SCIENTIFIC AND METHODOLOGICAL FOUNDATIONS OF TEACHING THE TOPIC OF SOLUTION CONCENTRATION BASED ON MODERN INFORMATION TECHNOLOGIES

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Abstract: *The article analyzes the role of digital tools, methodological approaches, and didactic possibilities in teaching chemistry in general education schools based on modern information technologies, in particular, in the in-depth study of the topic "Solution Concentration". Also, examples and problems related to the topic and the study of their solutions using modern means are highlighted.*

Keywords: *chemistry education, information technology, solution, concentration, mass fraction, molar concentration, interactive methods, virtual laboratories.*

Аннотация: *В статье анализируется роль цифровых средств, методических подходов и дидактических возможностей в обучении химии в общеобразовательных школах на основе современных информационных технологий, в частности, в углубленном изучении темы «Концентрация растворов». Также выделены примеры и задачи, связанные с темой, и изучение их решений с использованием современных средств.*

Ключевые слова: *химическое образование, информационные технологии, раствор, концентрация, массовая доля, молярная концентрация, интерактивные методы, виртуальные лаборатории.*

Input. Knowledge of solutions and their concentrations, which are one of the main components of chemistry, is of great importance in the practical activities of students. Concentration determination is a necessary skill in medicine, pharmacy, the food industry, and other fields.

With the help of modern information technologies (IT), it is possible to increase the effectiveness of studying this topic, especially strengthening theoretical concepts through virtual experience.

Theoretical foundations of studying the topic of solution concentration

The concentration of the solution is determined by the following expressions:

1. **Mass fraction (ω)**

$$\omega = \frac{m_{substance}}{m_{solution}}$$

2. **Molar concentration (C)**

$$C = \frac{n}{V}$$

here:

n – amount of substance (mol);

V – volume of solution (liters).

3. Concepts such as **molal** fraction (X) and **normality** (N) are also introduced to upper-level students.

Methods of teaching the topic based on information technologies

Visualization

- **PhET Interactive Simulations** – interactive laboratories for preparing solutions and monitoring concentration;
- **ChemCollective** is a virtual alternative to the chemistry laboratory.

Test and evaluation

Prepare online tests on **Google Forms** or **Kahoot** and track the results in real time.

Automatic evaluation based on formulas using the **AutoGradr** program.

Animated graphics

Explain the molecular structure of substances using programs such as **PowerPoint + ChemDraw** or molView.

Problems and their scientifically based solutions

Problem 1

How much NaCl is needed in 200 g of solution to prepare a 10% sodium chloride (NaCl) solution?

Solution:

$$\omega = \frac{m_{NaCl}}{m_{solution}} \quad \Rightarrow \quad m_{NaCl} = \omega \cdot m_{solution} = 0{,}1 \cdot 200 = 20\ g$$

Answer: 20 g NaCl.

Problem 2

500 ml of solution contains HCl at a concentration of 2 mol/l. What is the mass of HCl in it? (Molar mass of HCl = 36,5 g/mol)

Solution:

$$C = \frac{n}{V} \quad \Rightarrow \quad n = C \cdot V = 2 \cdot 0{,}5 = 1\ mol$$

$$m = n \cdot M = 1 \cdot 36{,}5 = 36{,}5\ g$$

Answer: 36,5 g of HCl.

Problem 3

100 g solution 15% KNO_3 solution. What is the mass of water in the solution?

Solution:

If 15% KNO_3, the mass of the substance is:

$$m_{KNO_3} = \frac{15}{100} \cdot 100 = 15\ g$$

$$m_{water} = 100 - 15 = 85\ g$$

Answer: 85 g of water.

Recommendations and scientific and methodological conclusions

— Integration of the topic with physics, biology, and mathematics based on the **STEM** approach increases the student's interdisciplinary knowledge;

— Each theoretical part should include a corresponding **virtual practice** or **interactive task**;

— Using platforms that encourage students to **research independently** (Khan Academy, Coursera) increases motivation;

— It is recommended that at **least several digital tools** (simulation, test, video, spreadsheet) participate in a single lesson.

Conclusion. Teaching theoretical knowledge in chemistry, especially topics such as “Solution Concentration” using modern information technologies, significantly improves the quality of students' knowledge and practical skills. Simulations are an important tool for bringing theoretical concepts closer to practice, encouraging students to be active.

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