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Method of Mathematical Modeling in the Study of Differential Equations Based on Professional Orientation

Khonkulov Ulugbek Khursanalievich

Associate professor of Fergana State University, (PhD)

u_xonqulov@mail.ru

Rasulova Farida Farhodjon kizi

Graduate student of Fergana State University

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Abstract: the article reveals the importance of the method of mathematical modeling in the study of differential equations based on their profession. In the process of studying differential equations of certain processes occurring in the fields of chemistry, mathematical models are given as an example.

Keywords: differential equation, cell, chemistry, reaction, reaction rate, melting law of substances, differential equation in which variables are separated.

Introduction: Real processes taking place in the modern world, nanotechnology (nanotechnology is a field of fundamental and Applied Science and technology, which deals with theoretical substantiation, practical methods of research, analysis and synthesis, as well as methods of manufacturing and using products with a certain atomic structure) dynamics especially require high - quality and deep, stable scientific knowledge from chemistry specialists. Today, thanks to globalization, technologies are improving every year, new knowledge and research is emerging in the field of chemistry and medicine. For the development of technologies, most industry representatives will also need expensive calculations with differential equations. At the moment, the modern world is changing in connection with the use of mathematical modeling, statistical data and other phenomena used in practice in the activities of chemists and medical workers[2,3].

In particular, the needs of society require specialists in Chemical Education to develop the ability to apply their knowledge in various fields. The development of the professional competence of the future specialist through the application of mathematical knowledge in chemistry and related medicine is of urgent importance. In chemistry, the apparatus of mathematics presents trends in the development of reactions, and in medicine, the role of mathematics is felt from the point of view of scientific and theoretical analysis in the implementation of diagnostic procedures. Currently, it is well known that the methods of treatment and diagnosis of diseases have significantly expanded[4,5]. A large part of medical centers use mathematical modeling methods, which increases the accuracy of a large part of the detected diagnoses. Knowledge of the basics of mathematics is the basis for observing, describing the processes taking place in the human body by chemists and doctors. In many educational institutions, students study mathematics and its various sections (differential equations), as well as basic chemical sciences. The main problem of Applied Mathematics is the choice of elementary mathematical models, that is, this situation encourages the implementation of mathematical knowledge in practice, the possibility of studying differential equations based on professional orientation, as in various fields, in particular in chemistry[6,7].

Literature review: The problem of organizing the study of educational materials by professional orientation, clarifying its methodological aspects has long been of interest to researchers. For Example, F.K. Matsur, M.I.

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Makhmutova, U. X. Khonkulov, A.G. Mordkovich, R.A. Nizami, M.F. Fakhtulina [1; 8] and others carried out effective methodological research in this direction.

Research Methodology: The branch of mathematics "differential equations" is one of the largest sections of modern mathematics. It intersects with many areas of activity. As you know, a differential equation is equations that contain unknown functions under the sign of a derivative or differential. While such equations serve as the basis for the construction of scientific developments and are functionally used to model real processes, which is very important for the technological development of modern chemical, medical and other industries. In this sense, differential equations are widely used in practice. For example, the result of chemical reactions, the laws of substance decomposition, trends in genetic change, the calculation of the company's main income, the dynamics of the current strength by Time, demographic situations in a particular region, etc.are modeled using differential equations, is calculated[2, 8]. Mathematical methods based on differential equations are used on a wide range of fronts, including in the field of chemistry, medicine. Every year, scientists are increasingly identifying new diseases, finding medicines, new pracedura and methods of treatment. And it is known to everyone that none of this can be done without Mathematics. In the study of differential equations based on professional orientation, the method of mathematical modeling is widely used. We bring a number of principles that will help increase the wushu method in the direction of Chemical Education.

1. Science. The content of various sections of mathematics means that it fully corresponds to the corresponding sections of fundamental science: the integrity, accuracy of the mathematical language, the logical coherence of the content, etc.

2. The fact that the methodological direction of learning is of a scientific nature. The methodological direction involves the formation of views of future chemists on mathematics as an important science by means of a means of studying the surrounding reality, mathematical modeling of real processes and objects, with the help of which general laws and relations in the material world are described.

3. Strengthening the fundamentalization of mathematical education. Mathematics must have a practical nature, while it is impossible to develop any engineering theory without relying on fundamental knowledge and research. “In the fundamental essence of the educational process, we understand the use of a systematic approach to the analysis of the problems of linking mathematical education with the technology of science within the framework of professional pedagogical tasks. Fundamental education should allow for a deep, thorough knowledge of science, their widespread use in professional activities. Combining fundamental with professional orientation in the educational process, when studying individual sections, it is necessary:

a) to achieve a clear perception of basic mathematical concepts, their logical structure and practical meaning;

b) formation of skills in the use of one or another mathematical apparatus in their specialty. As you know, deep theoretical knowledge, the rules of fundamental science of students are a prerequisite for the correct perception of all measures aimed at the practical purpose of mathematics and the implementation of professional orientation.

4. Another important condition for the implementation of the professional direction of education is the Coordination of the methodological system of learning with the psychological characteristics of students. We consider the combination of logic in the construction of science itself and the psychological side of the perception of educational material as one of the components of this condition.

5. Problematic and developmental education implies the use of such active learning methods as individualization and differentiation in education.

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6. Independent Education. The mathematical result obtained in the process of independent work "RE" passes at each stage of obtaining it, as a result of which it is most clearly stored in the mind. The correct planning of independent work of students is one of the most important tasks of the teacher. In our course, we propose to use such forms of independent work as individual and collective homework, standard calculations.

7. Internal and external integration. We also consider the implementation of interdisciplinary communications as a condition for professional orientation. Mathematics teachers should know how mathematical knowledge is applied within the framework of general theoretical and special disciplines, what mathematical apparatus this specialty relies on. In addition, teachers of special and general technical disciplines should not only have fundamental mathematical knowledge, but also carry out continuity in the learning process.

That is, the study of differential coins on the basis of professional orientation is the main factor, taking into account the need for the construction of mathematical education, and the combination of the above conditions for the implementation of the professional direction provides it, we think that the educational process is the most effective.

Based on the above, let's see some examples of the application of differential equations in solving certain problems encountered in chemistry. In this, the importance of the method of mathematical modeling is visible. Such examples increase the chances of studying differential equations based on professional orientation.

1. Dissolution of substances contained in the tablet (the law of extraction of all available substances in the tablet, that is, the dissolution of substances).

The "smelting" experiment is recorded in the medical literature or in regulatory documents on chemistry, pharmaceuticals, it is understood to determine the amount of active substance that must be released from the solid form to the melting medium under certain conditions and for a certain period of time in order to establish the dosage of the drug.

Let's assume, n - on the tablet t - let it be the amount of substance remaining until the time of dissolution. The melting rate is determined by the time by the following differential equation:

$$\frac{dn}{dt} = -kn \qquad (1)$$

This is k - an invariant magnitude is called a constant melting rate. In this equation, the minus sign means that over time, the number of substances in the tablet decreases as a result of melting.

We solve the differential equation above, for which we separate the variables and then integrate it:

$$\frac{dn}{n} = -kdt\,,\ \int\frac{dn}{n} = -\int kdt.$$

From this:

$$\ln|n| = -kt + C\,.$$

We use the properties of the logarithm:

$$|n| = e^{-kt+C}\,,\ |n| = C_1 e^{-kt}\,,$$

in this place $C_1 = e^C$ optional number.

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According to the property of the module and $e^x > 0,\ x \in R$ since we get:

$n = C_2 e^{-kt}$,

in this place $C_2 = \pm C_1$ optional number.

If $t = 0$ va $n = n_0$ assuming that $C_2 = n_0$, say:

$n = n_0 e^{-kt}$ (2)

(2) the formula represents the law of dissolution of substances in the tablet. From the last equation k - we find the constant melting (scattering) rate:

$$n = \frac{n_0}{e^{kt}},\quad e^{kt} = \frac{n_0}{n},\quad kt = \ln\left(\frac{n_0}{n}\right),\ k = \frac{1}{t}\cdot\ln\left(\frac{n_0}{n}\right).$$

Half of the tablets ($n = \frac{n_0}{2}$) melting time $t = t_{\frac{1}{2}}$ if we take the following:

$$\frac{n_0}{2} = n_0 e^{-k\cdot t_{\frac{1}{2}}},\ \frac{1}{2} = e^{-k\cdot t_{\frac{1}{2}}}.$$

Logarithm both sides of the last equation:

$$\ln\frac{1}{2} = -k\cdot t_{\frac{1}{2}}.$$

From this $t_{\frac{1}{2}}$ we find the half-melting time: $t_{\frac{1}{2}} = \frac{\ln 2}{k} = \frac{0,693}{k}$.

From this example, it can be seen that the law of melting of substances is determined by a differential equation in which the first order variables are separated.

2. Now let's look at an example related to the breakdown of the drug in the human body.

Issue: the drug was introduced into the patient's body. If, within 4 hours after the introduction of 4 mg into the body of the drug, its mass has halved, what part of the drug is broken down after 8 hours?

Solution: to solve this issue, it will first be necessary to determine whether the change in the amount of medicinal substance in the body depends on the time distribution. We enter the following designations: initial moment of time ($t = 0$) at amount of the drug (mg in the) $N_0 = 8$ and two hours ($t = 2$) the amount of the drug after $N_2 = 4$ let it be, here N - the amount of the drug for any time. The rate of change in the amount of Peparat is proportional to the amount of the drug over a given time: $\frac{dN}{dt} = kN$ (3)

in this place k - coefficient of proportionality. Our solution to the differential equation above to determine the relationship being sought:

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$\frac{dN}{N} = kdt$, $\ln|N| = kt + C$,

$|N| = e^C e^{kt} = Ce^{kt}$ (4)

From this follows the following formula:

$N = Ce^{kt}$ (5)

Using starting conditions ($N = 8,\ t = 0$) C we find the:

$8 = Ce^{k0}$, $e^0 = 1$, $C = 8$.

Say, $N = 8e^{kt}$. It is known that as soon as the drug was introduced into the body, after 4 hours its mass was halved. Now k we find the. To do this $N = 8e^{kt}$ to the equation $t = 4$, $N = 4$ we put the values of:

$4 = 8e^{4k}$, $0{,}5 = e^{4k}$.

Logarithm of both sides of the equation and we get:

$\ln 0{,}5 = \ln e^{4k}$, $\ln 0{,}5 = 4k \ln e$.

Because $\ln e = 1$, therefore $k = \frac{\ln 0{,}5}{4}$. Say, $N = 8e^{kt}$ taking into account the formula, the dependence of the amount of the drug on time in the body can be written as follows:

$N = 8e^{\frac{\ln 0{,}5}{4} \cdot t}$.

Now take the amount of the substance for 8 hours ($t = 8$) after that, we determine what part is decomposed, for which we use the last equation: $N = 8e^{\frac{\ln 0{,}5}{4} \cdot 8}$. In this place $\ln 0{,}5 = -0{,}693$, $2 \cdot \ln 0{,}5 = -1{,}386$. Say: $N = 8e^{-1{,}386} = 8 \cdot 0{,}25 = 2$, In this place $e^{-1{,}386} = 0{,}25$. To summarize, After 8 hours, 2 mg of the drug is in the body. During this time, the mg part of the drug was broken down, that is, it turned out that 6 mg of the substance was broken down in 8 hours.

Conclusion/Recommendations: Examples of this manifestation can be applied to students of the direction of Chemistry, Medical Education in the process of studying differential equations of the first order, the variables of which are separated. Such issues open up opportunities for the study of differential equations based on professional orientation. When studying a phenomenon, initially its mathematical model is created, which in mathematical form describes the basic laws to which this phenomenon is subject. In our examples, these regularities are expressed in the form of differential equations. Mathematical models facilitate the prediction of the results of experiments carried out in real systems, make it possible to study the phenomenon as a whole, predict its development, changes that occur over time. In the presented examples, we considered the melting model for determining the dosage levels of a substance from tablets, the use of differential equations for solving problems in chemistry and medicine using the example of modeling the treatment of oncological diseases. Recently, much attention has been paid to the quality control of pharmaceutical and medical products, for which it is mandatory to comply not only with temperature conditions, but also with good

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storage and transportation rules, which implies an unconditional guarantee. Based on all of the above, we make sure that differential equations are of great importance in the development of the chemical and health system, ensuring its continuous operation and the development, implementation of scientific developments.

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