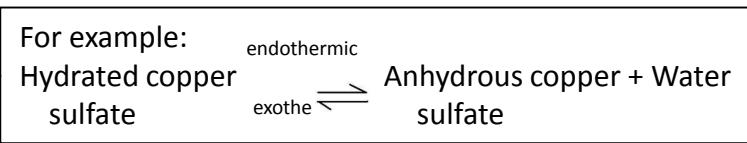


The relative amounts of reactants and products at equilibrium depend on the conditions of the reaction.

If one direction of a reversible reaction is exothermic, the opposite direction is endothermic. The same amount of energy is transferred in each case.



Energy changes and reversible reactions

Equilibrium in reversible reactions
When a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur exactly at the same rate.

Le Chatelier's Principles	States that when a system experiences a disturbance (change in condition), it will respond to restore a new equilibrium state.
Changing concentration	If the concentration of a reactant is increased, more products will be formed . If the concentration of a product is decreased, more reactants will react.
Changing temperature	If the temperature of a system at equilibrium is increased: - Exothermic reaction = products decrease - Endothermic reaction = products increase
Changing pressure (gaseous reactions)	For a gaseous system at equilibrium: - Pressure increase = equilibrium position shifts to side of equation with smaller number of molecules. - Pressure decrease = equilibrium position shifts to side of equation with larger number of molecules.

Reversible reactions

Changing conditions and equilibrium (HT)

Equilibria

Reversible reactions and equilibria

EDEXCEL TOPIC 4: Extracting metals and equilibria 2

Life cycle assessment and recycling

Ways of reducing the use of resources

Life cycle assessment

Reversible reactions	In some chemical reactions, the products can react again to re-form the reactants.
Representing reversible reactions	$A + B \rightleftharpoons C + D$
The direction	The direction of reversible reactions can be changed by changing conditions: $A + B \xrightleftharpoons[\text{cool}]{\text{heat}} C + D$

LCAS	Life cycle assessments are carried out to assess the environmental impact of products	They are assessed at these stages: - Extraction and processing raw materials - Manufacturing and packaging - Use and operation during lifetime - Disposal
Values	Allocating numerical values to pollutant effects is difficult	Value judgments are allocated to the effects of pollutants so LCA is not a purely objective process.

Reduce, reuse and recycle	This strategy reduces the use of limited resources	This, therefore, reduces energy sources being used, reduces waste (landfill) and reduces environmental impacts.
Limited raw materials	Used for metals, glass, building materials, plastics and clay ceramics	Most of the energy required for these processes comes from limited resources. Obtaining raw materials from the Earth by quarrying and mining causes environmental impacts.
Reusing and recycling	Metals can be recycled by melting and recasting/reforming	Glass bottles can be reused. They are crushed and melted to make different glass products. Products that cannot be reused are recycled.

The Haber process

The Haber process	This process uses nitrogen from the air and hydrogen from natural gas to form ammonia. The reaction is reversible and uses optimum conditions and a catalyst in order to reach dynamic equilibrium.
Optimum temperature	The optimum temperature for the Haber process is 450°C.
Optimum pressure	The optimum pressure for the Haber process is 200 atmospheres.
The use of a catalyst	The Haber process uses an iron catalyst. This does not alter the position of the equilibrium but it does increase the rate of the reaction.