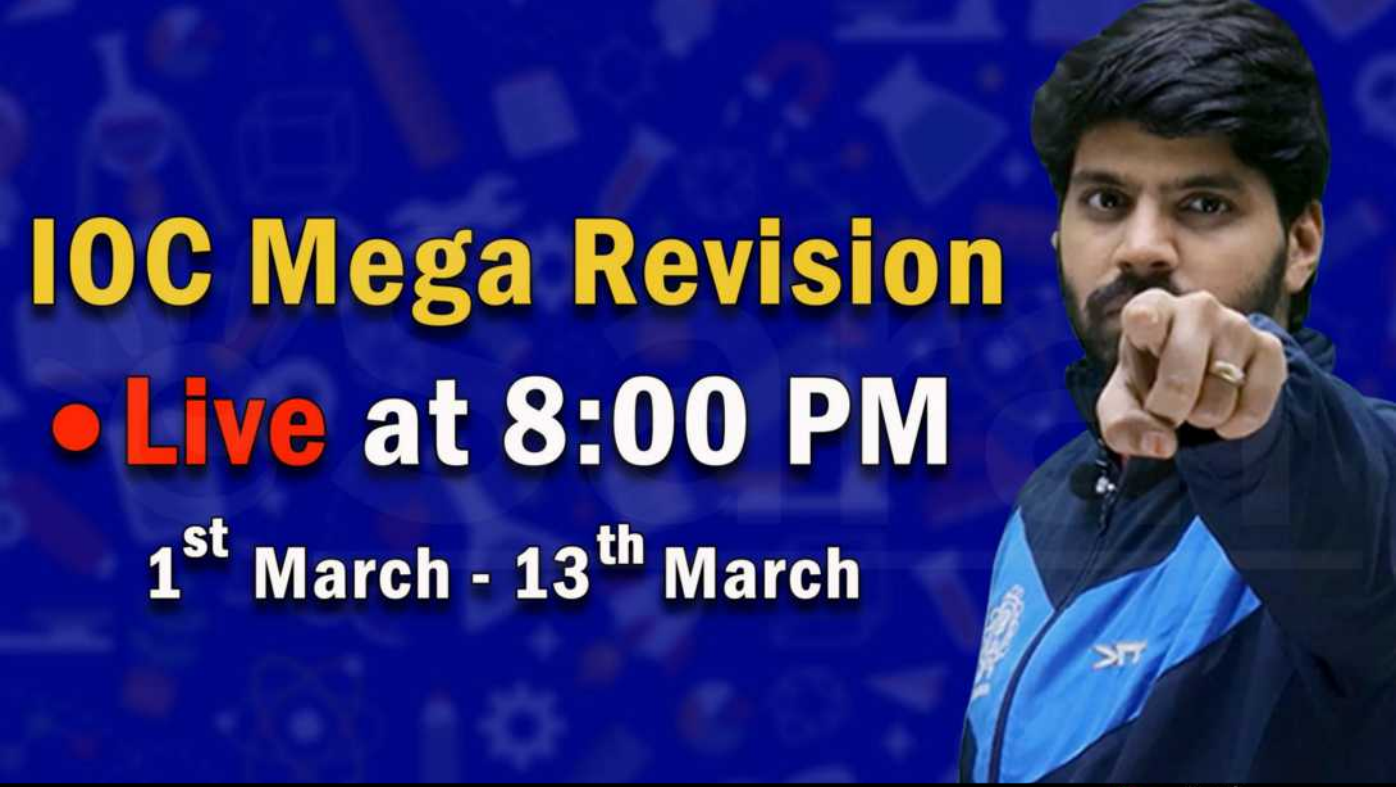
75 minutes

1) Aparna
2) Lokendra
3) Aayush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1st March - 13th March
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Complete Chemistry Mega Revision Timetable

1 March	3,4 March	5 March	6 March
Coordination Compounds	Chemical Bonding	p–block (Class 12)	p–block (class 11) + Periodic Table

8 March	10 March	12 March	13 March
Metallurgy	s-block + Hydrogen	d & f-block	Surprise Gift

Complete Chemistry Mega Revision PYQs & Quiz Timetable

Phod nahi paoge Practice makes Perfect

2 March	4 March	5 March	7 March
Coordination Compounds	Chemical Bonding	p–block (Class 12)	p–block (class 11) and Periodic Table
PYQs (JEE/NEET)	PYQs	PYQs	PYQs
Quiz	Quiz	Quiz	Quiz

11 March	12 March	13 March
Metallurgy	s-block + Hydrogen	d & f-block
PYQs	PYQs	PYQs
Quiz	Quiz	Quiz

Periodic Table 15-18 group

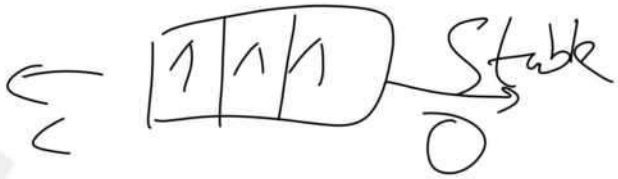
GROUP-15 ELEMENTS

(N, P, As, Sb, Bi)

TRICK

नानी पापा आशु सब बीमार

Nitrogen Family



Electronic Configuration

The valence shell electronic configuration of these elements is ns^2np^3.

Atomic And Ionic Radii

Covalent radius

N < P < As < Sb < Bi

GLAD

Ionisation Enthalpy

N > P > As > Sb > Bi (IE_1 values)

Electronegativity

+5 (+3)

N > P > As > Sb = Bi
(1.9) (1.9)

Inert pair

Physical Properties

(i) All the elements of this group are polyatomic.
Dinitrogen is a diatomic gas while all others are solids.

(ii) Metallic character increases down the group

Chemical Properties

(i) The common oxidation states of these elements are -3, +3 and +5.

Dinitrogen

Laboratory Preparation

$$NH_4Cl(aq) + NaNO_2(aq) \longrightarrow N_2(g) + 2H_2O(\ell) + NaCl\ (aq)$$

$$(NH_4)_2Cr_2O_7 \xrightarrow{\text{Heat}} N_2 + 4H_2O + Cr_2O_3$$

Reactions with metals :- → Ionic

$$6Li + \overset{0}{N_2} \xrightarrow{\text{Heat}} 2\overset{-3}{Li_3N}$$

$$3Mg + \overset{0}{N_2} \xrightarrow{\text{Heat}} \overset{-3}{Mg_3N_2}$$

Reaction with Non-Metals

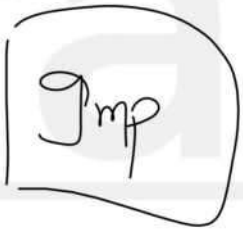
It combines with hydrogen at about 773 K in the presence of a catalyst (Haber's Process) to form ammonia

$$N_2(g) + 3H_2(g) \overset{773k}{\rightleftharpoons} 2NH_3(g)$$

Ammonia

Preparation

Ammonia is present in small quantities in air and soil where it is formed by the decay of nitrogenous organic matter e.g., urea.



$$NH_2CONH_2 + 2H_2O \longrightarrow (NH_4)_2CO_3 \rightleftharpoons 2NH_3 + H_2O + CO_2$$

$$2NH_4Cl + Ca(OH)_2 \longrightarrow 2NH_3 + 2H_2O + CaCl_2$$

$$(NH_4)_2SO_4 + 2NaOH \longrightarrow 2NH_3 + 2H_2O + Na_2SO_4$$

Large scale manufacturing
(Haber's Process)

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

$\Delta_f H^{\ominus}$ = – 46.1 kJ mol^{-1}

Properties

NH_3 → चतुर

Chatur

$N\text{-}H_3$ → H-bonding

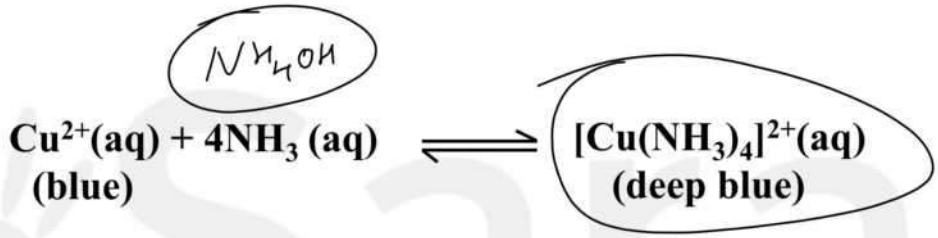
$NH_3 + H_2O \rightarrow NH_4OH$

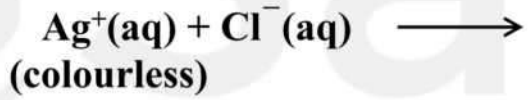
1. ~~is a colourless~~ gas with a pungent odour.

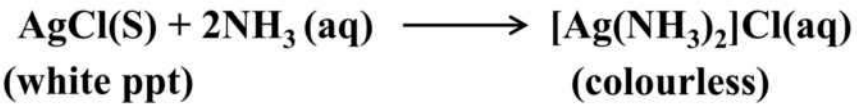
2. Its freezing and boiling points are 198.4 and 239.7 K respectively.

3. Ammonia gas is highly soluble in water.

Practical Application







hyb, structure **Oxides of Nitrogen** → neutral, acidic, structure

Name	Formula	Oxidation state of nitrogen	Common methods of preparation	Physical appearance and chemical nature
Dinitrogen oxide	$\overset{+1}{N_2}\overset{-2}{O}$	+1	$NH_4NO_3 \xrightarrow{\text{Heat}} N_2O + 2H_2O$	Colourless gas, neutral
Nitrogen monoxide [Nitrogen (II) oxide]	$\overset{+2}{N}\overset{-2}{O}$	+2	$2NaNO_2 + 2FeSO_4 + 3H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + 2NaHSO_4 + 2H_2O + 2NO$	Colourless gas, neutral

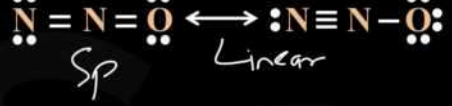
Name	Formula	Oxidation state of nitrogen	Common methods of preparation	Physical appearance and chemical nature
DiNitrogen trioxide [Nitrogen (III) oxide]	$\overset{+3}{N_2}\overset{-6}{O_3}$	+3	$2NO + N_2O_4 + \xrightarrow{250K} 2N_2O_3$	Blue Solid, acidic Blue liquid (-30°C)

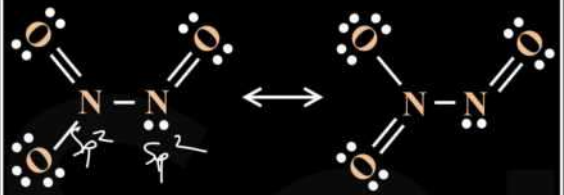
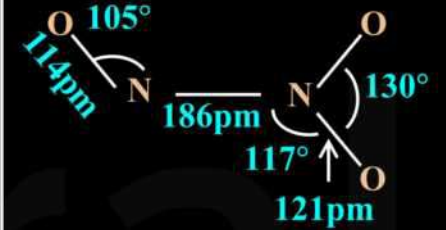
Colour → identification

Nitrogen dioxide [Nitrogen (IV) oxide]	NO_2	+4	$2Pb(NO_3)_2 \xrightarrow{673K} 4NO_2 + 2PbO + O_2$	Brown gas, acidic

Name	Formula	Oxidation state of nitrogen	Common methods of preparation	Physical appearance and chemical nature
Nitrogen tetroxide [Nitrogen (IV) oxide]	N_2O_4 Special	+4	$2NO_2 \underset{\text{Heat}}{\overset{\text{Cool}}{\rightleftharpoons}} N_2O_4$	Colourless solid/liquid, acidic
Dinitrogen pentaoxide [Nitrogen (V) oxide]	N_2O_5	+5	$4HNO_3 + P_4O_{10} \longrightarrow 4HPO_3 + 2N_2O_5$	Colourless solid, acidic

Structure of Oxides of Nitrogen

Formula	Resonance structures	Bond Parameters
N_2O		N — N — O 113pm 119pm Linear
NO		N — O 115pm

Formula	Resonance structures	Bond Parameters
2 gmp structures N_2O_3		

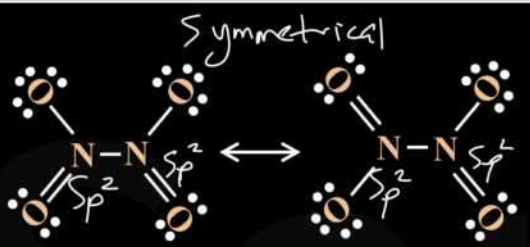
odd e⁻ molecule

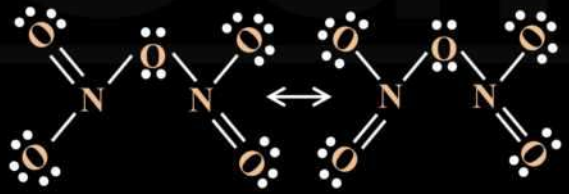
NO_2

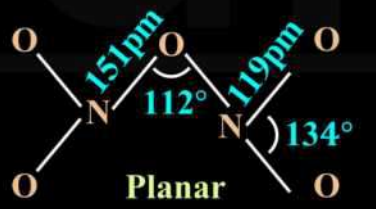
Learn

Bent

Angular

Formula	Resonance structures	Bond Parameters
N_2O_4		





Nitrous Acid (HNO_2)

Preparation

(a) $M-nitrite \xrightarrow[HCl \text{ or } H_2SO_4]{dil.acid} GMN_1$

(b) $N_2O_3 + H_2O \longrightarrow 2HNO_2$

Properties

+3 +2 +3 → +5

Because of its easy oxidation to liberate nascent oxygen, it acts as a strong oxidant

Good oxidising agent

p-block elements
d-block elements
Intermediate oxidation

$$2\overset{+3}{H}NO_2 \longrightarrow H_2O + 2NO + [O]$$

Nitrous acid also acts as a reducing agent as it can be oxidised into nitric acid.

reducing

$$2\overset{+7}{K}MnO_4 + 5HNO_2 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2\overset{+2}{M}nSO_4 + 5HNO_3 + 3H_2O$$

Nitric Acid

HNO_3 → bagap of oxidation

Laboratory Method

By heating KNO_3 or $NaNO_3$ and concentrated H_2SO_4 in a glass retort.

$$KNO_3 / NaNO_3 + H_2SO_4 \longrightarrow KHSO_4 / NaHSO_4 + HNO_3$$

1 Large Scale Preparation (Ostwald's Process) Learn

(i) This method is based upon catalytic oxidation of NH_3 by atmospheric Oxygen.

$$4NH_3(g) + 5O_2(g) \xrightarrow[500K,\ 9bar]{Pt/Rh-gauge\ catalyst} 4NO(g) + 6H_2O(g)$$

(from air)

Physical Properties

Nitric Acid → Long Standing

JM 2020
JA 2013

(i) Nitric acid usually acquires yellow or brown colour due to its decomposition by sunlight into NO_2.

$$4HNO_3 \xrightarrow{\text{Sunlight}} 4NO_2 + 2H_2O + O_2$$

Chemical Properties

Oxidising Nature → Highest oxidising state →

Nitric acid acts as a strong oxidising agent as it decomposes to give nascent Oxygen easily.

$$S + 6HNO_3 \longrightarrow \overset{+6}{H_2SO_4} + 6NO_2 + 2H_2O$$

Conc.
and hot

$$C + 4HNO_3 \longrightarrow \overset{+4}{H_2CO_3} + 4NO_2 + 2H_2O$$

$$Sb + 5HNO_3 \longrightarrow \overset{+5}{H_3SbO_4} + 5NO_2 + H_2O$$

(conc. and hot)

$$6FeSO_4 + 3H_2SO_4 + 2HNO_3 \longrightarrow 3Fe_2(SO_4)_3 + 2NO + 4H_2O$$

12 → 13

$$6KI + 8HNO_3 \longrightarrow 6KNO_3 + 2NO + 3I_2 + 4H_2O$$

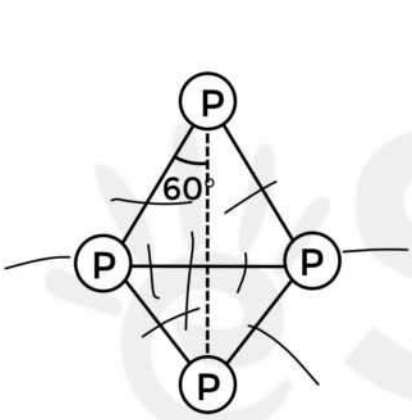
Redox rxn

Learn

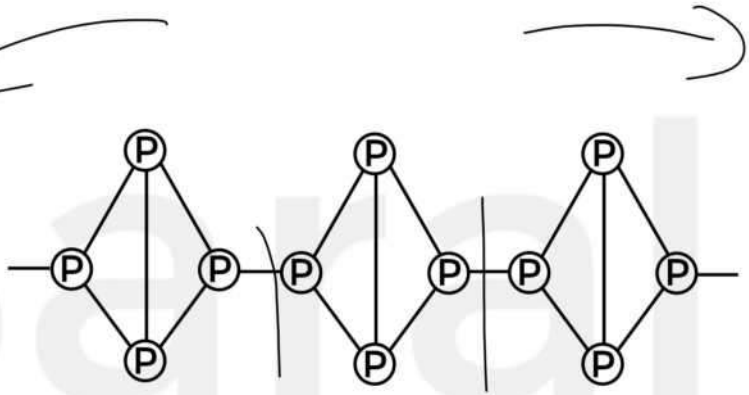
Uses

The major use of nitric acid is in the manufacture of ammonium nitrate for fertilizers and other nitrates for use in explosives and pyrotechnics.

Allotropic Forms of Phosphorus



White Phosphorus



Red Phosphorus

Note

Ghar waapas mat jao

If white Phosphorus is heated to about 250°C, or a lower temperature in the presence of sunlight, then red phosphorus is formed.

Black Phosphorus has two forms α-black Phosphorus and β-black Phosphorus.

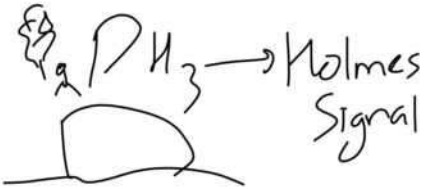
α-black Phosphorus is formed when red Phosphorus is heated in a sealed tube at 803K.

Comparison Between White And Red Phosphorus

Property	White Phosphorus	Red Phosphorus
Physical state	Soft waxy solid.	Brittle powder
Colour	White when pure. Attains yellow colour on standing.	Red
Solubility in CS_2	Soluble	Insoluble

Property	White Phosphorus	Red Phosphorus
Physiological action	Poisonous	Non-poisonous
Chemical activity	Very active	Less active
Molecular formula	P_4	Complex polymer

Phosphine



Phosphine is prepared by the reaction of Calcium phosphide with water or dilute HCl.

$$Ca_3P_2 + 6H_2O \longrightarrow 3Ca(OH)_2 + 2PH_3$$

$$Ca_3P_2 + 6HCl \longrightarrow 3CaCl_2 + 2PH_3$$

Laboratory preparation: it is prepared by heating white Phosphorus with concentrated NaOH solution in an inert atmosphere of CO_2.

$$P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$$

(sodium hypophosphite)

Properties

It is a colourless gas with rotten fish smell and is highly poisonous.

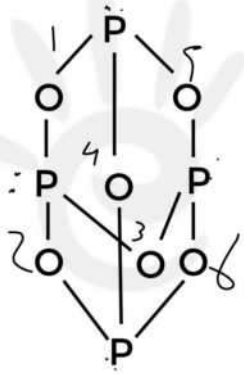
It explodes in contact with traces of oxidising agents like HNO_3, Cl_2 and Br_2 vapours.

gmp

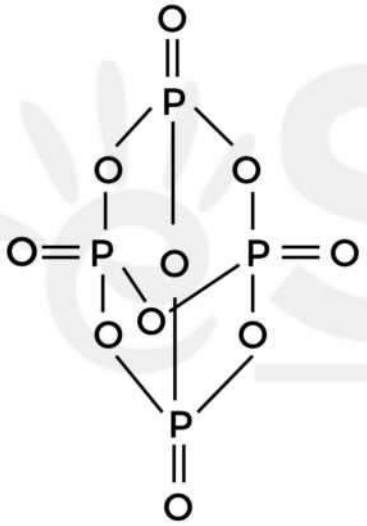
Phosphorus Trioxide (P_4O_6)

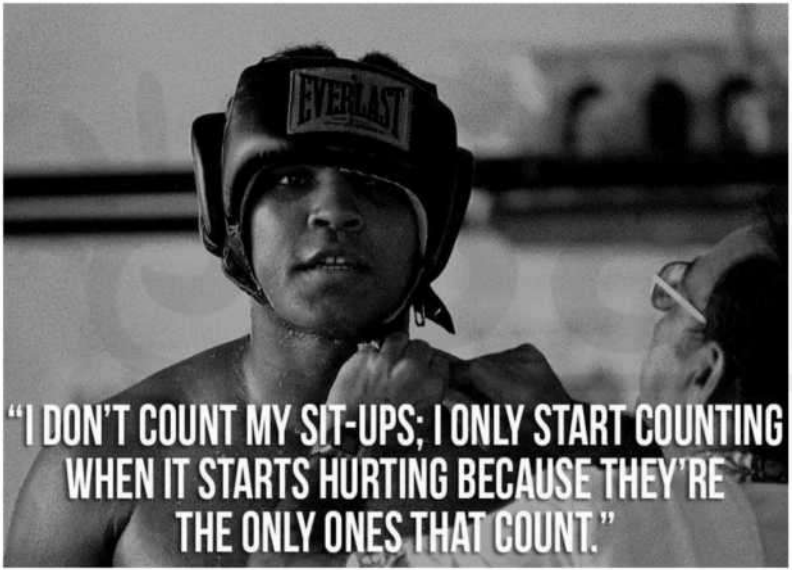
6 P—O—P

6p — 4/16



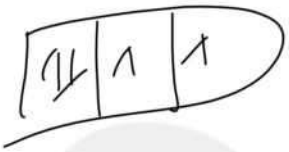
Phosphorus (V) Oxide (P_4O_{10})





Oxygen Family Group 16 Elements
(O, S, Se, Te, Po)
Oye Salike se Teepo

Electronic Configuration



ns^2np^4 is the general valence shell electronic configuration.

Atomic and Ionic Radii

Covalent radius O < S < Se < Te ↓ ↑

Ionisation Enthalpy

O > S > Se > Te > Po (IE_1 values)

Electron Gain Enthalpy

S > Se > Te > Po > O

Danger sign

Electronegativity

O > S > Se > Te

Metallic Character

O < S < Se < Te < Po

Melting and Boiling points

M.P. Te > Po > Se > S > O

B.P. Te > Po > Se > S > O

MP, BP $\propto$ MM

Oxygen and Sulphur are non-metals, Selenium and Tellurium metalloids, whereas Polonium is a metal.

Oxidation states and trends in chemical reactivity

$S = -2, +2, +4, +6$ SO_2

H_2O SO_3

H_2S H_2S^{-2}

The stability of -2 oxidation state decreases down the group.

Polonium hardly shows –2 oxidation state.

All the elements of Group 16 form hydrides of the type H_2E (E = O, S, Se, Te, Po).

Their acidic character increases from H_2O to H_2Te.

Reactivity with Oxygen

SF_2

SF_4

SF_6

(i) All these elements form oxides of the EO_2 and EO_3 types where E = S, Se, Te or Po.

(ii) Elements of Group 16 form a large number of halides of the type, EX_6, EX_4 and EX_2 where E is an element of the group and X is a halogen.

Dioxygen

Laboratory Method

(i) By heating Oxygen containing salts such as chlorates, nitrates and permanganates.

$$2KClO_3 \xrightarrow[MnO_2]{Heat} 2KCl + 3O_2$$

$$2Ag_2O(s) \longrightarrow 4Ag(s) + O\ (g)$$

$$2Pb_3O_4(s) \longrightarrow 6PbO(s) + O_2(g)$$

$$2HgO(s) \longrightarrow 2Hg(\ell) + O_2(g)$$

$$2PbO_2(s) \longrightarrow 2PbO(s) + O_2(g)$$

Imp

(ii) Hydrogen peroxide is readily decomposed into water and dioxygen by catalysts such as finely divided metals and manganese dioxide.

$$2H_2O_2(aq) \xrightarrow{MnO_2} 2H_2O(\ell) + O_2(g)$$

Formation of oxide

$$2Ca + O_2 \longrightarrow 2CaO$$

$$4Al + 3O_2 \longrightarrow 2Al_2O_3$$

$$P_4 + 5O_2 \longrightarrow P_4O_{10}$$

$$C + O_2 \longrightarrow CO_2$$

$$2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$$

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

Acidic Oxide

$SO_2 + H_2O \longrightarrow H_2SO_3 \rightarrow$ acid

An oxide that combines with water to give an acid is termed acidic oxide (e.g., SO_2, Cl_2O_7, CO_2, N_2O_5).

Basic Oxide

$Na_2O \xrightarrow{H_2O} 2NaOH$

The oxides which give a base with water are known as basic oxides (e.g., Na_2O, CaO, BaO).

In general, metallic oxides are basic.

Amphoteric Oxide

Some metallic oxides exhibit a dual behaviour.

They show characteristics of both acidic as well as basic oxides. Al_2O_3 reacts with acids as well as alkalies.

Neutral Oxide

Learn this

There are some oxides which are neither acidic nor basic.

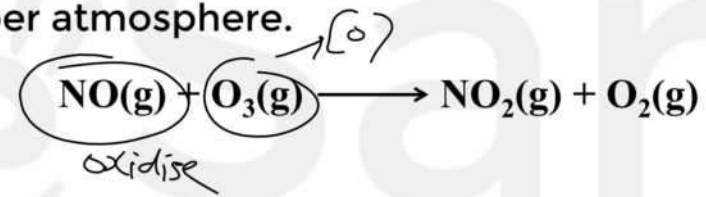
Such oxides are known as neutral oxides.

Examples of neutral oxides are **CO,H_2O, NO** and **N_2O**.

This ozone layer protects the earth's surface from an excessive concentration of ultraviolet (UV) radiations.

Ozone

There is the possibility that nitrogen oxides emitted from the exhaust systems of supersonic jet aeroplanes might be slowly depleting the concentration of the ozone layer in the upper atmosphere.



Another threat to this ozone layer is probably posed by the use of freons which are used in aerosol sprays and as refrigerants.

Preparation

$3O_2 \longrightarrow 2O_3$ endothermic rxn Electricity

$\Delta H^- (298\ K) = +\ 142\ kJ\ mol^{-1}$

Silent Electrical Discharge is used

Properties

Which of the following is a dia gas

(1) NO_2 (2) O_2 (3) O_3 (4) ClO_2

(i) Pure ozone is a pale blue gas, dark blue liquid and violet-black solid.

(ii) It is diamagnetic gas.

Toxic Effect

(a) Toxic enough (more toxic than KCN).

It's intense blue colour is due to the absorption of red light.

Oxidizing Properties

$O_2 \longrightarrow O_3$ endothermic

exothermic

It is one of best oxidising agent, in acid solution, its standard, reduction potential value is 2.07 V.

$$O_3 + 2H^+ + 2e \longrightarrow O_2 + H_2O$$

$$E^\circ = +2.07\ V$$

$$PbS(s) + 4O_3(g) \rightarrow PbSO_4(s) + 4O_2(g)$$

$$2I^-(aq) + H_2O(\ell) + O_3(g) \rightarrow 2OH^-(aq) + I_2(s) + O_2(g)$$

Allotropic Forms of Sulphur

Rhombic

Room

N_2O

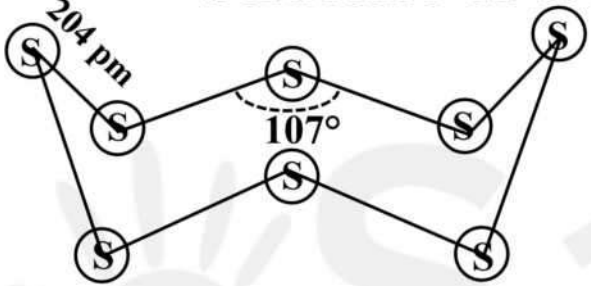
The stable form at room temperature is Rhombic Sulphur ,which transforms to Monoclinic Sulphur when heated above 369 K.

α-s

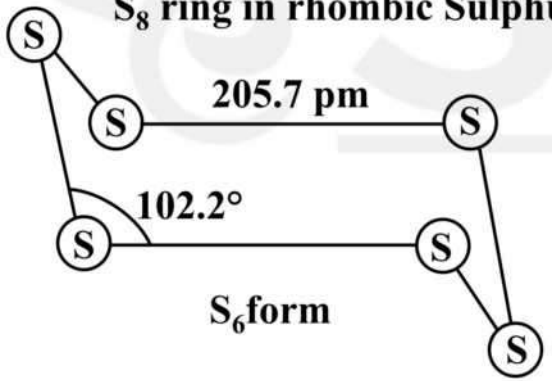
β

$$\alpha\text{—Sulphur} \underset{<369\ K}{\overset{>369\ K}{\rightleftharpoons}} \beta\text{—Sulphur}$$

Structure of α and β Sulphur



S_8 ring in rhombic Sulphur



S_6form

Rhombic Sulphur (α - Sulphur)

(i) This allotrope is yellow in colour, m.p. 385.8 K and specific gravity 2.06.

(ii) Rhombic Sulphur crystals are formed on evaporating the solution of roll Sulphur in CS_2.

(iii) It is insoluble in water but dissolves to some extent in Benzene, Alcohol and Ether.

(iv) It is readily soluble in CS_2.

Monoclinic Sulphur (β - Sulphur)

(i) Its m.p. is 393 K and specific gravity 1.98.

(ii) It is soluble in CS_2.

(iii) This form of Sulphur is prepared by melting rhombic sulphur in a dish and cooling ,till crust is formed.
Two holes are made in the crust and the remaining liquid poured out.

Hydrogen Sulphide(H_2S)

Preparation

By the action of dil. HCl or H_2SO_4 on Iron Pyrites.

$$FeS + H_2SO_4 \longrightarrow FeSO_4 + H_2S$$

It is a colourless gas having an offensive smell of rotten eggs.

It burns in air with blue flame gmp

$$2H_2S + O_2 \longrightarrow 2H_2O + S$$

It act as a reducing agent. It reduces halogen into corresponding hydroacid.

$$H_2S + X_2 \longrightarrow 2HX + S$$

Sulphuric Acid

300 million tonne

Sulphuric acid is one of the most important industrial chemical worldwide.

Industrial Manufacturing (Contact process)

(i) Burning of Sulphur or Sulphide ores in air to generate SO_2.

The key step in the manufacture of H_2SO_4 is the catalytic oxidation of SO_2 with O_2 to give SO_3 in the presence of V_2O_5 (catalyst).

$$2SO_2(g) + O_2(g) \xrightarrow{V_2O_5} 2SO_3(g)$$

$$\Delta_r H^{\ominus} = -196.6 \text{ kJ mol}^{-1}$$

V_2O_5 catalyst

reversible rxn

The reaction is exothermic, reversible and the forward reaction leads to a decrease in pressure.

The SO_3 gas from the catalytic converter is absorbed in concentrated H_2SO_4 to produce oleum.

Dilution of Oleum with water gives H_2SO_4 of the desired concentration.

It dissolves in water with the evolution of a large quantity of heat. Hence, care must be taken while preparing sulphuric acid solution from concentrated Sulphuric acid.

The concentrated acid must be added slowly into water with constant stirring.

Acidic Character

It is a very strong acid.

Organic Chem

Concentrated sulphuric acid is a strong dehydrating agent.

Many wet gases can be dried by passing them through sulphuric acid, provided the gases do not react with the acid.

Hot concentrated Sulphuric acid is a moderately strong oxidising agent.

In this respect, it is intermediate between phosphoric and nitric acids.

Zidd

Elon Musk
Steve Jobs
Sardar Patel
Phelps
Jordan
Federer
CV Raman

सपने उनके पूरे नही होते
जिनके बाप बड़े होते है सपने
उनके पूरे होते है जो जिद पर
अड़े होते है

Oxyacids

Halogen Family Group 17 Elements (F, Cl, Br, I, At)

First Class Break Indian Auto

Electronic Configuration

The electronic configuration of outermost shell 17th group element is (ns^2np^5).

Ionisation Enthalpy

$F > Cl > Br > I$

Electron Gain Enthalpy

$Cl > F > Br > I$

Electronegativity

$F > Cl > Br > I$

Bond energy order

$Cl_2 > Br_2 > F_2 > I_2$

Oxidation States

$-1, +3, +5, +7, +1$

(i) All the halogens exhibit –1 oxidation state.

However, Chlorine, Bromine and iodine exhibit +1, +3, +5 and +7 oxidation states also as explained below

Chemical Reactivity

(i) All the Halogens are highly reactive.

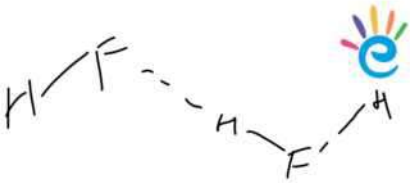
(ii) The reactivity of the halogens decreases down the group.
i.e. the order is $F_2 > Cl_2 > Br_2 > I_2$

$$2F_2(g) + H_2O(\ell) \longrightarrow 4H^+(aq) + 4F^-(aq) + O_2(g)$$

$$X_2(g) + H_2O(\ell) \longrightarrow HX(aq) + HOX(aq)$$

(where X = Cl or Br)

$$4I^-(aq) + 4H^+(aq) + O_2(g) \longrightarrow 2I_2(s) + 2H_2O(\ell)$$



Redox Imp

Hydrogen Fluoride is a liquid (b.p. 293 K) due to strong Hydrogen bonding. Other Hydrogen halides are gases.

O_2F_2 oxidises Plutonium to PuF_6 and the reaction is used in removing Plutonium as PuF_6 from spent nuclear fuel.

ClO_2 is used as a bleaching agent for paper pulp and textiles and in water treatment.

Fluorine

Moissan Process

$CaF_2 + H_2SO_4 \longrightarrow CaSO_4 + 2HF$

$HF + KF \longrightarrow KHF_2$

[KF decreases the m.p. of the mix. depending upon the composition]

$KHF_2 \xrightarrow{\text{Electrolysis}} H_2(\text{at cathode}) + F_2(\text{at anode})$

Chlorine

Preparation

Backpan

By electrolysis of aq. NaCl

$$2NaCl + 2H_2O \longrightarrow 2NaOH + H_2 + Cl_2$$

At anode: Cl_2

At cathode: H_2

$$2NaCl \xrightarrow{\text{Electrolysis}} 2Na + Cl_2$$

(Molten) (Cathode) (anode)

Deacon's Process

Industrial

By oxidation of Hydrogen Chloride gas by atmospheric Oxygen in the presence of $CuCl_2$ (catalyst) at 723 K.

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

Properties

Chlorine

It is a greenish yellow gas with Pungent and Suffocating odour.

Cl_2

It is soluble in water.

Chlorine reacts with a number of metals and non-metals to form chlorides.

Reactivity with Ammonia

With excess Ammonia, Chlorine gives Nitrogen and Ammonium Chloride whereas with excess Chlorine, Nitrogen trichloride (explosive) is formed.

Imp

$$8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$$

(excess)

$$NH_3 + 3Cl_2 \longrightarrow NCl_3 + 3HCl$$

(excess)

Reactivity with Alkalies

With cold and dilute alkalies Chlorine produces a mixture of Chloride and Hypochlorite but with hot and concentrated alkalies it gives Chloride and chlorate.

$$2NaOH + Cl_2 \longrightarrow NaCl + NaOCl + H_2O$$

(cold and dilute)

$$6\,NaOH + 3Cl_2 \longrightarrow 5NaCl + NaClO_3 + 3H_2O$$

(hot and conc.)

Hydrogen Chloride

HCl
↓
gas $\xrightarrow{H_2O}$ HCl(aq)

Base Acid CB CA

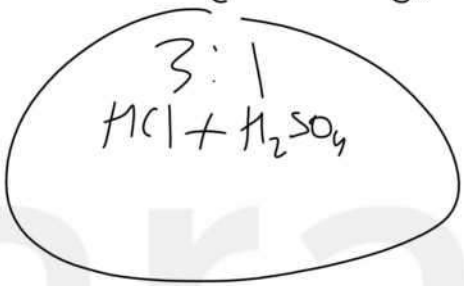
$$NaCl + H_2SO_4 \xrightarrow{420K} NaHSO_4 + HCl$$

$$NaHSO_4 + NaCl \xrightarrow{823K} Na_2SO_4 + HCl$$

It is a colourless and pungent smelling acidic gas.

Aqua Regia (Alchemy)

When three parts of concentrated HCl and one part of concentrated HNO_3 are mixed, aqua regia is formed which is used for dissolving noble metals, e.g., Gold, Platinum.

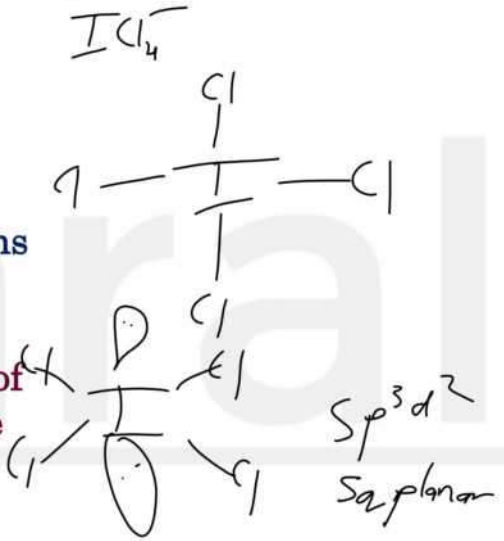


Interhalogen Compounds

When two different halogens react with each other, interhalogen compounds are formed.

They can be assigned general compositions as XX', XX_3', XX_5' and XX_7'

Where X is Halogen of larger size and X' of smaller size and X is more electropositive than X'.



TRICK

Noble Gases Family Group 18 Elements (He, Ne, Ar, Kr, Xe, Rn)

He Never Argues, Kal Xero Run pe out hua tha

Rahul Dravid

Electronic Configuration

General electronic configuration of 18 group element is ns^2np^6 except Helium which has $1s^2$.

noble
most stable

Ionisation Enthalpy

GIIEI

He > Ne > Ar > Kr > Xe > Rn

He < Ne < Ar < Kr < Xe < Rn (Melting point order) ∝ MM

Boiling point order

He < Ne < Ar < Kr < Xe < Rn ∝ MM

Chemical Properties

$Xe^+PtF_6^-$ is the first noble gas compound discovered.

Fluorides of Xenon → O, F

$$Xe(g) + F_2(g) \xrightarrow{673K,\ 1\ bar} XeF_2(s)$$

(xenon in excess)

$$Xe(g) + 2F_2(g) \xrightarrow{873K,\ 7\ bar} XeF_4(s)$$

(1:5 ratio)

XeF_2, XeF_4 and XeF_6 are colourless crystalline solids and sublime readily at 298 K.

Hydrolysis

Maha Important

XeO_4 → hydrolysis isko produce nahi

They are readily hydrolysed even by traces of water.

For example, XeF_2 is Hydrolysed to give Xe, HF and O_2.

$$2XeF_2(s) + 2H_2O(l) \longrightarrow 2Xe(g) + 4\,HF(aq) + O_2(g)$$ Learn

$$6XeF_4 + 12H_2O \longrightarrow 4Xe + 2XeO_3 + 24HF + 3O_2$$ Learn

$$XeF_6 + 3H_2O \longrightarrow XeO_3 + 6\,HF$$ Learn

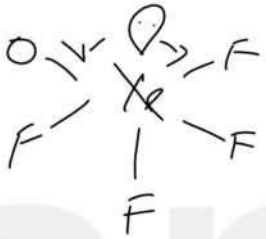
$1O \longrightarrow 2F$

Partial hydrolysis of XeF_6 gives oxyfluorides, $XeOF_4$ and XeO_2F_2.

$$XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$$

$$XeF_6 + 2H_2O \longrightarrow XeO_2F_2 + 4HF$$

Reaction with SiO_2



SiO_2 also converts XeF_6 into $XeOF_4$. sp^3d^2

$$2XeF_6 + SiO_2 \longrightarrow SiF_4\uparrow + 2XeOF_4$$

violet

Similarly,

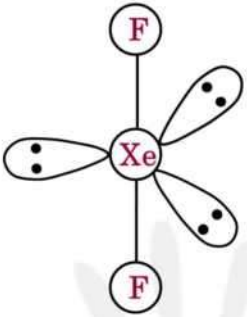
$$XeO_3 + XeOF_4 \longrightarrow 2XeO_2F_2$$

$$XeO_3 + 2XeF_6 \longrightarrow 3XeOF_4$$

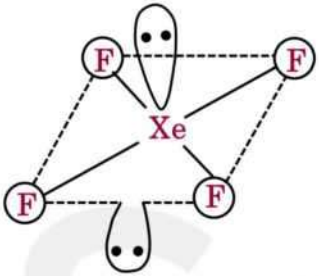
Xe - fluorides oxidise Cl^- to Cl_2 and I^- to I_2

$$XeF_2 + 2HCl \longrightarrow 2HF + Xe + Cl_2$$

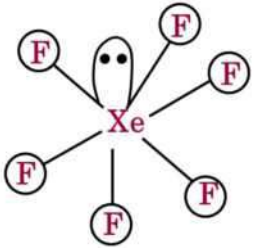
$$XeF_4 + 4KI \longrightarrow 4KF + Xe + 2I_2$$



(a) Linear

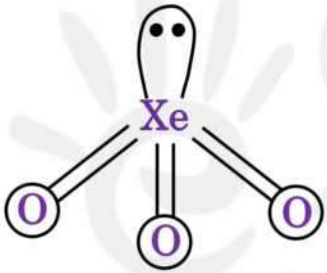


(b) Square plannar

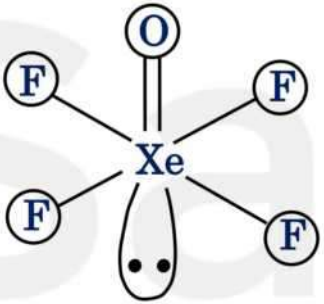


(c) Distorted octahedral

Xenon - Oxygen Compounds



Pyramidal



Square pyramidal

Naming of Oxyacids

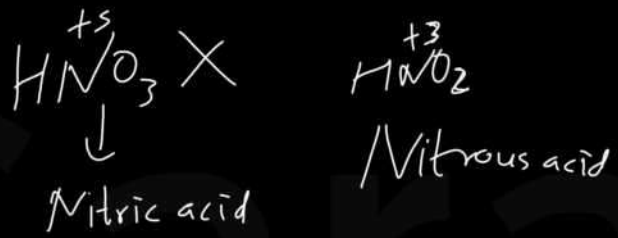
H_2SO_4 ⟶ Sulphuric acid

$HClO_4$ ⟶ Per – Chloric acid

prefix | Root word | suffix

3 parts of a name

Rule –1 for Suffix

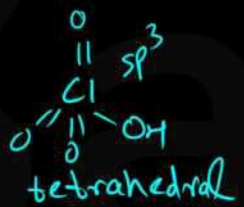


(i) Suffix ic is used when the oxidation state of the central atom is maximum & ous is used when the oxidation state of central in the oxyacid is lower than the ic from of Oxyacid in general.

Exceptions

The acid of Halogen family do not follow the above rule

HOF $^{-1}$



(iii) HXO_4

$HClO_4$ (+7) ⟶ Per Chloric Acid

$HClO_3$ (+5) ⟶ Chloric acid

$HClO_2$ ⟶ Chlorous acid [Hallous acid]

Rule – 2 'Meta' Prefix

(i) It is provided to that Oxy acid which is obtained by the elimination of water molecule from molecule of parent acid.

Parent acid $\xrightarrow{-H_2O}$ Meta (P.A)

$\overset{+5}{H_3PO_4} \xrightarrow{-H_2O} \overset{+5}{HPO_3}$ Meta phosphoric acid

HPO_3 & HPO_2 do not exist in their metameric actually they exist in their Polymeric form

$$nH_3PO_4 \xrightarrow{-nH_2O} (HPO_3)_n \longrightarrow \text{Polymeric from}$$

3& above

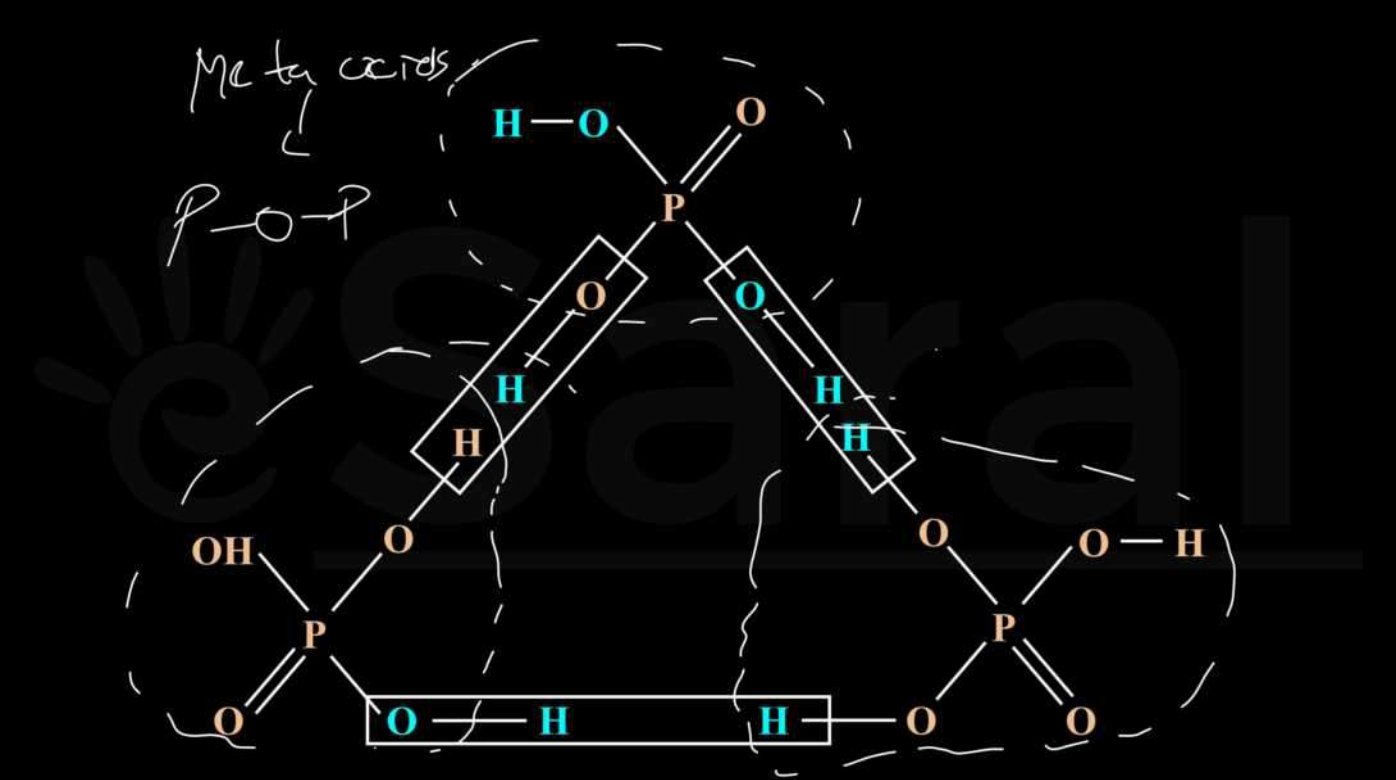
$$3H_3PO_4 \xrightarrow{-3H_2O} (HPO_3)_3$$

For n = 1

Structure is not known

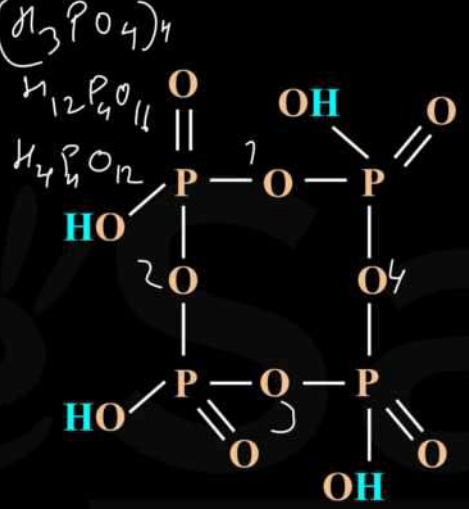
For n = 3

$(HPO_3)_3 \Rightarrow H_3P_3O_9$

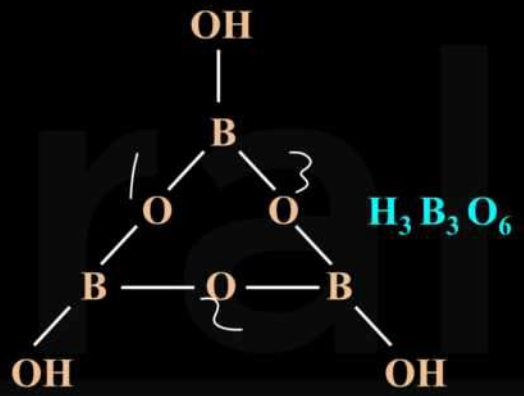


$H_4P_4O_{12}$

$P_4O_{12}^{-4}$



Meta Boric Acid



$H_3B_3O_6$

General Form

$H_nP_nO_{3n}$ → Cyclic Structure

Or $P_nO_{3n}^{-n}$

Rule – 3 'Ortho' Prefix

It is provided to ic from of that Oxyacid whose Meta derivative is possible

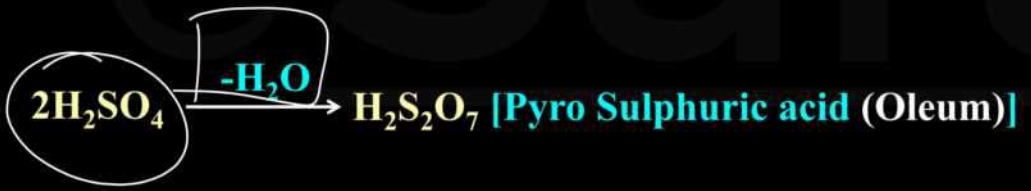
H_3PO_4 also ortho Phosphoric acid

$H_3BO_3 \rightarrow$ ortho B.A

[Exception $H_3PO_3 \rightarrow$ Ortho Phosphourous acid]

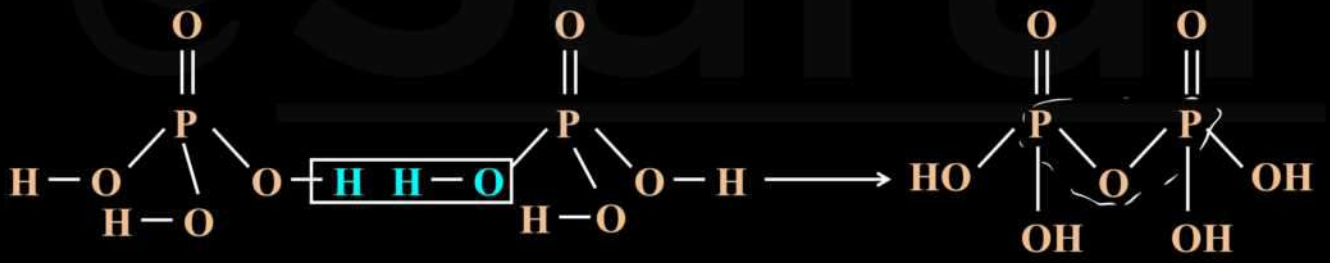
Rule - 4 'Pyro' Prefix

'Pyro' prefix is provided to that derivative of parent acid which is obtained by the elimination of water molecule from 2 molecule of the parent acid.



Oxo linkage is a characteristic property of Pyro acids.

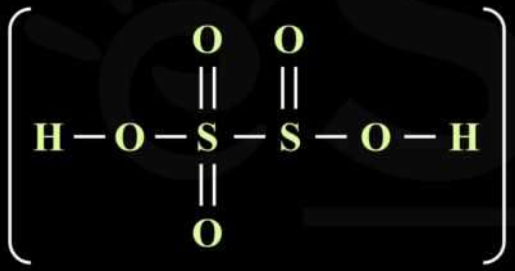
$$2H_3PO_4 \xrightarrow{-H_2O} H_4P_2O_7$$



Learn

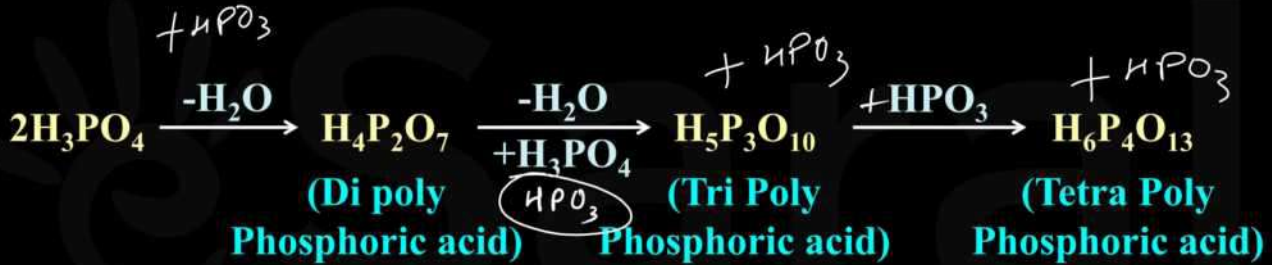
Sulphurous

$$2H_2SO_3 \xrightarrow{-H_2O} H_2S_2O_5$$ pyro sulphurous acid



no S–O–S linkage

Series of Poly Phosphoric acid



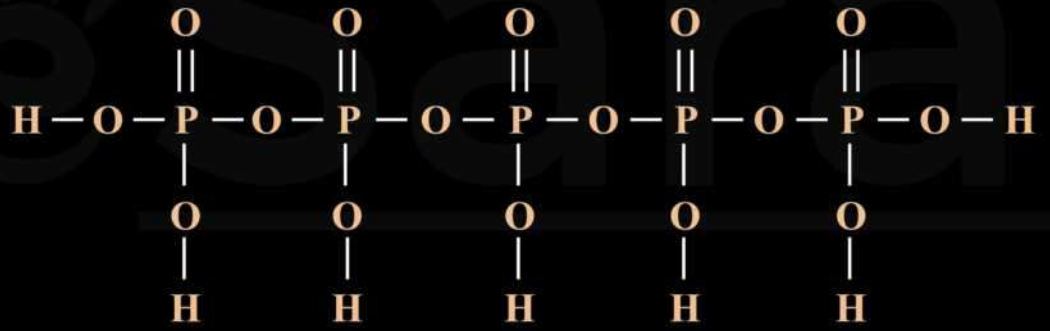
$H_{n+2}\ P_nO_{3n+1}$

Linear structure (all P are in the same line)

$H_7P_5O_{16}$

Meta → Cyclic Str

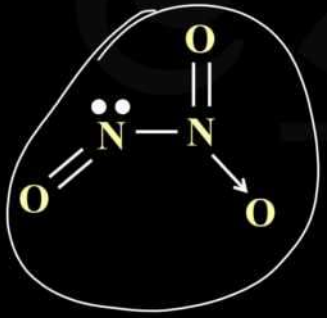
Pyro → Linear



N–O–N

$2HNO_2 \xrightarrow{-H_2O} N_2O_3$ (Nitrous Anhydride)

Symmetrical Structure



More Stable

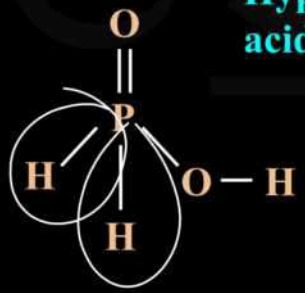
Dangr

Rule - 5 'Hypo' Prefix

Hypo prefix is provided to that oxyacid which is obtained by the removel one Oxygen atom from the ous form of the oxyacid.

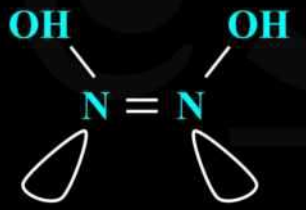
$$H_3PO_3 \xrightarrow{-O} H_3PO_2$$

Hypo Phosphorous acid

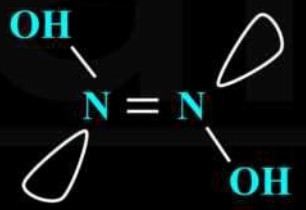


$$2(HNO) \longrightarrow H_2N_2O_2$$

Geometrical Isomerism



Cis – Hyponitrous acid



Trans – Hyponitrous acid

Hypo – ous
ic

Hypo Phosphoric acid $H_4P_2O_6$ Learn

$2H_3PO_4 \xrightarrow{-H_2O} H_4P_2O_7 \xrightarrow{-O} H_4P_2O_6$

Pyro phosphoric Acid Hypo phosphoric Acid

Exception – instead of ous, ic

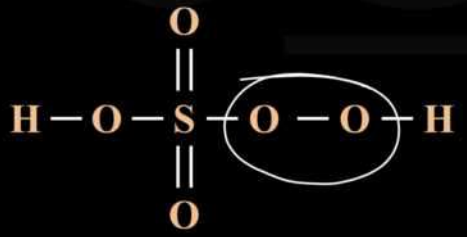
Rule – 6 'Per' Prefix

Per prefix is provided to that Oxyacid which is obtained by the addition of Oxygen atom in the ic from of Oxyacid.

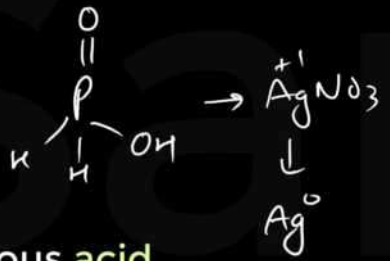
$$\underset{\text{(ic)}}{\text{(P.A)}} \xrightarrow{+O} \text{Per P.A}$$

$$H_2SO_4 \xrightarrow{+O} H_2SO_5$$

Per Sulphuric acid or
Per-oxy Sulphuric acid or
Per-mono Sulphuric acid
Comman name – Caro's acid



The acids which contain P-H bond have strong reducing properties.



Thus, hypophosphorous acid is a good reducing agent as it contains two P-H bonds and reduces, $AgNO_3$ to Metallic silver.

Heating Effect

$$H_3PO_2 \xrightarrow{140^\circ C} PH_3 + H_3PO_4$$

$$\underset{\text{Orthophosphoric acid}}{H_3PO_4} \xrightarrow[220^\circ C]{\text{Gentle heat}} \underset{\text{Pyrophosphoric acid}}{H_4P_2O_7} \xrightarrow[320^\circ C]{\text{Strong heat}} \underset{\text{Metaphosporic acid}}{(HPO_3)_n}$$

Graham Salt

Graham's salt is the best known of these long chain Polyphosphates, and is formed by quenching molten $NaPO_3$.