Unit

7

The *p*-Block Elements

I. Multiple Choice Questions (Type-I)

1. 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

(i) H_2SO_4 reduces HI to I_2

(ii) HI is of violet colour

(iii) HI gets oxidised to I_2

(iv) HI changes to HIO_3

2. In qualitative analysis when H_2S is passed through an aqueous solution of salt acidified with dil. HCl, a black precipitate is obtained. On boiling the precipitate with dil. HNO_3, it forms a solution of blue colour. Addition of excess of aqueous solution of ammonia to this solution gives _____.

(i) deep blue precipitate of $Cu(OH)_2$

(ii) deep blue solution of $[Cu(NH_3)_4]^{2+}$

(iii) deep blue solution of $Cu(NO_3)_2$

(iv) deep blue solution of $Cu(OH)_2.Cu(NO_3)_2$

3. In a cyclotrimetaphosphoric acid molecule, how many single and double bonds are present?

(i) 3 double bonds; 9 single bonds

(ii) 6 double bonds; 6 single bonds

(iii) 3 double bonds; 12 single bonds

(iv) Zero double bonds; 12 single bonds

4. Which of the following elements can be involved in pπ–dπ bonding?

(i) Carbon

(ii) Nitrogen

(iii) Phosphorus

(iv) Boron

5. Which of the following pairs of ions are isoelectronic and isostructural?

(i) CO_3^{2-}, NO_3^-

(ii) ClO_3^-, CO_3^{2-}

(iii) SO_3^{2-}, NO_3^-

(iv) ClO_3^-, SO_3^{2-}

6. Affinity for hydrogen decreases in the group from fluorine to iodine. Which of the halogen acids should have highest bond dissociation enthalpy?

(i) HF

(ii) HCl

(iii) HBr

(iv) HI

7. 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

(i) NH_3

(ii) PH_3

(iii) AsH_3

(iv) SbH_3

8. On heating with concentrated NaOH solution in an inert atmosphere of CO_2, white phosphorus gives a gas. Which of the following statement is **incorrect** about the gas?

(i) It is highly poisonous and has smell like rotten fish.

(ii) It's solution in water decomposes in the presence of light.

(iii) It is more basic than NH_3.

(iv) It is less basic than NH_3.

9. Which of the following acids forms three series of salts?

(i) H_3PO_2

(ii) H_3BO_3

(iii) H_3PO_4

(iv) H_3PO_3

10. Strong reducing behaviour of H_3PO_2 is due to

(i) Low oxidation state of phosphorus

(ii) Presence of two –OH groups and one P–H bond

(iii) Presence of one –OH group and two P–H bonds

(iv) High electron gain enthalpy of phosphorus

11. On heating lead nitrate forms oxides of nitrogen and lead. The oxides formed are _____.

(i) N_2O, PbO

(ii) NO_2, PbO

(iii) NO, PbO

(iv) NO, PbO_2

12. Which of the following elements does not show allotropy?

(i) Nitrogen

(ii) Bismuth

(iii) Antimony

(iv) Arsenic

13. Maximum covalency of nitrogen is _____.

(i) 3

(ii) 5

(iii) 4

(iv) 6

14. Which of the following statements is wrong?

(i) Single N–N bond is stronger than the single P–P bond.

(ii) PH_3 can act as a ligand in the formation of coordination compound with transition elements.

(iii) NO_2 is paramagnetic in nature.

(iv) Covalency of nitrogen in N_2O_5 is four.

15. A brown ring is formed in the ring test for NO_3^- ion. It is due to the formation of

(i) $[Fe(H_2O)_5(NO)]^{2+}$

(ii) $FeSO_4.NO_2$

(iii) $[Fe(H_2O)_4(NO)_2]^{2+}$

(iv) $FeSO_4.HNO_3$

16. 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

(i) Bi_2O_5

(ii) BiF_5

(iii) $BiCl_5$

(iv) Bi_2S_5

17. On heating ammonium dichromate and barium azide separately we get

(i) N_2 in both cases

(ii) N_2 with ammonium dichromate and NO with barium azide

(iii) N_2O with ammonium dichromate and N_2 with barium azide

(iv) N_2O with ammonium dichromate and NO_2 with barium azide

18. In the preparation of HNO_3, we get NO gas by catalytic oxidation of ammonia. The moles of NO produced by the oxidation of two moles of NH_3 will be _____.

(i) 2

(ii) 3

(iii) 4

(iv) 6

19. The oxidation state of central atom in the anion of compound NaH_2PO_2 will be _____.

(i) +3

(ii) +5

(iii) +1

(iv) –3

20. Which of the following is **not** tetrahedral in shape?

(i) NH_4^+

(ii) $SiCl_4$

(iii) SF_4

(iv) SO_4^{2-}

21. Which of the following are peroxoacids of sulphur?

(i) H_2SO_5 and $H_2S_2O_8$

(ii) H_2SO_5 and $H_2S_2O_7$

(iii) $H_2S_2O_7$ and $H_2S_2O_8$

(iv) $H_2S_2O_6$ and $H_2S_2O_7$

22. 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?

(i) Cu

(ii) S

(iii) C

(iv) Zn

23. A black compound of manganese reacts with a halogen acid to give greenish yellow gas. When excess of this gas reacts with NH_3 an unstable trihalide is formed. In this process the oxidation state of nitrogen changes from _____.

(i) – 3 to +3

(ii) – 3 to 0

(iii) – 3 to +5

(iv) 0 to – 3

24. In the preparation of compounds of Xe, Bartlett had taken $O_2^+ Pt F_6^-$ as a base compound. This is because

(i) both O_2 and Xe have same size.

(ii) both O_2 and Xe have same electron gain enthalpy.

(iii) both O_2 and Xe have almost same ionisation enthalpy.

(iv) both Xe and O_2 are gases.

25. In solid state PCl_5 is a _____.

(i) covalent solid

(ii) octahedral structure

(iii) ionic solid with $[PCl_6]^+$ octahedral and $[PCl_4]^-$ tetrahedra

(iv) ionic solid with $[PCl_4]^+$ tetrahedral and $[PCl_6]^-$ octahedra

26. Reduction potentials of some ions are given below. Arrange them in decreasing order of oxidising power.

Ion	ClO_4^-	IO_4^-	BrO_4^-
Reduction potential $E^\ominus/V$	$E^\ominus = 1.19V$	$E^\ominus = 1.65V$	$E^\ominus = 1.74V$

(i) $ClO_4^- > IO_4^- > BrO_4^-$

(ii) $IO_4^- > BrO_4^- > ClO_4^-$

(iii) $BrO_4^- > IO_4^- > ClO_4^-$

(iv) $BrO_4^- > ClO_4^- > IO_4^-$

27. Which of the following is isoelectronic pair?

(i) ICl_2, ClO_2

(ii) BrO_2^-, BrF_2^+

(iii) ClO_2, BrF

(iv) CN^-, O_3

II. Multiple Choice Questions (Type-II)

Note : In the following questions two or more options may be correct.

28. If chlorine gas is passed through hot NaOH solution, two changes are observed in the oxidation number of chlorine during the reaction. These are _____ and _____.

(i) 0 to +5

(ii) 0 to +3

(iii) 0 to –1

(iv) 0 to +1

29. Which of the following options are **not** in accordance with the property mentioned against them?

(i)	$F_2 > Cl_2 > Br_2 > I_2$	Oxidising power.
(ii)	MI > MBr > MCl > MF	Ionic character of metal halide.
(iii)	$F_2 > Cl_2 > Br_2 > I_2$	Bond dissociation enthalpy.
(iv)	HI < HBr < HCl < HF	Hydrogen-halogen bond strength.

30. Which of the following is correct for P_4 molecule of white phosphorus?

(i) It has 6 lone pairs of electrons.

(ii) It has six P–P single bonds.

(iii) It has three P–P single bonds.

(iv) It has four lone pairs of electrons.

31. 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.

32. Which of the following statements are correct for SO_2 gas?

(i) It acts as bleaching agent in moist conditions.

(ii) It's molecule has linear geometry.

(iii) It's dilute solution is used as disinfectant.

(iv) It can be prepared by the reaction of dilute H_2SO_4 with metal sulphide.

33. 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 is ionic in solid state in which cation is tetrahedral and anion is octahedral.

34. Which of the following orders are correct as per the properties mentioned against each?

(i)	$As_2O_3 < SiO_2 < P_2O_3 < SO_2$	Acid strength.
(ii)	$AsH_3 < PH_3 < NH_3$	Enthalpy of vapourisation.
(iii)	S < O < Cl < F	More negative electron gain enthalpy.
(iv)	$H_2O > H_2S > H_2Se > H_2Te$	Thermal stability.

35. Which of the following statements are correct?

(i) S–S bond is present in $H_2S_2O_6$.

(ii) In peroxosulphuric acid (H_2SO_5) sulphur is in +6 oxidation state.

(iii) Iron powder along with Al_2O_3 and K_2O is used as a catalyst in the preparation of NH_3 by Haber's process.

(iv) Change in enthalpy is positive for the preparation of SO_3 by catalytic oxidation of SO_2.

36. In which of the following reactions conc. H_2SO_4 is used as an oxidising reagent?

(i) $CaF_2 + H_2SO_4 \longrightarrow CaSO_4 + 2HF$

(ii) $2HI + H_2SO_4 \longrightarrow I_2 + SO_2 + 2H_2O$

(iii) $Cu + 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$

(iv) $NaCl + H_2SO_4 \longrightarrow NaHSO_4 + HCl$

37. 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 a redox reaction.

(iv) Xenon fluorides are not reactive.

III. Short Answer Type

38. In the preparation of H_2SO_4 by Contact Process, why is SO_3 not absorbed directly in water to form H_2SO_4?

39. Write a balanced chemical equation for the reaction showing catalytic oxidation of NH_3 by atmospheric oxygen.

40. Write the structure of pyrophosphoric acid.

41. PH_3 forms bubbles when passed slowly in water but NH_3 dissolves. Explain why?

42. In PCl_5, phosphorus is in sp^3d hybridised state but all its five bonds are not equivalent. Justify your answer with reason.

43. Why is nitric oxide paramagnetic in gaseous state but the solid obtained on cooling it is diamagnetic?

44. Give reason to explain why ClF_3 exists but FCl_3 does not exist.

45. Out of H_2O and H_2S, which one has higher bond angle and why?

46. SF_6 is known but SCl_6 is not. Why?

47. On reaction with Cl_2, phosphorus forms two types of halides 'A' and 'B'. Halide A is yellowish-white powder but halide 'B' is colourless oily liquid. Identify A and B and write the formulas of their hydrolysis products.

48. In the ring test of NO_3^- ion, Fe^{2+} ion reduces nitrate ion to nitric oxide, which combines with Fe^{2+} (aq) ion to form brown complex. Write the reactions involved in the formation of brown ring.

49. Explain why the stability of oxoacids of chlorine increases in the order given below:

$HClO < HClO_2 < HClO_3 < HClO_4$

50. Explain why ozone is thermodynamically less stable than oxygen.

51. P_4O_6 reacts with water according to equation $P_4O_6 + 6H_2O \longrightarrow 4H_3PO_3$. Calculate the volume of 0.1 M NaOH solution required to neutralise the acid formed by dissolving 1.1 g of P_4O_6 in H_2O.

52. White phosphorus reacts with chlorine and the product hydrolyses in the presence of water. Calculate the mass of HCl obtained by the hydrolysis of the product formed by the reaction of 62 g of white phosphorus with chlorine in the presence of water.

53. Name three oxoacids of nitrogen. Write the disproportionation reaction of that oxoacid of nitrogen in which nitrogen is in +3 oxidation state.

54. Nitric acid forms an oxide of nitrogen on reaction with P_4O_{10}. Write the reaction involved. Also write the resonating structures of the oxide of nitrogen formed.

55. Phosphorus has three allotropic forms — (i) white phosphorus (ii) red phosphorus and (iii) black phosphorus. Write the difference between white and red phosphorus on the basis of their structure and reactivity.

56. Give an example to show the effect of concentration of nitric acid on the formation of oxidation product.

57. PCl_5 reacts with finely divided silver on heating and a white silver salt is obtained, which dissolves on adding excess aqueous NH_3 solution. Write the reactions involved to explain what happens.

58. Phosphorus forms a number of oxoacids. Out of these oxoacids phosphinic acid has strong reducing property. Write its structure and also write a reaction showing its reducing behaviour.

IV. Matching Type

Note : Match the items of Column I and Column II in the following questions.

59. Match the compounds given in Column I with the hybridisation and shape given in Column II and mark the correct option.

Column I	**Column II**
(A) XeF_6	(1) sp^3d^3 – distorted octahedral
(B) XeO_3	(2) sp^3d^2 - square planar
(C) $XeOF_4$	(3) sp^3 - pyramidal
(D) XeF_4	(4) sp^3d^2 - square pyramidal

Code :

(i)	A (1)	B (3)	C (4)	D (2)
(ii)	A (1)	B (2)	C (4)	D (3)
(iii)	A (4)	B (3)	C (1)	D (2)
(iv)	A (4)	B (1)	C (2)	D (3)

60. Match the formulas of oxides given in Column I with the type of oxide given in Column II and mark the correct option.

Column I	**Column II**
(A) Pb_3O_4	(1) Neutral oxide
(B) N_2O	(2) Acidic oxide
(C) Mn_2O_7	(3) Basic oxide
(D) Bi_2O_3	(4) Mixed oxide

Code :

(i)	A (1)	B (2)	C (3)	D (4)
(ii)	A (4)	B (1)	C (2)	D (3)
(iii)	A (3)	B (2)	C (4)	D (1)
(iv)	A (4)	B (3)	C (1)	D (2)

61. Match the items of Columns I and II and mark the correct option.

Column I	**Column II**
(A) H_2SO_4	(1) Highest electron gain enthalpy
(B) CCl_3NO_2	(2) Chalcogen
(C) Cl_2	(3) Tear gas
(D) Sulphur	(4) Storage batteries

Code :

(i)	A (4)	B (3)	C (1)	D (2)
(ii)	A (3)	B (4)	C (1)	D (2)
(iii)	A (4)	B (1)	C (2)	D (3)
(iv)	A (2)	B (1)	C (3)	D (4)

62. Match the species given in Column I with the shape given in Column II and mark the correct option.

Column I	**Column II**
(A) SF_4	(1) Tetrahedral
(B) BrF_3	(2) Pyramidal
(C) BrO_3^-	(3) Sea-saw shaped
(D) NH_4^+	(4) Bent T-shaped

Code :

(i)	A (3)	B (2)	C (1)	D (4)
(ii)	A (3)	B (4)	C (2)	D (1)
(iii)	A (1)	B (2)	C (3)	D (4)
(iv)	A (1)	B (4)	C (3)	D (2)

63. Match the items of Columns I and II and mark the correct option.

	Column I		**Column II**
(A)	Its partial hydrolysis does not change oxidation state of central atom	(1)	He
(B)	It is used in modern diving apparatus	(2)	XeF_6
(C)	It is used to provide inert atmosphere for filling electrical bulbs	(3)	XeF_4
(D)	Its central atom is in sp^3d^2 hybridisation	(4)	Ar

Code :

(i)	A (1)	B (4)	C (2)	D (3)
(ii)	A (1)	B (2)	C (3)	D (4)
(iii)	A (2)	B (1)	C (4)	D (3)
(iv)	A (1)	B (3)	C (2)	D (4)

V. Assertion and Reason Type

Note : In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(i) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.

(ii) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.

(iii) Assertion is correct, but reason is wrong statement.

(iv) Assertion is wrong but reason is correct statement.

(v) Both assertion and reason are wrong statements.

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

65. **Assertion** : HNO_3 makes iron passive.
Reason : HNO_3 forms a protective layer of ferric nitrate on the surface of iron.

66. **Assertion** : HI cannot be prepared by the reaction of KI with concentrated H_2SO_4

Reason : HI has lowest H–*X* bond strength among halogen acids.

67. **Assertion** : Both rhombic and monoclinic sulphur exist as S_8 but oxygen exists as O_2.

Reason : Oxygen forms pπ – pπ multiple bond due to small size and small bond length but pπ – pπ bonding is not possible in sulphur.

68. **Assertion** : NaCl reacts with concentrated H_2SO_4 to give colourless fumes with pungent smell. But on adding MnO_2 the fumes become greenish yellow.

Reason : MnO_2 oxidises HCl to chlorine gas which is greenish yellow.

69. **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.

VI. Long Answer Type

70. An amorphous solid "A" burns in air to form a gas "B" which turns lime water milky. The gas is also produced as a by-product during roasting of sulphide ore. This gas decolourises acidified aqueous $KMnO_4$ solution and reduces Fe^{3+} to Fe^{2+}. Identify the solid "A" and the gas "B" and write the reactions involved.

71. On heating lead (II) nitrate gives a brown gas "A". The gas "A" on cooling changes to colourless solid "B". Solid "B" on heating with NO changes to a blue solid 'C'. Identify 'A', 'B' and 'C' and also write reactions involved and draw the structures of 'B' and 'C'.

72. On heating compound (A) gives a gas (B) which is a constituent of air. This gas when treated with 3 mol of hydrogen (H_2) in the presence of a catalyst gives another gas (C) which is basic in nature. Gas C on further oxidation in moist condition gives a compound (D) which is a part of acid rain. Identify compounds (A) to (D) and also give necessary equations of all the steps involved.

ANSWERS

I. Multiple Choice Questions (Type-I)

1. (iii)	2. (ii)	3. (i)	4. (iii)	5. (i)	6. (i)
7. (iv)	8. (iii)	9. (iii)	10. (iii)	11. (ii)	12. (i)
13. (iii)	14. (i)	15. (i)	16. (ii)	17. (i)	18. (i)
19. (iii)	20. (iii)	21. (i)	22. (iii)	23. (i)	24. (iii)
25. (iv)	26. (iii)	27. (ii)			

II. Multiple Choice Questions (Type-II)

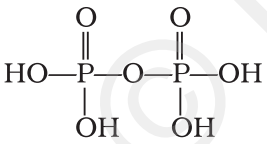
28. (i), (iii)	29. (ii), (iii)	30. (ii), (iv)	31. (i), (iii), (iv)
32. (i), (iii)	33. (iii), (iv)	34. (i), (iv)	35. (i), (ii)
36. (ii), (iii)	37. (i), (ii)		

III. Short Answer Type

38. Acid fog is formed, which is difficult to condense.

39. $4NH_3 + 5O_2 \xrightarrow[500K,\ 9\ bar]{Pt/Rh\ gauge\ catalyst} 4NO + 6H_2O$

(From air)

40. 

Pyrophosphoric acid

41. NH_3 forms hydrogen bonds with water therefore it is soluble in it but PH_3 cannot form hydrogen bond with water so it escapes as gas.

42. [**Hint :** It has trigonal bipyramidal geometry]

43. In gaseous state NO_2 exists as monomer which has one unpaired electron but in solid state it dimerises to N_2O_4 so no unpaired electron is left hence solid form is diamagnetic.

44. Because fluorine is more electronegative as compared to chlorine.

45. Bond angle of H_2O is larger, because oxygen is more electronegative than sulphur therefore bond pair electron of O–H bond will be closer to oxygen and there will be more bond-pair bond-pair repulsion between bond pairs of two O–H bonds.

46. Due to small size of fluorine six F^- ion can be accomodated around sulphur whereas chloride ion is comparatively larger in size, therefore, there will be interionic repulsion.

47. A is PCl_5 (It is yellowish white powder)

$$P_4 + 10Cl_2 \longrightarrow 4PCl_5$$

B is PCl_3 (It is a colourless oily liquid)

$$P_4 + 6Cl_2 \longrightarrow 4PCl_3$$

Hydrolysis products are formed as follows :

$$PCl_3 + 3H_2O \longrightarrow H_3PO_3 + 3HCl$$

$$PCl_5 + 4H_2O \longrightarrow H_3PO_4 + 5HCl$$

48. $NO_3^- + 3Fe^{2+} + 4H^+ \longrightarrow NO + 3Fe^{3+} + 2H_2O$

$[Fe(H_2O)_6]^{2+} + NO \longrightarrow [Fe(H_2O)_5(NO)]^{2+} + H_2O$

(brown complex)

49. Oxygen is more electronegative than chlorine, therefore dispersal of negative charge present on chlorine increases from ClO^- to ClO_4^- ion because number of oxygen atoms attached to chlorine is increasing. Therefore, stability of ions will increase in the order given below :

$$ClO^- < ClO_2^- < ClO_3^- < ClO_4^-$$

Thus due to increase in stability of conjugate base, acidic strength of corresponding acid increases in the following order

$$HClO < HClO_2 < HClO_3 < HClO_4$$

50. See the NCERT textbook for Class XII, page 186.

51. $P_4O_6 + 6H_2O \longrightarrow 4H_3PO_3$

$H_3PO_3 + 2NaOH \longrightarrow Na_2HPO_3 + 2H_2O] \times 4$ (Neutralisation reaction)

$P_4O_6 + 8NaOH \longrightarrow 4Na_2HPO_4 + 2H_2O$

1 mol 8 mol

Product formed by 1 mol of P_4O_6 is neutralised by 8 mols of NaOH

$\therefore$ Product formed by $\frac{1.1}{220}$ mol of P_4O_6 will be neutralised by $\frac{1.1}{220} \times 8$ mol of NaOH

Molarity of NaOH solution is 0.1M

$\Rightarrow$ 0.1 mol NaOH is present in 1 L solution

$\therefore \frac{1.1}{220} \times 8$ mol NaOH is present in $\frac{1.1 \times 8}{220 \times 0.1}$ L $= \frac{88}{220}$ L $= \frac{4}{10}$ L $= 0.4$ L = 400 mL of NaOH solution.

52. $P_4 + 6Cl_2 \longrightarrow 4PCl_3$

$PCl_3 + 3H_2O \longrightarrow H_3PO_3 + 3HCl] \times 4$

$P_4 + 6Cl_2 + 12H_2O \longrightarrow 4H_3PO_3 + 12HCl$

1 mol of white phosphorus produces 12 mol of HCl

62g of white phosphorus has been taken which is equivalent to $\frac{62}{124} = \frac{1}{2}$ mol.

Therefore 6 mol HCl will be formed.

Mass of 6 mol HCl = 6 × 36.5 = 219.0 g HCl

53. Three oxoacids of nitrogen are

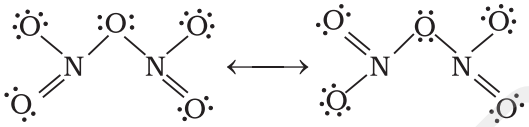
(i) HNO_2, Nitrous acid

(ii) HNO_3 , Nitric acid

(iii) Hyponitrous acid, $H_2N_2O_2$

$$3HNO_2 \xrightarrow{\text{Disproportionation}} HNO_3 + H_2O + 2NO$$

54. $4HNO_3 + P_4O_{10} \longrightarrow 4HPO_3 + 2N_2O_5$



55. (a)

- Structures (See NCERT textbook for Class XII)
- White phosphorus is discrete tetrahedral molecule. Thus it has tetrahedral structure with six P–P bonds.
- Red phosphorus has polymeric structure in which P_4 tetrahedra are linked together through P—P bonds to form chain.

(b) Reactivity

White phosphorus is much more reactive than red phosphorus. This is because in white phosphorus there is angular strain in P_4 molecules because the bond angles are only of 60°.

56. Dilute and concentrated nitric acid give different oxidation products on reaction with copper metal.

$$3Cu + 8HNO_3 \text{ (dil.)} \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$$

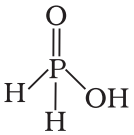
$$Cu + 4HNO_3 \text{ (Conc.)} \longrightarrow 3Cu(NO_3)_2 + 2NO + 2H_2O$$

57. $PCl_5 + 2Ag \longrightarrow 2AgCl + PCl_3$

$AgCl + 2NH_3(aq) \longrightarrow [Ag(NH_3)_2]^+Cl^-$

(soluble complex)

58. Structure of phosphinic acid (Hypophosphorous acid) is as follows :



Reducing behaviour of phosphinic acid is observable in the reaction with silver nitrate given below :

$$4AgNO_3 + 2H_2O + H_3PO_2 \longrightarrow 4Ag + 4HNO_3 + H_3PO_4$$

IV. Matching Type

59. (i) 60. (ii) 61. (i) 62. (ii) 63. (iii)

V. Assertion and Reason Type

64. (iii) 65. (iii) 66. (ii) 67. (i) 68. (i) 69. (i)

VI. Long Answer Type

70. 'A' is S_8 'B' is SO_2 gas

$$S_8 + 8O_2 \xrightarrow{\Delta} 8SO_2$$

$$2MnO_4^- + 5SO_2 + 2H_2O \longrightarrow 5\,SO_4^{2-} + 4H^+ + 2Mn^{2+}$$
(violet) (colourless)

$$2Fe^{3+} + SO_2 + 2H_2O \longrightarrow 2Fe^{2+} + SO_4^{2-} + 4H^+$$

71. $Pb(NO_3)_2 \xrightarrow[673K]{\Delta} 2PbO + 4NO_2$

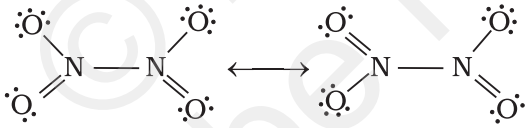
(A)
(Brown colour)

$$2NO_2 \underset{\text{Heating}}{\overset{\text{On cooling}}{\rightleftharpoons}} N_2O_4$$

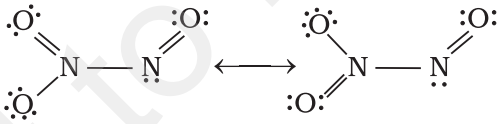
(B)
(Colourless solid)

$$2NO + N_2O_4 \xrightarrow{\Delta\ 250\ K} 2\,N_2O_3$$

(C)
(Blue solid)



(Structure of N_2O_4)



(Structure of N_2O_3)

72. A = NH_4NO_2 B = N_2 C = NH_3 D = HNO_3

(i) $NH_4NO_2 \rightarrow N_2 + 2H_2O$

(ii) $N_2 + 3H_2 \rightarrow 2NH_3$

(iii) $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

$4NO + O_2 \rightarrow 2NO_2$

$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$