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In the educational manual presents the theoretical and practical aspects of chemical kinetics and electrochemistry. The educational manual contains test questions that allow students to independently control their knowledge. Much attention is paid to the important section on the problems of catalysis. Modern views on the nature of homogeneous and heterogeneous catalysis are considered. And the features of the influence of the catalyst on the rate of chemical reactions are given. The problems of the theory of solutions of strong and weak electrolytes, the thermodynamics of electrochemical processes are considered.

The educational manual is intended for students studying in chemical and chemical-technical specialties, and can also be used by undergraduates, doctorants and teachers of higher educational institutions of the Republic of Kazakhstan.

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BASIC PRINCIPLES OF CHEMICAL KINETICS

THE SUBJECT AND TASKS OF CHEMICAL KINETICS, THE REACTION RATE, THE BASIC POSTULATE OF CHEMICAL KINETICS, THE ORDER AND MOLECULARITY OF CHEMICAL REACTIONS

Chemical kinetics is one of the important sections of physical chemistry. Chemical kinetics is a science that studies the patterns of chemical reactions in time and their mechanism. Chemical kinetics considers the dependence of the rate of chemical reaction on the concentration of reagents, temperature, environment properties, and other factors.

One of the important tasks of chemical kinetics is the clarification of chemical reaction mechanism, the relationship between the rate of the processes and the structure of the molecules of the reacting substances.

Usually, the laws of chemical thermodynamics are used for studying chemical processes.

For example, for the reaction:

$\nu_1A_1+\nu_2A_2+...+\nu_iA_i=\nu_1'A_1'+\nu_2'A_2'+...+\nu_k'A_k'$

a) Spontaneous condition $\Delta G<0$, i.e

$$\Delta G=-RT\left[\ln K_a-\ln\frac{(a_1'^{\nu_1'}\cdot a_2'^{\nu_2'}\cdot...a_k'^{\nu_k'})}{(a_1^{\nu_1}\cdot a_2^{\nu_2}...a_i^{\nu_i})}\right]<0$$

b) Equilibrium condition $\Delta G=0$, and then

$$K_a=e^{-\frac{\Delta G}{RT}}$$

c) Equilibrium output for certain values of T and P using the law of mass action can be written:

$$K_a=\left[\frac{(a_1'^{\nu_1'}\cdot a_2'^{\nu_2'}\cdot...a_k'^{\nu_k'})}{(a_1^{\nu_1}\cdot a_2^{\nu_2}...a_i^{\nu_i})}\right]$$

However, thermodynamics cannot specify how long the system will reach a certain state, i.e. an important parameter – time, is not taken into account in thermodynamics. Moreover, it is not always possible to judge the spontaneous nature of chemical processes by the values of ΔG, ΔF and ΔS (isolated system).

For example, for the reactions:

$H_2+O_2=2H_2O$ $\quad\Delta G$=-451kJ

$SO_2+1/2O_2=SO_3$ $\quad\Delta G$=-71kJ

These reactions proceed only in the presence of catalysts.

Chemical thermodynamics considers the initial and final states, when molecules and atoms are in stable states. However, in practice, the initial substances often pass into products through the certain transformations, i.e. through a series of stages in which radicals, intermediate-active forms of particles, etc. can take part, and each stage also goes in time. Therefore, any reaction is a complex reaction, and it is necessary to know its mechanism during its study. **The reaction mechanism is a combination of stages of which this chemical process is composed**. The establishment of a chemical reaction mechanism is a complex process. A complete description of the reaction mechanism involves the solution of several tasks.

1. The division of reactions into separate stages, and the equilibrium phase.
2. Characterization of intermediate products, and an assessment of their lifetime.
3. Description of the transition state for each stage.