

# Guidelines for Chemistry Report

## Industrial & Atmospheric Chemistry (Optional Topic)

This is essentially new to the syllabus, and is one of the options - the other being Materials & Metal Extraction. Only one option needs to be studied. Industrial Chemistry necessitates a case study (of which three are stated) of a manufacturing process, and this will illustrate various features involved in chemical manufacturing. The features listed on the syllabus are:

- Feedstock
- Rate of reaction
- Product yield
- Co-products
- Waste disposal
- Quality control
- Safety
- Costs
- Site location
- Construction

Apart from the case study, you are required to know something about fixation of nitrogen, the nitrogen cycle, oxygen manufacture, the two oxides of carbon, atmospheric pollution, and the ozone layer.

## Important Formulae

- Limewater =  $\text{Ca}(\text{OH})_2(\text{aq})$
- The carbonate ion =  $\text{CO}_3^{2-}$
- Ammonia =  $\text{NH}_3$
- Nitric acid =  $\text{HNO}_3$
- Nitrogen dioxide =  $\text{NO}_2$
- Sulphuric acid =  $\text{H}_2\text{SO}_4$
- Ammonium sulfate =  $(\text{NH}_4)_2\text{SO}_4$
- Ammonium nitrate =  $\text{NH}_4\text{NO}_3$
- Urea =  $\text{CO}(\text{NH}_2)_2$

## Oxygen, $\text{O}_2$

### Manufacture from the atmosphere

Purified air is liquefied and then the liquid is fractionally distilled. Co-products of this process are nitrogen, argon and other noble gases. (In the laboratory, oxygen is produced when hydrogen peroxide is catalytically decomposed by manganese dioxide.)

## Fixation of Nitrogen

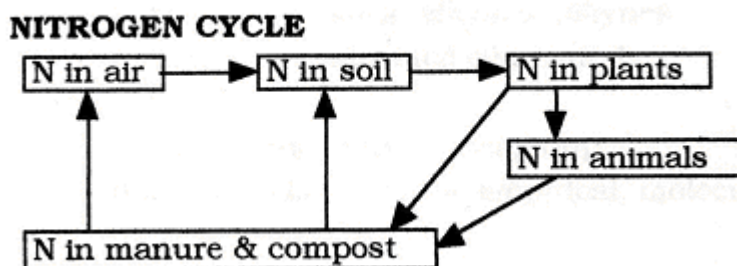
Fixation of nitrogen means the conversion of gaseous atmospheric nitrogen into useful compounds. It occurs in nature - during lightning, and by leguminous plants, and artificially by the Haber process.

## The Haber Process

Nitrogen and hydrogen react together to produce ammonia; the reaction is reversible and an equilibrium mixture of all three substances is formed:  
$$\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 \quad \Delta H = +$$

High pressure and low temperature are the conditions needed for the maximum yield of ammonia. However, practical considerations are helped by opposite conditions and a compromise between high yield at high cost and a lower yield at lower cost is adopted. The reaction is catalysed by iron, with some aluminium and potassium oxides added as promoters.

## Nitrogen Cycle



## Atmospheric Pollution

Main causes:

- CO, CO<sub>2</sub>, NO & partially-burnt hydrocarbons from car exhausts
- CO<sub>2</sub> from combustion of all fuels
- NO<sub>2</sub> & SO<sub>2</sub> from rain in industrial countries

## **Ozone and the Ozone Layer**

The main items are:

- How ozone is formed in the atmosphere
- Why ozone is essential for life on Earth
- How the ozone layer is being destroyed
- How this destruction can be prevented