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DEVELOPMENT OF MATHEMATICAL LITERACY IN CHEMISTRY LESSONS

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Abstract:

This article is devoted to the problem of the formation of mathematical literacy of students in teaching chemistry. Methodical approaches to the use of tasks in mathematical literacy are considered on the example of solving computational problems and using the proposed graphs. Various options for assignments for the development of mathematical literacy are proposed

Keywords: mathematical literacy, intersubject communications, educational process, chemistry, gas laws, state of aggregation, problem solving

In recent years, the ongoing reforms in the field of education have been noticeably felt. In the Decree of the President of the Republic of Uzbekistan Mirziyoyev Sh.M. "On the Strategy of Actions for the Further Development of the Republic of Uzbekistan" dated February 7, 2017, a number of tasks for the development of the social sphere, including education, were identified. [1].

As the President of the Republic of Uzbekistan Sh.M. Mirziyoyev notes in his address to the Oliy Majlis: "We have set ourselves the goal of joining a number of developed countries and we can achieve it only through accelerated reforms, relying on science, education and innovation. To do this, we first of all need to educate cadres of a new formation, acting as initiators of reforms, possessing a strategic vision, deep knowledge and high qualifications."[2].

For the implementation of the tasks set, it is necessary to change the goals, objectives, content of academic subjects. The modern school requires the use of a variety of methods in the classroom process and the use of an innovative approach in teaching subjects, including chemistry. Much has been said and said about the newest methods of teaching the lesson at its different stages. Of no small importance is a significant restructuring and improvement of methods and forms of organizing the educational process (complex lessons, intersubject excursions, conferences, competitions, Olympiads, the use of search teaching methods, problem-cognitive tasks, research elements in the educational process).

Interdisciplinary connections in school education are a concrete expression of the integration processes taking place today in science and in the life of society. These connections play an important role in enhancing the practical and scientific-theoretical training of students.

Interdisciplinary connections between chemistry and mathematics deserve special attention. The study of all subjects of the natural science cycle is closely related to mathematics. It provides students with a system of knowledge and skills necessary in everyday life and work activities of a person, as well as important for the study of related subjects. On the basis of knowledge in mathematics, in the first place, general subject calculation and measurement skills are formed. [3, C. 34-36]

Mathematical literacy in the study of chemistry is also considered in the international program for assessing the educational achievements of students PISA - a test that assesses the literacy of schoolchildren in different countries of the world and the ability to apply knowledge in practice. The study of educational achievements of students is carried out in three main areas: "reading literacy", "mathematical literacy" and "natural science literacy" [4]. The study is not aimed at determining the level of mastering school programs, but at assessing the ability of students to apply the acquired knowledge and skills in life situations, to be guided by common sense and logic when performing non-standard tasks.

Mathematical literacy is the ability of an individual to formulate, apply, and interpret mathematics in a variety of contexts. It includes mathematical reasoning, the use of mathematical concepts, procedures, methods, facts and tools in order to describe, explain and predict phenomena, as well as the interpretation of the obtained solution of a mathematical problem [5].

Mathematical exercises promote the acquisition of rational qualities of thought and its expression: order, accuracy, clarity, and conciseness. They require imagination and intuition, provide a sense of objectivity, intellectual honesty, and a taste for exploration [6, C. 79-79].

The study of all subjects of the natural science cycle is interconnected with mathematics. Interdisciplinary connections of mathematics with chemistry have quite large potentialities, proportions, percentages and many problems on mixtures are widely used in chemistry, solving problems with chemical content provides ample opportunities for constructing mathematical models using linear equations, systems of linear equations, derivative, integrals, differential equations, etc.

In the course of studying chemistry, gas laws occupy a separate place. When studying this topic, students should develop skills and abilities to solve computational and experimental problems using formulas, tables and graphs.

As its known, substances can be in various states of aggregation, including gaseous. Therefore, it is necessary to remember the gas laws to solve some problems. Gas laws relate pressure **p**, volume **V** and temperature **T** (according to Kelvin scale) [7,C. 45-47].

Clapeyron-Mendeleev equation or ideal gas equation of state. It should be noted that when carrying out calculations using the equation of state for an ideal gas, if the value of the universal gas constant R = 8.314 J / (mol K), then the pressure p should be expressed in Pa, the volume V - in m3, the temperature T - on the Kelvin scale, the amount of substance n - in moles [8,C. 71-80].

pV = nRT

Boyle-Mariotte's law: for a given mass of a given gas at a constant temperature, the product of pressure and volume is a constant value. p1V1 = p2V2 (for isothermal process, T = const)

Gay-Lussac's Law: The volume of a given amount of gas at constant pressure is directly proportional to the absolute temperature. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

(for isobaric process, p = const)

Charles's law: the pressure of a given mass of an ideal gas at a constant volume is directly proportional to the absolute temperature $\frac{p_1}{T_1} = \frac{p_2}{T_2}$

(For isochoric process, V = const)

Avogadro's Law: Equal volumes of different gases under the same conditions (p and T) contain the same number of molecules.

When explaining these topics, much attention is paid to the methodology for solving problems. When solving problems, a general solution algorithm is used, taking into account the specifics of problems on gas laws, which boils down to the following: in each case, they find out which parameters of the gas state change and which remain constant, and in this connection establish the nature of the process being performed.

When solving problems on gas laws, it is necessary to understand that:

A) If two states do not appear in the task, then one state can be selacted the state under normal conditions;

B) If the mass of the gas remains constant, then the problems should be solved using gas laws;

C) If the problems involve the mass or density of the gas, then when solving it is advisable to use the Mendeleev – Clapeyron equation.

On gas laws it is advisable to solve graphic problems. You can offer a certain system of graphic problems for gas laws.

The first group of tasks consists of those in which it is required to plot isoprocess graphs in one or more coordinate systems. For example: build a graph of an isothermal process occurring at a temperature of 25°C, if the product of pressure and volume PV = 10 Pa.m3 (plot the graph in coordinates P, V; V, t; P, t). The tasks of the second group require the ability to read the graph and determine the values of thermodynamic parameters from it.

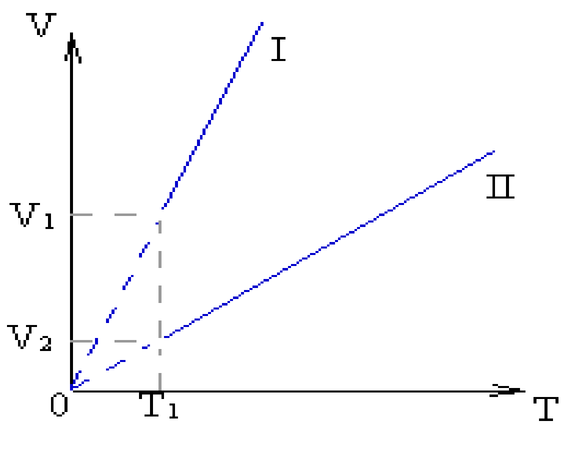

Fig. 1 Graph of isobars I and II for equal masses of the same gas

An example of such a group of problems can be the following: the figure shows two isobars I and II for equal masses of the same gas. Compare the pressures at which these processes were carried out (Fig. 1).

Solving such a problem, first of all, it is necessary to answer a number of questions: "The dependence of what quantities is shown on the graph?", "What is the nature of this dependence?", "What process does this dependence illustrate?" To answer the question of the problem, an isotherm is carried out and it is determined at which process the same temperature corresponds to a larger volume.

When studying this topic, computational problems are also used, for example:

1. When 3,6 g of the unknown metal is added to a closed vessel filled with 16,8 L of chlorine at normal conditions the reaction proceeds and the pressure in the vessel is set at 87 kPa at t = 47 oC. Determine which metal was involved in the reaction.

Solution:

1) $n = \frac{16,8}{22,4} = 0,75$ моль Cl_2 PV = nRT

$$n = \frac{87 \cdot 16,8}{8,314 \cdot 320} = 0,55 \text{ моль}$$

0,75 – 0,55 = 0.2 mol Cl_2 consumed 0,2 · 71 = 14,2 g

3,6 → 14,2 g Cl_2
x → 35,5 g
x = 9
9·3 = 27 Al.

2. Determine the pressure (atm) in a vessel with a volume of 16,8 liters containing 14 g of nitrogen, 15 g of C_2H_6 and 4 g of hydrogen at a temperature of 0 oC

n (total) = 0,5 + 0,5 + 2 = 3 mol

nRT = PV $P = \frac{3 \cdot 0,082 \cdot 273}{16,8} = 4$ атм.

Answer: 4 atm.

As the examples considered show, the potential possibilities of intersubject connections between mathematics and chemistry are quite extensive and diverse, and the teacher's task is to use them in the study of chemistry and mathematics,and the task of methodological scientists is to equip teachers with the necessary didactic materials. The use of interdisciplinary connections in teaching chemistry with mathematics performs the following functions: contributes to the solution of educational tasks to consolidate basic chemical knowledge, skills and abilities in the process of their constant use in teaching various subjects, being an important factor in improving the learning process at all its levels; helps to develop thinking; promotes the development of significant personality traits; integrates academic disciplines, showing how the same laws are applied in various scientific fields; builds a unified scientific picture of the world and thereby contributes to the formation of the scientific worldview.

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