

Short Answer Questions-I

Short Answer Questions-I (PYQ)

Q.1. Complete the following equations:

[CBSE (AI) 2014]

Q. $P_4 + H_2O \rightarrow$

Ans. $P_4 + H_2O \rightarrow$ No reaction

Q. $XeF_4 + O_2F_2 \rightarrow$

Ans. $XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$

Q.2. Complete the following chemical equations:

[CBSE Delhi 2014]

Q. $Ca_3P_2 + H_2O \rightarrow$

Ans. $Ca_3P_2 + 6H_2O \rightarrow 2PH_3 + 3Ca(OH)_2$

Q. $Cu + H_2SO_4$ (conc.) \rightarrow

Ans. $Cu + 2H_2SO_4$ (conc.) $\rightarrow CuSO_4 + SO_2 + 2H_2O$

Q.3. Complete the following equations:

[CBSE (AI) 2014]

Q. $2Ag + PCl_5 \rightarrow$

Ans. $2Ag + PCl_5 \rightarrow 2AgCl + PCl_3$

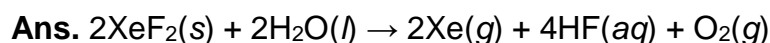
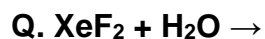
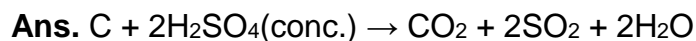
Q. $CaF_2 + H_2SO_4 \rightarrow$

Ans. $CaF_2 + H_2SO_4 \rightarrow 2HF + CaSO_4$

Q.4. Complete the following equations:

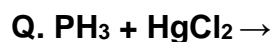
[CBSE (AI) 2014]

Q. $C + \text{conc. } H_2SO_4 \rightarrow$

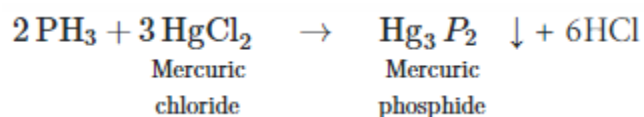


Q.5. Complete the following chemical reaction equations:

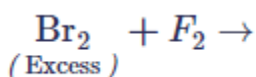
[CBSE (F) 2011]



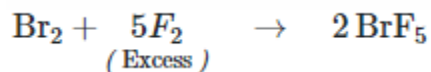
Ans.



Q.

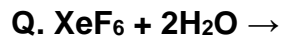


Ans.



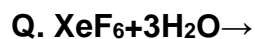
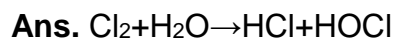
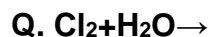
Q.6. Complete the following reactions:

[CBSE Delhi 2017]

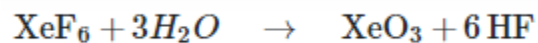


Q.7. Complete the following reactions:

[CBSE Delhi 2017]



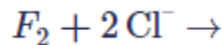
Ans.



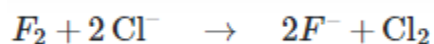
Q.8. Complete the following chemical equations:

[CBSE Delhi 2017]

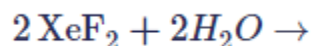
Q.



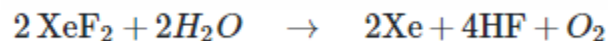
Ans.



Q.



Ans.



Q.9. What happens when

[CBSE Delhi 2017]

Q. $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ is heated

Write the equation.

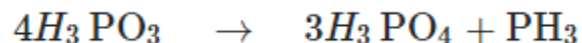
Ans.



Q. H_3PO_3 is heated?

Write the equation.

Ans.



Q.10. SO_3 is passed through water?

Write the equation.

Ans.



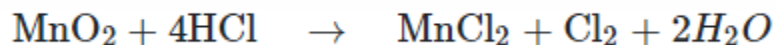
Q.11. What happens when

[CBSE Delhi 2017]

Q. HCl is added to MnO₂?

Write the equation involved.

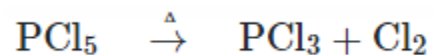
Ans.



Q. PCl₅ is heated?

Write the equation involved.

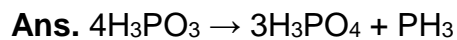
Ans.



Q.12. Write chemical equations for the following processes:

[CBSE Delhi 2010]

Q. Orthophosphorous acid is heated.



Q. PtF₆ and xenon are mixed together.

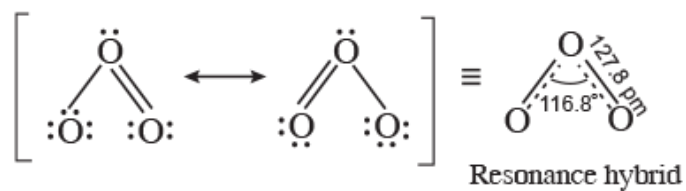


Q.13. Draw the structures of O₃ and S₈ molecules.

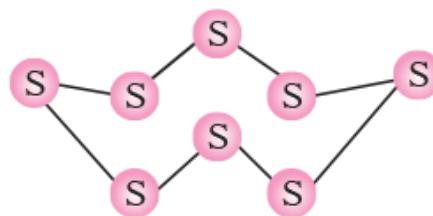
[CBSE (F) 2010]

Ans.

(i) Ozone molecule



(ii) S_8 molecule

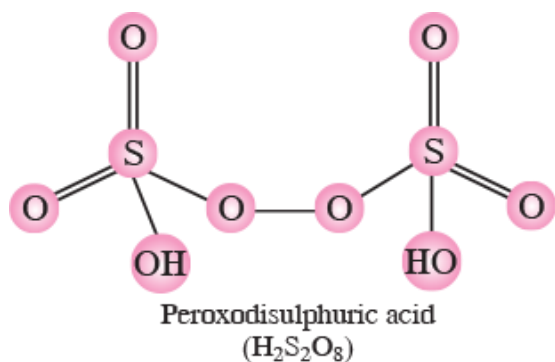


Q.14. Draw the structures of the following:

[CBSE Ajmer 2015]

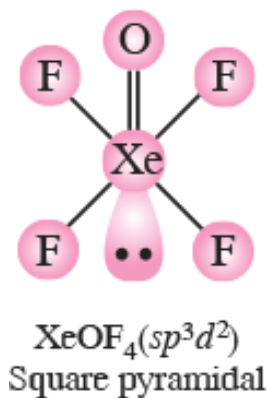
Q. $H_2S_2O_8$

Ans.



Q. $XeOF_4$

Ans.

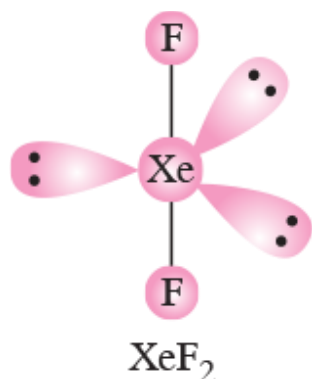


Q.15. Draw the structures of the following:

[CBSE (AI) 2014]

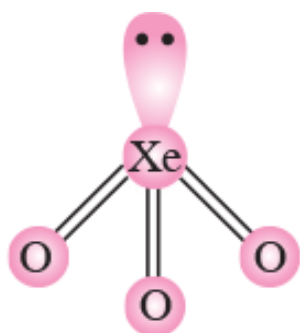
Q. XeF_2

Ans. There are two bond pairs and three lone pairs electrons around central Xe atom in XeF_2 . Therefore, according to VSEPR theory XeF_2 should be linear.



Q. XeO_3

Ans.

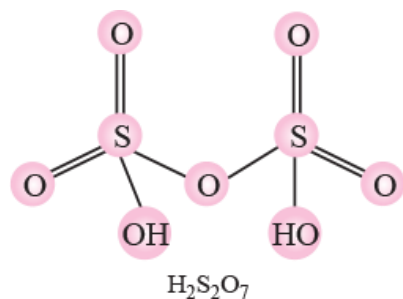


Q.16. Draw the structures of the following:

[CBSE Delhi 2017]

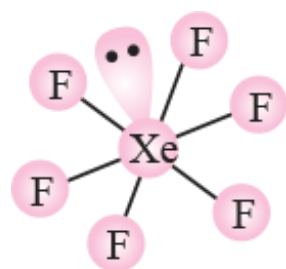
Q. $\text{H}_2\text{S}_2\text{O}_7$

Ans.



Q. XeF_6

Ans.



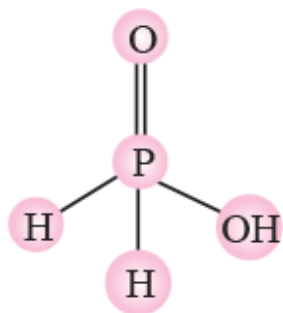
XeF_6
Distorted octahedral

Q. Draw the structures of the following:

[CBSE Delhi 2017]

Q. H_3PO_2

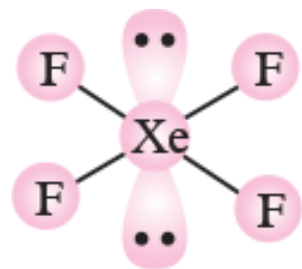
Ans.



Hypophosphorous acid
(H_3PO_2)

Q. XeF_4

Ans.



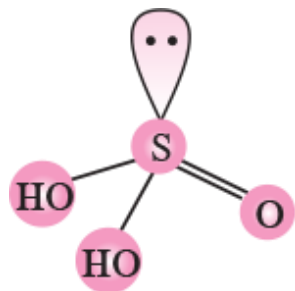
XeF_4
Square planar

Q.18. Draw the structures of the following:

[CBSE (AI) 2017]

Q. H_2SO_3

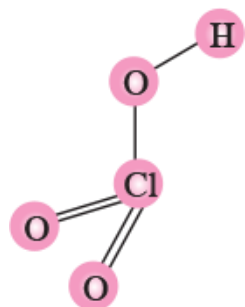
Ans.



Sulphurous acid
(H_2SO_3)

Q. HClO_3

Ans.



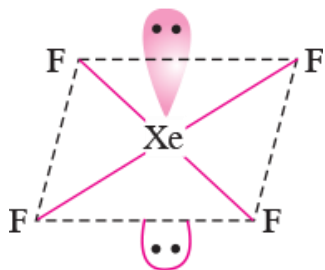
Chloric acid
(HClO_3)

Q. 19. Draw the structures of the following:

[CBSE (AI) 2017]

Q. XeF_4

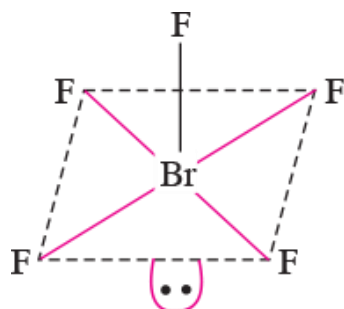
Ans.



XeF_4 : Square planar

Q. BrF₅

Ans.



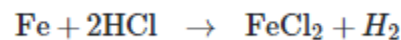
BrF₅: Square pyramidal

Q.20. Account for the following:

[CBSE (AI) 2014]

Q. Iron on reaction with HCl forms FeCl₂ and not FeCl₃.

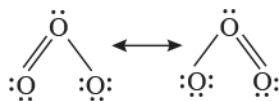
Ans. Iron reacts with HCl to form FeCl₂ and H₂.



H₂ thus produced prevents the oxidation of FeCl₂ to FeCl₃.

Q. The two O—O bond lengths in the ozone molecule are equal.

Ans. Ozone is a resonance hybrid of the following two main structures:



As a result of resonance, the two O—O bond lengths in O₃ are equal.

Q.21. Account for the following:

[CBSE Delhi 2014]

Q. Bi(V) is a stronger oxidising agent than Sb(V).

Ans. Due to inert pair effect +3 oxidation state of Bi is more stable than its +5 oxidation state while +5 oxidation state of Sb is more stable than its +3 oxidation state. Therefore, Bi (V) can accept a pair of electrons to form more stable Bi (III) more easily than Sb (V). Hence, Bi (V) is a stronger oxidising agent than Sb (V).

Q. N—N single bond is weaker than P—P single bond.

Ans. N—N single bond is weaker than P—P single bond due to large interelectronic repulsion between the lone pairs of electrons present on the N atoms of N—N bond having small bond length.

Q.22. Account for the following:

[CBSE South 2016]

Q. Boiling points of interhalogens are little higher as compared to pure halogens.

Ans. This is due to some amount of polarity associated with X—X' bond in interhalogens whereas pure halogens are non-polar.

Q. Out of He and Xe, which one can easily form compound and why?

Ans. Xe, due to much lower ionisation enthalpy of Xe (1170 kJ mol^{-1}) than He (2372 kJ mol^{-1}).

Q.23. State reasons for each of the following:

[CBSE Delhi 2011]

Q.

The N—O bond in NO_2^- is shorter than the N—O bond in NO_3^- .

Ans.

This is because the N—O bond in NO_2^- is an average of a single bond and a double bond whereas the N—O bond in NO_3^- is an average of two single bonds and a double bond.

Q. SF_6 is kinetically an inert substance.

Ans. In SF_6 , S atom is sterically protected by six F atoms and does not allow water molecules to attack the S atom. Further, F does not have d-orbitals to accept the electrons donated by H_2O molecules. Due to these reasons, SF_6 is kinetically an inert substance.

Q.24. How would you account for the following:

[CBSE (AI) 2011]

Q. H_2S is more acidic than H_2O .

Ans. This is because bond dissociation enthalpy of H—S bond is lower than that of H—O bond.

Q. Both O_2 and F_2 stabilise higher oxidation states but the ability of oxygen to stabilise the higher oxidation state exceeds that of fluorine.

Ans. This is due to tendency of oxygen to form multiple bonds with metal atom.

Q.25. Account for the following:

[CBSE (F) 2014]

Q. Sulphur in vapour state exhibits paramagnetism.

Ans. In vapour form sulphur partly exists as S_2 molecules which have two unpaired electrons in the antibonding π^* molecular orbitals like O_2 molecule and hence, exhibits paramagnetism.

Q. H_3PO_2 is a stronger reducing agent than H_3PO_3 .

Ans. Acids which contains P—H bonds have reducing character. Since H_3PO_2 contains two P—H bonds while H_3PO_3 contains only one P—H bond therefore H_3PO_2 is a stronger reducing agent than H_3PO_3 .

Q.26. Account for the following:

[CBSE (F) 2013]

Q. White phosphorus is more reactive than red phosphorus.

Ans. This is due to polymeric structure of red phosphorus or angular strain in P_4 molecule of white phosphorus where the angle is only 60° .

Q. O_3 is a powerful oxidising agent.

Ans. Due to the ease with which it liberates atoms of nascent oxygen, it acts as a powerful oxidising agent. $O_3 \rightarrow O_2 + O$ (nascent oxygen)

Q.27. Give reasons for the following:

[CBSE (AI) 2013]

Q. $R_3P = O$ exists but $R_3N = O$ does not, R is an alkyl group.

Ans. N due to the absence of d -orbitals, cannot form $p\pi - d\pi$ multiple bonds. Thus, N cannot expand its covalency beyond four but in $R_3N=O$, N has a covalency of 5. So, the

compound $R_3N=O$ does not exist. On the other hand, P due to the presence of d -orbitals forms $p\pi - d\pi$ multiple bonds and hence can expand its covalency beyond 4. Therefore, P forms R_3PO in which the covalency of P is 5.

Q. $PbCl_4$ is more covalent than $PbCl_2$.

Ans. Because Pb is in +4 oxidation state in $PbCl_4$ and has high charge/size ratio than Pb^{2+} , thus polarising power of Pb^{4+} is greater than Pb^{2+} , and hence it is more covalent.

Q.28. Account for the following:

[CBSE Delhi 2009]

Q. NH_3 is a stronger base than PH_3 .

Ans. NH_3 is a stronger base than PH_3 . This is because the lone pair of electrons on N atom in NH_3 is directed and not diffused as it is in PH_3 due to larger size of phosphorus and hence more available for donation.

Q. Sulphur has a greater tendency for catenation than oxygen.

Ans. Sulphur has a greater tendency for catenation than oxygen because S—S bond is stronger than O—O bond due to less inter-electronic repulsions.

Q. 29. Name the two most important allotropes of sulphur. Which one of the two is stable at room temperature? What happens when the stable form is heated above 370 K?

[CBSE (F) 2014]

Ans. Two most important allotropes of sulphur are rhombic sulphur and monoclinic sulphur. The stable form at room temperature is rhombic sulphur. When rhombic sulphur is heated above 370 K, it gets converted into monoclinic sulphur.

Short Answer Questions-I (OIQ)

Q.1. What happens when:

Q. XeF_6 is partially hydrolysed?

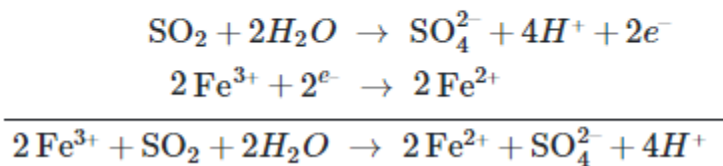
Ans. $XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$

$XeF_6 + 2H_2O \rightarrow XeO_2F_2 + 4HF$

Q. Sulphur dioxide is passed into aqueous solution of Fe (III) salt?

Ans.

SO₂ acts as a reducing agent and hence reduces an aqueous solution of Fe (III) salt to Fe (II) salt.



Q.2. Complete the following chemical reaction equations:

Q. P₄(s) + NaOH(aq) + H₂O(l) →

Ans.



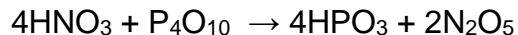
Q. I⁻ (aq) + H₂O(l) + O₃(g) →

Ans. 2I⁻ (aq) + H₂O(l) + O₃(g) → 2OH⁻ (aq) + I₂(s) + O₂(g)

Q.3. Nitric acid forms an oxide of nitrogen on reaction with P₄O₁₀. Write the reaction involved. Also write the resonating structures of the oxide of nitrogen formed.

[NCERT Exemplar]

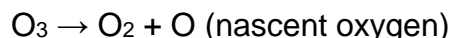
Ans.



Q.4. Account for the following:

Q. Ozone acts as a powerful oxidising agent.

Ans. Due to the ease with which it liberates atoms of nascent oxygen, it acts as a powerful oxidising agent.



Q. Noble gases have comparatively large atomic sizes.

Ans. Noble gases have only Van der Waals' radii while others have covalent radii. As van der Waals' radii are larger than covalent radii, hence, noble gases have comparatively large atomic sizes.

Q.5. Account for the following observations:

Q. Among the halogens, F_2 is the strongest oxidising agent.

Ans. This is due to the

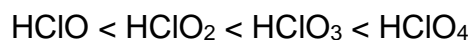
- low enthalpy of dissociation of $\text{F}-\text{F}$ bond.
- high hydration enthalpy of F^- .

Q. Acidity of oxo-acids of chlorine is $\text{HOCl} < \text{HOClO} < \text{HOClO}_2 < \text{HOClO}_3$.

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



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



Q.6. Give reasons for the following:

Q. CN^- ion is known but CP^- ion is not known.

Ans. Nitrogen being smaller in size forms $p\pi-p\pi$ multiple bonding with carbon, so CN^- ion is known, but phosphorus does not form $p\pi-p\pi$ bond as it is larger in size.

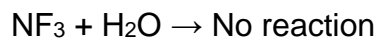
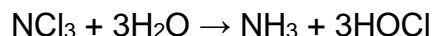
Q. NO_2 dimerises to form N_2O_4 .

Ans. This is because NO_2 is an odd electron molecule and therefore gets dimerised to stable N_2O_4 .

Q.7. Give reasons for the following:

Q. NCl_3 gets readily hydrolysed while NF_3 does not.

Ans. In NCl_3 , Cl has vacant d -orbitals to accept the lone pair of electrons donated by O-atom of H_2O molecule but in NF_3 , F does not have d -orbitals.



Q. Elemental nitrogen exists as a diatomic molecule whereas elemental phosphorus is a tetraatomic molecule.

Ans. Nitrogen because of its small size and high electronegativity forms $p\pi-p\pi$ multiple bonds. Thus, it exists as a diatomic molecule having a triple bond between the two N-atoms. Phosphorus due to its larger size and lower electronegativity usually does not form $p\pi-p\pi$ multiple bonds with itself. Instead it prefers to form P–P single bonds and hence it exists as tetrahedral P_4 molecules.

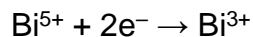
Q.8. Account for the following:

Q. PF_5 is known but NF_5 is not known.

Ans. P has vacant $3d$ -orbitals in its valence shell while N does not have. As a result, P can form additional bonds to give PF_5 while N cannot extend its covalency beyond three and hence it forms only NF_3 but not NF_5 .

Q. Bismuth is a strong oxidising agent in the pentavalent state.

Ans. As the inert pair effect is very prominent in Bi, its +5 oxidation state is less stable than its +3 oxidation state. In other words, bismuth in the pentavalent state can easily accept two electrons and thus gets reduced to trivalent bismuth.



Thus, it acts as a strong oxidising agent.

Q.9. Give reasons for the following:

Q. Oxygen generally exhibits an oxidation state of –2 only whereas other members of its family show oxidation states of +2, +4 and +6 as well.

Ans. The electronic configuration of oxygen is $1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$ i.e., it has two half-filled orbitals and there is no d -orbital available for excitation of electrons. Further, it is the most electronegative element of its family. Hence, it shows oxidation state of –2

only. Other elements like sulphur have d-orbitals available for excitation, thereby giving four and six half-filled orbitals. Moreover, they can combine with more electronegative elements. Hence, they show oxidation states of +2, +4 and +6 also.

Q. Among the hydrides of Group 16, water shows unusual physical properties.

Ans. Because of high electronegativity of O, the O—H in H₂O forms strong intermolecular H-bonds. Thus, water exists as an associated molecule while other hydrides of Group 16 do not form H-bonds and hence exist as discrete molecules. Hence, water shows unusual physical properties, *i.e.*, high boiling point, high thermal stability and weaker acidic character as compared to other hydrides of Group 16.

Q.10. Account for the following:

Q. Compounds of fluorine with oxygen are called fluorides of oxygen and not the oxides of fluorine.

Ans. This is because fluorine is more electronegative than oxygen.

Q. Sulphur disappears when boiled with sodium sulphite.

Ans. When sodium sulphite is heated with sulphur, we get sodium thiosulphate which is soluble in water that is why sulphur disappears.



Q.11. Assign a reason for each of the following:

[NCERT Exemplar]

Q. SCl₆ is not known but SF₆ is known.

Ans. Due to small size of fluorine, six F[−] ions can be accommodated around sulphur whereas chloride ion is comparatively larger in size, therefore, there will be interionic repulsion.

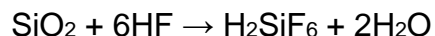
Q. Sulphur hexafluoride is used as a gaseous electrical insulator.

Ans. SF₆ is a colourless, odourless and non-toxic gas at room temperature. It is thermally stable and chemically inert. Because of its inertness and high tendency to suppress internal discharges, it is used as a gaseous electrical insulator in high voltage generators and switch gears.

Q.12. Answer the following question:

Q. Why is HF acid stored in wax coated glass bottles?

Ans. HF does not attack wax but reacts with glass. It dissolves SiO_2 present in glass forming hydrofluorosilicic acid.



Q. ClF_3 exists but FCl_3 does not. Explain.

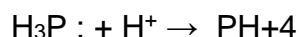
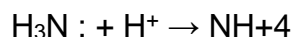
Ans.

- Cl has vacant d-orbitals and hence can show an oxidation state of +3 but F has no d-orbitals, so, it cannot show positive oxidation states. Since F can show only -1 oxidation state, FCl_3 does not exist.
- Because of bigger size, Cl can accommodate three small F atoms around it while F being smaller cannot accommodate three large sized Cl atoms around it.

Q.13. Give reasons:

Q. NH_3 has a higher proton affinity than PH_3 .

Ans. When NH_3 or PH_3 accepts a proton, an additional N—H or P—H bond is formed.



Due to the bigger size of P than N, P—H bond thus formed is much weaker than the N—H bond. Thus, NH_3 has higher proton affinity than PH_3 .

Q. NO (Nitric oxide) is paramagnetic in the gaseous state but diamagnetic in the liquid and solid states.

Ans. NO has an odd number of electrons (11 valence electrons) and hence is paramagnetic in the gaseous state. But in liquid and solid states, it exists as a symmetrical or asymmetrical dimer and hence is diamagnetic in these states.

Q.14. Name three oxoacids of nitrogen. Write the disproportionation reaction of that oxoacid of nitrogen in which nitrogen is in + 3 oxidation state.

[NCERT Exemplar]

Ans.

- i. Nitrous acid, HNO_2
- ii. Nitric acid, HNO_3
- iii. Hyponitrous acid, $\text{H}_2\text{N}_2\text{O}_2$

In HNO_2 , nitrogen is in +3 oxidation state.

