

## The p- block elements : TYPE- MLL

### One Mark questions

1. Why is  $\text{H}_3\text{PO}_3$  diprotic?
2. Nitrogen does not form pentahalide like phosphorous, why?
3.  $\text{H}_2\text{O}$  is a liquid while  $\text{H}_2\text{S}$  is a gas, why?
4. Arrange  $\text{NH}_3$ ,  $\text{PH}_3$ ,  $\text{AsH}_3$ ,  $\text{BiH}_3$ ,  $\text{SbH}_3$  in the increasing order of basic strength.
5. Oxygen is a gas while sulphur is a solid, why?
6. Write the formula of hyponitros acid.
7. Why does Al not react with conc. nitric acid?
8. Can  $\text{PCl}_5$  act as an oxidising agent and reducing agent?
9. Why does  $\text{NO}_2$  readily dimerise?
10. Why is  $\text{BiH}_3$  the strongest reducing agent amongst all the hydrides of nitrogen family?
11. Write the chemical formula of peroxodisulphuric acid.
12. Why does  $\text{NH}_3$  act as a Lewis base /complexing agent?
13. What is the basicity of  $\text{H}_3\text{PO}_4$ ?
14. Why does  $\text{R}_3\text{P}=\text{O}$  exist but  $\text{R}_3\text{N}=\text{O}$  does not (R = alkyl group)?
15. Why does the reactivity of nitrogen differ from phosphorus?
16. Why is white phosphorous highly reactive?
17. Why group 16 members are called chalcogens?
18.  $\text{OF}_4$  is not known but  $\text{SF}_4$  is known. Explain
19. Solid  $\text{PCl}_5$  exists as an ionic solid, Why?
20. Bismuth is a strong oxidizing agent in pentavalent state, why?

### Two Marks questions

21. Draw the shapes of  $\text{SF}_4$ ,  $\text{BrF}_3$  on the basis of VSEPR theory.
22. (a) Why is atomic radius of Argon more than that of Chlorine ?  
(b) Why is ionization enthalpy of Nitrogen more than oxygen?
23. (a) Arrange  $\text{F}_2$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{I}_2$  in the increasing order of bond dissociation energy.  
(b) Arrange  $\text{HOClO}$ ,  $\text{HOClO}_2$ ,  $\text{HOClO}_3$  in the increasing order of acidic strength.
24. Explain giving suitable reasons:  
(i)  $\text{NH}_3$  has higher boiling point than  $\text{PH}_3$   
(ii)  $\text{SbF}_5$  is known but  $\text{BiF}_5$  is unknown.

25. Explain giving suitable reasons:
- $\text{SF}_6$  is well known but  $\text{SH}_6$  is not known.
  - Proton affinity of  $\text{NH}_3$  is more than  $\text{PH}_3$ .
26. Explain giving suitable reasons.
- Sulphur in vapour form is paramagnetic in nature.
  - Catenation properties of Phosphorous is more than Nitrogen.
27. Give chemical equations, when :
- Ammonium dichromate is heated ?
  - Sodium azide is heated?
28. Complete the following equations:
- $\text{HgCl}_2 + \text{PH}_3 \longrightarrow$
  - $\text{P}_4 + \text{NaOH} + \text{H}_2\text{O} \longrightarrow$
29. Write main differences between the properties of white phosphorus and red phosphorus.
30. Arrange  $\text{H}_2\text{O}, \text{H}_2\text{S}, \text{H}_2\text{Se}, \text{H}_2\text{Te}$  in the increasing order of (i) Acidic Character (ii) Thermal stability .

### Three Marks questions

31.
  - Why is  $\text{ICl}$  more reactive than  $\text{I}_2$ ?
  - Interhalogen compounds are strong Oxidizing agents, why?
  - Bleaching of flowers by  $\text{Cl}_2$  is permanent while  $\text{SO}_2$  is temporary, why?
32. Give Reasons:
- Iodine is more soluble in  $\text{KI}$  solution than in water .
  - $\text{HF}$  is stored in wax -coated bottle .
  - $\text{HCl}$  is not used to make the medium acidic in titrations involving  $\text{KMnO}_4$  .
33. Explain giving suitable reasons:
- $\text{SbF}_5$  is known but  $\text{BiF}_5$  is unknown.
  - $\text{CN}^-$  ion is known but  $\text{CP}^-$  is not .
  - Compounds of Noble gases are known with Xe and fluorine.
34. Explain giving suitable reasons:
- $\text{PH}_3$  has lower boiling point than  $\text{NH}_3$ .
  - Nitric oxide becomes brown when released in air.
  - When  $\text{HCl}$  reacts with finely powdered iron, it forms ferrous chloride and not ferric chloride.
35.
  - Which Xe compound has distorted octahedral shape?
  - How does Chlorine react with hot and concentrated  $\text{NaOH}$  ?
  - Write the chemical reaction involved in the ring test.
36.
  - Are all the bonds in  $\text{PCl}_5$  equivalent in length?
  - On the basis of structure show that  $\text{H}_3\text{PO}_2$  is a good reducing agent.

© How many P-OH bonds are present in Pyrophosphoric acid?
37. Complete the following equations:
- $\text{P}_4 + \text{SOCl}_2 \longrightarrow$
  - $\text{NH}_3 + \text{CuSO}_4(\text{aq}) \longrightarrow$
  - $\text{XeF}_4 + \text{H}_2\text{O} \longrightarrow$

38. (i) Arrange M-F, M-Cl, M-Br, M-I in the increasing order of ionic character.  
 (ii) Arrange HF, HCl, HBr, HI in the increasing order of reducing behavior.  
 (iii) Arrange  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$  in the increasing order of bond dissociation energy.
39. Starting from sulphur, how would you manufacture  $H_2SO_4$  by contact process.
40. Write the reaction involved in formation of ammonia by Habers process? State the favorable conditions for good yield of ammonia.

### Five Marks questions

41. A gas "X" is soluble in water. Its aq. Solution turns red litmus blue with excess of aq.  $CuSO_4$  solution it gives deep blue colour and with  $FeCl_3$  solution a brownish ppt. soluble in  $HNO_3$  is obtained. *Identify gas "X" and write reactions for changes observed.*
42. Write the reaction involved in formation of Nitric acid by Ostwald's process? State the favorable conditions for good yield of Nitric oxide.
43. Complete the following equations:
- $XeF_4 + H_2O \longrightarrow$
  - $XeF_6 + PF_5 \longrightarrow$
  - $Cl_2 + F_2 \text{ (excess)} \longrightarrow$
  - $HgCl_2 + PH_3 \longrightarrow$
  - $SO_3 + H_2SO_4 \longrightarrow$
44. A translucent white waxy solid 'A' on heating in an inert atmosphere is converted into its allotropic form (B). Allotrope 'A' on reaction with very dilute aqueous KOH liberates a highly poisonous gas 'C' having rotten fish smell. With excess of chlorine 'A' forms 'D' which hydrolyses to compound 'E'. Identify compounds 'A' to 'E'.
45. What happens when Concentrated  $H_2SO_4$  is added to/ Give the reactions of  $H_2SO_4$  with (i) calcium fluoride (ii) KCl, (iii) Sugar (iv) Cu turnings. (v) Sulphur

### ANSWER KEY The p-block elements

Type : MLL

Q.N.	Answer
1	Two ionisable hydrogen
2	Absence of d-orbitals in nitrogen.
3	H-bonding in $H_2O$
4	$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$
5	Absence of $p\pi-p\pi$ bonding in oxygen.
6	$HNO_2$
7	Formation of passive oxide film
8	No, can act as oxidizing agent only.

9	To pair up odd electron.
10	Low bond dissociation enthalpy.
11	$\text{H}_2\text{S}_2\text{O}_8$
12	It can donate lone pair of electrons very easily.
13	3
14	Presence of d-orbitals in phosphorous.
15	Absence of d-orbitals, H-bonding, tendency to form multiple bond.
16	Strained structure.
17	Ore forming nature.
18	Absence of d-orbitals in oxygen.
19	It exists as $[\text{PCl}_4]^+[\text{PCl}_6]^-$ in solid state.
20	Inert pair effect.
21	$\text{SF}_4$ (See saw) $\text{BrF}_3$ (T-shape) Draw yourself
22	(a) Ar (Vander waal's radius) Cl (Covalent radius) The magnitude of $V_r > C_r$ . (b) Half-filled configuration shown by nitrogen.
23	(a) $\text{Cl}_2 > \text{Br}_2 > \text{F}_2 > \text{I}_2$ (b) $\text{HOClO}_3 > \text{HOClO}_2 > \text{HOClO}$
24	(a) H-bonding in ammonia (b) Inert pair effect shown by Bi.
25	(a) The enthalpy of atomization of H—H is very high as compared to F—F. High enthalpy of dissociation cannot be compensated by energy released during bond formation. (b) High electronegativity of nitrogen.
26	(a) In vapour form sulphur behaves like $\text{O}_2$ . (b) Phosphorous is unable to form multiple bonds.
27	(a) $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \longrightarrow \text{N}_2 + \text{Cr}_2\text{O}_3 + 4 \text{H}_2\text{O}$ (b) $2\text{NaN}_3 \longrightarrow 2\text{Na} + 3\text{N}_2$
28	(a) $3\text{HgCl}_2 + 2\text{PH}_3 \longrightarrow \text{Hg}_3\text{P}_2 + 6\text{HCl}$ (b) $\text{P}_4 + 3 \text{NaOH} + 3\text{H}_2\text{O} \longrightarrow \text{PH}_3 + 3\text{NaH}_2\text{PO}_2$
29	White Phosphorous: Stained structure, Highly reactive, Insoluble in water  Red Phosphorous: Stable structure, Less reactive, soluble in water
30	Acidic Character : $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$

	Thermal stability : $\text{H}_2\text{Te} < \text{H}_2\text{Se} < \text{H}_2\text{S} < \text{H}_2\text{O}$
31	(a) I-Cl bond is more polar than I-I bond . (b) Low bond dissociation enthalpy of X-Y bond. (c) $\text{Cl}_2$ bleach the colour by oxidation while $\text{SO}_2$ by Reduction.
32	(a) Formation of $\text{KI}_3$ complex. (b) HF reacts with silica frequently. (c) HCl can oxidise into $\text{Cl}_2$ .
33	(a) Due to Inert pair effect $\text{BiF}_5$ is not known. (b) Phosphorous is unable to form multiple bonds. (c) Low ionisation enthalpy of Xe and high electronegativity of F.
34	(a) Absence of hydrogen bonding in $\text{PH}_3$ . (b) Due to formation of $\text{NO}_2$ . (c) Fe on reaction with HCl forms $\text{H}_2$ which hinder the formation of $\text{FeCl}_3$ .
35	(a) $\text{XeF}_6$ (b) $3\text{Cl}_2 + \text{Hot and Conc. } 6\text{NaOH} \longrightarrow \text{NaClO}_3 + 5\text{NaCl} + 3\text{H}_2\text{O}$ (c) $\text{NO}_3^- + \text{Fe}^{2+} + 5\text{H}_2\text{O} \longrightarrow [\text{Fe}(\text{H}_2\text{O})_5\text{NO}]^{2+}$
36	(a) No, axial bonds are slightly longer than equatorial bonds. (b) $\text{H}_3\text{PO}_2$ has one P-H bond . (c) 4
37	(a) $\text{P}_4 + 8\text{SOCl}_2 \longrightarrow 4\text{SO}_2 + 4\text{PCl}_3 + 2\text{S}_2\text{Cl}_2$ (b) $4\text{NH}_3 + \text{CuSO}_4(\text{aq}) \longrightarrow [\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ (c) $6\text{XeF}_4 + 12\text{H}_2\text{O} \longrightarrow 2\text{XeO}_3 + 24\text{HF} + 4\text{Xe} + \text{O}_2$
38	(a) $\text{M-I} < \text{M-Br} < \text{M-Cl} < \text{M-F}$ (b) $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$ (c) $\text{I}_2 < \text{F}_2 < \text{Br}_2 < \text{Cl}_2$
39	(a) $\text{S} + \text{O}_2 \longrightarrow \text{SO}_2(\text{g})$ (b) $2\text{SO}_2 + \text{O}_2 \longrightarrow 2\text{SO}_3$ [In presence of $\text{V}_2\text{O}_5$ catalyst] (c) $\text{SO}_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{H}_2\text{S}_2\text{O}_7$ (d) $\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \longrightarrow 2\text{H}_2\text{SO}_4$
40	$\text{N}_2 + 3\text{H}_2 \longrightarrow 2\text{NH}_3(\text{g})$ [ In presence of Fe/Mo] Low temperature ,High Pressure
41	$\text{X} = \text{NH}_3$ $4\text{NH}_3 + \text{CuSO}_4(\text{aq}) \longrightarrow [\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ $3\text{NH}_3 + 3\text{H}_2\text{O} + \text{FeCl}_3 \longrightarrow \text{Fe}(\text{OH})_3 + 3\text{NH}_4\text{Cl}$ Brown ppt
42	$4\text{NH}_3 + 5\text{O}_2 \longrightarrow 4\text{NO} + 6\text{H}_2\text{O}$ $2\text{NO} + \text{O}_2 \longrightarrow 2\text{NO}_2$ $3\text{NO}_2 + \text{H}_2\text{O} \longrightarrow 2\text{HNO}_3 + \text{NO}$

43	<p>(a) <math>6\text{XeF}_4 + 12\text{H}_2\text{O} \longrightarrow 2\text{XeO}_3 + 24\text{HF} + 4\text{Xe} + \text{O}_2</math></p> <p>(b) <math>\text{XeF}_6 + \text{PF}_5 \longrightarrow [\text{XeF}_5]^+[\text{PF}_6]^-</math></p> <p>© <math>\text{Cl}_2 + 3\text{F}_2(\text{excess}) \longrightarrow 2\text{ClF}_3</math></p> <p>(d) <math>3\text{HgCl}_2 + 2\text{PH}_3 \longrightarrow \text{Hg}_3\text{P}_2 + 6\text{HCl}</math></p> <p>(e) <math>\text{SO}_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{H}_2\text{S}_2\text{O}_7</math></p>
44	<p>A=White <math>\text{P}_4</math></p> <p>B= Red <math>\text{P}_4</math></p> <p>C= <math>\text{PH}_3</math></p> <p>D=<math>\text{PCl}_5</math></p> <p>E= <math>\text{H}_3\text{PO}_4</math></p>
45	<p><math>\text{CaF}_2 + \text{Conc. H}_2\text{SO}_4 \longrightarrow \text{CaSO}_4 + 2\text{HF}</math></p> <p><math>2\text{KCl} + \text{Conc. H}_2\text{SO}_4 \longrightarrow 2\text{HCl} + \text{K}_2\text{SO}_4</math></p> <p><math>\text{C}_{12}\text{H}_{22}\text{O}_{11} + \text{Conc. H}_2\text{SO}_4 \longrightarrow 12\text{C} + 11\text{H}_2\text{O}</math></p> <p><math>\text{Cu} + \text{Conc. 2 H}_2\text{SO}_4 \longrightarrow \text{CuSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}</math></p> <p><math>3\text{S} + \text{Conc. 2 H}_2\text{SO}_4 \longrightarrow 3\text{SO}_2 + 2\text{H}_2\text{O}</math></p>