Equilibrium and Le Chatelier’s principle

Reversible chemical reactions reach equilibrium in closed systems (no substances added or lost). Here’s how different conditions affect that equilibrium.

**Equilibrium**

\[ A + B \rightleftharpoons C + D \]

In reversible reactions products of the reaction can react to produce the original reactants. At dynamic equilibrium the rates of the forwards and backwards reactions are equal, the concentrations of the reactants and products don’t change.

1 removes dirt at the same rate as 2 replaces it.

The size of the hole and pile of dirt stay the same.

**Concentration**

Reactant concentration increased

- The equilibrium position shifts to reduce the reactant concentration.
- Reaction forming products favoured
  - In the example below the new equilibrium mixture will contain a higher concentration of \( C \) and \( D \).

Product concentration increased

- The equilibrium position shifts to reduce the product concentration.
- Reaction forming reactants favoured
  - In the example above the new equilibrium mixture will contain a higher concentration of \( A \) and \( B \).

**Temperature**

Temperature increased

- The equilibrium position shifts to reduce the temperature.
- The endothermic reaction will be favoured
  - In the example below the new equilibrium mixture will contain more \( A \) and \( B \), and less \( C \) and \( D \).

Temperature decreased

- The equilibrium position shifts to increase the temperature.
- The exothermic reaction will be favoured
  - In the example above the new equilibrium mixture will contain more \( C \) and \( D \), and less \( A \) and \( B \).

**Pressure**

Pressure increased

- The equilibrium position shifts to reduce the pressure.
- Side of reaction with fewer gas molecules favoured
  - In the example below the new equilibrium mixture will contain more \( C \) and \( D \), and less \( A \) and \( B \).

Pressure decreased

- The equilibrium position shifts to increase the pressure.
- Side of reaction with more gas molecules favoured
  - In the example above the new equilibrium mixture will contain more \( A \) and \( B \), and less \( C \) and \( D \).

Note: using a catalyst increases the rate of both the forwards and backwards reactions but doesn’t change the equilibrium position.