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 800°C.

B-5.🏊	Write the following for a wh	nite 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, TeO₂ and TeO₃. 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
N2O3	
NO2/N2O4	
N ₂ O ₅	
P4O6	
P4O10	

- **B-10.** N₂, CO, CN⁻ and NO⁺ are isoelectronic but the former is chemically inert and latter three are very reactive, why ?
- B-11. Con moving down the group from H₂O to H₂Te 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 15th and 16th 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 15th 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 NH₃ is dissolved in (a) water (b) HCl (c) aq. CO₂
- D-4. What happens when phosphine is absorbed in mercuric chloride solution ?
- D-5. On being slowly passed through water, PH₃ forms bubbles but NH₃ dissolves. Why is it so ?
- D-6. How is hydrazine prepared ?
- D-7. Both PH₃ and NH₃ are Lewis bases, but basic strength of PH₃ is less than that of NH₃. 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 15th 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 NO₂ 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 SO₂Cl₂.SO₃ and SO₂ 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 Cl₂. Identify 'X' :
- G-3. Which hydride of the oxygen family shows the lowest boiling point?
- G-4. What happens when
 (A) PCl₅ is heated.
 (B) PCl₅ is reacted with heavy water.
- **G-5.** Why does PCl₃ fume in moist air ?
- **G-6.** Complete and balance the following : (i) $P_4O_{10} + PCI_5 \longrightarrow$ (ii) $NH_3 + NaOCI \xrightarrow{Gelatin}$

Section (H) : Miscellaneous Compounds

- $\begin{array}{ll} \mbox{H-1.} & \mbox{NaHSO}_3 + [X] \mbox{(excess)} + \mbox{H}_2 O \longrightarrow \mbox{NaHSO}_4 + \mbox{HI} \\ & \mbox{[X]} + \mbox{Na}_2 S_2 O_3 \longrightarrow \mbox{NaI} + [Y] \\ & \mbox{Identify X \& Y ?} \end{array}$
- **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) NH₄Cl
 (B) NH₄NO₃
 (C) AgNO₃
 (D) NH₄NO₂
- 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-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. Li₃N.

- (B) Formation of electron pair bonds. e.g. NH₃ or NF₃ Azo compounds (–N=N–)
- (C) Formation of electron pair bonds with electron gain. e.g. Amide ion NH2- and imide ion NH2-.
- (D) Formation of electron pair bonds with electron gain : NH₄⁺ ; N₂H₅⁺; (C₂H₅)₄ N⁺

B-4.	NH_4^+ , NH_3^- , NH_2^- , Ammonium Ammonia Amide	NH ²⁻ and N ³⁻ are : Imide Nitride		
	(A) Isoelectronic(C) Homologous memb	ers	(B) Isostructural(D) Nitrogen has differe	nt oxidation state
B-5.	How many P=O bonds (A) 0	are present in (HPO₃)₃ ? (B) 6	(C) 3	(D) 9
B-6.24	The correct order of sul (A) $S_2O_3^{2-} < SO_4^{2-} < SO_4^{2-} < SO_4^{2-}$ (C) $S_2O_3^{2-} < SO_4^{2-} < SO_4^{2-} < SO_4^{2-}$	phur – oxygen bond ene D3 < S2O6 ^{2–} O6 ^{2–} < SO3	rgy in S ₂ O ₃ ²⁻ , SO ₄ ²⁻ , SO ₃ (B) S ₂ O ₃ ²⁻ < S ₂ O ₆ ²⁻ < So (D) S ₂ O ₆ ²⁻ < SO ₄ ²⁻ < SO	₃ and S₂O ₆ ^{2−} is O4 ^{2−} < SO3 O3 < S2O3 ^{2−}
B-7.æ	Which of the following b (A) Se–Se	oonds has the highest bo (B) Te–Te	nd energy ? (C) S–S	(D) O–O
B-8.24	The wrong statement al (A) it is nitrous oxide (C) it is not a linear mole	pout N ₂ O is : ecule	(B) it is a neutral oxide(D) it is known as laugh	ing gas
B-9.≿	The hydrides of group 1 (A) lewis acid	5 elements can act as : (B) lewis base	(C) both	(D) none
B-10.	The basic strength of th (A) decreases on movin (B) increases on moving	e hydrides of group 15 e ig down the group g down the group	lements :	

- (C) first decreases upto AsH_3 and then increases
- (D) first increases upto $AsH_{\rm 3}$ and then decreases

Section (C) : Preparation & Properties of elements

C-1.a	Ammonium salts decom (i) Ammonium salt of we (ii) Ammonium salt of st Identify X, Y, Z (A) N ₂ , NH ₃ , N ₂ O	npose quite readily on he eak oxidizing anion (e.g. rrong oxidizing anion (e.g (B) NH ₃ , N ₂ , N ₂ O	eating : CI ⁻ , CO ₃ ²⁻ , SO ₄ ²⁻) <u>heat</u> J. NO ₂ ⁻ , NO ₃ ⁻ , CIO ₄ ⁻ , Cr ₂ (C) N ₂ O, NH ₃ , N ₂	→ Gas X O7 ^{2–}) — ^{heat} → Gas Y/Z (D) NO, NH₃, N₂O	
C-2.æ	Which of the following c (A) $(NH_4)_2Cr_2 O_7$	loes not give oxygen on (B) KClO ₃	heating ? (C) Zn(ClO ₃) ₂	(D) K ₂ Cr ₂ O ₇	
C-3.১	Red and white phospho (A) smell (C) exhibiting phosphor	orus will differ but not in : escence	(B) solubility in $CHCI_3$ (D) reaction with concer	ntrated HNO ₃	
C-4.	Which of the following is (A) Ammonia is prepare (B) All the hydrides of 1 (C) Metal phosphides u (D) Metal phosphides u	s incorrect ? ed in the laboratory by the 5 th group are colourless, pon hydrolysis give phos pon hydrolysis give phos	e action of NaOH on Amr highly volatile and poiso phine. phoric acid.	monium salt. nous gases	
C-6.	$\begin{array}{l} P_4 \ + \ NaOH \ \xrightarrow{\text{warm}} \ F \\ Products \ will \ be : \\ (A) \ H_3PO_4 \ + \ PH_3 \\ (C) \ NaH_2PO_2 \ + \ H_3PO_4 \end{array}$	Products	(B) PH ₃ + NaH ₂ PO ₂ (D) H ₃ PO ₄		
C-7.১	Hydrolysis of Nitride of s (A) NH ₃ + Metal hydroxi (C) NH ₃ + HNO ₃	s-Block elements (for e.g ide	g. Ba₃N₂, Ca₃N₂, Li₃N) will yield (B) only NH₃ (D) NH₄OH		
Section	on (D) : Hydrides				
D-1.১	The thermal stability of (A) $NH_3 < PH_3 < AsH_3 <$ (C) $PH_3 > NH_3 > AsH_3 >$	the hydrides of group 15 < SbH3 < BiH3 > SbH3 < BiH3	follows the order : (B) NH ₃ > PH ₃ > AsH ₃ > (D) AsH ₃ < PH ₃ > SbH ₃	• SbH₃ > BiH₃ > BiH₃ > NH₃	
D-2.	One mole of calcium ph (A) one mole of phosph (C) two moles of phosph	osphide on reaction with ine hine	excess water gives : (B) two moles of phosph (D) one mole of phosph	noric acid orus pentoxide	
D-3.	H_2S burns in O_2 to form (A) $H_2O + S$	(B) H ₂ O + SO ₂	(C) H ₂ O + SO ₃	(D) H ₂ SO ₄ + S	
D-4.১	PH₃ (anhydrous) + HBr (A) H₃BrO₃	(anhydrous) —→ X. (B) PH₄Br	Identify X ? (C) Br ₂	(D) P ₄	
D-5.	Calcium phosphide read but produces dense wh (A) $X = PH_3$ and $Y = PH$ (C) $X = PH_4^+$ and $Y = PH_4^+$	cts with water or dil. HCl ite fumes with HI (g) due l₄I H₄I	and gives a compound ' to formation of 'Y'. Comp (B) $X = NaH_2PO_2$ and Y (D) $X = PH_3$ and $Y = H_3$	X', which fails to react with HCl pound X and Y respectively. T = H ₃ PO ₂ PO ₂	
D-6.১	$N_2 \xrightarrow{H_2} X \xrightarrow{Os}$ Haber's Process X \overline{Os}	$\xrightarrow{O_2} Y \xrightarrow{O_2+H_2O}$	→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	on (E) : Oxides				
E-1.	Sulphur trioxide can be (A) S + H ₂ SO ₄ $\xrightarrow{\Delta}$ (C) CaSO ₄ + C $\xrightarrow{\Delta}$	obtained by which of the	$\begin{array}{c} \text{following reactions :} \\ (B) H_2 SO_4 + PCI_5 & \xrightarrow{\Delta} \\ (D) Fe_2(SO_4)_3 & \xrightarrow{\Delta} \end{array}$	\rightarrow	
E-2.æ	NO ₂ can be prepared by (A) NH ₄ NO ₃	y heating : (B) NaNO₃	(C) Pb(NO ₃) ₂	(D) KNO ₃	

p-blo	ck elements (N & O Family)			
E-3.a	$\begin{array}{l} HNO_3 + P_4O_{10} \longrightarrow HPO_3 + X \\ \text{in the above reaction the produ} \\ (A) NO_2 \qquad \qquad (B) N_2 \end{array}$	uct X is : 2O3	(C) N ₂ O ₄	(D) N ₂ O ₅
E-4.2		of Nitrogen is Neut 2O3	ral (C) N2O4	(D) N ₂ O
E-5.æ		is amphoteric in na ₄O ₆	iture ? (C) Sb₄O ₆	(D) Bi ₂ O ₃
E-6.24	Following are neutral oxides ex (A) NO (B) N ₂	xcept : ₂O	(C) CO	(D) NO ₂
E-7.24	Aqueous solution of SO ₂ is a : (A) weak acid (B) red	ducing agent	(C) bleaching agent	(D) All of these
E-8.		is the most acidic $?_{2}O_{5}$	(C) As ₂ O ₅	(D) Sb ₂ O ₅
Sectio	on (F) : Oxyacids			
F-1.æ	The correct order of decreasing (A) $HNO_3 > H_3SbO_4 > H_3AsO_4$ (C) $HNO_3 > H_3PO_4 > H_3AsO_4 >$	ig acidic strength o - > H₃PO₄ > H₃SbO₄	f oxy acids of group 15 e (B) H ₃ PO ₄ > H ₃ AsO ₄ > H (D) HNO ₃ > H ₃ AsO ₄ > H	elements : H3SbO4 > HNO3 I3PO4 > H3SbO4
F-2.	Industrial preparation of nitric a (A) oxidation of NH ₃ (C) Hydrogenation of NH ₃	acid by ostwald's p	rocess involves : (B) Reduction of NH_3 (D) Hydrolysis of NH_3	
F-3.১		nost powerful oxidis PO ₃	sing agent : (C) H₃BO₃	(D) H ₃ PO ₄
F-4.	When P_4O_{10} is dissolved in wa (A) H_3PO_2 (B) H_3	ater, the acid forme ₃PO₄	ed finally is : (C) H₃PO₃	(D) H ₄ P ₂ O ₇
F-5.	Which of the following reactions depict the oxidising behaviour of H_2SO_4 ? (A) $2PCI_5 + H_2SO_4 \longrightarrow 2POCI_3 + 2HCI + SO_2CI_2$ (B) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$ (C) $NaCI + H_2SO_4 \longrightarrow NaHSO_4 + HCI$ (D) $2HI + H_2SO_4 \longrightarrow I_2 + SO_2 + 2H_2O$?
Sectio	on (G) : Halides and Oxyl	halides		
G-1.	The order of stability of halides (A) $ - > Br - > C - > F^-$ (B) F^-	s of sulphur with dii ⁻ > Cl⁻ > Br⁻ > I⁻	fferent halogens is : (C) Br⁻ > Cl⁻ > I⁻ > F⁻	(D) F [_] > CI [_] > I [_] > Br [_]
G-2.æ	$\begin{array}{llllllllllllllllllllllllllllllllllll$	of chlorine to form : Cl₃ and HCl	(C) NH ₄ Cl and NCl ₃	(D) N ₂ and HCI
G-3.	A yellow coloured crystalline thermally stable and has octah (A) SF_4 (B) SF	substance gave a nedral geometry. X F ₆	a colourless gas X on r can be. (C) SF ₂	eaction with flourine, which is (D) S_2F_6
G-4.	$\begin{array}{llllllllllllllllllllllllllllllllllll$: 3PO3 and HCI	(C) POCI ₃	(D) H ₃ PO ₄
G-5.	The final product obtained on $H_{(A)}$ (A) H_3PO_4 (B) H_3	hydrolysis of PCl₅ i ₃PO₃	is : (C) POCl₃	(D) PH ₃
G-6.	Which of the following phospho (A) PCl ₃ (B) PF	orus halide is the t_3	best reducing agent? (C) PBr ₃	(D) PI ₃
Sectio	on (H) : Miscellaneous Co	ompounds		

H-1. When sulphur is boiled with Na₂SO₃ solution, the compound formed is :
 (A) sodium sulphide
 (B) sodium sulphate
 (C) sodium persulphate
 (D) sodium thiosulphate

p-b	lock elements (N & C	D Family)		
H-2.	Na ₂ S ₂ O ₃ is prepared (A) reacting H ₂ S ₂ O ₃ (C) heating NaOH a	l by : with NaOH. nd S.	(B) reacting Na ₂ SO ₄ (D) reducing Na ₂ SO ₄	with S in alkaline medium. with S in acidic medium.
H-3.	The products of the (A) HCl + Na ₂ S	chemical reaction betwee (B) HCl + NaHSO4	n Na ₂ S ₂ O ₃ , Cl ₂ and H ₂ O (C) HCl + Na ₂ SO ₃	are : (D) NaHClO₃ + H₂O
H-4.	The term 'thio' is use (A) Na ₂ S ₂ O ₃	ed in the names of all of th (B) Na ₂ S ₂ O ₆	e following compounds (C) NaSCN	except : (D) Na₂SO₃
H-5.	Which of the followir (A) H ₂ S ₂ O ₃	ng gives H ₂ O ₂ on hydrolys (B) H ₂ SO ₅	is ? (C) H ₂ S ₂ O ₇	(D) H ₂ S ₄ O ₆
H-6.	Which of the followir O ₃ + KI + D ₂ O \longrightarrow (A) KOH	ng is not formed in the bel (B) O ₂	ow reaction : (C) l ₂	(D) KOD

PART - III : MATCH THE COLUMN

Match the reactions listed in column-I with characteristic(s) / type of reactions listed in column-II. 1.2

	Column–I		Column–II
(A)	$PCI_5 \xrightarrow{Moist}_{Air}$	(p)	Hydrolysis
(B)	P_4 + NaOH (conc.) + $H_2O \xrightarrow{Warm} $	(q)	At least one of the products has tetrahedral
			hybridisation
(C)	$H_3PO_3 \xrightarrow{200^{\circ}C} \rightarrow$	(r)	Disproportionation
(D)	$P_4O_6 + H_2O \xrightarrow{200^\circC} \rightarrow$	(s)	At least one of the products has $p\pi$ -d π bonding.

2.

ا دد	Match the oxy	/-acids of pho	sphorus list	ed in column-	I with type of	of bond(s) list	ed in column-II.
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	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 ₃ P ₃ O 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

- In case of nitrogen, NCI3 is possible but not NCI5 while in case of phosphorous, PCI3 as well as PCI5 are 1.2 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.
- The P-P-P bond angle in white phosphorus is close to : 2.2
 - (A) 120° (B) 109°28' (C) 90° (D) 60°
- 3.2 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 250°C or at low temperature in the presence of sun light.
 - (D) heating white phosphorus at high pressure and 473 k temperature.

4.æ	As Rh	nombic sulphur is heated in a test tube	:	1	
		Process	Temperature		
	(a)	Viscosity increases	T ₁	-	
	(b)	Viscosity decreases	T ₂	-	
	(C)	Paramagnetic molecules	T ₃	-	
	(d)	Breakage of S ₈ rings	Τ4	-	
		(Diradical formation in molten phase)			
	(A) T ₁		1 (C) T ₄ < T ₁ < T	2 < T3 (D) T ₃ < T ₄ < T ₁ < T ₂
5.	Dinitro (A) alo (C) wi	ogen gas is evolved when sodium nitrit one ith sodium chloride	e is heated below 5 (B) with ammo (D) with potass	500°C : nium chlorid ium nitrate	e
6.	Which (A) It (C) It	n statement is not correct for nitrogen ? is obtained by heating (NH4)2Cr2O7 is a typical non-metal	(B) It does not (D) d-orbitals a	readily reac re available	t with O2 for bonding
7.24	Nitroli (A) he (C) ca	m is obtained by passing nitrogen over eated mixture of Al ₂ O ₃ and carbon alcium carbide	r : (B) oleum (D) heated calo	cium carbide	3
8.১	Which (A) O:	to of the following have $\Delta H^{o}_{f} < 0$: zone (B) O (g)	(C) P (red)	(D) S₀ (monoclinic)
9.2	CS2 c (A) P4 (C) S8	an separate a mixture of : and S8 (rhombic) 3 (rhombic) and S8 (monoclinic)	(B) P4 and S8 ((D) S8 (rhombic	monoclinic) c) and S (pla	astic)
10.2	Which (A) O: (C) K0	the following reactions does not lib $_3 + KI + H_2O \longrightarrow$ $D_2 (s) + CO_2 (g) \longrightarrow$	erate oxygen ? (B) H ₂ O ₂ + Cl ₂ (D) None	>	
11.24	The g (A) C	as respectively absorbed by alkaline p P_2, O_3 (B) SO ₂ , O ₂	yrogallol and oil of c (C) O ₃ , CH ₄	innamon is (D	:)) N ₂ O, O ₃
12.24	Alkalii (A) po (C) bo	ne KI is oxidised by ozone to : otassium iodate oth (A) and (B)	(B) potassium (D) None of the	periodate ese	
13.2	NH₃ c (A) h∉ (C) h∉	an't be obtained by : eating of NH₄NO₃ or NH₄NO₂ eating of NH₄NO₃ with NaOH	(B) heating of N (D) reaction of	NH₄Cl or (NI AIN or Mg₃l	H4)2 CO3 N2 or CaCN2 with H2O
14.	When (A) H ₂	H ₂ S is passed through nitric acid or a SO ₄ (B) colloidal sulphu	cidified KMnO ₄ solut (C) SO ₂	tion, the pro (D	duct first formed is :) plastic sulphur
15.	Ammo (A) Cu	$\begin{array}{llllllllllllllllllllllllllllllllllll$: (C) Cu(OH)2, N	l ₂ (D) [Cu(NH ₃) ₄](OH) ₂
16.æ 17.æ	Phosp (A) W (B) Re (C) Ca (D) Pl When	bhine is not obtained by the reaction : hite P is heated with NaOH ed P is heated with NaOH a ₃ P ₂ reacts with water hosphorus trioxide is boiled with water ammonia is oxidsed by oxygen in the	under pressure. presence of platinu	m at 500⁰C,	the gas obtained is :
18.	(A) N ₂ Subst	20 (B) NO ances burn more readily in N2O than ir	(C) NO ₂ n air because N ₂ O :	(D) N2O5
	(A) is (B) dis (C) th (D) dis	reactive at high temperature. ssociates to give more nitrogen than in e activation energy is increased on inc ssociates more readily than O ₂ .	air. reasing temperature) .	

19 >=	Which of the following is a mixed acid anhydri	de ?	
. .	(A) NO (B) NO ₂	(C) N ₂ O ₅	(D) N ₂ O
20.	When an article is bleached by SO ₂ it loses its (A) exposure to air (B) heating	colour. The colour can b (C) dilution	e restored by : (D) none of these
21. 🕿	The true statement for the acids of phosphoru (A) H ₃ PO ₃ on heating does not disproportiona (B) all of them are reducing in nature (C) all of them are tribasic acids (D) H ₃ PO ₂ is obtained by alkaline hydrolysis o	s H ₃ PO ₂ , H ₃ PO ₃ and H ₃ P te f P4 (white)	O4 is.
22.১	Which of the following does not have S–S link (A) $S_2O_8^{2-}$ (B) $S_2O_6^{2-}$	age but has O—O linkage (C) S ₂ O ₅ ^{2–}	e ? (D) S₂O₃²−
23.2	The true statement for the acids of phosphoru (A) the order of their reducing strength is H_3PG (B) the hybridisation of phosphorus is sp^2 in al (C) The acidic strength order is $H_3PO_2 > H_3PG$ (D) all of these.	s H ₃ PO ₂ , H ₃ PO ₃ and H ₃ P D ₂ > H ₃ PO ₃ > H ₃ PO ₄ . I these. D ₃ > H ₃ PO ₄ .	O4 is :
24.æ	 Hydrolysis of one mole of peroxydisulphuric ac (A) two moles of sulphuric acid (B) two moles of peroxymonosulphuric acid. (C) one mole of sulphuric acid and one mole of (D) one mole of sulphuric acid, one mole of hy 	cid produces of peroxy monosulphuric a rdrogen peroxide.	acid.
25.	The reaction of SO ₂ with PCI ₅ yield two oxol reaction of SO ₃ and SCI ₂ . Which of the followin (A) The structure of B is tetrahedral (B) The structure of A is trigonal pyramidal (C) A reacts vigorously with water and is hydrolysable inorganic halides (D) A and B contain their respective central at	nalides A and B. 'A' can ng about A and B is incorn s particularly useful for oms in their highest oxida	also be prepared industrially by rect ? drying or dehydrating readily ition states.
26.24	Which of the following cannot dissociate as P2 (A) PF_5 (B) PCI_5	$X_5 PX_3 + X_2$ (C) PBr ₅	(D) PI5
27.24	The aqueous solution of hydrogen peroxide : (A) converts blue litmus pink (C) converts red litumus blue	(B) converts blue litum (D) None of these	nus white
28.	Consider the following compounds : (1) sulphur dioxide (2) hydrogen peroxide Among these compounds, those which can ac (A) 1 and 3 (B) 2 and 3	e (3) ozone t as bleaching agents wo (C) 1 and 2	uld include : (D) 1, 2 and 3
29.2	Bleaching of a fabric cloth is done using A and (A) CaOCl ₂ , Na ₂ SO ₃ (B) Na ₂ S ₂ O ₃ , CaOCl ₂	excess of chlorine is ren (C) CaCl ₂ , Na ₂ S ₂ O ₃	noved using B. A and B are : (D) CaOCl₂ , Na₂S₂O₃
30.	Aqueous hypo solution on reaction with aqueo (A) yellow precipitate changing to black (C) orange precipitate to blue	bus AgNO₃ gives : (B) white precipitate cl (D) no precipitate	hanging to black

2.2

PART - II : SINGLE AND DOUBLE VALUE INTEGER TYPE

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

How m	nany of the following is corre	ct 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 (f) Metallic character.

- (d) Reducing power of hydrides (e) Extent of $p\pi$ - $p\pi$ overlap.
- (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) BF₃ (ii) BCl₃ (iii) NCl₃ (iv) AlCl₃ (v) CCl₄ (vi) PCl₃ (vii) AsCl₃
- **9.** In how many of the following reactions N₂ gas may be released

	(a) NH ₄ NO ₂ —	$\xrightarrow{\Delta}$	(b) (NH ₄) ₂ Cr ₂	$0_7 \xrightarrow{\Delta}$	(c) NH₂CON	$H_2 + HNO_2 \xrightarrow{\Delta}$
	(d) NH ₂ CONH ₂	$_{2}$ + NaOBr \longrightarrow	(e) NH ₃ + Cl ₂	$_{\rm e}$ (LR) \longrightarrow	(f) NH ₃ + Br	$_{2}$ (LR) \longrightarrow
	(g) NH₃ + NaO	$CI \longrightarrow$	(h) NH₃ + Ca	$OCI_2 \longrightarrow$	(i) Ba(N ₃) ₂ -	$\xrightarrow{\Delta}$
10.১	(i) NH₃ (vii) SbH₃	(ii) N₂H₄ (viii) H₂Se	(iii) HN₃ (ix) H₂Te	(iv) PH ₃	(v) H ₂ S	(vi) AsH_3

Number of molecules in which lone pair of electrons on the central atom is present in pure s-orbital.

12.2 Number of acidic oxides among the following is : (b) NO (f) P₄O₆ (a) N₂O (c) N_2O_3 (d) N₂O₄ (e) N₂O₅ (g) P₄O₁₀ (h) SO₃ (i) B_2O_3 (j) CO 13. Number of gaseous oxides among the following at room temperature is : (a) N₂O (b) NO (c) N_2O_3 (d) NO₂ (e) N₂O₅ (f) P₄O₆ (g) P₄O₁₀ (h) SO₂ (i) SO₃

<u>r</u>						
14.æ	The number o	f O-atoms having	g sp² hybridisati	on in P4O10 mo	lecule is :	
15.	N ₂ O ₄ , (HPO ₃) ₃ , H ₂ CO ₃ , SO ₂ , SO ₃ , P ₄ O ₁₀ H ₂ SO ₄ , N ₂ O ₃ , HNO ₃ , H ₃ PO 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.					
16.2	Number of aci (a) HNO ₂ (g) H ₄ P ₂ O ₇	ds having centra (b) HNO ₃ (h) H ₂ SO ₃	ll atom in +3 oxio (c) H ₃ PO ₂ (i) H ₂ S ₂ O ₇	dation state am (d) H ₃ PO ₃ (j) H ₂ S ₂ O ₈	ong the following (e) H ₃ PO ₄ (k) H ₂ SO ₄	is : (f) H ₄ P ₂ O ₅
17.2	Cold conc. HN (i) Pb (vii) Hg	IO ₃ will complete (ii) Pb ₃ O ₄ (viii) Au	ely dissolve : (iii) Fe (ix) Ag	(iv) Sn (x) Pt.	(v) Mg	(vi) MgO
18.	Cold dil. H ₂ SC (i) Pb (vii) CoCO ₃	04 will completely (ii) Fe ₃ O4 (viii) CuCO ₃	dissolve : (iii) Fe (ix) SrCO ₃	(iv) Cu	(v) Mg	(vi) MgO
19.	How many are(i)K4[Fer(iii)conc.(v)conc.(vii)conc.(ix)conc.	e redox reactions (CN) ₆] + conc. H H ₂ SO ₄ + KBr — H ₂ SO ₄ + KNO ₃ – H ₂ SO ₄ + COCl ₂ H ₂ SO ₄ + Cu —	$\begin{array}{c} \vdots \\ 2SO_4 \longrightarrow \\ \rightarrow \\ \longrightarrow \\ \rightarrow \\ \rightarrow \\ \rightarrow \\ \rightarrow \\ \rightarrow \\ \rightarrow \end{array}$	(ii) conc. H2S (iv) conc. H2 (vi) conc. H2 (vii) conc. H	$SO_4 + KCI \longrightarrow$ $SO_4 + NH_3 \longrightarrow$ $SO_4 + PCI_5 \longrightarrow$ $I_2SO_4 + Zn \longrightarrow$	
20.	x P ₄ + y SO ₂ C then y/x ?	$l_2 \longrightarrow$				
21.24	Complete hyd NaOH for com SOCl ₂ , SO ₂ C	rolysis product o plete neutralisat l₂, PCl₃, PCl₅,	of 1 mole each o ion? NCl₃	of following will	need how many	total number of moles of
22.	Aqueous solut (i) SF4 (vii) AsCl ₃ (xiii) CCl4	tion of how many (ii) PCl₃ (viii) POCl₃	v of the following (iii) N2O (ix) SO2	species turn b (iv) NO ₂ Cl (x) SO ₂ Cl ₂	lue litmus red ? (v) SF ₆ (xi) SOCl ₂	(vi) SeF₀ (xii) COCl₂
23.	How many of solution. (i) S	the following co	ompounds are p (iii) Na ₂ S	oossible produc (iv) Na ₂ SO ₄	ts when chlorine (v) Na ₂ S ₄ O ₆	is passed through hypo (vi) HClO ₄
24.	The difference	e in oxidation sta	tes of sulphur at	oms (in differer	nt oxidation states) present in Na ₂ S ₄ O ₆ is :
25.	How many coi (i) AsO ₃ ^{3–} (vi) PbS	mpound(s) or ior (ii) SO4 ^{2–} (vii) O3	n(s) can be oxidi (iii) Fe₂(SO₄)₃	sed by H ₂ O ₂ ar (iv)	nong the following NH2–NH2	g : (v) H ₂ S
26.2	A gas is pale I forbidden in g molar mass of	blue in colour on aseous state. T this gas.	liquifaction, the he gas does no	colour arises fi t burn but is a	rom electronic tra strong supporter	nsitions. This transition is of combustion. Give the

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

- 1.a. As, Sb and Bi show lesser tendency to form negative ions of the type M³⁻. 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 PF6⁻ ion exists
 - (B) The NF6⁻ 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 CS₂.
 - (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 NH₃ to BiH₃
 - (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_4CI .
 - (B) treating H_2O_2 with $NaNO_2$.
 - (C) passing ammonia gas over red hot CuO.
 - (D) treating ammonia with KMnO₄ 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) NH₃ 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 CS₂
 (D) heating with an alkali solution
- 9.The compound(s) which on strong heating gives oxygen is/are :
(A) AgNO3(B) BaO2(C) Pb(NO3)2(D) CaCO3
- **10.** Which of the following is/are true for oxygen.
 - (A) KMnO₄(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 $\boldsymbol{\pi}$ 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 (H₂E) 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
- 12.2. 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

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13.浊	The incorrect statement(s) regarding oxides of (A) Reducing property of dioxide decreases for (B) All these elements form oxides of the EO ₂ (C) Selenium and tellurium do not form SeO ₃ (D) SO ₂ is an oxidising agent while TeO ₂ is a	of group-16 elements is from SO ₂ to TeO ₂ and EO ₄ types and TeO ₃ reducing agent.	/are
14.2	Which of the following ions dissolve in excess (A) Al ³⁺ (B) Cu ²⁺	s of aq. NH₃. (C) Ag⁺	(D) Zn ²⁺
15.১	 Which of the following is/are incorrect statem. (A) It is less basic then NH₃ (B) It is less poisonous than NH₃ (C) The solution of copper sulphate gives no (D) Phosphine burns in air forming predomina 	ent(s) for phosphine ? precipitate with PH ₃ . antly H ₃ PO ₄ .	
16.	 Which of the following process(es) can give s (A) H₂S gas is passed through nitric acid. (B) Cl₂ gas is passed into water saturated wit (C) Hydrogen sulphide is passed through soc (D) H₂S gas is passed through acidified KMn0 	ulphur ? h hydrogen sulphide. lium bisulphate solutior D4 solution.	۱.
17.	How is H ₂ S prepared in laboratory ? (A) FeS + H ₂ SO ₄ (C) FeS + HCl	(B) FeSO ₄ + H ₂ SO ₄ (D) Elemental H ₂ +	₄ elemental S ₈
18.	A gas is obtained on heating ammonium nitr this gas : (A) causes laughter (C) is acidic in nature	ate. Which of the follov (B) brings tears to t (D) is basic in natur	wing statements are incorrect about the eyes re
19.	Which of the following represents correct dise	ociation of nitrate salts	on heating.
	(A) $2\text{LiNO}_3 \longrightarrow \text{Li}_2\text{O} + 2\text{NO}_2 + \frac{1}{2}\text{O}_2$	(B) $Pb(NO_3)_2 \longrightarrow I$	$PbO + 2NO_2 + \frac{1}{2}O_2$
	(C) $NH_4NO_3 \longrightarrow N_2O + 2H_2O$	(D) $NH_4NO_2 \longrightarrow N$	I ₂ + 2H ₂ O
20.	$\begin{array}{llllllllllllllllllllllllllllllllllll$	³⁺ (C) MnO ₄ ⁻ / H ⁺ to M	In ²⁺ (D) IO_{3}^{-} to I_{2}
21.	 A white crystaline oxide (A) having garlic sr heating, (B) gives compound (C) & gas (D). V (A) Solution of gas (D) does not turn red litmu (B) The gas (D) can also be produced by read (C) Gas (D) exists in dimeric form. (D) Compound (B) can act as a reducing age 	nell reacts with cold Vhich of the following a is blue ction of NaOH with red nt but (C) cannot.	water to form a compound (B). O re correct statements : phosphorus
22.	 Select the correct statement. (A) Ostwald's method of preparation of HNO oxygen. (B) HNO₂ can act as both oxidising and reduct (C) NO₂ reacts with O₃ to form N₂O₅. (D) HNO₃ can be used both as oxidising and 	₃ is based upon cataly ing agent. reducing agent.	tic oxidation of NH₃ by atmospheri
23.	Which of the following statements is (are) cor (A) Antimony on reaction with conc. HNO ₃ giv (B) Manganese on reaction with cold and dilu (C) HNO ₂ disproportionate to give HNO ₃ and (D) HNO ₃ on reaction with P_4O_{10} gives N_2O_5	rect ? ⁄es antimonic acid. te HNO₃ gives NO₂ gas NO	S.
24.	Concentrated sulphuric acid acts as (A) dehydrating agent (C) reducing agent	(B) sulphonating ag (D) oxidising agent	gent

p-bl	ock elements (N &	a O Family)				
25.2	Which among the (A) H ₂ S ₂ O ₃	following is/are peroxo (B) H ₂ SO ₅	acid (s) ? (C) H ₂ S ₂ O ₇	(D) H ₂ S ₂ O ₈		
26.	Which of the follo converted to acid (A) SOCl ₂	wing are used as chlor chloride). (B) SO ₂ Cl ₂	inating agents in organic s (C) PCl ₃	synthesis of compounds ? (Like acio (D) PCl₅		
27.	 Select the correct statement(s) regarding reaction of SO₂ with PCI₅. (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.	$\begin{array}{c} (P) \xrightarrow{NaH} (Q) \\ (A) \operatorname{SCI}_2 \end{array}$	$\uparrow \xrightarrow{CuSO_4} (R) \downarrow blac$ (B) PCl ₃	k precipitate, (P) may be : (C) NCl₃	(D) HCI		
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) O_2O_2 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 SO₂ 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 H₂O₂ ? (A) It is neutral towards litmus, but bleaches litmus white. (B) It is more acidic than H₂O. (C) Density and dielectric constant are higher than dilute solution of H₂O. (D) H₂O₂ is produced by auto oxidation of 2-ethyl anthraquinol. 					
32.	A solution of amm (A) H⁺ (aq.)	nonia in water contains (B) OH⁻(aq.)	which of the following spec (C) NH₄⁺ (aq.)	ies : (D) NH₃ (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 N₂O₅, all are gases at ordinary temperature. N₂O₃ 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.ര.	The gas which is	acidic in nature is :		
	(A) NO	(B) N ₂ O	(C) NO ₂	(D) both (A) and (C)

- 2.2 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 CaCl₂. (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 HCI
- (C) It produces dense white fumes with BF_3
- 4. The compound (A) : (A) turns moist red litmus blue
 - (C) is used as a dehydrating agent
- (B) reacts completely with water

(D) It can act as oxidising agent.

(B) It produces dense violet fumes on combustion

(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 π 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.

8.2	Which one is the weakest acid among the following?						
	(A) HF	(B) HCI	(C) HBr	(D) HI			
9.2	Which hydride has no	reaction with water ?					
	(A) NH ₃	(B) CH ₄	(C) BeH ₂	(D) NaH			

10.১	Which (A) OH	one is strongest -	t base ? (B) HS⁻			(C) HSe⁻		(D)	HTe [_]
Comp	rehensio Answe	on # 5 r Q.11, Q.12 ar	nd Q.13 by	y appi	ropriately	matching th	he inform	ation ç	given in the three
C	bserve t	he three colum	ns in which	ch col	umn-1 rej	presents che	mical rea	ctions,	column-2 represents
		Column-1		рпузі		olumn-2	-s represe	ints um	Column-3
()) C	$\mu + dil. HNO_3$		(i)	Colourle	ss das. Neuti	ral	(P)	NO
(1) C	$u + conc. HNO_3$		(ii)	Blue sol	id, Acidic		(Q)	NO ₂
(1	II) Zr	n + dil. HNO ₃		(iii)	Brown g	as, Acidic		(R)	N ₂ O
(I	V) Zr	n + conc. HNO ₃		(iv)	Colourle	ss solid, Acid	dic	(S)	N ₂ O ₃
11.	Which (A) (I),	of the following (iv), (S)	set of com (B) (II), (nbinati (ii), (Q	ion is corr	ect ? (C) (II), (iii),	(Q)	(D)	(IV), (iv), (S)
12.	Which (A) (III)	of the following , (i), (R)	set of com (B) (I), (nbinati i), (P)	ion is inco	rrect ? (C) (IV), (iii),	, (Q)	(D)	(III), (iv), (S)
13.	Which (A) (I),	of the following (ii), (P)	set of con (B) (IV),	nbinati (iii), ((ion is corr Q)	ect ? (C) (IV), (ii),	(Q)	(D)	(I), (iii), (P)
	Ex	ercise	. 3 =						
* Marl	ked Ques	stions may hav	e more th	nan or	ne correc	t option.			
	ART - I	: JEE (AD	VANCI	ED)	/ IIT-JE	E PROB	LEMS	(PRE	VIOUS YEARS)
Sacti	$ion(\Lambda)$	· Group 15th						•	•
3ecti 1.	The nu (A) zer	mber of P—O—	-P bonds i (B) two	in cycl	ic trimeta	ohosphoric ac (C) three	cid is :	(D) 1	[JEE 2000,(S) 3/35] four
2.	The co (A) Cl₂((C) Na₂	rrect order of ac D ₇ > SO ₂ > P ₄ O 2O > MgO > Al ₂ (idic streng 10 O3	gth is :	:	(B) CO ₂ > N (D) K ₂ O > C	l₂O₅ > SO₃ aO > MgC	3)	[JEE 2000,(S) 3/35]
3.	Ammor (A) con	nia can be dried c. H₂SO₄	by : (B) P ₄ O	10		(C) CaO		(D)	[JEE 2000,(S) 3/35] anhydrous CaCl ₂
4.	Give re tetra-at	eason why elem omic molecule.	nental nitro	ogen (exists as	diatomic mol	ecule whe	ereas e	elemental phosphorus is a [JEE 2000 (M), 2/100]
5.	Polyph (A) forr (C) forr	osphates are us n soluble compl n soluble compl	ed as wat exes with exes with	ter sof anion catior	tening age ic species nic species	ents because (B) precipita s (D) precipita	e they : ate anionio ate cation	c speci ic spec	[JEE 2002(S) , 3/90] es ies
6.	For H₃ł (A) H₃F (C) H₃F	PO ₃ and H ₃ PO ₄ , PO ₃ is dibasic ar PO ₄ is tribasic a	the corre nd reducin nd reducir	ct cho Ig Ig	ice is :	(B) H₃PO₃ is (D) H₃PO₃ is	s dibasic a s tribasic a	ind nor and nor	[JEE 2003 (S), 3/84] n-reducing n-reducing
7.	(NH4)2 (A) hea (C) trea	Cr ₂ O ₇ on heatin iting NH4NO ₂ ating Mg ₃ N ₂ with	g gives a n H₂O	gas w	hich is als	o given by (B) heating I (D) treating	: NH₄NO₃ Na(compo	ound) v	[JEE 2004 (S), 3/84] vith H ₂ O ₂
8.	A pale (A) N₂C	blue liquid is ob)	tained by (B) N₂O	equim 3	iolar mixtu	ire of two gas (C) N ₂ O ₄	ses at –30	⁰C. (D)	[JEE 2005 (S), 3/84] N ₂ O ₅
9.	Thermo (A) Red	odynamically mo	ost stable (B) Whit	allotro te	pe of pho	sphorus is : (C) Black		(D)	[JEE 2005 (S), 3/84] Yellow
10.	(a) (b)	What amount of Write the struct	of CaO in ture of P4	grams O ₁₀ .	s is require	ed to neutralis	se 852 g c	of P ₄ O ₁	0 . [JEE 2005 (M), 1/60] [JEE 2005 (M), 1/60]

Paragraph for Question Nos. 11 to 13

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 NH₃ and PH₃. Phosphine is a flammable gas and is prepared from white phosphorous.

- 11. Among the following, the correct statement is :
 - (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.
- 12. Among the following, the correct statement is :

(A) between NH₃ and PH₃, NH₃ is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional.

(B) between NH₃ and PH₃, PH₃ is a better electron donor because the lone pair of electrons occupies sp³ orbital and is more directional.

(C) between NH₃ and PH₃, NH₃ is a better electron donor because the lone pair of electrons occupies sp³ orbital and is more directional.

(D) between NH₃ and PH₃, PH₃ is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional.

13. White phosphorus on reaction with NaOH gives PH₃ as one of the products. This is a : (B) disproportionation reaction [JEE 2008, 4/163] (A) dimerization reaction (D) precipitation reaction

(C) condensation reaction

The reaction of P₄ with X leads selectively to P₄O₆. The X is : 14. (B) A mixture of O₂ and N₂ (A) Dry O₂ (C) Moist O₂ (D) O₂ in the presence of aqueous NaOH

15. 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 HNO₃	(r)	N ₂ O
(D)	Zn + conc HNO ₃	(S)	Cu(NO ₃) ₂
		(t)	Zn(NO ₃) ₂

- 16. Extra pure N₂ can be obtained by heating (C) $(NH_4)_2Cr_2O_7$ (A) NH₃ with CuO (B) NH₄NO₃
- Among the following, the number of compounds that can react with PCI₅ to give POCI₃ is O₂, CO₂, SO₂, 17. H₂O, H₂SO₄, P₄O₁₀. [JEE 2011, 3/160]

18. Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen? [JEE 2012, 3/136]

(A) HNO₃, NO, NH₄Cl, N₂ (B) HNO₃, NO, N₂, NH₄Cl (C) HNO₃, NH₄Cl, NO, N₂ (D) NO, HNO₃, NH₄Cl, N₂

19. Concentrated nitric acid, upon long standing, turns yellow-brown due to the formation of : [JEE(Advanced) 2013, 2/120]

20.*	The pair(s) of reagents that yield paramagnet	ic 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 HNO₃	(D) O ₂ and 2-ethy	lanthraquinol

21.	The product formed in t	he reaction of SOCI2 with	white phosphorous is :	[JEE(Advanced) 2014, 3/120]
	(A) PCI ₃	(B) SO ₂ Cl ₂	(C) SCl ₂	(D) POCl ₃

[JEE 2008, 4/163]

[JEE 2008, 4/163]

[JEE 2009, 3/160]

[JEE 2011, 3/160]

(D) Ba(N₃)₂

(D) N₂O₄

22.*	The compound(s)	which generate(s) N ₂ gas up	oon thermal decomposition	on below 300°C is (are)
	(A) NH ₄ NO ₃	(B) (NH4)2Cr2O7	(C) Ba(N ₃) ₂	[JEE(Advanced) 2018, 4/120] (D) Mg ₃ N ₂
23.*	Based on the comp (A) Bi₂O₅ is more b (B) NF₃ is more cov (C) PH₃ boils at low (D) The N–N single	bounds of group 15 element asic than N_2O_5 valent than BiF ₃ ver temperature than NH ₃ bond is stronger than the l	ts, the correct statement(P–P single bond	(s) is (are) [JEE(Advanced) 2018, 4/120]
Secti	on (B) : Group 1	6 th		
24.	Amongest H_2O , H_2 (A) H_2O because o (C) H_2S because o	S, H₂Se and H₂Te the one ∖ í H-bonding. í H-bonding.	with highest boiling point (B) H ₂ Te because of h (D) H ₂ Se because of h	is : [JEE 2000 (S), 3/35] higher molecular weight. lower molecular weight.
25.	The number of S–S (A) three	bonds, in sulphur trioxide (B) two	trimer (S₃O∍) is : (C) one	[JEE 2001 (S), 3/35] (D) Zero
26.	Which of the follow (A) $H_2 S_2 O_3$	ing oxoacids of sulphur has (B) $H_2 S_2 O_5$	s –O–O– linkage ? (C) H ₂ S ₂ O ₆	[JEE 2004 (S), 3/84] (D) H ₂ S ₂ O ₈
27.	Which of the follow (A) KI	ing is not oxidised by O ₃ ? (B) KMnO ₄	(C) K ₂ MnO ₄	[JEE 2005 (S), 3/84] (D) FeSO4
28.	Which gas is evolv (A) NO ₂	ed when PbO ₂ is treated wi (B) O ₂	th concentrated HNO ₃ ? (C) N ₂	[JEE 2005 (S), 3/84] (D) N ₂ O
29.	Aqueous solution c (A) Na ₂ S ₄ O ₆	f Na ₂ S ₂ O ₃ on reaction with (B) NaHSO ₄	Cl ₂ gives : (C) NaCl	[JEE 2008, 3/162] (D) NaOH
30.	Hydrogen peroxide	in its reaction with KIO4 an	d NH2OH respectively, is	s acting as a
	(A) reducing agent (C) oxidising agent	oxidising agent , oxidising agent	(B) reducing agent, re(D) oxidising agent, re	educing agent
31.*	The nitrogen conta (A) can also be pre (B) is diamagnetic (C) contains one N (D) react with Na m	n the reaction of HNO_3 w HNO_3	/ith P₄O₁₀. [JEE(Advanced) 2016, 4/124]	
	Upon heating KCIC W reacts with white	Paragraph for Qu B ₃ in the presence of catalyt phosphorus to give X . The	estion Nos. 32 to 33 ic amount of MnO ₂ , a ga reaction of X with pure	s W is formed. Excess amount o HNO₃ gives Y and Z .
32.	Y and Z are, respe- (A) N ₂ O ₄ and HPO:	ctively 3 (B) N2O4 and H3PO3	(C) N ₂ O ₃ and H ₃ PO ₄	[JEE(Advanced) 2017, 3/122] (D) N_2O_5 and HPO $_3$
33.	W and X are, respective (A) O ₂ and P ₄ O ₁₀	ctively (B) O ₂ and P ₄ O ₆	(C) O_3 and P_4O_6	[JEE(Advanced) 2017, 3/122] (D) O ₃ and P ₄ O ₁₀
	PART - II : JE	E (MAIN) / AIEEE	PROBLEMS (PR	EVIOUS YEARS)
		JEE(MAIN) OFF	LINE PROBLEMS	
	The number of hyd	rogen atom (s) attached to	phosphorus atom in hype	ophosphorus acid is : [AIEEE 2005, 3/225]
1.		(2) two	(3) one	(4) three
1.	(1) zero	(2) (110		
1. 2.	(1) zero Which of the follow (1) 2HI + H ₂ SO ₄ \rightarrow	ing chemical reactions depi	icts the oxidizing behavio (2) Ca(OH) ₂ + H ₂ SO ₄	our of H₂SO₄? [AIEEE 2006, 3/165] → CaSO₄ + 2H₂O

3.	Regular use of which o (1) Superphosphate of (3) Potassium nitrate	of the following fertilizers i lime	ncreases the acidity of so (2) Ammonium sulphate (4) Urea	bil? [AIEEE 2007, 3/120]
4.*	Which of the following (1) The stability of hydr (2) Nitrogen cannot for (3) Single N – N bond (4) N ₂ O ₄ has two resor	[AIEEE 2011, 4/120] periodic table :		
5.	Which of the following (1) S_2 molecule is para (2) The vapour at 200° (3) At 600°C the gas m (4) The oxidation state	[AIEEE 2011, 4/120]		
6.	Which of the following (1) ONCI and ONO ⁻ ar (3) Ozone is violet-blac	is the wrong statement ? e not isoelectronic. ck in solid state	(2) O₃ molecule is bent(4) Ozone is diamagnet	[JEE(Main) 2013, 4/120] ic gas.
7.	Which of the following (1) It is dimagnetic in g (3) It combines with ox	properties is not shown b aseous state ygen to form nitrogen dio	y NO ? xide	[JEE(Main) 2014, 4/120] (2) It is a neutral oxide (4) It's bond order is 2.5
8.	From the following stat (1) It can act only as an (2) It decomposed on e (3) It has to be stored i (4) It has to be kept aw	ements regarding H ₂ O ₂ , on oxidizing agent exposure to light n plastic or wax lined glas vay from dust	choose the incorrect sta	tement : [JEE(Main) 2015, 4/120]
9.	Assertion : Nitrogen a form oxides of nitrogen Reason : The reaction (1) Both assertion and (2) Both assertion and (3) The assertion is inc (4) Both are assertion a	and Oxygen are the main between nitrogen and ox reason are correct, and the reason are correct, but the correct, but the reason is conditioned and reason are incorrect.	components in the atmos cygen requires high temp he reason is the correct e he reason is not the corre correct	sphere but these do not react to [JEE(Main) 2015, 4/120] erature. explanation for the assertion ct explanation for the assertion
10.	The pair in which phos (1) Pyrophosphorous a (3) Pyrophosphorous a	phorous atoms have a fo and hypophosphoric acids and pyrophosphoric acids	rmal oxidation state of +3 (2) Orthophosphorous a (4) Orthophosphorous a	B is: [JEE(Main) 2016, 4/120] and hypophosphoric acids and pyrophosphorous acids
11.	The reaction of zinc wi	th dilute and concentrated	d nitric acid, respectively,	produces:
	(1) NO ₂ and NO	(2) NO and N_2O	(3) NO ₂ and N ₂ O	(4) N ₂ O and NO ₂
12.	Hydrogen peroxide of $[Fe(CN)_6]^{4-}$ in alkaline (1) H ₂ O and (H ₂ O + O ₂) (3) (H ₂ O + O ₂) and H ₂ O	xidises [Fe(CN) ₆] ^{4–} to [F medium. The other produ :))	e(CN) ₆] ^{3–} in acidic medi cts formed are, respectiv (2) H ₂ O and (H ₂ O + OH (4) (H ₂ O + O ₂) and (H ₂ O	um but reduces [Fe(CN) ₆] ^{3–} to ely. [JEE(Main) 2018, 4/120] [–]))+ OH [–])
13.	The compound that do	es not produce nitrogen g	as by the thermal decon	position is :
	(1) NH4NO2	(2) (NH4)2SO4	(3) Ba(N ₃) ₂	(4) $(NH_4)_2Cr_2O_7$

	۲. ۲			
		JEE(IVIAIN) (JINLINE PRO	
1.	Which of the follow	ving is not formed when H	H ₂ S reacts with	acidic K ₂ Cr ₂ O ₇ solution ? [JEE(Main) 2014 Online (09-04-14), 4/120]
	(1) CrSO ₄	(2) Cr ₂ (SO ₄) ₃	(3) K ₂ SO	4 (4) S
2.	Hydrogen peroxide reacting species. I	e acts both as an oxidizin n which of the following c	ng and as a red cases H ₂ O ₂ acts	ucing agent depending upon the nature of the as a reducing agent in acid medium ? [JEE(Main) 2014 Online (12-04-14), 4/120]
	(1) MnO ₄ -	(2) Cr ₂ O ₇ ²⁻	(3) SO ₃ ^{2–}	(4) KI
3.	Which of these sta (1) NO ⁺ is not isoe (2) B is always cov (3) In aqueous sol (4) LiAlH4 is a vers	atements is not true ? electronic with O ₂ valent in its compounds ution, the TI ⁺ ion is much satile reducing agent in o	more stable the	[JEE(Main) 2014 Online (19-04-14), 4/120] an TI(III) s.
4.	The non-metal tha	t does not exhibit positive	e oxidation state	
	(1) Fluorine	(2) Oxygen	(3) Chlori	ne (4) lodine
5.	Identify the incorre (1) Rhombic and n (2) S₀ ring has a c (3) S₂ is paramagr (4) The S–S–S bo	ect statement: nonoclinic sulphur have S rown shape. netic like oxygen. nd angles in the S ₈ and S	[, S8 molecules. S6 rings are the	JEE(Main) 2016 Online (10-04-16), 4/120] same.
6.	Identify the polluta Taj Mahal. (1) SO₂ and NO₂	nt gases largely respons (2) SO ₂ and O ₃	ible for the disc [. (3) O₃ an	oloured and lustreless nature of marble of the JEE(Main) 2017 Online (08-04-17), 4/120] d CO ₂ (4) CO ₂ and NO ₂
7.	In which of the foll	owing reactions, hydroge	en peroxide acts	s as an oxidizing agent ?
	(1) PbS + 4H ₂ O ₂ ? (3) l ₂ + H ₂ O ₂ + 2OI	PbSO₄ + 4H₂O H⁻ ? 2I⁻ + 2H₂O₂ + O₂	ן 2MnC(2) 2MnC (4) HOCI	JEE(Main) 2017 Online (08-04-17), 4/120] 4 ⁻ + 3H ₂ O ₂ ? 2MnO ₂ + 3O ₂ + 2H ₂ O + 2OH ⁻ + H ₂ O ₂ ? H ₃ O ⁺ + Cl ⁻ + O ₂
8.	For per gram of redecomposition real (Given : Atomic wt (1) $(NH_4)_2Cr_2O_7(s)$ (2) $2NH_4NO_3(s) \rightarrow$ (3) $Ba(N_3)_2(s) \rightarrow B$ (4) $2NH_3(g) \rightarrow N_2(s)$	eactant, the maximum quactions ? \therefore : Cr = 52 u, Ba = 137 u) $\rightarrow N_2(g) + 4H_2O(g) + Cr;$ $\Rightarrow 2N_2(g) + 4H_2O(g) + O_2(g)$ $\Rightarrow 3N_2(g)$ g) + 3H ₂ (g)	uantity of N₂ gas) ₂O₃(s) ȝ)	s is produce in which of the following thermal [JEE(Main) 2018 Online (15-04-18), 4/120]
9.	Good reducing nat	ture of H ₃ PO ₂ is attributed	d to the presend	ce of :
	(1) One P–H bond	(2) One P–OH bon	nd (3) Two F	[JEE(Main) 2019 Online (09-01-19), 4/120] P–OH bonds (4) Two P–H bonds
10.	The chemical natu (1) Oxidising agen (2) Oxidising and r (3) Reducing agen (4) Oxidising and r	re of hydrogen peroxide t in acidic medium, but no reducing agent in both ac nt in basic medium, but no reducing agent in acidic n	is : ot in basic med :idic and basic r ot in acidic med nedium, but not	[JEE(Main) 2019 Online (10-01-19), 4/120] ium. nedium. ium. : in basic medium.
11.	lodine reacts with in Y, is : (1) 7	concentrated HNO ₃ to yie	eld Y along with (3) 1	n other products. The oxidation state of iodine [JEE(Main) 2019 Online (12-01-19), 4/120] (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 60°. 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 S₂ molecule. S₂ molecule, like O₂ molecule, has two unpaired electrons in the anti-bonding n* orbitals. Hence, like O₂, it exhibits paramagnetism.
- **B-5.** (a) Oxidation state of phosphorus in P₄ molecule is zero.
 - (b) Valency of P in P₄ 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 P₄ molecule is one.
 - (e) Bond angle 60°.
 - (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.

> 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 PH₄⁺, phosphoros undergo sp³ hybridization, but in PH₃ phosphoros uses pure p-orbitals for bonding. Hence bond angle in PH₃ is nearly 90°.
- B-9.

Oxide	Oxyacids
N2O3	HNO ₂
NO2/N2O	HNO ₂ + HNO ₃
N2O5	HNO ₃
P ₄ O ₆	H ₃ PO ₃
P ₄ O ₁₀	H ₃ PO 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 (P₄).
- **D-1.** Due to high electronegativity of O, the O–H in H₂O 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 : $NH_{4^+} = 1.48 \text{ Å}, \text{ K}^+ = 1.33 \text{ Å}, \text{ Rb}^+ = 1.48 \text{ Å}.$
- D-3. (a) NH₃ + H₂O → NH₃.H₂O (Ammonium hydroxide) → NH₄+ (aq) + OH⁻ (aq) This reaction occurs to small extent only (1-2 %). Rest of NH₃ remains unreacted. (b) NH₃ (aq.) + HCl (aq.) → NH₄Cl(aq.)
 (c) NH₃(aq.) + H₂O + CO₂ (aq.) → NH₄HCO₃ (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, NH₃ forms hydrogen bonds with H₂O molecules and hence dissolves in it whereas PH₃ does not dissolve and forms bubbles. Also same electronegativity of P and H.
- **D-6.** $NH_3 + NaOCI \longrightarrow NH_2CI + NaOH (fast)$ $NH_3 + NH_2CI \longrightarrow NH_2NH_2 + NH_4CI (slow)$
- **D-7.** 'N' atom of NH₃ or 'P' atom of PH₃ has a lone pair of electrons available for donation. Hence NH₃ and PH₃ are Lewis bases. The electron pair density on a larger 'P' atom is less than that of smaller 'N' atom. Hence PH₃ is a weaker base.
- **E-1.** Pure oxygen will oxidise P₄O₆ to P₄O₁₀ despite an excess of P₄ is kept at the start of the reaction. Hence, nitrogen gas is used as a diluent.



- **E-4.** NO₂ being odd molecule, on dimerisation is converted to stable N₂O₄ molecule with even number of electrons.
- **F-1.** SO₃ reacts with water to form H₂SO₄ which forms a mist that is difficult to condense. It escapes in the atmosphere. It is, therefore, absorbed in conc. H₂SO₄ to form oleum which may be diluted to form H₂SO₄.

p-block elements (N & O Family)

F-2. SO ₂ Cl ₂ is formed from H ₂ SO ₄ by treating with excess of phosphorus pentachloride.												
	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 obta 2H ₂ SO ₄ (co	SO ₂ is obtained from conc. H ₂ SO ₄ , when heated with copper metal. 2H ₂ SO ₄ (conc.) + Cu \longrightarrow CUSO ₄ + 2H ₂ O + 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.	PCI ₅	PCI ₅										
G-3.	H ₂ S											
G-4.	(A) $PCI_5 \xrightarrow{\Delta} PCI_3 + CI_2$ (B) $PCI_5 + D_2O \longrightarrow POCI_3 + 2 DCI$ $POCI_3 + 3D_2O \longrightarrow D_3PO_4 + 3DCI$											
G-5.	PCl₃ hydrol PC	yses in the I₃ + H₂O —	presence o → H₃PO₃ +	f moisture giv 3 HCl	ing fumes	of HCI						
G-6.	(i) $P_4O_{10} + 6PCI_5 \longrightarrow 10POCI_3$ (ii) $NH_3 + NaOCI \longrightarrow NH_2CI + NaOH$ (fast) $NH_3 + NH_2CI \longrightarrow NH_2NH_2 + NH_4CI$ (slow)											
H-1.	$ \begin{aligned} X &= I_2 \\ Y &= Na_2S_4C \end{aligned} $	D ₆										
H-2.	AgBr + 2Na ₂ S ₂ O ₃ Na ₃ [Ag(S ₂ O ₃) ₂] + NaBr H ₂ SO ₄ (dil) + Na ₂ S ₂ O ₃ \longrightarrow Na ₂ SO ₄ + S (white turbidity) + H ₂ O + SO ₂ 3H ₂ SO ₄ (conc.) + Na ₂ S ₂ O ₃ \longrightarrow Na ₂ SO ₄ + 4SO ₂ + 3H ₂ O											
H-3.	Atomic num Excess sulp to give tetra 2S + Cl ₂ —	hber of A = phur reacts achloride. $M \rightarrow S_2Cl_2$;	16. It is sulp with chlorin lolten dimer S	ohur. Atomic r ne to give din ric monochlori 22Cl2 + Cl2	number of I neric mono de on satu → 2SCl₂	B = 17. It is ch ochloride. Sulp ration with chl	lorine. hur reacts orine give	s with excess s dichloride.	chlorine			
				PAR	RT - 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)			
				PAR	T - III							
1.	(A - p. g. s)	·(B-p.a	rs) · (C - a	rs) · (D - p	ars)							
2.	(A - q, s) ; (B - q, r) ; (C	C - q, s) ; (D	- q)	9, 1, 0)							
				EXERC	CISE - 2	2						
	<i>(</i> .)	-	(-)	PAF	RT - I	_		_	<u> </u>			
1.	(A)	2.	(D)	3.	(C)	4.	(C)	5.	(B)			
6.	(D)	7.	(D)	8.	(C)	9.	(D)	10.	(D)			

_ <u>p</u> -b	lock elements (N	& O F	Family)						
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)
				ΡΑ	RT - 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 v	/ii)		9.	9 (a,b,c,d,e,	f,g,h and i)		
10.	6 (except a,b a	nd 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, i	v and ix)			
19.	3 (iii, viii, ix)	20.	10	21.	24	22.	10 (except iii	v and >	ciii)
23.	3 (i,ii and iv) 24. 5				4 (i, iv, v and vi) 26 . 32, O ₂				
				PA	RT - 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.	(BCD)
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)						
				PAI	RT - IV				
1.	(C)	2.	(B)	3.	(C)	4.	(B)	5.	(D)
6.	(C)	7.	(A)	8.	(A)	9.	(B)	10.	(A)
11.	(C)	1 2.	(D)	1 3.	(B)				
			E	XER	CISE - 3				
				PA	RT - I				
1.	(C)	2.	(A)	3.	(C)				

4. 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.

(A)

8.

(B)

9.

(C)

7.

(A)

6.

5. (C)

10.

(a) 1008 g.

(b) Structure of P_4O_{10} .



11.	(C)	12.	(C)	13.	(B)	14.	(B)		
15.	$A \rightarrow p,s\ ; B \rightarrow$	q, s ; C	\rightarrow r, t; D \rightarrow q,	t		16.	(D)	17.	4
18.	(B)	19.	(B)	20.*	(ABC)	21.	(A)	22.*	(BC)
23.*	(ABC)	24.	(A)	25.	(D)	26.	(D)	27.	(B)
28.	(B)	29.	(B)	30.	(A)	31.*	(BD)	32.	(D)
33.	(A)								

PART - I	
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	JEE(MAIN) OFFLINE PROBLEMS									
1.	(2)	2.	(1)	3.	(2)	4.*	(1, 4)	5.	(4)	
6.	All statement are correct there is no answer						(1)	8.	(1)	
9.	(1)	10.	(4)	11.	(4)	12.	(1)	13.	(2)	
			JEE(I	MAIN) ON	LINE PRO	BLEMS				
1.	(1)	2.	(1)	3.	(1)	4.	(1)	5.	(4)	
6.	(1)	7.	(1)	8.	(4)	9.	(4)	10.	(2)	
11.	(4)									