

7 Equilibrium – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	Write it 3 times (English)
reversible reactions	_____
equilibrium	_____
closed system	_____
dynamic equilibrium	_____
forward rate	_____
reverse rate	_____
Le Chatelier's principle	_____
catalyst	_____

Recall

At IGCSE you met **reversible reactions** (shown by $\rightleftharpoons$). Now we look at the balance point – **equilibrium** – and how to shift it.

- A reversible reaction goes both ways at once.
- In a closed system it settles into a steady balance.

Nothing here is harder than IGCSE – it just adds the right words and one rule.

New ideas

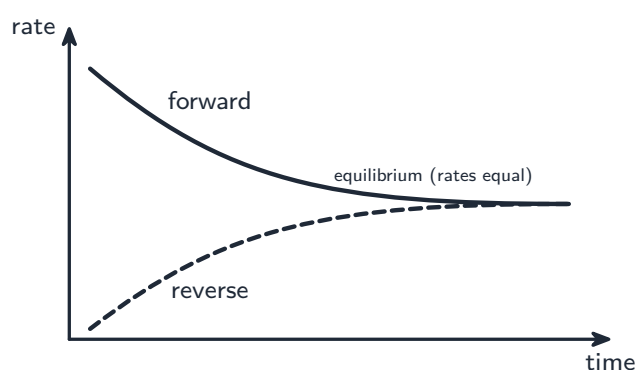
Read these first, then do the Practice.

■ 1 Dynamic equilibrium

In a **closed system**, a reversible reaction reaches **dynamic equilibrium** when:

- the **forward rate** equals the **reverse rate**.
- the concentrations of reactants and products stay **constant**.

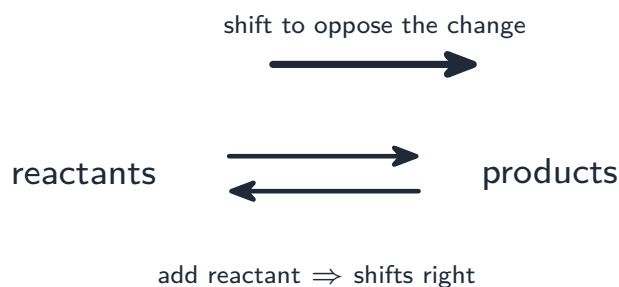
It is *dynamic* because both reactions are still happening – they just cancel out.



■ 2 Le Chatelier's principle

Le Chatelier's principle: if you change a system at equilibrium, the equilibrium moves to **oppose** the change.

Change	Equilibrium moves...
add more reactant	towards the products
increase pressure	towards fewer gas molecules
increase temperature	in the endothermic direction
add a catalyst	no shift (just reaches it faster)



■ 3 The equilibrium constant

For $aA + bB \rightleftharpoons cC + dD$:

$$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

Only **temperature** changes the value of K_c .

Watch out: a catalyst does *not* shift the equilibrium – it speeds up both directions equally, so the system just reaches the same position faster. And K_c changes *only* with temperature.

Practice

Try these in order.

7.1 State the two conditions for a dynamic equilibrium. [2]

7.2 Why must the system be *closed* for equilibrium to be reached? [1]

7.3 State Le Chatelier's principle. [1]

7.4 For an exothermic reaction, which way does the equilibrium shift if you **raise** the temperature? [1]

7.5 Does adding a catalyst change the position of equilibrium? Explain. [2]

7.6 For $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$ at equilibrium, $[\text{H}_2] = 0.20$, $[\text{I}_2] = 0.20$, $[\text{HI}] = 1.6 \text{ mol dm}^{-3}$. Find K_c . [2]

7.7 Challenge. For the exothermic reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$, state and explain the effect on the yield of ammonia of (a) increasing the pressure, (b) increasing the temperature. [3]