Cambridge IGCSE Chemistry

Topic 11: air and water

Nitrogen and fertilisers

Notes

Describe the need for nitrogen, phosphorus and potassium containing fertilisers

- Compounds of nitrogen, phosphorus and potassium are used as fertilisers to improve agricultural productivity
- plants need nitrogen, potassium and phosphorus in order to grow well, but can't absorb it as a pure element- it must be a soluble salt (dissolved in water) that the roots can absorb
- nitrogen ⟶ nitrate and ammonium salts
- phosphorus ⟶ phosphate salts
- potassium ⟶ potassium salts

Describe the displacement of ammonia from its salts

- Ammonia can be produced by a displacement reaction involving ammonium salts
- If an ammonium salt is reacted with a strong base, ammonia will be produced along with water and a salt
    - E.g. $NH_4Cl(aq) + NaOH(aq) \rightarrow NH_3(g) + H_2O(l) + NaCl(aq)$

(Extended only) Describe and explain the essential conditions for the manufacture of ammonia by the Haber process including the sources of the hydrogen and nitrogen, i.e. hydrocarbons or steam and air

- The Haber Process is used to manufacture ammonia, which is used to produce nitrogen-based fertilisers
- The raw materials for the Haber process are nitrogen and hydrogen:
    - Nitrogen is obtained from the air and hydrogen may be obtained from natural gas/hydrocarbons or steam
- The purified gases are passed over a catalyst of iron at a high temperature (about 450 °C) and a high pressure (about 200 atmospheres).
- Some of the hydrogen and nitrogen reacts to form ammonia.
- The reaction is reversible so ammonia breaks down again into nitrogen and hydrogen.

$$\text{nitrogen} + \text{hydrogen} \rightleftharpoons \text{ammonia}$$

- On cooling, the ammonia liquefies and is removed.
- The remaining nitrogen and hydrogen are recycled.