

# AQA Chemistry A-level

## 3.1.6: Equilibria Detailed Notes

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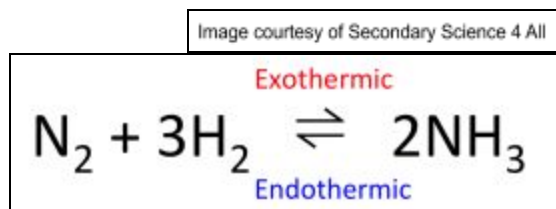




### 3.1.6.1 - Le Chatelier's Principle

Some reactions are **reversible**, where the reactants react to form products, which can then react to reform the original reactants. It is represented using a **double arrow**.

*Example:*



In each reaction system, one reaction will be **endothermic** and the opposite reaction will be **exothermic**.

#### Dynamic Equilibrium

Reversible reactions will eventually reach **dynamic equilibrium**. This is when the forward and backward **rate of reaction is the same** and remains at a **constant** rate. At this point, the concentrations of the reactants and products are constant and appear not to change.

Dynamic equilibrium can only occur in **closed systems** where no substances can get in or out in order to influence the reactions.

#### Le Chatelier's Principle

This theory is used to predict how an equilibrium mixture will change if the **reaction conditions are altered**. It states:

**When a system is subject to change, the system will alter to lessen the effect of that change.**

It is therefore a useful principle to consider in industry so that the reaction conditions can be altered to **maximise the yield** of a desired product.

#### Changing Temperature

**Increasing** temperature favours the **endothermic reaction** (+ve  $\Delta H$ ) as the excess heat needs to be removed from the system to lessen the effect of the initial increase. It will increase the yield of the endothermic products. Likewise, **decreasing** temperature favours the **exothermic reaction** (-ve  $\Delta H$ ) as heat needs to be gained and the yield of the exothermic products will be increased.



In exam questions, the  $\Delta H$  of the forward reaction will be given so it is clear which direction is endothermic and which is exothermic.

### Changing Pressure

**Increasing** pressure favours the side of the reaction with **fewer moles** as this will help to release the build up in pressure. It will increase the yield of the products on this side of the reaction.

Likewise, **decreasing** pressure favours the side of the reaction with **more moles** as pressure has been lost. The yield of the products on this side of the reaction will be increased.

### Changing Concentration

**Increasing** the concentration of the reactants will favour the reaction that **produces the products** as more molecules are available to react. It will increase the yield of the products. Likewise, **decreasing** the concentration of products will favour the reaction that **reforms the reactants**.

### Catalysts

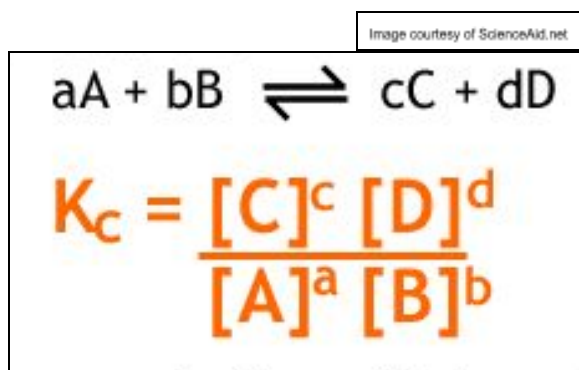
Catalysts appear not to affect the equilibrium position as they **affect the forward and backward reaction equally**. However it does allow equilibrium to be reached **faster**.

### 3.1.6.2 - Equilibrium Constant ( $K_c$ )

For reversible reactions, there is an equilibrium constant,  $K_c$ , that indicates the **position of equilibrium** for a reaction at a certain temperature.  $K_c$  for a reaction always has the **same value** unless the reaction conditions and therefore the position of equilibrium is changed.

In order to find the value of  $K_c$ , the **concentrations** of the substances in the reaction at the equilibrium position needs to be known. It is equal to the **concentration of the products divided by the concentration of the reactants**. Any variation in the number of moles, **raises that substance to a power** with the same value as the number of moles.

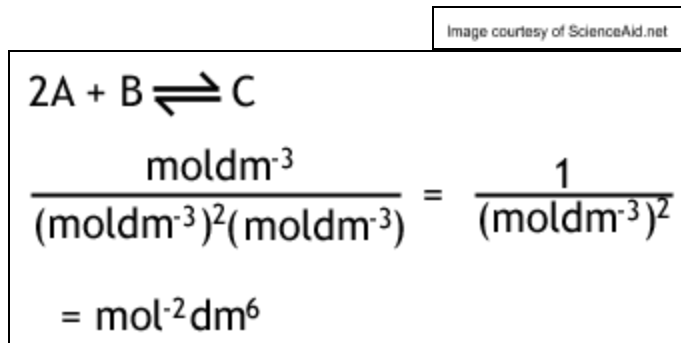
*Example:*





The equilibrium constant has **varying units** depending on the chemical reaction. It can be calculated by **subbing the units into the Kc expression**. Some of these then cancel to give the overall units of Kc for that reaction.

*Example:*



The value of Kc is **not affected by concentration change or use of a catalyst**, however it is affected by changing the reaction **temperature** as the equilibrium position change results in different concentrations of reactants and products.

