CHAPTER

21

THE p-BLOCK ELEMENTS (GROUP 15, 16, 17 AND 18)

FACT/DEFINITION TYPE QUESTIONS

1. Ionic radii (in Å) of As^{3+}, Sb^{3+} and Bi^{3+} follow the order
(a) $As^{3+} > Sb^{3+} > Bi^{3+}$ (b) $Sb^{3+} > Bi^{3+} > As^{3+}$
(c) $Bi^{3+} > As^{3+} > Sb^{3+}$ (d) $Bi^{3+} > Sb^{3+} > As^{3+}$

2. Which of the following statements 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

3. Collectively the elements of group 15 are called –
(a) pnicogens (b) pnicopens
(c) nicopen (d) None of these

4. Which one of the following elements is most metallic ?
(a) P (b) As
(c) Sb (d) Bi

5. Which of the following statement is incorrect for group 15 elements ?
(a) Order of ionization enthalpies is
$\Delta_i H_1 < \Delta_i H_2 < \Delta_i H_3$
(b) The boiling point and melting point increases from top to bottom in the group
(c) Dinitrogen is a gas while all others are solids
(d) All statements are correct

6. Which of the follow group 15 element forms metallic bonds in elemental state ?
(a) As (b) P
(c) Sb (d) Bi

7. The three important oxidation states of phosphorus are
(a) –3, +3 and +5 (b) –3, +3 and –5
(c) –3, +3 and +2 (d) –3, +3 and +4

8. 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

9. Which of the following has the highest $p\pi - p\pi$ bonding tendency ?
(a) N (b) P
(c) As (d) Sb

10. Pick out the wrong statement.
(a) Nitrogen has the ability to form $p\pi$-$p\pi$ bonds with itself.
(b) Bismuth forms metallic bonds in elemental state.
(c) Catenation tendency is higher in nitrogen when compared with other elements of the same group.
(d) Nitrogen has higher first ionisation enthalpy when compared with other elements of the same group.

11. Nitrogen forms N_2, but phosphorus is converted into P_4 from P, the reason is
(a) Triple bond is present between phosphorus atom
(b) $p_\pi - p_\pi$ bonding is strong
(c) $p_\pi - p_\pi$ bonding is weak
(d) Multiple bond is formed easily

12. What causes nitrogen to be chemically inert ?
(a) Multiple bond formation in the molecule
(b) Absence of bond polarity
(c) Short internuclear distance
(d) High bond energy

13. Among the 15th group elements, as we move from nitrogen to bismuth, the pentavalency becomes less pronounced and trivalency becomes more pronounced due to
(a) Non metallic character (b) Inert pair effect
(c) High electronegativity (d) Large ionization energy

14. Pentavalence in phosphorus is more stable when compared to that of nitrogen even though they belong to same group. This is due to
(a) dissimilar electronic configuration
(b) due to presence of vacant d-orbitals
(c) reactivity of phosphorus
(d) inert nature of nitrogen

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

16. Most acidic oxide among the following is –
(a) N_2O_5 (b) P_2O_5
(c) N_2O_4 (d) As_2O_3

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

18. The correct decreasing order of basic strength is:
(a) $AsH_3 > SbH_3 > PH_3 > NH_3$
(b) $SbH_3 > AsH_3 > PH_3 > NH_3$
(c) $NH_3 > PH_3 > AsH_3 > SbH_3$
(d) $PH_3 > AsH_3 > SbH_3 > NH_3$

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

20. The p-block element of group 15 that forms predominantly basic oxide is
(a) N (b) P
(c) As (d) Bi

21. With respect to protonic acids, which of the following statements is correct ?
(a) PH_3 is more basic than NH_3
(b) PH_3 is less basic than NH_3
(c) PH_3 is equally basic as NH_3
(d) PH_3 is amphoteric while NH_3 is basic

22. PCl_5 is possible but NCl_5 does not exist :
(a) in N, d-sub-shell is absent
(b) ionization energy of N is very high
(c) it does not like Cl
(d) None of these

23. Maximum covalency of nitrogen is _____.
(a) 3 (b) 5
(c) 4 (d) 6

24. Elements of group-15 form compounds in +5 oxidation state. However, bismuth forms only one well characterised compound in +5 oxidation state. The compound is
(a) Bi_2O_5 (b) BiF_5
(c) $BiCl_5$ (d) Bi_2S_5

25. 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) $NH_4Cl + NaNO_2$.

26. On heating ammonium dichromate and barium azide separately we get
(a) N_2 in both cases
(b) N_2 with ammonium dichromate and NO with barium azide
(c) N_2O with ammonium dichromate and N_2 with barium azide
(d) N_2O with ammonium dichromate and NO_2 with barium azide

27. In Haber's process for the manufacture of NH_3 :
(a) finely divided nickel is used as a catalyst
(b) finely divided iron is used as a catalyst
(c) finely divided molybdenum is used as a catalyst
(d) no catalyst is necessary

28. Ammonia on reaction with hypochlorite anion can form :
(a) NO (b) N_2H_4
(c) NH_4Cl (d) Both (b) and (c)

29. NH_3 gas is dried over :
(a) CaO (b) HNO_3
(c) P_2O_5 (d) $CuSO_4$

30. The shape of ammonia molecule is
(a) tetrahedral (b) pyramidal
(c) planar triangle (d) octahedral

31. When ammonia is heated with cupric oxide, a molecule of ammonia will
(a) gain 3 electrons (b) lose 3 electrons
(c) gain 2 electrons (d) lose 2 electrons

32. In which the NH_3 is not used ?
(a) Cold storage
(b) Anaesthetic
(c) Manufacture of rayon and plastic
(d) None of these

33. Liquid ammonia bottles are opened after cooling them in ice for sometime. It is because liquid NH_3
(a) Brings tears to the eyes
(b) Has a high vapour pressure
(c) Is a corrosive liquid
(d) Is a mild explosive

34. Ammonia is generally manufactured for fertilizers by the reaction
(a) $2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O + 2NH_3$
(b) By passing an electric discharge in a mixture of N_2 and H_2
(c) By passing a mixture of N_2 and H_2 under high pressure and moderate temperature over a catalyst
(d) None of these

35. Nitrogen dioxide cannot be obtained by heating :
(a) KNO_3 (b) $Pb(NO_3)_2$
(c) $Cu(NO_3)_2$ (d) $AgNO_3$

36. Which of the following oxides is neutral ?
(a) N_2O_3 (b) N_2O_4
(c) N_2O_5 (d) N_2O

37. The bonds present in N_2O_5 are :
(a) only ionic (b) covalent and coordinate
(c) only covalent (d) covalent and ionic

38. Which of the following oxides of nitrogen is a coloured gas?
(a) N_2O (b) NO
(c) N_2O_5 (d) NO_2

39. Which of the following shows nitrogen with its increasing order of oxidation number?
(a) $NO < N_2O < NO_2 < NO_3^- < NH_4^+$
(b) $NH_4^+ < N_2O < NO_2 < NO_3^- < NO$
(c) $NH_4^+ < N_2O < NO < NO_2 < NO_3^-$
(d) $NH_4^+ < NO < N_2O < NO_2 < NO_3^-$

40. In which one of the following oxides of nitrogen, one nitrogen atom is not directly linked to oxygen?
(a) NO (b) N_2O_4
(c) N_2O (d) N_2O_3

41. Which of the following oxides of nitrogen reacts with $FeSO_4$ to form a dark brown compound
(a) N_2O (b) NO
(c) NO_2 (d) N_2O_3

42. Which oxide of nitrogen is obtained on heating ammonium nitrate at 250ºC ?
(a) Nitric oxide (b) Nitrous oxide
(c) Nitrogen dioxide (d) Dinitrogen tetraoxide

43. Which of the following can be used as an anaesthesia ?
(a) N_2O (b) NO
(c) NCl_3 (d) NO_2

44. 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

45. Which of the following elements does not form stable diatomic molecules ?
(a) Iodine (b) Phosphorus
(c) Nitrogen (d) Oxygen

46. The catalyst used in the manufacture of HNO_3 by Ostwald's process is :
(a) platinum gauze (b) vanadium pentoxide
(c) finely divided nickel (d) platinum black .

47. Concentrated nitric acid, upon long standing, turns yellow brown due to the formation of
(a) NO (b) NO_2
(c) N_2O (d) N_2O_4

48. Which of the following trihalide is unstable?
(a) NF_3` (b) $AsCl_3$
(c) $SbBr_3$ (d) NCl_3

49. What will be the A and B in the following equations.

$$\underset{(A)}{8NH_3} + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$$

$$NH_3 + \underset{(B)}{3Cl_2} \longrightarrow NCl_3 + 3HCl$$

(a) A = Excess, B = Excess
(b) A = Limited, B = Excess
(c) A = Excess, B = Limited
(d) A = Limited, B = Limited

50. Which of the following is the strongest reducing agent ?
(a) NH_3 (b) PH_3
(c) BiH_3 (d) SbH_3

51. Which of the following element will form acidic oxides of type E_2O_3?
(a) As (b) Sb
(c) Bi (d) P

52. Which one of the following is not an use of ammonia ?
(a) To produce various nitrogenous fertilizers.
(b) In manufacture of nitric acid
(c) As a refrigerate
(d) In the pickling of stainless steel

53. The nitrogen oxides that contain(s) N–N bond(s) is /are
(i) N_2O (ii) N_2O_3
(iii) N_2O_4 (iv) N_2O_5
(a) (i) , (ii) (b) (ii) , (iii) , (iv)
(c) (iii) , (iv) (d) (i), (ii) and (iii)

54. Zinc on reaction with dilute HNO_3 gives x and zinc on reaction with concentrated HNO_3 gives y. Identify x and y.
(a) $x = NO_2, y = N_2O$ (b) $x = N_2O, y = NO$
(c) $x = NO, y = NO_2$ (d) $x = N_2O, y = NO_2$

55. Which of the following is incorrect for white and red phosphorus ?
(a) They are both soluble in CS_2
(b) They can be oxidised by heating in air
(c) They consist of the same kind of atoms
(d) They can be converted into one another

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

57. White phosphorus is
(a) a monoatomic gas (b) P_4, a tetrahedral solid
(c) P_8, a crown (d) a linear diatomic molecule

58. Which property of white phosphorus is common to red phosphorous ?
(a) It burns when heated in air.
(b) It reacts with hot caustic soda solution to give phosphine.
(c) It shows chemiluminescence.
(d) It is soluble in carbon disulphide.

59. Which of the following statements regarding allotropic forms of phosphorus is incorrect?
(a) White phosphorus is more reactive than red and black due to high angular strain.
(b) Red phosphorus on heating catches fire and give dense red fumes of P_4O_{10}.
(c) Red phosphorus is polymeric in nature consisting of chains of P_4 tetrahedral.
(d) Black phosphorus has two forms α-black and β-black phosphorus

60. Which of the following is incorrect?
(a) M.p of monoclinic sulphur > m.p. of rhombic sulphur.
(b) Specific gravity of rhombic sulphur > specific gravity of monoclinic sulphur.
(c) Monoclinic sulphur is stable below 369 K.
(d) Both rhombic sulphur and monoclinic sulphur have S_8 molecules.

61. One mole of calcium phosphide on reaction with excess water gives
(a) one mole of phosphine
(b) two moles of phosphoric acid
(c) two moles of phosphine
(d) one mole of phosphorus pentoxide

62. PH_3, the hydride of phosphorus is
(a) metallic (b) ionic
(c) non-metallic (d) covalent

63. Phosphine is not obtained by which of the following reaction
(a) White P is heated with NaOH
(b) Red P is heated with NaOH
(c) Ca_3P_2 reacts with water
(d) Phosphorus trioxide is boiled with water

64. Phosphine is not evolved when
(a) white phosphorus is boiled with a strong solution of $Ba(OH)_2$
(b) phosphorus acid is heated
(c) calcium hypophosphite is heated
(d) metaphosphoric acid is heated.

65. Pure phosphine is not combustible while impure phosphine is combustible, this combustibility is due to presence of
(a) P_2H_4 (b) N_2
(c) PH_5 (d) P_2O_5

66. 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

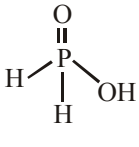
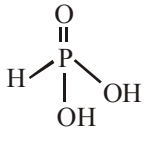
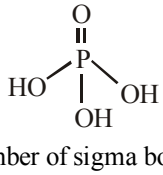
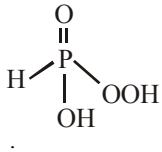
67. P_2O_5 is heated with water to give
(a) hypophosphorous acid (b) phosphorous acid
(c) hypophosphoric acid (d) orthophosphoric acid

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

69. PCl_3 reacts with water to form
(a) PH_3 (b) H_3PO_4 and HCl
(c) $POCl_3$ (d) H_3PO_4

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

71. The structural formula of hypophosphorous acid is

(a) 
(b) 
(c) 
(d) 

72. Number of sigma bonds in P_4O_{10} is
(a) 6 (b) 7
(c) 17 (d) 16.

73. The number of hydrogen atom(s) attached to phosphorus atom in hypophosphorous acid is
(a) three (b) one
(c) two (d) zero

74. The number of P – O – P bonds in cyclic metaphosphoric acid is
(a) zero (b) two
(c) three (d) four

75. Oxidation states of P in $H_4P_2O_5$, $H_4P_2O_6$, and $H_4P_2O_7$, are respectively:
(a) $+3, +5, +4$ (b) $+5, +3, +4$
(c) $+5, +4, +3$ (d) $+3, +4, +5$

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

77. 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 and one P — OH group.

78. What is hybridization of P in PCl_5 ?
(a) sp^3 (b) sp^3d^2
(c) sp^3d (d) sp^2

79. Which of the following is a cyclic phosphate ?
(a) $H_3P_3O_{10}$ (b) $H_6P_4O_{13}$
(c) $H_5P_5O_{15}$ (d) $H_7P_5O_{16}$

80. P—O—P bond is present in
(a) $H_4P_2O_6$ (b) $H_4P_2O_5$
(c) Both (a) and (b) (d) Neither (a) nor (b)

81. Orthophosphoric acid is
(a) monobasic (b) dibasic
(c) tribasic (d) tetrabasic

82. The oxyacid of phosphorous in which phosphorous has the lowest oxidation state is
(a) hypophosphorous acid
(b) orthophosphoric acid
(c) pyrophosphoric acid
(d) metaphosphoric acid

83. The number of P—O—P bonds in cyclic metaphosphoric acid is
(a) zero (b) two
(c) three (d) four

84. Among the oxyacids of phosphorus, the dibasic acid is
(a) $H_4P_2O_7$ (b) H_3PO_2
(c) HPO_3 (d) H_3PO_3

85. The basicity of pyrophosphorus acid is
(a) 2 (b) 4
(c) 1 (d) 5

86. The oxidation state of phosphorus in cyclotrimetaphosphoric acid is
(a) +3 (b) +5
(c) –3 (d) +2

87. Which acid has P – P linkage ?
(a) Hypophosphoric acid (b) Pyrophosphoric acid
(c) Metaphosphoric acid (d) Orthophosphoric acid

88. In a cyclotrimetaphosphoric acid molecule, how many single and double bonds are present?
(a) 3 double bonds; 9 single bonds
(b) 6 double bonds; 6 single bonds
(c) 3 double bonds; 12 single bonds
(d) Zero double bonds; 12 single bonds

89. Strong reducing behaviour of H_3PO_2 is due to
(a) Low oxidation state of phosphorus
(b) Presence of two –OH groups and one P–H bond
(c) Presence of one –OH group and two P–H bonds
(d) High electron gain enthalpy of phosphorus

90. In solid state PCl_5 is a _____.
(a) covalent solid
(b) octahedral structure
(c) ionic solid with $[PCl_6]^+$ octahedral and $[PCl_4]^-$ tetrahedra
(d) ionic solid with $[PCl_4]^+$ tetrahedral and $[PCl_6]^-$ octahedra

91. Electron affinity of sulphur is
(a) more than O and Se
(b) more than O but less than Se
(c) less than O but more than Se
(d) equal to O and Se

92. All the elements of oxygen family are
(a) non metals (b) metalloids
(c) radioactive (d) polymorphic

93. Which shows maximum catenation property ?
(a) S (b) Se
(c) Te (d) O

94. Oxygen and sulphur both are the members of the same group in periodic table but H_2O is liquid while H_2S is gas because
(a) molecular weight of water is more
(b) electronegativity of sulphur is more
(c) H_2S is weak acid
(d) water molecules are having weak hydrogen bonds between them

95. Which of the following hydrides has the lowest boiling point?
(a) H_2O (b) H_2S
(c) H_2Se (d) H_2Te

96. Which of the following hydrides is most acidic ?
(a) H_2Te (b) H_2Se
(c) H_2O (d) H_2S

97. Which of the following hydrides shows the highest boiling point ?
(a) H_2O (b) H_2S
(c) H_2Se (d) H_2Te

98. Which is the best oxidising agent among the following ?
(a) S (b) O
(c) Se (d) Te

99. Which of the following oxide is amphoteric ?
(a) SnO_2 (b) CaO
(c) SiO_2 (d) CO_2

100. Which of the following is not correctly matched ?
(a) SF_4 – gas (b) SeF_4 – liquid
(c) TeF_4 – solid (d) SF_6 – solid

101. The compound which gives off oxygen on moderate heating is :
(a) cupric oxide (b) mercuric oxide
(c) zinc oxide (d) aluminium oxide

102. Oxygen molecule is
(a) diamagnetic with no-unpaired electron(s)
(b) diamagnetic with two unpaired electrons
(c) paramagnetic with two unpaired electrons
(d) paramagnetic with no unpaired electron(s)

103. The number of electrons that are paired in oxygen molecule are
(a) 16 (b) 12
(c) 14 (d) 7

104. On heating $KClO_3$ we get
(a) $KClO_2 + O_2$ (b) $KCl + O_2$
(c) $KCl + O_3$ (d) $KCl + O_2 + O_3$

105. Which of the following is not oxidized by O_3 ?
(a) KI (b) $FeSO_4$
(c) $KMnO_4$ (d) K_2MnO_4

106. 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) Ozone has a triatomic linear molecule
(b) It is harmful as it stops useful radiation
(c) It is beneficial to us as it stops U.V radiation
(d) Conversion of O_3 to O_2 is an endothermic reaction

107. Oxygen gas can be prepared from solid $KMnO_4$ by :
(a) treating the solid with H_2 gas
(b) strongly heating the solid
(c) dissolving the solid in dil. H_2SO_4
(d) dissolving solid in dil. HCl

108. Which of the following statements is correct :
(a) Ozone is a resonance hybrid of oxygen
(b) Ozone is an isomer of oxygen
(c) Ozone has no relationship with oxygen
(d) Ozone is an allotropic modification of oxygen

109. Which of the following on thermal decomposition gives oxygen gas ?
(a) Ag_2O (b) Pb_3O_4
(c) PbO_2 (d) All of these

110. Which of the following is an acidic oxide?
(a) Mn_2O_7 (b) Na_2O
(a) N_2O (b) BaO

111. Atomicity of sulphur in rhombic sulphur is
(a) 1 (b) 2
(c) 8 (d) 6

112. Which of the following form of the sulphur shows paramagnetic behaviour ?
(a) S_8 (b) S_6
(c) S_2 (d) All of these

113. What is X in the following reaction ?

$2SO_2(g) + O_2(g) \xrightarrow{X} 2SO_3(g)$

(a) V_2O_5 (b) CuO
(c) $CuCl_2$ (d) MnO_2

114. Which of the following oxo acid of sulphur has O–O bond ?

(a) $H_2S_2O_7$ (b) $H_2S_2O_8$
(c) $H_2S_2O_6$ (d) $H_2S_2O_5$

115. Carbohydrates on reaction with conc. H_2SO_4 becomes charred due to

(a) hydrolysis (b) dehydration
(c) hydration (d) oxidation

116. Which of the following is the key step in the manufacture of sulphuric acid ?

(a) Burning of sulphur or sulphide ores in air to generate SO_2
(b) Conversion of SO_2 to SO_3 by the reaction with oxygen in presence of catalyst.
(c) Absorption of SO_3 in H_2SO_4 to give oleum.
(d) Both (b) and (c)

117. Hybridization of S in SO_3 is

(a) sp^2 (b) sp^3
(c) sp^2d (d) sp^3d^2

118. By which of the following SO_2 is formed ?

(a) Reaction of dil. H_2SO_4 with O_2
(b) Hydrolysis of dil. H_2SO_4
(c) Reaction of conc. H_2SO_4 with Cu
(d) None of these

119. Number of bonds in SO_2 are

(a) two σ and two π (b) two σ and one π
(c) two σ and three π (d) None of these

120. Bleaching action of SO_2 is due to its

(a) oxidising property (b) acidic property
(c) reducing property (d) basic property

121. The acid which has a peroxy linkage is

(a) Sulphurous acid (b) Pyrosulphuric acid
(c) Dithionic acid (d) Caro's acid

122. S – S bond is not present in

(a) $S_2O_4^{2-}$ (b) $S_2O_5^{2-}$
(c) $S_2O_3^{2-}$ (d) $S_2O_7^{2-}$

123. Oleum is

(a) castor Oil (b) oil of vitriol
(c) fuming H_2SO_4 (d) None of them

124. On addition of conc. H_2SO_4 to a chloride salt, colourless fumes are evolved but in case of iodide salt, violet fumes come out. This is because

(a) H_2SO_4 reduces HI to I_2
(b) HI is of violet colour
(c) HI gets oxidised to I_2
(d) HI changes to HIO_3

125. Which of the following are peroxoacids of sulphur?

(a) H_2SO_5 and $H_2S_2O_8$ (b) H_2SO_5 and $H_2S_2O_7$
(c) $H_2S_2O_7$ and $H_2S_2O_8$ (d) $H_2S_2O_6$ and $H_2S_2O_7$

126. Hot conc. H_2SO_4 acts as moderately strong oxidising agent. It oxidises both metals and nonmetals. Which of the following element is oxidised by conc. H_2SO_4 into two gaseous products?

(a) Cu (b) S
(c) C (d) Zn

127. Caro's acid is

(a) H_2SO_3 (b) $H_3S_2O_5$
(c) H_2SO_5 (d) $H_2S_2O_8$

128. Sulphuric acid reacts with PCl_5 to give

(a) thionyl chloride (b) sulphur monochloride
(c) sulphuryl chloride (d) sulphur tetrachloride

129. Which one of the following reacts with conc. H_2SO_4?

(a) Au (b) Ag
(c) Pt (d) Pb

130. The number of dative bonds in sulphuric acid molecule is

(a) 0 (b) 1
(c) 2 (d) 4

131. What is the number of sigma (σ) and pi (π) bonds present in sulphuric acid molecule ?

(a) $6\sigma, 2\pi$ (b) $6\sigma, 0\pi$
(c) $2\sigma, 4\pi$ (d) $2\sigma, 2\pi$

132. Which characteristic is not correct about H_2SO_4 ?

(a) Reducing agent (b) Oxidising agent
(c) Sulphonating agent (d) Highly viscous

133. Among F, Cl, Br and I the lowest ionization potential will be of

(a) fluorine (b) chlorine
(c) bromine (d) iodine

134. The electronegativity follows the order

(a) F > O > Cl > Br (b) F > Cl > Br > O
(c) O > F > Cl > Br (d) Cl > F > O > Br

135. The bond energies of F_2, Cl_2, Br_2 and I_2 are 155, 244, 193 and 151 kJ mol^{-1} respectively. The weakest bond will be in

(a) Br_2 (b) Cl_2
(c) F_2 (d) I_2

136. The outer electronic structure of $3s^2\ 3p^5$ is possessed by

(a) O (b) Cl
(c) Br (d) Ar

137. Electron gain enthalpy with negative sign of fluorine is less than that of chlorine due to :

(a) High ionization enthalpy of fluorine
(b) Smaller size of chlorine atom
(c) Smaller size of fluorine atom
(d) Bigger size of 2*p* orbital of fluorine

138. Which one of the following order is correct for the bond energies of halogen molecules ?

(a) $I_2 > Cl_2 > Br_2$ (b) $Br_2 > Cl_2 > I_2$
(c) $I_2 > Br_2 > Cl_2$ (d) $Cl_2 > Br_2 > I_2$

139. The correct order of reactivity of halogens with alkalies is

(a) F > Cl > Br > I (b) F < Cl > Br < I
(c) F < Cl < Br < I (d) F < Cl < Br > I

140. The correct order of increasing oxidising power is
(a) $F_2 > Br_2 > Cl_2 > I_2$ (b) $F_2 < Cl_2 < Br_2 < I_2$
(c) $Cl_2 > Br_2 > F_2 > I_2$ (d) $I_2 < Br_2 < Cl_2 < F_2$

141. Fluorine is a stronger oxidising agent than chlorine in aqueous solution. This is attributed to many factors except
(a) heat of dissociation (b) ionisation potential
(c) heat of hydration (d) electron affinity

142. Fluorine exhibits an oxidation state of only –1 because
(a) it can readily accept an electron
(b) it is very strongly electronegative
(c) it is a non-metal
(d) it belongs to halogen family

143. Which of the following halogen does not exhibit positive oxidation state in its compounds?
(a) Cl (b) Br
(c) I (d) F

144. The halogen that is most easily reduced is
(a) F_2 (b) Cl_2
(c) Br_2 (d) I_2

145. Which one of the following elements shows more than one oxidation states ?
(a) Sodium (b) Fluorine
(c) Chlorine (d) Potassium

146. Which of the following halogens exhibit only one oxidation state in its compounds ?
(a) Bromine (b) Chlorine
(c) Fluorine (d) Iodine

147. Which of the following is the best description for the behaviour of bromine in the reaction given below ?
$H_2O + Br_2 \rightarrow HOBr + HBr$
(a) Proton acceptor only
(b) Both oxidized and reduced
(c) Oxidized only
(d) Reduced only

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

149. The correct order of heat of formation of halogen acids is
(a) HI > HBr > HCl > HF (b) HF > HCl > HBr > HI
(c) HCl > HF > HBr > HI (d) HCl > HBr > HF > HI

150. Which is the weakest out of HF, HCl, HBr and HI?
(a) HF (b) HCl
(c) HBr (d) HI

151. Which of the following is most volatile ?
(a) HI (b) HBr
(c) HCl (d) HF

152. At room temperature, HCl is a gas while HF is a low boiling liquid. This is because
(a) H- F bond is covalent (b) H- F bond is ionic
(c) HF has metallic bond (d) HF has hydrogen bond

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

154. Cl_2 reacts with hot and conc. NaOH to give –
(a) NaClO (b) $NaClO_3$
(c) $NaClO_2$ (d) $NaClO_4$

155. When chlorine reacts with cold and dilute solution of sodium hydroxide, the products obtained are
(a) $Cl^- + ClO^-$ (b) $Cl^- + ClO_2^-$
(c) $Cl^- + ClO_3^-$ (d) $Cl^- + ClO_4^-$

156. Chlorine is liberated when we heat
(a) $KMnO_4 + NaCl$ (b) $K_2Cr_2O_7 + MnO_2$
(c) $Pb(NO_3)_2 + MnO_2$ (d) $K_2Cr_2O_7 + HCl$

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

158. The reaction of $KMnO_4$ and HCl results in
(a) oxidation of Mn in $KMnO_4$ and production of Cl_2
(b) reduction of Mn in $KMnO_4$ and production of H_2
(c) oxidation of Mn in $KMnO_4$ and production of H_2
(d) reduction of Mn in $KMnO_4$ and production of Cl_2

159. Bleaching powder on standing forms mixture of :
(a) $CaO + Cl_2$ (b) $CaO + CaCl_2$
(c) $HOCl + Cl_2$ (d) $CaCl_2 + Ca(ClO_3)_2$

160. Hydrochloric acid at 25ºC is
(a) ionic and liquid (b) covalent and liquid
(c) ionic and gas (d) None of these

161. Gaseous HCl is a poor conductor of electricity while its aqueous solution is a good conductor this is because
(a) H_2O is a good conductor of electricity
(b) a gas cannot conduct electricity but a liquid can
(c) HCl gas does not obey Ohm's law, whereas the solution does
(d) HCl ionises in aqueous solution

162. Which one is most stable to heat –
(a) HClO (b) $HClO_2$
(c) $HClO_3$ (d) $HClO_4$

163. Interhalogen compounds are more reactive than the individual halogen because
(a) two halogens are present in place of one
(b) they are more ionic
(c) their bond energy is less than the bond energy of the halogen molecule
(d) they carry more energy

164. Which of the following is not the characteristic of interhalogen compounds ?
(a) They are more reactive than halogens
(b) They are quite unstable but none of them is explosive
(c) They are covalent in nature
(d) They have low boiling points and are highly volatile.

165. The hybridization in ICl_7 is
(a) sp^3d^3 (b) d^2sp^3
(c) sp^3d (d) sp^3

166. In which of the following reactions chlorine is both reduced and oxidized?
(a) $2KMnO_4 + 16HCl \longrightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$
(b) $6NaOH + 3Cl_2 \longrightarrow 5NaCl + NaClO_3 + 3H_2O$
(c) $NH_3 + 3Cl_2 \longrightarrow NCl_3 + 3HCl$
(d) $I_2 + 6H_2O + 5Cl_2 \longrightarrow 2HIO_3 + 10HCl$

167. Which of the following is observed when Cl_2 reacts with hot and concentrated NaOH?
(a) NaCl, NaOCl (b) NaCl, $NaClO_2$
(c) NaCl, $NaClO_3$ (d) NaOCl, $NaClO_3$

168. Which one of the following noble gases is not found in the atmosphere
(a) Rn (b) Kr
(c) Ne (d) Ar

169. The last member of the family of inert gases is
(a) argon (b) radon
(c) xenon (d) neon

170. Which of the following is the correct sequence of the noble gases in their group in the periodic table?
(a) Ar, He, Kr, Ne, Rn, Xe (b) He, Ar, Ne, Kr, Xe, Rn
(c) He, Ne, Kr, Ar, Xe, Rn (d) He, Ne, Ar, Kr, Xe, Rn

171. Which of the following noble gases *do not* have an octet of electrons in its outermost shell?
(a) Neon (b) Radon
(c) Argon (d) Helium

172. Number of unpaired electrons in inert gas is
(a) zero (b) 8
(c) 4 (d) 18

173. In the following four elements, the ionisation potential of which one is the highest ?
(a) Oxygen (b) Argon
(c) Barium (d) Cesium

174. Gradual addition of electronic shells in the noble gases causes a decrease in their
(a) ionisation energy (b) atomic radius
(c) boiling point (d) density

175. Which of the following noble gas is least polarisable?
(a) He (b) Xe
(c) Ar (d) Ne

176. In which of the following groups, when He is placed, its all the properties are satisfied
(a) with alkali metals (b) with halogens
(c) with inert gases (d) None of these

177. The most abundant inert gas in the atmosphere is
(a) He (b) Ne
(c) Ar (d) Kr

178. The lowest boiling point of helium is due to its
(a) inertness
(b) gaseous nature
(c) high polarisability
(d) weak van der Waal's forces between atoms

179. Which of the noble gas has highest polarisability?
(a) He (b) Ar
(c) Kr (d) Xe

180. The noble gas which was discovered first in the sun and then on the earth
(a) argon (b) xenon
(c) neon (d) helium

181. A radioactive element X decays to give two inert gases X is
(a) $^{238}_{92}U$ (b) $^{226}_{88}Ra$
(c) Both (a) and (b) (d) Neither (a) nor (b)

182. Which of the following noble gases has the highest positive electron gain enthalpy value?
(a) Helium (b) Krypton
(c) Argon (d) Neon

183. Which inert gas show abnormal behaviour on liquefaction
(a) Xe (b) He
(c) Ar (d) Kr

184. The ease of liquefaction of noble gases increases in the order
(a) He < Ne < Ar < Kr < Xe
(b) Xe < Kr < Ne < Ar < He
(c) Kr < Xe < He < Ne < Ar
(d) Ar < Kr < Xe < Ne < He

185. The correct order of solubility in water for He, Ne, Ar, Kr, Xe is
(a) He > Ne > Ar > Kr > Xe
(b) Ne > Ar > Kr > He > Xe
(c) Xe > Kr > Ar > Ne > He
(d) Ar > Ne > He > Kr > Xe

186. Which one of the following elements is most reactive ?
(a) He (b) Ne
(c) Ar (d) Xe

187. Noble gases are group of elements which exhibit very
(a) high chemical activity
(b) low chemical activity
(c) minimum electronegativity
(d) much paramagnetic properties

188. In XeF_2, XeF_4, XeF_6 the number of lone pairs on Xe are respectively
(a) 2, 3, 1 (b) 1, 2, 3
(c) 4, 1, 2 (d) 3, 2, 1.

189. Total number of lone pair of electrons in $XeOF_4$ is
(a) 0 (b) 1
(c) 2 (d) 3

190. Noble gases do not react with other elements because
(a) they have completely filled valence shell (ns^2np^6)
(b) the sizes of their atoms are very small
(c) they are not found in abundance
(d) they are monoatomic

191. Which one of the following reactions of xenon compounds is not feasible?
(a) $3XeF_4 + 6H_2O \longrightarrow 2Xe + XeO_3 + 12HF + 1.5O_2$
(b) $2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$
(c) $XeF_6 + RbF \longrightarrow Rb[XeF_7]$
(d) $XeO_3 + 6HF \longrightarrow XeF_6 + 3H_2O$

192. Which of the following has maximum number of lone pairs associated with Xe ?
(a) XeF_4 (b) XeF_6
(c) XeF_2 (d) XeO_3

193. The shape of XeO_2F_2 molecule is
(a) trigonal bipyramidal (b) square planar
(c) tetrahedral (d) see-saw

194. XeF_4 on partial hydrolysis produces
(a) XeF_4 (b) $XeOF_2$
(c) $XeOF_4$ (d) XeO_3

195. Which element out of He, Ar, Kr and Xe forms least number of compounds ?
(a) He (b) Ar
(c) Kr (d) Xe

196. The element which has not yet been reacted with F_2 is
(a) Ar (b) Xe
(c) Kr (d) Rn

197. XeF_6 on complete hydrolysis gives
(a) Xe (b) XeO_2
(c) XeO_3 (d) XeO_4

198. XeF_4 involves which hybridization
(a) sp (b) sp^2
(c) sp^2d (d) sp^3d^2

199. Shape of $XeOF_4$ is
(a) octahedral (b) square pyramidal
(c) pyramidal (d) T-shaped

200. The hybridization of Xe in XeF_2 is
(a) sp^3 (b) sp^2
(c) sp^3 d (d) sp^2d

201. Which is a planar molecule ?
(a) XeO_4 (b) XeF_4
(c) $XeOF_4$ (d) XeO_2F_2

202. Which of the following has sp^3 hybridization ?
(a) XeO_3 (b) BCl_3
(c) XeF_4 (d) BBr_3

203. The number of lone pair of electrons present on Xe in XeF_2 is
(a) 3 (b) 4
(c) 2 (d) 1

204. Hybridization and structure of XeF_4 is
(a) sp^3d, trigonal bipyramidal
(b) sp^3, tetrahedral
(c) sp^3d^2, square planar
(d) sp^3d^2, hexagonal

205. Number of lone pairs of electrons on Xe atoms XeF_2, XeF_4 and XeF_6 molecules are respectively
(a) 3, 2 and 1 (b) 4, 3 and 2
(c) 2, 3 and 1 (d) 3, 2 and 0

206. Which one of the following is correct pair with respect to molecular formula of xenon compound and hybridization state of Xenon in it?
(a) XeF_4, sp^3 (b) XeF_2, sp
(c) XeF_2, sp^3d (d) XeF_4, sp^2

207. Which statement about noble gases is not correct?
(a) Xe forms XeF_6
(b) Ar is used in electric bulbs
(c) Kr is obtained during radioactive disintegration
(d) He has the lowest b.pt among all the noble gases

208. The geometry of XeF_6 is
(a) planar hexagon (b) regular octahedron
(c) distorted octahedron (d) square bipyramid

209. Trigonal bipyramidal geometry is shown by :
(a) XeO_3F_2 (b) XeO_3F_2
(c) $FXeOSO_2F$ (d) $[XeF_8]^{2-}$

210. Which has trigonal bipyramidal shape ?
(a) $XeOF_4$ (b) XeO_3
(c) XeO_3F_2 (d) $XeOF_2$

211. Argon is used
(a) in filling airships
(b) to obtain low temperature
(c) in high temperature welding
(d) in radiotherapy for treatment of cancer

212. Noble gases are used in discharge tubes to gives different colours. Reddish orange glow is due to
(a) Ar (b) Ne
(c) Xe (d) Kr

213. 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 to fill gas balloons instead of hydrogen because it is lighter and non-inflammable.
(d) It is used in gas-cooled nuclear reactors.

214. The coloured discharge tubes for advertisement mainly contain
(a) xenon (b) helium
(c) neon (d) argon

215. Sea divers go deep in the sea water with a mixture of which of the following gases
(a) O_2 and He (b) O_2 and Ar
(c) O_2 and CO_2 (d) CO_2 and Ar

216. Which of the following is the life saving mixture for an asthma patient ?
(a) Mixture of helium and oxygen
(b) Mixture of neon and oxygen
(c) Mixture of xenon and nitrogen
(d) Mixture of argon and oxygen

217. Which of the following statements are true?
(i) Only type of interactions between particles of noble gases are due to weak dispersion forces.
(ii) Ionisation enthalpy of molecular oxygen is very close to that of xenon.
(iii) Hydrolysis of XeF_6 is redox reaction.
(iv) Xenon fluorides are not reactive.
(a) (i) and (iii) (b) (i) and (ii)
(c) (ii) and (iii) (d) (iii) and (iv)

218. Which of the following element has the property of diffusing through most commonly used laboratory materials such as rubber, glass or plastics.
(a) Xe (b) Rn
(c) He (d) Ar

219. Which of the following is used to produce and sustain powerful superconducting magnets to form an essential part of NMR spectrometer ?
(a) Ar (b) Ne
(c) Rn (d) He

STATEMENT TYPE QUESTIONS

220. Which of the following statements are correct?
(i) Arsenic and antimony are metalloids.
(ii) Phosphorus, arsenic and antimony are found mainly as sulphide minerals.
(iii) Covalent redii increases equally from N to Bi.
(iv) Elements of group 15 have extra stability and higher ionisation energy due to exactly half filled ns^2np^3 electronic configuration.
(v) In group 15 elements only nitrogen is gas whereas all others are solids.
(a) (i), (iv) and (v) (b) (ii), (iii) and (iv)
(c) (i), (ii) and (iii) (d) (ii), (iii) and (v)

221. Read the following statements regarding chemical reactivity of group 15 elements.
(i) Only compound of Bi with +5 oxidation state is BiF_5.
(ii) Intermediate oxidation states for both nitrogen and phosphorus disproportionate in both acid and alkali.
(iii) Nitrogen due to absence of d-orbitals in its valence shell cannot form $d\pi$-$p\pi$ bond as the heavier elements thus $R_3P = O$ exists but $R_3N = O$ does not exists.
(iv) BiH_3 is the strongest reducing agent amongst the hydrides of nitrogen family.
(v) P_2O_3 is more acidic than P_2O_5.
Which of the following is the correct code for the statements above?
(a) FTFFT (b) FFTTF
(c) TFTTF (d) TFTFT

222. Which of the following statements are correct?
(i) All the three N—O bond lengths in HNO_3 are equal.
(ii) All P—Cl bond lengths in PCl_5 molecule in gaseous state are equal.
(iii) P_4 molecule in white phohsphorus have angular strain therefore white phosphorus is very reactive.
(iv) PCl_5 is ionic in solid state in which cation is tetrahedral and anion is octahedral.
(a) (i) and (iv) (b) (iii) and (iv)
(c) (ii) and (iii) (d) (ii) only

223. Which of the following is the correct code for statements below ?
(i) Due to small size oxygen has less negative electron gain enthalpy than sulphur.
(ii) Oxygen shows only –2 oxidation state whereas S, Se and Te shows +4 O.S in their compounds with oxygen and +6 with fluorine.
(iii) All hydrides of oxygen family possess reducing property which increases from H_2S to H_2Te.
(iv) Among hexahalides of group 16 hexafluorides are the onlys table halides.
(v) Dimeric monohalides of group 16 undergo disproportionation.
(a) TFFTT (b) FTTFF
(c) FTFTF (d) TFTFT

224. The correct statement(s) about O_3 is(are)
(i) O—O bond lengths are equal
(ii) Thermal decomposition of O_3 is endothermic
(iii) O_3 is diamagnetic in nature
(iv) O_3 has a bent structure
(a) (i) and (iii) (b) (ii) and (iii)
(c) (i), (ii) and (iv) (d) (i) and (iv)

225. Consider the following statements
(i) Reaction $2Fe^{3+} + SO_2 + 2H_2O \rightarrow 2Fe^{2+} + SO_4^{2-} + 4H^+$ shows reducing character of sulphur dioxide
(ii) $H_2S_2O_8$ contains four S = O, two S – OH and one O–O bond
(iii) NH_3 gas can be dried effectively by using conc. H_2SO_4.
(iv) One of the major use of H_2SO_4 is in the manufacture of fertilizers.
Which of the following is the correct code for the statements above?
(a) TTFF (b) TTFT
(c) FTFT (d) TFFT

226. Which of the following statements regarding properties of halogens are correct?
(i) Due to small size electron gain enthalpy of fluorine is less than that of chlorine.
(ii) Iodine has same physical state but different colour as compare to other members of the group.
(iii) Fluorine shows no positive oxidation state.
(iv) In $X_2(g) + H_2O(l) \longrightarrow HX(aq) + HOX(aq)$ (where X_2 = Cl or Br)
(a) (i), (ii) and (iv) (b) (i), (iii) and (iv)
(c) (ii), (iii) and (iv) (d) (iii) and (iv)

227. Consider the following statements regarding interhalogen compounds
(i) For all types of interhalogen compounds $\left(XX^1, XX_3^1, XX_5^1 \text{ and } XX_7^1\right)$ X is the halogen of lesser electronegativity in comparison to X^1.
(ii) At 298 K all interhalogen compounds are either volatile solids or liquids.
(iii) ClF undergoes hydrolysis as below,
$ClF + H_2O \longrightarrow HF + HOCl$
(iv) Fluorine containing interhalogen compounds are very useful as fluorinating agents.
(a) TTFF (b) TFTT
(c) FTFT (d) TFFT

228. Which of the following statements are correct?
(i) Among halogens, radius ratio between iodine and fluorine is maximum.
(ii) Leaving F—F bond, all halogens have weaker X—X bond than X—X′ bond in interhalogens.
(iii) Among interhalogen compounds maximum number of atoms are present in iodine fluoride.
(iv) Interhalogen compounds are more reactive than halogen compounds.
(a) (i) and (ii) (b) (i), (ii) and (iii)
(c) (ii) and (iii) (d) (i), (iii) and (iv)

229. Which of the following statements are correct?
(i) Natural abundance of noble gases is ~ 1% by volume of which Ar is the major constituent.
(ii) Noble gases have high positive values of electron gain enthalpy.
(iii) Preparation of XeF_2 requires F_2 in excess amount.
(iv) Complete hydrolysis of all three XeF_2, XeF_4 and XeF_6 gives Xe as one of product.
(a) (i) and (iii) (b) (ii) and (iv)
(c) (i) and (ii) (d) (ii) and (iii)

MATCHING TYPE QUESTIONS

230. Match the columns

	Column-I		Column-II
(A)	$2Pb(NO_3)_2 \xrightarrow{673K} 4NO_2 + 2PbO + O_2$	(p)	High pressure favours the formation of product
(B)	$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$	(q)	Product formed is acidic brown gas
(C)	$NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$	(r)	This reaction occurs at a high temperature about 2000 K
(D)	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$	(s)	Product formed is a neutral colourless gas

(a) A – (r, s), B – (q), C – (s), D – (p)
(b) A – (q), B – (r,s), C – (s), D – (p)
(c) A – (q), B – (s), C – (r, s), D – (p)
(d) A – (q), B – (r, s), C – (p), D – (s)

231. Match the columns

	Column - I		Column - II
(A)	Used in manufacture of calcium cyanamide	(p)	Ammonia
(B)	Used in manufacture of nitric acid	(q)	Nitric acid
(C)	Used in pickling of stainless steel	(r)	Dinitrogen

(a) A – (r), B – (p), C – (q) (b) A – (p), B – (r), C – (q)
(c) A – (r), B – (q), C – (p) (d) A – (q), B – (p), C – (r)

232. Match the columns.

	Column-I (Oxyacid)		Column-II (Materials for preparation)
(A)	H_3PO_2	(p)	Red P + alkali
(B)	H_3PO_3	(q)	$P_4O_{10} + H_2O$
(C)	H_3PO_4	(r)	$P_2O_3 + H_2O$
(D)	$H_4P_2O_6$	(s)	White P + alkali

(a) (A) – (s), (B) – (r), (C) – (q), (D) – (p)
(b) (A) – (p), (B) – (r), (C) – (q), (D) – (s)
(c) (A) – (s), (B) – (r), (C) – (p), (D) – (q)
(d) (A) – (q), (B) – (r), (C) – (p), (D) – (s)

233. Match the columns

	Column - I		Column - II
(A)	$POCl_3$	(p)	Contains four P – OH two P = O and one P – O – P
(B)	$H_4P_2O_5$	(q)	Yellowish white chloride of phosphorus reacts with moist air
(C)	$H_4P_2O_6$	(r)	Contains four P – OH, two P = O and one P – P bond
(D)	$H_4P_2O_7$	(s)	Colourless oily chloride of phosphorus reacts with orthophosphoric acid

(a) A – (q), B – (s), C – (p), D – (r)
(b) A – (s), B – (q), C – (r), D – (p)
(c) A – (q), B – (s), C – (r), D – (p)
(d) A – (q), B – (r), C – (s), D – (p)

234. Match the columns

	Column - I		Column - II
(A)	Metal that shows no reaction with dioxygen	(p)	Platinum
(B)	Metal forms strong acidic oxide with oxygen	(q)	Nitrogen
(C)	A non-metal discharge of whose oxide might be slowly depleting the concentration of the ozone layer	(r)	Manganese
(D)	Metal which forms amphoteric oxide	(s)	Aluminium

(a) A – (p), B – (r), C – (q), D – (s)
(b) A – (r), B – (p), C – (q), D – (s)
(c) A – (p), B – (q), C – (r), D – (s)
(d) A – (p), B – (r), C – (s), D – (q)

235. Match the columns.

Column-I		Column-II
(A)	Pb_3O_4	(p) Neutral oxide
(B)	N_2O	(q) Acidic oxide
(C)	Mn_2O_7	(r) Basic oxide
(D)	Bi_2O_3	(s) Mixed oxide

(a) A – (p), B – (q), C – (r), D – (s)
(b) A – (s), B – (p), C – (q), D – (r)
(c) A – (r), B – (q), C – (s), D – (p)
(d) A – (s), B – (r), C – (p), D – (q)

236. Match the columns.

Column-I		Column-II
(A)	SF_4	(p) Tetrahedral
(B)	BrF_3	(q) Pyramidal
(C)	BrO_3^-	(r) Sea-saw shaped
(D)	NH_4^+	(s) Bent T-shaped

(a) A – (r), B – (q), C – (p), D – (s)
(b) A – (r), B – (s), C – (q), D – (p)
(c) A – (p), B – (q), C – (r), D – (s)
(d) A – (p), B – (s), C – (r), D – (q)

237. Match the columns

Column - I		Column - II
(A)	$HClO_2$	(p) Contains all different bonds
(B)	$HClO_3$	(q) Contains maximum Cl = O bond
(C)	HClO	(r) Contains Cl with lowest O.S.
(D)	$HClO_4$	(s) Contains three types of bonds

(a) A – (s), B – (p, s), C – (p, r), D – (q, s)
(b) A – (p, s), B – (s), C – (p, r), D – (q, s)
(c) A – (s), B – (p, r), C – (p, s), D – (q, s)
(d) A – (p, s), B – (s), C – (q, s), D – (p, r)

238. Match the columns.

Column - I (Oxides of halogens)		Column - II (Uses)
(A)	O_2F_2	(p) in water treatment
(B)	ClO_2	(q) in estimation of CO
(C)	I_2O_5	(r) for removing plutonium from spent nuclear fuel.

(a) A – (q) , B – (p), C – (r)
(b) A – (r), B – (p), C – (q)
(c) A – (p), B – (r), C – (q)
(d) A – (r), B – (q), C – (p)

239. Match the columns

Column - I		Column - II
(A)	XeF_4	(p) Contains similar types of bonds
(B)	$XeOF_4$	(q) Contains maximum lone pair
(C)	XeF_2	(r) Square pyramidal geometry
(D)	XeO_3	(s) Contains one lone pair

(a) A – (p), B – (r, s), C – (p, q), D – (p, s)
(b) A – (r, s), B – (p), C – (r, s), D – (p, s)
(c) A – (p), B – (p, q), C – (r, s), D – (p, s)
(d) A – (p), B – (r, s), C – (p, s), D – (p, q)

240. Match the columns.

Column-I		Column-II
(A)	Partial hydrolysis of the compound does not change oxidation state of central atom	(p) He
(B)	It is used in modern diving apparatus	(q) XeF_6
(C)	It is used to provide inert atmosphere for filling electrical bulbs	(r) XeF_4
(D)	Its central atom is in sp^3d^2 hybridisation	(s) Ar

(a) A – (p), B – (s), C – (p), D – (r)
(b) A – (p), B – (q), C – (r), D – (s)
(c) A – (q), B – (p), C – (s), D – (r)
(d) A – (p), B – (r), C – (q), D – (s)

241. Match the columns.

Column-I		Column-II
(A)	XeF_6	(p) sp^3d^3– distorted octahedral
(B)	XeO_3	(q) sp^3d^2 – square planar
(C)	$XeOF_4$	(r) sp^3 – pyramidal
(D)	XeF_4	(s) sp^3d^2 – square pyramidal

(a) A – (p), B – (r), C – (s), D – (q)
(b) A – (p), B – (q), C – (s), D – (r)
(c) A – (s), B – (r), C – (p), D – (q)
(d) A – (s), B – (p), C – (q), D – (s)

ASSERTION-REASON TYPE QUESTIONS

Directions : Each of these questions contain two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

242. **Assertion :** Dinitrogen is inert at room temperature.
Reason : Dinitrogen directly combines with lithium to form ionic nitrides.

243. **Assertion :** N_2 is less reactive than P_4.
Reason : Nitrogen has more electron gain enthalpy than phosphorus.

244. **Assertion :** When a metal is treated with conc. HNO_3 it generally yields a nitrate, NO_2 and H_2O.
Reason : Conc. HNO_3 reacts with metal and first produces a metal nitrate and nascent hydrogen. The nascent hydrogen then further reduces HNO_3 to NO_2.

245. **Assertion :** White phosphorus is more reactive than red phosphorus.
Reason : Red phosphorus consists of P_4 tetrahedral units linked to one another to form linear chains.

246. **Assertion :** Bond angle of H_2S is smaller than H_2O.
Reason : Electronegativity of the central atom increases, bond angle decreases.

247. **Assertion :** Both rhombic and monoclinic sulphur exist as S_8 but oxygen exists as O_2.
Reason : Oxfygen forms $p\pi - p\pi$ multiple bond due to small size and small bond length but $p\pi - p\pi$ bonding is not possible in sulphur.

248. **Assertion :** SF_6 cannot be hydrolysed but SF_4 can be.
Reason : Six F atoms in SF_6 prevent the attack of H_2O on sulphur atom of SF_6.

CRITICAL THINKING TYPE QUESTIONS

249. In nitrogen family, the H-M-H bond angle in the hydrides gradually becomes closer to 90° on going from N to Sb. This shows that gradually
(a) The basic strength of the hydrides increases
(b) Almost pure p-orbitals are used for M-H bonding
(c) The bond energies of M-H bonds increase
(d) The bond pairs of electrons become nearer to the central atom

250. Bond dissociation enthalpy of E—H (E = element) bonds is given below. Which of the compounds will act as strongest reducing agent?

Compound	**NH_3**	**PH_3**	**AsH_3**	**SbH_3**
Δ_{diss} (E—H)/kJ mol^{-1}	389	322	297	255

(a) NH_3 (b) PH_3
(c) AsH_3 (d) SbH_3

251. The deep blue colour produced on adding excess of ammonia to copper sulphate is due to presence of
(a) Cu^{2+} (b) $Cu(NH_3)_4^{2+}$
(c) $Cu(NH_3)_6^{2+}$ (d) $Cu(NH_3)_2^{2+}$

252. Blue solid which is obtained on reacting equimolar amounts of two gases at 245K is?
(a) N_2O (b) N_2O_3
(c) N_2O_4 (d) N_2O_5

253. Concentrated nitric acid, upon long standing, turns yellow brown due to the formation of
(a) NO (b) NO_2
(c) N_2O (d) N_2O_4

254. In the reaction
$4HNO_3 + P_4O_{10} \rightarrow 4HPO_3 + X$, the product X is
(a) N_2O_5 (b) N_2O_3
(c) NO_2 (d) H_2O

255. Ammonia on catalytic oxidation gives an oxide from which nitric acid is obtained. The oxide is :
(a) N_2O_3 (b) NO
(c) NO_2 (d) N_2O_5

256. What is the change observed when AgCl reacts with NH_3?
(a) White ppt is formed
(b) Solution become colourless
(c) Yellow ppt is formed
(d) No change is observed

257. In which of the following equations the product formed has similar oxidation state for nitrogen?

(i) $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

(ii) $2Pb(NO_3)_2 \xrightarrow{673K} 4NO_2 + 2PbO + O_2$

(iii) $4HNO_3 + P_4O_{10} \longrightarrow 4HPO_3 + 2N_2O_5$

(iv) $2NO_2 \underset{\text{Heat}}{\overset{\text{Cool}}{\rightleftharpoons}} N_2O_4$

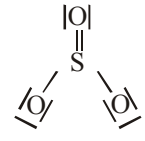
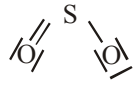
(a) (i) and (iii) (b) (ii) and (iv)
(c) (i) and (v) (d) (iii) and (iv)

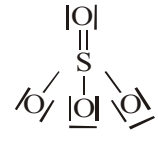
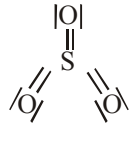
258. What is Z in following reaction
$CuSO_4 + Z \rightarrow Cu_3P_2 + H_2SO_4$
$HgCl_2 + Z \rightarrow Hg_3P_2 + HCl$
(a) White phosphorus (b) Red phosphorus
(c) Phosphine (d) Orthophosphoric acid

259. Electronegativity of oxygen is more than sulphur yet H_2S is acidic while water is neutral. This is because
(a) water is highly associated compound
(b) molecular mass of H_2S is more than H_2O
(c) H_2S is gas while H_2O is a liquid
(d) H–S bond is weaker than H–O bond

260. 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.

261. Which of the following structures is the most preferred and hence of lowest energy for SO_3 ?

(a)  (b) 

(c)  (d) 

262. Which one of the following arrangements does not give the correct picture of the trends indicated against it ?
(i) $F_2 > Cl_2 > Br_2 > I_2$: Oxidizing power
(ii) $F_2 > Cl_2 > Br_2 > I_2$: Electron gain enthalpy
(iii) $F_2 > Cl_2 > Br_2 > I_2$: Bond dissociation energy
(iv) $F_2 > Cl_2 > Br_2 > I_2$: Electronegativity.
(a) (ii) and (iv) (b) (i) and (iii)
(c) (ii) and (iii) (d) (ii), (iii) and (iv)

263. The correct order of the thermal stability of hydrogen halides (H–X) is
(a) HI > HCl < HF > HBr (b) HCl< HF > HBr < HI
(c) HF > HCl > HBr > HI (d) HI < HBr > HCl < HF

264. In the case of alkali metals, the covalent character decreases in the order:
(a) MF > MCl > MBr > MI (b) MF > MCl > MI > MBr
(c) MI > MBr > MCl > MF (d) MCl > MI > MBr > MF

265. Which of the following order is/are incorrect regarding the property indicated against it?
(i) HF > HI > HBr > HCl : Thermal stability
(ii) $Cl_2O_7 > Cl_2O_6 > ClO_2 > Cl_2O$: Acidic character
(iii) $SbCl_3 > SbCl_5$: Covalent character
(iv) MCl > MBr : Ionic character
(a) (iii) only (b) (ii) only
(c) (i) and (iii) (d) (ii) and (iv)

266. What is X and Y in the given reactions ?
$2X_2(g) + 2H_2O(l) \rightarrow 4H^+(aq) + 4X^-(aq) + O_2(g)$
$Y_2(g) + H_2O(l) \rightarrow HY(aq) + HOY(aq)$
(a) X = Cl, Y = F (b) X = Cl, Y = Br
(c) X = F, Y = Cl (d) X = I, Y = F

267. Which of the following is correct about the reaction?

$$3NaClO \xrightarrow{heat} NaClO_3 + 2NaCl$$

(a) It is disproportionation reaction
(b) Oxidation number of Cl decreases as well as increases in this reaction
(c) This reaction is used for the manufacture of halates
(d) All of these

268. Which pair gives Cl_2 at room temperature :
(a) NaCl + Conc. H_2SO_4 (b) Conc. HCl + $KMnO_4$
(c) NaCl + Conc. HNO_3 (d) NaCl + MnO_2

269. The elements which occupy the peaks of ionisation energy curve are
(a) Na, K, Rb, Cs (b) Na, Mg, Cl, I
(c) Cl, Br, I, F (d) He, Ne, Ar, Kr

270. End-product of the hydrolysis of XeF_6 is
(a) XeF_4O (b) XeF_2O_2
(c) XeO_3 (d) XeO_3^-

271. The formation of $O_2^+[PtF_6]^-$ is the basis for the formation of xenon fluorides. This is because
(a) O_2 and Xe have comparable sizes
(b) both O_2 and Xe are gases
(c) O_2 and Xe have comparable ionisation energies
(d) Both (a) and (c)

272. What are the products formed in the reaction of xenon hexafluoride with silicon dioxide ?
(a) $XeSiO_4 + HF$ (b) $XeF_2 + SiF_4$
(c) $XeOF_4 + SiF_4$ (d) $XeO_3 + SiF_2$

273. XeO_4 molecule is tetrahedral having :
(a) Two $p\pi - d\pi$ bonds (b) One $p\pi - d\pi$ bonds
(c) Four $p\pi - d\pi$ bonds (d) Three $p\pi - d\pi$ bonds

HINTS AND SOLUTIONS

FACT/DEFINITION TYPE QUESTIONS

1. (d) Ionic radii increases down the group

2. (b) In case of nitrogen, d-orbitals are not available.

3. (a) Collectively these elements are called pnicogens and their compound pniconides.

4. (d) Metallic character increases down the group, Bi is most metallic

5. (b) The melting point in group 15 increases upto arsenic and then decreases upto bismuth.

6. (d) Bismuth forms metallic bonds in elemental state.

7. (a) –3, +3, +5

8. (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.

9. (a) Nitrogen due to small size is able to show $p\pi$-$p\pi$ lateral overlap forming $N \equiv N$, rest elements due to bigger size are not able to show $p\pi$-$p\pi$ lateral overlap.

10. (c) Catenation tendency is higher in phosphorus when compared with other elements of same group.

11. (c) Nitrogen form N_2 (i.e. $N \equiv N$) but phosphorus form P_4, because in P_2, p_π — p_π bonding is present which is a weaker bonding.

12. (d) The cause of inert nature of N_2 is the presence of triple bond $\dot{\dot{N}} \equiv \dot{\dot{N}}$

13. (b)

14. (b) Phosphorous can achieve coordination number 5 due to vacant d atomic orbitals in valence shell which is not possible in nitrogen

15. (b) The order of boiling points of the group 15 hydrides is : $BiH_3 > SbH_3 > NH_3 > AsH_3 > PH_3$

16. (a) Oxide in which central atom has higher charge and more electronegativity is more acidic, i.e.
$N_2O_5 > N_2O_4 > P_2O_5 > As_2O_3$.

17. (a) Order of dipole moment
$NH_3 > PH_3 > AsH_3 > SbH_3$
(Based upon electronegativity)

18. (c) As the size of central atom increases the lone pair of electrons occupies a larger volume. In other words electron density on the central atom decreases and consequently its tendency to donate a pair of electrons decreases along with basic character from NH_3 to BiH_3.

19. (a) NF_5 does not exist because N does not form pentahalides due to the absence of d-orbital in its valence shell. While P, As and Sb form pentahalides of the general formula MX_5 (where, M = P, As and Sb) due to the presence of vacant d-orbitals in their respective valence shell.

20. (d) Bi forms basic oxides whereas N and P form acidic and As and Sb form amphoteric oxides.

21. (b) The basic character decreases from NH_3 to BiH_3. The basic nature is due to the presence of lone pair of electrons on the central atom. NH_3 is the strongest electron pair donor due to its small size as the electron density of the electron pair is concentrated over a small region. As the size increases the electron density gets diffused over a large region and hence the ability to donate the electron pair (basic nature) decreases.

22. (a) NCl_5 in not possible because N does not contain d-orbitals.
Only nitrogen has a tendency to form $p\pi - p\pi$ multiple bonds. Other forms $d\pi - p\pi$ multiple bonds easily.

23. (c) **24. (b)**

25. (d) $NH_4Cl + NaNO_2 \xrightarrow[-NaCl]{Heat} NH_4NO_2$

$\xrightarrow{Heat} N_2 + 2H_2O.$

26. (a)

27. (b) In Haber's process for manufacture of NH_3, finely divided iron is used as catalyst and molybdenum is used as catalytic promoter

$$N_2(g) + 3H_2(g) \xrightarrow[800K,\ High\ P]{Fe + Mo} 2NH_3(g)$$

28. (d) N_2H_4 and NH_4Cl are obtained by reaction of ammonia with hypochlorite anion.

$3NH_3 + NaOCl \longrightarrow N_2H_4 + NH_4Cl + NaOH$

29. (a) HNO_3 and $CuSO_4$ are not drying agents, while P_2O_5 reacts with NH_3. The moisture present in NH_3 is removed by passing it through a tower packed with quicklime (CaO).

30. (b) Ammonia has pyramidal shape with sp^3 hybridisation.

31. (b) $3CuO + 2NH_3 \rightarrow 3Cu + 3H_2O + N_2$,

O.S. of N in NH_3 is –3 and in N_2 is zero. Hence loss of 3 electrons

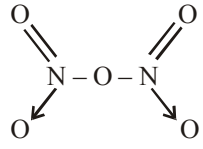
32. (b) NH_3 is not used as anaesthetic

33. (b) Liquid ammonia has high vapour pressure which is lowered down by cooling, otherwise the liquid will bump.

34. (c) By Haber's process

35. (a) Only nitrates of heavy metals and lithium decompose on heating to produce NO_2.

36. (d) N_2O_3, N_2O_4 and N_2O_5 are acidic oxides. Only N_2O is neutral oxide.

37. (b) 

The structure clearly shows the presence of covalent and co-ordinate bonds.

38. (d) NO_2 is reddish brown coloured gas. Rest of the oxides are colourless.

39. (c)

Compound	O.S. of N
N_2O	+1
NO	+2
NO_2	+4
NO_3^-	+5
NH_4^+	−3

Therefore increasing order of oxidation state of N is:

$NH_4^+ < N_2O < NO < NO_2 < NO_3^-$.

40. (c) In N_2O (nitrous oxide) two N atoms are covalently bonded through triple bond

$[N \equiv N \longrightarrow O]$

41. (b) $FeSO_4 + NO \rightarrow FeSO_4.NO$

42. (b)

43. (a) N_2O is used as anaesthetic

44. (c) $2NO + O_2 \rightarrow 2NO_2$ brown

45. (b) Phosphorus from stable P_4 molecule.

46. (a) $4NH_3 + 5O_2 \xrightarrow{\text{Pt. gauge}} 4NO + 6H_2O$

47. (b) The slow decomposition of HNO_3 is represented by the eqn.

$4HNO_3 \rightarrow \underset{\text{(yellow-brown)}}{4NO_2} + 2H_2O + O_2$

48. (d) For nitrogen, only NF_3 is known to be stable.

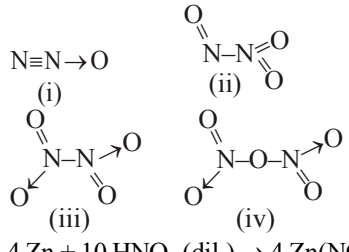
49. (a) $\underset{\text{(excess)}}{8NH_3} + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$

$NH_3 + \underset{\text{(excess)}}{3Cl_2} \longrightarrow NCl_3 + 3HCl$

50. (c) BiH_3 is the strongest reducing agent while NH_3 is the weakest reducing agent.

51. (d) The oxides of the type E_2O_3 of nitrogen and phosphorus are purely acidic.

52. (d) NH_3 is not used in the pickling of stainless steel.

53. (d) 

(i) (ii) (iii) (iv)

54. (d) $4\,Zn + 10\,HNO_3\,(dil.) \rightarrow 4\,Zn(NO_3)_2 + 5H_2O + N_2O$

$Zn + 4\,HNO_3\,(conc.) \rightarrow Zn(NO_3)_2 + 2H_2O + 2NO_2$

55. (a) Both white and red phosphorus are not soluble in CS_2 only white phosphorus is soluble in CS_2.

56. (b) White phosphorous is most reactive

57. (b) White phosphorous is P_4 and tetrahedral

58. (a) Except (a) all other properties are shown by white phosphorous.

59. (b) White phosphorus on heating readily catches fire in air to give dense white fumes of P_4O_{10}.

$P_4 + 5O_2 \longrightarrow P_4O_{10}$.

60. (c) Monoclinic sulphur is stable above 369 K.

61. (c) $Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$; i.e 2 moles of phosphine are produced from one mole of calcium phosphide.

62. (d) PH_3 is covalent hydride

63. (b) Red P does not react with NaOH to give PH_3.

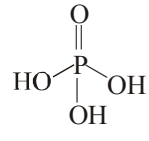
64. (d) PH_3 is not obtained when metaphosphoric acid is heated.

65. (a) The combustibility of PH_3 is due to presence of P_2H_4. The pure PH_3 is not combustible.

66. (d) $2H_3PO_4 \xrightarrow[-2H_2O]{600°C} 2HPO_3$

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

68. (b) Orthophosphoric acid, H_3PO_4 contains three P – OH bonds and is therefore, tribasic.

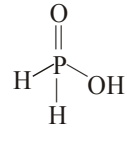


orthophosphoric acid

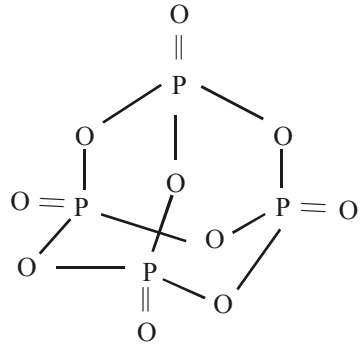
69. (b) $PCl_3 + H_2O \longrightarrow POCl_3 + 2HCl$

$POCl_3 + 3H_2O \longrightarrow H_3PO_4 + 3HCl$

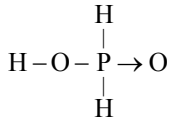
70. (c) H_3PO_2 is named as hypophosphorous acid. It is monobasic as it contains only one P – OH bond, its basicity is one.



71. (a) We know that empirical formula of hypophosphorus acid is H_3PO_2. In this only one ionisable hydrogen atom is present i.e. it is monobasic. Therefore option (a) is correct structural formula of it.

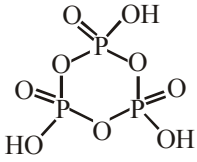
72. (d) 

73. **(c)** Structure of hypophosphorous acid



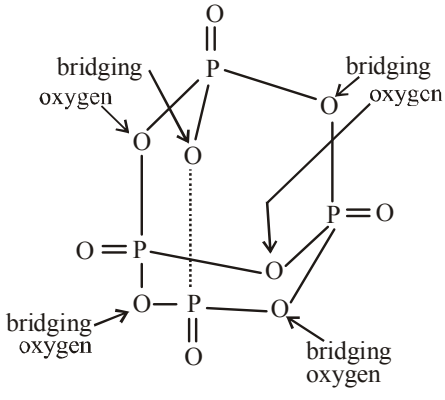
Two H-atoms are attached to P atom.

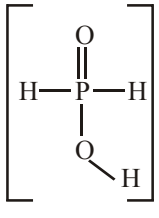
74. **(c)** In cyclic metaphosporic acid number of P–O–P bonds is three.



75. **(d)**

76. **(b)**



77. **(b)**  Hypophosphorous acid (H_3PO_2) is a monobasic acid. i.e., it has only one ionisable hydrogen atom or one OH is present.

78. **(c)** Hybridisation in $PCl_5 = \frac{1}{2}(5+5+0-0) = 5\ sp^3d$

79. **(c)** $H_5P_5O_{15}$ $(HPO_3)_5$. It is metaphosphoric acid which is a cyclic phosphate.

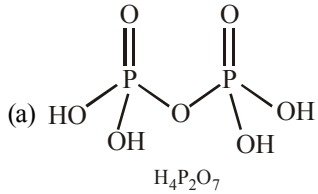
80. **(b)** $H_4P_2O_5$ is pyrophosphorous acid it contains P–O–P bond

81. **(c)** H_3PO_4 is tribasic

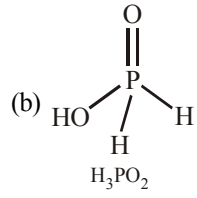
82. **(a)** Hypophosphorous acid is H_3PO_2 in which O.S. of P is +1

83. **(c)**

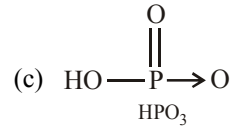
84. **(d)** Structures of given oxyacids are following



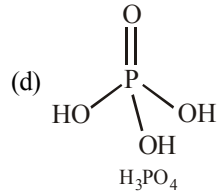
$H_4P_2O_7$



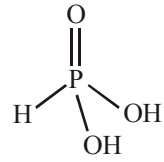
H_3PO_2



HPO_3



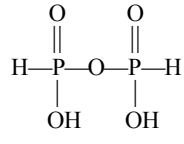
H_3PO_4



H_3PO_3

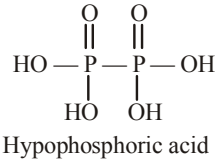
The H–atom of the –OH group is ionisable whereas H–atom which is directly linked to P–atom is non-ionisable. Thus H_3PO_3 is dibasic acid.

85. **(a)** Pyrophosphorous acid ($H_4P_2O_5$) is a dibasic acid as it contains two P—OH bonds.

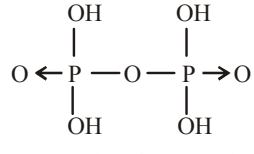


86. **(b)** Formula of cyclotrimetaphosphoric acid is $(HPO_3)_3$
Oxidation state of 'P' is $3(+1+x+3(-2))=0$
$x+-6+1=0 \Rightarrow x=+5$

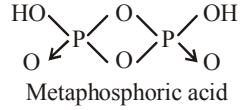
87. **(a)**



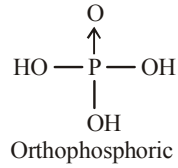
Hypophosphoric acid



Pyrophosphoric acid



Metaphosphoric acid



Orthophosphoric acid

88. **(a)** **89.** **(c)** **90.** **(d)**

91. **(a)** Electron affinity increases from left to right in period and decreases from top to bottom in a group but electron affinity of O is less than S due to small size.

92. **(d)** All exhibit polymorphism

93. **(a)**

94. **(d)** H_2O is liquid but H_2S is a gas. This can be attributed to the presence of intermolecular hydrogen bonding in case of H_2O.

95. **(b)**

96. **(a)**

97. **(a)** H_2O (due to intermolecular H - bonding)

98. **(b)** Oxygen being more electronegative

99. **(a)** SnO_2 is an amphoteric oxide because it reacts with acids as well as with bases to form corresponding salts.

$SnO_2 + 2H_2SO_4(conc) \longrightarrow Sn(SO_4)_2 + 2H_2O$

$SnO_2 + 2NaOH \longrightarrow Na_2SnO_3 + H_2O$

100. **(d)** All hexafluorides of group 16 elements are gaseous in nature.

101. **(b)** Oxygen can be prepared by heating oxides of Hg, Pb, Ag, Mn and Ba.

$$2HgO \xrightarrow{\Delta} 2Hg + O_2$$

102. **(c)** It is paramagnetic with two unpaired electrons

103. **(c)** Total number of electrons in O_2 is 16. It has 2 unpaired electrons, the rest 14 are paired.

104. **(b)** $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2$

105. **(c)** In $KMnO_4$ manganese is already present in its highest possible oxidation state i.e. +7.So no further oxidation is possible.

106. **(c)** Ozone layer is beneficial to us, because it stops harmful ultraviolet radiations from reaching the earth.

107. **(b)** $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + 4MnO_2 + O_2$

108. **(d)** Ozone is an allotrope of oxygen.

109. **(d)** $2Ag_2O\,(s) \rightarrow 4Ag\,(s) + O_2\,(g)$

$2Pb_3O_4\,(s) \rightarrow 6PbO\,(s) + O_2\,(g)$

$2PbO_2\,(s) \rightarrow 2PbO\,(s) + O_2\,(g)$

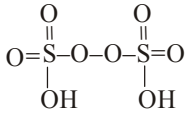
110. **(a)** Mn_2O_7 is an acidic oxide. BaO and Na_2O are basic oxides while N_2O is a neutral oxides.

111. **(c)** It is 8

112. **(c)** S_2 is paramagnetic. It contains two unpaired electrons in the antibonding π^* orbital

113. **(a)** $2SO_2(g) + O_2(g) \xrightarrow{V_2O_5} 2SO_3(g)$

114. **(b)**



Peroxodisulphuric acid

$(H_2S_2O_8)$

115. **(b)** Conc. H_2SO_4 is a strong dehydrating agent due to which carbohydrates becomes charred on reaction with conc. H_2SO_4 acid.

116. **(b)** The key step in the manufacture of H_2SO_4 is catalystic oxidation of SO_2 with O_2 to give SO_3 in presence of V_2O_5.

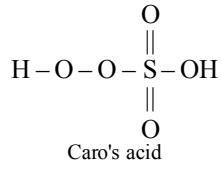
117. **(a)** In SO_3, sp^2 hybridisation

118. **(c)** $Cu + 2H_2SO_4(conc) \longrightarrow CuSO_4 + SO_2 + 2H_2O$

119. **(b)** 2σ, one π see structure

120. **(c)** $SO_2 + 2H_2O \rightarrow H_2SO_4 + 2H$. Bleaching action is due to reduction.

121. **(d)** Caro's acid is H_2SO_5 which contains one S – O – O – H peroxy linkage. It is also known as permonosulphuric acids.



Caro's acid

122. **(d)**

123. **(c)** Oleum is $H_2S_2O_7$ $(H_2SO_4 + SO_3)$ which is obtained by dissolving SO_3 in H_2SO_4 and is called fuming sulphuric acid.

124. **(c)** **125.** **(a)** **126.** **(c)**

127. **(c)** It is H_2SO_5.

128. **(c)** $HO.SO_2OH + 2PCl_5 \rightarrow ClSO_2Cl + 2POCl_3 + 2HCl$

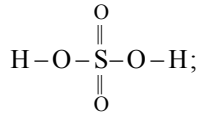
Sulphuryl chloride

129. **(b)** $2Ag + 2H_2SO_4 \rightarrow 2H_2O + SO_2 + Ag_2SO_4$.

Au, Pt does not react. Pb forms insoluble $PbSO_4$

130. **(c)**

131. **(a)**



6σ & 2π

132. **(a)** In H_2SO_4, the S atom is present in its highest oxidation state of +6. Hence H_2SO_4 can act an oxidant only by gain of electrons

133. **(d)** Ionisation potential decreases down the group.

134. **(a)**

135. **(d)** The lesser the bond energy, the weaker is the bond

136. **(b)** $3s^2\,3p^5$ is electronic configuration of Cl

137. **(c)** The electron gain enthalpy order for halogens is $Cl > F > Br > I$

Due to small size of fluorine the extra electron to be added feels more electron-electron repulsion. Therefore fluorine has less value for electron affinity than chlorine.

138. **(d)**

139. **(a)** Reactivity follows the order $F > Cl > Br > I$

140. **(d)**

141. **(b)** Except ionisation potential other factors are true to explain the oxidising (strong) behaviour of F_2.

142. **(b)**

143. **(d)** Fluorine exhibit -ve oxidation state

144. **(a)** Since F_2 is most oxidising, it is easily reduced

145. **(c)** Chlorine shows O.S. from –1,+1 to +7, whereas others show O.S. as Na→ +1 ; K→ +1 ; F→ –1

146. (c) Fluorine always exhibit –1 oxidation state.

147. (b) $\overset{0}{H_2O} + \overset{0}{Br_2} \longrightarrow \overset{+1}{HO}\overset{-1}{Br} + \overset{-1}{HBr}$

Thus here oxidation number of Br increases from 0 to +1 and also decreases from 0 to –1. Thus it is oxidised as well as reduced.

148. (d) Since all the halogens have a strong tendency to accept electrons. Therefore halogens act as strong oxidising agents and their oxidising power decreases from fluorine to iodine.

149. (b) On moving from top to bottom of halogen group the bond dissociation energy of hydrogen halides decreases and so the heat of formation of halogen acids also decreases.

150. (a) HF, due to intermolecular H-bonding is weakest among HX acids

151. (c) Volatile character HCl > HBr > HI > HF

152. (d) Due to hydrogen bonding HF is a liquid

153. (d) Bleaching action of chlorine is due to oxidation in presence of moisture.

$Cl_2 + H_2O \rightarrow HCl + HClO$

$HClO \rightarrow HCl + O$

Colouring matter + | O | → Colourless matter

154. (b) $Cl_2 + 2NaOH \xrightarrow{\text{(cold \& dil)}} NaCl + NaClO + H_2O$

$3Cl_2 + 6NaOH \xrightarrow{\text{(hot \& conc.)}} 5NaCl + NaClO_3 + 3H_2O$

155. (a) $2NaOH + Cl_2 \rightarrow NaCl + NaOCl + H_2O$

hence Cl^- and OCl^-

156. (d) $K_2Cr_2O_7 + \text{conc.}HCl \rightarrow Cl_2$

157. (d) MnO_2 or $KMnO_4$ with conc HCl give Cl_2.

158. (d) $2\overset{+7}{K}\overset{+7}{Mn}O_4 + 16HCl \rightarrow 2\overset{+2}{Mn}Cl_2 + 2KCl + 8H_2O + 5Cl_2$

O.S of Mn changes from +7 to +2 hence reduction occurs and Cl_2 is formed.

159. (d) $6CaOCl_2 \rightarrow Ca(ClO_3)_2 + 5CaCl_2$

It is autooxidation.

160. (d) HCl acid at 25° C is a gas and polar in nature

161. (d) In gaseous state the HCl is covalent in nature while in aqueous solution it ionises to give H^+ and Cl^- ions

162. (d) As the oxidation state of the central halogen atom increases, the halogen-oxygen bond becomes more and more covalent. As a result the thermal stability of the oxoacid increases. Thus, $HClO_4$ is most stable to heat, whereas HClO is least stable to heat.

163. (c) The bond energy of interhalogen compounds is less than the bond energy of halogens.

164. (d) Interhalogen compounds are not highly volatile

165. (a) ICl_7. The hybridisation is $\frac{1}{2}(7+7+0-0) = 7\ (sp^3d^3)$

166. (b) $6NaOH + 3\overset{0}{Cl_2} \longrightarrow 5\overset{-1}{NaCl} + \overset{+5}{NaClO_3} + 3H_2O$

167. (c) $6NaOH + 3Cl_2 \rightarrow 5NaCl + NaClO_3 + 3H_2O$ (hot and conc.)

168. (a) Rn because it is radioactive element obtained by the disintegration of radium

$_{88}Ra^{226} \rightarrow_{86} Rn^{222} +_2 He^4$

169. (b) Radon is the last member of family

170. (d)

171. (d) Electronic configuration of He is $1s^2$

172. (a) Inert gases do not contain unpaired electrons

173. (b) Ionization potential of inert gases is highest in periodic table due to stable electronic configuration.

174. (a) Ionisation energy decreases as we move away from nucleus due to less electrostatic attraction between electrons and nucleus

175. (a) The smaller the size the least is the polarisability

176. (c) The differentiating electron enter in s subshell in case of He, hence it is s- block element. Its electronic configuration $1s^2$ makes it inert in nature hence it is placed with inert gases.

177. (c) Ar is the most abundant in atmosphere

178. (d) Due to weak van der Waal's forces, He has lowest boiling point

179. (d) The larger the size the more is the polarisiability

180. (d) He was observed in the spectrum of the sun

181. (b) $_{88}Ra^{226} \rightarrow_{86} Rn^{222} +_2 He^4$. Both are inert gases

182. (d) Electron gain enthalpy for noble gases is positive and it becomes less positive with increase in size of atom.

Value of electron gain enthalpy

He – 48 kJ mol^{-1}, Ne – 116 kJ mol^{-1}

Ar, Kr – 96 kJ mol^{-1}, Xe – 77 kJ mol^{-1}

Hence, Ne has highest positive electron gain enthalpy.

183. (b)

184. (a) As size increases, van der Waal's forces of attraction between noble gas atoms also increases. Consequently, ease of their liquefaction increases.

185. (c) Solubility increases from He to Rn

186. (d) Xe forms maximum compounds hence it is most reactive

187. (b) Noble gases exhibit low chemical activity

188. (d)

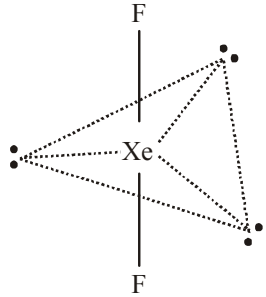
189. (b) In $XeOF_4$, Xenon is sp^3d^2 hybridised and has one lone pair of electrons.

190. (a)

191. (d) The products of the concerned reaction react each other forming back the reactants.

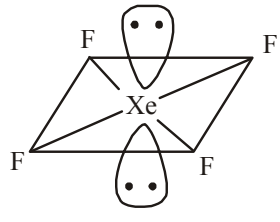
$XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$.

192. (c) XeF_2 :



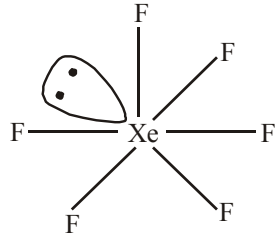
3*l*p

XeF_4 :

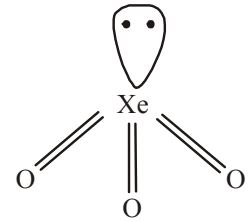


2*l*p

XeF_6 :



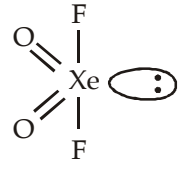
XeO_3 :



1*l*p

Hence XeF_2 has maximum no. of lone pairs of electrons.

193. (d) XeO_2F_2 has trigonal bipyramidal geometry, but due to presence of lone pair of electrons on equitorial position, its actual shape is *see-saw*.



194. (b) $XeF_4 + H_2O \rightarrow 2HF + XeOF_2$

195. (a) No compound of He as yet been reported

196. (a) No compound of Ar as yet been reported with F_2

197. (c) $XeF_6 + 3H_2O \rightarrow 6HF + XeO_3$

198. (d) Hybridisation in

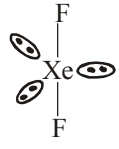
$$XeF_4 = \frac{1}{2}(8+4+0-0) = 6 \; sp^3d^2$$

199. (b) $XeOF_4$ square pyramidal

200. (c) Hybridisation of XeF_2 is sp^3d

201. (b) XeF_4 is planar

202. (a) In XeO_3 the hybridisation is sp^3

203. (a) XeF_2 has  structure hence number of lone pair of electrons 3

204. (c) Hybridisation of XeF_4 is sp^3d^2 and structure is square planar

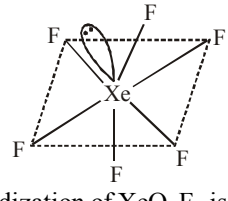
205. (a)

	XeF_2	XeF_4	XeF_6
Valence electrons of Xe	8	8	8
Electrons involved in bond formation	2	4	6
Lone pairs left	3	2	1

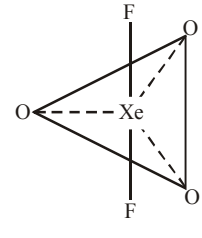
206. (c) Hybridisation in each case is $XeF_4 sp^3d^2$, $XeF_2 sp^3d$,

207. (c) He is obtained during radioactive decay

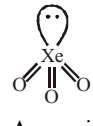
208. (c) The geometry of XeF_6 is distorted octahedral in which all the six positions are occupied by fluorine atoms and the lone pair of electrons of Xe atom is present at the corner of one of the triangular faces.



209. (b) The hybridization of XeO_3F_2 is sp^3d and its structure is trigonal bipyramidal in which oxygen atoms are situated on the plane and the fluoride atoms are on the top and bottom.



210. (b) The shape of XeO_3 is Trigonal Pyramidal.



(Trigonal Pyramidal Structure)

211. (c) Argon is used in high temperature welding and other operations which require a non-oxidising atmosphere and the absence of nitrogen.

212. (b) Neon gives a distinct reddish glow when used in either low-voltage neon glow lamps or in high voltage discharge tube.

213. (c) Helium is twice as heavy as hydrogen it is inflammable but not lighter than hydrogen. Helium has the lowest melting and boiling point of any element which makes liquid helium an ideal coolant for many extremely low temperature application such as super conducting magnet and cryogenic research where temperature close to absolute zero are needed. He is used in gas cooled atomic reactors as a heat transfer agent.

214. (c) Coloured discharge tubes mainly contain Neon

215. (a) Breathing mixture is $(O_2 + He)$

216. (a) Mixture of $(He + O_2)$ is used for asthma patient

217. (b) **218. (c)** **219. (d)**

STATEMENT TYPE QUESTIONS

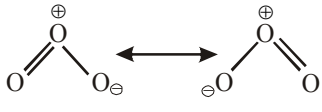
220. (a) Phosphorus occurs in minerals of the apatite family, $Ca_9(PO_4)_6$, CaX_2 (X = F, Cl or OH) which are main components of phosphate rocks whereas arsenic and antimony are found as sulphide minerals. The increase in covalent radii from N to P is greater in comparison to increase from As to Bi.

221. (c) For nitrogen oxidation states from +1 to +4 disproportionate in acidic solution only. Oxidation state of phosphorous in P_2O_5 is + 5 whereas in P_2O_5 is +3 thus P_2O_5 is more acidic than P_2O_3.

222. (b)

223. (a) Oxygen shows oxidation state of +2 in OF_2. H_2O which is a hydride of oxygen element of group 16 is neutral in nature.

224. (c)



Ozone is diamagnetic in nature (due to presence of paired electron) and both the O – O bond length are equal. It has a bent structure.

225. (b) NH_3 being basic reacts with acidic H_2SO_4 thus H_2SO_4 cannot be used for drying NH_3.

226. (b) Physical state of iodine is different from other halogens as iodine is solid, bromine is a liquid whereas fluorine and chlorine are gases.

227. (b) At 298K, ClF exits as a gas.

228. (d)

229. (c) For statement (iii) preparation of XeF_2 requires Xe in excess amount

$$\underset{\text{(excess)}}{Xe(g)} + F_2(g) \xrightarrow{673K,\,1\,bar} XeF_2(s)$$

For statements (iv)

$$2XeF_2(s) + 2H_2O(l) \longrightarrow 2Xe(g) + 4HF(aq) + O_2(g)$$

$$6XeF_4 + 12H_2O \longrightarrow 4Xe + XeO_3 + 24HF + 3O_2$$

$$XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$$

MATCHING TYPE QUESTIONS

230. (b) **231. (a)** **232. (a)** **233. (c)** **234. (a)**
235. (b) **236. (b)** **237. (b)** **238. (b)** **239. (a)**
240. (c) **241. (a)**

ASSERTION-REASON TYPE QUESTIONS

242. (c) At higher temperatures, dinitrogen combines with metals to form ionic nitrides.

243. (c)

244. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

$$\underset{\text{(metal)}}{M} + \underset{\text{(conc.)}}{HNO_3} \longrightarrow \underset{\text{(metal nitrate)}}{MNO_3} + \underset{\text{(nascent hydrogen)}}{H}$$

$$2HNO_3 + \underset{\text{(nascent hydrogen)}}{2H} \longrightarrow 2NO_2 + 2H_2O$$

245. (b) White phosphorus exists as P_4 tetrahedral molecule having P-P-P bond angle 60°. Hence the molecule is under strain and more reactive. On the other hand red phosphorus exists as P_4 tetrahedra which are joined together through covalent bonds giving polymeric structure.

246. (c) Bond angle of H_2S (92°) < H_2O (104°31). As the electronegativity of the central atom decreases, bond angle decreases. In the present case, S is less electronegative than oxygen. Thus bond pairs in H_2S are more away from the central atom than in H_2O and thus repulsive forces between bond pairs are smaller producing smaller bond angle.

247. (a) **248. (a)**

CRITICAL THINKING TYPE QUESTIONS

249. (b) With the decrease in the electronegativity of central atom the bond angle decreases

250. (d)

251. (b) $CuSO_4 + 4NH_3 \rightarrow [Cu(NH_3)_4]SO_4$

Blue complex due to $Cu(NH_3)_4^{2+}$

252. (b) $2NO + N_2O_4 \xrightarrow[250K]{} 2N_2O_3$

253. (b) The slow decomposition of HNO_3 is represented by the eqn.

$$4HNO_3 \rightarrow \underset{\text{(yellow-brown)}}{4NO_2} + 2H_2O + O_2$$

254. (a)

255. (c) $[Fe(H_2O)_5NO]^{2+}$ ion is formed

256. (b) $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

Colourless White ppt

$AgCl(s) + 2NH_3(aq) \rightarrow [Ag(NH_3)_2]Cl(aq)$

White ppt Colourless

257. (b) NO_2 and N_2O_4 has + 4 oxidation state for nitrogen.

258. (c) $3CuSO_4 + 2PH_3 \rightarrow Cu_3P_2 + 3H_2SO_4$

$3HgCl_2 + 2PH_3 \rightarrow Hg_3P_2 + 6HCl$

259. (d) SH–bond is weaker than, O–H bond. Hence H_2S will furnish more H^+ ions

260. (c) Air is liquified 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 major 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 $N_2 = -195.8°C$)

261. (d) Formal charges help in the selection of the lowest energy structure from a number of possible Lewis structures for a given compound. The lowest energy structure means the structure with the smallest formal charge on each atom of the compound. A Lewis dot structure is preferable when all formal charges are zero.

262. (c) From the given options we find option (a) is correct. The oxidising power of halogens follow the order $F_2 > Cl_2 > Br_2 > I_2$. Option (b) is incorrect because it in not the correct order of electron gain enthalpy of halogens.

The correct order is $Cl_2 > F_2 > Br_2 > I_2$. The low value of F_2 than Cl_2 is due to its small size.

Option (c) is incorrect. The correct order of bond dissociation energies of halogens is

$Cl_2 > Br_2 > F_2 > I_2$.

Option (d) is correct. It is the correct order of electronegativity values of halogens. Thus option (b) and (c) are incorrect.

263. (c) The H–X bond strength decreases from HF to HI. i.e. HF > HCl > HBr > HI. Thus HF is most stable while HI is least stable. The decreasing stability of the hydrogen halide is also reflected in the values of dissociation energy of the H–X bond

H – F	H – Cl	H – Br	H – I
135 kcal mol^{-1}	103 kcal mol^{-1}	87 kcal mol^{-1}	71 kcal mol^{-1}

264. (c) MI > MBr > MCl > MF. As the size of the anion decreases covalent character also decreases.

265. (a) Metal halides with higher oxidation state are more covalent than the one in lower oxidation state.

266. (c) $2F_2(g) + 2H_2O(l) \rightarrow 4H^+(aq) + 4F^-(aq) + O_2(g)$

$Cl_2(g) + 2H_2O(l) \rightarrow HCl(aq) + HOCl$

267. (d) $\overset{+1}{NaClO} \longrightarrow \overset{+5}{NaClO_3} + 2\overset{-1}{NaCl}$ All statements are correct as evident from the reaction

268. (b) $2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$

269. (d)

270. (c) $XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$

$\therefore$ Complete hydrolysis of XeF_6 gives XeO_3 (an explosive).

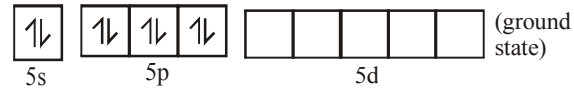
271. (d) (i) The first ionization energy of xenon (1, 170 kJ mol^{-1}) is quite close to that of dioxygen (1,180 kJ mol^{-1}).

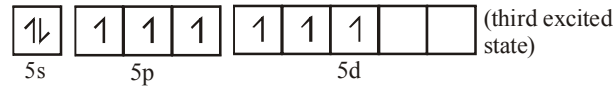
(ii) The molecular diameters of xenon and dioxygen are almost identical.

Based on the above similarities Barlett (who prepared $O_2^+[PtF_6]^-$ compound) suggested that since oxygen combines with PtF_6, so xenon should also form similar compound with PtF_6.

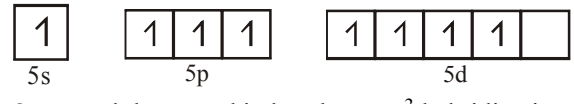
272. (c) $2XeF_6 + SiO_2 \rightarrow SiF_4 + 2XeOF_4$

273. (c) Xenon undergo sp^3 hybridization.





In the fourth excited state xenon atom, has 8 unpaired electrons



One *s* and three *p* orbital undergo sp^3 hybridization. Four sp^3 hybrid orbitals form four σ bonds with oxygen atoms. They are $\sigma sp^3 - p$. Four $p\pi - d\pi$ bonds are also formed with oxygen atoms by the unpaired electrons.