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TEACHING SUBJECT-RELATED COMPETENCIES TO STUDENTS IN SOLVING CHEMISTRY PROBLEMS

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Abstract
This article discusses the development of subject-related competencies in students during the solving of problems in chemistry lessons.

Keywords: Chemistry, competency, problem, method, tool.

Introduction

The globalization of education and the introduction of modern pedagogical and information technologies in the educational process are contributing to the improvement of the quality of education in educational institutions. It is known that any technology is based on principles that shape the new content of education. The active subjects of the modern educational process are teachers and students, whose collaborative activities enable the deep assimilation of theoretical and practical knowledge on a specific topic.

Literature Review

Education is one of the most complex activities in human life. The purpose of this activity is directly aimed at mastering certain information, actions, and behavioral patterns. Education consists of the following [1]:
– Acquisition of information about significant properties of the external world necessary for the successful organization of a particular type of ideal and practical activity (knowledge);
– Mastery of ways to correctly select methods and processes that correspond to the set task and proposed goal, as well as using the given information for control (skills);

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– Acquisition of methods and processes that make up all these types of activities (competence).

In nurturing these qualities in students, along with imparting subject-related knowledge, skills, and abilities during lessons, it is also necessary to form competencies.

Competency-based education aims to develop competencies that allow students to apply the knowledge, skills, and abilities they have acquired in their personal, professional, and social activities.

Competency-based education helps students develop independence, an active civic position, initiative, the ability to use media resources and information-communication technologies wisely in their activities, conscious career choice, healthy competition, and universal cultural skills.

RESEARCH METHODOLOGY AND EMPIRICAL ANALYSIS

For students to independently solve chemical problems and exercises, the knowledge they have acquired from mathematics, geometry, physics, biology, and other subjects is important. When organizing the teaching of chemistry in schools and academic lyceums, it is necessary to consider the requirements set by the State Educational Standard (SES) as well as the ability of students to successfully complete test problems and exercises used during university entrance examinations.

Based on the above considerations, we will present usual and unusual chemical problems and methods of solving them.

Problem 1:

Given:

When 10 mol of $Zn(NO_3)_2$ dissociates in water, 16 mol of NO_3^- ions are formed.

Find: The degree of dissociation (α).

Solution:

1. Write the dissociation equation of $Zn(NO_3)_2$:

   $Zn(NO_3)_2 \leftrightarrow Zn^{2+} + 2NO_3^-$

   From this, 1 mol of $Zn(NO_3)_2$ produces 2 mol of NO_3^- ions.

2. Set up the proportion based on nitrate ions:

   1 mol $Zn(NO_3)_2 \rightarrow$ 2 mol NO_3^-

   x mol $Zn(NO_3)_2 \rightarrow$ 16 mol NO_3^-

   Calculate x:

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$x = (16 \text{ mol } NO_3^-) / 2 = 8 \text{ mol } Zn(NO_3)_2$

3. Calculate the degree of dissociation:

10 mol $Zn(NO_3)_2$ corresponds to 100%, so 8 mol corresponds to:

$\alpha = 8/10 \times 100\% = 80\%$

Answer: The degree of dissociation is 80%, meaning 80% of the zinc nitrate has dissociated.

Alternative Interpretation Using a Graph:

If the problem is presented graphically, the student should analyze the data logically. Given the starting amount of $Zn(NO_3)_2$ (10 mol) and the produced nitrate ions (16 mol), the dissociated amount of $Zn(NO_3)_2$ can be found similarly and degree of dissociation calculated as above.

Problem 2:

Task:

Based on the given Venn diagram, identify the unique and common properties of the substances shown.

Solution:

- The first circle represents sulfur(IV) oxide (SO_2).
- The second circle represents carbon(IV) oxide (CO_2).
- The overlapping area represents properties common to both oxides.

Multiple-choice options are given where properties include: combustion in oxygen, formation during burning of glycine or cysteine, oxidation states (+4), molecular structure, physical state, and presence of metal atoms.

Approach:

- The student must have sufficient theoretical knowledge about these oxides and their properties.
- Then match the properties to the correct substance and their intersection as depicted in the Venn diagram.

Conclusion and Discussion:

- The problem-solving methods remain the same, but presenting problems in various forms strengthens students' theoretical knowledge.
- Using unconventional problems and exercises helps increase logical reasoning and develop competencies.
- It also creates opportunities to connect knowledge from other subjects (e.g., math, physics) with chemistry.

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