

## Unit

# 7

## The p-Block Elements

### I. Multiple Choice Questions (Type-I)

- On addition of conc.  $\text{H}_2\text{SO}_4$  to a chloride salt, colourless fumes are evolved but in case of iodide salt, violet fumes come out. This is because
  - $\text{H}_2\text{SO}_4$  reduces HI to  $\text{I}_2$
  - HI is of violet colour
  - HI gets oxidised to  $\text{I}_2$
  - HI changes to  $\text{HIO}_3$
- In qualitative analysis when  $\text{H}_2\text{S}$  is passed through an aqueous solution of salt acidified with dil. HCl, a black precipitate is obtained. On boiling the precipitate with dil.  $\text{HNO}_3$ , it forms a solution of blue colour. Addition of excess of aqueous solution of ammonia to this solution gives \_\_\_\_\_.
  - deep blue precipitate of  $\text{Cu}(\text{OH})_2$
  - deep blue solution of  $[\text{Cu}(\text{NH}_3)_4]^{2+}$
  - deep blue solution of  $\text{Cu}(\text{NO}_3)_2$
  - deep blue solution of  $\text{Cu}(\text{OH})_2 \cdot \text{Cu}(\text{NO}_3)_2$
- In a cyclotrimetaphosphoric acid molecule, how many single and double bonds are present?
  - 3 double bonds; 9 single bonds
  - 6 double bonds; 6 single bonds
  - 3 double bonds; 12 single bonds
  - Zero double bonds; 12 single bonds
- Which of the following elements can be involved in  $p\pi-d\pi$  bonding?
  - Carbon
  - Nitrogen

- (iii) Phosphorus  
(iv) Boron
5. Which of the following pairs of ions are isoelectronic and isostructural?
- (i)  $\text{CO}_3^{2-}$ ,  $\text{NO}_3^-$   
(ii)  $\text{ClO}_3^-$ ,  $\text{CO}_3^{2-}$   
(iii)  $\text{SO}_3^{2-}$ ,  $\text{NO}_3^-$   
(iv)  $\text{ClO}_3^-$ ,  $\text{SO}_3^{2-}$
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  | $\text{NH}_3$ | $\text{PH}_3$ | $\text{AsH}_3$ | $\text{SbH}_3$ |
|---|---------------|---------------|----------------|----------------|
| $\Delta_{\text{diss}}(\text{E—H})/\text{kJ mol}^{-1}$ | 389           | 322           | 297            | 255            |
- (i)  $\text{NH}_3$   
(ii)  $\text{PH}_3$   
(iii)  $\text{AsH}_3$   
(iv)  $\text{SbH}_3$
8. On heating with concentrated NaOH solution in an inert atmosphere of  $\text{CO}_2$ , 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  $\text{NH}_3$ .  
(iv) It is less basic than  $\text{NH}_3$ .
9. Which of the following acids forms three series of salts?
- (i)  $\text{H}_3\text{PO}_2$   
(ii)  $\text{H}_3\text{BO}_3$   
(iii)  $\text{H}_3\text{PO}_4$   
(iv)  $\text{H}_3\text{PO}_3$
10. Strong reducing behaviour of  $\text{H}_3\text{PO}_2$  is due to
- (i) Low oxidation state of phosphorus  
(ii) Presence of two  $-\text{OH}$  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)  $\text{N}_2\text{O}$ ,  $\text{PbO}$   
(ii)  $\text{NO}_2$ ,  $\text{PbO}$   
(iii)  $\text{NO}$ ,  $\text{PbO}$   
(iv)  $\text{NO}$ ,  $\text{PbO}_2$
- 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)  $\text{PH}_3$  can act as a ligand in the formation of coordination compound with transition elements.  
(iii)  $\text{NO}_2$  is paramagnetic in nature.  
(iv) Covalency of nitrogen in  $\text{N}_2\text{O}_5$  is four.
- 15.** A brown ring is formed in the ring test for  $\text{NO}_3^-$  ion. It is due to the formation of
- (i)  $[\text{Fe}(\text{H}_2\text{O})_5(\text{NO})]^{2+}$   
(ii)  $\text{FeSO}_4 \cdot \text{NO}_2$   
(iii)  $[\text{Fe}(\text{H}_2\text{O})_4(\text{NO})_2]^{2+}$   
(iv)  $\text{FeSO}_4 \cdot \text{HNO}_3$
- 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)  $\text{Bi}_2\text{O}_5$   
(ii)  $\text{BiF}_5$   
(iii)  $\text{BiCl}_5$   
(iv)  $\text{Bi}_2\text{S}_5$

17. On heating ammonium dichromate and barium azide separately we get
- $N_2$  in both cases
  - $N_2$  with ammonium dichromate and NO with barium azide
  - $N_2O$  with ammonium dichromate and  $N_2$  with barium azide
  - $N_2O$  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 \_\_\_\_\_.
- 2
  - 3
  - 4
  - 6
19. The oxidation state of central atom in the anion of compound  $NaH_2PO_2$  will be \_\_\_\_\_.
- +3
  - +5
  - +1
  - 3
20. Which of the following is **not** tetrahedral in shape?
- $NH_4^+$
  - $SiCl_4$
  - $SF_4$
  - $SO_4^{2-}$
21. Which of the following are peroxyacids of sulphur?
- $H_2SO_5$  and  $H_2S_2O_8$
  - $H_2SO_5$  and  $H_2S_2O_7$
  - $H_2S_2O_7$  and  $H_2S_2O_8$
  - $H_2S_2O_6$  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?
- Cu
  - S
  - C
  - 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 \_\_\_\_\_.
- 3 to +3
  - 3 to 0
  - 3 to +5
  - 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
- both  $O_2$  and Xe have same size.
  - both  $O_2$  and Xe have same electron gain enthalpy.
  - both  $O_2$  and Xe have almost same ionisation enthalpy.
  - both Xe and  $O_2$  are gases.
25. In solid state  $PCl_5$  is a \_\_\_\_\_.
- covalent solid
  - octahedral structure
  - ionic solid with  $[PCl_6]^+$  octahedral and  $[PCl_4]^-$  tetrahedra
  - 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 $E^\ominus/V$	$E^\ominus=1.19V$	$E^\ominus=1.65V$	$E^\ominus=1.74V$

- $ClO_4^- > IO_4^- > BrO_4^-$
  - $IO_4^- > BrO_4^- > ClO_4^-$
  - $BrO_4^- > IO_4^- > ClO_4^-$
  - $BrO_4^- > ClO_4^- > IO_4^-$
27. Which of the following is isoelectronic pair?
- $ICl_2, ClO_2$
  - $BrO_2^-, BrF_2^+$
  - $ClO_2, BrF$
  - $CN^-, O_3$

## 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 \_\_\_\_\_.
- 0 to +5
  - 0 to +3
  - 0 to -1
  - 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?
- It has 6 lone pairs of electrons.
  - It has six P–P single bonds.
  - It has three P–P single bonds.
  - It has four lone pairs of electrons.
- 31.** Which of the following statements are correct?
- Among halogens, radius ratio between iodine and fluorine is maximum.
  - Leaving F–F bond, all halogens have weaker X–X bond than X–X' bond in interhalogens.
  - Among interhalogen compounds maximum number of atoms are present in iodine fluoride.
  - Interhalogen compounds are more reactive than halogen compounds.
- 32.** Which of the following statements are correct for  $SO_2$  gas?
- It acts as bleaching agent in moist conditions.
  - It's molecule has linear geometry.
  - It's dilute solution is used as disinfectant.
  - It can be prepared by the reaction of dilute  $H_2SO_4$  with metal sulphide.
- 33.** Which of the following statements are correct?
- All the three N–O bond lengths in  $HNO_3$  are equal.
  - All P–Cl bond lengths in  $PCl_5$  molecule in gaseous state are equal.
  - $P_4$  molecule in white phosphorus have angular strain therefore white phosphorus is very reactive.
  - $PCl$  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  $\text{H}_2\text{S}_2\text{O}_6$ .
  - (ii) In peroxosulphuric acid ( $\text{H}_2\text{SO}_5$ ) sulphur is in +6 oxidation state.
  - (iii) Iron powder along with  $\text{Al}_2\text{O}_3$  and  $\text{K}_2\text{O}$  is used as a catalyst in the preparation of  $\text{NH}_3$  by Haber's process.
  - (iv) Change in enthalpy is positive for the preparation of  $\text{SO}_3$  by catalytic oxidation of  $\text{SO}_2$ .
- 36.** In which of the following reactions conc.  $\text{H}_2\text{SO}_4$  is used as an oxidising reagent?
- (i)  $\text{CaF}_2 + \text{H}_2\text{SO}_4 \longrightarrow \text{CaSO}_4 + 2\text{HF}$
  - (ii)  $2\text{HI} + \text{H}_2\text{SO}_4 \longrightarrow \text{I}_2 + \text{SO}_2 + 2\text{H}_2\text{O}$
  - (iii)  $\text{Cu} + 2\text{H}_2\text{SO}_4 \longrightarrow \text{CuSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}$
  - (iv)  $\text{NaCl} + \text{H}_2\text{SO}_4 \longrightarrow \text{NaHSO}_4 + \text{HCl}$
- 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  $\text{XeF}_6$  is a redox reaction.
  - (iv) Xenon fluorides are not reactive.

### III. Short Answer Type

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- 38.** In the preparation of  $\text{H}_2\text{SO}_4$  by Contact Process, why is  $\text{SO}_3$  not absorbed directly in water to form  $\text{H}_2\text{SO}_4$ ?
- 39.** Write a balanced chemical equation for the reaction showing catalytic oxidation of  $\text{NH}_3$  by atmospheric oxygen.
- 40.** Write the structure of pyrophosphoric acid.
- 41.**  $\text{PH}_3$  forms bubbles when passed slowly in water but  $\text{NH}_3$  dissolves. Explain why?
- 42.** In  $\text{PCl}_5$ , 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  $\text{ClF}_3$  exists but  $\text{FCl}_3$  does not exist.
- 45.** Out of  $\text{H}_2\text{O}$  and  $\text{H}_2\text{S}$ , which one has higher bond angle and why?
- 46.**  $\text{SF}_6$  is known but  $\text{SCl}_6$  is not. Why?
- 47.** On reaction with  $\text{Cl}_2$ , 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  $\text{NO}_3^-$  ion,  $\text{Fe}^{2+}$  ion reduces nitrate ion to nitric oxide, which combines with  $\text{Fe}^{2+}$  (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:  
 $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$
50. Explain why ozone is thermodynamically less stable than oxygen.
51.  $\text{P}_4\text{O}_6$  reacts with water according to equation  $\text{P}_4\text{O}_6 + 6\text{H}_2\text{O} \longrightarrow 4\text{H}_3\text{PO}_3$ . Calculate the volume of 0.1 M NaOH solution required to neutralise the acid formed by dissolving 1.1 g of  $\text{P}_4\text{O}_6$  in  $\text{H}_2\text{O}$ .
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  $\text{P}_4\text{O}_{10}$ . 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.  $\text{PCl}_5$  reacts with finely divided silver on heating and a white silver salt is obtained, which dissolves on adding excess aqueous  $\text{NH}_3$  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) $\text{Xe F}_6$	(1) $sp^3d^3$ – distorted octahedral
(B) $\text{Xe O}_3$	(2) $sp^3d^2$ - square planar
(C) $\text{Xe OF}_4$	(3) $sp^3$ - pyramidal
(D) $\text{Xe F}_4$	(4) $sp^3 d^2$ - 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**

- (A)  $\text{Pb}_3\text{O}_4$   
(B)  $\text{N}_2\text{O}$   
(C)  $\text{Mn}_2\text{O}_7$   
(D)  $\text{Bi}_2\text{O}_3$

**Column II**

- (1) Neutral oxide  
(2) Acidic oxide  
(3) Basic oxide  
(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**

- (A)  $\text{H}_2\text{SO}_4$   
(B)  $\text{CCl}_3\text{NO}_2$   
(C)  $\text{Cl}_2$   
(D) Sulphur

**Column II**

- (1) Highest electron gain enthalpy  
(2) Chalcogen  
(3) Tear gas  
(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**

- (A)  $\text{SF}_4$   
(B)  $\text{BrF}_3$   
(C)  $\text{BrO}_3^-$   
(D)  $\text{NH}_4^+$

**Column II**

- (1) Tetrahedral  
(2) Pyramidal  
(3) Sea-saw shaped  
(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 <sub>6</sub>
(C) It is used to provide inert atmosphere for filling electrical bulbs	(3) XeF <sub>4</sub>
(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<sub>2</sub> is less reactive than P<sub>4</sub>.

**Reason :** Nitrogen has more electron gain enthalpy than phosphorus.

**65. Assertion :** HNO<sub>3</sub> makes iron passive.

**Reason :** HNO<sub>3</sub> 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  $\text{H}_2\text{SO}_4$   
**Reason** : HI has lowest H-X bond strength among halogen acids.
- 67. Assertion** : Both rhombic and monoclinic sulphur exist as  $\text{S}_8$  but oxygen exists as  $\text{O}_2$ .  
**Reason** : Oxygen 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.
- 68. Assertion** : NaCl reacts with concentrated  $\text{H}_2\text{SO}_4$  to give colourless fumes with pungent smell. But on adding  $\text{MnO}_2$  the fumes become greenish yellow.  
**Reason** :  $\text{MnO}_2$  oxidises HCl to chlorine gas which is greenish yellow.
- 69. Assertion** :  $\text{SF}_6$  cannot be hydrolysed but  $\text{SF}_4$  can be.  
**Reason** : Six F atoms in  $\text{SF}_6$  prevent the attack of  $\text{H}_2\text{O}$  on sulphur atom of  $\text{SF}_6$ .

## VI. Long Answer Type

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- 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  $\text{KMnO}_4$  solution and reduces  $\text{Fe}^{3+}$  to  $\text{Fe}^{2+}$ . 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 ( $\text{H}_2$ ) 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)

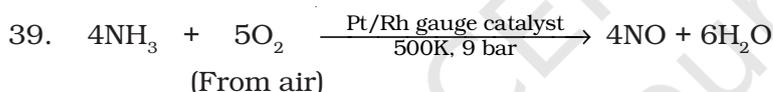
- |           |           |          |           |          |           |
|-----------|-----------|----------|-----------|----------|-----------|
| 1. (iii)  | 2. (ii)   | 3. (i)   | 4. (iii)  | 5. (i)   | 6. (i)    |
| 7. (iv)   | 8. (iii)  | 9. (iii) | 10. (iii) | 11. (ii) | 12. (i)   |
| 13. (iii) | 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)   |                |                      |

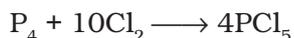
### III. Short Answer Type

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

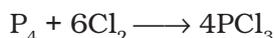


41.  $\text{NH}_3$  forms hydrogen bonds with water therefore it is soluble in it but  $\text{PH}_3$  cannot form hydrogen bond with water so it escapes as gas.
42. **[Hint :** It has trigonal bipyramidal geometry]
43. In gaseous state  $\text{NO}_2$  exists as monomer which has one unpaired electron but in solid state it dimerises to  $\text{N}_2\text{O}_4$  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  $\text{H}_2\text{O}$  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  $\text{F}^-$  ion can be accommodated around sulphur whereas chloride ion is comparatively larger in size, therefore, there will be interionic repulsion.

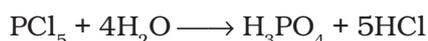
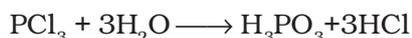
47. A is  $\text{PCl}_5$  (It is yellowish white powder)



- B is  $\text{PCl}_3$  (It is a colourless oily liquid)

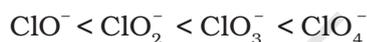


Hydrolysis products are formed as follows :



48.  $\text{NO}_3^- + 3\text{Fe}^{2+} + 4\text{H}^+ \longrightarrow \text{NO} + 3\text{Fe}^{3+} + 2\text{H}_2\text{O}$   
 $[\text{Fe}(\text{H}_2\text{O})_6]^{2+} + \text{NO} \longrightarrow [\text{Fe}(\text{H}_2\text{O})_5(\text{NO})]^{2+} + \text{H}_2\text{O}$   
 (brown complex)

49. Oxygen is more electronegative than chlorine, therefore dispersal of negative charge present on chlorine increases from  $\text{ClO}^-$  to  $\text{ClO}_4^-$  ion because number of oxygen atoms attached to chlorine is increasing. Therefore, stability of ions will increase in the order given below :

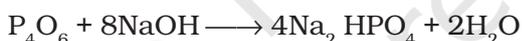


Thus due to increase in stability of conjugate base, acidic strength of corresponding acid increases in the following order



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

51.  $\text{P}_4\text{O}_6 + 6\text{H}_2\text{O} \longrightarrow 4\text{H}_3\text{PO}_3$



1 mol    8 mol

Product formed by 1 mol of  $\text{P}_4\text{O}_6$  is neutralised by 8 mols of NaOH

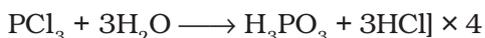
$\therefore$  Product formed by  $\frac{1.1}{220}$  mol of  $\text{P}_4\text{O}_6$  will be neutralised by  $\frac{1.1}{220} \times 8$  mol of NaOH

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  $\frac{1.1 \times 8}{220 \times 0.1} \text{L} = \frac{88}{220} \text{L} = \frac{4}{10} \text{L} = 0.4 \text{L} = 400 \text{mL}$  of NaOH solution.

52.  $\text{P}_4 + 6\text{Cl}_2 \longrightarrow 4\text{PCl}_3$



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.

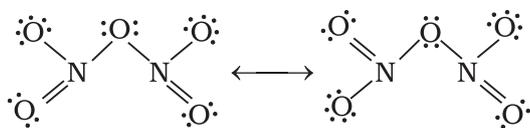
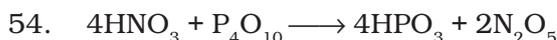
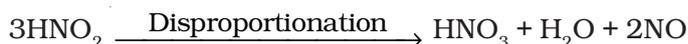
$$\text{Mass of 6 mol HCl} = 6 \times 36.5 = 219.0 \text{ g HCl}$$

53. Three oxoacids of nitrogen are

(i)  $\text{HNO}_2$ , Nitrous acid

(ii)  $\text{HNO}_3$ , Nitric acid

(iii) Hyponitrous acid,  $\text{H}_2\text{N}_2\text{O}_2$



55. (a) • Structures (See NCERT textbook for Class XII)

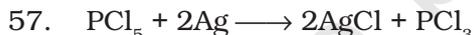
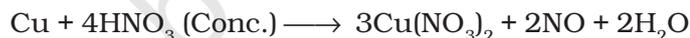
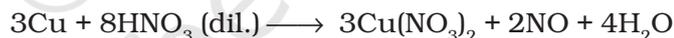
• White phosphorus is discrete tetrahedral molecule. Thus it has tetrahedral structure with six P–P bonds.

• Red phosphorus has polymeric structure in which  $\text{P}_4$  tetrahedra are linked together through P–P bonds to form chain.

(b) Reactivity

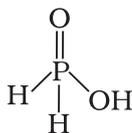
White phosphorus is much more reactive than red phosphorus. This is because in white phosphorus there is angular strain in  $\text{P}_4$  molecules because the bond angles are only of  $60^\circ$ .

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

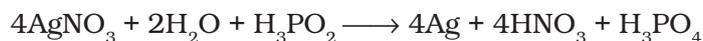


(soluble complex)

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 :



#### IV. Matching Type

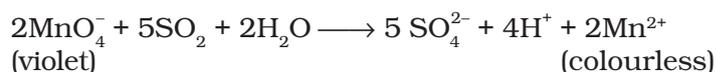
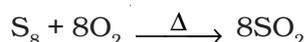
59. (i)      60. (ii)      61. (i)      62. (ii)      63. (iii)

#### 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

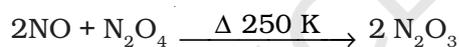


71.  $Pb(NO_3)_2 \xrightarrow[673K]{\Delta} 2PbO + 4NO_2$

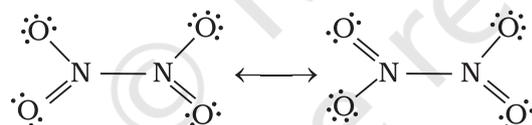
(A)  
(Brown colour)



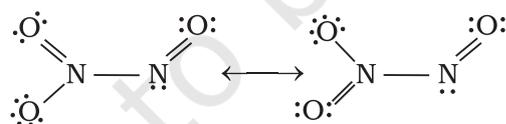
(B)  
(Colourless solid)



(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 =  $HNO_3$

