Chemical Reactions (FBLT)

Chemical reactions are events in which one group of compounds, reactants', *are transformed into other compounds,* ***products***. We describe reactions with chemical equations.

E.g. in the equation

$$a\,A + b\,B \rightarrow c\,C + d\,D \qquad (1)$$

means

A, B	*reactants,*
C, D	*products,*
a, b, c, d	***stoichiometric coefficients*** *which express the ratio of the number of particles of the compounds participating in the reaction.*

The term "equation" implies the existence of equality between the two sides: in every chemical reaction, ***mass, energy, and electric charge*** **must be conserved.**

Let us now look at the reactions between copper and ferric ions in solution:

$$Cu^{+} + Fe^{3+} \rightleftharpoons Cu^{2+} + Fe^{2+} \qquad (2)$$

Like most reactions in chemistry (and almost all in biochemistry), this reaction is **reversible**. *It means it can go both ways. The process stops after a certain amount of iron is reduced and a certain amount of copper is oxidized. We say that at this point the reaction has reached* ***an equilibrium state***, i.e. that **the concentration of reactants** and **products** in the reaction system **does not change** any further.

The established equilibrium can be mathematically described using the equilibrium constant, K_{eq}, which is defined as the quotient of the product of the equilibrium concentrations of products and reactants (squared by their stoichiometric coefficients):

$$K = \frac{[C]^c \cdot [D]^d}{[A]^a \cdot [B]^b} \qquad (3)$$

In the case of reaction (2), we therefore get

$$K = \frac{[Cu^{2+}] \cdot [Fe^{2+}]}{[Cu^{+}] \cdot [Fe^{3+}]} \qquad (4)$$

Assume that **the equilibrium constant** for reaction (1) is **equal to 1**, *i.e. that in the equilibrium state* ***the product of the concentrations of products and reactants is the same***. *If we now add more compound A to the system, we will break the established equilibrium, and the reaction will therefore start in a direction that will try to restore the original state again. In our case, substance A will react with substance B to form substances C and D as long as the products of concentrations ([A]·[B] and [C]·[D]) are not equal again and a new equilibrium state is reached. This rule is called* ***Le Chatelier's principle***.

A system in equilibrium reacts to a change in conditions (pressure, temperature, concentration) in such a way as to suppress this change.