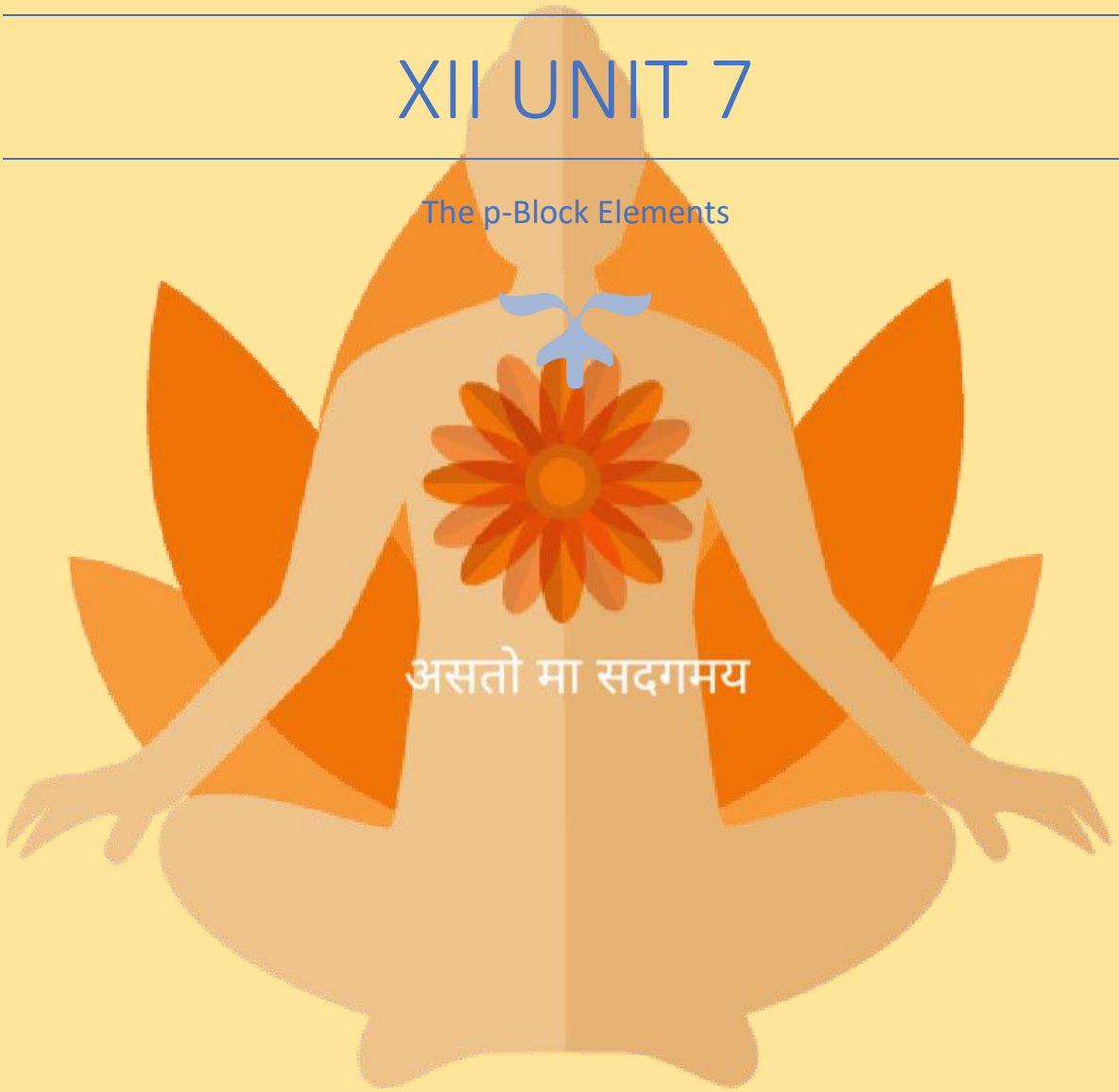
XII UNIT 7

The p-Block Elements



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Unit 7

The p block elements

Q.1 Write the elements of group 15?
Ans. The elements of group 15 are Nitrogen (N), Phosphorous (P) , Arsenic (As) , Antimony (Sb) and Bismuth (Bi).
Q.2 Write chemical name & formulae of
a) Chile saltpetre
b) Indian saltpetre
Ans. (a) Chile saltpetre – Sodium nitrate – $NaNO_3$
(b) Indian saltpetre – Potasium nitrate –KNO_3
Q.3 What is special about the valence configuration of Group 15?
Ans. The valence configuration of 15 group is ns^2np^3 the s-orbital is completely filled and p-orbital is half filled . This half filled orbital gives extra stability to elements of this group.
Q.4 The atomic radii increases considerably from N to P but very little increase is observed from As to Bi. why?
Ans. There is a considerable increase in size from N to P as expected but due to the presence of completely filled d- orbitals which have very poor shielding effects, the increases in size is very little from As to Bi.
Q.5 Give reason for the following- the first ionization enthalpy of 15^{th} group elements is higher than 16^{th} group elements ?
Ans. Due to extra stability of half filled configuration, the first Ionisation enthalpy of 15^{th}
group elements is higher than 16^{th} group configuration ns^2np^3
Q.6 How does metallic character vary down the 15 group & why?
Ans. The metallic character increases down the group due to decrease in ionization enthalpy and increase in size of atom.
Q.7 What are the common oxidation states of this group?
Ans. The common oxidation states of the group are -3, +3 & +5.
Q.8 What is the maximum covalence shown by N?
Ans. Nitrogen shows a maximum covalence of +4 because only four orbitals, one S and three P- orbitals are available for bonding in Nitrogen.
Q.9 Bi (v) is a stronger oxidizing agent than Bi(III). Why?
Ans. Bi is more stable in +3 oxidation state in comparison to +5 due to inert pair effect
therefore Bi (v) has a strong tendency to act as oxidizing agent.
Q.10 Give an example showing disproportionation of oxidation state of nitrogen?
Ans.

$$\underset{+3}{3HNO_2} \rightarrow \underset{+5}{HNO_3} + H_2O + \underset{+2}{2NO}$$

Here Nitrogen is getting oxidized to a higher oxidation state as well as reduced to a lower oxidation state.

Q.11 Complete and balance -

(i) $(NH_4)_2SO_4 + 2NaOH \rightarrow$

(ii) $2FeCl_3(aq) + 3NH_4OH(aq) \rightarrow$

(iii) $AgCl(s) + 2NH_3(aq) \rightarrow$

(iv) $NaNO_3 + H_2SO_4 \rightarrow$

(v) $3NO_2(g) + H_2O(l) \rightarrow$

(vi) $Cu + 4HNO_3(conc) \rightarrow$

(vii) $4Zn + 10HNO3\ (dil) \rightarrow$

(viii) $[Fe(H_2O)_6]_2+NO \rightarrow$

(ix) $I_2\ 10HNO_3 \rightarrow$

(x) $S_s + 48\ HNO_3(conc) \rightarrow$

Ans. (i) $(NH_4)_2\ SO_4 + 2\ NaOH \rightarrow 2NH_3 + 2H_2O + Na_2SO_4$

(ii) $2FeCl_3(aq) + 3NH_4OH(aq) \rightarrow Fe_2O_3.xH_2O(s) + 3NH_4Cl(aq)$

(iii) $AgCl(s) + 2NH_3(aq) \rightarrow [Ag(NH_3]_2]\ Cl(aq)$

(iv) $NaNO_3 + H_2SO_4 \rightarrow NaHSO_4 + HNO_3$

(v) $3NO_2(g) + H_2O(l) \rightarrow 2HNO_3(aq) + NO(g)$

(vi) $Cu + 4HNO_3(conc) \rightarrow Cu(NO_3)_2 + 5H_2O + N_2O$

(vii) $4Zn + 10HNO_3(dil) \rightarrow 4Zn(NO_3)_2 + 5H_2O + N_2O$

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

(ix) $I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10\ NO_2 + 4H_2O$

(x) $S_8+48HNO_3(conc) \rightarrow 8H_2SO_4 + 48NO_2 + 16H_2O$

Q.12 What are the optimum conditions for maximum yield of ammonia?

Ans. The optimum conditions for the production of ammonia are - $200*10^5$ Pa or 200 atm pressure, 700K temperature , and presence of catalyst such as iron oxide with K_2O and Al_2O_3 as promoters.

Q.13 Ammonia is a Lewis base. Why?

Ans. Due to the presence of lone pairs on nitrogen atom of ammonia, it can donate electron pair and acts as a lewis base.

Q.14 Ammonia has higher boiling and melting points than expected. Why?

Ans. In solid and liquid states, ammonia molecules are associated by inter-molecular
hydrogen bonding. There fore ammonia has higher boiling and melting points.

Q.15 Give reasons for the following:-

a)Halogens have smallest atomic radii in their periods

b) The negative electron gain enthalpy of fluorine is less than that of chlorine.

c) All halogens are coloured.

d) The only possible oxidation state of fluorine -1.

e) Fluorine forms only one oxoacid.

f) The stability of hydrides follows the order HF>HCl>HBr>HI.

Ans. (a) Due to maximum effective nuclear charge, halogens have smallest atomic radii.

(b) Due to small size of fluorine atom, there are strong inter electronic repulsions in the
small 2p orbital of fluorine and thus incoming electron does not experience much attraction and fluorine has less negative electron gain enthalpy than that of chlorine.
(c) Halogens absorb radiation in visible region which results in oxidation of electrons to
higher energy level by absorbing different quanta of radiation, they show different colours.
(d) Since fluorine is most electronegative element and is short of only one electron for
completing octet, it shows the only oxidation state of -1.
(e) Due to small size and high electro-negativity, Fluorine forms only one hypohalous acid.
(f) As the size of element increases down the group, the bond dissociation enthalpy for HX bond decreases making the bond weaker and weaker therefore the order of thermal stability is HI < HBr < HCl < HF.

Q.16 Complete and balance-

(i) $2F(g) + 2H2O(l) \rightarrow$

(ii) $4NaCl + MnO_2 + 4H_2SO_4 \rightarrow$

(iii) $4HCl + O_2 \xrightarrow{CuCl_2}$

(iv) $C_{10}H_{16} + 8Cl_2 \rightarrow$

(v) $6NaOH + 3Cl_2 \rightarrow$

Ans. (i) $2F_2(g) + 2H_2O(l) \rightarrow 4H^+(aq) + 4F^- + O_2(g)$

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

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

(iv) $C_{10}H_{16} + 8Cl_2 \rightarrow 16HCL + 10C$

(v) $6NaOH + 3Cl_2 \rightarrow 5NaCl + NaCiO_3 + 3H_2O$

Q.17 Chlorine water on standing loses its yellow colour. Why?

Ans. On standing chlorine water forms HCl and Hypochlorous acid (HOCl) due to which it loses its colour. $Cl_2 + H_2O \rightarrow HCL + HOCI$

Q.18 . Explain the bleaching action of chlorine?

Ans. The bleaching action of chlorine is due to its tendency to give nascent oxygen so that the substance gets oxidized. $Cl_2 + H_2O$ ---> 2HCl +[O]
Coloured substances + [O] → colourless substance.

Q.19 Write two uses of chlorine?

Ans. Chlorine is used for
a) Bleaching wood pulp, cotton and textiles
b) Manufacturing dyes, drugs, refrigerants etc.
c) Sterilizing drinking water.

Q.20 Give reasons for the following?

(a) Nitrogen does not show catenation.

(b) PCl_5 exists but NCl_5 does not.

(c) The stability of Hydrides follows the order-
NH_3>PH_3>Ar_5H_3>SbH_3
(d) PH3 is a weaker base than NH_3 .
(e) Molecular nitrogen is chemically inert.
Ans. (a) Nitrogen being small in size has high electron density. Due to strong inter electronic repulsions, N-N single bond is weak & nitrogen does not undergo catenation.
(b) Due to absence of d-orbitals, nitrogen cannot expand its oxidation state to +5 and NCl5 does not exist whereas in P due to presence of empty 3d orbital +5 oxidation state is attained.
(c) As we move down the group 15, atomic radii increases making the bond of element with Hydrogen weaker this decreases the stability of hydrides of heavier elements. Therefore the order of stability is.
NH_3>PH_3>AsH_3>SbH_3
(d) As Phosphorous atom is larger than N- atom, the lone pair of electrons is distributed over a large surface area of P-atom than N-atom. Therefore the tendency of P to donate the lone pair of electrons is less.
(e) Molecular nitrogen (N_2) is inert because N N bond energy is very high due to small size of N- atom and presence of multiple bond.