CBSE Class 12 physics

Important Questions

Chapter 7

The p-Block Elements

2 Marks Questions

1. Complete and Balance-

a) $P_4 + 8SOCl_2 \rightarrow$

b) $3CH_3COOH + PCl_3 \rightarrow$

c) $P_4 + 10SO_2Cl_2 \rightarrow$

d) $POCl_3 + 3H_2O \rightarrow$

e) $Sn + PCl_5 \rightarrow$

f) $4AgNO_3 + 2H_2O + H_3PO_2 \rightarrow$

Ans. Complete and Balance-

a) $P_4 + 8SOCl_2 \rightarrow 4PCl_3 + 4SO_2 + 2S_2Cl_2$

b) $3CH_3COOH + PCl_3 \rightarrow 3CH_3COCl + H_3PO_3$

c) $P_4 + 10SO_2Cl_2 \rightarrow 4PCl_5 + 10SO_2$

d) $POCl_3 + 3H_2O \rightarrow H_3PO_4 + 3HCl$

e) $Sn + PCl_5 \rightarrow SnCl_4 + 2\ PCl_3$

f) $4AgNO_3 + 2H_2O + H_3PO_2 \rightarrow 4Ag + 4HNO_3 + H_3PO_4$

2. All five bonds in PCl_5 are not equal. Give an equation in support of this statement.

Ans. When heated, PCl_5 loses a chlorine molecule this shows that two P- CL bonds are weaker and hence longer than others.

$$PCl_5 \xrightarrow{Heat} PCl_3 + Cl_2$$

3. Draw the structure of following :-

(i) N_2O

(ii) N_2O_4

(iii) HNO_3

(iv) PCl_5

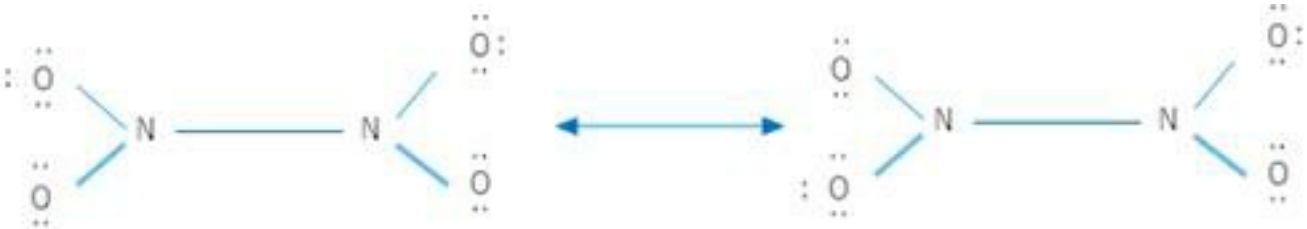
(v) $(HPO_3)_3$

(vi) H_3PO_2

(vii) H_3PO_3

Ans. (i)

(ii)



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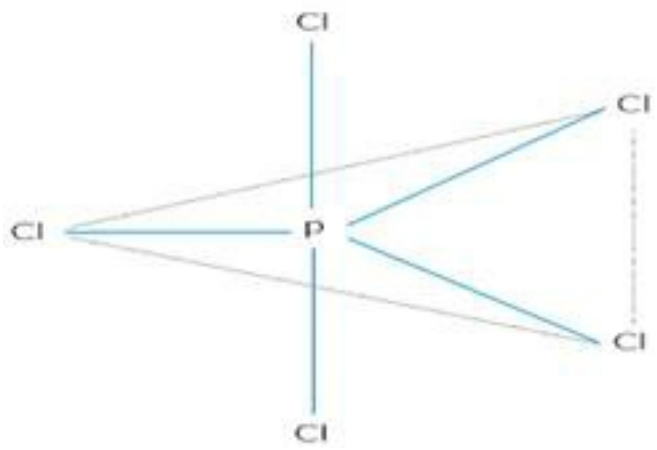

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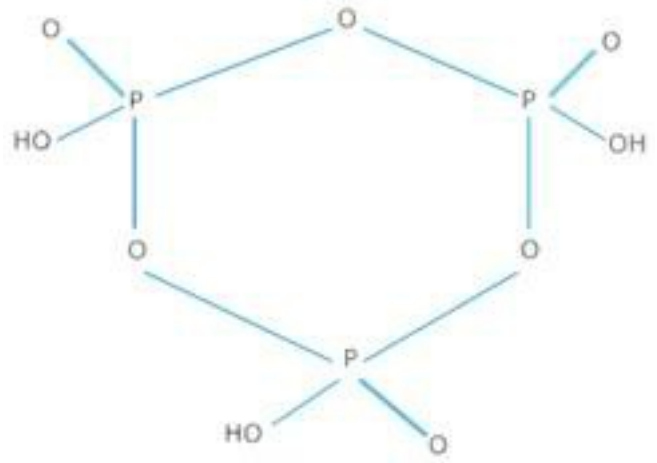

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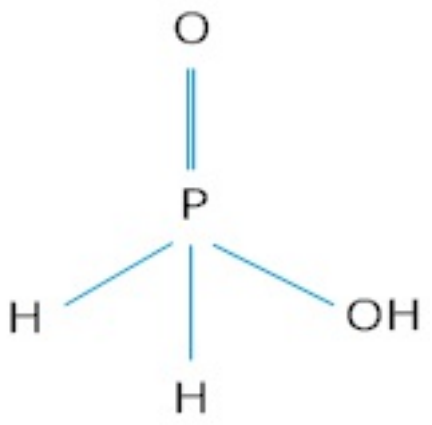

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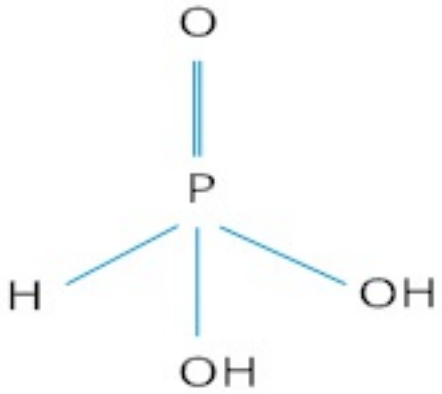


4. Write two uses of dinitrogen.

Ans. Dinitrogen is used

(a) In the manufacture of ammonia.

(b) As a refrigerant to preserve biological material, food items.

(c) In cryosurgery.

5. Explain the chemistry behind brown ring test for detection of nitrate ions.

Ans. The brown ring test for nitrate ions depends on the ability of Fe^{2+} to reduce nitrates to nitric oxide, which reacts with Fe^{2+} to form a brown coloured complex.

$$NO_3^- + 3Fe^{2+} + 4H^+ \rightarrow NO + 3Fe^{3+} + 2H_2O$$

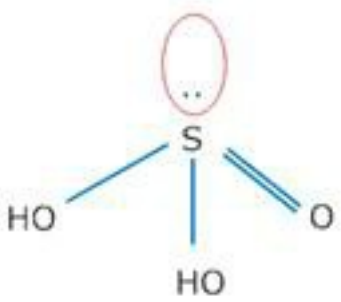
$$\left[Fe(H_2O)_6\right]^{2+} + NO \rightarrow \left[Fe(H_2O)_5 NO\right]^{2+} + H_2O$$

6. Give the structures of

(i) sulphurous acid and

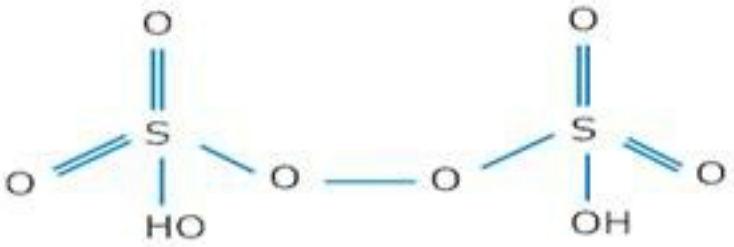
(ii) Peroxodisulphurous acid?

Ans. (i) Sulphurous acid



H_2SO_3

(ii) Peroxodisulphuric acid



H_2SO_8

7. Write the various steps for preparation of sulphuric acid by contact process?

Ans. Contact process for sulphuric acid:-

Step 1: Burning of sulphur in air to give SO_2 .

$S + O_2 SO_2$

Step 2: Conversion of SO_2 *to* SO_3 by reacting it with oxygen in presence of V_2O_5 .

$2SO_2 + O_2 \xrightarrow{V_2O_5} 2SO_3$

Step 3: Absorption of SO_3 in H_2SO_4 to give of oleum $(H_2S_2O_7)$

$$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7\,(oleum)$$

Step 4: Dilution of oleum with water to get H_2SO_4 of desired concentration

$$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$$

8. Name different sulphates formed by sulphuric acid?

Ans. The two type of sulphates are –

(i) Normal sulphate eg. Na_2SO_4, $CuSO_4$

(ii) acid sulphate eg. $NaHSO_4$.

9. Why are pentahalides more covalent than trihalides?

Ans. In pentahalides, the oxidation state is +5 and in trihalides, the oxidation state is +3. Since the metal ion with a high charge has more polarizing power, pentahalides are more covalent than trihalides.

10. Why is BiH_3 the strongest reducing agent amongst all the hydrides of Group 15 elements?

Ans. As we move down a group, the atomic size increases and the stability of the hydrides of group 15 elements decreases. Since the stability of hydrides decreases on moving from NH_3 to BiH_3, the reducing character of the hydrides increases on moving from NH_3 to BiH_3.

11. Why is N_2 less reactive at room temperature?

Ans. The two N atoms in N_2 are bonded to each other by very strong triple covalent bonds. The bond dissociation energy of this bond is very high. As a result, N_2 is less reactive at room temperature.

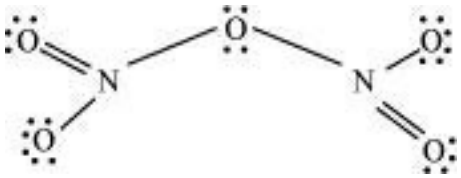
12. How does ammonia react with a solution of Cu^{2+}?

Ans. NH_3 acts as a Lewis base. It donates its electron pair and forms a linkage with metal ion.

$$\underset{\text{Blue}}{Cu^{2+}_{(aq)}} + 4NH_{3(aq)} \leftrightarrow \underset{\text{Deep Blue}}{\left[Cu(NH_3)_4\right]^{2+}_{(aq)}}$$

13. What is the covalence of nitrogen in N_2O_5 ?

Ans.



From the structure of N_2O_5, it is evident that the covalence of nitrogen is 4.

14. What happens when white phosphorus is heated with concentrated NaOH solution in an inert atmosphere of CO_2 ?

Ans. White phosphorous dissolves in boiling NaOH solution (in a CO_2 atmosphere) to give phosphine, PH_3.

$$PH_3.P_4 + 3NaOH + 3H_2O \rightarrow \underset{\text{Phosphine}}{PH_3} + \underset{\text{Sodium hypophosphite}}{3NaH_2PO_2}$$

15. Write a balanced equation for the hydrolytic reaction of PCl_5 in heavy water.

Ans. All the bonds that are present in PCl_5 are not similar. It has three equatorial and two axial bonds. The equatorial bonds are stronger are stronger than the axial ones. Therefore, when PCl_5 is heated strongly, it decomposes to form PCl_3.

16. What happens when PCl_5 is heated ?

Ans. $PCl_5 + D_2O \rightarrow POCl_3 + 2DCl_2$

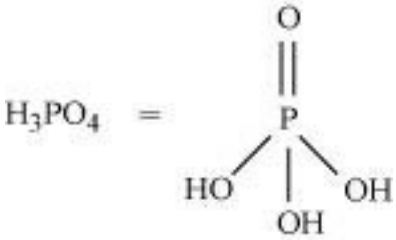
$POCl_3 + 3D_2O \rightarrow D_3PO_4 + 3DCl$

Therefore, the net reaction can be written as

$PCl_5 + 4D_2O \rightarrow D_3PO_4 + 5DCl$

17. What is the basicity of H_3PO_4?

Ans. H_3PO_4



Since there are three OH groups present in H_3PO_4, its basicity is three i.e., it is a tribasic acid.

Concept Insight: Basicity is the Number of hydrogen that are replacable.

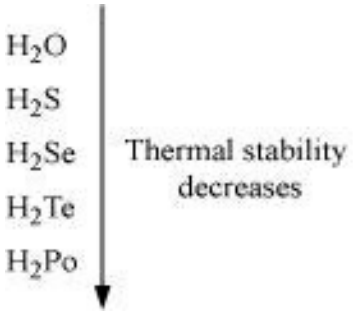
18. List the important sources of sulphur.

Ans. Sulphur mainly exists in combined form in the earth's crust primarily as sulphates [gypsum ($CaSO_4.2H_2O$), Epsom salt $(MgSO_4.7H_2O)$, baryte $(BaSO_4)$] and sulphides [(galena (PbS), zinc blends (ZnS), copper pyrites $(CuFeS_2)$].

19. Write the order of thermal stability of the hydrides of Group 16 elements.

Ans. The thermal stability of hydrides decreases on moving down the group. This is due to a decrease in the bond dissociation enthalpy (H-E) of hydrides on moving down the group.

Therefore,



20. Why is H_2O a liquid and H_2S a gas?

Ans. H_2O has oxygen as the central atom. Oxygen has smaller size and higher

electronegativity as compared to sulphur. Therefore, there is extensive hydrogen bonding in H_2O, which is absent in H_2S. Molecules of H_2S are held together only by weak van der Waal's forces of attraction.

Hence, H_2O exists as a liquid while H_2S as a gas.

21. Complete the following reactions:

(i) $C_2H_4 + O_2 \rightarrow$

(ii) $4Al + 3O_2 \rightarrow$

Ans. (i) $\underset{\text{Ethane}}{C_2H_4} + \underset{\text{Oxygen}}{3O_2} \rightarrow \underset{\text{Carbondioxide}}{2CO_2} + \underset{\text{Water}}{2H_2O}$

(ii) $\underset{\text{Aluminium}}{4Al} + \underset{\text{Oxygen}}{3O_2} \rightarrow \underset{\text{Alumina}}{2Al_2O_3}$

$\underset{\text{Ozone}}{O_3} \xrightarrow{\Delta} \underset{\text{Oxygen}}{O_2} + \underset{\text{Nascent oxygen}}{[O]}$

Therefore, ozone acts as a powerful oxidising agent.

22. Why does O_3 act as a powerful oxidizing agent?

Ans. Ozone is not a very stable compound under normal conditions and decomposes readily on heating to give a molecule of oxygen and nascent oxygen. Nascent oxygen, being a free readical, is very reactive.

$\underset{\text{Ozone}}{O_3} \xrightarrow{\Delta} \underset{\text{Oxygen}}{O_2} + \underset{\text{Nascent oxygen}}{[O]}$

Therefore, ozone acts as a powerful oxidizing agent.

23. What happens when sulphur dioxide is passed through an aqueous solution of Fe(III) salt?

Ans. SO_2 acts as a reducing agent when passed through an aqueous solution containing Fe(III) salt. It reduces Fe(III) to Fe(II) i.e., ferric ions to ferrous ions.

$$2Fe^{2+} + SO_2 + 2H_2O \rightarrow 2Fe^{2+} + SO_4^{2-} + 4H^+$$

24. Give two examples to show the anomalous behaviour of fluorine.

Ans. **Anomalous behaviour of fluorine**

(i) It forms only one oxoacid as compared to other halogens that form a number of oxoacids.

(ii) Ionisation enthalpy, electronegativity, and electrode potential of fluorine are much higher than expected.

25. Sea is the greatest source of some halogens. Comment.

Ans. Sea water contains chlorides, bromides, and iodides of Na, K, Mg, and Ca. However, it primarily contains NaCl. The deposits of dried up sea beds contain sodium chloride and carnallite, $KCl.MgCl_2.6H_2O$. Marine life also contains iodine in their systems. For example, sea weeds contain upto 0.5% iodine as sodium iodide. Thus, sea is the greatest source of halogens.

26. Give the reason for bleaching action of C_{12}.

Ans. When chlorine reacts with water, it produces nascent oxygen. This nascent oxygen then combines with the coloured substances present in the organic matter to oxide them into colourless substances.

$$Cl_2 + H_2O \rightarrow 2HCl + [O]$$

Coloured substances + [O] $\rightarrow$ ' Oxidized colourless substance

27. Name two poisonous gases which can be prepared from chlorine gas.

Ans. Two poisonous gases that can be prepared from chlorine gas are

(i) Phosgene $(COCl_2)$

(ii) Mustard gas $(ClCH_2CH_2SCH_2CH_2Cl)$

28. Why has it been difficult to study the chemistry of radon?

Ans. It is difficult to study the chemistry of radon because it is a radioactive substance

having a half-life of only 3.82 days. Also, compounds of radon such as RnF_2 have not been isolated. They have only been identified.

29. Why is helium used in diving apparatus?

Ans. Air contains a large amount of nitrogen and the solubility of gases in liquids increases with increase in pressure. When sea divers dive deep into the sea, large amount of nitrogen dissolves in their blood. When they come back to the surface, solubility of nitrogen decreases and it separates from the blood and forms small air bubbles. This leads to a dangerous medical condition called bends. Therefore, air in oxygen cylinders used for diving is diluted with helium gas. This is done as He is sparingly less soluble in blood.

30. Why does the reactivity of nitrogen differ from phosphorus?

Ans. Nitrogen is chemically less reactive. This is because of the high stability of its molecule, N_2. In, N_2 the two nitrogen atoms form a triple bond. This triple bond has very high bond strength, which is very difficult to break. It is because of nitrogen's small size that it is able to form $p\pi - p\pi$ bonds with itself. This property is not exhibited by atoms such as phosphorus. Thus, phosphorus is more reactive than nitrogen.

31. Why does NX_3 form hydrogen bond but PH_3 does not?

Ans. Nitrogen is highly electronegative as compared to phosphorus. This causes a greater attraction of electrons towards nitrogen in NX_3 than towards phosphorus in PH_3. Hence, the extent of hydrogen bonding in PH_3 is very less as compared to NX_3.

32. How is nitrogen prepared in the laboratory? Write the chemical equations of the reactions involved.

Ans. An aqueous solution of ammonium chloride is treated with sodium nitrite.

$$NH_4Cl_{(aq)} + NaNO_{2(aq)} \rightarrow N_{2(g)} + 2H_2O_{(l)} + NaCl_{(aq)}$$

NO and HNO3are produced in small amounts. These are impurities that can be removed on passing nitrogen gas through aqueous sulphuric acid, containing potassium dichromate.

33. Why does nitrogen show catenation properties less than phosphorus?

Ans. Catenation is much more common in phosphorous compounds than in nitrogen compounds. This is because of the relative weakness of the N-N single bond as compared to the P-P single bond. Since nitrogen atom is smaller, there is greater repulsion of electron density of two nitrogen atoms, thereby weakening the N-N single bond.

34. Give the disproportionation reaction of H_3PO_3.

Ans. On heating, orthophosphorus acid (H_3PO_3) disproportionates to give orthophosphoric acid (H_3PO_3) and phosphine (PH_3). The oxidation states of P in various species involved in the reaction are mentioned below.

$$4\overset{+3}{H_3P}O_3 \rightarrow 3\overset{+5}{H_3P}O_4 + \overset{-3}{P}H_3$$

35. Which aerosols deplete ozone?

Ans. Freons or chlorofluorocarbons (CFCs) are aerosols that accelerate the depletion of ozone. In the presence of ultraviolet radiations, molecules of CFCs break down to form chlorine-free radicals that combine with ozone to form oxygen.

36. Explain why inspite of nearly the same electronegativity, oxygen forms hydrogen bonding while chlorine does not.

Ans. Both chlorine and oxygen have almost the same electronegativity values, but chlorine rarely forms hydrogen bonding. This is because in comparison to chlorine, oxygen has a smaller size and as a result, a higher electron density per unit volume.

37. Write two uses of ClO_2.

Ans. Uses of ClO_2:

(i) It is used for purifying water.

(ii) It is used as a bleaching agent.

38. Why are halogens coloured?

Ans. Almost all halogens are coloured. This is because halogens absorb radiations in the

visible region. This results in the excitation of valence electrons to a higher energy region. Since the amount of energy required for excitation differs for each halogen, each halogen displays a different colour.

39. Write the reactions of F_2 and Cl_2 with water.

Ans.(i) $Cl_2 + H_2O \rightarrow \underset{\text{Hydrochloric acid}}{HCl} + \underset{\text{Hypochlorous acid}}{HOCl}$

(ii) $2F_{2(g)} + 2H_2O_{(l)} \rightarrow 4H^+_{(aq)} + 4F^-_{(aq)} + O_2 + 4HF_{(aq)}$

40. How can you prepare Cl_2 from HCl and HCl from Cl_2? Write reactions only.

Ans.(i) Cl_2 can be prepared from HCl by Deacon's process.

$$4HCl + O_2 \xrightarrow{CuCl_2} 2Cl_2 + 2H_2O$$

(ii) HCl can be prepared from Cl2on treating it with water.

$$Cl_2 + H_2O \rightarrow \underset{\text{Hydrochloric acid}}{HCl} + \underset{\text{Hypochlorous acid}}{HOCl}$$

41. What inspired N. Bartlett for carrying out reaction between Xe and PtF_6?

Ans. Neil Bartlett initially carried out a reaction between oxygen and PtF_6. This resulted in the formation of a red compound, $O_2^+[PtF_6]^-$.

Later, he realized that the first ionization energy of oxygen (1175 kJ/mol) and Xe (1170 kJ/mol) is almost the same. Thus, he tried to prepare a compound with Xe and PtF_6. He was successful and a red-coloured compound, $Xe^+[PtF_6]^-$ was formed.

42. Write balanced equations for the following:

(i) NaCl is heated with sulphuric acid in the presence of MnO_2.

(ii) Chlorine gas is passed into a solution of NaI in water.

Ans. (i) $4NaCl + MnO_2 + 4H_2SO_4 \rightarrow MnCl_2 + 4NaHSO_4 + 2H_2O + Cl_2$

(ii) $Cl_2 + NaI \rightarrow 2NaCl + I_2$

43. With what neutral molecule is ClO^- isoelectronic? Is that molecule a Lewis base?

Ans. ClO^- is isoelectronic to ClF. Also, both species contain 26 electrons in all as shown.

Total electrons ClO^- = 17 + 8 + 1 = 26

In ClF = 17 + 9 = 26

ClF acts like a Lewis base as it accepts electrons from F to form ClF_3.

44. How are XeO_3 and $XeOF_4$ prepared?

Ans. (i) XeO_3 can be prepared in two ways as shown.

$$6XeF_4 + 12H_2O \rightarrow 4Xe + 2XeO_3 + 24HF + 3O_2$$

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

(ii) $XeOF_4$ can be prepared using XeF_6.

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

45. Why do noble gases have comparatively large atomic sizes?

Ans. Noble gases do not form molecules. In case of noble gases, the atomic radii corresponds to van der Waal's radii. On the other hand, the atomic radii of other elements correspond to their covalent radii. By definition, van der Waal's radii are larger than covalent radii. It is for this reason that noble gases are very large in size as compared to other atoms belonging to the same period.