Рабочий лист № 8

Subject: **“The kinetics of life processes”**

Theoretical part

Vocabulary

- Найдите соответствие, запишите слова в словарную тетрадь.

rate	приближаться/достигать	elementary step	быстро
reactant	способствовать	to cope with	формироваться
to be consumed	элементарная стадия	Rate law	последовательность
to be formed	преобразовывать	rate constant	деленный
step	справиться с	average	образование
to take place	переменные	the instantaneous rate	расходование
quickly	оптимизировать	to express	определенный, некоторый
to approach	приводить к	to convert	побочные реакции
variable	выражать	divided	реагент
to optimize	скорость в конкретный момент времени	formation	иметь место
lead to	Закон действующих масс	certain	константа скорости
sequence	стадия	consumption	средняя
to contribute	скорость	side reactions	расходоваться

- Составьте 3 предложения, употребляя словарные слова.

Examples: *The branch of physical chemistry called chemical kinetics is concerned with the rates of chemical reactions.*

The study of reaction rates leads to an understanding of the mechanism of a reaction.

When dealing with physical and chemical changes, we need to cope with a wide variety of different rates.

_____

_____

_____

_____

Main laws, equations and definitions

- Переведите на русский язык:

Reaction rates:

The raw data from experiments to measure reaction rates are the concentrations or (for gases) partial pressures of reactants and products at a series of times after the reaction is initiated.

The first step in the investigation of the rate and mechanism of a reaction is the determination of the overall stoichiometry of the reaction and the identification of any side reactions. The next step is to determine how the concentrations of the reactants and products change with time after the reaction has been initiated.

The average rate of a reaction is defined in terms of the rate of change of the concentration of a designated species:

$$\text{average rate} = \frac{|\Delta[J]|}{\Delta t}$$

Definition of average rate

Because the rates at which reactants are consumed and products are formed typically change in the course of a reaction, it is necessary to consider **the instantaneous rate**, v, of the reaction, its rate at a specific instant.

$$\text{instantaneous rate} = \frac{|d[J]|}{dt}$$

Definition of instantaneous rate

An empirical observation of the greatest importance is that ***the rate of reaction*** is often found to be proportional to the molar concentrations of the reactants raised to a simple power.

$$\mathbf{v = k_r[A][B]}$$

The coefficient k_r, which is characteristic of the reaction being studied, is called **the rate constant.**

The units of k_r are always such as to convert the product of concentrations into a rate expressed as a change in concentration divided by time. For example, if the rate law is the one shown above, with concentrations expressed in moles per cubic decimeter (mol dm^{-3}), then the units of k_r will be cubic decimeters per mole per second ($dm^3\ mol^{-1}\ s^{-1}$) because

$$\overbrace{dm^3\,mol^{-1}\,s^{-1}}^{k_r} \times \overbrace{mol\,dm^{-3}}^{[A]} \times \overbrace{mol\,dm^{-3}}^{[B]} = \overbrace{mol\,dm^{-3}\,s^{-1}}^{v}$$

Practical part

Self-test 6.1 The rate of formation of NH_3 in the reaction $N_2(g) + 3\,H_2(g) \rightarrow 2\,NH_3(g)$ was reported as 1.2 mmol $dm^{-3}\ s^{-1}$ under a certain set of conditions. What is the rate of consumption of H_2?

Answer: 1.8 mmol $dm^{-3}\ s^{-1}$

The problem of having a variety of different rates for the same reaction is avoided by bringing the stoichiometric coefficients into the definition of the rate. Thus, for a reaction of the type

$$a\,A + b\,B \rightarrow c\,C + d\,D$$

we write the **unique reaction rate** as any of the four following quantities:

$$v = \frac{1}{d}\frac{d[D]}{dt} = \frac{1}{c}\frac{d[C]}{dt} = -\frac{1}{a}\frac{d[A]}{dt} = -\frac{1}{b}\frac{d[B]}{dt} \qquad \text{Definition of unique rate} \qquad (6.3)$$

Now there is a single rate for the reaction.

Self-test 6.2 A reaction has a rate law of the form $k_r[A]^2[B]$. What are the units of the rate constant k_r if the reaction rate is measured in mol $dm^{-3}\ s^{-1}$?

Answer: $dm^6\ mol^{-2}\ s^{-1}$