NCERT Solutions for Class 12 Chemistry Chapter 7 The p-block elements

Question 7.1 Why are pentahalides more covalent than trihalides ?

Answer :

Pentahalides are more covalent than trihalides. This is due to the fact that in pentahalides +5 oxidation state exists while in the case of trihalides +3 oxidation state exists. So, Higher the +ve O.S of the central atom more will be the polarising power and more will be the covalent character in the bond between the central atom and a halogen atom. Since elements in +5 oxidation state will have more polarising power than in +3 oxidation state, the covalent character of bonds is more in pentahalides.

Question 7.2 Why is BiH_3 the strongest reducing agent amongst all the hydrides of Group 15 elements ?

Answer :

We see that the stability of hydrides becomes lesser as we go from NH_3 to BiH_3 .this can be seen from dissociation enthalpy of their bond. due to that, the reducing character of the hydrides will be more. Ammonia is only a very mild reducing agent while BiH_3 is the strongest reducing agent amongst all of the hydrides.

Question 7.3 Why is N_2 less reactive at room temperature?

Answer :

N_2 reacts poorly at room temperature. high bond enthalpy of N≡N bond is the reason behind this. Reactivity, however, increases rapidly with increase in temperature.

Question 7.4 Mention the conditions required to maximise the yield of ammonia.

Answer :

Ammonia is produced by Haber's process-

$$N_2 + 3H_2 \overset{700k}{\leftrightharpoons} 2NH_3 \quad \Delta H^o = -46.1KJmol^{-1}$$

The maximum yield conditions for the production of ammonia are-

1. pressure = $200\ atm\ or\ 200 \times 10^5 Pa$,
2. Temperature of around 700 K
3. catalyst = Iron oxide
4. Promotor= small amounts of K_2O and Al_2O_3 to increase the rate of attainment of equilibrium.

Question 7.5 How does ammonia react with a solution of Cu^{2+} ?

Answer :

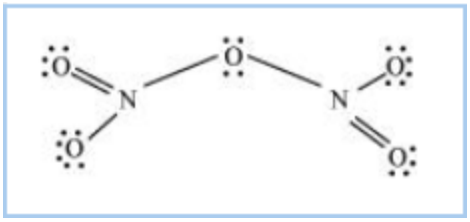
Ammonia is a Lewis base due to The presence of a lone pair of electrons on the nitrogen atom of the ammonia molecule. It forms a linkage with metal ions by donating the electron pair.

$$Cu^{2+}(aq)(blue) + 4NH_3 \rightarrow [Cu(NH_3)_4]^{2+}(aq)(deepblue)$$

Question 7.6 What is the covalence of nitrogen in N_2O_5 ?

Answer :

We can see From the structure of N_2O_5 that covalence of nitrogen is four.



Question 7.7 Bond angle in PH_4^+ is higher than that in PH_3 . Why?

Answer :

As we can see Both are sp^3 hybridised. In PH_4^+ all of the 4 orbitals are bonded whereas in PH_3 there is a lone pair of electrons on P.this lone pair is responsible for lone pair-bond pair repulsion in PH_3 , which results in reducing the bond angle to less than 109° 28′.

Question 7.7 What is formed when PH_3 reacts with an acid?

Answer :

PH_3 reacts with acids like HI to form PH_4I which shows that it is basic in nature. Because of lone pair on phosphorus atom, PH_3 is acting as a Lewis base in the above reaction

$$PH_3 + HI \rightarrow PH_4I$$

$$PH_3 + Acid \rightarrow salt$$

Question 7.8 What happens when white phosphorus is heated with concentrated $NaOH$ solution in an inert atmosphere of CO_2 ?

Answer :

When white phosphorus is heated with the concentrated $NaOH$ solution in an inert atmosphere of CO_2 we see that phosphine and sodium hypophosphite is formed.

$$P_4 + 3NaOH + H_2O \rightarrow 3NaH_2PO_2 + PH_3$$

Question 7.9 What happens when PCI_5 is heated?

Answer :

When we heat PCI_5 , it sublimes but decomposes on stronger heating and phosphorus trichloride is formed.

PCI_5 + Heat $\rightarrow PCI_3 + Cl_2$

Question 7.10 Write a balanced equation for the reaction of PCI_5 with heavy water.

Answer :

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

Question 7.11 What is the basicity of H_3PO_4 ?

Answer :

There are three P–OH bonds present in the molecule of H_3PO_4 . Hence, its basicity is three.

$$H_3PO_4 \overset{H_2O}{\rightleftharpoons} 3H^+ + PO_4^{3-}$$

Question 7.12 What happens when H_3PO_3 is heated?

Answer :

H_3PO_4 when heated, it will disproportionates and give orthophosphoric acid (or phosphoric acid) and phosphine.

$$4H_3PO_3 \rightarrow 3H_3PO_4 + PH_3$$

Question 7.13 List the important sources of sulphur.

Answer :

- The presence of sulphur in the earth’s crust is only about 0.03-0.1%.

- mixed sulphur exists primarily as sulphates such as gypsum $CaSO_4.2H_2O$, Epsom salt $MgSO_4.7H_2O$, baryte $BaSO_4$.
- another source is by sulphides such as galena PbS , zinc blende ZnS , copper pyrites $CuFeS_2$. some sulphur also occurs as hydrogen sulphide in volcanoes. eggs, proteins, garlic, onion, mustard, hair and wool also contain sulphur.

Question 7.14 Write the order of thermal stability of the hydrides of Group 16 elements.

Answer :

Hydrides of group 16 elements become less thermally stable as we go down the group, i.e., H_2O > H_2S > H_2Se > H_2Te > H_2Po . This is due to M-H bond dissociation energy decreases down the group as we increase in the size of the atom.

Question 7.15 Why is H_2O a liquid and H_2S a gas ?

Answer :

H_2O has oxygen as the centre atom. oxygen is small in size as well as high electronegative when we compare it with sulpher.molecules of water are highly associated through hydrogen bonding which is not present in sulpher.molecules of H_2S are connected to each other through weak van der Wal force only. Hence a H_2O liquid and H_2S a gas.

Question 7.16 Which of the following does not react with oxygen directly? Zn, Ti, Pt, Fe

Answer :

Since Platinum(Pt) is a noble metal .it will not react with oxygen directly

Question 7.17 Complete the following reactions:

(i) $C_2H_4 + O_2 \rightarrow$

Answer :

The reaction is:

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

Question 7.17 Complete the following reactions:

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

Answer :

The complete reaction is:

$$4AI + 3O_2 \rightarrow 2Al_2O_3$$

Question 7.18 Why does O_3 act as a powerful oxidising agent?

Answer :

O_3 act as a powerful oxidising agent .This is because of the ease with which it frees atoms of nascent oxygen.i.e.

$$O_3 \rightarrow O_2 + O$$

Question 7.19 How is O_3 estimated quantitatively?

Answer :

A quantitative method for estimating O3 gas is:

When we reacts O_3 with an excess of potassium iodide solution which is buffered with a borate buffer (pH 9.2), iodine is released which can be then titrated against a standard solution of sodium thiosulphate.

$$2I^- + H_2O + O_3 \rightarrow 2OH^- + I_2 + O_2$$

we use starch as an indicator when I_2 liberated is titrated against a standard solution of sodium thiosulphate.

Question 7.20 What happens when sulphur dioxide is passed through an aqueous solution of Fe(III) salt?

Answer :

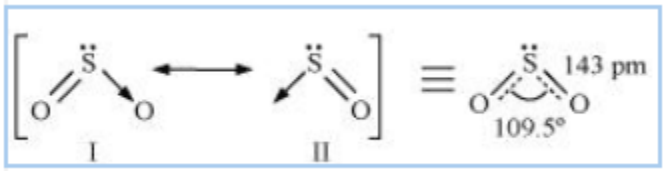
When we pass sulphur dioxide through an aqueous solution of Fe(III) salt, it converts iron(III) ions to iron(II) ions.

$$2Fe^{3+} + SO_2 + 2H_20 \rightarrow 2Fe^{2+} + SO_4^{2-} + 4H^+$$

Question 7.21 Comment on the nature of two $S-O$ bonds formed in SO_2 molecule. Are the two $S-O$ bonds in this molecule equal ?

Answer :

The two $S-O$ bonds in SO_2 molecule are covalent and have equal strength because of having resonating structures.



Question 7.22 How is the presence of SO_2 detected ?

Answer :

Presence of sulphur dioxide is measured by the following reaction. it decolourises acidified potassium permanganate(VII) solution.

$$5SO_2 + 2MnO_4^- + 2H_2O \rightarrow 5SO_4^{2-} + 4H^+ + 2Mn^{2+}$$

it decolourises acidified potassium permanganate(VII) solution.

Hence This can be used to detect the presence of SO_2 .

Question 7.23 Mention three areas in which H_2SO_4 plays an important role.

Answer :

1. Manufacture of fertilisers (e.g., ammonium sulphate, superphosphate) from H_2SO_4 .
2. Use is petroleum refining
3. Manufacture of pigments, paints and dyestuff intermediates and detergent industry.

Question 7.24 Write the conditions to maximise the yield of H_2SO_4 by Contact process.

Answer :

Contact process which we use to create sulphuric acid is exothermic, reversible and the forward reaction which leads to a decrease in volume. hence, low temperature and high pressure are the optimum conditions for maximum yield. But if the temperature will be very low then the rate of reaction will become slow. Also, the presence of catalyst V_2O_5 fastens the reaction.

Question 7.25 Why is $K_{a_2} << K_{a1}$ for H_2SO_4 in water ?

Answer :

H_2SO_4 is a very strong acid in water mostly due to its first ionisation to H_3O^+ and HSO_4^-.The ionisation of HSO_4^- to H_3O^+ and SO_4^{2-} is minuscule. That is the reason why Ka2 << Ka1.

Question 7.26 Considering the parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy, compare the oxidising power of F_2 and CI_2 .

Answer :

F_2 is much more powerful in oxidising, than Cl_2 .The reason being, hydration enthalpy of F– ions (515 kJ mol–1) is much higher than that of Cl– ion (381 kJ mol–1). the dissociation energy of bond F-F is less than Cl-Cl bond but The former factor more than compensate the less negative electron gain enthalpy of F2. Hence it is a much stronger oxidising agent.

Question 7.27 Give two examples to show the anomalous behaviour of fluorine.

Answer :

We see anomalous behaviour of fluorine and this is because of its small size, highest electronegativity, very low F-F bond dissociation enthalpy, and non-availability of d orbitals in the valence shell.

1. ionisation enthalpy, electronegativity, and electrode potentials are all higher for fluorine than expected from the trends set by other halogens

2.ionic and covalent radii, melting point and boiling point., enthalpy for bond dissociation and electron gain enthalpy are very much lower than expected

3. Fluorine shows only an oxidation state of –1 due to non-availability of d-orbitals in its valence shell.

Question 7.28 Sea is the greatest source of some halogens. Comment.

Answer :

The water of the sea contains bromides, chlorides, and iodides of sodium, magnesium, potassium and calcium, but mainly solution of sodium chloride (2.5% by mass). The deposits of dried up seas have these compounds in it, e.g., sodium chloride and carnallite, KCl.MgCl2 .6H2O. iodine is also formed in Certain forms of marine life in their systems; many seaweeds, for example, contain up to 0.5% of iodine. Chile saltpeter contains up to 0.2% of sodium iodate. That's why the sea is the greatest source of halogens.

Question 7.29 Give the reason for bleaching action of CI_2 .

Answer :

Chlorine is a powerful bleaching agent and its bleaching action happens due to oxidation.

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

Chlorine + Water $\rightarrow$ Hydrochloric acid + nascent Oxygen

Coloured substance + nascent Oxygen $[O] \rightarrow$ Colourless substance

Question 7.30 Name two poisonous gases which can be prepared from chlorine gas.

Answer :

The poisonous gases which we can be prepared from chlorine are

1. phosgene ($COCl_2$)
2. mustard gas $ClCH_2CH_2SCH_2CH_2CL$.

Question 7.31 Why is ICl more reactive than I_2 ?

Answer :

ICl is more reactive than I_2 . this is because interhalogen compounds are more reactive than halogens (except fluorine). This is because X–X′ bond in interhalogens is weaker than X–X bond in halogens except F–F bond.

Question 7.32 Why is helium used in diving apparatus?

Answer :

Helium is used in diving apparatus because it is very low soluble in blood.

Question 7.33 Balance the following equation:

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

Answer :

The balanced reaction is:

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

Question 7.34 Why has it been difficult to study the chemistry of radon?

Answer :

It has been difficult to study the chemistry of radon because radon is a radioactive element and it has a short half-life.

NCERT Solutions for Class 12 Chemistry Chapter 7 The p-block elements-Exercise Questions

Question 7.1 Discuss the general characteristics of Group 15 elements with reference to their electronic configuration, oxidation state, atomic size, ionisation enthalpy and electronegativity

Answer :

Since all the elements in group 15 have 5 valence electrons, Electronic configuration of group 15 element is ns2np3 where n= 2 to 6. All element requires three more electrons to complete their octets. However, gaining electrons is very difficult as the nucleus will have to attract three more electrons. This can take place only with nitrogen as it is the smallest in size and the distance between the nucleus and the valence shell is relatively small. The rest elements of this group show a formal oxidation state of -3 in their covalent compounds. N and P also show -1 and -2 oxidation states In addition to the -3 state. every element which is present in this group shows +3 and +5 oxidation states. whereas, the stability of the +5 oxidation state decreases as we go down a group, whereas the stability of +3 oxidation state increases. This happens because of the inert pair effect.

First ionization decreases on moving down a group. This is because of increasing atomic sizes. As we move down a group, electronegativity decreases, due to an increase in size. As we go down in the group, the atomic size increases. This increase in the atomic size is credited to an increase in the number of shells.

Question 7.2 Why does the reactivity of nitrogen differ from phosphorus?

Answer :

Nitrogen is a diatomic molecule $N \equiv N$. The two atoms of nitrogen form a triple bond which makes it highly stable. The triple bond present is very strong and difficult to break due to the small size of the nitrogen atom, this is not the case in phosphorus atom and phosphorus exists in a tetra-atomic molecule. Since $P - P$ single bond (213KJ/mol) is weaker than $N \equiv N$ triple bond (941KJ/mol) hence they both react differently..

Question 7.3 Discuss the trends in chemical reactivity of group 15 elements.

Answer :

The element of group 15 :

React with hydrogen in order to form hydrides of type EH_3 , where E = N, P, As, Sb, or Bi.

React with oxygen in order to form two types of oxides: $E_2O_3 \; and \; E_2O_5$ where E = N, P, As, Sb, or Bi.

React with halogens in order to form two series of salts: EX_3 and EX_5 .
Except $NBr_3, \; NI_3 \; and \; NX_5$ because it lacks the *d* -orbital.

React with metals for forming binary compounds in which metals exhibit -3 oxidation states.

Question 7.4 Why does NH_3 form hydrogen bond but PH_3 does not?

Answer :

NH_3 form hydrogen bond but PH_3 does not because Nitrogen has the massive attraction of the electron to the nucleus due to its higher electronegativity in comparison to the phosphorus. hence H-bonding in PH3 is very less as compared to NH3.

Note: Conditions for the formation of H-bond are-

- high electronegativity
- small size

Question 7.5 How is nitrogen prepared in the laboratory? Write the chemical equations of the reactions involved.

Answer :

We prepare nitrogen by the following method,

when An aqueous solution of ammonium chloride is reacted with sodium nitrite.

$$NH_4Cl(aq) + NaNO_2(aq) \rightarrow N_2(g) + 2H_2O(l) + NaCl$$

here, NO and HNO_3 are produced in small amounts. These are counted in impurities that we can remove by passing nitrogen gas through aqueous sulphuric acid, containing potassium dichromate.

Question 7.6 How is ammonia manufactured industrially?

Answer :

Ammonia is produced by Haber's process-

$$N_2 + 3H_2 \overset{700k}{\leftrightharpoons} 2NH_3 \quad \Delta H^o = -46.1 KJmol^{-1}$$

According to Le-Chatelier's principle, High pressure would favour the production. The maximum yield conditions for the production of ammonia are-

1. pressure = $200\ atm\ or\ 200 \times 10^5 Pa$,
2. Temperature of around 700 K
3. catalyst = Iron oxide
4. Promotor= small amounts of K_2O and Al_2O_3 to increase the rate of attainment of equilibrium.

Question 7.7 Illustrate how copper metal can give different products on reaction with HNO_3 .

Answer :

Concentrated nitric acid has a strong oxidizing property. It is used for oxidizing most metals. The concentration of the acid and temperature decides the products of oxidation.

(i) Cu reacts with dilute HNO_3

$$3Cu + 8HNO_3(dilute) \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$$

(i) Cu reacts with conc. HNO_3

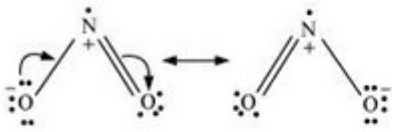
$$Cu + 4HNO_3(conc) \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$$

Question 7.8 Give the resonating structures of NO_2 and N_2O_5 .

Answer :

Resonance structure of NO_2 and N_2O_5 are

(1)



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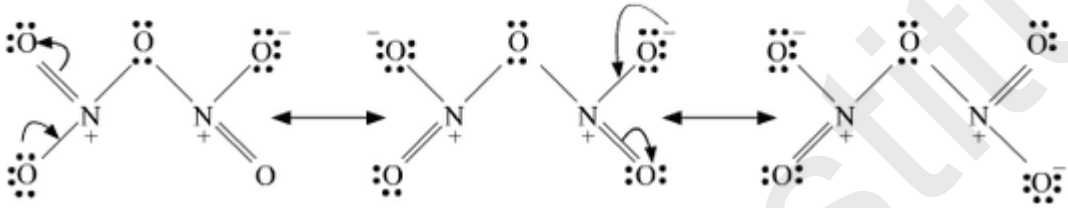


Question 7.9 The HNH angle value is higher than HPH, HAsH and HSbH angles. Why?

Answer :

The angle value of HNH is higher than HPH, HAsH and HSbH angles. This is due to the higher electronegativity of the electron. Since nitrogen is highly electronegative, there is high electron density around the atom of nitrogen. This causes greater repulsion between the electron pairs which are around nitrogen, resulting in maximum bond angle.

Question 7.10 Why does $R_3P=0$ exist but $R_3N=0$ does not $(R = alkyl\ group)$?

Answer :

N does not have any d -orbitals but phosphorus(P) does. This is the restriction which comes in nitrogen(N) to expand its coordination number beyond four.
Hence, $R_3N=O$ does not exist.

Question 7.11 Explain why NH_3 is basic while BiH_3 is only feebly basic.

Answer :

Nitrogen has a small size because of which the lone pair of electrons are concentrated in a small region. As we go down a group, the size of the central atom increases and the charge gets distributed over a large area which results in decreasing the electron density. Hence, the electron donating capacity(Basicity) of group 15 element hydrides decreases on moving down the group. And that's why electron releasing tendency(basicity) of BiH_3 is less than ammonia.

Question 7.12 Nitrogen exists as diatomic molecule and phosphorus as P_4 . Why?

Answer :

The nitrogen atom has small size and high electronegativity due to this nitrogen form $p\pi-p\pi$ multiple bonds with itself and with other elements which have small size and high electronegativity (e.g., C, O). The elements which are heavier of this group do not form $p\pi-p\pi$ bonds because their atomic orbitals are so large and diffuse that they cannot have effective overlapping. Thus, nitrogen exists as a diatomic molecule with a triple bond (one s and two p) between the two atoms. On the contrary, phosphorus has less the tendency to form pπ-pπ bonds and hence it exists in the form P_4 .

Question 7.13 Write main differences between the properties of white phosphorus and red phosphorus.

Answer :

White phosphorus	**Red phosphorus**
It is a translucent white waxy solid	It is crystalline solid.
It is insoluble in water but soluble in carbon disulphide	It is insoluble in water as well as in carbon disulphide
poisonous	non-poisonous
It consists of discrete tetrahedral P4 molecule	red phosphorus is polymeric, consisting of chains of P4 tetrahedra linked together

Question 7.14 Why does nitrogen show catenation properties less than phosphorus?

Answer :

The single $N-N$ bond in nitrogen is weaker than the single $P-P$ bond because of high interelectronic repulsion of the non-bonding electrons in N_2 , due to the small bond length. Therefor, the catenation tendency is weaker in nitrogen.

Question 7.15 Give the disproportionation reaction of H_3PO_3 .

Answer :

When we heat, orthophosphorus acid (H_3PO_3) disproportionates into orthophosphoric acid (H_3PO_4) and phosphine (PH_3).

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

Question 7.16 Can PCI_5 act as an oxidising as well as a reducing agent? Justify.

Answer :

No PCI_5 can not act as reducing agent but it can act as an oxidising. In PCI_5, phosphorus have its highest oxidation state (+5) which cannot be increased further but it can decrease its oxidation state and act as an oxidizing agent. For example-

$$Sn + \overset{+5}{2P}Cl_5 \rightarrow SnCl_4 + \overset{+3}{2P}Cl_3$$

Question 7.17 Justify the placement of O, S, Se, Te and Po in the same group of the periodic table in terms of electronic configuration, oxidation state and hydride formation.

Answer :

- **Electronic Configuration-**

  O, S, Se, Te and Po, all have six valance electron each. The general electronic configuration of these elements is $ns^2,\ np^4$, where n varies from 2 to 6.

- **Oxidation state-**

  As all of these elements have six valence electrons, they should display an oxidation state of -2. The stability of the -2 oxidation state decreases on moving down a group due to a decrease in the electronegativity of the elements. The heavier elements show +2, +4 and

+6 oxidation state due to availability of d -orbitals. It also exhibits the oxidation state of -1 (H_2O_2), zero (O_2), and +2 (OF_2)

- **Hydrides-**

  They all form hydrides of formula H_2E , where $E = O, S, Se, Te, Po.$ Oxygen and sulphur also form hydrides of type H_2E_2 . These hydrides are volatile in nature.

Question 7.18 Why is dioxygen a gas but sulphur a solid?

Answer :

Oxygen is smaller in size as compared to the sulphur. Thus it can effectively form $p\pi - p\pi$ bond and form $O_2(O = O)$ molecules. The intermolecular forces in oxygen are weak van der Wall's, which cause it to exist as gas.whereas sulphur exists as a puckered structure held together by strong covalent bonds. Hence, it is solid.

Question 7.19 Knowing the electron gain enthalpy values for $O \rightarrow O^-$ and $O \rightarrow O^{2-}$ as -141 and $702kJmol^{-1}$ respectively, how can you account for the formation of a large number of oxides having O^{2-} species and not O^- ?

Answer :

Lattice energy directly depends on the charge carried by an ion. More the lattice energy, more stable the compound will be. When metal and oxygen combine, the lattice energy of the oxide, which involves O^{2-} ion is much more than the oxide which involves O^- ion. Ionic compound stability depends on the lattice energy of the compound. Thus the oxides of $O^{2-}$is more stable than oxides having O^- .

Question 7.20 Which aerosols deplete ozone?

Answer :

Freons which are used in aerosol sprays and as refrigerants is accountable for the depletion of the ozone layer, freons are also called chlorofluorocarbons.\

Question 7.21 Describe the manufacture of H_2SO_4 by contact process?

Answer :

Sulphuric acid is manufactured by the Contact Process that involves three steps:

(i) burning of sulphide ores or sulphur in the air to generate. SO_2

(ii) conversion of SO_2 to SO_3 by the reaction with oxygen in the presence of a catalyst (V_2O_5), and

(iii) absorption of SO_3 in H_2SO_4 to give Oleum ($H_2S_2O_7$)

Diluting the oleum with water gives H_2SO_4 of the desired concentration.

$$2SO_2 + O_2 \rightarrow 2SO_3$$

$$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7(olium)$$

Question **7.22** How is SO_2 an air pollutant?

Answer:

- Sulphur dioxide SO_2 is considered an air pollutant because it readily undergoes oxidation in the atmosphere to form Sulphur trioxide SO_3 which then reacts with water vapour to form sulphuric acid H_2SO_4 . Which comes down in the form of acid rain. acid rain causes deforestation which is also not good for the environment.
- Even in low concentration of SO_2 causes the irritation in the eyes, respiratory problem and due to this it affects the larynx to cause breathlessness.

- Harmful for plants also, long exposure to SO_2 can reduce the colour of the leaves. It is because the formation of chlorophyll is affected by sulphur dioxide.

Question 7.23 Why are halogens strong oxidising agents?

Answer :

Halogens have 7 electrons in their valance shell and they need only one more electron to complete their octet and to attain the stable noble gas configuration. So they have a high tendency to gain an electron. Also, halogens are highly electronegative with low dissociation energies and high negative electron gain enthalpies which just increase the tendency to gain an electron. Hence they are strong oxidising agent.

Question 7.24 Explain why fluorine forms only one oxoacid, HOF .

Answer :

In fluorine d-orbitals are absent and also it has very high electronegativity and small size.o it shows only +1 oxidation state in oxo-acid, but not + 3, + 5 or + 7. Hence It forms only one oxoacid HOF and doesn't form oxoacid having other oxidation states than +1 like $HOFO, HOFO_2 \, and \, HOFO_3.$

Question 7.25 Explain why inspite of nearly the same electronegativity, nitrogen forms hydrogen bonding while chlorine does not.

Answer :

Inspite of nearly the same electronegativity, nitrogen forms hydrogen bonding while chlorine does not, the reason behind this is the small size of nitrogen atom as compared to the chlorine atom. The small size makes electron density per volume higher.

Question 7.26 Write two uses of ClO_2 .

Answer :

Uses of ClO_2 .

1. ClO_2 is used as a bleaching agent for paper pulp and in textiles
2. ClO_2 is used as a germicide in water treatment.

Question 7.27 Why are halogens coloured?

Answer :

All halogens are coloured due to the absorption of radiations which comes under visible region, which results in the excitation of outer electrons to higher energy level. The different quanta of radiation absorb by different halogens and they display different colours, for example is, F_2 , has yellow, Cl_2 , greenish yellow, Br_2 , red and I_2 , violet colour.

Question 7.28 Write the reactions of F_2 and ClI_2 with water.

Answer :

Cl_2 with water

$Cl_2 + H_2O \rightarrow HCl + HOCl$

F_2 with water

$2F_2 + 2H_2O \rightarrow 4H^+ + 4F^- + O_2 + 4HF$

Question 7.29 How can you prepare CI_2 from HCL and HCL from CI_2 ? Write reactions only.

Answer :

Chlorine has a great affinity for hydrogen. Chlorine reacts with hydrogen-containing compounds to form HCl.

$H_2 + Cl_2 \rightarrow 2HCl$

$H_2S + Cl_2 \rightarrow 2HCl + S$

$C_{10}H16 + 8Cl_2 \rightarrow 16HCl + 10C$

HCL to Chlorine

$4HCL + O_2 \rightarrow 2Cl_2 + 2H_2O$

Question 7.30 What inspired N . Bartlett for carrying out reaction between Xe and PtF_6 ?

Answer :

Initially, he prepared a red compound of formula $O_2^+PtF_6^-$ with the help of oxygen and PtF_6 . Later, he realised that the first ionisation enthalpy of molecular oxygen (1175 kJ/mol) and that of xenon (1170 kJ/mol) are almost identical and then he tried to prepare

the same type of compound with Xe and PtF_6 . He was successful in preparing another red colour compound. $Xe^{+}\ PtF_6^{-}$

Question 7.31 What are the oxidation states of phosphorus in the following:

H_3PO_3

Answer :

It is known that the oxidation state of H = 1 and O is -2.

Let the oxidation state of P be x

$$3 + x + 3(-2) = 0$$
$$3 + x - 6 = 0$$
$$x - 3 = 0$$
$$x = 3$$

hence oxidation state of H_3PO_3 is 3

Question **7.31** What are the oxidation states of phosphorus in the following:

PCl_3

Answer:

It is known that the oxidation state of chlorine is -1

let oxidation state P be x

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

hence oxidation state phosphorus in PCl_3 is +3

Question 7.31 What are the oxidation states of phosphorus in the following:

Ca_3P_2

Answer :

We know that the oxidation state of calcium is +2

let oxidation state P be x

$$3(+2) + 2(x) = 0$$
$$6 + 2x = 0$$
$$2x = -6$$
$$x = -6/2$$
$$x = -3$$

Hence the oxidation state of the phosphorus is -3

Question 7.31 What are the oxidation states of phosphorus in the following:

Na_3PO_4

Answer :

we know the oxidation state of sodium(Na) is +1 and oxygen(O_2) is -2

Let Oxidation state = x

$$3(+1) + x + 4(-2) = 0$$
$$3 + x - 8 = 0$$
$$x - 5 = 0$$
$$x = 5$$

Thus the oxidation state of phosphorus in Na_3PO_4 is +5

Question 7.31 What are the oxidation states of phosphorus in the following:

POF_3

Answer :

It is known that the oxidation state of the oxygen and fluorine are -2 and -1 respectively

Let oxidation state be x

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

$x - 2 - 3 = 0$

$x - 5 = 0$

$x = 5$

So, the oxidation state of the phosphorus in POF_3 is +5

Question 7.32 Write balanced equations for the following:

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

Answer :

Nacl is heated with sulphuric acid in presence of Kmno4

$4NaCl + MnO_2 + 4H_2SO_4 \rightarrow MnCl_2 + 4NaHSO_4 + 2H_2O + Cl_2$

Question 7.32 Write balanced equations for the following:

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

Answer :

Chlorine gas is passed into a solution of water

$Cl_2 + 2NaI \rightarrow 2NaCl + I_2$

Question 7.33 How are xenon fluorides XeF_2 , XeF_4 and XeF_6 obtained?

Answer :

Under different concentration of Xenon, it forms , XeF2 , XeF4 and XeF6 by the direct reaction.

$$F_2 + Xe(in - excess) \rightarrow XeF_2; under - 673k, 1bar$$

$$2F_2 + Xe(1 : 5ratio) \rightarrow XeF_4; under - 873k, 7bar$$

$$3F_2 + Xe(1 : 20ratio) \rightarrow XeF_6; under - 573k, 65bar$$

XeF6 can also be made by the interacting XeF_4 and O_2F_2 at 143K.

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

Question 7.34 With what neutral molecule is ClO^- isoelectronic? Is that molecule a Lewis base?

Answer :

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

ClO^- is isoelectronic with two neutral molecules. And these two are ClF and OF_2

In $ClF = 17 + 9 = 26$

In $OF_2 = 8 + \ 9 \times 2 = 26$

both species also contain 26 electrons.

Question 7.35 How are XeO_3 and $XeOF_4$ prepared?

Answer :

- When we do Hydrolysis of XeF_4 and XeF_6 with water we get $XeOF_3$

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

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

- And Partial hydrolysis of XeF_6 gives us, $XeOF_4$

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

Question 7.36 Arrange the following in the order of property indicated for each set:

(i) F_2 , CI_2 , Br_2 , I_2 - increasing bond dissociation enthalpy.

Answer :

Bond dissociation energy usually decreases as we move down in a group, Bond dissociation energy usually decreases as the atomic size increases. whereas, the bond dissociation energy of F_2 is lower than that of Cl_2 and Br_2 . This is due to the small atomic size of fluorine. hence,

$$I_2 < F_2 < Br_2 < Cl_2$$

Question 7.36 Arrange the following in the order of property indicated for each set:

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

Answer :

The dissociation energy of bond of H-X molecules where X = F, Cl, Br, I, decreases as we increase the atomic size.

HI is the strongest acid Since H-I bond is the weakest

$$HF < HCl < HBr < HI$$

Question 7.36 Arrange the following in the order of property indicated for each set:

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

Answer :

As we move from nitrogen to bismuth, the size of the atom increases and the electron density on the atom decreases. hence, the basic strength will decrease.

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

Question 7.37 Which one of the following does not exist?

$(i)\ XeOF_4$

$(ii)\ NeF_2$

$(iii)\ XeF_2$

$(iv)\ XeF_6$

Answer :

NeF_2 does not exist because neon has very high ionization enthalpy. But ionization enthalpy of xenon is low.

Question 7.37 Which one of the following does not exist?

NeF_2

Answer :

NeF2 Does not Exists.

Question 7.37 Which one of the following does not exist?

XeF_2

Answer :

XeF2 Exists.

Question 7.37 Which one of the following does not exist?

XeF_6

Answer :

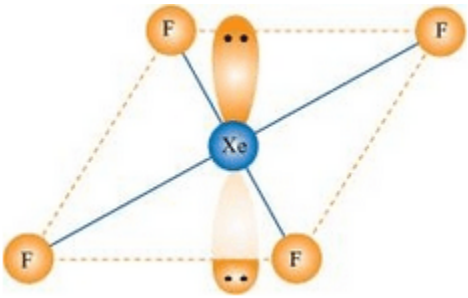
XeF6 Exists.

Question 7.38 Give the formula and describe the structure of a noble gas species which is isostructural with:

ICI_4^-

Answer :

XeF_4 has square planar geometry and is isoelectronic with ICl_4^-.

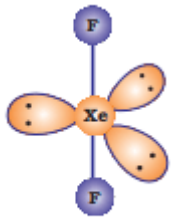


Question 7.38 Give the formula and describe the structure of a noble gas species which is isostructural with:

IBr_2^-

Answer :

XeF_2 has a linear structure and is isoelectronic to IBr_2^- and



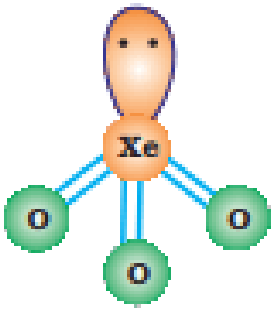
(a) Linear

Question 7.38 Give the formula and describe the structure of a noble gas species which is isostructural with:

BrO_3^-

Answer :

XeO_3 has a pyramidal molecular structure and is isostructural to BrO_3^- and.



(e) Pyramidal

Question 7.39 Why do noble gases have comparatively large atomic sizes?

Answer :

The atomic radius of an element corresponds to the covalent radius. but noble gases do not form any molecule, so for them, the radius is Vander walls radius. Vander wall radius is larger than the covalent radius.

Question 7.40 List the uses of neon and argon gases.

Answer :

We use Neon in discharge tubes and fluorescent bulbs for advertisement display purposes. Neon bulbs are used in botanical gardens and in green houses. We use Argon mainly to provide an inert atmosphere during metallurgical processes involving high temperature(arc welding of metals or alloys) and for filling electric bulbs. We use It in the laboratory too for handling substances that are air-sensitive