# Chapter 7

# The *p*-Block Elements

## Solutions

### SECTION - A

**Objective Type Questions**

**(Group 15 Elements)**

1. $NH_3 + O_2 \xrightarrow[\Delta]{Pt} A + H_2O$

   $A + O_2 \longrightarrow B$

   $B + H_2O \longrightarrow C + D$

   A, B, C and D respectively are

   (1) NO, $NO_2$, $HNO_3$ and $HNO_2$ (2) $NO_2$, $HNO_2$, NO and $HNO_3$

   (3) $HNO_2$, $NO_2$, $HNO_3$ and $N_2O$ (4) $HNO_2$, $N_2O$, NO and $HNO_3$

**Sol.** Answer (1)

$$NH_3 + O_2 \xrightarrow[\Delta]{Pt} \underset{A}{NO} + H_2O$$

$$NO + O_2 \longrightarrow \underset{B}{NO_2}$$

$$NO_2 + H_2O \longrightarrow \underset{C}{HNO_3} + \underset{D}{HNO_2}$$

2. Which of the following can hydrolysed?

   (1) $TeF_6$ (2) $NCl_3$ (3) $SF_6$ (4) All of these

**Sol.** Answer (4)

$$NCl_3 + 3H_2O \longrightarrow NH_3 + 3HOCl$$

$$TeF_6 + 6H_2O \longrightarrow Te(OH)_6 + 6HF$$

3. Phosphine on reaction with hydrobromic acid gives

(1) $PBr_3$ (2) $P_2H_4Br_2$ (3) $PBr_5$ (4) $PH_4Br$

**Sol.** Answer (4)

$PH_3$ (Phosphine) is weakly basic and gives phosphonium compounds with acids like HBr.

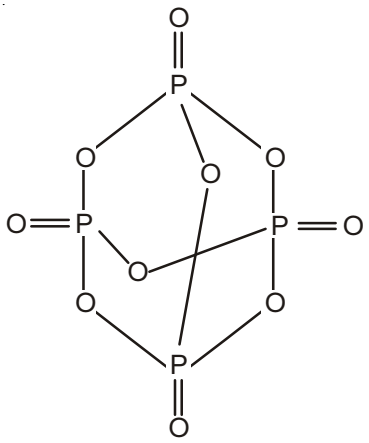
$$PH_3 + HBr \longrightarrow PH_4Br$$

4. In $P_4O_{10}$ the number co-ordinate bonds is

(1) 1 (2) 8 (3) 3 (4) 4

**Sol.** Answer (4)

In $P_4O_{10}$, the number of co-ordinate bonds is 4



There are 4 oxygen atoms co-ordinated to P.

5. Calomel ($Hg_2Cl_2$) on reaction with $NH_4OH$ gives

(1) $Hg_2O$ (2) HgO (3) $HgNH_2Cl$ (4) $NH_2Hg_2Cl$

**Sol.** Answer (3)

$$Hg_2Cl_2 + 2NH_4OH \longrightarrow \underset{\text{Black ppt.}}{HgNH_2Cl} + Hg + NH_4Cl + H_2O$$

6. Nitrogen is obtained when $NaNO_2$ reacts with

(1) $NH_4Cl$ (2) $NH_4NO_3$ (3) $(NH_4)_2CO_3$ (4) $NH_4OH$

**Sol.** Answer (1)

$$NH_4Cl(aq) + NaNO_2(aq) \longrightarrow N_2(g) + H_2O(l) + NaCl(aq)$$

7. Which of the following is a sesqui oxide?

(1) $N_2O_4$ (2) $N_2O_3$ (3) $N_2O$ (4) $N_2O_5$

**Sol.** Answer (2)

A sesqui oxide is an oxide containing three oxygen atom with two atoms of another element. $N_2O_3$ is an example of sesqui oxide.

8. $HNO_3 + HCl \longrightarrow A + NOCl + H_2O$

$\downarrow$ Pt/HCl

'P'

The product 'P' will be

(1) $H_2PtCl_4$ (2) $H_2PtCl_6$ (3) $H_2PtCl_2$ (4) $H_3PtCl_3$

**Sol.** Answer (2)

$$HNO_3 + 3HCl \longrightarrow Cl_2 + NOCl + 2H_2O$$

$$Cl_2 + Pt/HCl \longrightarrow \underset{P}{H_2PtCl_6}$$

$H_2PtCl_6$ is chloroplatinic acid. $HNO_3$ and HCl forms aqua regia, a mixture which can dissolve noble metals like Pt.

9. What is the product formed when $NH_3$ reacts with excess of $Cl_2$?

(1) $NH_4Cl$ & HCl (2) $NH_4Cl$ & $N_2$ (3) $NCl_3$ & HCl (4) $NH_4Cl$ & $NCl_3$

**Sol.** Answer (3)

$$NH_3 + \underset{\text{Excess}}{Cl_2} \longrightarrow NCl_3 + 3HCl$$

10. Hybridisation of central 'N'-atom in $N_2O$ is

(1) *sp* (2) $sp^2$ (3) $sp^3$ (4) *sp* & $sp^2$

**Sol.** Answer (1)

$$N \equiv \overset{+}{N} - \overset{-}{O} \longleftrightarrow \overset{-}{N} = \overset{+}{N} = O$$

In $N_2O$, the hybridization of central N atom is *sp*, since it contains one $\sigma$ bond and 3 $\pi$ bonds and no lone pair of electrons.

11. In solid state $PBr_5$ exist as

(1) $[PBr_4]^+ [PBr_6]^-$ (2) $[PBr_5]^+ [PBr_5]^-$ (3) $[PBr_4]^+ [Br^-]$ (4) $PBr_5$

**Sol.** Answer (3)

In solid state $PBr_5$ exist as $[PBr_4]^+ [Br^-]$, in which $[PBr_4]^+$ has tetrahedral shape.

12. Which of the following metal gives $NH_4NO_3$ with very dilute $HNO_3$?

(1) Fe (2) Ti (3) Cu (4) Hg

**Sol.** Answer (1)

With very dilute $HNO_3$, Fe gives $NH_4NO_3$

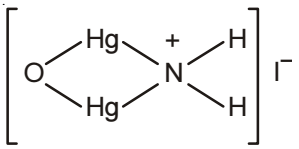
$$4Fe + 10HNO_3 \longrightarrow 4Fe(NO_3)_2 + NH_4NO_3 + 3H_2O$$

13. In iodide of Millon's base formed by the reaction of Nessler's reagent with $NH_3$, the coordination number of Hg will be

(1) 2 (2) 3 (3) 4 (4) 6

**Sol.** Answer (1)

$$\underset{\text{Nessler's Reagent}}{K_2HgI_4} + NH_3 + 3KOH \longrightarrow \underset{\text{Iodide of millon's base}}{NH_2 - Hg - O - Hg - I} + 7KI + 2H_2O$$



Iodide of millon's base

In iodide of millon's base, the coordination number of Hg is 2.

14. The compound insoluble in aqueous $NH_3$ is

(1) AgI (2) AgCl (3) $ZnSO_4$ (4) $HgCl_2$

**Sol.** Answer (1)

Silver Iodide (AgI) is insoluble in aqueous solution of ammonia.

15. Which of the following is called mixed anhydride?

(1) $NO_2$ (2) $N_2O_3$ (3) $N_2O_5$ (4) All of these

**Sol.** Answer (1)

$NO_2$ is called as mixed anhydride because an reaction with water it gives a mixture of nitric acid and nitrous acid

$$2NO_2 + H_2O \rightleftharpoons HNO_2 + HNO_3$$

16. Which of the following do not exist?

(1) $NCl_5$ (2) $PH_5$ (3) $[BCl_6]^{3-}$ (4) All of these

**Sol.** Answer (4)

$NCl_5$ does not exist neither do $[BCl_6]^{3-}$ because of the non availability *d* orbital in N and B. $PH_5$ does not exist because H is more electropositive than P and it cannot bring +5 oxidation state of phosphorus. Since Cl is more electronegative than P, $PCl_5$ exist.

17. $PCl_3 + H_2O \longrightarrow A + B$. What are A and B

(1) $H_3PO_2 + HCl$ (2) $H_3PO_4 + HCl$ (3) $H_3PO_3 + HCl$ (4) $HPO_3 + HClO_3$

**Sol.** Answer (3)

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

$PCl_3$ on complete hydrolysis gives $H_3PO_3$ and HCl.

18. Which of the following is correct?

(1) In $PF_5$, axial and equatorial bonds are interchanged, known as pseudoreaction

(2) In solid state $PF_5$ remains covalent

(3) $PH_5$ cannot be obtained, because H is not sufficiently electronegative to make the d-orbitals contact sufficiently

(4) All of these

**Sol.** Answer (4)

When axial and equatorial bonds are interchanged in a trigonal bipyramidal compound, this is known as pseudo reaction or pseudo rotation. In solid state $PF_5$ exists as covalent compound unlike $PCl_5$ which exists as $[PCl_5^+][PCl_6]^-$. $PH_5$ does not exist because H is not much electronegative to make the *d* orbital contact which is required for the formation of $PH_5$.

**(Group 16 Elements)**

19. The most acidic oxide among the following is

(1) $SO_3$ (2) $P_2O_5$ (3) $Cl_2O_7$ (4) $SiO_2$

**Sol.** Answer (3)

$Cl_2O_7$ is more acidic than $SO_2$, $P_2O_5$ and $SiO_2$ because Cl is present in a very high oxidation state of +7. Higher the oxidation state of central atom in an oxide, highers the acidity.

20. When Cu is reacted with hot concentrated solution of $H_2SO_4$ then the gas obtained is

(1) $O_2$ (2) $H_2$ (3) $SO_2$ (4) $SO_3$

**Sol.** Answer (3)

$$Cu(s) + \underset{\text{Hot \& conc.}}{2H_2SO_4(l)} \longrightarrow CuSO_4 + 2H_2O(l) + SO_2(g)$$

21. A metal X when burnt in air, X-forms oxide and nitride both, X can be

(1) Rb (2) Mg (3) Na (4) K

**Sol.** Answer (2)

$$2Mg + \underset{\text{From air}}{O_2} \longrightarrow 2MgO$$

$$3Mg + \underset{\text{From air}}{N_2} \longrightarrow Mg_3N_2$$

**(Group 17 Elements)**

22. Which of the following is most basic?

(1) $Cl^-$ (2) $F^-$ (3) $I^-$ (4) $Br^-$

**Sol.** Answer (2)

A conjugate base of a strong acid is weak whereas conjugate base of a weak acid is strong. Since the acidic strength of group 17 hydrides is in the order HF < HCl < HBr < HI, HF is the weakest acid and hence its conjugate base $F^-$ is strongest base.

23. The final product formed, when alkaline KI solution reacts with ozone, is

(1) $I_2$ (2) $KIO_3$ (3) HI (4) Reaction will not occur

**Sol.** Answer (1)

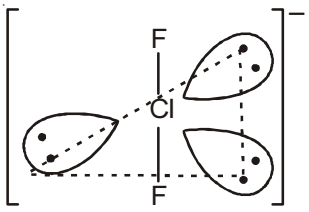
$$2KI + H_2O + O_3 \longrightarrow 2KOH + I_2 + O_2$$

24. The shape of $ClF_2^-$, is

(1) Linear (2) Trigonal bipyramidal (3) Square pyramidal (4) T-shape

**Sol.** Answer (1)

$ClF_2^-$ is linear shaped




Linear structure of $ClF_2^-$.

25. Reaction of $Cl_2$ with hot and conc. NaOH produces

(1) NaClO (2) $NaClO_3$ (3) $NaClO_4$ (4) $NaClO_2$

**Sol.** Answer (2)

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

Conc. and hot NaOH on reaction with $Cl_2$ produces sodium hypochlorate ($NaClO_3$).

**(Group 18 Elements)**

26. $XeF_6$ on complete hydrolysis gives

(1) Xe (2) $XeO_2$ (3) $XeO_3$ (4) $XeO_2F_2$

**Sol.** Answer (3)

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

27. Which one of the following does not form during the hydrolysis of $XeF_6$?

(1) $XeO_3$ (2) $XeOF_4$ (3) $XeO_2F_2$ (4) $XeOF_3$

**Sol.** Answer (4)

$XeOF_3$ is not formed during the hydrolysis of $XeF_6$ because Xe is not pentavalent.

28. In xenon fluorides most reactive in $XeF_6$, $XeF_4$ and $XeF_2$ is

(1) $XeF_6$ (2) $XeF_2$ (3) $XeF_4$ (4) All are equally reactive

**Sol.** Answer (1)

$XeF_6$ has strongest fluorinating tendency.

## SECTION - B

**Previous Years Questions**

1. Which is the correct thermal stability order for $H_2E$ (E = O, S, Se, Te and Po)? **[NEET-2019]**

   (1) $H_2S < H_2O < H_2Se < H_2Te < H_2Po$

   (2) $H_2O < H_2S < H_2Se < H_2Te < H_2Po$

   (3) $H_2Po < H_2Te < H_2Se < H_2S < H_2O$

   (4) $H_2Se < H_2Te < H_2Po < H_2O < H_2S$

**Sol.** Answer (3)

On going down the group thermal stability order for $H_2E$ decreases because H–E bond energy decreases

$\therefore$ Order of stability would be:-

$H_2Po < H_2Te < H_2Se < H_2S < H_2O$

2. Which of the following is incorrect statement? **[NEET-2019]**

   (1) $PbF_4$ is covalent in nature

   (2) $SiCl_4$ is easily hydrolysed

   (3) $GeX_4$ (X = F, Cl, Br, I) is more stable than $GeX_2$

   (4) $SnF_4$ is ionic in nature

**Sol.** Answer (1)

$PbF_4$ and $SnF_4$ are ionic in nature.

3. Match the following : **[NEET-2019]**

| | | | |
|---|---|---|---|
| (a) | Pure nitrogen | (i) | Chlorine |
| (b) | Haber process | (ii) | Sulphuric acid |
| (c) | Contact process | (iii) | Ammonia |
| (d) | Deacon's process | (iv) | Sodium azide or Barium azide |

Which of the following is the correct option?

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (1) | (i) | (ii) | (iii) | (iv) |
| (2) | (ii) | (iv) | (i) | (iii) |
| (3) | (iii) | (iv) | (ii) | (i) |
| (4) | (iv) | (iii) | (ii) | (i) |

**Sol.** Answer (4)

| | | | |
|---|---|---|---|
| (a) | Pure nitrogen | : | Sodium azide or Barium azide |
| (b) | Haber process | : | Ammonia |
| (c) | Contact process | : | Sulphuric acid |
| (d) | Deacon's process | : | Chlorine |

4. Identify the **incorrect** statement related to $PCl_5$ from the following: **[NEET-2019]**

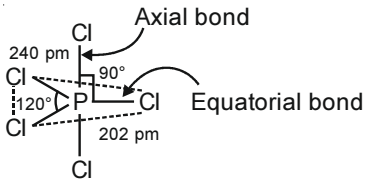
   (1) Three equatorial P–Cl bonds make an angle of 120° with each other

   (2) Two axial P–Cl bonds make an angle of 180° with each other

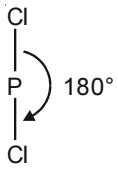
   (3) Axial P–Cl bonds are longer than equatorial P–Cl bonds

   (4) $PCl_5$ molecule is non-reactive

**Sol.** Answer (4)




(1) True

(2) True 


(3) True

Axial bond : 240 pm

Equatorial bond : 202 pm

(4) False

Due to longer and hence weaker axial bonds, $PCl_5$ is a reactive molecule.

5. Which of the following species is **not** stable? **[NEET-2019]**

(1) $[SiF_6]^{2-}$ (2) $[GeCl_6]^{2-}$ (3) $[Sn(OH)_6]^{2-}$ (4) $[SiCl_6]^{2-}$

**Sol.** Answer (4)

- Due to presence of d-orbital in Si, Ge and Sn they form species like $SiF_6^{2-}$, $[GeCl_6]^{2-}$, $[Sn(OH)_6]^{2-}$
- $SiCl_6^{2-}$ does not exist because six large chloride ions cannot be accommodated around $Si^{4+}$ due to limitation of its size.

6. Which of the following statements is **not** true for halogens? **[NEET-2018]**

(1) All form monobasic oxyacids (2) All are oxidizing agents

(3) Chlorine has the highest electron-gain enthalpy (4) All but fluorine show positive oxidation states

**Sol.** Answer (4)

Due to high electronegativity and small size, F forms only one oxoacid, HOF known as Fluoric (I) acid. Oxidation number of F is +1 in HOF.

7. Name the gas that can readily decolourises acidified $KMnO_4$ solution **[NEET-2017]**

(1) $CO_2$ (2) $SO_2$ (3) $NO_2$ (4) $P_2O_5$

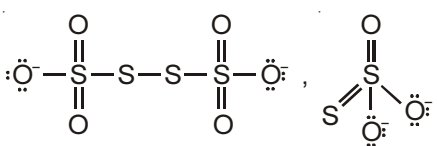
**Sol.** Answer (2)

$SO_2$ is readily decolourises acidified $KMnO_4$.

8. In which pair of ions both the species contain S – S bond? **[NEET-2017]**

(1) $S_2O_7^{2-}$, $S_2O_3^{2-}$ (2) $S_4O_6^{2-}$, $S_2O_3^{2-}$ (3) $S_2O_7^{2-}$, $S_2O_8^{2-}$ (4) $S_4O_6^{2-}$, $S_2O_7^{2-}$

**Sol.** Answer (2)



$[S_4O_6]^{2(-)}$ $[S_2O_3]^{2(-)}$

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

| Column I | Column II |
|---|---|
| (a) $XX'$ | (i) T-shape |
| (b) $XX_3'$ | (ii) Pentagonal bipyramidal |
| (c) $XX_5'$ | (iii) Linear |
| (d) $XX_7'$ | (iv) Square-pyramidal |
| | (v) Tetrahedral |

**Code :** **[NEET-2017]**

(1) a(iii), b(iv), c(i), d(ii) (2) a(iii), b(i), c(iv), d(ii)

(3) a(v), b(iv), c(iii), d(ii) (4) a(iv), b(iii), c(ii), d(i)

**Sol.** Answer (2)

$XX' \rightarrow$ Linear

$XX_3' \rightarrow$ Example : $ClF_3 \rightarrow$ T-shape

$XX_5' \rightarrow$ Example : $BrF_5 \rightarrow$ Square pyramidal

$XX_7' \rightarrow$ Example : $IF_7 \rightarrow$ Pentagonal bipyramidal

10. $AlF_3$ is soluble in HF only in presence of KF. It is due to the formation of **[NEET (Phase-2) 2016]**

(1) $K_3[AlF_3H_3]$ (2) $K_3[AlF_6]$ (3) $AlH_3$ (4) $K[AlF_3H]$

**Sol.** Answer (2)

Fact.

11. Hot concentrated sulphuric acid is a moderately strong oxidizing agent. Which of the folllowing reactions does not show oxidizing behaviour? **[NEET (Phase-2) 2016]**

(1) $Cu + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2H_2O$

(2) $3S + 2H_2SO_4 \rightarrow 3SO_2 + 2H_2O$

(3) $C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$

(4) $CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

**Sol.** Answer (4)

$CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

In this reaction there is no change in oxidation state of any atom.

12. When copper is heated with conc. $HNO_3$, it produces **[NEET-2016]**

(1) $Cu(NO_3)_2$ and $N_2O$ (2) $Cu(NO_3)_2$ and $NO_2$

(3) $Cu(NO_3)_2$ and NO (4) $Cu(NO_3)_2$, NO and $NO_2$

**Sol.** Answer (2)

$$Cu + \underset{\text{(Conc.)}}{4HNO_3} \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$$

13. Which is the **correct** statement for the given acids? **[NEET-2016]**

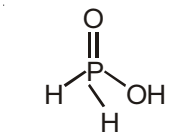
(1) Phosphinic acid is a diprotic acid while phosphonic acid is a monoprotic acid

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

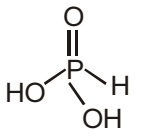
(3) Both are diprotic acids

(4) Both are triprotic acids

**Sol.** Answer (2)



(Phosphinic acid)
Monoprotic



(Phosphonic acid)
Diprotic

14. Among the following, the correct order of acidity is **[NEET-2016]**

(1) $HClO_4 < HClO_2 < HClO < HClO_3$ (2) $HClO_3 < HClO_4 < HClO_2 < HClO$

(3) $HClO < HClO_2 < HClO_3 < HClO_4$ (4) $HClO_2 < HClO < HClO_3 < HClO_4$

**Sol.** Answer (3)

$$\underset{\text{Acidic - strength}}{\overset{+1}{HClO} < \overset{+3}{HClO_2} < \overset{+5}{HClO_3} < \overset{+7}{HClO_4} \longrightarrow}$$

15. The product obtained as a result of a reaction of nitrogen with $CaC_2$ is **[NEET-2016]**

(1) $Ca_2CN$ (2) $Ca(CN)_2$ (3) $CaCN$ (4) $CaCN_3$

**Sol.** Answer (2)

Option (2) should be $CaCN_2$ instead of $Ca(CN)_2$

$$N_2 + CaC_2 \xrightarrow{\Delta} CaCN_2 + C$$

16. Which one of the following orders is **correct** for the bond dissociation enthalpy of halogen molecules? **[NEET-2016]**

(1) $F_2 > Cl_2 > Br_2 > I_2$ (2) $I_2 > Br_2 > Cl_2 > F_2$ (3) $Cl_2 > Br_2 > F_2 > I_2$ (4) $Br_2 > I_2 > F_2 > Cl_2$

**Sol.** Answer (3)

Fact

17. Match the compounds given in Column-I with the hybridisation and shape given in Column-II and mark the correct option. **[NEET-2016]**

| **Column-I** | **Column-II** |
|---|---|
| (a) $X_3F_6$ | (i) Distorted octahedral |
| (b) $XeO_3$ | (ii) Square planar |
| (c) $XeOF_4$ | (iii) Pyramidal |
| (d) $XeF_4$ | (iv) Square pyramidal |

(1) a(iv), b(i), c(ii), d(iii) (2) a(i), b(iii), c(iv), d(ii)

(3) a(i), b(ii), c(iv), d(iii) (4) a(iv), b(iii), c(i), d(ii)

**Sol.** Answer (2)

Fact.

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

What explains the higher boiling point of hydrogen fluoride? **[Re-AIPMT-2015]**

(1) The bond energy of HF molecules is greater than in other hydrogen halides

(2) The effect of nuclear shielding is much reduced in fluorine which polarises the HF molecule

(3) The electronegativity of fluorine is much higher than for other elements in the group

(4) There is strong hydrogen bonding between HF molecules

**Sol.** Answer (4)

Fact.

19. Which of the statements given below is incorrect? **[Re-AIPMT-2015]**

(1) ONF is isoelectronic with $O_2N^-$ (2) $OF_2$ is an oxide of fluorine

(3) $Cl_2O_7$ is an anhydride of perchloric acid (4) $O_3$ molecule is bent

**Sol.** Answer (2)

In oxides, oxidation state of oxygen is –2, but in $OF_2$, oxidation state of oxygen is +2 because F is more electronegative than oxygen.

20. Strong reducing behaviour of $H_3PO_2$ is due to **[Re-AIPMT-2015]**

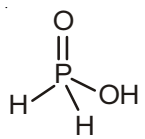
(1) High oxidation state of phosphorus

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

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

(4) High electron gain enthalpy of phosphorus

**Sol.** Answer (3)




$[H_3PO_2]$

Strong reducing behaviour of $H_3PO_2$ is due to presence of one –OH group and two P – H bonds.

21. Acidity of diprotic acids in aqueous solutions increases in the order **[AIPMT-2014]**

(1) $H_2S < H_2Se < H_2Te$ (2) $H_2Se < H_2S < H_2Te$ (3) $H_2Te < H_2S < H_2Se$ (4) $H_2Se < H_2Te < H_2S$

**Sol.** Answer (1)

In aqueous solution, acidity of *p*-block element increases down the group.

$\Rightarrow$ due to maximum molecular weight.

Or

The dissociation energy decreases as the bond length M – H increases from O to Te, this facilitates the release of proton.

22. Which of these is least likely to act as a Lewis base ? **[NEET-2013]**

(1) $F^-$ (2) $BF_3$ (3) $PF_3$ (4) CO

**Sol.** Answer (2)

23. Which is the strongest acid in the following? **[NEET-2013]**

(1) $HClO_3$ (2) $HClO_4$ (3) $H_2SO_3$ (4) $H_2SO_4$

**Sol.** Answer (2)

In $HClO_4$, the oxidation state of chlorine is +7 and the conjugate base of $HClO_4$ is stabilized by four oxygen atom which are involved in resonance. $HClO_4$ is even more acidic than $H_2SO_4$ since Cl is more electronegative than S which makes the release of $H^+$ easier.

24. Roasting of sulphides give the gas X as by product. This is a colourless gas with choking smell of burnt sulphur and causes great damage to respiratory organs as a result of acid rain. Its aqueous solution is acidic, acts as a reducing agent and its acid has never been isolated. The gas X is **[NEET-2013]**

(1) $SO_2$ (2) $CO_2$ (3) $SO_3$ (4) $H_2S$

**Sol.** Answer (1)

25. $XeF_2$ is isostructural with **[NEET-2013]**

(1) $ICl_2^-$ (2) $SbCl_3$ (3) $BaCl_2$ (4) $TeF_2$

**Sol.** Answer (1)

Both $XeF_2$ and $ICl_2$ are linear in shape.

26. Which of the following does not give oxygen on heating? **[NEET-2013]**

(1) $Zn(ClO_3)_2$ (2) $K_2Cr_2O_7$ (3) $(NH_4)_2Cr_2O_7$ (4) $KClO_3$

**Sol.** Answer (3)

Ammonium dichromate gives the following products upon heating

$$(NH_4)_2Cr_2O_7(s) \longrightarrow Cr_2O_3(s) + N_2(g) + H_2O(g)$$

27. Which of the following species contains three bond pairs and one lone pair around the central atom ? **[AIPMT (Prelims)-2012]**

(1) $NH_2^-$ (2) $PCl_3$ (3) $H_2O$ (4) $BF_3$

**Sol.** Answer (2)

28. When $Cl_2$ gas reacts with hot and concentrated sodium hydroxide solution, the oxidation number of chlorine changes from **[AIPMT (Prelims)-2012]**

(1) Zero to –1 and zero to +3 (2) Zero to +1 and zero to –3

(3) Zero to +1 and zero to –5 (4) Zero to –1 and zero to +5

**Sol.** Answer (4)

This reaction is $6NaOH + 3\overset{0}{Cl}_2 \xrightarrow[\text{(hot \& conc.)}]{} \overset{-1}{NaCl} + \overset{+5}{NaClO}_3 + 3H_2O$

In $Cl_2$, the oxidation number of Cl is O but in $NaClO_3$ the oxidation number of Cl is +5 and – 1 in NaCl.

29. A mixture of potassium chlorate, oxalic acid and sulphuric acid is heated. During the reaction which element undergoes maximum change in the oxidation number? **[AIPMT (Prelims)-2012]**

(1) Cl (2) C (3) S (4) H

**Sol.** Answer (1)

30. Sulphur trioxide can be obtained by which of the following reaction **[AIPMT (Prelims)-2012]**

(1) $S + H_2SO_4 \xrightarrow{\Delta}$ (2) $H_2SO_4 + PCl_5 \xrightarrow{\Delta}$

(3) $CaSO_4 + C \xrightarrow{\Delta}$ (4) $Fe_2(SO_4)_3 \xrightarrow{\Delta}$

**Sol.** Answer (4)

$$Fe_2(SO_4)_3 \xrightarrow{\Delta} Fe_2O_3 + 3SO_3$$

31. Which of the following statements is not valid for oxoacids of phosphorus? **[AIPMT (Prelims)-2012]**

(1) All oxoacids contain tetrahedral four coordinated phosphorus

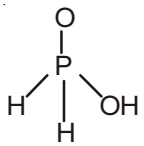
(2) All oxoacids contain atleast one P = O unit and one P–OH group

(3) Orthophosphoric acid is used in the manufacture of triple superphosphate

(4) Hypophosphorous acid is a diprotic acid

**Sol.** Answer (4)

Hypophosphorous acid is $H_3PO_2$ which contains only one ionizable –OH group. It is a monoprotic (monobasic) acid.




32. In which of the following arrangements the given sequence is not strictly according to the property indicated against it? **[AIPMT (Mains)-2012]**

(1) HF < HCl < HBr < HI : increasing acidic strength

(2) $H_2O < H_2S < H_2Se < H_2Te$ : increasing $pK_a$ values

(3) $NH_3 < PH_3 < AsH_3 < SbH_3$ : increasing acidic character

(4) $CO_2 < SiO_2 < SnO_2 < PbO_2$ : increasing oxidising power

**Sol.** Answer (2)

On moving down the group in group 16, acidity of hydrides increases because the bond strength decreases due to increases in size of central atom. Since acidity is increasing down the group, pKa value decreases. Higher the acidity, lower is the pKa value.

33. Which of the following is least likely to behave as Lewis base? **[AIPMT (Prelims)-2011]**

(1) $OH^-$ (2) $H_2O$

(3) $NH_3$ (4) $BF_3$

**Sol.** Answer (4)

34. The correct order of increasing bond angles in the following species are **[AIPMT (Prelims)-2010]**

(1) $Cl_2O < ClO_2 < ClO_2^-$ (2) $ClO_2 < Cl_2O < ClO_2^-$

(3) $Cl_2O < ClO_2^- < ClO_2$ (4) $ClO_2^- < Cl_2O < ClO_2$

**Sol.** Answer (3)

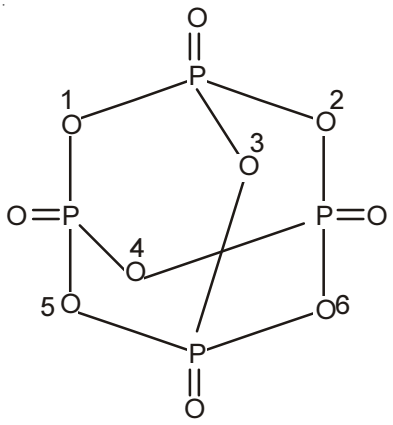
Bond pair-bond pair repulsion is maximum in $ClO_2$, and minimum in $ClO_2^-$. Therefore bond angle is maximum in $ClO_2$ and minimum in $ClO_2^-$.

35. How many bridging oxygen atoms are present in $P_4O_{10}$? **[AIPMT (Mains)-2010]**

(1) 6 (2) 4 (3) 2 (4) 5

**Sol.** Answer (1)

Structure of $P_4O_{10}$




Number of Bridging oxygen atom = 6.

36. Among the following which is the strongest oxidising agent? **[AIPMT (Prelims)-2009]**

(1) $Br_2$ (2) $I_2$ (3) $Cl_2$ (4) $F_2$

**Sol.** Answer (4)

37. Which one of the following orders correctly represents the increasing acid strengths of the given acids ? **[AIPMT (Prelims)-2007]**

(1) $HOClO_3 < HOClO_2 < HOClO < HOCl$ (2) $HOCl < HOClO < HOClO_2 < HOClO_3$

(3) $HOClO_3 < HOCl < HOClO_3 < HOClO_2$ (4) $HOClO_2 < HOClO_3 < HOClO < HOCl$

**Sol.** Answer (2)

38. Which of the following oxidation states are the most characteristic for lead and tin respectively ? **[AIPMT (Prelims)-2007]**

(1) +2, +2 (2) +4, +2 (3) +2, +4 (4) +4, +4

**Sol.** Answer (3)

Lower oxidation state (+2) is more stable as we move down the group.

39. Which one of the following orders is not in accordance with the property stated against it ? **[AIPMT (Prelims)-2006]**

(1) $F_2 > Cl_2 > Br_2 > I_2$ : Oxidising power

(2) HI > HBr > HCl > HF : Acidic property in water

(3) $F_2 > Cl_2 > Br_2 > I_2$ : Electronegativity

(4) $F_2 > Cl_2 > Br_2 > I_2$ : Bond dissociation energy

**Sol.** Answer (4)

40. Which of the following is not isostructural with $SiCl_4$ ? **[AIPMT (Prelims)-2006]**

(1) $SCl_4$ (2) $SO_4^{2-}$ (3) $PO_4^{3-}$ (4) $NH_4^+$

**Sol.** Answer (1)

41. In which of the following molecules are all the bonds not equal? **[AIPMT (Prelims)-2006]**

(1) $ClF_3$ (2) $BF_3$ (3) $AlF_3$ (4) $NF_3$

**Sol.** Answer (1)

42. In which of the following compounds, nitrogen exhibits highest oxidation state?

(1) $N_3H$ (2) $NH_2OH$ (3) $N_2H_4$ (4) $NH_3$

**Sol.** Answer (1)

(1) $N_3H \Rightarrow 3x + 1 = 0 \Rightarrow x = -\frac{1}{3}$

(2) $NH_2OH \Rightarrow x + 2 - 2 + 1 = 0 \Rightarrow x = -1$

(3) $N_2H_4 \Rightarrow 2x + 1 \times 4 = 0 \Rightarrow x = -2$

(4) $NH_3 \Rightarrow x + 3 = 0 \Rightarrow x = -3$

43. Which of the following displaces $Br_2$ from an aqueous solution containing bromide ions?

(1) $I_2$ (2) $I_3^-$ (3) $Cl_2$ (4) $Cl^-$

**Sol.** Answer (3)

Chlorine is stronger oxidizing agent as compared to $Br_2$. It oxidizes Br– ions present in solution,

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

44. Repeated use of which one of the following fertilizers would increase the acidity of the soil?

(1) Ammonium sulphate (2) Superphosphate of lime

(3) Urea (4) Potassium nitrate

**Sol.** Answer (1)

Ammonium sulphate on hydrolysis gives sulphuric acid which can increase the acidity of soil if it is used regularly

$$\underset{\text{Ammonium sulphate}}{(NH_4)_2SO_4} + 2H_2O \longrightarrow 2NH_4OH + H_2SO_4$$

45. Which of the following oxides is most acidic?

(1) $As_2O_5$ (2) $P_2O_5$ (3) $N_2O_5$ (4) $Sb_2O_5$

**Sol.** Answer (3)

In the given options, all group 15 elements are present in +5 oxidation state. But since nitrogen is most electronegative and has maximum non-metallic character, its oxide, $N_2O_5$ is most acidic.

46. Which of the following phosphorus is the most reactive?

(1) Scarlet phosphorus (2) White phosphorus (3) Red phosphorus (4) Violet phosphorus

**Sol.** Answer (2)

White phosphorus is most reactive form of phosphorus because it is less stable due to angular strain present in its molecule. Thus angular strain makes white phosphorus unstable and reactive.

47. The decomposition of organic compounds, in the presence of oxygen and without the development of odoriferous substances, is called

(1) Nitrification (2) $N_2$-fixation (3) Decay (4) Denitrification

**Sol.** Answer (3)

The decomposition of organic compounds, in presence of oxygen and without the formation of odoriferous substances is called decay.

48. Nitrogen forms $N_2$, but phosphorus does not form $P_2$, however, it forms $P_4$, reason is

(1) Triple bond present between phosphorus atom (2) $p\pi - p\pi$ bonding is weak

(3) $p\pi - p\pi$ bonding is strong (4) Multiple bonds form easily

**Sol.** Answer (2)

Nitrogen forms $N_2$ because small size of nitrogen atom allows it to from strong $p\pi - p\pi$ bond but in phosphorus, $p\pi - p\pi$ bonding is weak due to the large size of phosphorus atom. Therefore phosphorus forms sigma bonds and exist as $P_4$ which is tetrahedral in shape.

49. Which reaction is not feasible?

(1) $2KI + Br_2 \rightarrow 2KBr + I_2$ (2) $2KBr + I_2 \rightarrow 2KI + Br_2$

(3) $2KBr + Cl_2 \rightarrow 2KCl + Br_2$ (4) $2H_2O + 2F_2 \rightarrow 4HF + O_2$

**Sol.** Answer (2)

The oxidation of Br by $I_2$ is not possible because Br is stronger oxidizing agent than iodine. Hence the above reaction is not feasible.

50. Which one of the following statements is not true?

(1) Among halide ions, iodide is the most powerful reducing agent

(2) Fluorine is the only halogen that does not show a variable oxidation state

(3) HOCl is a stronger acid than HOBr

(4) HF is a stronger acid than HCl

**Sol.** Answer (4)

HCl is a stronger acid than HF. H–Cl bond is weaker than H–F bond because of bigger size of chlorine atom which allows easier release of $H^+$ ion.

51. Oxidation states of P in $H_4P_2O_5$, $H_4P_2O_6$, $H_4P_2O_7$, are respectively

(1) + 3, + 4, + 5 (2) + 3, + 5, + 4 (3) + 5, + 3, + 4 (4) + 5, + 4, + 3

**Sol.** Answer (1)

**$H_4P_2O_5$**

$(4 \times 1) + (2 \times P) + 5 \times (-2) = 0$ Oxidation no. of H = +1

$4 + 2P - 10 = 0$ Oxidation no. of O = –2

$2P = +6 \Rightarrow P = +3$

**$H_4P_2O_6$**

$(4 \times 1) + 2 \times P + 6 \times (-2) = 0$

$2P = 8 \Rightarrow P = +4$

**$H_4P_2O_7$**

$4 \times (+1) + 2 \times P + 7 \times (-2) = 0$ Oxidation no. of H = +1

$2P = +10 \Rightarrow P = +5$

Hence oxidation state of P in $H_4P_2O_5$, $H_4P_2O_6$ and $H_4P_2O_7$ are +3, +4 and +5 respectively.

52. In which one of the following species the central atom has the type of hybridisation which is not the same as that present in the other three?

(1) $PCl_5$ (2) $SF_4$ (3) $I_3^-$ (4) $SbCl_5^{2-}$

**Sol.** Answer (4)

$PCl_5 \Rightarrow$ No. of bond pairs = 5
No. of lone pairs = 0
Hybridization = $sp^3d$

$SF_4 \Rightarrow$ No. of bond pairs = 4
No. of lone pairs = 1
Hybridization = $sp^3d$

$I_3^- \Rightarrow$ No. of bond pairs = 2
No. of lone pairs = 3
Hybridization = $sp^3d$

$SbCl_5^{2-} \Rightarrow$ No. of bond pairs = 5
No. of lone pairs = 1
Hybridization = $sp^3d^2$

53. Least volatile hydrogen halide is

(1) HF (2) HCl
(3) HBr (4) HI

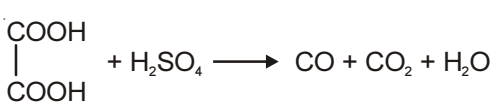
**Sol.** Answer (1)

HF is least volatile hydrogen halide because it is associated through hydrogen bonding. This hydrogen bonding is responsible for high B.P. of HF.

54. Oxalic acid on heating with conc. $H_2SO_4$ gives

(1) CO only (2) $CO_2$ only (3) $CO_2 + H_2O$ (4) $CO + CO_2 + H_2O$

**Sol.** Answer (4)



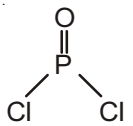

Oxalic acid

55. Chemical formula of phosgene is

(1) $COCl_2$ (2) $CaOCl_2$ (3) $CaCO_3$ (4) COCl

**Sol.** Answer (1)

Phosgene is $COCl_2$



Phosgene

56. Pb + conc. $HNO_3$ gives

(1) $Pb(NO_3)_2 + NO_2$ (2) $PbNO_3 + N_2O$ (3) $Pb(NO_3)_2 + N_2O_3$ (4) $Pb(NO_3)_2 + N_2O$

**Sol.** Answer (1)

$$Pb + \underset{\text{Conc.}}{4HNO_3} \longrightarrow Pb(NO_3)_2 + 2NO_2 + 2H_2O$$

57. Which has ability to release bromine from KBr?

(1) $I_2$ (2) $Br_2$ (3) $F_2$ (4) $SO_2$

**Sol.** Answer (3)

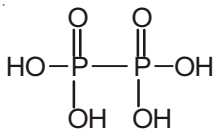
Fluorine is the strongest oxidizing agent and it can release bromine from KBr

$$F_2 + 2KBr \longrightarrow 2KF + Br_2$$

58. Which of the following has P-P linkage?

(1) $H_4P_2O_6$ (2) $H_4P_2O_7$ (3) $HPO_3$ (4) $H_3PO_4$

**Sol.** Answer (1)



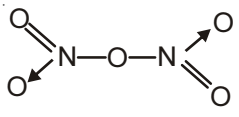
($H_4P_2O_6$) Hypophosphoric acid contains one P–P bond.

59. Bonds present in $N_2O_5$ are

(1) Only covalent (2) Only ionic

(3) Covalent and coordinate (4) Covalent and ionic

**Sol.** Answer (3)



$N_2O_5$ contains both covalent bond and coordinate bond.

60. Which of the following dissolves in water but does not gives any oxyacid solution?

(1) $SO_2$ (2) $OF_2$ (3) $SCl_4$ (4) $SO_3$

**Sol.** Answer (2)

Oxygen fluorides do not form oxyacid due to small difference in E.N. power and the bond is energy covalent.

61. Which of the following is used during the preparation of fluorine by Whytlaw Gray method?

(1) KF(aq) (2) HF(aq) (3) Molten $KHF_2$ (4) $NH_4F$

**Sol.** Answer (3)

$KHF_2 \longrightarrow KF + HF,\ KF \longrightarrow K^+ + F^-$

At cathode, $K^+ + e^- \longrightarrow K,\ 2K + 2HF \longrightarrow 2KF + H_2 \uparrow$

At anode, $2F^- \longrightarrow F_2 + 2e^-$

## SECTION - C

### Assertion-Reason Type Questions

1. A : $H_2O$ is the only hydride of chalcogen family which is liquid.

R : Acidic nature of hydrides of chalcogen family increases down the group.

**Sol.** Answer (2)

$H_2O$ is the only hydride of chalcogen family (group 16) which is liquid while rest of the hydrides are gases because $H_2O$ is associated through hydrogen bonding. Also in chalcogen family, the acidity of hydrides increases down the group but this is not the explanation of Assertion.

2. A : $PF_5$ and $IF_5$ have similar shapes.

R : All the bond lengths are equal in $PF_5$.

**Sol.** Answer (4)

$PF_5$ is $sp^3d$ hybridized because it contains five bond pairs while $IF_5$ is $sp^3d^2$ hybridized because it five bond pair and one lone pair, therefore they have different shapes. $PF_5$ has trigonal bipyramidal shape in which three P–F bonds are equatorial and 2 P–F bonds are axial and axial bonds are longer than equatorial bonds. Hence both Assertion and Reason are false.

3. A : Atomic size of F is smaller than that of Cl.

R : F-F bond is stronger than Cl-Cl bond.

**Sol.** Answer (3)

Atomic size of F is smaller than Cl because Cl contains extra shell. F–F bond is weaker than Cl–Cl bond because there is repulsion between lone pairs of electrons in the smaller sized $F_2$ molecules. Hence Assertion is true and Reason is false.

4. A : $P_4$ is more reactive than $N_2$.

R : P-P bonds are relatively weaker than N ≡ N bond.

**Sol.** Answer (1)

$P_4$ is more reactive than $N_2$ because $N_2$ contains a triple bond which requires a high amount of energy to break, whereas in $P_4$ single bonds are present which can be easily broken. Hence $P_4$ is more reactive.

5. A : Noble gases have highest ionization energies in their respective periods.

R : The outermost sub-shell of noble gases in which electron enters is completely filled.

**Sol.** Answer (1)

Higher the stability of an element, higher is its ionization enthalpy. Noble gases are very stable due to completely filled sub-shells hence exhibit highest ionization enthalpy among their respective period.

6. A : The bond angle of $NH_3$ is greater than $BiH_3$.

R : 'Bi' is metal while 'N' is non-metal.

**Sol.** Answer (2)

Bond angle depends on the electronegativity of control atom. N is more electronegative than B and pulls the electrons of N–H towards itself, which makes the bond angle greater in $NH_3$ than in $BH_3$.

7. A : '$XeF_6$' on the reaction with 'RbF' gives $Rb[XeF_7]$.

R : $XeF_6$ is non-reactive.

**Sol.** Answer (3)

$$XeF_6 + RbF \longrightarrow Rb[XeF_7]$$

This shows that $XeF_6$ is reactive. Hence Reason is false.

8. A : Tailing of Hg caused by ozone is due to formation of HgO.

R : In the presence of $O_3$, Hg does not loses its meniscus.

**Sol.** Answer (4)

Tailing of Hg caused by ozone is due to the formation of $Hg_2O$

$$O_3 + 2Hg \longrightarrow Hg_2O + O_2$$

This results in the change in the meniscus of liquid mercury. Hence both Assertion and Reason are false.

9. A : The valency and oxidation number of sulphur in $S_8$ respectively are 2 and 0.

R : $S_8$ Rhombic is the most stable allotropic form of sulphur.

**Sol.** Answer (2)

Valency of S in $S_8$ is two since each S is linked with other two S atoms and in elemental state oxidation state of every element is O. Rhombic sulphur is the most stable allotropic form of sulphur but this reason does not explains the Assertion.

10. A : Dissolution of concentrated $H_2SO_4$ in water is highly exothermic process.

R : Sulphuric acid is always diluted by adding acid to water slowly.

**Sol.** Answer (2)

Dissolution of $H_2SO_4$ in water is highly exothermic process.

11. A : $N_2$ is more stable than $O_2$.

R : Bond order of $N_2$ is 3.

**Sol.** Answer (1)

$N_2$ contains a triple bond whereas $O_2$ contains a double bond. Since a triple bond is more stable than a double bond $N_2$ is more stable than $O_2$. Bond order of three indicates triple bond. Higher the bond order, higher is the stability.

12. A : $PH_5$ is not possible.

R : –5 oxidation state of phosphorus is not possible.

**Sol.** Answer (1)

$PH_5$ does not exist because five oxidation state of phosphorus is not possible. Hence Assertion is true and Reason is the correct Explanation.

13. A : $NH_3$ is more polar than $NF_3$.

R : $NF_3$ cannot be hydrolysed.

**Sol.** Answer (2)

$NH_3$ is more polar than $NF_3$ because in $NF_3$ magnetic moment due to lone pair and N–F bond are aligned in opposite direction. $NF_3$ does not undergoes hydrolysis.

14. A : $O_3$ is better oxidizing agent than $H_2O_2$.

R : $O_3$ converts Ag to $Ag_2O$.

**Sol.** Answer (2)

$O_3$ is a better oxidizing agent than $H_2O_2$ because $O_2$ is unstable and easily provides oxygen required for oxidation $O_3$ oxidizes Ag to $Ag_2O$. This Reason is not the correct explanation of Assertion.

15. A : $Na_2S_2O_3$ on reaction with $I_2$ gives $Na_2S_4O_6$.

R : This reaction involves colour and electronic change both.

**Sol.** Answer (2)

$$2Na_2S_2O_3 + I_2 \longrightarrow Na_2S_4O_6 + 2NaI$$

This reaction envolve charge in oxidation state which changes the colour of compound as well as electronic configuration of S. But Reason does not explain the Assertion.

16. A : $Cl_2$ on reaction with NaOH (cold and dilute) gives $NaClO_3$.

R : $Cl_2$ get oxidized only in this reaction.

**Sol.** Answer (4)

$Cl_2$ on reaction with cold and dilute NaOH gives NaOCl

$$Cl_2 + 2NaOH \longrightarrow NaCl + NaOCl + H_2O$$

This is a disproportionation reaction in which Cl goes both oxidation as well as reduction. Hence both Assertion and Reason are false.

17. A : $2F^- + Cl_2 \longrightarrow 2Cl^- + F_2$, is a reaction having $\Delta G$ = –ve.

R : $Cl_2$ is better oxidizing agent than $F_2$.

**Sol.** Answer (4)

$$2F^- + Cl_2 \longrightarrow 2Cl^- + F_2$$

This reaction is not feasible because flourine is the strongest oxidizing agent. $\Delta G$ for this reaction is positive

$\therefore$ Both Assertion and Reason are false.

18. A : $H_3PO_4$ is less acidic than $H_3PO_3$.

R : Oxidation state of phosphorus in $H_3PO_4$ < $H_3PO_3$.

**Sol.** Answer (3)

$H_3PO_4$ is less acidic then $H_3PO_3$ because $H_3PO_3$ contains only two O–OH group which can be easily ionized as compared $H_3PO_4$ which contains 3–OH group. Oxidation state of P in $H_3PO_4$ is +5 whereas in $H_3PO_4$ it is +3.

19. A : $CN^-$ is pseudohalide.

R : $(CN)_2$ is pseudohalogen.

**Sol.** Answer (2)

$CN^-$ is cyanide ion and it is a pseudohalide because at resembles halide ions. It gives corresponding molecule $(CN)_2$ which is known cyanogen which resembles Halogen. Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

20. A : Xe is the only element of group 18 which from compounds.

R : Xe does not form clatherates.

**Sol.** Answer (4)

In group 18, Kr can also form compound. Xe forms clatherates with phenol derivatives. Hence both Assertion and Reason are false.

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