

7 Dynamic equilibrium and the equilibrium constant – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	Write it 3 times (English)
reversible reaction	_____
Chemical equilibrium	_____
equilibrium constant	_____

Recall

You have met reversible reactions before:

- Some reactions can go both forwards and backwards (shown with $\rightleftharpoons$).
- At **equilibrium**, the amounts stop changing even though the reaction has not stopped.
- The Haber process for ammonia is a famous reversible reaction.

This sheet makes equilibrium exact. Each idea has a worked example.

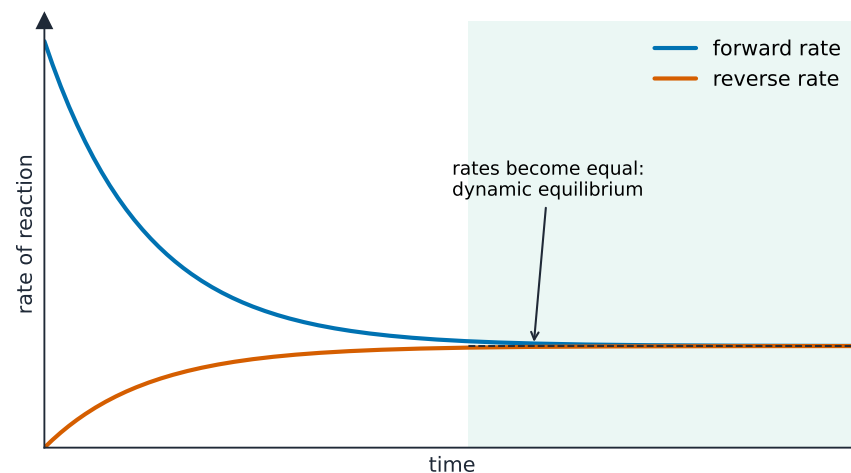
New ideas

■ 1 Reversible reactions

A **reversible reaction** can run both ways at once. Reactants make products, and products remake reactants.

■ 2 Dynamic equilibrium

Chemical equilibrium is reached when the forward and reverse reactions go at the **same rate**, so the concentrations stop changing. It is **dynamic** – both reactions keep going, they just balance out.



■ 3 The equilibrium constant

The **equilibrium constant** K compares products to reactants at equilibrium:

$$K = \frac{[\text{products}]}{[\text{reactants}]},$$

each concentration raised to its coefficient.

Worked example. For $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$ with $[\text{N}_2\text{O}_4] = 0.20 \text{ M}$ and $[\text{NO}_2] = 0.10 \text{ M}$:

$$K = \frac{[\text{NO}_2]^2}{[\text{N}_2\text{O}_4]} = \frac{(0.10)^2}{0.20} = 0.050.$$

■ 4 What K tells you

- K much greater than 1: products are favoured (reaction nearly complete).
- K much less than 1: reactants are favoured (little reaction).

Watch out: at equilibrium the forward and reverse **rates** are equal, but the **amounts** of reactant and product are usually **not** equal – they are just no longer changing.

Practice

Try these in order. The methods are all above.

2.1 State what “dynamic equilibrium” means.

[2]

2.2 For $A \rightleftharpoons B$ with $[A] = 0.40 \text{ M}$ and $[B] = 0.80 \text{ M}$, find $K = \frac{[B]}{[A]}$. [2]

2.3 A reaction has $K = 1 \times 10^6$. State whether products or reactants are favoured. [1]

2.4 For $H_2 + I_2 \rightleftharpoons 2HI$ with $[H_2] = [I_2] = 0.10 \text{ M}$ and $[HI] = 0.50 \text{ M}$, find $K = \frac{[HI]^2}{[H_2][I_2]}$. [3]

2.5 State whether the amounts of reactant and product must be equal at equilibrium. [1]