

## P BLOCK ELEMENTS

### 15<sup>th</sup> GROUP

1. The Bi (V) compounds are unknown except BiF<sub>5</sub>. Why?

**Due to inert pair effect, +5 oxidation state of Bi is unstable**

2. Nitrogen exists as a gas in elemental state, whereas other elements of the group exist as solid. Why?

**Due to ability of nitrogen to form  $\pi\pi$ -  $\pi\pi$  multiple bond, it exists as discrete molecules of N<sub>2</sub>.**

3. The tendency of catenation for Nitrogen is less than Phosphorous. Why?

**N-N bond is weaker than P-P bond due to inter electronic repulsion between non bonding pair of electrons in Nitrogen owing to its small size.**

4. Arrange the hydrides of 15<sup>th</sup> group elements in the decreasing order of the property mentioned

a. Thermal stability : NH<sub>3</sub> > PH<sub>3</sub> > AsH<sub>3</sub> > SbH<sub>3</sub> > BiH<sub>3</sub>

b. Basic strength : NH<sub>3</sub> > PH<sub>3</sub> > AsH<sub>3</sub> > SbH<sub>3</sub> > BiH<sub>3</sub>

c. Reducing character : BiH<sub>3</sub> > SbH<sub>3</sub> > AsH<sub>3</sub> > PH<sub>3</sub> > NH<sub>3</sub>

5. Arrange the oxide E<sub>2</sub>O<sub>3</sub> of 15<sup>th</sup> group element in the decreasing order of acid strength

**N<sub>2</sub>O<sub>3</sub> > P<sub>2</sub>O<sub>3</sub> > As<sub>2</sub>O<sub>3</sub> > Sb<sub>2</sub>O<sub>3</sub> > Bi<sub>2</sub>O<sub>3</sub>**

6. Nitrogen doesn't form pentahalides. Why?

**Due to non availability of 'd' orbitals in Nitrogen to expand its covalency beyond 4.**

7. NH<sub>3</sub> has exceptionally higher boiling point compared to the other hydrides of 15<sup>th</sup> group. Why?

**Due to strong inter molecular association in NH<sub>3</sub> through H-bonding**

8. NH<sub>3</sub> is most basic among the hydrides of 15<sup>th</sup> group elements. Why?

**Due to small size of Nitrogen the availability of lone pair electron in NH<sub>3</sub> is more.**

9.  $\text{BiH}_3$  is the strongest reducing agent among the hydrides of 15<sup>th</sup> group elements .Why?

**B'cause Bi-H bond is the weakest**

10. The pentahalides of 15<sup>th</sup> group elements are more covalent than their trihalides .Why?

**The +5 oxidation state of the element in their penta halides is more polarizing than the +3 state of elements in their trihalides .**

11. The thermal stability of  $\text{BiH}_3$  is the lowest among the hydrides of 15<sup>th</sup> group elements Why?

**Bi-H bond is the weakest bond due to it's small bond dissociation enthalpy.**

12. Dinitrogen(  $\text{N}_2$ ) is inert at room temperature .Why?

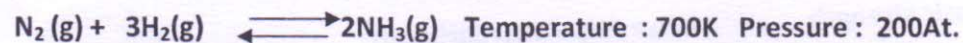
**Due to very high bond enthalpy of  $\text{N}=\text{N}$**

13. How is Nitrogen prepared in pure form ?

**By thermal decomposition of Sodium/Barium azide**



14. How is  $\text{NH}_3$  manufactured by Haber process



**Catalyst : Iron oxide Promoters :  $\text{K}_2\text{O}$  and  $\text{Al}_2\text{O}_3$**

15.  $\text{AgCl}$  is soluble in  $\text{NH}_3$  .Why ?

**Due to formation of a soluble complex with  $\text{NH}_3$ .  $\text{AgCl}(\text{s}) + \text{NH}_3(\text{aq}) \longrightarrow [\text{Cu}(\text{NH}_3)_4]^{2+}$**

16. How does  $\text{NH}_3$  react with  $\text{Cu}^{2+}(\text{aq})$  ?



17.  $\text{NO}_2$  undergoes dimerisation .Why?

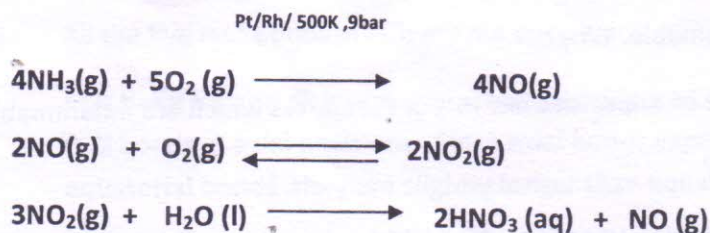
**$\text{NO}_2$  is an odd electron molecule . So on dimerisation it is converted to  $\text{N}_2\text{O}_4$  which contains even no .of electrons . (Diagram)**

18.  $\text{NO}$  being an odd electron molecule , doesn't undergo dimerisation . Why?

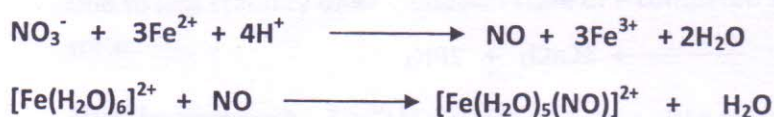
**The unpaired electron in  $\text{NO}$  is delocalized and gets stabilized .(Diagram)**



19. How is  $\text{HNO}_3$  manufactured by Ostwald's process .



20. What is the Chemistry of Brown ring test ?



21. Methods of preparation of oxides of Nitrogen .(Table 7.3)

22. Reactions of con.  $\text{HNO}_3$  with Zn, Cu, I<sub>2</sub>, C, S<sub>8</sub>, P<sub>4</sub>

23. How does white P<sub>4</sub> react with boiling NaOH ?



24. White Phosphorous is more reactive than red phosphorous .Why?

**In white phosphorous there is angular strain in P<sub>4</sub> molecule .so it is less stable and more reactive compared to red phosphorous.**

25. What are the differences between white phosphorous and red phosphorous?

**a. White P consists of discrete tetrahedral P<sub>4</sub> molecules whereas red p consists of chain of P<sub>4</sub> tetrahedra.**

**b. White P is soluble in CS<sub>2</sub> while red P is insoluble in CS<sub>2</sub> .**

**c. White P glows in darkness whereas red P doesn't glow .**

**d. white P is more reactive than red P**

26. White P glows in darkness .Why?

**Due to chemiluminescence .**

27. White P catches fire spontaneously .Why?

**Because it's ignition temperature is lower than atmospheric temperature.**

28. How are  $\alpha$  and  $\beta$  Black Phosphorous prepared ?

**$\alpha$  Black P is prepared by heating red P in a sealed tube at 803k .**

**$\beta$  black P is prepared by heating white P under high pressure.**

29. Impure  $\text{PH}_3$  is inflammable. Why?

**Due to the presence of impurities like  $\text{PH}_3$  or  $\text{P}_4$  vapours which are inflammable .**

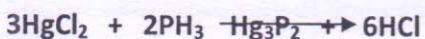
30. How is  $\text{PH}_3$  purified ?

**Impure  $\text{PH}_3$  is absorbed in HI to form  $\text{PH}_4\text{I}$  which on treating with KOH gives off  $\text{PH}_3$ .**

31. How does  $\text{Ca}_3\text{P}_2$  react with HCl?



32. How does  $\text{PH}_3$  react with a.  $\text{CuSO}_4$  b.  $\text{HgCl}_2$



33. Show that  $\text{PH}_3$  is Basic .

**$\text{PH}_3$  is a Lewis acid due to the presence of a lone pair electron on P atom .It reacts with acids like HI and gives salt .**



34. Bond angle in  $\text{PH}_4^+$  is higher than that in  $\text{PH}_3$  . Why?

**In  $\text{PH}_3$  there are 3 bond pairs and 1 lone pair of electrons , whereas in  $\text{PH}_4^+$  there are only 4 bond pairs of electrons . Due to greater repulsion between lone pair and bond pair in  $\text{PH}_3$  as compared to bond pair –bond pair repulsion in  $\text{PH}_4^+$  , the bond angle in  $\text{PH}_3$  is less than that in  $\text{PH}_4^+$  .**

35.  $\text{PCl}_3$  fumes in moist air .Why?

**Due to formation of HCl gas with water.**



36. What happens when  $\text{PCl}_5$  is heated ?

**It decomposes to give  $\text{PCl}_3$  and  $\text{Cl}_2$  .**



37. Why does  $\text{PCl}_5$  fumes in moist air

**Due to formation of HCl gas with water.**



38. All the five P-Cl bonds in  $\text{PCl}_5$  are not equivalent. Why?

**$\text{PCl}_5$  has a trigonalbipyramidal structure with 3 P-Cl bonds in equatorial position and 2 P-Cl bonds in axial positions. Since axial bonds experience more repulsion from equatorial bonds, they are slightly longer than equatorial bonds.**

39.  $\text{H}_3\text{PO}_3$  undergoes disproportionation. Why?

**Due to less stability of +3 oxidation state of P compared to its +5 and -3 oxidation state.**



40.  $\text{H}_3\text{PO}_2$  is a reducing agent. Why?

**Due to the presence of 2 P-H bonds.**



41.  $\text{H}_3\text{PO}_3$  is a dibasic acid though there are 3 hydrogen atoms. Why?

**In  $\text{H}_3\text{PO}_3$  there are only 2 H atoms which are ionisable (due to 2 P-OH bonds). The third H atom is bonded to P, so not ionisable.**

42. How many types of salts are formed by the following acids?

a)  $\text{H}_3\text{PO}_3$  - 2 types (basicity is 2)

b)  $\text{H}_3\text{PO}_4$  -- 3 types (basicity is 3)

c)  $\text{H}_3\text{PO}_2$  -- 1 type (basicity is 1)

43. Solid form of  $\text{PCl}_5$  is conducting. Why?

**In solid form  $\text{PCl}_5$  exists as an ionic compound  $[\text{PCl}_4]^+ [\text{PCl}_6]^-$**

44.  $\text{CN}^-$  is a known compound whereas  $\text{CP}^-$  is not known. Why?

**Nitrogen can form  $\pi$ - $\pi$  bond with carbon, whereas Phosphorous can't form  $\pi$ - $\pi$  with carbon.**

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