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The p-Block Elements (Group 15, 16, 17 & 18)

TOPIC 1 Nitrogen Family

1. The correct statement with respect to dinitrogen is: **[Sep. 06, 2020 (I)]**

(a) N_2 is paramagnetic in nature.
(b) it can combine with dioxygen at 25 °C.
(c) liquid dinitrogen is not used in cryosurgery.
(d) it can be used as an inert diluent for reactive chemicals.

2. The reaction of NO with N_2O_4 at 250 K gives : **[Sep. 06, 2020 (II)]**

(a) N_2O (b) NO_2 (c) N_2O_3 (d) N_2O_5

3. Reaction of ammonia with excess Cl_2 gives : **[Sep. 05, 2020 (II)]**

(a) NH_4Cl and N_2 (b) NH_4Cl and HCl
(c) NCl_3 and NH_4Cl (d) NCl_3 and HCl

4. On heating, lead (II) nitrate gives a brown gas (A). The gas (A) on cooling changes to a colourless solid/liquid (B). (B) on heating with NO changes to a blue solid (C). The oxidation number of nitrogen in solid (C) is : **[Sep. 04, 2020 (I)]**

(a) +5 (b) +2 (c) +3 (d) +4

5. Aqua regia is used for dissolving noble metals (Au, Pt, etc.). The gas evolved in this process is : **[Sep. 03, 2020 (I)]**

(a) NO (b) N_2O_5 (c) N_2 (d) N_2O_3

6. In a molecule of pyrophosphoric acid, the number of P – OH, P = O and P – O – P bonds/ moiety(ies) respectively are : **[Sep. 03, 2020 (I)]**

(a) 2, 4 and 1 (b) 3, 3 and 3
(c) 4, 2 and 0 (d) 4, 2 and 1

7. On heating compound (A) gives a gas (B) which is a constituent of air. This gas when treated with H_2 in the presence of a catalyst gives another gas (C) which is basic in nature. (A) should **not** be : **[Sep. 02, 2020 (I)]**

(a) NaN_3 (b) $Pb(NO_3)_2$
(c) $(NH_4)_2Cr_2O_7$ (d) NH_4NO_2

8. White phosphorus on reaction with concentrated NaOH solution in an inert atmosphere of CO_2 gives phosphine and compound (*X*). (*X*) on acidification with HCl gives compound (*Y*). The basicity of compound (*Y*) is: **[Jan. 08, 2020 (II)]**

(a) 2 (b) 1 (c) 4 (d) 3

9. The number of pentagons in C_{60} and trigons (triangles) in white phosphorous, respectively, are : **[April 10, 2019 (II)]**

(a) 20 and 3 (b) 12 and 4
(c) 12 and 3 (d) 20 and 4

10. The correct order of the oxidation states of nitrogen in NO, N_2O, NO_2 and N_2O_3 is: **[April 9, 2019 (I)]**

(a) $NO_2 < NO < N_2O_3 < N_2O$
(b) $NO_2 < N_2O_3 < NO < N_2O$
(c) $N_2O < N_2O_3 < NO < NO_2$
(d) $N_2O < NO < N_2O_3 < NO_2$

11. The pair that contains two P–H bonds in each of the oxoacids is: **[Jan. 10, 2019 (II)]**

(a) $H_4P_2O_5$ and $H_4P_2O_6$ (b) H_3PO_2 and $H_4P_2O_5$
(c) H_3PO_3 and H_3PO_2 (d) $H_4P_2O_5$ and H_3PO_3

12. Good reducing nature of H_3PO_2 is attributed to the presence of: **[Jan. 9, 2019 (II)]**

(a) Two P — OH bonds (b) One P — H bond
(c) Two P — H bonds (d) One P — OH bond

13. The compound that **does not** produce nitrogen gas by the thermal decomposition is : **[2018]**

(a) $Ba(N_3)_2$ (b) $(NH_4)_2Cr_2O_7$
(c) NH_4NO_2 (d) $(NH_4)_2SO_4$

14. Among the oxides of nitrogen: N_2O_3, N_2O_4 and N_2O_5; the molecule(s) having nitrogen-nitrogen bond is/are: **[Online April 16, 2018]**

(a) N_2O_3 and N_2O_4 (b) N_2O_4 and N_2O_5
(c) N_2O_3 and N_2O_5 (d) Only N_2O_5

15. The number of P – O bonds in P_4O_6 is: **[Online April 15, 2018 (II)]**

(a) 9 (b) 6 (c) 12 (d) 18

16. For per gram of reactant, the maximum quantity of N_2 gas is produced in which of the following thermal decomposition reactions? (Given: Atomic wt. : Cr = 52 u, Ba = 137 u).
[Online April 15, 2018 (II)]
(a) $Ba(N_3)_2(s) \rightarrow Ba(C) + 3N_2(g)$
(b) $(NH_4)_2Cr_2O_7(s) \rightarrow N_2(g) + 4H_2O(g) + Cr_2O_3(s)$
(c) $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$
(d) $2NH_4NO_3(s) \rightarrow 2N_2(g) + 4H_2O(g) + O_2(g)$

17. The number of P–OH bonds and the oxidation state of phosphorus atom in pyrophosphoric acid ($H_4P_2O_7$) respectively are : **[Online April 9, 2017]**
(a) four and four (b) five and four
(c) five and five (d) four and five

18. A metal 'M' reacts with nitrogen gas to afford 'M_3N'. 'M_3N' on heating at high temperature gives back 'M' and on reaction with water produces a gas 'B'. Gas 'B' reacts with aqueous solution of $CuSO_4$ to form a deep blue compound. 'M' and 'B' respectively are :
[Online April 8, 2017]
(a) Li and NH_3 (b) Ba and N_2
(c) Na and NH_3 (d) Al and N_2

19. The pair in which phosphorus atoms have a formal oxidation state of + 3 is : **[2016]**
(a) Orthophosphorous and hypophosphoric acids
(b) Pyrophosphorous and pyrophosphoric acids
(c) Orthophosphorous and pyrophosphorous acids
(d) Pyrophosphorous and hypophosphoric acids

20. Which of the following compound has a P–P bond ?
[Online April 11, 2015]
(a) $H_4P_2O_5$ (b) $(HPO_3)_3$ (c) $H_4P_2O_6$ (d) $H_4P_2O_7$

21. Which one of the following does not have a pyramidal shape? **[Online April 11, 2014]**
(a) $(CH_3)_3N$ (b) $(SiH_3)_3N$ (c) $P(CH_3)_3$ (d) $P(SiH_3)_3$

22. The molecule having smallest bond angle is : **[2012]**
(a) NCl_3 (b) $AsCl_3$ (c) $SbCl_3$ (d) PCl_3

23. Regular use of the following fertilizers increases the acidity of soil? **[2007]**
(a) Ammonium sulphate (b) Potassium nitrate
(c) Urea (d) Superphosphate of lime.

24. The number of hydrogen atom(s) attached to phosphorus atom in hypophosphorous acid is **[2005]**
(a) three (b) one (c) two (d) zero

25. What may be expected to happen when phosphine gas is mixed with chlorine gas ? **[2003]**
(a) PCl_3 and HCl are formed and the mixture warms up
(b) PCl_5 and HCl are formed and the mixture cools down
(c) $PH_3 . Cl_2$ is formed with warming up
(d) The mixture only cools down

26. Which one of the following substances has the highest proton affinity ? **[2003]**
(a) H_2S (b) NH_3 (c) PH_3 (d) H_2O

27. In case of nitrogen, NCl_3 is possible but not NCl_5 while in case of phosphorus, PCl_3 as well as PCl_5 are possible. It is due to **[2002]**
(a) availability of vacant *d* orbitals in P but not in N
(b) lower electronegativity of P than N
(c) lower tendency of H-bond formation in P than N
(d) occurrence of P in solid while N in gaseous state at room temperature.

28. Number of sigma bonds in P_4O_{10} is **[2002]**
(a) 6 (b) 7 (c) 17 (d) 16.

TOPIC 2 Oxygen Family

29. Reaction of an inorganic sulphite X with dilute H_2SO_4 generates compound Y. Reaction of Y with NaOH gives X. Further, the reaction of X with Y and water affords compound Z. Y and Z, respectively, are: **[Sep. 06, 2020 (II)]**
(a) SO_2 and Na_2SO_3 (b) SO_3 and $NaHSO_3$
(c) SO_2 and $NaHSO_3$ (d) S and Na_2SO_3

30. If the boiling point of H_2O is 373 K, the boiling point of H_2S will be : **[Sep. 03, 2020 (I)]**
(a) less than 300 K
(b) equal to 373 K
(c) more than 373 K
(d) greater than 300 K but less than 373 K

31. The number of bonds between sulphur and oxygen atoms in and the number of bonds between sulphur and sulphur atoms in rhombic sulphur, respectively, are:
[Jan. 08, 2020 (I)]
(a) 4 and 6 (b) 8 and 8 (c) 8 and 6 (d) 4 and 8

32. The oxoacid of sulphur that does not contain bond between Sulphur atoms is : **[April 10, 2019 (I)]**
(a) $H_2S_4O_6$ (b) $H_2S_2O_3$ (c) $H_2S_2O_7$ (d) $H_2S_2O_4$

33. In KO_2, the nature of oxygen species and the oxidation state of oxygen atom are, respectively:
[Online April 15, 2018 (II)]
(a) Superoxide and –1 (b) Superoxide and –1/2
(c) Peroxide and –1/2 (d) Oxide and –2

34. The number of S=O and S–OH bonds present in peroxodisulphuric acid and pyrosulphuric acid respectively are : **[Online April 8, 2017]**
(a) (2 and 2) and (2 and 2)
(b) (2 and 4) and (2 and 4)
(c) (4 and 2) and (2 and 4)
(d) (4 and 2) and (4 and 2)

35. The correct sequence of decreasing number of π-bonds in the structures of H_2SO_3, H_2SO_4 and $H_2S_2O_7$ is : **[Online April 9, 2017]**
(a) $H_2SO_3 > H_2SO_4 > H_2S_2O_7$
(b) $H_2SO_4 > H_2S_2O_7 > H_2SO_3$
(c) $H_2S_2O_7 > H_2SO_4 > H_2SO_3$
(d) $H_2S_2O_7 > H_2SO_3 > H_2SO_4$

36. Identify the incorrect statement : **[Online April 10, 2016]**
(a) The S–S–S bond angles in the S_8 and S_6 rings are the same.
(b) Rhombic and monoclinic sulphur have S_8 molecules.
(c) S_2 is paramagnetic like oxygen
(d) S_8 ring has a crown shape.

37. **Assertion:** Nitrogen and oxygen are the main components in the atmosphere but these do not react to form oxides of nitrogen.
Reason: The reaction between nitrogen and oxygen requires high temperature. **[2015]**
(a) The assertion is incorrect, but the reason is correct
(b) Both the assertion and reason are incorrect
(c) Both assertion and reason are correct, and the reason is the correct explanation for the assertion
(d) Both assertion and reason are correct, but the reason is not the correct explanation for the assertion

38. The number of S—S bonds in SO_3, $S_2O_3^{2-}$ $S_2O_6^{2-}$ and $S_2O_8^{2-}$ respectively are **[Online May 26, 2012]**
(a) 1, 0, 0, 1 (b) 1, 0, 1, 0 (c) 0, 1, 1, 0 (d) 0, 1, 0, 1

39. Concentrated hydrochloric acid when kept in open air, sometimes produces a cloud of white fumes. The explanation for it is that **[2003]**
(a) oxygen in air reacts with the emitted HCl gas to form a cloud of chlorine gas
(b) strong affinity of HCl gas for moisture in air results in forming of droplets of liquid solution which appears like a cloudy smoke.
(c) due to strong affinity for water, concentrated hydrochloric acid pulls moisture of air towards itself. This moisture forms droplets of water and hence the cloud.
(d) concentrated hydrochloric acid emits strongly smelling HCl gas all the time.

TOPIC 3 Halogen Family

40. The number of Cl = O bonds in perchloric acid is, "_____." **[NV Sep. 06, 2020 (I)]**

41. Arrange the following bonds according to their average bond energies in descending order: C – Cl, C – Br, C – F, C – I **[Jan. 08, 2020 (II)]**
(a) C – F > C – Cl > C – Br > C – I
(b) C – Br > C – I > C – Cl > C – F
(c) C – I > C – Br > C – Cl > C – F
(d) C – Cl > C – Br > C – I > C – F

42. Chlorine reacts with hot and concentrated NaOH and produces compounds (*X*) and (*Y*). Compound (*X*) gives white precipitate with silver nitrate solution. The average bond order between Cl and O atoms in (*Y*) is _____. **[NV Jan. 07, 2020 (I)]**

43. In the following reactions, products (A) and (B), respectively, are: **[Jan. 07, 2020 (II)]**
$NaOH + Cl_2 \rightarrow (A) +$ side products (hot and conc.)
$Ca(OH)_2 + Cl_2 \rightarrow (B) +$ side products (dry)
(a) $NaClO_3$, and $Ca(OCl)_2$ (b) $NaClO_3$ and $Ca(ClO_3)_2$
(c) NaOCl and $Ca(OCl)_2$ (d) NaOCl and $Ca(ClO_3)_2$

44. HF has highest boiling point among hydrogen halides, because it has: **[April 9, 2019 (II)]**
(a) strongest van der Waals' interactions
(b) lowest ionic character
(c) strongest hydrogen bonding
(d) lowest dissociation enthalpy

45. Iodine reacts with concentrated HNO_3 to yield Y along with other products. The oxidation state of iodine in Y, is: **[Jan. 12, 2019 (I)]**
(a) 5 (b) 7 (c) 3 (d) 1

46. Chlorine on reaction with hot and concentrated sodium hydroxide gives : **[Jan. 12, 2019 (II)]**
(a) Cl^- and ClO_3^- (b) Cl^- and ClO^-
(c) ClO_3^- and ClO_2^- (d) Cl^- and ClO_2^-

47. The products obtained when chlorine gas reacts with cold and dilute aqueous NaOH are : **[2017]**
(a) ClO^- and ClO_3^- (b) ClO_2^- and ClO_3^-
(c) Cl^- and ClO^- (d) Cl^- and ClO_2^-

48. The non–metal that does not exhibit positive oxidation state is : **[Online April 9, 2016]**
(a) Chlorine (b) Iodine (c) Fluorine (d) Oxygen

49. Aqueous solution of which salt will not contain ions with the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6$? **[Online April 10, 2016]**
(a) NaF (b) KBr (c) NaCl (d) CaI_2

50. Which among the following is the most reactive ? **[2015]**
(a) I_2 (b) ICl (c) Cl_2 (d) Br_2

51. The least number of oxyacids are formed by : **[Online April 10, 2015]**
(a) Chlorine (b) Nitrogen (c) Fluorine (d) Sulphur

52. Chlorine water on standing loses its colour and forms : **[Online April 11, 2015]**
(a) HCl only (b) HCl and $HClO_2$
(c) HCl and HOCl (d) HOCl and $HOCl_2$

53. Shapes of certain interhalogen compounds are stated below. Which one of them is not correctly stated? **[Online April 11, 2014]**

(a) IF_7 : pentagonal bipyramid
(b) BrF_5 : trigonal bipyramid
(c) BrF_3 : planar T-shaped
(d) ICl_3 : planar dimeric

54. Electron gain enthalpy with negative sign of fluorine is less than that of chlorine due to : **[Online April 9, 2013]**

(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

55. Identify the incorrect statement among the following. **[2007]**

(a) Br_2 reacts with hot and strong NaOH solution to give NaBr and H_2O.
(b) Ozone reacts with SO_2 to give SO_3.
(c) Silicon reacts with $NaOH_{(aq)}$ in the presence of air to give Na_2SiO_3 and H_2O.
(d) Cl_2 reacts with excess of NH_3 to give N_2 and HCl.

56. Which of the following statements is true? **[2006]**

(a) $HClO_4$ is a weaker acid than $HClO_3$
(b) HNO_3 is a stronger acid than HNO_2
(c) H_3PO_3 is a stronger acid than H_2SO_3
(d) In aqueous medium HF is a stronger acid than HCl

57. What products are expected from the disproportionation reaction of hypochlorous acid? **[2006]**

(a) HCl and Cl_2O (b) HCl and $HClO_3$
(c) $HClO_3$ and Cl_2O (d) $HClO_2$ and $HClO_4$

58. The correct order of the thermal stability of hydrogen halides (H–X) is **[2005]**

(a) HI > HCl < HF > HBr (b) HCl< HF > HBr < HI
(c) HF > HCl > HBr > HI (d) HI < HBr > HCl < HF

59. Which among the following factors is the most important in making fluorine, the strongest oxidizing halogen ? **[2004]**

(a) Hydration enthalpy (b) Ionization enthalpy
(c) Electron affinity (d) Bond dissociation energy

60. Excess of KI reacts with $CuSO_4$ solution and then $Na_2S_2O_3$ solution is added to it. Which of the statements is **incorrect** for this reaction ? **[2004]**

(a) $Na_2S_2O_3$ is oxidised (b) CuI_2 is formed
(c) Cu_2I_2 is formed (d) Evolved I_2 is reduced

61. Oxidation number of Cl in $CaOCl_2$ (bleaching power) is:

(a) zero, since it contains Cl_2 **[2002]**
(b) – 1, since it contains Cl^-
(c) + 1, since it contains ClO^-
(d) + 1 and – 1 since it contains ClO^- and Cl^-

TOPIC 4 Noble Gases

62. The reaction in which the hybridisation of the underlined atom is affected is : **[Sep. 04, 2020 (II)]**

(a) $\underline{H_3P}O_2 \xrightarrow{\text{Disproportionation}}$
(b) $\underline{H_2S}O_4 + NaCl \xrightarrow{420\ K}$
(c) $\underline{N}H_3 \xrightarrow{H^+}$
(d) $\underline{Xe}F_4 + SbF_5 \longrightarrow$

63. The noble gas that does NOT occur in the atmosphere is : **[April 10, 2019 (II)]**

(a) He (b) Kr (c) Ne (d) Ra

64. The type of hybridisation and number of lone pair(s) of electrons of Xe in $XeOF_4$, respectively, are: **[Jan. 10, 2019 (I)]**

(a) sp^3d^2 and 1 (b) sp^3d and 2
(c) sp^3d^2 and 2 (d) sp^3d and 1

65. In XeO_3F_2, the number of bond pair(s), π-bond(s) and lone pair(s) on Xe atom respectively are: **[Online April 15, 2018 (II)]**

(a) 5, 3, 0 (b) 5, 2, 0
(c) 4, 2, 2 (d) 4, 4, 0

66. Xenon hexafluoride on partial hydrolysis produces compounds 'X' and 'Y'. Compounds 'X', 'Y' and the oxidation state of Xe are respectively : **[Online April 15, 2018 (I)]**

(a) $XeOF_4$(+6) and XeO_3(+6)
(b) XeO_2(+4) and XeO_3(+6)
(c) $XeOF_4$(+6) and XeO_2F_2(+6)
(d) XeO_2F_2(+6) and XeO_2(+4)

67. XeF_6 on partial hydrolysis with water produces a compound 'X'. The same compound 'X' is formed when XeF_6 reacts with silica. The compound 'X' is : **[Online April 9, 2017]**

(a) XeF_2 (b) XeF_4 (c) $XeOF_4$ (d) XeO_3

68. Which intermolecular force is most responsible in allowing xenon gas to liquefy? **[Online April 9, 2016]**

(a) Instantaneous dipole–induced dipole
(b) Ion–dipole
(c) Ionic
(d) Dipole – dipole

69. Which one has the highest boiling point ? **[2015]**

(a) Kr (b) Xe (c) He (d) Ne

70. The geometry of $XeOF_4$ by VSEPR theory is : **[Online April 10, 2015]**

(a) pentagonal planar (b) octahedral
(c) square pyramidal (d) trigonal bipyramidal

71. Which of the following xenon-oxo compounds may not be obtained by hydrolysis of xenon fluorides?
[Online April 12, 2014]
(a) XeO_2F_2 (b) $XeOF_4$ (c) XeO_3 (d) XeO_4

72. Trigonal bipyramidal geometry is shown by :
[Online April 9, 2013]
(a) XeO_2F_2 (b) XeO_3F_2
(c) $FXeOSO_2F$ (d) $[XeF_8]^{2-}$

73. XeO_4 molecule is tetrahedral having :
[Online April 22, 2013]
(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

74. Which has trigonal bipyramidal shape ?
[Online April 23, 2013]
(a) $XeOF_4$ (b) XeO_3 (c) XeO_3F_2 (d) $XeOF_2$

75. The compound of xenon with zero dipole moment is
[Online May 19, 2012]
(a) XeO_3 (b) XeF_4 (c) $XeOF_4$ (d) XeO_2

76. Which of the following has maximum number of lone pairs associated with Xe ? **[2011RS]**
(a) XeF_4 (b) XeF_6 (c) XeF_2 (d) XeO_3

77. Which one of the following reactions of xenon compounds is not feasible? **[2009]**
(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) $XeO_3 + 6HF \longrightarrow XeF_6 + 3H_2O$

78. Which one of the following statement regarding helium is **incorrect** ? **[2004]**
(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

79. In XeF_2, XeF_4, XeF_6 the number of lone pairs on Xe are respectively **[2002]**
(a) 2, 3, 1 (b) 1, 2, 3 (c) 4, 1, 2 (d) 3, 2, 1.

Hints & Solutions

1. (d)

(a) N_2 is diamagnetic in nature.

(b) $N_2 + O_2 \overset{2000K}{\rightleftharpoons} NO(g)$

(c) Liquid N_2 is used in cryosurgery.

(d) Because of its inertness, it is used where an inert atmosphere is required.

2. (c) $2NO + N_2O_4 \xrightarrow{250\ K} 2N_2O_3$

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

If NH_3 is used in excess then NH_4Cl is formed instead of NCl_3.

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

4. (c) $Pb(NO_3)_2 \xrightarrow{\Delta} \underset{\text{'A'}}{PbO} + 2NO_2(g)$ (brown gas)

$$\underset{\text{'A'}}{2NO_2(g)} \xrightarrow{\text{cooling}} \underset{\text{'B'}}{N_2O_4}$$

$$\underset{\text{'B'}}{N_2O_4} + NO \longrightarrow \overset{+3}{\underset{\text{'C'}}{N_2O_3}}$$

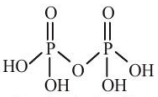
5. (a) Aqua regia is $HNO_3 : HCl$

1 : 3

$$Au + 4H^+ + NO_3^- + 4Cl^- \longrightarrow AuCl_4^- + NO + 2H_2O$$

$$3Pt + 16H^+ + 4NO_3^- + 18Cl^- \longrightarrow 3PtCl_6^{2-} + 4NO + 8H_2O$$

6. (d)



Pyrophosphoric acid

No. of P = O bond = 2.

P – OH bond = 4

P – O – P bond = 1.

7. (b) $Pb(NO_3)_2$ does not produce nitrogen gas on heating.

(a) $NaN_3 \xrightarrow{300°C} 3N_2 + 2Na$

(b) $Pb(NO_3)_2 \xrightarrow{\Delta} PbO + 2NO_2$

(c) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + H_2O$

(d) $NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$

8. (b) $P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + \underset{\text{(X)}}{3NaH_2PO_2}$

$$\underset{\text{(X)}}{NaH_2PO_2} \xrightarrow{HCl} \underset{\text{(Y)}}{H_3PO_2}$$

Basicity of $H_3PO_2 = 1$

9. (b) Number of pentagons in C_{60} (Buckminsterfullerene) = 12

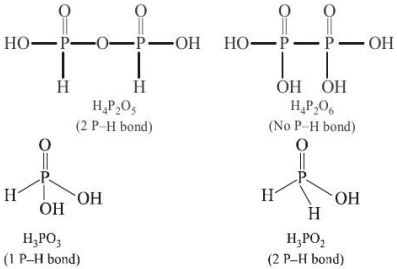
Number of triangles in P_4 (White phosphorous) = 4

10. (d)

Oxide	oxidation state
N_2O	+1
NO	+2
N_2O_3	+3
NO_2	+4

So, $N_2O < NO < N_2O_3 < NO_2$

11. (b)



$H_4P_2O_5$ (2 P–H bond) $\quad$ $H_4P_2O_6$ (No P–H bond)

H_3PO_3 (1 P–H bond) $\quad$ H_3PO_2 (2 P–H bond)

12. (3) Structure of H_3PO_2:

Greater the number of P—H bonds present in the acid, greater will be its reducing property.

13. (d)

(a) $Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$

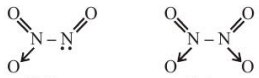
(b) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} Cr_2O_3 + N_2 + 4H_2O$

(c) $NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$

(d) $(NH_4)_2SO_4 \xrightarrow{\Delta} 2NH_3 + H_2SO_4$

NH_3 is evolved in reaction (d).

14. (a)



N_2O_3 $\quad$ N_2O_4

15. **(c)** The number of P–O bonds in $P_4O_6 = 12$

16. **(c)**

(a) Molar mass of $Ba(N_3)_2(s) = 221$ g/mol

1 mole of $Ba(N_3)_2(s)$ gives 3 moles of N_2

Hence, $\frac{1\text{ g}}{221\text{ g/mol}}$ moles of $Ba(N_3)_2(s)$ will give $3 \times \frac{1}{221}$

$= 0.014$ moles of N_2

(b) Molar mass of $(NH_4)_2Cr_2O_7 = 252$ g/mol.

1 mole of $(NH_4)_2Cr_2O_7$ gives 1 mole of N_2

Hence, $\frac{1\text{ g}}{252\text{ g/mol}}$ moles of $(NH_4)_2Cr_2O_7$ will give

$1 \times \frac{1}{252} = 0.0039$ moles of N_2

(c) Molar mass of NH_3=17 g/mol.

2 mole of NH_3 gives 1 mole of N_2

Hence $\frac{1\text{ g}}{17\text{ g/mol}}$ moles of NH_3 will give

$\frac{1}{2 \times 17} = 0.0297$ moles of N_2.

(d) Molar mass of $NH_4NO_3 = 80$ g/mol.

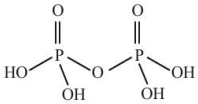
1 mole of NH_4NO_3 gives 1 mole of N_2

Hence $\frac{1\text{ g}}{80\text{ g/mol}}$ moles NH_4NO_3 will give

$1 \times \frac{1}{80} = 0.0125$ moles of N_2

Hence thermal decomposition of NH_3 will produce maximum amount of N_2.

17. **(d)**



Pyrophosphoric acid ($H_4P_2O_7$)

Oxidation State :

Each P atom is bound to one oxygen = –1

2OH = –1 × 2 = –2

1 Oxygen = – 2

Total = –5

P = +5.

18. **(a)** $Li\,(s) + N_2\,(g) \underset{\text{high temperature}}{\rightleftharpoons} 2Li_3N\,(s)$

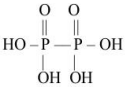
$Li_3N + 3H_2O \longrightarrow 3LiOH + NH_3$

$CuSO_4 + 4NH_3 \longrightarrow \underset{\text{deep blue compound}}{[Cu(NH_3)_4]SO_4}$

19. **(c)** Phosphorous acids contain P in +3 oxidation state.

Acid	Formula	Oxidation state of phosphorus
Pyrophosphorous acid	$H_4P_2O_5$	+3
Pyrophosphoric acid	$H_4P_2O_7$	+5
Orthophosphorous acid	H_3PO_3	+3
Hypophosphoric acid	$H_4P_2O_6$	+4

20. **(c)** $H_4P_2O_6$ has P–P linkage



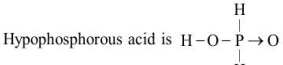
21. **(b)** In case of $N(SiH_3)_3$, N atom is sp^2 hybridised, the lone pair is present in $2p$ orbital and it is transferred to empty d orbital of Si forming $d\pi - p\pi$ bond. Hence nitrogen with sp^2 hybridisation has trigonal planar shape.

22. **(c)** All the members form volatile halides of the type AX_3. All halides are pyramidal in shape. The bond angle decreases on moving down the group (from NCl_3 to $SbCl_3$) due to decrease in bond pair-bond pair repulsion or increase in lone pair-bond pair repulsion.

23. **(a)** $(NH_4)_2SO_4 + 2H_2O \longrightarrow 2H_2SO_4 + NH_4OH$

H_2SO_4 is strong acid and increases the acidity of soil.

24. **(c)** Hypophosphorous acid is



Two H-atoms are attached to P atom.

25. **(b)** On mixing phosphine with chlorine gas, PCl_5 and HCl are formed. The mixture cools down.

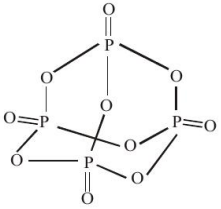
$PH_3 + 4Cl_2 \longrightarrow PCl_5 + 3HCl$

26. **(b)** Among the given compounds, the $\ddot{N}H_3$ is most basic. Hence it has highest proton affinity.

27. **(a)** $_7N = 1s^2\,2s^2\,2p^3$; $_{15}P = 1s^2\,2s^2\,2p^6\,3s^2\,3p^3$

Note: In phosphorus the 3d-orbitals are available. Hence phosphorus can form pentahalides but nitrogen can not form pentahalide due to absence of d-orbitals.

28. **(d)**



29. **(c)** $X = Na_2SO_3$

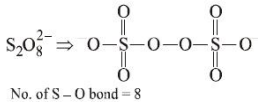
$$\underset{(X)}{SO_3^{2-}} + H_2SO_4 \rightarrow [H_2SO_3] \rightarrow H_2O + \underset{(Y)}{SO_2}$$

$$SO_2 + 2NaOH \rightarrow \underset{(X)}{Na_2SO_3} + H_2O$$

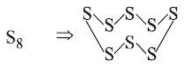
$$\underset{(X)}{Na_2SO_3} + \underset{(Y)}{SO_2} + H_2O \rightarrow \underset{(Z)}{2NaHSO_3}$$

30. **(a)** At room temperature, water is liquid and has boiling point 373 K due to hydrogen bonding. Whereas H_2S is a gas and it has no hydrogen bonding. Hence boiling point of H_2S is less than 300 K (boiling point of H_2S is –60°C).

31. **(b)**

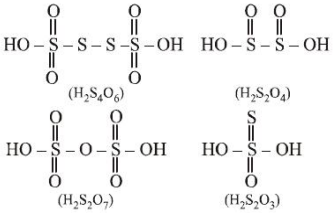


No. of S – O bond = 8



No. of S – S bond = 8

32. **(c)**

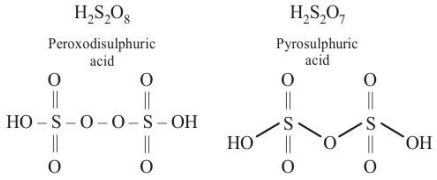


33. **(b)** In KO_2, the nature of oxygen species and the oxidation state of oxygen atom are superoxide (superoxide ion is O_2^-) and –1/2 respectively.

Let x be oxidation state of oxygen. The oxidation state of K is +1. Hence

$$+1 + 2(x) = 0$$
$$2x = -1$$
$$x = -\frac{1}{2}$$

34. **(d)**

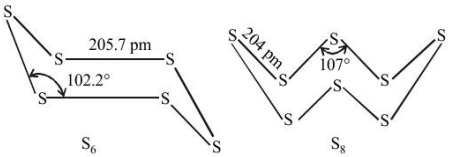


No. of S = O bonds	4		4
No. of S – OH bonds	2		2

35. **(c)**

Compounds	Number of π-bonds
$H_2S_2O_7 = HO-S(=O)_2-O-S(=O)_2-OH$	4
$H_2SO_4 = HO-S(=O)_2-OH$	2
$H_2SO_3 = HO-\ddot{S}(=O)-OH$	1

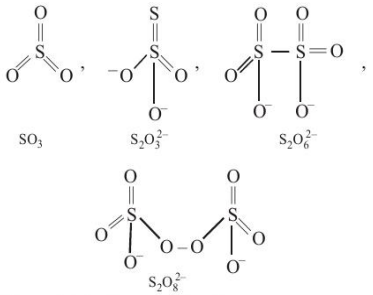
36. **(a)** The S_6 molecule has a chair-form hexagon ring with the approx same bond length as that in S_8, but with some what smaller bond angles i.e. bond lengths are approx same but bond angles are different.



S_6 S_8

37. **(c)** Nitrogen and oxgen in air do not react to form oxides of nitrogen in atmosphere because the reaction between nitrogen and oxygen requires high temperature.s

38. **(c)**



SO_3 $S_2O_3^{2-}$ $S_2O_6^{2-}$ $S_2O_8^{2-}$

Hence (c) is the correct option.

39. **(a)** $\underset{\text{air}}{4HCl + O_2} \longrightarrow \underset{\text{cloud of white fumes}}{2Cl_2\uparrow + 2H_2O}$

40. **(3)**
The structure of perchloric acid is

The number Cl = O bond in $HClO_4$ is 3.

41. **(a)** Generally, bond energy $\propto \frac{1}{\text{Bond length}}$
So bond energy order is C–F > C–Cl > C–Br > C–I

42. **(1.67)**

$$3Cl_2 + 6NaOH \xrightarrow[\text{Hot \& conc.}]{} \underset{(X)}{5NaCl} + \underset{(Y)}{NaClO_3} + 3H_2O$$

$$\underset{(X)}{NaCl} + AgNO_3 \longrightarrow \underset{(\text{white ppt.})}{AgCl} + NaNO_3$$

Average bond order between Cl and O atom in $NaClO_3$

$$= \frac{5}{3} = 1.67$$

43. **(a)** $6NaOH + 3Cl_2 \rightarrow 5NaCl + \underset{(A,\ \text{Sodium chlorate})}{NaClO_3} + 3H_2O$

$$2Ca(OH)_2 + Cl_2 \rightarrow Ca(OCl)_2 + CaCl_2 + H_2O$$
(B, Calcium hypochlorite)

44. **(c)** Due to strong H-bonding between HF molecules. HF has highest boiling point among the hydrogen halides.

45. **(a)** Conc. HNO_3 oxidises I_2 to iodic acid (HIO_3).

$$I_2 + 10HNO_3 \rightarrow \underset{Y}{2HIO_3} + 10NO_2 + 4H_2O$$

In HIO_3 oxidation state of iodine is +5.

46. **(a)** $3Cl_2 + 6NaOH \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

47. **(c)** $Cl_2 + NaOH \longrightarrow NaCl + NaClO + H_2O$
[cold and dilute]

48. **(c)** Fluorine is most electronegative element in periodic table and exhibits O.S. value of –1 only.

49. **(a)** NaF is composed of Na^+ and F^-.

$$Na^+ \longrightarrow [He]2s^2 2p^6$$

$$F^- \longrightarrow [He]2s^2 2p^6$$

Hence configuration of Na^+ and F^- do not match with the configuration given in the question.

50. **(b)** Order of reactivity of halogens

$$Cl_2 > Br_2 > I_2$$

But the interhalogen compounds are generally more reactive than halogens (except F_2), since the bond between two dissimilar electronegative elements is weaker than the bond between two similar atoms i.e, X – X

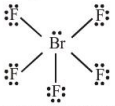
51. **(c)** Flourine is the most electronegative element & has least tendency to form double bonds.

52. **(c)** Chlorinated water is yellow in colour on standing following reaction occurs

$$Cl_2 + H_2O \longrightarrow HCl + HOCl$$

Thus, HCl and HOCl are formed.

53. **(b)** The molecular geometry of BrF_5 is square pyramidal with asymmetric charge distribution on the central atom.



54. **(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.

55. **(a)** $(NH_4)_2SO_4 + 2H_2O \longrightarrow 2H_2SO_4 + NH_4OH$

H_2SO_4 is strong acid and increases the acidity of soil.

56. **(b)** The $\overset{+5}{HNO_3}$ is stronger than $\overset{+3}{HNO_2}$. The more the oxidation state of N, the more is the acid character.

57. **(b)** During disproportionation same compound undergoes simultaneous oxidation and reduction.

$$\overset{\text{Oxidation}}{\overset{-\ +}{3HOCl} \longrightarrow \underset{\text{Reduction}}{\overset{-1\qquad +5}{2HCl + HClO_3}}}$$

58. **(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
135kcal mol^{-1}	103kcal mol^{-1}	87kcal mol^{-1}	71kcal mol^{-1}

59. **(d)** Fluorine has low dissociation energy of F – F bond, and reaction of atomic fluorine is exothermic in nature.

60. **(b)** $\overset{-1}{4KI} + 2CuSO_4 \rightarrow \overset{0}{I_2} + Cu_2I_2 + 2K_2SO_4$

$$\overset{0}{I_2} + 2\overset{2+}{Na_2S_2O_3} \rightarrow \overset{+2.5}{Na_2S_4O_6} + 2\overset{-1}{NaI}$$

In this CuI_2 is **not** formed.

61. **(d)** $CaOCl_2$ can also be written as

$$\underset{x_1}{Ca}(\underset{x_2}{OCl})Cl$$

Hence oxidation no of Cl in OCl^- is

$-2 + x_1 = -1$

$x_1 = 2 - 1 = +1$

Oxidation no. of another Cl is –1 as it is present as Cl^-.

62. (d)

(a) $\underset{sp^3}{H_3PO_2} \xrightarrow{\text{Disproportionation}} \underset{sp^3}{H_3PO_4} + \underset{sp^3}{PH_3}$

(b) $\underset{sp^3}{H_2SO_4} + NaCl \xrightarrow{420K} \underset{sp^3}{Na_2SO_4} + 2HCl$

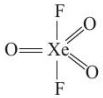
(c) $\underset{sp^3}{NH_3} \xrightarrow{H^+} \underset{sp^3}{NH_4^+}$

(d) $\underset{sp^3d^2}{XeF_4} + SbF_5 \longrightarrow \underset{sp^3d}{[XeF_3]^+}\,[SbF_6]^-$

63. (d) Radon is radioactive element and not present in atmosphere.

64. (a)  , sp^3d^2, no. of lone pair = 1

65. (a) Structure of XeO_3F_2



So, bond pairs = 5, π bonds = 3 lone pairs = 0

66. (c) $XeF_6 + H_2O \xrightarrow[\text{hydrolysis}]{\text{partial}} \underset{\text{'X'}}{\overset{+6}{XeOF_4}} + 2HF$

$\underset{\text{'X'}}{XeOF_4} + H_2O \longrightarrow \underset{\text{'Y'}}{\overset{+6}{XeO_2F_2}} + 2HF$

67. (c) $XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$ (Partial hydrolysis)

$XeF_6 + 2H_2O \longrightarrow XeO_2F_2 + 4HF$

$SiO_2 + 2XeF_6 \longrightarrow \underset{\text{(Xenone oxytetrafluoride)}}{2XeOF_4} + SiF_4$

68. (a) Instantaneous dipole-induced dipole forces are most responsible in allowing xenon gas to liquify.

69. (b) Xe. As we move down the group, the melting and boiling points show a regular increase due to corresponding increase in the magnitude of their van der waal forces of attraction as the size of the atom increases.

70. (c) In $XeOF_4$, Xe is sp^3d^2, hybridised having 6 bond pairs and 1 lone pair respectively.

$XeOF_4$

Square pyramidal

(sp^3d^2)

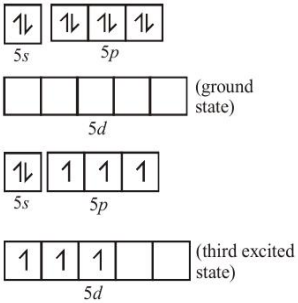
71. (d) $XeF_6 + H_2O \xrightarrow{\text{Partial}} XeOF_4 + 2HF$

$XeF_6 + 2H_2O \xrightarrow{\text{Partial}} XeO_2F_2 + 4HF$

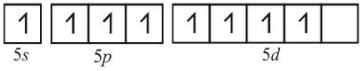
$XeF_6 + 3H_2O \xrightarrow{\text{Complete}} XeO_3 + 6HF$

72. (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.

73. (c) Xenon undergo sp^3 hybridisation.

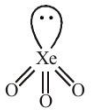


In the fourth excited state xenon atom, has 8 unpaired electrons

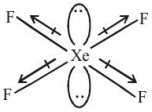


One s and three p orbitals undergo sp^3 hybridisation. Four sp^3 hybrid orbitals form four σ bonds with oxygen atoms. They are $\sigma sp^3 - p$. Four $p\pi - d\pi$ bonds are also formed with oxygen atoms by the unpaired electrons.

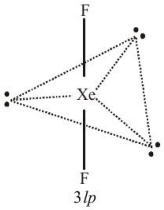
74. (b) The shape of XeO_3F_2 is trigonal Pyramidal.



75. (b) XeF_4 has zero dipole moment. It has square planar structure due to which the bond moments of Xe – F cancel each other.

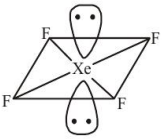


76. **(c)** XeF_2 :



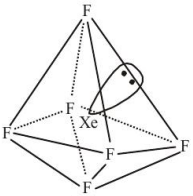
3 *lp*

XeF_4 :



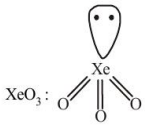
2 *lp*

XeF_6 :



1 *lp*

XeO_3 :



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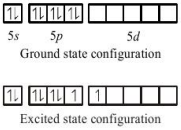
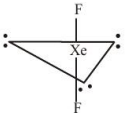
77. **(d)** The products of the concerned reaction react each other forming back the reactants.

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

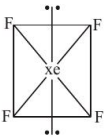
78. **(c)** Helium is heavier than hydrogen although it is non-inflammable

79. **(d)** In the formation of XeF_2, sp^3d hybridisation occurs which gives the molecule a trigonal bipyramidal structure.





In the formation of XeF_4, sp^3d^2 hybridization occurs which gives the molecule an octahedral structure.



In the formation of XeF_6, sp^3d^3 hybridization occurs which gives the molecule a pentagonal bipyramidal structure.