



CHEMISTRY

TOPIC: OXIDES OF NITROGEN-PART 1

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Nitrogen (II) Oxide, NO

This is a gas that hardly exist in nature. This is so because no sooner has the gas been formed than it becomes oxidized to form nitrogen (IV) oxide.

It was discovered by Cavendish in 1770 as one of the products that is produced on passing an electric spark through air.

Laboratory Preparation

Nitrogen (II) oxide is prepared by the action of dilute trioxonitrate (V) oxide on copper turnings.

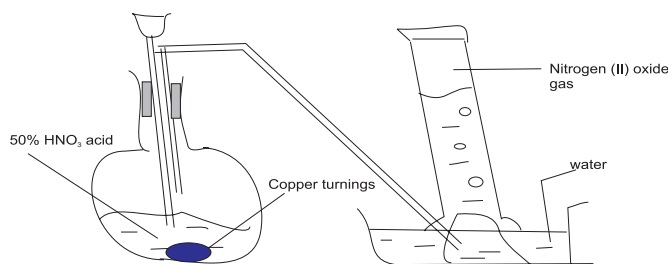
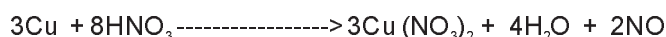


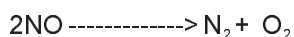
Fig.1: Preparation of Nitrogen (II) oxide

Physical properties

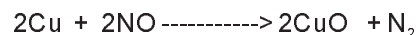
1. The gas is colourless and poisonous. Because of the transient nature of the gas, that is to the effect that it changes immediately to nitrogen (IV) oxide immediately on exposure to air, the smell is not known.
2. It is almost insoluble in water
3. It is slightly denser than air
4. It is a neutral oxide and so has no effect on damp litmus paper.

Chemical properties

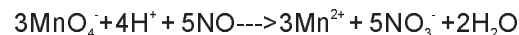
5. Action of heat: It will only support the combustion of strongly burning substances.



6. Reduction by hot metals: Nitrogen (II) oxide reacts with heated metals which reduces it to N_2 . Thus:



6. As reducing Agent: It decolorizes acidified KMnO_4 . However, it is a very weak reducing agent. Thus:

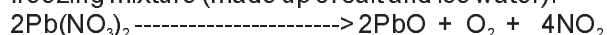


Nitrogen (IV) Oxide, NO_2

When trioxonitrates (V) of metals are heated, a reddish-brown fume is given off, and this is nitrogen (IV) oxide gas. It is what imparts the yellow colour that is noticeable in trioxonitrate (V) acid (or nitric acid) which appears after some period of storage,

Laboratory preparation

The gas is prepared by the strong heating of lead(II) trioxonitrate (V) crystals. The products include lead (II) oxide, oxygen and nitrogen (IV) oxide gas. The gas is liquefied by passing it through a U-tube that is immersed in a freezing mixture (made up of salt and ice water).



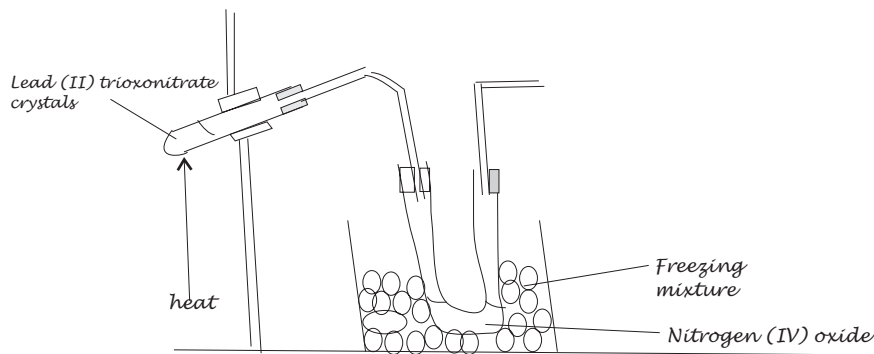


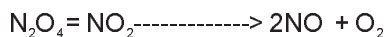
Fig. 2: Preparation of Nitrogen (IV) oxide

Physical properties

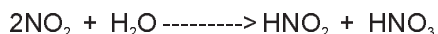
1. The gas is reddish-brown and has very irritating smell. It is highly toxic.
2. It turns damp blue litmus paper scarlet red.
3. The gas dissolves and reacts with water to form an acidic solution
4. It is much denser than air and so can be collected by downward delivery.

Chemical properties

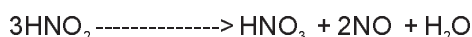
5. Action of heat: NO_2 can exist in two alternative molecular structures. At low temperature like 22°C , it is found as N_2O_4 while on heating, this molecule readily dissociates to give NO_2 . Above 150°C , the NO_2 again dissociates into nitrogen (II) oxide, and oxygen.



6. Reaction with water: The gas dissolves and react with water to form two acids. Thus:

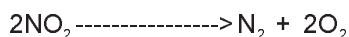


The HNO_2 will further decompose to give more trioxonitrate (V) acid



7. Reactions with alkali: $2\text{KOH} + 2\text{NO}_2 \rightleftharpoons \text{KNO}_3 + \text{KNO}_2 + \text{H}_2\text{O}$

8. Support of Combustion: The gas, itself, does not burn in air. It will however support the burning or combustion of other substance that is hot enough to decompose it to nitrogen and oxygen.



9. Reduction by reducing agents: Nitrogen (IV) oxide is reduced to nitrogen by heated copper tunings or iron.

This property is quite common with all the oxides of nitrogen. $4\text{Cu} + 2\text{NO}_2 \rightleftharpoons 4\text{CuO} + \text{N}_2$

It is also reduced to nitrous oxide (or nitrogen (IV) oxide) by hydrogen sulphide and carbon (IV) oxide.



QUESTIONS

1. Describe how NO_2 gas can be prepared in the laboratory.
2. Explain the effects of heating and cooling on nitrogen (IV) oxide gas.
3. Show with appropriate equations how nitrogen (IV) oxide could behave as
 - (i) reducing agent
 - (ii) supporter of combustion
 - (iii) an acidic oxide.
4. List and explain three chemical properties of nitrogen (II) oxide gas.

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