

WJEC (Wales) Chemistry GCSE

2.6 - Reversible Reactions, Industrial Processes and Important Chemicals Flashcards

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What is a reversible reaction?



What is a reversible reaction?

- A reaction which occurs in 2 directions
- The products can react to form the original reactants
- $A+B \rightleftharpoons C+D$



For $A+B \rightleftharpoons C+D$, which are the products for the forward reaction and which are the products for the backward reaction?



For $A+B \rightleftharpoons C+D$, which are the products for the forward reaction and which are the products for the backward reaction?

- Forward: C+D
- Backward: A+B



How can the direction of a reversible reaction be changed?



How can the direction of a reversible reaction be changed?

By changing the conditions:

- Pressure
- Temperature
- Concentration of reactants or products



If the forward reaction is exothermic, will the backward reaction be endothermic or exothermic?



If the forward reaction is exothermic, will the backward reaction be endothermic or exothermic?

Endothermic, the same amount of energy is transferred

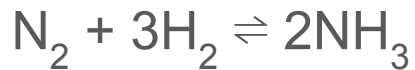


What is the reaction in the Haber process?



What is the reaction in the Haber process?

Nitrogen + Hydrogen \rightleftharpoons Ammonia



What can ammonia be used for?



What can ammonia be used for?

To produce nitrogen-based fertilisers



Where can nitrogen and hydrogen gas be obtained from?



Where can nitrogen and hydrogen gas be obtained from?

Nitrogen: from air

Hydrogen gas: natural gas or other sources



What are the conditions required for the Haber process?



What are the conditions required for the Haber process?

- High temperature (450°C)
- High pressure (200 atm)
- Iron catalyst



What happens during the Haber process?



What happens during the Haber process?

1. Purified gases passed over iron catalyst
2. Some nitrogen and hydrogen reacts to form ammonia
3. Some ammonia breaks down into nitrogen and hydrogen (because reaction is reversible)
4. Mixture is cooled, ammonia liquefies and is removed
5. Remaining nitrogen and hydrogen recycled



What does it mean for the Haber process to be in dynamic equilibrium?



What does it mean for the Haber process to be in dynamic equilibrium?

Forward and backward reaction happen at a constant rate once equilibrium is reached.



In which way does the equilibrium shift in the Haber process when pressure is increased? Why?



In which way does the equilibrium shift in the Haber process when pressure is increased? Why?

Equilibrium shifts to the right. The total number of moles of gases is fewer on the right.



The forward reaction of the Haber process is exothermic. How can the conditions be changed to produce more ammonia?



The forward reaction of the Haber process is exothermic. How can the conditions be changed to produce more ammonia?

By lowering the temperature, the forward reaction is favoured.



What are the disadvantages of using a low temperature and very high pressure?



What are the disadvantages of using a low temperature and very high pressure?

Low temperature: slower rate of reaction

High pressure: requires high energy



What are the two things aimed to be maximized when choosing the conditions of the Haber process?



What are the two things aimed to be maximized when choosing the conditions of the Haber process?

Rate of reaction and yield of ammonia



How can the presence of ammonia gas be tested?



How can the presence of ammonia gas be tested?

Moist red litmus paper will turn blue as ammonia is alkaline

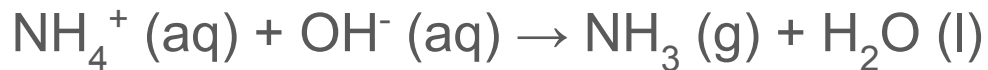


How can the presence of ammonium ions be tested? What is the ionic equation for this reaction?



How can the presence of ammonium ions be tested?
What is the ionic equation for this reaction?

1. Add solution containing hydroxide ions (e.g. NaOH)
2. Test for ammonia gas



What kind of reactions are used to make nitrogenous fertilisers from ammonia?



What kind of reactions are used to make nitrogenous fertilisers from ammonia?

Neutralisation reactions



What are some examples of nitrogenous fertilisers? What are their molecular formulas?



What are some examples of nitrogenous fertilisers?
What are their chemical formulas?

- Ammonium sulfate - $(\text{NH}_4)_2\text{SO}_4$
- Ammonium nitrate - NH_4NO_3



How can ammonium sulfate be formed from sulfuric acid (2 different ways)?



How can ammonium sulfate be formed from sulfuric acid (2 different ways)?

- Ammonia + sulfuric acid \rightarrow ammonium sulfate
- Ammonium hydroxide + sulfuric acid \rightarrow ammonium sulfate + water



What are the 2 ways used to form ammonium nitrate from nitric acid?



What are the 2 ways used to form ammonium nitrate from nitric acid?

- Ammonia + nitric acid \rightarrow ammonium nitrate
- Ammonium hydroxide + nitric acid \rightarrow ammonium nitrate + water



What are the advantages of using fertilisers?



What are the advantages of using fertilisers?

- Increases crop yield and growth
- Increases profit for farmers



What are the disadvantages of using fertilisers?



What are the disadvantages of using fertilisers?

- Eutrophication when fertilisers are washed off into rivers and lakes
 - Increase of nitrate and phosphate in water encourage algae growth
 - Algae bloom blocks sunlight from water plants underneath
 - Water plants die and are broken down by bacteria
 - Oxygen is used up by bacteria, killing other living organisms in the water
- Many stages in manufacture
- Changes pH of soil
- Can cause baby blue syndrome



What does it mean for sulfuric acid to be a strong acid?



What does it mean for sulfuric acid to be a strong acid?

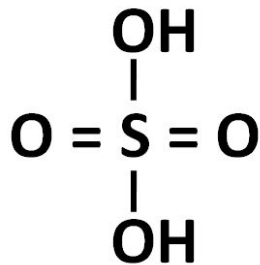
It completely dissociates in water to release H^+ ions.



What is the molecular formula and the structure of sulfuric acid?



What is the molecular formula and the structure of sulfuric acid?



What is the Contact process?



What is the Contact process?

The manufacture of sulfuric acid

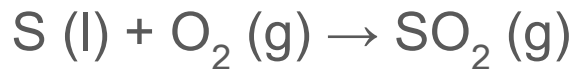


What is the first step of the Contact process?



What is the first step of the Contact process?

Sulfur is burned in air and reacts with oxygen to form sulfur dioxide



What is the second step of the Contact process?



What is the second step of the Contact process?

Sulfur dioxide reacts further with oxygen to form sulfur trioxide



- Reversible
- Catalyst: vanadium(V) oxide (V_2O_5)
- Temperature: $450\text{ }^\circ\text{C}$
- Pressure: 2atm



What is the third (final) step of the
Contact process?



What is the third (final) step of the Contact process?

Sulfur trioxide reacts with water to form sulfuric acid



Which is the reversible step in the Contact process and what are the conditions for this reaction?



Which is the reversible step in the Contact process and what are the conditions for this reaction?

The second step: $2\text{SO}_2 (\text{g}) + \text{O}_2 (\text{g}) \rightleftharpoons \text{SO}_3 (\text{g})$

- Catalyst: vanadium(V) oxide (V_2O_5)
- Temperature: $450\text{ }^\circ\text{C}$
- Pressure: 2atm



What are the uses of sulfuric acid?



What are the uses of sulfuric acid?

- Mostly used to make fertilisers
- Manufacture of chemicals (e.g. HCl, HNO₃, sulfate salts, synthetic detergents, fibres, plastics, dyes and pigments, explosives and drugs)
- Petroleum refining: washing impurities out of gasoline and other refinery products
- Processing metals
- Manufacture of rayon which is used as electrolyte in the lead-acid storage battery



What does a dehydrating agent do?



What does a dehydrating agent do?

Removes water from other compounds



How does concentrated sulfuric acid act as a dehydrating agent with sugar?



How does concentrated sulfuric acid act as a dehydrating agent with sugar?

- concentrated sulfuric acid removes 6 water molecules per glucose ($C_6H_{12}O_6$) molecule
- Highly exothermic reaction
- Water molecules released as steam and a black mass of carbon forms



What change can be observed when concentrated sulfuric acid act as a dehydrating agent on hydrated copper(II) sulfate?



What change can be observed when concentrated sulfuric acid act as a dehydrating agent on hydrated copper(II) sulfate?

Blue crystals (hydrated copper sulfate) → white powder (anhydrous copper sulfate)

