than oxygen atom
(b) oxygen is more electronegative
(c) addition of electron in oxygen results in larger size of the ion
(d) electron repulsion outweighs the stability gained by achieving noble gas configuration.
(2015)

12. Nitrogen dioxide and sulphur dioxide have some properties in common. Which property is shown by one of these compounds, but not by the other?
(a) Is soluble in water.
(b) Is used as a food preservative.
(c) Forms 'acid-rain'.
(d) Is a reducing agent. *(2015, Cancelled)*

13. Acidity of diprotic acids in aqueous solutions increases in the order
(a) $H_2S < H_2Se < H_2Te$
(b) $H_2Se < H_2S < H_2Te$
(c) $H_2Te < H_2S < H_2Se$
(d) $H_2Se < H_2Te < H_2S$ *(2014)*

14. Which is the strongest acid in the following?
(a) $HClO_4$ (b) H_2SO_3
(c) H_2SO_4 (d) $HClO_3$
(NEET 2013)

15. Which one of the following molecules contains no π bond?
(a) SO_2 (b) NO_2
(c) CO_2 (d) H_2O
(NEET 2013)

16. Which of the following does not give oxygen on heating?
(a) $K_2Cr_2O_7$ (b) $(NH_4)_2Cr_2O_7$
(c) $KClO_3$ (d) $Zn(ClO_3)_2$
(NEET 2013)

17. Identify the incorrect statement, regarding the molecule XeO_4 :
(a) XeO_4 molecule is square planar.
(b) There are four $p\pi$ - $d\pi$ bonds.
(c) There are four sp^3 - p, σ bonds.
(d) XeO_4 molecule is tetrahedral.
(Karnataka NEET 2013)

18. In which of the following compounds, nitrogen exhibits highest oxidation state?
(a) N_2H_4 (b) NH_3
(c) N_3H (d) NH_2OH
(2012)

19. Which of the following statements is not valid for oxoacids of phosphorus?
(a) Orthophosphoric acid is used in the manufacture of triple superphosphate.
(b) Hypophosphorous acid is a diprotic acid.
(c) All oxoacids contain tetrahedral four coordinated phosphorus.
(d) All oxoacids contain atleast one P═O unit and one P—OH group. *(2012)*

20. Sulphur trioxide can be obtained by which of the following reaction?
(a) $CaSO_4 + C \xrightarrow{\Delta}$
(b) $Fe_2(SO_4)_3 \xrightarrow{\Delta}$
(c) $S + H_2SO_4 \xrightarrow{\Delta}$
(d) $H_2SO_4 + PCl_5 \xrightarrow{\Delta}$ *(2012)*

21. In which of the following arrangements the given sequence is not strictly according to the property indicated against it?
(a) HF < HCl < HBr < HI : increasing acidic strength
(b) $H_2O < H_2S < H_2Se < H_2Te$: increasing pK_a values

(c) $NH_3 < PH_3 < AsH_3 < SbH_3$: increasing acidic character
(d) $CO_2 < SiO_2 < SnO_2 < PbO_2$: increasing oxidising power *(Mains 2012)*

22. Oxidation states of P in $H_4P_2O_5$, $H_4P_2O_6$, $H_4P_2O_7$ are respectively
(a) +3, +5, +4 (b) +5, +3, +4
(c) +5, +4, +3 (d) +3, +4, +5 *(2010)*

23. The correct order of increasing bond angles in the following species is
(a) $Cl_2O < ClO_2 < ClO_2^-$
(b) $ClO_2 < Cl_2O < ClO_2^-$
(c) $Cl_2O < ClO_2^- < ClO_2$
(d) $ClO_2^- < Cl_2O < ClO_2$ *(2010)*

24. How many bridging oxygen atoms are present in P_4O_{10}?
(a) 6 (b) 4
(c) 2 (d) 5 *(Mains 2010)*

25. Among the following which is the strongest oxidising agent?
(a) Br_2 (b) I_2
(c) Cl_2 (d) F_2 *(2009)*

26. The angular shape of ozone molecule (O_3) consists of
(a) 1σ and 1π bond (b) 2σ and 1π bond
(c) 1σ and 2π bonds (d) 2σ and 2π bonds *(2008)*

27. Which one of the following orders correctly represents the increasing acid strengths of the given acids?
(a) $HOClO < HOCl < HOClO_3 < HOClO_2$
(b) $HOClO_2 < HOClO_3 < HOClO < HOCl$
(c) $HOClO_3 < HOClO_2 < HOClO < HOCl$
(d) $HOCl < HOClO < HOClO_2 < HOClO_3$ *(2007, 2005)*

28. The electronegativity difference between N and F is greater than that between N and H yet the dipole moment of NH_3 (1.5 D) is larger than that of NF_3 (0.2 D). This is because
(a) in NH_3 the atomic dipole and bond dipole are in the opposite directions whereas in NF_3 these are in the same direction
(b) in NH_3 as well as in NF_3 the atomic dipole and bond dipole are in the same direction
(c) in NH_3 the atomic dipole and bond dipole are in the same direction whereas in NF_3 these are in opposite directions
(d) in NH_3 as well as in NF_3 the atomic dipole and bond dipole are in opposite directions. *(2006)*

29. Which one of the following orders is not in accordance with the property stated against it?
(a) $F_2 > Cl_2 > Br_2 > I_2$: Bond dissociation energy
(b) $F_2 > Cl_2 > Br_2 > I_2$: Oxidising power
(c) $HI > HBr > HCl > HF$: Acidic property in water
(d) $F_2 > Cl_2 > Br_2 > I_2$: Electronegativity. *(2006)*

30. In which of the following molecules are all the bonds are not equal?
(a) NF_3 (b) ClF_3
(c) BF_3 (d) AlF_3 *(2006)*

31. What is the correct relationship between the pH of isomolar solutions of sodium oxide, Na_2O (pH_1), sodium sulphide, Na_2S (pH_2), sodium selenide, Na_2Se (pH_3) and sodium telluride Na_2Te (pH_4)?
(a) $pH_1 > pH_2 > pH_3 > pH_4$
(b) $pH_1 > pH_2 \approx pH_3 > pH_4$
(c) $pH_1 < pH_2 < pH_3 < pH_4$
(d) $pH_1 < pH_2 < pH_3 \approx pH_4$ *(2005)*

32. Which one of the following oxides is expected to exhibit paramagnetic behaviour?
(a) CO_2 (b) SiO_2
(c) SO_2 (d) ClO_2 *(2005)*

33. Which of the following would have a permanent dipole moment?
(a) SiF_4 (b) SF_4
(c) XeF_4 (d) BF_3 *(2005)*

34. Among K, Ca, Fe and Zn, the element which can form more than one binary compound with chlorine is
(a) Fe (b) Zn
(c) K (d) Ca *(2004)*

35. Which of the following statement is true?
(a) Silicon exhibits 4 coordination number in its compound.
(b) Bond energy of F_2 is less than Cl_2.
(c) Mn(III) oxidation state is more stable than Mn(II) in aqueous state.
(d) Elements of 15^{th} gp shows only + 3 and +5 oxidation states. *(2002)*

36. Which of the following order is wrong?
(a) $NH_3 < PH_3 < AsH_3$ – acidic
(b) Li < Be < B < C – 1^{st} IP

(c) $Al_2O_3 < MgO < Na_2O < K_2O$ – basic
(d) $Li^+ < Na^+ < K^+ < Cs^+$ – ionic radius.
(2002)

37. Correct order of 1st ionisation potential among following elements Be, B, C, N, O is
(a) B < Be < C < O < N
(b) B < Be < C < N < O
(c) Be < B < C < N < O
(d) Be < B < C < O < N *(2001)*

38. Which compound has planar structure?
(a) XeF_4 (b) $XeOF_2$
(c) XeO_2F_2 (d) XeO_4 *(2000)*

39. Which of the following oxides is most acidic?
(a) As_2O_5 (b) P_2O_5
(c) N_2O_5 (d) Sb_2O_5 *(1999)*

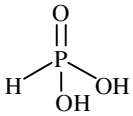
40. Which of the following phosphorus is the most reactive?
(a) Scarlet phosphorus
(b) White phosphorus
(c) Red phosphorus
(d) Violet phosphorus *(1999)*

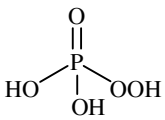
41. Which of the following is used in the preparation of chlorine?
(a) Both MnO_2 and $KMnO_4$
(b) Only $KMnO_4$
(c) Only MnO_2
(d) Either MnO_2 or $KMnO_4$ *(1999)*

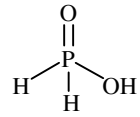
42. Repeated use of which one of the following fertilizers would increase the acidity of the soil?
(a) Ammonium sulphate
(b) Superphosphate of lime
(c) Urea
(d) Potassium nitrate *(1998)*

43. Which of the following has the highest dipole moment?
(a) SbH_3 (b) AsH_3
(c) NH_3 (d) PH_3 *(1997)*

44. The structural formula of hypophosphorous acid is

(a) 

(b) 

(c) 

(d) None of these
(1997)

45. Which of the following bonds has the highest energy?
(a) S–S (b) O–O
(c) Se–Se (d) Te–Te *(1996)*

46. The basic character of hydrides of the V group elements decreases in the order
(a) $NH_3 > PH_3 > AsH_3 > SbH_3$
(b) $SbH_3 > AsH_3 > PH_3 > NH_3$
(c) $SbH_3 > PH_3 > AsH_3 > NH_3$
(d) $NH_3 > SbH_3 > PH_3 > AsH_3$ *(1996)*

47. Among the following oxides, the lowest acidic is
(a) As_4O_6 (b) As_4O_{10}
(c) P_4O_6 (d) P_4O_{10} *(1996)*

48. Which of the following has the greatest electron affinity?
(a) I (b) Br
(c) F (d) Cl *(1996)*

49. Which of the following represents calcium chlorite?
(a) $Ca(ClO_3)_2$ (b) $Ca(ClO_2)_2$
(c) $CaClO_2$ (d) $Ca(ClO_4)_2$
(1996)

50. Reaction of sodium thiosulphate with iodine gives
(a) tetrathionate ion (b) sulphide ion
(c) sulphate ion (d) sulphite ion.
(1996)

51. About 20 km above the earth, there is an ozone layer. Which one of the following statements about ozone and ozone layer is true?
(a) It is beneficial to us as it stops U.V. radiation.
(b) Conversion of O_3 to O_2 is an endothermic reaction.
(c) Ozone has a triatomic linear molecule.
(d) It is harmful as it stops useful radiation.
(1995)

52. The electronic configuration of an element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$. What is the atomic number of the element, which is just below the above element in the periodic table?
(a) 36 (b) 49
(c) 33 (d) 34 *(1995)*

53. Which of the following oxides of nitrogen is paramagnetic?
(a) NO_2 (b) N_2O_3
(c) N_2O (d) N_2O_5 *(1994)*

54. Which of the following displaces Br_2 from an aqueous solution containing bromide ions?
(a) I_2 (b) I_3^-
(c) Cl_2 (d) Cl^- *(1994)*

55. Which of the following fluorides does not exist?
(a) NF_5 (b) PF_5
(c) AsF_5 (d) SbF_5 *(1993)*

56. Which of the following species has four lone pairs of electrons?
(a) I (b) O
(c) Cl^- (d) He *(1993)*

57. Which of the following sets has strongest tendency to form anions?
(a) Ga, Ni, Tl (b) Na, Mg, Al
(c) N, O, F (d) V, Cr, Mn. *(1993)*

58. A solution of potassium bromide is treated with each of the following. Which one would liberate bromine?
(a) Hydrogen iodide
(b) Sulphur dioxide
(c) Chlorine (d) Iodine *(1993)*

59. Which of the following elements is extracted commercially by the electrolysis of an aqueous solution of its compound?
(a) Cl (b) Br
(c) Al (d) Na *(1993)*

60. Number of electrons shared in the formation of nitrogen molecule is
(a) 6 (b) 10
(c) 2 (d) 8 *(1992)*

61. Sugarcane on reaction with nitric acid gives
(a) CO_2 and SO_2
(b) $(COOH)_2$
(c) 2HCOOH(two moles)
(d) no reaction. *(1992)*

62. Nitrogen is relatively inactive element because
(a) its atom has a stable electronic configuration
(b) it has low atomic radius
(c) its electronegativity is fairly high
(d) dissociation energy of its molecule is fairly high. *(1992)*

63. H_3PO_2 is the molecular formula of an acid of phosphorus. Its name and basicity respectively are
(a) phosphorous acid and two
(b) hypophosphorous acid and two
(c) hypophosphorous acid and one
(d) hypophosphoric acid and two. *(1992)*

64. Which of the following bonds will be most polar?
(a) N – Cl (b) O – F
(c) N – F (d) N – N *(1992)*

65. Elements of which of the following groups will form anions most readily?
(a) Oxygen family (b) Nitrogen family
(c) Halogens (d) Alkali metals *(1992)*

66. Strongest hydrogen bonding is shown by
(a) water (b) ammonia
(c) hydrogen fluoride
(d) hydrogen sulphide. *(1992)*

67. 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) $Ca(OCl)_2$ *(1992)*

68. In the manufacture of bromine from sea water, the mother liquor containing bromides is treated with
(a) carbon dioxide (b) chlorine
(c) iodine
(d) sulphur dioxide. *(1992)*

69. Which would quickly absorb oxygen?
(a) Alkaline solution of pyrogallol
(b) Conc. H_2SO_4
(c) Lime water
(d) Alkaline solution of $CuSO_4$. *(1991)*

70. Oleum is
(a) castor oil (b) oil of vitriol
(c) fuming H_2SO_4 (d) none of these. *(1991)*

71. Aqueous solution of ammonia consists of
(a) H^+ (b) OH^-
(c) NH_4^+ (d) NH_4^+ and OH^-. *(1991)*

72. P_2O_5 is heated with water to give
(a) hypophosphorous acid
(b) phosphorous acid
(c) hypophosphoric acid
(d) orthophosphoric acid. *(1991)*

73. Basicity of orthophosphoric acid is
(a) 2 (b) 3
(c) 4 (d) 5 *(1991)*

74. PCl_3 reacts with water to form
(a) PH_3 (b) H_3PO_3, HCl
(c) $POCl_3$ (d) H_3PO_4 *(1991)*

75. PH_4I + NaOH forms
(a) PH_3 (b) NH_3
(c) P_4O_6 (d) P_4O_{10} *(1991)*

76. Pure nitrogen is prepared in the laboratory by heating a mixture of
(a) NH_4OH + NaCl (b) NH_4NO_3 + NaCl
(c) NH_4Cl + NaOH (d) NH_4Cl+$NaNO_2$.
(1991)

77. The bleaching action of chlorine is due to
(a) reduction (b) hydrogenation
(c) chlorination (d) oxidation.
(1991)

78. Which of the following statement is not correct for nitrogen?
(a) Its electronegativity is very high.
(b) *d*-orbitals are available for bonding.
(c) It is a typical non-metal.
(d) Its molecular size is small. *(1990)*

79. Which of the following compound does not exist?
(a) NCl_5 (b) AsF_5
(c) $SbCl_5$ (d) PF_5 *(1989)*

80. Each of the following is true for white and red phosphorus except that they
(a) are both soluble in CS_2
(b) can be oxidised by heating in air
(c) consist of the same kind of atoms
(d) can be converted into one another.
(1989)

81. When orthophosphoric acid is heated to 600°C, the product formed is
(a) PH_3 (b) P_2O_5
(c) H_3PO_3 (d) HPO_3
(1989)

82. Which one has the lowest boiling point?
(a) NH_3 (b) PH_3
(c) AsH_3 (d) SbH_3 *(1989)*

83. Oxygen will directly react with each of the following elements except
(a) P (b) Cl
(c) Na (d) S *(1989)*

84. The gases respectively absorbed by alkaline pyrogallol and oil of cinnamon are
(a) O_3, CH_4 (b) O_2, O_3
(c) SO_2, CH_4 (d) N_2O, O_3.
(1989)

85. It is possible to obtain oxygen from air by fractional distillation because
(a) oxygen is in a different group of the periodic table from nitrogen
(b) oxygen is more reactive than nitrogen
(c) oxygen has higher b.p. than nitrogen
(d) oxygen has a lower density than nitrogen.
(1989)

86. Bleaching powder reacts with a few drops of conc. HCl to give
(a) chlorine
(b) hypochlorous acid
(c) calcium oxide
(d) oxygen. *(1989)*

87. Which of the following is a nitric acid anhydride?
(a) NO (b) NO_2
(c) N_2O_5 (d) N_2O_3
(1988)

88. Bleaching powder is obtained by the action of chlorine gas and
(a) dilute solution of $Ca(OH)_2$
(b) concentrated solution of $Ca(OH)_2$
(c) dry CaO
(d) dry slaked lime.
(1988)

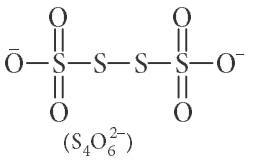
Answer Key

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

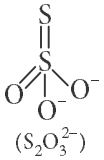
EXPLANATIONS

1. (a)

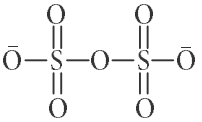
2. (a):



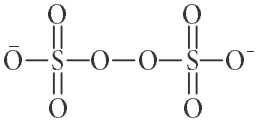
$(S_4O_6^{2-})$



$(S_2O_3^{2-})$

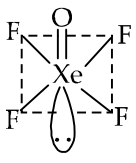


$(S_2O_7^{2-})$

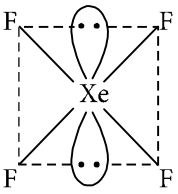


$(S_2O_8^{2-})$

3. (c) :



$XeOF_4$
Square pyramidal
sp^3d^2



XeF_4
Square planar
sp^3d^2

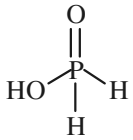
4. (a) :

5. (d) : The order of bond dissociation enthalpy is : $Cl_2 > Br_2 > F_2 > I_2$

6. (c) : $Cu + 4HNO_3(conc.) \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

7. (d) : The acidic character of the oxoacids increases with increase in oxidation number of the halogen atom *i.e.*, $HClO < HClO_2 < HClO_3 < HClO_4$. This can be explained on the basis of relative stability of the anions left after removal of a proton. Since the stability of the anion decreases in the order : $ClO_4^- > ClO_3^- > ClO_2^- > ClO^-$, acid strength also decreases in the same order.

8. (d) : All oxyacids of phosphorus which have P—H bonds act as strong reducing agents. H_3PO_2 has two P—H bonds hence, it acts as a strong reducing agent.



9. (a) : HF forms strong intermolecular H-bonding due to high electronegativity of F. Hence, the boiling point of HF is abnormally high. Boiling points of other hydrogen halides gradually increase from HCl to HI due to increase in size of halogen atoms from Cl to I which further increase the magnitude of van der Waals forces.

10. (c) : OF_2 (oxygen difluoride) is a fluoride of oxygen because fluorine is more electronegative than oxygen.

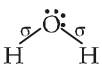
11. (d)

12. (b) : NO_2 is not used as a food preservative.

13. (a) : As the atomic size increases down the group, the bond length increases and the bond strength decreases and the cleavage of *E*–H bond becomes easier thus, more will be the acidity. Thus, the correct order is : $H_2S < H_2Se < H_2Te$.

14. (a) : $H\underset{}{\overset{7}{Cl}}O_4$ with highest oxidation number and its conjugate base is resonance stabilised, hence it is most acidic. Cl is more electronegative than S.

15. (d) :



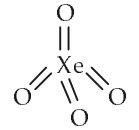
16. (b) : $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$

$Zn(ClO_3)_2 \xrightarrow{\Delta} ZnCl_2 + 3O_2$

$KClO_3 \xrightarrow{\Delta} KCl + 3/2O_2$

$2K_2Cr_2O_7 \xrightarrow{\Delta} 2K_2CrO_4 + Cr_2O_3 + 3/2O_2$

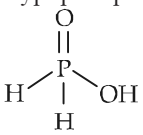
17. (a) :



Tetrahedra (sp^3)

18. (c) : $N_2H_4 \Rightarrow 2x + 4(+1) = 0 \Rightarrow 2x + 4 = 0$
$\Rightarrow x = -2$
$NH_3 \Rightarrow x + 3(+1) = 0 \Rightarrow x = -3$
$N_3H \Rightarrow 3x + 1(+1) = 0 \Rightarrow 3x + 1 = 0 \Rightarrow x = -1/3$
$NH_2OH \Rightarrow x + 2 + 1(-2) + 1 = 0 \Rightarrow x + 1 = 0$
$\Rightarrow x = -1$
Thus, highest oxidation state is $-1/3$.

19. (b) : Hypophosphorous acid is a monoprotic acid.



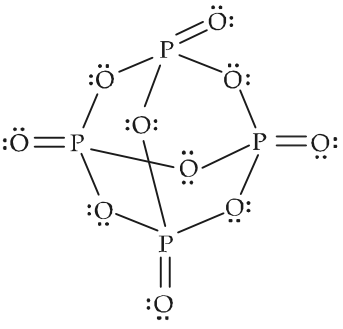
20. (b) : $Fe_2(SO_4)_3 \xrightarrow{\Delta} Fe_2O_3 + 3SO_3$

21. (b) : Acidic strength of hydrides increase with increase in molecular mass.
Thus order of acidic strength is
$HF < HCl < HBr < HI$
$H_2O < H_2S < H_2Se < H_2Te$
$NH_3 < PH_3 < AsH_3 < SbH_3$
And as acidic strength increases, pK_a decreases.
Thus order of pK_a
$H_2O > H_2S > H_2Se > H_2Te$

22. (d) : The oxidation state can be calculated as :
$H_4P_2O_5$
$+4 + 2x + 5(-2) = 0$
$2x - 6 = 0$
$x = +3$
$H_4P_2O_6$
$+4 + 2x + 6(-2) = 0$
$2x - 8 = 0$
$x = +4$
$H_4P_2O_7$
$+4 + 2x + 7(-2) = 0$
$2x - 10 = 0$
$2x = 10$
$x = +5$

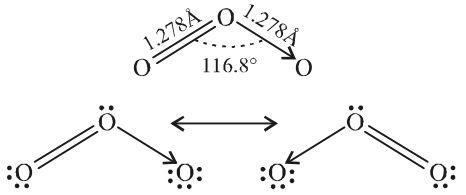
23. (d)

24. (a) :

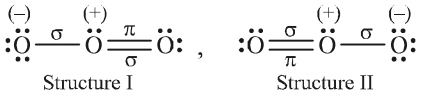


25. (d) : Standard reduction potentials of halogens are positive and decrease from fluorine to iodine. So, F_2 is the strongest oxidising agent.

26. (b) : The angular shape of ozone molecule (O_3)



O_3 molecules can be represented by the following two lewis structures.



Structure I Structure II

27. (d) : $\overset{+1}{HOCl} < \overset{+3}{HClO_2} < \overset{+5}{HClO_3} < \overset{+7}{HClO_4}$
As the number of oxygen atom increases, an increasing amount of electron density shifts from Cl atom to more electronegative O atom. Hence as the oxidation number of Cl atom increases, the amount of actual positive charge on Cl atom increases which in turn attracts the electron density from O – H bond, hence the O – H bond is weakened and proton is easily released and acidity increases.

28. (c) : The dipole moment of NF_3 is 0.24 D and of NH_3 is 1.48 D. The difference is due to fact that while the dipole moment due to N – F bonds in NF_3 are in opposite direction to the direction of the dipole moment of the lone pair on N atom which partly cancel out, the dipole moment of N – H bonds in NH_3 are in the same direction of the dipole moment of the lone pair on N atom which adds up as shown below.

29. (a) :

$X-X$ bond	F–F	Cl–Cl	Br–Br	I–I
Bond dissociation energy (kcal/mol)	38	57	45.5	35.6

The lower value of bond dissociation energy of fluorine is due to the high inter-electronic repulsions between non-bonding electrons in the $2p$-orbitals of fluorine. As a result F – F bond is weaker in comparison to Cl – Cl and Br – Br bonds.

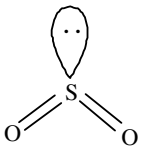
30. (b) : The Cl – F ($Cl - F_{eq}$) bond length is equal to 1.60 Å while each of the two axial Cl – F ($Cl - F_a$) bond length is equal to 1.70 Å.

31. (a) : Na_2O | basic character
Na_2S | decreases down the group
Na_2Se |
Na_2Te ↓ Means Na_2O is most basic

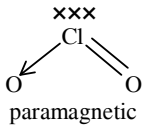
We know that more the basic compound more is the pH [pH ∝ basic character]
Hence $pH_1 > pH_2 > pH_3 > pH_4$

32. (d) : O=C=O diamagnetic

O=Si=O diamagnetic

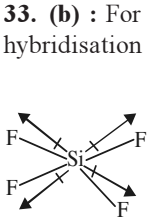


diamagnetic

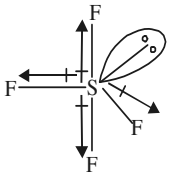


paramagnetic

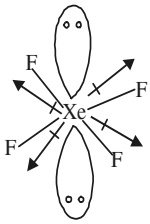
33. (b) : For dipole moment, we have to know the hybridisation and shape.



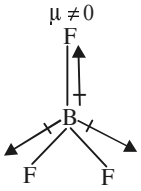
$\mu = 0$



$\mu \neq 0$



$\mu = 0$



$\mu = 0$

34. (a) : A binary compound is one made of two different elements. These can be one of each element such as $CuCl_2$ or FeO. These can also be several of each element such as Fe_2O_3 or $SnBr_4$.
Metals which have variable oxidation number can form more than one type of binary compound like Fe shows the oxidation state +2 and +3. Hence it forms two types of binary compounds. *e.g.*, $FeCl_2$, $FeCl_3$.

35. (b) : Fluorine is more reactive than chlorine. So bond energy of chlorine is greater than fluorine.
Silicon exhibits 6 coordination number.
In aqueous state Mn(II) is more stable.

$$Mn \rightleftharpoons Mn^{2+} + 2e^-$$

36. (b) : Li, Be, B, C - these elements belong to the same period. Generally the value of 1st ionisation potential increases in moving from left to right in a period, since the nuclear charge of the elements also increase in the same direction. But the ionisation potential of boron ($B \rightarrow 2s^2\ p^1$) is lower than that of beryllium ($Be \rightarrow 2s^2$), since in case of boron, $2p^1$ electron have to be removed to get B^+ [$B\ (2s^2\ p^1) \rightarrow B^+\ (2s^2) + e^-$], while in case of Be, $2s^2$ electron have to be removed to get $Be^+\ (2s^1)$. *p* electron can be removed more easily than *s* electron so the energy required to remove electron will be less in case of boron. The order will be

$$Li < B < Be < C.$$

37. (a) : The energy required to remove the most loosely bound electron from an isolated gaseous atom is called the ionisation energy.
The ionisation potential decreases as the size of the atom decreases. Atoms with fully or partly filled orbitals have high ionisation potential.

38. (a) : In XeF_4 the 'Xe' atom is sp^3d^2 hybridised, which contains two lone pair orbitals and four bond pair orbitals. Therefore the shape of XeF_4 molecule is square planar, with one lone pair orbital over and other below the plane.

39. (c) : As among N, P, As and Sb, the former has highest electronegativity (*EN*) so its oxide is most acidic.
As the electronegativity value of element increases, the acidic character of the oxide also increases.

40. (b) : White phosphorus has low ignition temperature so it is most reactive among all the allotropes.

41. (a) : $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2\uparrow$
$2KMnO_4 + 16\ HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2\uparrow$

42. (a) : Ammonium sulphate is a salt of strong acid (H_2SO_4) and weak base (NH_4OH). Therefore repeated use of ammonium sulphate would increase the concentration of sulphuric acid, while ammonia from NH_4OH is used up by the plant. Hence the acidity of soil will increase.

43. (c) : Due to greater electronegativity of nitrogen, dipole moment for NH_3 is greater.

44. (c) : The formula of hypophosphorous acid is H_3PO_2 as shown in (c). It is monobasic acid.

45. (a) :

	O – O	S – S	Se – Se	Te – Te
$kJmol^{-1}$	142	226	172	126

46. (a) : All the hydrides of group V elements have one lone pair of electrons on their central atom. Therefore, they can act as Lewis bases. The basic character of these hydrides decreases down the group.

47. (a) : The acidic character of the oxides decreases with the decrease in the oxidation state and also decreases down the group.

48. (d) : In general, the electron affinity decreases from top to bottom in a group. But in group 17,

fluorine has lower electron affinity as compared to chlorine due to very small size of fluorine atom.

49. (b) : Since the valency of calcium is 2 and a chlorite ion is ClO_2^-, therefore calcium chlorite is $Ca(ClO_2)_2$.

50. (a) : $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2\,NaI$.
(Sodium tetrathionate)

51. (a) : Ozone layer is very beneficial to us, because it stops harmful ultraviolet radiations to reach the earth.

52. (c) : Atomic number of the given element is 15 and it belongs to 5th group. Therefore atomic number of the element below the above element $= 15 + 18 = 33$.

53. (a) : NO_2 is paramagnetic due to the presence of unpaired electrons.

54. (c) : Since chlorine is more electronegative than bromine, therefore it will displace bromine from an aqueous solution containing bromide ions.

$$Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$$

55. (a) : Except nitrogen and bismuth, all elements of fifth group form pentahalides especially pentafluorides. As mentioned earlier, nitrogen cannot form pentahalides because it cannot expand its octet due to non-availability of *d*-orbitals.

56. (b) : Outer electronic configuration of Cl $= 3s^2 3p_x^2 3p_y^2 3p_z^1$.

Outer electronic configuration of Cl^- $= 3s^2 3p_x^2 3p_y^2 3p_z^2$, *i.e.*, 4 lone pair of electrons.

57. (c) : N, O and F are highly electronegative non metals and will have the strongest tendency to form anions by gaining electrons from metal atoms.

58. (c) : A stronger oxidising agent (Cl_2) displaces a weaker oxidising agent (Br_2) from its salt solution.

$$2KBr + Cl_2 \rightarrow 2KCl + Br_2$$

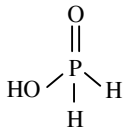
59. (a) : Caustic soda is manufactured by the electrolysis of NaCl solution where Cl_2 is evolved at the anode and H_2 at the cathode.
At anode : $Cl^- \rightarrow Cl + e^-$, $Cl + Cl \rightarrow Cl_2 \uparrow$
At cathode : $Na^+ + e^- \rightarrow Na$.

60. (a) : Nitrogen molecule is diatomic containing a triple bond between two N atoms, $\dot{\ddot{N}} \equiv \dot{\ddot{N}}$. Therefore, nitrogen molecule is formed by sharing six electrons.

61. (b) : $C_{12}H_{22}O_{11} + 18[O] \longrightarrow 6(COOH)_2 + 5H_2O$
Cane sugar; From HNO_3; Oxalic acid

62. (d) : N_2 molecule contains triple bond between N atoms having very high dissociation energy (946 kJ mol^{-1}) due to which it is relatively inactive.

63. (c) : H_3PO_2 is named as hypophosphorous acid. As it contains only one P–OH group, its basicity is one.

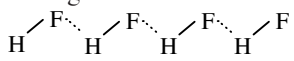


64. (c) : Polarity of the bond depends upon the electronegativity difference of the two atoms forming the bond. Greater the electronegativity difference, more is the polarity of the bond.

N – Cl	O – F	N – F	N – N
3.0–3.0	3.5–4.0	3.0–4.0	3.0–3.0

65. (c) : As halogens have seven electrons (ns^2np^5) in the valence shell, they have a strong tendency to acquire the nearest inert gas configuration by gaining an electron from the metallic atom and form halide ions easily.

66. (c) : Fluorine because of its smaller size and highest electronegativity shows strongest hydrogen bonding.



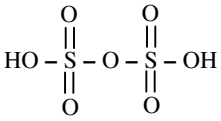
67. (c) : $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

68. (b) : Bromide in the mother liquor (containing $MgBr_2$) is oxidised to Br_2 by passing Cl_2 which is a stronger oxidising agent.

$$2Br^- + Cl_2 \rightarrow Br_2 + 2Cl^-$$

69. (a) : Alkaline solution of pyrogallol absorbs oxygen quickly.

70. (c) : Pyrosulphuric acid or oleum (+6) is $H_2S_2O_7$ which is obtained by dissolving SO_3 and is called fuming sulphuric acid.

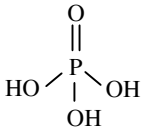


71. (d) : Aqueous solution of ammonia is obtained by passing NH_3 and OH^- ions.

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

72. (d) : $P_2O_5 + 3H_2O \xrightarrow{\Delta} 2H_3PO_4$

73. (b) : Orthophosphoric acid, H_3PO_4 contains three P–OH groups and is therefore, tribasic.



74. (b) : $PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$

75. (a) : $PH_4I + NaOH \rightarrow NaI + PH_3 + H_2O$

76. (d) : $NH_4Cl + NaNO_2 \xrightarrow{\text{Heat}} NH_4NO_2 + NaCl$

$NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$

77. (d) : Bleaching action of chlorine is due to oxidation in presence of moisture. It is permanent.

$$H_2O + Cl_2 \rightarrow 2HCl + [O]$$

Colouring matter + [O] $\rightarrow$ colourless matter

78. (b) : In case of nitrogen, *d*-orbitals are not available. Nitrogen belongs to *p*-block elements.

$N = 1s^2\ 2s^2\ 2p^3$

79. (a) : All the elements of group 15 form trihalides and pentahalides of the type MX_3 and MX_5 except nitrogen which forms only trihalides. Moreover, nitrogen does not form pentahalides due to the absence of *d*-orbitals in its valence shell.

80. (a) : Red phosphorus is insoluble in CS_2 and only white P is soluble in CS_2.

81. (d) : On heating, it gives pyrophosphoric acid at 525 K and metaphosphoric acid at 875 K.

$$2H_3PO_4 \xrightarrow[-H_2O]{525\ K} \underset{\text{Pyrophosphoric acid}}{H_4P_2O_7} \xrightarrow[-H_2O]{875\ K} \underset{\text{Metaphosphoric acid}}{2HPO_3}$$

82. (b) : Due to the absence of H-bonding, PH_3 has the lowest b.p. The boiling point of the V group hydrides is :

$$BiH_3 > SbH_3 > NH_3 > AsH_3 > PH_3$$

83. (b) : Chlorine does not react directly with oxygen.

84. (b) : Alkaline pyrogallol absorbs O_2 and oil of cinnamon absorbs O_3.

85. (c) : Air is liquefied by making use of the Joule - Thompson effect (cooling by expansion of the gas). Water vapour and CO_2 are removed by solidification. The remaining constituents of liquid air *i.e.*, liquid oxygen and liquid nitrogen are separated by means of fractional distillation (b.p. of O_2 = –183°C : b.p. of N_2 = –195.8°C).

86. (a) : $CaOCl_2 + 2HCl \rightarrow CaCl_2 + H_2O + Cl_2$.

The liberated Cl_2 gives the disinfectant nature to bleaching powder.

$Cl_2 + H_2O \rightarrow HCl + HOCl$ (Kill germs)

87. (c) : When 2-molecules of nitric acid undergoes heating, loose a water molecule to form an anhydride.

$$\begin{matrix} HO \cdot NO_2 \\ HO \cdot NO_2 \end{matrix} \xrightarrow{\Delta} N_2O_5 + H_2O$$

Thus, N_2O_5 is nitric acid anhydride.

88. (d) : Cl_2 gas reacts with dry slaked lime, $Ca(OH_2)$ to give bleaching powder.

$Ca(OH)_2 + Cl_2 \xrightarrow{\Delta} CaOCl_2 + H_2O$