

Le Chatelier's Principle

"When a change is applied to a system in dynamic equilibrium, the system reacts in such a way as to oppose the effect of the change."

When a chemical equilibrium is established . . .

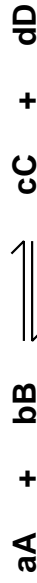
- the reaction is dynamic - it is moving forwards and backwards
- the rates of forward and backward reactions are equal
- both the reactants and the products are present at all times
- the equilibrium can be approached from either side
- concentrations of reactants and products remain constant

The Equilibrium Law

"If the concentrations of all the substances present at equilibrium are raised to the power of the number of moles they appear in the equation, the product of the concentrations of the products divided by the product of the concentrations of the reactants is a constant, provided the temperature remains constant"

There are several forms of the constant; all vary with temperature.

- K_c equilibrium values are expressed as concentrations of mol dm⁻³
- K_p equilibrium values are expressed as partial pressures
(can be used for reactions with at least one gas in the equation)



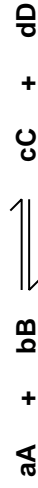
then
$$\frac{[C]^c \cdot [D]^d}{[A]^a \cdot [B]^b} = \text{a constant, } (K_c)$$

[] denotes the equilibrium concentration in mol dm⁻³
 K_c is known as the Equilibrium Constant

- it is **AFFECTED** by a change of temperature
- but **NOT AFFECTED** by changes in concentration
 a change of pressure
 adding a catalyst

FACTORS AFFECTING THE EQUILIBRIUM POSITION

K_c is not affected if you change any concentration at constant temperature to maintain the constant the composition of the equilibrium mixture changes



increase [A] or [B] equilibrium moves to right
decrease [C] or [D] equilibrium moves to right
increase [C] or [D] equilibrium moves to left
decrease [A] or [B] equilibrium moves to left

CONCENTRATION

PRESSURE

Pressure Change	Effect on Equilibrium
INCREASE	moves to side with FEWER GASEOUS MOLECULES
DECREASE	moves to side with MORE GASEOUS MOLECULES

TEMPERATURE

Type of reaction	ΔH	Increase T	Decrease T
EXOTHERMIC	-	moves to LEFT	moves to RIGHT
ENDOTHERMIC	+	moves to RIGHT	moves to LEFT

CATALYSTS

Do **not** affect the position of equilibrium but equilibrium is **reached quicker**