Exercise-1

Marked questions are recommended for Revision.

PART - I : SUBJECTIVE QUESTIONS

Section (A) : Occurence, Atomic & Physical Properties.

A-1. Nitrogen forms a simple diatomic molecule but other elements of same group do not form. Explain.

A-2. White phosphorus is very reactive, but not the red one. Why ?

A-3. Which allotropic form of sulphur is thermodynamically stable at room temperature and pressure ?

A-4. The important source of phosphorus is phosphorite rocks which is mainly phosphates. The same chemical compound is also present in bones. What is the formula of the compound(s).

Section (B) : General trends & Chemical Properties.

B-1. Why is Bi (V) a stronger oxidant than Sb (V)?

B-2. Nitrogen shows different oxidation states in the range _____ to _____. It most stable oxidation state is_____ .

B-3. The tendency to exhibit –3 oxidation state by a group VA element decreases down the group. Why ?

B-4. Why sulphur in vapour state exhibits paramagnetic behaviour at above 800ºC.

B-5. Write the following for a white phosphorus molecule :
(a) oxidation state of P (b) covalency of P (c) total number of bonds
(d) bond order. (e) bond angle (f) geometry

B-6. Tellurium forms oxides of the formula TeO, TeO_2 and TeO_3. What is the nature of these tellurium oxides?

B-7. Write the structure and oxidation numbers of sulphur in tetrathionate ion.

B-8. The bond angle in PH_4^+ is higher than that in PH_3. Why ?

B-9. Write the oxyacids of the following :

Oxide	Oxyacids
N_2O_3	
NO_2/N_2O_4	
N_2O_5	
P_4O_6	
P_4O_{10}	

B-10. N_2, CO, CN^- and NO^+ are isoelectronic but the former is chemically inert and latter three are very reactive, why ?

B-11. On moving down the group from H_2O to H_2Te acidic strength increases, why ?

Section (C) : Preparation & Properties of elements

C-1. What happens when barium azide is heated ?

C-2. Which stable elements of 15^{th} and 16^{th} group do not react with water under normal conditions ?

C-3. Chemiluminescence is a phenomenon in which on element glows in dark when exposed to moisture. Which element of 15^{th} group shows this phenomenon ?

Section (D) : Hydrides

D-1. Among the hydrides of group 16, water shows unusual boiling point. Why ?

D-2. Ammonium salts generally resemble those of potassium and rubidium in solubility & structure. Give reason

D-3. Write balanced equation when NH_3 is dissolved in
(a) water (b) HCl (c) aq. CO_2

D-4. What happens when phosphine is absorbed in mercuric chloride solution ?

D-5. On being slowly passed through water, PH_3 forms bubbles but NH_3 dissolves. Why is it so ?

D-6. How is hydrazine prepared ?

D-7. Both PH_3 and NH_3 are Lewis bases, but basic strength of PH_3 is less than that of NH_3. Explain

Section (E) : Oxides

E-1. In the preparation of P_4O_6, a mixture of N_2 and O_2 is used rather than pure O_2, Why ?

E-2. A compound of 15^{th} group element is used as a fast drying agent in the laboratory. It is :

E-3. Write the structures of the oxides : N_2O_3, N_2O_5, P_4O_6 and P_4O_{10}.

E-4. Why does NO_2 dimerise ?

Section (F) : Oxyacids

F-1. In the manufacture of sulphuric acid by the contact process, sulphur trioxide is not directly dissolved in water. Why ?

F-2. How are $SO_2Cl_2.SO_3$ and SO_2 obtained from sulphuric acid ?

F-3. Sulphur on oxidation with hot sulphuric acid gives :

Section (G) : Halides and Oxyhalides

G-1. Pentahalides of phosphorus are known, but not pentahydride. Why ?

G-2. A compound 'X' which is a yellowish white powder is prepared by the reactions of white phosphours with excess of dry Cl_2. Identify 'X' :

G-3. Which hydride of the oxygen family shows the lowest boiling point?

G-4. What happens when
(A) PCl_5 is heated.
(B) PCl_5 is reacted with heavy water.

G-5. Why does PCl_3 fume in moist air ?

G-6. Complete and balance the following :
(i) $P_4O_{10} + PCl_5 \longrightarrow$ (ii) $NH_3 + NaOCl \xrightarrow{\text{Gelatin}}$

Section (H) : Miscellaneous Compounds

H-1. $NaHSO_3 + [X]$ (excess) $+ H_2O \longrightarrow NaHSO_4 + HI$
$[X] + Na_2S_2O_3 \longrightarrow NaI + [Y]$
Identify X & Y ?

H-2. Identify the product of the given reaction :
$AgBr + 2Na_2S_2O_3 \longrightarrow$ H_2SO_4 (dil) $+ Na_2S_2O_3 \longrightarrow$ H_2SO_4 (conc.) $+ Na_2S_2O_3 \longrightarrow$

H-3. A and B are elements with atomic numbers 16 and 17. Write different combinations of binary compounds known from them.

PART - II : ONLY ONE OPTION CORRECT TYPE

Section (A) : Occurence, Atomic & Physical properties.

A-1. Which of the following is least reactive ?
(A) White phosphorus (B) Yellow phosphorus (C) Red phosphorus (D) Black phosphorus

A-2. Nitrogen is best obtained by the thermal decomposition of which one of the following :
(A) NH_4Cl (B) NH_4NO_3 (C) $AgNO_3$ (D) NH_4NO_2

A-3. In modern process, white phosphorus is manufactured by :
(A) heating a mixture of phosphorite mineral with sand and coke in an electric furnace
(B) heating calcium phosphate with lime
(C) heating bone ash with coke
(D) heating phosphate mineral with sand.

Section (B) : General trends & Chemical Properties.

B-1. The oxidation state of sulphur in the anions SO_3^{2-}, $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follows the order :
(A) $S_2O_6^{2-} < SO_4^{2-} < SO_3^{2-}$ (B) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$
(C) $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$ (D) $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$

B-2. Correct statement about allotropy of sulphur is :
(A) Monoclinic sulphur is more stable than Rhombic sulphur at room temperature.
(B) Both Monoclinic and Rhombic sulphur have same ring structures and crystalline structure.
(C) Rhombic sulphur exists at room temperature.
(D) None of these

B-3. The nitrogen atom may complete its octet in several ways. Which one is incorrect ?
(A) Electron gain to form the nitride Ion, N^{3-} e.g. Li_3N.
(B) Formation of electron pair bonds. e.g. NH_3 or NF_3 Azo compounds (–N=N–)
(C) Formation of electron - pair bonds with electron gain. e.g. Amide ion NH_2^- and imide ion NH^{2-}.
(D) Formation of electron pair bonds with electron gain : NH_4^+ ; $N_2H_5^+$; $(C_2H_5)_4\ N^+$

B-4. $\underset{\text{Ammonium}}{NH_4^+}$, $\underset{\text{Ammonia}}{NH_3}$, $\underset{\text{Amide}}{NH_2^-}$, $\underset{\text{Imide}}{NH^{2-}}$ and $\underset{\text{Nitride}}{N^{3-}}$ are :
(A) Isoelectronic (B) Isostructural
(C) Homologous members (D) Nitrogen has different oxidation state

B-5. How many P=O bonds are present in $(HPO_3)_3$?
(A) 0 (B) 6 (C) 3 (D) 9

B-6. The correct order of sulphur – oxygen bond energy in $S_2O_3^{2-}$, SO_4^{2-}, SO_3 and $S_2O_6^{2-}$ is
(A) $S_2O_3^{2-} < SO_4^{2-} < SO_3 < S_2O_6^{2-}$ (B) $S_2O_3^{2-} < S_2O_6^{2-} < SO_4^{2-} < SO_3$
(C) $S_2O_3^{2-} < SO_4^{2-} < S_2O_6^{2-} < SO_3$ (D) $S_2O_6^{2-} < SO_4^{2-} < SO_3 < S_2O_3^{2-}$

B-7. Which of the following bonds has the highest bond energy ?
(A) Se–Se (B) Te–Te (C) S–S (D) O–O

B-8. The wrong statement about N_2O is :
(A) it is nitrous oxide (B) it is a neutral oxide
(C) it is not a linear molecule (D) it is known as laughing gas

B-9. The hydrides of group 15 elements can act as :
(A) lewis acid (B) lewis base (C) both (D) none

B-10. The basic strength of the hydrides of group 15 elements :
(A) decreases on moving down the group
(B) increases on moving down the group
(C) first decreases upto AsH_3 and then increases
(D) first increases upto AsH_3 and then decreases

Section (C) : Preparation & Properties of elements

C-1. Ammonium salts decompose quite readily on heating :
(i) Ammonium salt of weak oxidizing anion (e.g. Cl^-, CO_3^{2-}, SO_4^{2-}) $\xrightarrow{heat}$ Gas X
(ii) Ammonium salt of strong oxidizing anion (e.g. NO_2^-, NO_3^-, ClO_4^-, $Cr_2O_7^{2-}$) $\xrightarrow{heat}$ Gas Y/Z
Identify X, Y, Z
(A) N_2, NH_3, N_2O (B) NH_3, N_2, N_2O (C) N_2O, NH_3, N_2 (D) NO, NH_3, N_2O

C-2. Which of the following does not give oxygen on heating ?
(A) $(NH_4)_2Cr_2O_7$ (B) $KClO_3$ (C) $Zn(ClO_3)_2$ (D) $K_2Cr_2O_7$

C-3. Red and white phosphorus will differ but not in :
(A) smell (B) solubility in $CHCl_3$
(C) exhibiting phosphorescence (D) reaction with concentrated HNO_3

C-4. Which of the following is incorrect ?
(A) Ammonia is prepared in the laboratory by the action of NaOH on Ammonium salt.
(B) All the hydrides of 15th group are colourless, highly volatile and poisonous gases
(C) Metal phosphides upon hydrolysis give phosphine.
(D) Metal phosphides upon hydrolysis give phosphoric acid.

C-6. P_4 + NaOH $\xrightarrow{warm}$ Products
Products will be :
(A) $H_3PO_4 + PH_3$ (B) $PH_3 + NaH_2PO_2$
(C) $NaH_2PO_2 + H_3PO_4$ (D) H_3PO_4

C-7. Hydrolysis of Nitride of s-Block elements (for e.g. Ba_3N_2, Ca_3N_2, Li_3N) will yield
(A) NH_3 + Metal hydroxide (B) only NH_3
(C) $NH_3 + HNO_3$ (D) NH_4OH

Section (D) : Hydrides

D-1. The thermal stability of the hydrides of group 15 follows the order :
(A) $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$ (B) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$
(C) $PH_3 > NH_3 > AsH_3 > SbH_3 < BiH_3$ (D) $AsH_3 < PH_3 > SbH_3 > BiH_3 > NH_3$

D-2. One mole of calcium phosphide on reaction with excess water gives :
(A) one mole of phosphine (B) two moles of phosphoric acid
(C) two moles of phosphine (D) one mole of phosphorus pentoxide

D-3. H_2S burns in O_2 to form
(A) $H_2O + S$ (B) $H_2O + SO_2$ (C) $H_2O + SO_3$ (D) $H_2SO_4 + S$

D-4. PH_3 (anhydrous) + HBr (anhydrous) $\longrightarrow$ X. Identify X ?
(A) H_3BrO_3 (B) PH_4Br (C) Br_2 (D) P_4

D-5. Calcium phosphide reacts with water or dil. HCl and gives a compound 'X', which fails to react with HCl but produces dense white fumes with HI (g) due to formation of 'Y'. Compound X and Y respectively.
(A) X = PH_3 and Y = PH_4I (B) X = NaH_2PO_2 and Y = H_3PO_2
(C) X = PH_4^+ and Y = PH_4I (D) X = PH_3 and Y = H_3PO_2

D-6. $N_2 \xrightarrow[\text{Haber's Process}]{H_2} X \xrightarrow[\text{Ostwald's Process}]{O_2} Y \xrightarrow{O_2+H_2O} Z$
Identify X, Y, Z
(A) NH_3, NO_2, HNO_3 (B) NH_3, NO, HNO_3 (C) NO_2, NH_3, HNO_2 (D) NH_3, NO, HNO_2

Section (E) : Oxides

E-1. Sulphur trioxide can be obtained by which of the following reactions :
(A) $S + H_2SO_4 \xrightarrow{\Delta}$ (B) $H_2SO_4 + PCl_5 \xrightarrow{\Delta}$
(C) $CaSO_4 + C \xrightarrow{\Delta}$ (D) $Fe_2(SO_4)_3 \xrightarrow{\Delta}$

E-2. NO_2 can be prepared by heating :
(A) NH_4NO_3 (B) $NaNO_3$ (C) $Pb(NO_3)_2$ (D) KNO_3

E-3. $HNO_3 + P_4O_{10} \longrightarrow HPO_3 + X$
in the above reaction the product X is :
(A) NO_2 (B) N_2O_3 (C) N_2O_4 (D) N_2O_5

E-4. Which of the following oxides of Nitrogen is Neutral
(A) N_2O_5 (B) N_2O_3 (C) N_2O_4 (D) N_2O

E-5. Which of the following oxides is amphoteric in nature ?
(A) N_2O_3 (B) P_4O_6 (C) Sb_4O_6 (D) Bi_2O_3

E-6. Following are neutral oxides except :
(A) NO (B) N_2O (C) CO (D) NO_2

E-7. Aqueous solution of SO_2 is a :
(A) weak acid (B) reducing agent (C) bleaching agent (D) All of these

E-8. Which of the following oxides is the most acidic ?
(A) N_2O_5 (B) P_2O_5 (C) As_2O_5 (D) Sb_2O_5

Section (F) : Oxyacids

F-1. The correct order of decreasing acidic strength of oxy acids of group 15 elements :
(A) $HNO_3 > H_3SbO_4 > H_3AsO_4 > H_3PO_4$ (B) $H_3PO_4 > H_3AsO_4 > H_3SbO_4 > HNO_3$
(C) $HNO_3 > H_3PO_4 > H_3AsO_4 > H_3SbO_4$ (D) $HNO_3 > H_3AsO_4 > H_3PO_4 > H_3SbO_4$

F-2. Industrial preparation of nitric acid by ostwald's process involves :
(A) oxidation of NH_3 (B) Reduction of NH_3
(C) Hydrogenation of NH_3 (D) Hydrolysis of NH_3

F-3. Which of the following is the most powerful oxidising agent :
(A) H_2SO_4 (B) HPO_3 (C) H_3BO_3 (D) H_3PO_4

F-4. When P_4O_{10} is dissolved in water, the acid formed finally is :
(A) H_3PO_2 (B) H_3PO_4 (C) H_3PO_3 (D) $H_4P_2O_7$

F-5. Which of the following reactions depict the oxidising behaviour of H_2SO_4 ?
(A) $2PCl_5 + H_2SO_4 \longrightarrow 2POCl_3 + 2HCl + SO_2Cl_2$
(B) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$
(C) $NaCl + H_2SO_4 \longrightarrow NaHSO_4 + HCl$
(D) $2HI + H_2SO_4 \longrightarrow I_2 + SO_2 + 2H_2O$

Section (G) : Halides and Oxyhalides

G-1. The order of stability of halides of sulphur with different halogens is :
(A) $I^- > Br^- > Cl^- > F^-$ (B) $F^- > Cl^- > Br^- > I^-$ (C) $Br^- > Cl^- > I^- > F^-$ (D) $F^- > Cl^- > I^- > Br^-$

G-2. Ammonia reacts with excess of chlorine to form :
(A) N_2 and NH_4Cl (B) NCl_3 and HCl (C) NH_4Cl and NCl_3 (D) N_2 and HCl

G-3. A yellow coloured crystalline substance gave a colourless gas X on reaction with flourine, which is thermally stable and has octahedral geometry. X can be.
(A) SF_4 (B) SF_6 (C) SF_2 (D) S_2F_6

G-4. PCl_3 reacts with water to form :
(A) PH_3 (B) H_3PO_3 and HCl (C) $POCl_3$ (D) H_3PO_4

G-5. The final product obtained on hydrolysis of PCl_5 is :
(A) H_3PO_4 (B) H_3PO_3 (C) $POCl_3$ (D) PH_3

G-6. Which of the following phosphorus halide is the best reducing agent?
(A) PCl_3 (B) PF_3 (C) PBr_3 (D) PI_3

Section (H) : Miscellaneous Compounds

H-1. When sulphur is boiled with Na_2SO_3 solution, the compound formed is :
(A) sodium sulphide (B) sodium sulphate (C) sodium persulphate (D) sodium thiosulphate

H-2. $Na_2S_2O_3$ is prepared by :
(A) reacting $H_2S_2O_3$ with NaOH. (B) reacting Na_2SO_4 with S in alkaline medium.
(C) heating NaOH and S. (D) reducing Na_2SO_4 with S in acidic medium.

H-3. The products of the chemical reaction between $Na_2S_2O_3$, Cl_2 and H_2O are :
(A) HCl + Na_2S (B) HCl + $NaHSO_4$ (C) HCl + Na_2SO_3 (D) $NaHClO_3$ + H_2O

H-4. The term 'thio' is used in the names of all of the following compounds except :
(A) $Na_2S_2O_3$ (B) $Na_2S_2O_6$ (C) NaSCN (D) Na_2SO_3

H-5. Which of the following gives H_2O_2 on hydrolysis ?
(A) $H_2S_2O_3$ (B) H_2SO_5 (C) $H_2S_2O_7$ (D) $H_2S_4O_6$

H-6. Which of the following is not formed in the below reaction :
$O_3 + KI + D_2O \longrightarrow$
(A) KOH (B) O_2 (C) I_2 (D) KOD

PART - III : MATCH THE COLUMN

1. Match the reactions listed in column-I with characteristic(s) / type of reactions listed in column-II.

	Column–I		**Column–II**
(A)	$PCl_5 \xrightarrow[Air]{Moist}$	(p)	Hydrolysis
(B)	$P_4 + NaOH\ (conc.) + H_2O \xrightarrow{Warm}$	(q)	At least one of the products has tetrahedral hybridisation
(C)	$H_3PO_3 \xrightarrow{200^oC}$	(r)	Disproportionation
(D)	$P_4O_6 + H_2O \xrightarrow{200^oC}$	(s)	At least one of the products has $p\pi$–$d\pi$ bonding.

2. Match the oxy-acids of phosphorus listed in column-I with type of bond(s) listed in column-II.

	Column-I		**Column-II**
	(Oxy acids of phosphoros)		**(Characteristic bonds)**
(A)	$H_4P_2O_7$	(p)	P—P bond (s)
(B)	$H_4P_2O_5$	(q)	P—O—P bond (s)
(C)	$H_3P_3O_9$	(r)	P—H bond (s)
(D)	$(HPO_3)_n$ (cyclic)	(s)	Three or four P—OH bonds

Exercise-2

Marked questions are recommended for Revision.

PART - I : ONLY ONE OPTION CORRECT TYPE

1. In case of nitrogen, NCl_3 is possible but not NCl_5 while in case of phosphorous, PCl_3 as well as PCl_5 are possible. It is due to
(A) Availability of vacant d-orbital in P but not in N
(B) Lower electronegativity of P than N
(C) Lower tendency of H bond formation in P than N
(D) Occurrence of P in solid while N in gaseous state at room temperature.

2. The P-P-P bond angle in white phosphorus is close to :
(A) 120º (B) 109º28' (C) 90º (D) 60º

3. Red phosphorus can be prepared from white phosphorus by :
(A) adding red colour to white phosphorus
(B) heating white phosphorus to red heat
(C) heating white phosphorus in inert atmosphere to 250ºC or at low temperature in the presence of sun light.
(D) heating white phosphorus at high pressure and 473 k temperature.

4. As Rhombic sulphur is heated in a test tube :

	Process	**Temperature**
(a)	Viscosity increases	T_1
(b)	Viscosity decreases	T_2
(c)	Paramagnetic molecules	T_3
(d)	Breakage of S_8 rings	T_4
	(Diradical formation in molten phase)	

Correct order of temperature is :
(A) $T_1 < T_3 < T_4 < T_2$ (B) $T_2 < T_4 < T_3 < T_1$ (C) $T_4 < T_1 < T_2 < T_3$ (D) $T_3 < T_4 < T_1 < T_2$

5. Dinitrogen gas is evolved when sodium nitrite is heated below 500ºC :
(A) alone (B) with ammonium chloride
(C) with sodium chloride (D) with potassium nitrate

6. Which statement is not correct for nitrogen ?
(A) It is obtained by heating $(NH_4)_2Cr_2O_7$ (B) It does not readily react with O_2
(C) It is a typical non-metal (D) d-orbitals are available for bonding

7. Nitrolim is obtained by passing nitrogen over :
(A) heated mixture of Al_2O_3 and carbon (B) oleum
(C) calcium carbide (D) heated calcium carbide

8. Which of the following have $\Delta H^o_f < 0$:
(A) Ozone (B) O (g) (C) P (red) (D) S_8 (monoclinic)

9. CS_2 can separate a mixture of :
(A) P_4 and S_8 (rhombic) (B) P_4 and S_8 (monoclinic)
(C) S_8 (rhombic) and S_8 (monoclinic) (D) S_8 (rhombic) and S (plastic)

10. Which of the following reactions does not liberate oxygen ?
(A) $O_3 + KI + H_2O \longrightarrow$ (B) $H_2O_2 + Cl_2 \longrightarrow$
(C) $KO_2\ (s) + CO_2\ (g) \longrightarrow$ (D) None

11. The gas respectively absorbed by alkaline pyrogallol and oil of cinnamon is :
(A) O_2, O_3 (B) SO_2, O_2 (C) O_3, CH_4 (D) N_2O, O_3

12. Alkaline KI is oxidised by ozone to :
(A) potassium iodate (B) potassium periodate
(C) both (A) and (B) (D) None of these

13. NH_3 can't be obtained by :
(A) heating of NH_4NO_3 or NH_4NO_2 (B) heating of NH_4Cl or $(NH_4)_2\ CO_3$
(C) heating of NH_4NO_3 with NaOH (D) reaction of AIN or Mg_3N_2 or $CaCN_2$ with H_2O

14. When H_2S is passed through nitric acid or acidified $KMnO_4$ solution, the product first formed is :
(A) H_2SO_4 (B) colloidal sulphur (C) SO_2 (D) plastic sulphur

15. Ammonia and red hot CuO react to produce :
(A) Cu_2O, N_2, H_2 (B) Cu, H_2O, N_2 (C) $Cu(OH)_2$, N_2 (D) $[Cu(NH_3)_4](OH)_2$

16. Phosphine is not obtained by the reaction :
(A) White P is heated with NaOH
(B) Red P is heated with NaOH
(C) Ca_3P_2 reacts with water
(D) Phosphorus trioxide is boiled with water under pressure.

17. When ammonia is oxidsed by oxygen in the presence of platinum at 500ºC, the gas obtained is :
(A) N_2O (B) NO (C) NO_2 (D) N_2O_5

18. Substances burn more readily in N_2O than in air because N_2O :
(A) is reactive at high temperature.
(B) dissociates to give more nitrogen than in air.
(C) the activation energy is increased on increasing temperature.
(D) dissociates more readily than O_2.

19. Which of the following is a mixed acid anhydride ?
(A) NO (B) NO_2 (C) N_2O_5 (D) N_2O

20. When an article is bleached by SO_2 it loses its colour. The colour can be restored by :
(A) exposure to air (B) heating (C) dilution (D) none of these

21. The true statement for the acids of phosphorus H_3PO_2, H_3PO_3 and H_3PO_4 is.
(A) H_3PO_3 on heating does not disproportionate
(B) all of them are reducing in nature
(C) all of them are tribasic acids
(D) H_3PO_2 is obtained by alkaline hydrolysis of P_4 (white)

22. Which of the following does not have S–S linkage but has O—O linkage ?
(A) $S_2O_8^{2-}$ (B) $S_2O_6^{2-}$ (C) $S_2O_5^{2-}$ (D) $S_2O_3^{2-}$

23. The true statement for the acids of phosphorus H_3PO_2, H_3PO_3 and H_3PO_4 is :
(A) the order of their reducing strength is $H_3PO_2 > H_3PO_3 > H_3PO_4$.
(B) the hybridisation of phosphorus is sp^2 in all these.
(C) The acidic strength order is $H_3PO_2 > H_3PO_3 > H_3PO_4$.
(D) all of these.

24. Hydrolysis of one mole of peroxydisulphuric acid produces
(A) two moles of sulphuric acid
(B) two moles of peroxymonosulphuric acid.
(C) one mole of sulphuric acid and one mole of peroxy monosulphuric acid.
(D) one mole of sulphuric acid, one mole of hydrogen peroxide.

25. The reaction of SO_2 with PCl_5 yield two oxohalides A and B. 'A' can also be prepared industrially by reaction of SO_3 and SCl_2. Which of the following about A and B is incorrect ?
(A) The structure of B is tetrahedral
(B) The structure of A is trigonal pyramidal
(C) A reacts vigorously with water and is particularly useful for drying or dehydrating readily hydrolysable inorganic halides
(D) A and B contain their respective central atoms in their highest oxidation states.

26. Which of the following cannot dissociate as $PX_5 \rightleftharpoons PX_3 + X_2$
(A) PF_5 (B) PCl_5 (C) PBr_5 (D) PI_5

27. The aqueous solution of hydrogen peroxide :
(A) converts blue litmus pink (B) converts blue litumus white
(C) converts red litumus blue (D) None of these

28. Consider the following compounds :
(1) sulphur dioxide (2) hydrogen peroxide (3) ozone
Among these compounds, those which can act as bleaching agents would include :
(A) 1 and 3 (B) 2 and 3 (C) 1 and 2 (D) 1, 2 and 3

29. Bleaching of a fabric cloth is done using A and excess of chlorine is removed using B. A and B are :
(A) $CaOCl_2$, Na_2SO_3 (B) $Na_2S_2O_3$, $CaOCl_2$ (C) $CaCl_2$, $Na_2S_2O_3$ (D) $CaOCl_2$, $Na_2S_2O_3$

30. Aqueous hypo solution on reaction with aqueous $AgNO_3$ gives :
(A) yellow precipitate changing to black (B) white precipitate changing to black
(C) orange precipitate to blue (D) no precipitate

PART - II : NUMERICAL VALUE TYPE

1. What is the sum of highest and lowest oxidation states for oxygen family.

2. How many of the following is correct order of specified property.

(a)	N > P > As > Sb > Bi	(First ionisation enthalpy)
(b)	N > P > As > Sb	(Electronegativity)
(c)	N–N < P–P < As–As	(Single bond length)
(d)	$As^{3+} > Sb^{3+} > Bi^{3+}$	(Stability of +3 oxidation state)
(e)	White > Red > Black	(Reactivity of allotropes of phosphorus)
(f)	$H_3PO_2 < H_3PO_3 < H_3PO_4$	(Proticity of acids)
(g)	$H_3PO_2 < H_3PO_3 < H_3PO_4$	(Reducing power of acids)

3. How many of the following properties increase down the group for nitrogen family.
(a) Atomic size (b) Acidic character of oxides (c) Boiling point of hydrides
(d) Reducing power of hydrides (e) Extent of $p\pi$-$p\pi$ overlap. (f) Metallic character.
(g) Basic character of hydrides

4. Given below are some properties. How many of these can hold good for phosphorous.
(a) Metal (b) Non-metal (c) Metalloid (d) Exhibits allotropy
(e) Catenation property (f) Solid (g) Good conductor of electricity
(h) Least dense among nitrogen family elements.

5. Below reaction sequence illustrates the various stages of reduction of nitric acid where a, b, c, d are the number of electrons involved in the reduction of 1 mole N-atoms.

$HNO_3 \xrightarrow[ae^-]{} NO_2 \xrightarrow[be^-]{} NO \xrightarrow[ce^-]{} N_2O \xrightarrow[de^-]{} NH_3$

Find the value of (2a + b + 3c – d).

6. A yellow coloured crystalline element gives a colourless gas (X) on reaction with fluorine which is thermally stable & has octahedral geometry. The atomicity of compound (X) would be....

7. Sulphur can form dihalide, tetrahalide and hexahalide with fluorine. One mole of each of these three compounds is mixed with water. The total number of moles of product molecules obtained is____. If no reaction occurs, count zero.

8. Number of halides undergoing complete reaction in presence of water under normal conditions is :
(i) BF_3 (ii) BCl_3 (iii) NCl_3 (iv) $AlCl_3$ (v) CCl_4 (vi) PCl_3
(vii) $AsCl_3$

9. In how many of the following reactions N_2 gas may be released

(a) $NH_4NO_2 \xrightarrow{\Delta}$ (b) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta}$ (c) $NH_2CONH_2 + HNO_2 \xrightarrow{\Delta}$
(d) $NH_2CONH_2 + NaOBr \longrightarrow$ (e) $NH_3 + Cl_2$ (LR) $\longrightarrow$ (f) $NH_3 + Br_2$ (LR) $\longrightarrow$
(g) $NH_3 + NaOCl \longrightarrow$ (h) $NH_3 + CaOCl_2 \longrightarrow$ (i) $Ba(N_3)_2 \xrightarrow{\Delta}$

10. (i) NH_3 (ii) N_2H_4 (iii) HN_3 (iv) PH_3 (v) H_2S (vi) AsH_3
(vii) SbH_3 (viii) H_2Se (ix) H_2Te
Number of molecules in which lone pair of electrons on the central atom is present in pure s-orbital.

11. $NH_3 + NaOCl \xrightarrow{\text{gelatin or } EDTA^{4-}}$ products
The number of moles of N–H bonds present in one mole of the strongest nucleophile present in the product is :

12. Number of acidic oxides among the following is :
(a) N_2O (b) NO (c) N_2O_3 (d) N_2O_4 (e) N_2O_5 (f) P_4O_6
(g) P_4O_{10} (h) SO_3 (i) B_2O_3 (j) CO

13. Number of gaseous oxides among the following at room temperature is :
(a) N_2O (b) NO (c) N_2O_3 (d) NO_2 (e) N_2O_5 (f) P_4O_6
(g) P_4O_{10} (h) SO_2 (i) SO_3

14. The number of O-atoms having sp^2 hybridisation in P_4O_{10} molecule is :

15. N_2O_4, $(HPO_3)_3$, H_2CO_3, SO_2, SO_3, P_4O_{10} H_2SO_4, N_2O_3, HNO_3, H_3PO_3.
(a) Among the above compounds, compounds having at least one $p\pi$-$p\pi$ bond are x.
(b) Among the above compounds, compounds having at least one $d\pi$-$p\pi$ bond are y.
Give the answer as x + y.

16. Number of acids having central atom in +3 oxidation state among the following is :
(a) HNO_2 (b) HNO_3 (c) H_3PO_2 (d) H_3PO_3 (e) H_3PO_4 (f) $H_4P_2O_5$
(g) $H_4P_2O_7$ (h) H_2SO_3 (i) $H_2S_2O_7$ (j) $H_2S_2O_8$ (k) H_2SO_4

17. Cold conc. HNO_3 will completely dissolve :
(i) Pb (ii) Pb_3O_4 (iii) Fe (iv) Sn (v) Mg (vi) MgO
(vii) Hg (viii) Au (ix) Ag (x) Pt.

18. Cold dil. H_2SO_4 will completely dissolve :
(i) Pb (ii) Fe_3O_4 (iii) Fe (iv) Cu (v) Mg (vi) MgO
(vii) $CoCO_3$ (viii) $CuCO_3$ (ix) $SrCO_3$

19. How many are redox reactions -
(i) $K_4[Fe(CN)_6] + \text{conc. } H_2SO_4 \xrightarrow{\Delta}$ (ii) $\text{conc. } H_2SO_4 + KCl \longrightarrow$
(iii) $\text{conc. } H_2SO_4 + KBr \longrightarrow$ (iv) $\text{conc. } H_2SO_4 + NH_3 \longrightarrow$
(v) $\text{conc. } H_2SO_4 + KNO_3 \longrightarrow$ (vi) $\text{conc. } H_2SO_4 + PCl_5 \longrightarrow$
(vii) $\text{conc. } H_2SO_4 + COCl_2 \longrightarrow$ (viii) $\text{conc. } H_2SO_4 + Zn \longrightarrow$
(ix) $\text{conc. } H_2SO_4 + Cu \longrightarrow$

20. $x\ P_4 + y\ SO_2Cl_2 \longrightarrow$
then y/x ?

21. Complete hydrolysis product of 1 mole each of following will need how many total number of moles of NaOH for complete neutralisation?
$SOCl_2$, SO_2Cl_2 , PCl_3 , PCl_5 , NCl_3

22. Aqueous solution of how many of the following species turn blue litmus red ?
(i) SF_4 (ii) PCl_3 (iii) N_2O (iv) NO_2Cl (v) SF_6 (vi) SeF_6
(vii) $AsCl_3$ (viii) $POCl_3$ (ix) SO_2 (x) SO_2Cl_2 (xi) $SOCl_2$ (xii) $COCl_2$
(xiii) CCl_4

23. How many of the following compounds are possible products when chlorine is passed through hypo solution.
(i) S (ii) HCl (iii) Na_2S (iv) Na_2SO_4 (v) $Na_2S_4O_6$ (vi) $HClO_4$

24. The difference in oxidation states of sulphur atoms (in different oxidation states) present in $Na_2S_4O_6$ is :

25. How many compound(s) or ion(s) can be oxidised by H_2O_2 among the following :
(i) AsO_3^{3-} (ii) SO_4^{2-} (iii) $Fe_2(SO_4)_3$ (iv) $NH_2–NH_2$ (v) H_2S
(vi) PbS (vii) O_3

26. A gas is pale blue in colour on liquifaction, the colour arises from electronic transitions. This transition is forbidden in gaseous state. The gas does not burn but is a strong supporter of combustion. Give the molar mass of this gas.

PART - III : ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

1. As, Sb and Bi show lesser tendency to form negative ions of the type M^{3-}. This is because
(A) these elements are less electronegative
(B) metallic character increases down the group
(C) they are unable to hold the added electrons due to inert pair effect
(D) they do not posses half filled np subshells

2. The correct statement(s) is/are :
(A) The PF_6^- ion exists
(B) The NF_6^- ion does not exist
(C) N can form $p\pi$-$p\pi$ bonds with itself and with other elements having small size and high E.N.
(D) The catenation tendency is weaker in N than P

3. Correct statements about allotropy ?
(A) Plastic sulphur exists as zig-zag chains of sulphur.
(B) Monoclinic sulphur is soluble in water and insoluble in CS_2.
(C) Milk of sulphur gradually changes to Rhombic sulphur.
(D) Milk of sulphur is used in medicines.

4. Which of the following statements is/are correct ?
(A) The hydrides of group 15 elements act as oxidising agents
(B) The hydrides of group 15 elements act as reducing agents
(C) The oxidising power increases in going from NH_3 to BiH_3
(D) The reducting power increases in going from NH_3 to BiH_3

5. Ammonium dichromate on heating liberates a gas. The same gas will be obtained by :
(A) heating $NaNO_2$ and NH_4Cl.
(B) treating H_2O_2 with $NaNO_2$.
(C) passing ammonia gas over red hot CuO.
(D) treating ammonia with $KMnO_4$ in neutral medium.

6. Nitrogen differs from rest of the members on the account of various factors. Which of the following properties can be classified as anomalous properties of nitrogen ?
(A) Bond enthalpy of N≡N is 941.4 kJ/mol.
(B) Hydride of nitrogen i.e. ammonia has appreciable boiling point as compared to the other members like P, As.
(C) NH_3 can form unstable complexes by donating its lone pair.
(D) Molecular nitrogen comprises 78% by volume of the atmosphere.

7. Which of the following elements react with metals to form their binary compounds exhibiting –3 oxidation state ?
(A) N (B) P (C) As (D) Bi

8. White phosphorus may be removed from red phosphorus by :
(A) sublimation under reduced pressure (B) dissolving in water
(C) dissolving in CS_2 (D) heating with an alkali solution

9. The compound(s) which on strong heating gives oxygen is/are :
(A) $AgNO_3$ (B) BaO_2 (C) $Pb(NO_3)_2$ (D) $CaCO_3$

10. Which of the following is/are true for oxygen.
(A) $KMnO_4$(s) on strong heating gives oxygen gas
(B) Oxygen mixed with helium is used for artificial respiration.
(C) It has two unpaired electrons in bonding π molecular orbitals.
(D) Fractional distillation of liquefied air is used as an industrial method for the preparation of oxygen gas.

11. The correct statements(s) regarding hydrides (H_2E) of group-16 is/are :
(A) The acidic character increases from H_2O to H_2Te.
(B) The bond (H-E) dissociation enthalpy decreases down the group.
(C) The thermal stability of hydrides decreases down the group
(D) The reducing character of hydrides increases down the group

12. The correct statements regarding ozone is/are
(A) Ozone is thermodynamically less stable with respect to oxygen
(B) It acts as powerful oxidising agent
(C) It rapidly react with $NO_{(g)}$ and form $NO_{2(g)}$ and $O_{2(g)}$
(D) It is toxic substance

13. The incorrect statement(s) regarding oxides of group-16 elements is/are
(A) Reducing property of dioxide decreases from SO_2 to TeO_2
(B) All these elements form oxides of the EO_2 and EO_4 types
(C) Selenium and tellurium do not form SeO_3 and TeO_3
(D) SO_2 is an oxidising agent while TeO_2 is a reducing agent.

14. Which of the following ions dissolve in excess of aq. NH_3.
(A) Al^{3+} (B) Cu^{2+} (C) Ag^{+} (D) Zn^{2+}

15. Which of the following is/are incorrect statement(s) for phosphine ?
(A) It is less basic then NH_3
(B) It is less poisonous than NH_3
(C) The solution of copper sulphate gives no precipitate with PH_3.
(D) Phosphine burns in air forming predominantly H_3PO_4.

16. Which of the following process(es) can give sulphur ?
(A) H_2S gas is passed through nitric acid.
(B) Cl_2 gas is passed into water saturated with hydrogen sulphide.
(C) Hydrogen sulphide is passed through sodium bisulphate solution.
(D) H_2S gas is passed through acidified $KMnO_4$ solution.

17. How is H_2S prepared in laboratory ?
(A) $FeS + H_2SO_4$ (B) $FeSO_4 + H_2SO_4$
(C) $FeS + HCl$ (D) Elemental H_2 + elemental S_8

18. A gas is obtained on heating ammonium nitrate. Which of the following statements are incorrect about this gas :
(A) causes laughter (B) brings tears to the eyes
(C) is acidic in nature (D) is basic in nature

19. Which of the following represents correct dissociation of nitrate salts on heating.
(A) $2LiNO_3 \longrightarrow Li_2O + 2NO_2 + \frac{1}{2}O_2$ (B) $Pb(NO_3)_2 \longrightarrow PbO + 2NO_2 + \frac{1}{2}O_2$
(C) $NH_4NO_3 \longrightarrow N_2O + 2H_2O$ (D) $NH_4NO_2 \longrightarrow N_2 + 2H_2O$

20. SO_2 can reduce :
(A) $HClO_3$ to HCl (B) $Cr_2O_7^{2-}$ / H^+ to Cr^{3+} (C) MnO_4^- / H^+ to Mn^{2+} (D) IO_3^- to I_2

21. A white crystaline oxide (A) having garlic smell reacts with cold water to form a compound (B). On heating, (B) gives compound (C) & gas (D). Which of the following are correct statements :
(A) Solution of gas (D) does not turn red litmus blue
(B) The gas (D) can also be produced by reaction of NaOH with red phosphorus
(C) Gas (D) exists in dimeric form.
(D) Compound (B) can act as a reducing agent but (C) cannot.

22. Select the correct statement.
(A) Ostwald's method of preparation of HNO_3 is based upon catalytic oxidation of NH_3 by atmospheric oxygen.
(B) HNO_2 can act as both oxidising and reducing agent.
(C) NO_2 reacts with O_3 to form N_2O_5.
(D) HNO_3 can be used both as oxidising and reducing agent.

23. Which of the following statements is (are) correct ?
(A) Antimony on reaction with conc. HNO_3 gives antimonic acid.
(B) Manganese on reaction with cold and dilute HNO_3 gives NO_2 gas.
(C) HNO_2 disproportionate to give HNO_3 and NO
(D) HNO_3 on reaction with P_4O_{10} gives N_2O_5

24. Concentrated sulphuric acid acts as
(A) dehydrating agent (B) sulphonating agent
(C) reducing agent (D) oxidising agent.

25. Which among the following is/are peroxo acid (s) ?
(A) $H_2S_2O_3$ (B) H_2SO_5 (C) $H_2S_2O_7$ (D) $H_2S_2O_8$

26. Which of the following are used as chlorinating agents in organic synthesis of compounds ? (Like acid converted to acid chloride).
(A) $SOCl_2$ (B) SO_2Cl_2 (C) PCl_3 (D) PCl_5

27. Select the correct statement(s) regarding reaction of SO_2 with PCl_5.
(A) It is a redox reaction.
(B) One of the product is sulphuryl chloride.
(C) Both the products on addition of water produce strongly acidic solutions.
(D) Both the products have same hybridisation of central atom.

28. (P) $\xrightarrow{NaH}$ (Q) $\uparrow$ $\xrightarrow{CuSO_4}$ (R) $\downarrow$ black precipitate, (P) may be :
(A) SCl_2 (B) PCl_3 (C) NCl_3 (D) HCl

29. What is true for hydrogen peroxide and ozone ?
(A) H_2O_2 acts as a stronger reducing agent in alkaline medium than in acidic medium
(B) H_2O_2 and O_3 both are oxidising agents as well as bleaching agents
(C) H_2O_2 forms a hydrate, $H_2O_2.H_2O$
(D) Ozone is used in the manufacture of potassium permangnate from pyrolusite.

30. Which of the following statement (s) is/are true for sodium thiosulphate ?
(A) it acts as an antichlor
(B) it is used as a reducing agent in iodometric titration.
(C) it reacts with hydrochloric acid to form SO_2 and sulphur.
(D) it is used in photography as hypo to dissolve excess of AgBr as a soluble complex.

31. Which of the following statements are correct for H_2O_2 ?
(A) It is neutral towards litmus, but bleaches litmus white.
(B) It is more acidic than H_2O.
(C) Density and dielectric constant are higher than dilute solution of H_2O.
(D) H_2O_2 is produced by auto oxidation of 2-ethyl anthraquinol.

32. A solution of ammonia in water contains which of the following species :
(A) H^+ (aq.) (B) OH^- (aq.) (C) NH_4^+ (aq.) (D) NH_3 (aq.)

PART - IV : COMPREHENSION

Read the following passage carefully and answer the questions.

Comprehension # 1

Nitrogen forms the largest number of oxides as it is capable of forming stable multiple bonds with oxygen. They range from N_2O (O.S of nitrogen +1) through NO, N_2O_3, NO_2, N_2O_4 to N_2O_5 (O.S of nitrogen +5). Following points are important regarding the study of oxides of nitrogen.
(a) All oxides of nitrogen except N_2O_5 are endothermic as a large amount of energy is required to dissociate the stable molecule of oxygen and nitrogen.
(b) The small electronegativity difference between oxygen and nitrogen make N–O bond easily breakble to give oxygen and hence oxides of nitrogen are said to be better oxidising agents.
(c) Except N_2O_5, all are gases at ordinary temperature. N_2O_3 is stable only at lower temperature (253 K).
(d) Except N_2O and NO which are neutral oxides, all are acidic oxides which dissolve in water forming corresponding oxy acids.
(e) They are also good example for illustrating the concept of resonance.

1. The gas which is acidic in nature is :
(A) NO (B) N_2O (C) NO_2 (D) both (A) and (C)

2. Which of the following statements is correct for the oxides of nitrogen ?
(A) Dinitrogen trioxide dissolves in potassium hydroxide forming potassium nitrate.
(B) Aqueous solution of nitrogen dioxide behaves both as a reducing agent and as an oxidising agent.
(C) Nitrous oxide is fairly soluble in cold water and turns blue litmus red.
(D) Nitrogen dioxide is not acidic oxide.

Comprehension # 2

An inorganic iodide (A) on heating gives gases (B) and (C). (B) is neutral towards litmus while (C) is acidic.(B) gives back dense white fumes of (A) when cooled with (C). (A) functions as a strong acid in water. (C) is also obtained by action of (D) on water. (D) can be obtained when (B) reacts with I_2 in presence of anhydrous $CaCl_2$. (B) is poisonous, has smell of rotten fish and it is sparingly soluble in water. Now answer the following questions :

3. Select the correct statement from the following for the gas (B).
(A) It produces dense white fumes with HCl (B) It produces dense violet fumes on combustion
(C) It produces dense white fumes with BF_3 (D) It can act as oxidising agent.

4. The compound (A) :
(A) turns moist red litmus blue (B) reacts completely with water
(C) is used as a dehydrating agent (D) all of these

5. What is true about compound (D) ?
(A) The oxidation number of central atom of (D) is + IV
(B) Compound (D) produces a yellow precipitate with silver nitrate solution.
(C) Compound (D) dissolves in water forming an acid which with sodium hydroxide forms three series of salts.
(D) Both (B) and (C)

Comprehension # 3

Oxygen differs from the other elements of the group. Compounds of oxygen with metals are more ionic in nature and hydrogen bonding is more important for oxygen compounds. Oxygen is never more than divalent because when it has formed two covalent bonds, there are no low energy orbitals which can be used to form further bonds. However, the elements S, Se, Te and Po have empty d-orbitals which may be used for bonding, and they can form four or six bonds by unpairing electrons. The higher oxidation states become less stable on descending the group.
The bond between S and O, or Se and O, are much shorter than might be expected for a single bond owing to $p\pi$–$d\pi$ interaction between the p–orbital of oxygen and d - orbital of S or Se.

6. Which of the following statement is incorrect ?
(A) Oxo-anions of sulphur have little tendency to polymerise compared with the phosphates and silicates.
(B) In pyrosulphurous acid ($H_2S_2O_5$), the oxidation states of both the sulphur atoms are not same, they are +V and +III
(C) Concentrated HNO_3 oxidises both sulphur and selenium to H_2SO_4 (+VI) and H_2SeO_4 (+VI) respectively.
(D) Most metal oxides are ionic and basic in nature while non-metallic oxides are usually covalent and acidic in nature.

7. Which one of the following orders represents the correct order for the properties indicated against them?
(A) $H_2O < H_2S < H_2Se < H_2Te$ – acidic character (B) $H_2O < H_2S < H_2Se < H_2Te$ – thermal stability
(C) $H_2S > H_2Se < H_2Te < H_2O$ – reducing character (D) $H_2S < H_2Se < H_2O < H_2Te$ – boiling point

Comprehension # 4

The property of hydrides of p–block elements mostly depends on :
(i) electronegativity difference between central atom and hydrogen
(ii) size of central atom
(iii) number of valence electrons in central atom
Some undergo hydrolysis in which central atom is less electronegative, react with OH^- to give hydrogen. While acidic property of hydride in a period depends on electronegativity of central atoms, i.e. more electronegative is the atom, more acidic is hydride. In a group, acidic property is proportional to size of central atom. Some electron deficient hydride behaves as Lewis acid while only one hydride of an element in p–block behaves as Lewis base with lone pair of electrons. Hydrides in which central atom's electronegativity is close to hydrogen has no reaction with water.

8. Which one is the weakest acid among the following ?
(A) HF (B) HCl (C) HBr (D) HI

9. Which hydride has no reaction with water ?
(A) NH_3 (B) CH_4 (C) BeH_2 (D) NaH

10. Which one is strongest base ?
(A) OH^- (B) HS^- (C) HSe^- (D) HTe^-

Comprehension # 5

Answer Q.11, Q.12 and Q.13 by appropriately matching the information given in the three columns of the following table.

Observe the three columns in which column-1 represents chemical reactions, column-2 represents nature of substance with colour and physical state while column-3 represents differentiate products.

Column-1		Column-2		Column-3	
(I)	Cu + dil. HNO_3	(i)	Colourless gas, Neutral	(P)	NO
(II)	Cu + conc. HNO_3	(ii)	Blue solid, Acidic	(Q)	NO_2
(III)	Zn + dil. HNO_3	(iii)	Brown gas, Acidic	(R)	N_2O
(IV)	Zn + conc. HNO_3	(iv)	Colourless solid, Acidic	(S)	N_2O_3

11. Which of the following set of combination is correct ?
(A) (I), (iv), (S) (B) (II), (ii), (Q) (C) (II), (iii), (Q) (D) (IV), (iv), (S)

12. Which of the following set of combination is incorrect ?
(A) (III), (i), (R) (B) (I), (i), (P) (C) (IV), (iii), (Q) (D) (III), (iv), (S)

13. Which of the following set of combination is correct ?
(A) (I), (ii), (P) (B) (IV), (iii), (Q) (C) (IV), (ii), (Q) (D) (I), (iii), (P)

Exercise-3

*** Marked Questions may have more than one correct option.**

PART - I : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

Section (A) : Group 15th

1. Ammonia can be dried by : **[JEE 2000,(S) 3/35]**
(A) conc. H_2SO_4 (B) P_4O_{10} (C) CaO (D) anhydrous $CaCl_2$

2. Give reason why elemental nitrogen exists as diatomic molecule whereas elemental phosphorus is a tetra-atomic molecule. **[JEE 2000 (M), 2/100]**

3. Polyphosphates are used as water softening agents because they : **[JEE 2002(S), 3/90]**
(A) form soluble complexes with anionic species (B) precipitate anionic species
(C) form soluble complexes with cationic species (D) precipitate cationic species

4. For H_3PO_3 and H_3PO_4, the correct choice is : **[JEE 2003 (S), 3/84]**
(A) H_3PO_3 is dibasic and reducing (B) H_3PO_3 is dibasic and non-reducing
(C) H_3PO_4 is tribasic and reducing (D) H_3PO_3 is tribasic and non-reducing

5. $(NH_4)_2\ Cr_2O_7$ on heating gives a gas which is also given by : **[JEE 2004 (S), 3/84]**
(A) heating NH_4NO_2 (B) heating NH_4NO_3
(C) treating Mg_3N_2 with H_2O (D) treating Na(compound) with H_2O_2

6. A pale blue liquid is obtained by equimolar mixture of two gases at –30ºC. **[JEE 2005 (S), 3/84]**
(A) N_2O (B) N_2O_3 (C) N_2O_4 (D) N_2O_5

7. Thermodynamically most stable allotrope of phosphorus is : **[JEE 2005 (S), 3/84]**
(A) Red (B) White (C) Black (D) Yellow

8. **(a)** What amount of CaO in grams is required to neutralise 852 g of P_4O_{10} . **[JEE 2005 (M), 1/60]**
(b) Write the structure of P_4O_{10}. **[JEE 2005 (M), 1/60]**

Paragraph for Question Nos. 9 to 11

There are some deposits of nitrates and phosphates in earth's crust. Nitrates are more soluble in water. Nitrates are difficult to reduce under the laboratory conditions but microbes do it easily. Ammonia forms large number of complexes with transition metal ions. Hybridization easily explains the ease of sigma donation capability of NH_3 and PH_3. Phosphine is a flammable gas and is prepared from white phosphorous.

9. Among the following, the correct statement is : **[JEE 2008, 4/163]**
(A) phosphates have no biological significance in humans.
(B) between nitrates and phosphates, phosphates are less a abundant in earth's crust.
(C) between nitrates and phosphates, nitrates are less abundant in earth's crust.
(D) oxidation of nitrates is possible in soil.

10. Among the following, the correct statement is : **[JEE 2008, 4/163]**
(A) between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional.
(B) between NH_3 and PH_3, PH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional.
(C) between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional.
(D) between NH_3 and PH_3, PH_3 is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional.

11. White phosphorus on reaction with NaOH gives PH_3 as one of the products. This is a : **[JEE 2008, 4/163]**
(A) dimerization reaction (B) disproportionation reaction
(C) condensation reaction (D) precipitation reaction

12. The reaction of P_4 with **X** leads selectively to P_4O_6. The **X** is : **[JEE 2009, 3/160]**
(A) Dry O_2 (B) A mixture of O_2 and N_2
(C) Moist O_2 (D) O_2 in the presence of aqueous NaOH

13. Match each of the reactions given in **column-I** with the corresponding products (s) given in **column II.** **[JEE 2009, 8/160]**

	Column-I		**Column-II**
(A)	Cu + dil HNO_3	(p)	NO
(B)	Cu + conc HNO_3	(q)	NO_2
(C)	Zn + dil HNO_3	(r)	N_2O
(D)	Zn + conc HNO_3	(s)	$Cu(NO_3)_2$
		(t)	$Zn(NO_3)_2$

14. Extra pure N_2 can be obtained by heating **[JEE 2011, 3/160]**
(A) NH_3 with CuO (B) NH_4NO_3 (C) $(NH_4)_2Cr_2O_7$ (D) $Ba(N_3)_2$

15. Among the following, the number of compounds that can react with PCl_5 to give $POCl_3$ is O_2, CO_2, SO_2, H_2O, H_2SO_4, P_4O_{10}. **[JEE 2011, 3/160]**

16. Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen? **[JEE 2012, 3/136]**
(A) HNO_3, NO, NH_4Cl, N_2 (B) HNO_3, NO, N_2, NH_4Cl
(C) HNO_3, NH_4Cl, NO, N_2 (D) NO, HNO_3, NH_4Cl, N_2

17.* The correct statement(s) about O_3 is (are) **[JEE (Advanced)-2013, 3/120] (PNO)**
(A) O–O bond lengths are equal. (B) Thermal decomposition of O_3 is endothermic.
(C) O_3 is diamagnetic in nature. (D) O_3 has a bent structure.

18. Concentrated nitric acid, upon long standing, turns yellow-brown due to the formation of : **[JEE(Advanced) 2013, 2/120]**
(A) NO (B) NO_2 (C) N_2O (D) N_2O_4

19.* The pair(s) of reagents that yield paramagnetic species is/are **[JEE(Advanced) 2014, 3/120]**
(A) Na and excess of NH_3 (B) K and excess of O_2
(C) Cu and dilute HNO_3 (D) O_2 and 2-ethylanthraquinol

20. The product formed in the reaction of $SOCl_2$ with white phosphorous is : **[JEE(Advanced) 2014, 3/120]**
(A) PCl_3 (B) SO_2Cl_2 (C) SCl_2 (D) $POCl_3$

21.* The compound(s) which generate(s) N_2 gas upon thermal decomposition below 300ºC is (are) **[JEE(Advanced) 2018, 4/120]**
(A) NH_4NO_3 (B) $(NH_4)_2Cr_2O_7$ (C) $Ba(N_3)_2$ (D) Mg_3N_2

23.* Based on the compounds of group 15 elements, the correct statement(s) is (are) **[JEE(Advanced) 2018, 4/120]**
(A) Bi_2O_5 is more basic than N_2O_5
(B) NF_3 is more covalent than BiF_3
(C) PH_3 boils at lower temperature than NH_3
(D) The N–N single bond is stronger than the P–P single bond

Section (B) : Group 16th

23. Which of the following oxoacids of sulphur has –O–O– linkage ? **[JEE 2004 (S), 3/84]**
(A) $H_2S_2O_3$ (B) $H_2S_2O_5$ (C) $H_2S_2O_6$ (D) $H_2S_2O_8$

24. Which of the following is not oxidised by O_3 ? **[JEE 2005 (S), 3/84]**
(A) KI (B) $KMnO_4$ (C) K_2MnO_4 (D) $FeSO_4$

25. Which gas is evolved when PbO_2 is treated with concentrated HNO_3 ? **[JEE 2005 (S), 3/84]**
(A) NO_2 (B) O_2 (C) N_2 (D) N_2O

26. Aqueous solution of $Na_2S_2O_3$ on reaction with Cl_2 gives : **[JEE 2008, 3/162]**
(A) $Na_2S_4O_6$ (B) $NaHSO_4$ (C) NaCl (D) NaOH

27. Hydrogen peroxide in its reaction with KIO_4 and NH_2OH respectively, is acting as a **[JEE(Advanced) 2014, 3/120]**
(A) reducing agent, oxidising agent (B) reducing agent, reducing agent
(C) oxidising agent, oxidising agent (D) oxidising agent, reducing agent

28.* The nitrogen containing compound produced in the reaction of HNO_3 with P_4O_{10}. **[JEE(Advanced) 2016, 4/124]**
(A) can also be prepared by reaction of P_4 and HNO_3
(B) is diamagnetic
(C) contains one N-N bond
(D) react with Na metal producing a brown gas

Paragraph for Question Nos. 29 to 30

Upon heating $KClO_3$ in the presence of catalytic amount of MnO_2, a gas **W** is formed. Excess amount of **W** reacts with white phosphorus to give **X**. The reaction of **X** with pure HNO_3 gives **Y** and **Z**.

29. **Y** and **Z** are, respectively **[JEE(Advanced) 2017, 3/122]**
(A) N_2O_4 and HPO_3 (B) N_2O_4 and H_3PO_3
(C) N_2O_3 and H_3PO_4 (D) N_2O_5 and HPO_3

30. **W** and **X** are, respectively **[JEE(Advanced) 2017, 3/122]**
(A) O_2 and P_4O_{10} (B) O_2 and P_4O_6
(C) O_3 and P_4O_6 (D) O_3 and P_4O_{10}

PART - II : JEE (MAIN) ONLINE PROBLEMS (PREVIOUS YEARS)

1. Which of the following is not formed when H_2S reacts with acidic $K_2Cr_2O_7$ solution ? **[JEE(Main) 2014 Online (09-04-14), 4/120]**
(1) $CrSO_4$ (2) $Cr_2(SO_4)_3$ (3) K_2SO_4 (4) S

2. Hydrogen peroxide acts both as an oxidizing and as a reducing agent depending upon the nature of the reacting species. In which of the following cases H_2O_2 acts as a reducing agent in acid medium ? **[JEE(Main) 2014 Online (12-04-14), 4/120]**
(1) MnO_4^- (2) $Cr_2O_7^{2-}$ (3) SO_3^{2-} (4) KI

3. Which of these statements is not true ? **[JEE(Main) 2014 Online (19-04-14), 4/120]**
(1) NO^+ is not isoelectronic with O_2
(2) B is always covalent in its compounds
(3) In aqueous solution, the Tl^+ ion is much more stable than Tl(III)
(4) $LiAlH_4$ is a versatile reducing agent in organic synthesis.

4. The non-metal that does not exhibit positive oxidation state is:
[JEE(Main) 2016 Online (09-04-16), 4/120]
(1) Fluorine (2) Oxygen (3) Chlorine (4) Iodine

5. Identify the incorrect statement: **[JEE(Main) 2016 Online (10-04-16), 4/120]**
(1) Rhombic and monoclinic sulphur have S_8 molecules.
(2) S_8 ring has a crown shape.
(3) S_2 is paramagnetic like oxygen.
(4) The S–S–S bond angles in the S_8 and S_6 rings are the same.

6. Identify the pollutant gases largely responsible for the discoloured and lustreless nature of marble of the Taj Mahal. **[JEE(Main) 2017 Online (08-04-17), 4/120]**
(1) SO_2 and NO_2 (2) SO_2 and O_3 (3) O_3 and CO_2 (4) CO_2 and NO_2

7. In which of the following reactions, hydrogen peroxide acts as an oxidizing agent ?
[JEE(Main) 2017 Online (08-04-17), 4/120]
(1) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$ (2) $2MnO_4^- + 3H_2O_2 \rightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$
(3) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O_2 + O_2$ (4) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

8. For per gram of reactant, the maximum quantity of N_2 gas is produce in which of the following thermal decomposition reactions ? **[JEE(Main) 2018 Online (15-04-18), 4/120]**
(Given : Atomic wt. : Cr = 52 u, Ba = 137 u)
(1) $(NH_4)_2Cr_2O_7(s) \rightarrow N_2(g) + 4H_2O(g) + Cr_2O_3(s)$
(2) $2NH_4NO_3(s) \rightarrow 2N_2(g) + 4H_2O(g) + O_2(g)$
(3) $Ba(N_3)_2(s) \rightarrow Ba(s) + 3N_2(g)$
(4) $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

9. Good reducing nature of H_3PO_2 is attributed to the presence of :
[JEE(Main) 2019 Online (09-01-19), 4/120]
(1) One P–H bond (2) One P–OH bond (3) Two P–OH bonds (4) Two P–H bonds

10. The chemical nature of hydrogen peroxide is : **[JEE(Main) 2019 Online (10-01-19), 4/120]**
(1) Oxidising agent in acidic medium, but not in basic medium.
(2) Oxidising and reducing agent in both acidic and basic medium.
(3) Reducing agent in basic medium, but not in acidic medium.
(4) Oxidising and reducing agent in acidic medium, but not in basic medium.

11. Iodine reacts with concentrated HNO_3 to yield Y along with other products. The oxidation state of iodine in Y, is : **[JEE(Main) 2019 Online (12-01-19), 4/120]**
(1) 7 (2) 3 (3) 1 (4) 5

Answers

EXERCISE - 1

PART - I

A-1. Atomic size of nitrogen is very less. Hence 'N' atom can approach close to another 'N' atom. This facilitates the lateral overlap of the p-orbitals forming π-bonds.
Due to large size, other atoms of the same group form only single bonds, but not multiple bonds.

A-2. White phosphorus is very reactive, due to the P-P-P bond angle strain at 60º.
Red phosphorus is very stable, due to chain like polymeric structure.

A-3. Rhombic sulphur

A-4. Phosphorite $Ca_3(PO_4)_2$ and fluoroapatite $Ca_5(PO_4)_3F$.

B-1. Bismuth and antimony both belong to the nitrogen family and exhibit the +5 oxidation state. However, on moving down the group, i.e., from antimony to bismuth, the stability of the +5 oxidation state decreases. This is due to the inert pair effect. Thus, Bi (V) is a stronger oxidant than Sb (V).

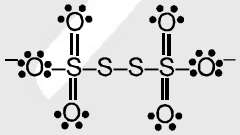
B-2. –3 to + 5, 0

B-3. Nitrogen exhibits –3 state in nitride and phosphorus exhibits –3 state in phosphide. Going down the group, the atomic size increases and metallic character also increases. Hence, the tendency to exhibit negative oxidation state decreases down the group VA.

B-4. In vapour state, sulphur exists as S_2 molecule. S_2 molecule, like O_2 molecule, has two unpaired electrons in the anti-bonding n* orbitals. Hence, like O_2, it exhibits paramagnetism.

B-5. (a) Oxidation state of phosphorus in P_4 molecule is zero.
(b) Valency of P in P_4 molecule is three. Each P atom forms 3 bond pairs and possesses on lone pair.
(c) Total number of P-P sigma bonds in a molecule of phosphorus is six.
(d) Phosphorus-Phosphorus bond order in P_4 molecule is one.
(e) Bond angle 60º.
(f) Tetrahedral.

B-6. TeO (oxidation number of Te is +2) is basic.
TeO_2 (oxidation number of Te is +4) is amphoteric.
TeO_3 (oxidation number of Te is +6) is acidic.
As the oxidation number of the element forming oxide increases, the acidic nature also increases.

B-7. Tetrathionate 

Tetrathionate has S–S linkage.
The oxidation states of sulphur are : +5, 0, 0 and +5.
The average oxidation state of S is +2.5.

B-8. In PH_4^+, phosphoros undergo sp^3 hybridization, but in PH_3 phosphoros uses pure p-orbitals for bonding. Hence bond angle in PH_3 is nearly 90º.

B-9.

Oxide	**Oxyacids**
N_2O_3	HNO_2
NO_2/N_2O	$HNO_2 + HNO_3$
N_2O_5	HNO_3
P_4O_6	H_3PO_3
P_4O_{10}	H_3PO_4

B-10. Although each of the above has same electronic distribution in bonding orbitals, nitrogen is inert because of non-polar nature of bond and high N≡N dissociation energy. Rest all (CO, CN^-, NO^+) are polar.

B-11. Due to the decrease in bond (E – H) dissociation enthalpy down the group acidic character increases.

C-1. Barium azide on heating undergoes thermal decomposition. Pure dinitrogen gas is obtained on heating azide. $Ba(N_3)_2 \xrightarrow{heat} Ba + 3N_2$

C-2. All the elements show no reaction with water.

C-3. White phosphorus (P_4).

D-1. Due to high electronegativity of O, the O–H in H_2O forms strong intermolecular H-Bonds. As a result water exists as an associated molecule while other hydrides of group 16 do not form H–Bonds and hence exist as discrete molecules. As a result, water shows unusual physical properties, i.e. high b.p., high thermal stability and weaker acidic character as compared to other hydrides of group 16.

D-2. They resemble since the three ions are of comparable radii and same charge :
NH_4^+ = 1.48 Å, K^+ = 1.33 Å, Rb^+ = 1.48 Å.

D-3. (a) $NH_3 + H_2O \rightleftharpoons NH_3.H_2O$ (Ammonium hydroxide) $\rightleftharpoons NH_4^+(aq) + OH^-(aq)$
This reaction occurs to small extent only (1-2 %). Rest of NH_3 remains unreacted.
(b) NH_3 (aq.) + HCl (aq.) $\rightleftharpoons NH_4Cl$(aq.)
(c) NH_3(aq.) + H_2O + CO_2 (aq.) $\longrightarrow NH_4HCO_3$ (solvay ammonia process)

D-4. Mercuric phosphide is formed by the reaction between phosphine and mercuric salt,
$2PH_3 + 3HgCl_2 \longrightarrow Hg_3P_2 \downarrow + 6HCl$

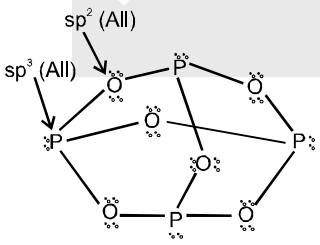
D-5. N–H bond is more polar than P–H bond. Hence, NH_3 forms hydrogen bonds with H_2O molecules and hence dissolves in it whereas PH_3 does not dissolve and forms bubbles.
Also same electronegativity of P and H.

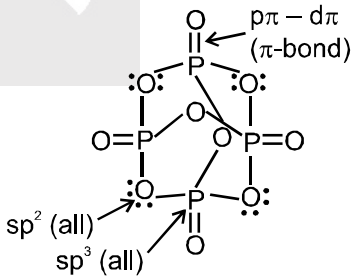
D-6. $NH_3 + NaOCl \longrightarrow NH_2Cl + NaOH$ (fast)
$NH_3 + NH_2Cl \longrightarrow NH_2NH_2 + NH_4Cl$ (slow)

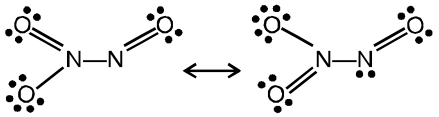
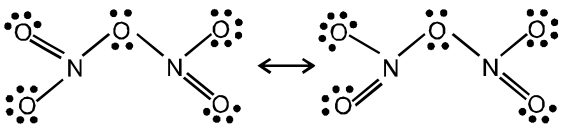
D-7. 'N' atom of NH_3 or 'P' atom of PH_3 has a lone pair of electrons available for donation. Hence NH_3 and PH_3 are Lewis bases. The electron pair density on a larger 'P' atom is less than that of smaller 'N' atom. Hence PH_3 is a weaker base.

E-1. Pure oxygen will oxidise P_4O_6 to P_4O_{10} despite an excess of P_4 is kept at the start of the reaction. Hence, nitrogen gas is used as a diluent.

E-2. P_4O_{10}

E-3. P_4O_6 

; P_4O_{10} 

N_2O_3 
; N_2O_5: 

E-4. NO_2 being odd molecule, on dimerisation is converted to stable N_2O_4 molecule with even number of electrons.

F-1. SO_3 reacts with water to form H_2SO_4 which forms a mist that is difficult to condense. It escapes in the atmosphere. It is, therefore, absorbed in conc. H_2SO_4 to form oleum which may be diluted to form H_2SO_4.

F-2. SO_2Cl_2 is formed from H_2SO_4 by treating with excess of phosphorus pentachloride.
$H_2SO_4 + 2PCl_5 \longrightarrow SO_2Cl_2 + 2HCl + 2POCl_3$
SO_3 is obtained from sulphuric acid by dehydration with phosphorus pentachloride.
$2H_2SO_4 + P_4O_{10} \longrightarrow 4HPO_3 + 2SO_3$
SO_2 is obtained from conc. H_2SO_4, when heated with copper metal.
$2H_2SO_4$ (conc.) + $Cu \longrightarrow CUSO_4 + 2H_2O + 2SO_2$

F-3. SO_2

G-1. Phosphorus exhibits pentavalency in excited state. Fluorine, chlorine or bromine is more electronegative and influences excitation to form PX_5. However, hydrogen is not that much electronegative to incluence the excitation in phosphorus. Hence PH_5 is not formed.

G-2. PCl_5

G-3. H_2S

G-4. (A) $PCl_5 \xrightarrow{\Delta} PCl_3 + Cl_2$
(B) $PCl_5 + D_2O \longrightarrow POCl_3 + 2\ DCl$
$POCl_3 + 3D_2O \longrightarrow D_3PO_4 + 3DCl$

G-5. PCl_3 hydrolyses in the presence of moisture giving fumes of HCl
$PCl_3 + H_2O \longrightarrow H_3PO_3 + 3\ HCl$

G-6. (i) $P_4O_{10} + 6PCl_5 \longrightarrow 10POCl_3$ (ii) $NH_3 + NaOCl \longrightarrow NH_2Cl + NaOH$ (fast)
$NH_3 + NH_2Cl \longrightarrow NH_2NH_2 + NH_4Cl$ (slow)

H-1. $X = I_2$
$Y = Na_2S_4O_6$

H-2. $AgBr + 2Na_2S_2O_3 \rightarrow Na_3[Ag(S_2O_3)_2] + NaBr$
H_2SO_4 (dil) + $Na_2S_2O_3 \longrightarrow Na_2SO_4 + S$ (white turbidity) + $H_2O + SO_2$
$3H_2SO_4$ (conc.) + $Na_2S_2O_3 \longrightarrow Na_2SO_4 + 4SO_2 + 3H_2O$

H-3. Atomic number of A = 16. It is sulphur. Atomic number of B = 17. It is chlorine.
Excess sulphur reacts with chlorine to give dimeric monochloride. Sulphur reacts with excess chlorine to give tetrachloride. Molten dimeric monochloride on saturation with chlorine gives dichloride.
$2S + Cl_2 \longrightarrow S_2Cl_2$; $S_2Cl_2 + Cl_2 \longrightarrow 2SCl_2$

PART - II

A-1.	(D)	**A-2.**	(D)	**A-3.**	(A)	**B-1.**	(B)	**B-2.**	(C)
B-3.	(D)	**B-4.**	(A)	**B-5.**	(C)	**B-6.**	(C)	**B-7.**	(C)
B-8.	(C)	**B-9.**	(B)	**B-10.**	(A)	**C-1.**	(B)	**C-2.**	(A)
C-3.	(D)	**C-4.**	(D)	**C-6.**	(B)	**C-7.**	(A)	**D-1.**	(B)
D-2.	(C)	**D-3.**	(B)	**D-4.**	(B)	**D-5.**	(A)	**D-6.**	(B)
E-1.	(D)	**E-2.**	(C)	**E-3.**	(D)	**E-4.**	(D)	**E-5.**	(C)
E-6.	(D)	**E-7.**	(D)	**E-8.**	(A)	**F-1.**	(C)	**F-2.**	(A)
F-3.	(A)	**F-4.**	(B)	**F-5.**	(D)	**G-1.**	(B)	**G-2.**	(B)
G-3.	(B)	**G-4.**	(B)	**G-5.**	(A)	**G-6.**	(D)	**H-1.**	(D)
H-2.	(C)	**H-3.**	(B)	**H-4.**	(D)	**H-5.**	(B)	**H-6.**	(A)

PART - III

1. (A - p, q, s) ; (B - p, q, r, s) ; (C - q, r, s) ; (D - p, q, r, s)

2. (A - q, s) ; (B - q, r) ; (C - q, s) ; (D - q)

EXERCISE - 2

PART - I

1.	(A)	**2.**	(D)	**3.**	(C)	**4.**	(C)	**5.**	(B)
6.	(D)	**7.**	(D)	**8.**	(C)	**9.**	(D)	**10.**	(D)
11.	(A)	**12.**	(C)	**13.**	(A)	**14.**	(B)	**15.**	(B)
16.	(B)	**17.**	(B)	**18.**	(D)	**19.**	(B)	**20.**	(A)
21.	(D)	**22.**	(A)	**23.**	(A)	**24.**	(C)	**25.**	(D)
26.	(A)	**27.**	(B)	**28.**	(D)	**29.**	(D)	**30.**	(B)

PART - II

1.	4	**2.**	5 (a, b, c, e, f)	**3.**	3 (a, d, f)	**4.**	5 (b,d,e,f,g)
5.	3 (a=1, b=2, c=1, d=4)			**6.**	7 (SF_6)	**7.**	8
8.	5 (i,ii,iii,vi and vii)			**9.**	9 (a,b,c,d,e,f,g,h and i)		
10.	6 (except a,b and c)			**11.**	4	**12.**	7
13.	4 (a,b,d and h)	**14.**	10	**15.**	12	**16.**	3
17.	6 (i, iv, v, vi, vii and ix)			**18.**	6 (except i, iv and ix)		
19.	3 (iii, viii, ix)	**20.**	10	**21.**	24	**22.**	10 (except iii, v and xiii)
23.	3 (i,ii and iv)	**24.**	5	**25.**	4 (i, iv, v and vi)	**26.**	32, O_2

PART - III

1.	(AB)	**2.**	(ABCD)	**3.**	(ACD)	**4.**	(BD)	**5.**	(AC)
6.	(AB)	**7.**	(ABCD)	**8.**	(ACD)	**9.**	(ABC)	**10.**	(ABD)
11.	(ABCD)	**12.**	(ABCD)	**13.**	(BCD)	**14.**	(BCD)	**15.**	(BC)
16.	(ABCD)	**17.**	(AC)	**18.**	(BCD)	**19.**	(ABCD)	**20.**	(ABCD)
21.	(AD)	**22.**	(ABC)	**23.**	(ACD)	**24.**	(ABD)	**25.**	(BD)
26.	(ABCD)	**27.**	(CD)	**28.**	(AB)	**29.**	(ABCD)	**30.**	(ABCD)
31.	(ABCD)	**32.**	(ABCD)						

PART - IV

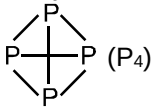
1.	(C)	**2.**	(B)	**3.**	(C)	**4.**	(B)	**5.**	(D)
6.	(C)	**7.**	(A)	**8.**	(A)	**9.**	(B)	**10.**	(A)
11.	(C)	**12.**	(D)	**13.**	(B)				

EXERCISE - 3

PART - I

1. (C)

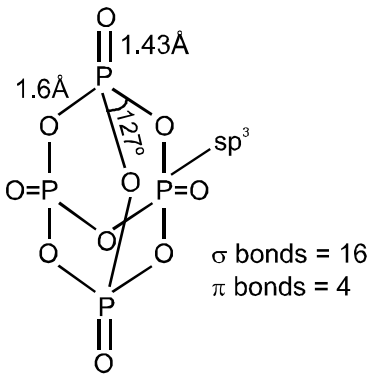
2. In the form of elemental nitrogen it exists as a diatomic molecule (N_2). This is due to the fact that nitrogen can form $p\pi$-$p\pi$ multiple bond ($N \equiv N$) because of small size of nitrogen atom. Heavier elements of this group do not able to form $p\pi$-$p\pi$ bonds as their atomic orbitals are so large and diffuse that they cannot have effective overlapping. Further P–P single bond is stronger than N – N single bond. Hence phosphorus as tendency to under go catenation.

$N \equiv N$ (N_2)  (P_4)

3. (C) **4.** (A) **5.** (A) **6.** (B) **7.** (C)

8. **(a)** 1008 g.

(b) Structure of P_4O_{10}.



σ bonds = 16
π bonds = 4

9. (C) **10.** (C) **11.** (B) **12.** (B)

13. A $\rightarrow$ p, s ; B $\rightarrow$ q, s ; C $\rightarrow$ r, t ; D $\rightarrow$ q, t **14.** (D) **15.** 4

16. (B) **17.*** (ACD) **18.** (B) **19.*** (ABC) **20.** (A)

21.* (BC) **22.*** (ABC) **23.** (D) **24.** (B) **25.** (B)

26. (B) **27.** (A) **28.*** (BD) **29.** (D) **30.** (A)

PART - II

1. (1) **2.** (1) **3.** (2) **4.** (1) **5.** (4)

6. (1) **7.** (1) **8.** (4) **9.** (4) **10.** (2)

11. (4)