

Equilibrium

forward and reverse running at the same rate, not stopped, just balanced

Physical and chemical equilibrium

- physical equilibrium: melting, dissolving, evaporating going forward and backward at equal rates
- in a closed system, e.g. liquid in equilibrium with its own vapour
- chemical equilibrium: forward and reverse rates become equal, so concentrations stop changing
- equilibrium is dynamic, not static: both reactions keep running, cancelling each other's effect
- isotope-labelling experiments can still detect molecules crossing over at equilibrium
- a reaction reaches equilibrium only in a closed system: an open one keeps losing material

Start

$$\text{rate}_f \gg \text{rate}_r$$

only reactants present,
forward reaction dominates

→
rates converge

Approaching

$$\text{rate}_f > \text{rate}_r$$

products building up,
reverse reaction speeding up
as they accumulate

→
rates converge

Equilibrium

$$\text{rate}_f = \text{rate}_r$$

concentrations stop
changing, though both
reactions still run

if products are removed, rate_r drops below rate_f again, and the system shifts forward to restore the balance