10.4 THE HABER PROCESS AND THE USE OF NPK FERTILISERS (Chemistry only)

The Haber process

- Makes ammonia, NH_3
  - $N_2 + 3H_2 \rightleftharpoons 2NH_3$
  - Reversible
    - Some ammonia breaks down into the reactants
    - Unused hydrogen and ammonia is reused – no waste
  - Ammonia forms as a gas which cools in the coneser to form a liquid
    - Liquid run out the bottom
- Conditions: 450°C temperature, 200 atm pressure
  - Compromise
    - Low temperature favours forwards reaction ...
      - ...but there still needs to be a temperature high enough to have a fast rate of reaction
    - Increasing pressure increases the percentage yield...
      - ...but high pressures are expensive and dangerous
  - Iron catalyst
- Nitrogen and ammonia reactants
  - Hydrogen from reacting methane with steam
  - Nitrogen from the air

NPK fertilisers

- Provide plants with important elements for growth
  - Help the crop grow bigger and faster
- Contain salts of nitrogen, phosphorus and potassium
  - Potassium chloride and potassium sulfate can be mined
  - Phosphate rock can be mined
    - Insoluble
      - To produce soluble phosphates, react with...
        - Sulfuric acid – produces calcium phosphate and calcium sulfate
        - Nitric acid – produces phosphoric acid and calcium nitrate
        - Phosphoric acid – produces calcium phosphate
  - Ammonia is used to produce nitrogen salts
    - Ammonia used to make nitric acid
      - React ammonia with nitric acid to produce ammonium nitrate
      - Compare the lab reaction with the industrial reaction

AQA