

Edexcel GCSE Chemistry

Topic 5: Separate chemistry 1

Dynamic equilibria

Notes





5.19C Describe the Haber process as a reversible reaction between nitrogen and hydrogen to form ammonia

- The reaction is reversible so ammonia breaks down again into nitrogen and hydrogen.



5.20C (HT only) Predict how the rate of attainment of equilibrium is affected by: changes in temperature, changes in pressure, changes in concentration, use of a catalyst

equilibrium is reached at a faster rate when:

- a higher temperature is used (particles have more kinetic energy so collide more frequently so have more successful collisions)
- a higher pressure/concentration is used (more particles in a given volume, so more frequent successful collisions)
- a catalyst is used

5.21C (HT only) Explain how, in industrial reactions, including the Haber process, conditions used are related to: the availability and cost of raw materials and energy supplies, and the control of temperature, pressure and catalyst used produce an acceptable yield in an acceptable time

- For the Haber process - the purified gases are passed over a catalyst of iron at a high temperature (about 450 °C) and a high pressure (about 200 atmospheres).
 - o High temperatures and pressures are desired for industrial reactions to increase the rate of reaction
 - o But, a higher temperature shifts equilibrium towards the reactants (as the forwards reaction is exothermic), therefore a compromise is required to ensure a fast rate of reaction and a high yield of products
 - o Catalyst is used because of the effect of having an increased rate of reaction, however they are also expensive
 - o High temperatures and pressures can be expensive and dangerous as well (particularly pressures) and the equipment required for them can be very expensive

5.22C Recall that fertilisers may contain nitrogen, phosphorus and potassium compounds to promote plant growth

- Compounds of nitrogen, phosphorus and potassium are used as fertilisers to improve agricultural productivity
- NPK fertilisers contain compounds of all three elements





5.23C Describe how ammonia reacts with nitric acid to produce a salt that is used as a fertiliser

- Ammonia can be used to manufacture ammonium salts with nitric acid
 - Ammonia acts as a base
 - ammonia + nitric acid → ammonium nitrate
 - $\text{NH}_3 + \text{HNO}_3 \rightarrow \text{NH}_4\text{NO}_3$

5.24C Describe and compare: the laboratory preparation of ammonium sulfate from ammonia solution and dilute sulfuric acid on a small scale and the industrial production of ammonium sulfate, used as a fertiliser, in which several stages are required to produce ammonia and sulfuric acid from their raw materials and the production is carried out on a much larger scale (details of the industrial production of sulfuric acid are not required)

- In the lab:
 - reactants: ammonia solution and dilute sulfuric acid (bought from chemical manufacturers)
 - SMALL scale (very little is produced)
 - only involves a few stages (titration then crystallisation)
- In industry:
 - reactants: natural gas, air, water (to make ammonia) and sulfur, air, water (to make sulfuric acid)
 - LARGE scale (produces a lot)
 - Many stages required (need to make ammonia and sulfuric acid, react accurate volumes then evaporate)

