

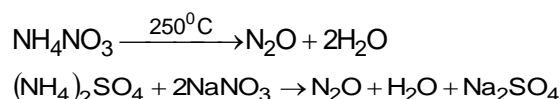
OXIDES :

Oxides of Nitrogen :

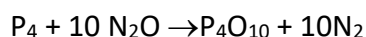
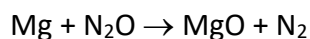
- Oxides of N₂ are endothermic (except N₂O₅) and acts as better oxidants.
- Except N₂O₅ all are gases.

N₂O (Laughing gas): First prepared by priestly.

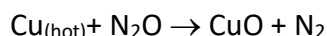
- Berthelot prepared it from Ammonium nitrate or ammonium sulphate and sodium nitrate.



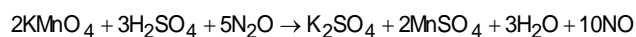
- It is colourless neutral gas.
- Fairly soluble in cold water.
- It is incombustible but supports combustion of Mg and P.



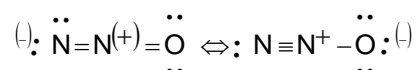
- Oxidising property : - It oxidises metals.



- Mixture of O₂ and N₂O is used as anaesthetic in surgery and dentistry.
- In the presence of acidified potassium permanganate it undergoes oxidation to give nitric oxide.



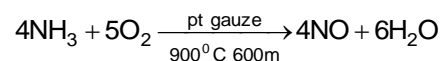
- **Structure :** N₂O is hybrid of following structures. It is a linear molecule.



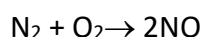
Nitric oxide (NO) Nitrogen monoxide : (Priestley)



2) Catalytic oxidation of Ammonia gives Nitric oxide. (Ostward's method) .

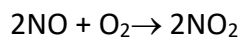


3) By passing electric arc through N₂ and O₂

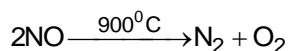


Properties :

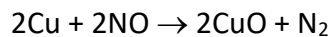
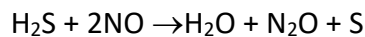
- NO is colourless gas and heavier than air.
- At 12 K it freezes to Blue solid & its M.P is 1232 K.
- On reaction with oxygen it gives reddish brown fumes.



- NO is most thermally stable oxide of N₂.



- Oxidising properties :

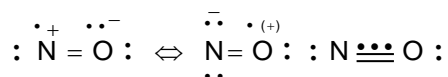


- In the manufacture of H₂SO₄ by lead chamber process NO is used as catalyst.

Structure : NO has 11 valence electrons

(N → 5, O → 6).

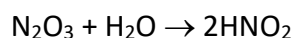
- Presence of odd, electron makes it as paramagnetic.
- It doesn't dimerises due to delocalised odd electron.



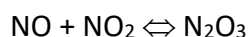
- In liquid and solid states it dimerises hence it is diamagnetic.

Nitrogen sesquioxide or dinitrogen trioxide (N₂O₃) :

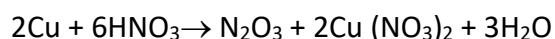
- N₂O₃ is a hydride of nitrous acid.



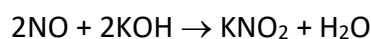
- By cooling a mixture of NO and NO₂ in equimolar ratio to – 20°C N₂O₃ is obtained.



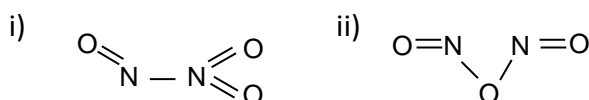
- On action of Cu on HNO₃ N₂O₃ is obtained.



- It is blue liquid and a pale blue solid.
- M.P is –102° C.
- It is acidic oxide.
- It's salts are called as nitrites.

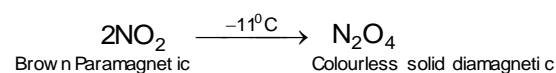


Structure :



Nitrogen Dioxide :

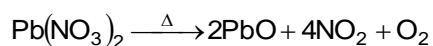
- It is reddish brown gas.
- It dimerises to dinitrogen tetraoxide which is colourless solid.



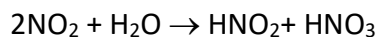
- Reduction of conc nitric acid with metals like Cu, Ag gives NO₂.



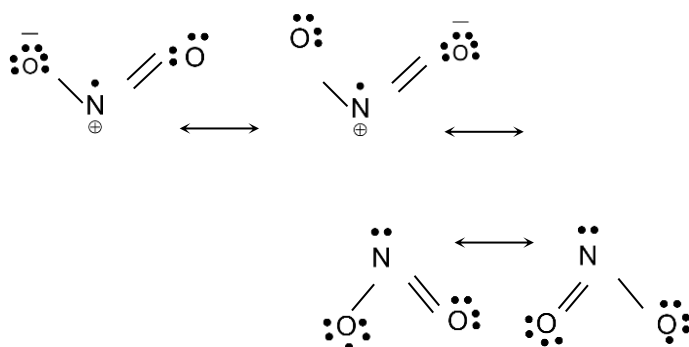
- Lead nitrate on heating gives NO₂



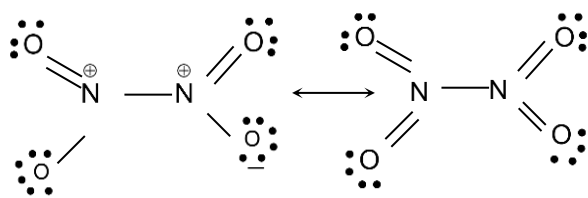
- NO₂ dissolves in water to give nitrous and nitric acids hence it is called as mixed anhydride of HNO₂ and HNO₃.



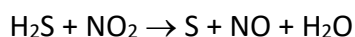
Structure : NO₂ has angular structure with a bond angle of 132°. It possesses a three electron bond and hence it is coloured and paramagnetic.



The structure of N₂O₄ :



- It turns ferrous sulphate solution black.
- NO₂ gives nascent oxygen hence it acts as oxidizing agent $\text{NO}_2 \rightarrow \text{NO} + (\text{O})$

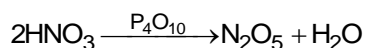


- When reacts with alkalis it forms nitrates and nitrites.



Nitrogen pentoxide :

- On dehydration of Nitric acid with the help of phosphorous pentoxide N₂O₅ is obtained.



- $4\text{AgNO}_3 + 2\text{Cl}_2 \rightarrow 4\text{AgCl} + 2\text{N}_2\text{O}_5 + \text{O}_2$
- N₂O₅ is white solid.

- M.P. 35°C.
- Above its melting point it decomposes to N_2O_4 and O_2 .

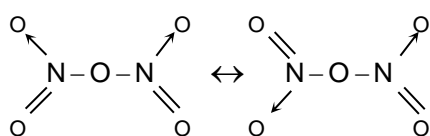
$$2\text{N}_2\text{O}_5 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3$$
- It is anhydride of nitric acid.

$$\text{N}_2\text{O}_5 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3$$
- It reacts with bases to give nitrate salts.

$$\text{N}_2\text{O}_5 + 2\text{NaOH} \rightarrow 2\text{NaNO}_3 + \text{H}_2\text{O}$$
- As it decomposes easily it acts as powerful oxidizing agent.

Structure :

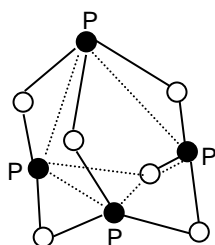
- It is an ionic solid i.e., Nitronium nitrate ($\text{NO}_2^+, \text{NO}_3^-$)



- As the size of the central atom increases the basic property increases.
- Phosphorous forms the following oxides.

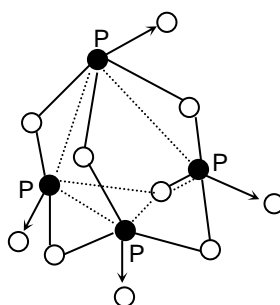
+3	+4	+5
P_2O_3	P_2O_4	P_2O_5
- P_2O_3 and P_2O_5 exist as dimers P_4O_6 and P_4O_{10} .

P_4O_6



Phosphorus is linked
to 3 oxygens

P_4O_{10}



Phosphorus is linked to
4 oxygens

- Acidic character of the oxides increases with increases in the oxidation state of central atom.
- Oxides of Nitrogen and phosphorous are acidic. As and Sb are amphoteric and Bismuth are basic.