Chemistry Study Materials for Class 12

(NCERT Intext and Exercise Questions –Answers)

Ganesh Kumar Date:- 03/08/2021

The p-Block Elements

Question 19: Knowing the electron gain enthalpy values for $O \rightarrow O^-$ and $O \rightarrow O^{2-}$ as —141 and 702 kJ mol^{-1} respectively, how can you account for the formation of a large number of oxides having species and not O^-?(Hint: Consider lattice energy factor in the formation of compounds).

Solution 19: Stability of an ionic compound depends on its lattice energy. More the lattice energy of a compound, more stable it will be. Lattice energy is directly proportional to the charge carried by an ion. When a metal combines with oxygen, the lattice energy of the oxide involving O^{2-} ion is much more than the oxide involving O^{2-} ion. Hence, the oxide having O^{2-} ions are more stable than oxides having O^{2-}. Hence, we can say that formation of O^{2-} is energetically more favourable than formation of O^{2-}

Question 20: Which aerosols deplete ozone?

Solution 20: Freon's 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.

Question 22: How is SO_2 an air pollutant?

Solution 22: Sulphur dioxide causes harm to the environment in many ways:

1. It combines with water vapour present in the atmosphere to form sulphuric acid. This causes acid rain. Acid rain damages soil, plants, and buildings, especially those made of marble.
2. Even in very low concentrations, SO_2 causes irritation in the respiratory tract. It causes throat and eye irritation and can also affect the larynx to cause breathlessness.
3. It is extremely harmful to plants. Plants exposed to sulphur dioxide for a long time lose colour from their leaves. This condition is known as chlorosis. This happens because the formation of chlorophyll is affected by the presence of sulphur dioxide.

Question 23: Why are halogens strong oxidising agents?

Solution 23: The general electronic configuration of halogens is np^5, where n = 2-6. Thus, halogens need only one more electron to complete their octet and to attain the stable noble gas configuration. Also, halogens are highly electronegative with low dissociation energies and high negative electron gain enthalpies. Therefore, they have a high tendency to gain an electron. Hence, they act as strong oxidizing agents.

Question 24: Explain why fluorine forms only one oxoacid, HOF

Solution 24: Fluorine forms only one oxoacid i.e., HOF because of its high electronegativity, small size and non availability of d orbitals.

Question 25: Explain why inspite of nearly the same electronegativity, oxygen forms hydrogen bonding while chlorine does not.

Solution 25: 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.

Question 26: **Write two uses of ClO_2**

Solution 26: Uses of ClO_2 **(i)** It is used for purifying water. (ii) It is used as a bleaching agent**.**

Question 27: Why are halogens coloured?

Solution 27: 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. F2- yellow Cl2- greenish yellow, Br2- red, I2- violet

Question 28: Write the reactions of F_2 and Cl_2 with water.

Solution 28: **(i)** $Cl_2 + H_2O \longrightarrow$ **HCl + HOCl**

Hydrochloric acid *Hypochlorous acid*

(ii) $2F_{2(g)} + 2H_2O \longrightarrow O_{2(g)} + 4HF(aq)$

Question 29: **How can you prepare Cl_2 from HCl and HCl from Cl_2 ? Write reasons only**

Solution 29**:** *(i)* Cl_2 can be prepared from HCl by Deacon's process.

$$4HCl + O_2 \longrightarrow CaCl_2 + 2Cl_2 + 2H_2O$$

(ii) HCl can be prepared from Cl_2 on treating it with water.

$$Cl_2 + H_2O \longrightarrow HCl + HOCl$$

Hydrochloric acid *Hypochlorous acid*

Question 31: What are the oxidation states of phosphorus in the following:

(i) H_2PO_3 (ii) PCl_3 (iii) Ca_3P_2 (iv) Na_3PO_4 (v) POF_3 ?

Solution 31: Let the oxidation state of p of x.

(i) H_3PO_3

$3 + x + 3(-2) = 0$

$3 + x - 6 = 0$

$x = +3$

(ii) PCl_3

$x + 3(-1) = 0$

$x - 3 = 0$

$x = +3$

(iii) Ca_3P_2

$3(+2) + 2(x) = 0$

$6 + 2x = 0$

$2x = 6 \quad x = -3$

(iv) Na_3PO_4

$3(+1) + x + 4(-2) = 0$

$3 + x - 8 = 0$

$x - 5 = 0$

$x = +5$

(v) POF_3

$x + (-2) + 3(-1) = 0$

$x - 5 = 0$

$x = +5$

Question 32: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.

Solution 32: *(i)* $4NaCl + MnO_2 + 4H_2SO_4 \longrightarrow MnCl_2 + 4NaHSO_4 + 2H_2O + Cl_2$

(ii) $Cl_2 + NaI \longrightarrow 2NaCI + I_2$

Question 35: How are XeO_3 and $XeOF_4$ prepared?

Solution 35: (i) XeO_3 can be prepared in two ways as shown.

$$6XeF_4 + 12H_2O \longrightarrow 4XeO_3 + 24HF + 1O_2$$

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

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

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

Question 36: Arrange the following in the order of property indicated for each set:

(i) F_2, Cl_2, Br_2, I_2 increasing bond dissociation enthalpy.

(ii) HF, HCl, HBr, HI increasing acid strength.

(iii) $NH_3, PH_3, AsH_3, SbH_3, BiH_3$ increasing base strength

Solution 36: (i) Bond dissociation energy usually decreases on moving down a group as the atomic size increases. However, the bond dissociation energy of F_2 is lower than that of Br_2 and Cl_2. This is due to is due to the small atomic size of fluorine. Thus, the increasing order for bond dissociation energy among halogens is as $F_2 < Cl_2 < Br_2 < I_2$

(ii) The bond dissociation energy of H-X molecules where X = F, Cl, Br, I, decreases with an increase in the atomic size. Since H-I bond is the weakest, HI is the strongest acid.

(iii) On moving from nitrogen to bismuth, the size of the atom increases while the electron density on the atom decreases. Thus, the basic strength decreases.

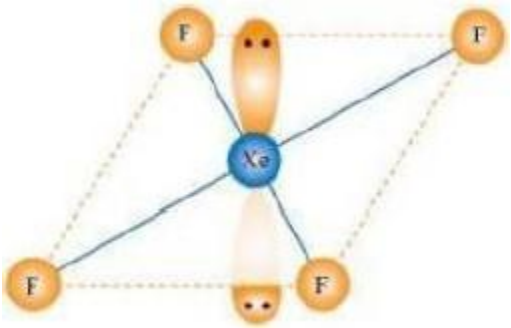
$$BiH_3 < SbH_3 < AsH_3 < PH_3 < NH_3$$

Question 37: Which one of the following does not exist? (i) XeF_4 (ii) NeF_4 (iii) XeF_2 (iv) XeF_6

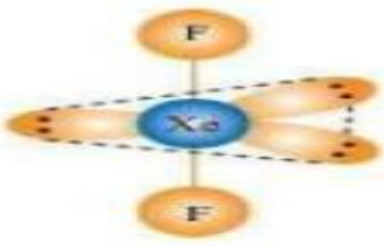
Solution 37: NeF_2 **does not exist.**

Question 38 : Describe the structure of a noble gas species (i) XeF_4 **(ii)** XeF_2 **(iii)** XeO_3

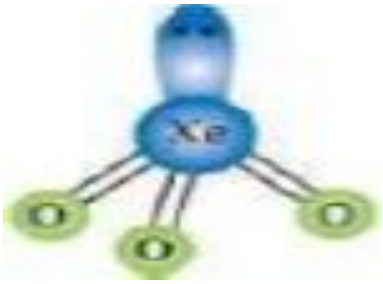
Solution 38 : (i) The structure of XeF_4



(ii) The structure of XeF_2



(iii) The structure of XeO_3



Question 39: Why do noble gases have comparatively large atomic sizes?

Solution 39: Noble gases do not form molecules. In case of noble gases, the atomic radii correspond to vander 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.

Question 40: List the uses of Neon and argon gases.

Solution 40: Uses of neon gas:

(i) It is mixed with helium to protect electrical equipment's from high voltage

(ii) It is filled in discharge tubes with characteristic colours.

(iii) It is used in beacon lights.

Uses of Argon gas:

(i) Argon along with nitrogen is used in gas-filled electric lamps. This is because Ar is more inert than N.

(ii) It is usually used to provide an inert temperature in a high metallurgical process.

(iii) It is also used in laboratories to handle air-sensitive substances.

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