1. What is inert pair effect?

In heavier post-transition metals, the outer s electrons (ns) have a tendency to remain inert and show reluctance to take part in the bonding, which is known as inert pair effect. This effect is also observed in groups 14, 15 and 16.

2. Chalcogens belongs to p-block. Give reason.

i) The chalcogens are the first group in the p block to have no stable metallic elements.

ii) All isotopes of polonium (Po), the only metal in group 16, are radioactive, and only one element in the group, tellurium (Te), can even be described as a semimetal.

iii) As in groups 14 and 15, the lightest element of group 16, oxygen, is found in nature as the free element.

3. Explain why fluorine always exhibit an oxidation state of -1?

1.fluorine the most electronegative element, also behaves quiet differently compared to the rest of the members of group

2. Absence of d orbitals in their valance shell

3. The fluorine is the strongest oxidising agent and the most reactive element among the halogens.

4. Give the oxidation state of halogen in the following.

a) OF_2 **b) O_2F_2** **c) Cl_2O_3** **d) I_2O_4**

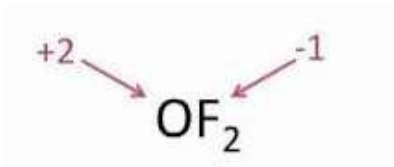
Fluorine shows only -1 oxidation state

a) OF_2

$2 + 2x = 0$

$2x = -2$

$x = -1$



b) O_2F_2

$2(1) + 2x = 0$

$2 - 2x = 0$

$2x = -2$, $X = -1$

c) Cl_2O_3

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

$2x - 6 = 0$

$2x = 6$

$X = 3$

Oxidation state of Cl is +3

I) I_2O_4

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

$2x - 8 = 0$

$2x = 8$

$X = 4$

Oxidation state of I is +4

5. What are interhalogen compounds? Give examples.

Each halogen combines with other halogens to form a series of compounds called inter halogen compounds.

A is less electronegative than B.

AB type - ClF, BrF

AB_3 type -BrF_3

AB_5 type - IF_5

AB_7 type - IF_7

6 Why fluorine is more reactive than other halogens?

Fluorine is more reactive.

Due to very small size of F there is inter electronic repulsion in F_2

This is due to the low value of F-F bond dissociation energy.

Fluorine wants to get to a stable 10 electrons to be like Neon.

This is because the valence/bonding electrons are closer to the nucleus in Fluorine than they are Chlorine and others and thus more strongly attracted

Fluorine is most electronegative, thus it is most reactive.

7. Give the uses of helium.

i). Helium is used to provide inert atmosphere in electric arc welding of metals

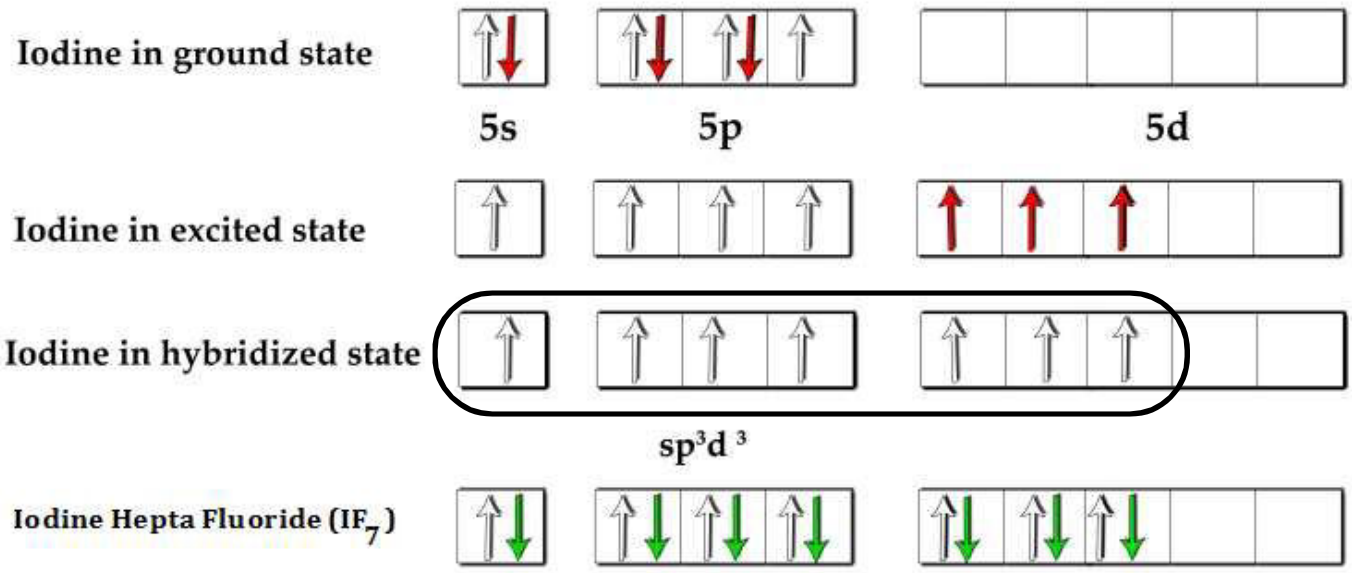
ii). Helium has lowest boiling point hence used in cryogenics (low temperature science).

iii) It is much less denser than air and hence used for filling air balloons

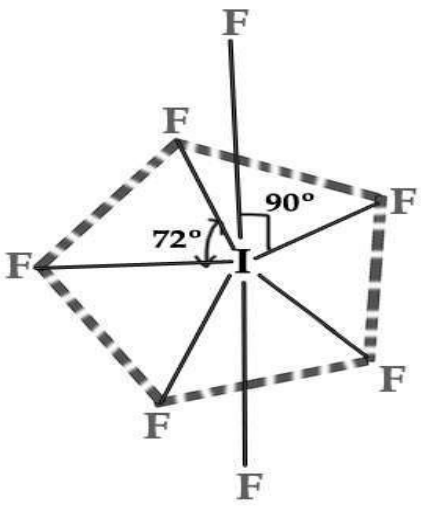
8. What is the hybridisation of iodine in IF_7? Give its structure.

Iodine atom undergoes sp^3d^3 hybridization to give 7 half filled sp^3d^3 hybrid orbitals in pentagonal bipyramidal symmetry. shape of IF_7 is pentagonal bipyramidal.

F - I - F bond angles in the pentagonal plane are equal to 72^o



Geomentry of IF_7 is pentagonal bipyramidal.



9 Give the balanced equation for the reaction between chlorine with cold NaOH and hot NaOH.

i) Cold dilute alkali to give chloride and hypochlorite

$$2NaOH_{(aq)} + Cl_2 \rightarrow NaCl_{(aq)} + NaOCl + H_2O$$

ii) hot concentrated alkali to give chlorides and chlorates are formed.

$$6NaOH_{(aq)} + 3Cl_2 \rightarrow 5\,NaCl_{(aq)} + NaClO_3\,(aq) + 3H_2O\,(l)$$

10. How will you prepare chlorine in the laboratory?

Chlorine can also be prepared by dripping concentrated hydrochloric acid on $KMnO_4$ crystals:

$$\mathbf{2KMnO_4 + 16HCl \rightarrow 2\,KCl + 2\,MnCl_2 + 8H_2O + 5Cl_2}$$

11. Give the uses of sulphuric acid.

1. Sulphuric acid is used in the manufacture of fertilisers, ammonium sulphate and super phosphates and other chemicals such as hydrochloric acid, nitric acid etc...
2. It is used as a drying agent and also used in the preparation of pigments, explosives etc..

12. Give a reason to support that sulphuric acid is a dehydrating agent.

i) It is highly soluble in water and has strong affinity towards water and hence it can be used as a dehydrating agent .

ii) When dissolved in water, it forms mono ($H_2SO_4.H_2O$) and dihydrates ($H_2SO_4.2H_2O$) and the reaction is exothermic

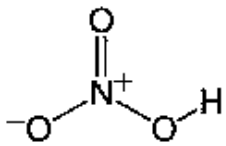
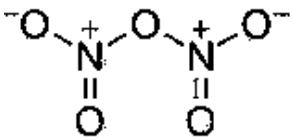
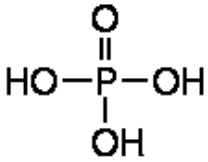
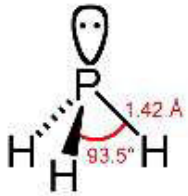
Example : $\mathbf{C_{12}H_{22}O11 + H_2SO_4 \rightarrow 12C + H_2SO_4.11H_2O}$

13. Write the reason for the anamolous behaviour of Nitrogen.

i) Small size of N atom.
ii) High value of electronegativity of N atom and high ionization energy.
iii) Absence of d-orbitals in the valency shell.
iv) Tendency of form multipole bonds.
v) As a result the catenation tendency is weaker in nitrogen

14. Write the molecular formula and structural formula for the following molecules.

a) Nitric acid b) dinitrogen pentoxide c) phosphoric acid d) phosphine

Name	Molecular Formula	Structure
a) Nitric acid	HNO_3	
b) dinitrogen pentoxide	N_2O_5	
c) phosphoric acid	H_3PO_4	
d) phosphine	PH_3	

15. Give the uses of argon.

Argon prevents the oxidation of hot filament and prolongs the life in filament bulbs

16. Write the valence shell electronic configuration of group-15 elements.

The general valence shell electronic set up of group fifteen elements is ns^2, np^{1-6}

17. Give two equations to illustrate the chemical behaviour of phosphine.

Basic nature: Phosphine is weakly basic and forms phosphonium salts with halogen acids.

$$PH_3 + HI \rightarrow PH_4I$$

Reducing property : Phosphine precipitates some metal from their salt solutions.

$$3AgNO_3 + PH_3 \rightarrow Ag_3P + 3HNO_3$$

18. Give a reaction between nitric acid and a basic oxide.

Nitric acid react with zinc oxide to produce zinc nitrate and water.

$$2HNO_3 + ZnO \rightarrow Zn(NO_3)_2 + H_2O$$

Magnesium react with nitric acid to produce nitrate magnesium and water.

$$MgO + 2HNO_3 \rightarrow Mg((NO_3)_2 + H_2O$$

19. What happens when PCl_5 is heated?

$$PCl_{5(g)} \xrightarrow{\Delta} PCl_{3(g)} + Cl_{2(g)}$$

20. Suggest a reason why HF is a weak acid, whereas binary acids of the all other halogens are strong acids.

HF is the weakest acid because of it's strong H-F bond.
Fluorine being small in size overlaps better with 1s orbital of hydrogen leading to a strong bond.
Hence can not give proton easily.Here bond strength overweighs the electronegativity of F

21. Deduce the oxidation number of oxygen in hypofluorous acid – HOF.

H - O - F +1 + x - 1= 0 , x =0

The oxidation state of the oxygen in hypofluorites is 0.
It is also the only hypohalous acid that can be isolated as a solid.

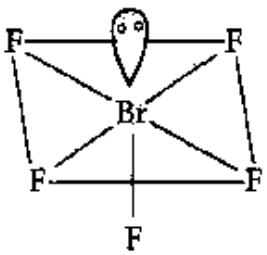
22. What type of hybridisation occur in a) BrF_5 b) BrF_3

b) BrF_5

Valence electron 7+ bonding electron 5 = 12

$X = \frac{12}{2} = 6$

Hybridization : sp^3d^2
Geometry: Square Pyramidal

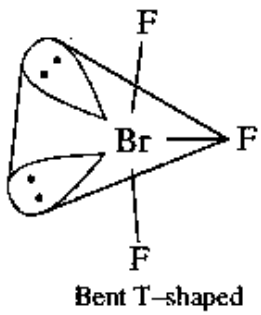


b) BrF3

Valence electron 7+ bonding electron 3 = 10

$X = \frac{10}{2} = 5$

Hybridization: sp^3d
Geometry: Trigonal Bipyramidal
Shape - T-shaped
lone pair - 2 bond pair - 3



Bent T–shaped

23. Complete the following reactions.

1. $NaCl + MnO_2 + H_2SO_4 \longrightarrow$
2. $NaNO_2 + HCl \longrightarrow$
3. $IO_3^- + I^- + H^+ \longrightarrow$
4. $I_2 + S_2O_3^{2-} \longrightarrow$
5. $P_4 + NaOH + H_2O \longrightarrow$
6. $AgNO_3 + PH_3 \longrightarrow$
7. $Mg + HNO_3 \longrightarrow$
8. $KClO_3 \xrightarrow{\Delta}$
9. $Cu + \underset{\text{Hot conc}}{H_2SO_4} \longrightarrow$
10. $Sb + Cl_2 \longrightarrow$
11. $HBr + H_2SO_4 \longrightarrow$
12. $XeF_6 + H_2O \longrightarrow$
13. $XeO_6^{4-} + Mn^{2+} + H^+ \longrightarrow$
14. $XeOF_4 + SiO_2 \longrightarrow$
15. $Xe + F_2 \xrightarrow[400^0C]{Ni\ /\ 200\ atm}$

Ans:

1. $4NaCl + MnO_2 + 4H_2SO_4 \longrightarrow Cl_2 + MnCl_2 + 4NaHSO_4 + 2H_2O$
2. $NaNO_2 + HCl \longrightarrow NaCl + HNO_2$
3. $IO^{3-} + 5\ I^- + 6\ H^+ \longrightarrow 3\ I_2 + 3\ H_2O$
4. $I_2 + 2\ S_2O_3^{2-} \longrightarrow 2I^- + S_4O_6^{2-}$
5. $P_4 + 3NaOH + 3H_2O \longrightarrow 3NaH_2PO_2 + PH_3$
6. $3AgNO_3 + PH_3 \longrightarrow Ag_3P + 3HNO_3$
7. $4Mg + 10\ HNO_3 \longrightarrow 4Mg(NO_3)_2 + NH_4NO_3 + 3H_2O$

   If the acid is diluted we get N_2O

   $4Mg + 10\ HNO_3 \longrightarrow 4Mg(NO_3)_2 + N_2O_5 + 5H_2O$
8. $2\ KClO_3 \xrightarrow{MnO_2} 2\ KCl + 3O_2$
9. $Cu + 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$

   (Hot Conc.)
10. $2Sb + 3Cl_2 \longrightarrow 2SbCl_3$
11. $2HBr + H_2SO_4 \longrightarrow 2H_2O + Br_2 + SO_2$
12. $XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$
13. $5XeO_6^{4-} + 2\ Mn^{2+} + 14H^+ \longrightarrow 2MnO_4^- + 5XeO_3 + 7H_2O$
14. $2\ XeOF_4 + SiO_2 \longrightarrow 2XeO_2F_2 + SiF_4$
15. $Xe + F_2 \xrightarrow[400°C]{Ni\ /200\ atm} XeF_2$