

Reversible Reactions and Equilibria

N Goalby
Chemrevise.org

Reversible reactions and equilibrium

Many reactions are reversible

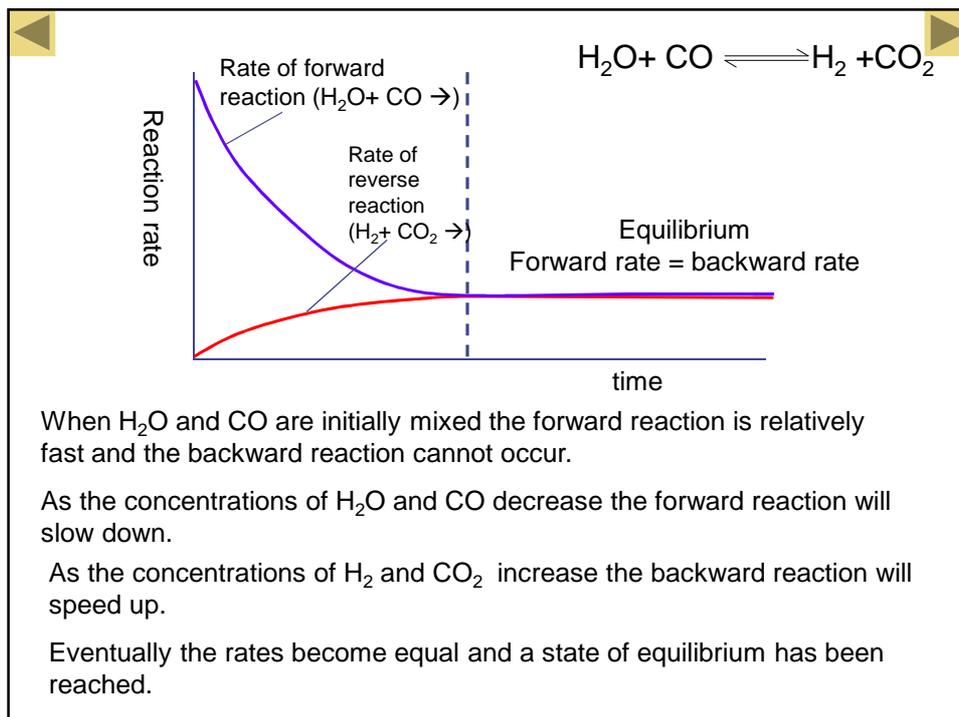


All reversible reactions reach an **dynamic equilibrium** state.

• **Dynamic equilibrium** occurs when

- **forward** and **backward** reactions are occurring at **equal rates**.

- The **concentrations** of reactants and products stays **constant** and the reaction is continuous.



Position of Equilibrium

We use the expression 'position of equilibrium' to describe the composition of the equilibrium mixture.

If the position of equilibrium favours the reactants (also described as "towards the left") then the equilibrium mixture will contain mostly reactants.

If the external conditions (temperature, pressure) are altered then the position of equilibrium will shift and a new equilibrium will form.

Le Chatelier's Principle

We use Le Chatelier's principle to work out how changing conditions affect the position of equilibrium.

Le Chatelier's principle states that if an external condition is changed the equilibrium will shift to oppose the change (and try to reverse it).

Effect of Temperature on equilibrium

If temperature is increased the **equilibrium will shift to oppose** this and move in the **endothermic** direction to **try to reduce the temperature** by absorbing heat.



In the above example because the endothermic reaction is the backwards one the position of equilibrium will **shift towards the left**, giving a **lower yield** of ammonia.
(A low temperature would therefore give a high yield of ammonia)

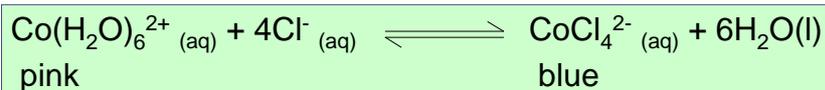
Effect of Changing Concentration



If extra A is added to the equilibrium mixture the forward reaction occurs more to oppose the change and remove some of the extra A and form extra C and D. The equilibrium has moved to the right.

If C is removed from the equilibrium mixture the forward reaction occurs more to oppose the change and replace some of the C removed; the amount of D therefore increases whilst A and B are used up. The equilibrium has moved to the right.

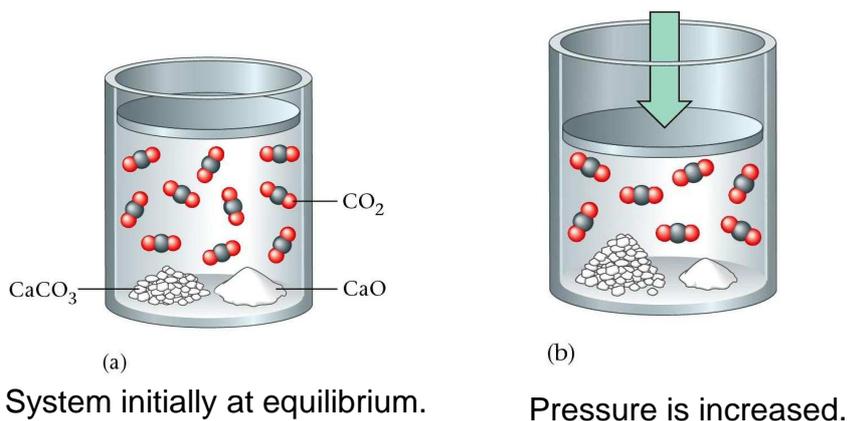
Effect of Changing Concentration



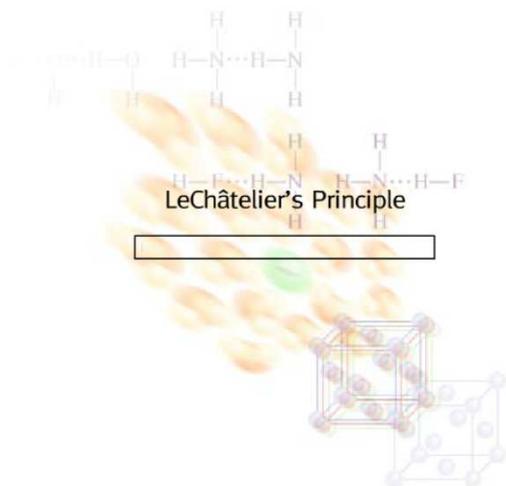
If the concentration of Cl⁻ ions is increased by adding extra HCl to an equilibrium mixture, the position of equilibrium will shift towards the products and thereby removing some of the extra Cl⁻ ions added. So the colour will change from pink to blue.



Increasing the pressure will force this reaction to the left (i.e the side with fewer moles of gas)



Animation of Le Chatelier's Principle



Effect of a catalyst.

The catalyst has **no effect** on the position of equilibrium, but it will speed up the rate at which the equilibrium is achieved.

It does not affect the position of equilibrium because it speeds up the rates of the forward and backward reactions by the same amount

Reversible Reactions

