UNIT-7: p - BLOCK ELEMENTS

Group-15 elements	
Give reasons for the following (one mark each):	
1. In group 15 elements, there is considerable increase in covalent radius from N to P but small increase from As to Bi. Why?	U
2. The ionization enthalpies of group 15 elements are higher than those of corresponding members of group 14 and 16 elements.	U
3. Bi (V) is a strong oxidizing agent.	U
4. $(CH_3)_3P$= O exists but $(CH_3)_3N$= O does not.	U
5. The boiling point of PH_3 is lesser than NH_3.	U
6. Metallic character increases down the 15th group elements.	U
7. NO_2 dimerises to form N_2O_4.	U
8. Cr, Al do not dissolve in concentrated HNO_3.	U
9. White phosphorus is the most reactive allotrope of the element.	U
10. PCl_3 fumes in moist air.	U
11. The five bonds in $PCl_{5(g)}$ are not equivalent.	U
12. The basicity of H_3PO_3 is 1.	U
13. H_3PO_2 is a stronger reducing agent than H_3PO_3	U
One mark questions	
1. Name the 15th group element that does not exhibit allotropy.	K
2. Complete the equation: $3HNO_2 \xrightarrow{\text{disproportionation}}$	K
3. Write the formula of the halide of nitrogen that is known to be stable.	K
4. Give an example for a neutral oxide of nitrogen.	K
5. Complete the equation: $PCl_3 + 3H_2O \longrightarrow$	K
6. Which oxyacid of phosphorus on disproportionation gives H_3PO_4 and PH_3?	K
Two mark questions	
1. N_2 molecule is chemically inert while white phosphorus is more reactive. Give reasons.	U
2. How is nitrogen prepared in the laboratory? Write the equation for the reaction involved.	K
3. Ammonium salt $\xrightarrow[\Delta]{+\text{caustic soda}}$ X (g) $\xrightarrow{Cu^{2+}_{aq}}$ Y. What are X and Y?	K
4. Complete the following equations : i) $(NH_4)_2Cr_2O_7 \xrightarrow{\text{heat}}$ ii) $Ca_3P_2 + 6H_2O_{(l)} \longrightarrow$	K

5. Complete the following equations : i) $Ba(N_3)_2 \xrightarrow{heat}$ ii) $PH_4I + KOH \longrightarrow$	K
6. Complete the following equations : i) $Cu + 4HNO_{3\ (conc.)} \longrightarrow$ ii) $I_2 + 10HNO_3(conc.) \longrightarrow$	K
7. Complete the following equations : i) $4Zn + 10HNO_{3(dil)} \longrightarrow$ ii) $P_4 + 20HNO_{3(conc)} \longrightarrow$	K
8. Complete the following equation and name the gas liberated: $P_4 + 3NaOH + 3H_2O \longrightarrow$	K
9. i) What is the shape of PCl_5 in gaseous and liquid state? ii) In the solid state PCl_5 exists as an ionic solid. Write the cation and anion in it.	K
10. Draw the structures of: a) Nitric acid b) Hypophosphorous acid	S
11. Draw the structure of $H_4P_2O_7$. What is its basicity?	S
12. What is the formula of cyclotrimetaphosphoric acid? How many P–O–P bonds are in it?	S
Three mark questions:	
1. Arrange: NH_3, PH_3, AsH_3, SbH_3, BiH_3 as directed. i) increasing order of base strength ii) decreasing order of stability iii) decreasing order of reducing character	U
2. For the preparation of ammonia by Haber's process, i) Write the balanced chemical equation ii) mention the reaction conditions iii) Draw the flow chart	K
3. How is HNO_3 prepared commercially by Ostwald process? Write chemical equations for the reactions involved.	K
4. Give differences between white phosphorus and red phosphorus based on i) structure ii) solubility in CS_2 iii) reaction with air.	U
5. $P_4 + 10Cl_2 \longrightarrow X \xrightarrow{1\ mol\ H_2O} Y \xrightarrow{3\ mol\ H_2O} Z$. What are X, Y, Z? (All are compounds of phosphorus)	A
Five mark questions:	
1. a) Give appropriate reason for the following anomalous behaviour of nitrogen: i) it is a diatomic gas ii) it has least catenation property iii) it does not form a pentahalide b) Complete the following equations: i) $4H_3PO_3 \xrightarrow{heat}$ ii) $3HgCl_2 + 2PH_3 \longrightarrow$	U

2. An unknown salt 'X' reacts with hot conc. H_2SO_4 to produce a reddish brown gas 'Y' which intensifies on adding on copper turnings. On adding dilute ferrous sulphate solution to an aqueous solution of X and then carefully adding conc. H_2SO_4 along the sides of the test tube, a brown complex 'Z' is formed at the interface between the solution and H_2SO_4. Identify X, Y and Z and write the chemical equations involved in the reaction.	A
3. a) How is PH_3 prepared in the laboratory? How is it purified? Write the chemical equations for the reactions involved.	
b) Name the gas liberated when a solution of PH_3 in water is exposed to light.	K
4. A white waxy, translucent solid, X, insoluble in water but soluble in CS_2, glows in dark. X dissolves in NaOH in an inert atmosphere giving a poisonous gas (Y). X catches fire in air to give dense white fumes of Z.	
i) Identify X, Y and Z and write the chemical equations of the reactions involved.	A
Group-16 elements	
Give reasons for the following (one mark each):	
1. There is large difference between the melting and boiling points of oxygen and sulphur.	U
2. Oxygen has less negative electron gain enthalpy than sulphur.	U
3. In group 16, +4 oxidation state becomes more stable than +6 oxidation state on going down the group.	U
4. Oxygen can show a maximum covalency of 4 and it cannot form hexavalent compound.	U
5. Boiling point of H_2O is higher than that of H_2S.	U
6. H_2S is more acidic than H_2O	U
7. O_3 is thermodynamically unstable than O_2	U
8. Ozone is a powerful oxidising agent.	U
9. Sugar chars in concentrated sulphuric acid.	U
10. SF_6 is exceptionally stable.	U
11. The bond lengths O–O in ozone are identical.	U
One mark questions:	
1. Name the radioactive element in the 16th group.	K
2. What is the oxidation number of oxygen in OF_2?	K
3. Write the structure of oleum.	S

Two mark questions:	
1. Write the chemical formula of : a) Gypsum salt b) Epsom salt	K
2. Complete the equations: i) $2Pb_3O_{4\,(s)} \xrightarrow{heat}$ ii) $4Al + 3O_2 \xrightarrow{heat}$	K
3. Which among these is (i) basic oxide ii) mixed oxide? a) Al_2O_3 b) Na_2O c) Cl_2O_7 d) Fe_3O_4	U
4. How is ozone prepared? Mention the conditions required and write an equation.	K
5. How is ozone estimated quantitatively?	K
6. Complete the following equations : i) $C_{12}H_{22}O_{11} \xrightarrow{conc.H_2SO_4}$ ii) $2KClO_3 \xrightarrow[heat]{MnO_2}$	K
7. How do you prepare β-sulphur from α-sulphur?	K
8. Above 1000°C which species of sulphur is dominant? What is its magnetic property?	K
9. $SO_3^{2-} + 2H^+ \longrightarrow$ A(gas) $\xrightarrow[charcoal]{+Cl_2}$ B. What are A and B?	K
10. High pressure and low temperature favours maximum yield of sulphur trioxide in contact process. Give reasons.	U
11. Complete the equation: i) $Cu + 2H_2SO_{4\,(conc.)} \longrightarrow$ ii) $CaF_2 + H_2SO_{4\,(conc)} \longrightarrow$	K
12. Write the formula of any two oxoacids of Sulphur.	K
13. Draw the structure of $H_2S_2O_8$ and name the acid.	S
14. Complete the following equations : i) $3S + 2H_2SO_4 \xrightarrow{conc}$ ii) $PbS + 4O_3 \longrightarrow$	K
15. Complete the following equations : i) $2KI + H_2O + O_3 \longrightarrow$ ii) $NaNO_3 + H_2SO_4 \longrightarrow$	K
Three mark questions:	
1. Give any three reasons for the anomalous behaviour of oxygen.	K
2. Arrange: H_2O, H_2S, H_2Se, H_2Te as directed: i) decreasing acidity ii) increasing reducing property iii) increasing thermal stability	U
3. Out of the following hydrides : H_2S , H_2O , H_2Te which one will have : i) lowest boiling point ii) highest bond angle iii) highest electropositive hydrogen.	U
4. Write chemical equations involved during the manufacture of sulphuric acid by contact process mentioning the reaction conditions.	K

Group-17 elements	
Give reasons for the following (one mark each):	
1. The negative value of electron gain enthalpy of fluorine is less than that of chlorine.	U
2. Bond dissociation enthalpy of F_2 is less than that of Cl_2.	U
3. Most of the reactions of fluorine are exothermic.	U
4. HF is the weakest acid among hydrogen halides.	U
5. Thermal stability of hydrogen halides decreases from fluoride to iodide.	U
6. HF is a liquid while other hydrogen halides are gases.	U
7. Halogens have maximum negative electron gain enthalpy in their corresponding periods.	U
8. Halogens are coloured.	U
9. Halogens are strong oxidizing agent.	U
10. Interhalogen compound is more reactive than the halogens from which it is formed.	U
11. HCl reacts with finely powdered iron to form ferrous chloride, but not ferric chloride.	U
One mark questions:	
1. Name the gas liberated when fluorine reacts with water.	K
2. Name the only oxyacid of fluorine.	K
3. Arrange these in the decreasing order of their stability: I_2O_4, ClO_2, BrO_2.	U
4. Name the iodine oxide that is used in estimation of carbon monoxide.	K
5. Complete the equation: $I_2 + 6H_2O + 5Cl_2 \longrightarrow$	K
6. Write the composition of bleaching powder.	K
7. What is the composition of aqua regia?	K
8. Write the structure of perchloric acid.	S
9. Which one of the interhalogen compound is not known: ICl_3 or ICl_2?	U
Two mark questions	
1. Fluorine exhibits only –1 oxidation state whereas other halogens exhibit positive oxidation states also.	U
2. Compare the reaction of fluorine and chlorine with water. Give equations.	K
3. Describe how chlorine is manufactured by Deacon's process. Give the equation.	K
4. $KMnO_4 + HCl \longrightarrow P_{(g)} \xrightarrow{+H_2S} Q$ (yellow solid). What are P and Q?	A

5. Complete the following equations :

   i) $SO_2 + 2H_2O + Cl_2 \longrightarrow$ ii) $2Ca(OH)_2 + 2Cl_2 \longrightarrow$ K

6. Complete the following equations :

   i) $8NH_{3(Excess)} + 3\ Cl_2 \longrightarrow$ ii) $Cl_2 + 2NaOH_{\text{ (cold and dil)}} \longrightarrow$ K

7. Complete the following equations :

   i) $NH_3 + 3Cl_{2(Excess)} \longrightarrow$ ii) $Cl_2 + 6NaOH_{\text{ (hot \& conc)}} \longrightarrow$ K

8. Complete the following equations :

   i) $Fe + 2HCl \longrightarrow$ ii) $Cl_2 + 3F_{2(Excess)} \xrightarrow{573K}$ K

9. What is the cause for bleaching action of chlorine water? Explain it with equations. K

10. How are interhalogen compounds formed? IF_7 is possible but not ICl_7. Why? K

11. What is the shape of: i) ClF_3 ii) IF_7 ? S

Three mark questions:

1. Arrange the following in the order of the property indicated for each set.

   i) F_2, Cl_2, Br_2, I_2 (Increasing bond dissociation energy).

   ii) HF, HCl, HBr, HI (decreasing acid strength)

   iii) Cl_2O, Cl_2O_6, ClO_2, Cl_2O_7 (increasing oxidation state of chlorine). U

2. Match the following:

Formula	Property	Use
i) O_2F_2	Bleaching	Estimation of CO
ii) ClO_2	Fluorinating	Pu from spent fuel
iii) I_2O_5	Oxidising	Water treatment

A

3. X_2 is a greenish yellow gas with pungent smell used in purification of water. It partially dissolves in H_2O to give a solution which turns blue litmus red. When X_2 is passed through NaBr solution, Y_2 is liberated. Identify X_2 and Y_2. What is the colour of Y_2? A

4. What is aqua regia? How does it dissolve noble metals like Au? Write the ionic equations for the reactions involved. K

Five mark questions:

1. a) Name two properties each that have exceptionally high and exceptionally low values for fluorine.

   b) Complete the equation: $XX' + H_2O \longrightarrow$ K

2. a) Identify A, B and C: $MnO_2 + HCl \xrightarrow{heat} A_{(g)} \xrightarrow{NaI_{(aq)}} B \xrightarrow{A_{(excess)}} C$

   b) i) Between $PbCl_2$ and $PbCl_4$ which is more covalent?

   ii) Arrange MF, MCl, MBr, MI in decreasing order of their ionic character. U

Group-18 elements	
Give reasons for the following (one mark each):	
1. Group 18 elements have very high ionisation enthalpy.	U
2. Noble gases have large positive value for electron gain enthalpy.	U
3. Group 18 elements have very low boiling and melting point.	U
One mark questions:	
1. Name the main commercial source of helium.	K
2. Radon is obtained by radioactive decay of the isotope _____	K
3. Name the most abundant noble gas present in dry air.	K
4. The first ionisation enthalpy of which molecule is almost similar to ionisation enthalpy of xenon?	K
5. Arrange the following in the increasing number of lone pair of electrons on xenon: XeF_4, XeF_6, XeF_2	U
6. Name the noble gas that has lowest boiling point known and also diffuses through rubber.	K
7. Complete the equation: $2XeF_{2\,(s)} + 2H_2O_{\,(l)} \longrightarrow$	K
8. Complete the equation: $XeF_6 + NaF \longrightarrow$	K
Two mark questions:	
1. Noble gases are chemically inert. Give two reasons.	K
2. Complete the following equations: i) $XeF_6 + 3H_2O \xrightarrow{\text{Complete hydrolysis}}$ ii) $PtF_6 + Xe \longrightarrow$	K
3. Draw the structures of : i) XeF_2 ii) XeO_3.	S
4. What is the geometry of i) XeF_4 ii) XeF_6.	S
5. How many lone pair of electrons in: i) $XeOF_4$ ii) XeO_3?	K