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THE USE OF PISA RESEARCH IN ADDRESSING CHEMICAL PROBLEMS AND EXERCISES

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Abstract: This article presents methodological recommendations and examples for utilizing the Programmed for International Student Assessment (PISA) methodology in evaluating students' knowledge while they solve chemical problems. It also provides insights into the application of PISA research in teaching chemistry in general education schools, focusing on the development of competencies related to science and practical applications in everyday life.
Keywords: Chemical education, PISA research, competence, water, salt, chemical problems, exercises, chemical calculations.

In accordance with the Decree of the President of the Republic of Uzbekistan No. PF-5712 dated April 29, 2019, "On the Approval of the Concept for the Development of the Public Education System of the Republic of Uzbekistan until 2030," general and extracurricular education is aimed at defining priority areas for reforming this sphere, raising the spiritual, moral, and intellectual development of the younger generation to a new qualitative level, and organizing education through upbringing based on innovative approaches.

The use of PISA research in teaching chemistry should prepare students to apply this science in solving problematic situations that arise in everyday life. Instead of typical educational tasks, students are encouraged to use real problematic situations and tasks related to chemistry.

The context of a chemical problem refers to the specific elements and characteristics of the surrounding environment that are relevant to the situation. In PISA research, everyday situations encountered by students (such as social interactions, sports activities, shopping, leisure, and household tasks) are examined in a realistic manner to illustrate the practical applications of chemistry.

PISA research can be applied to solving chemical problems, as demonstrated by the following example:

"Pine Groves in Our Cities"

We often encounter pine groves in our cities, especially around medical facilities. In the air of these groves and forests, a gas accumulates that is beneficial for patients with tuberculosis (inhalation of this gas significantly speeds up recovery). If 4.48 liters of this gas react with a silver earring, the earring turns into a black compound. What is the chemical composition of the black compound?"

This example illustrates how real-world situations can be used to engage students in practical chemical problem-solving exercises, aligning with the approach of PISA research.

PISA Tasks:

1. Which gas was released?
   A) Ozone
   B) Oxygen

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C) Atomic oxygen

2. Why did patients recover when inhaling this gas?
   A) Because it is essential for human health.
   B) Due to its impact on the human body during tuberculosis.
   C) Because of the presence of ozone in the air.
3. What is the black compound?
4. How many distinct black compounds were formed as a result of the reaction?

Evaluation criteria:

1) It was discovered that juniper emits gaseous ozone (O_3) into the air.
2) Gaseous ozone is unstable and decomposes into molecular and atomic oxygen. When inhaled, air mixed with ozone quickly cures the disease due to the action of atomic oxygen.
3) A silver earring oxidizes due to the attachment of ozone in the air.
   $2O_3 + 2Ag = (Ag^{I}Ag^{III})O_2 + 2O_2$
4) 24.8 grams

"The Inflation of a Child's Balloon"

In the experiment, a child's balloon is to be inflated with gaseous hydrogen, a gas generated through the reaction of concentrated hydrochloric acid (HCl) and zinc (Zn) in a champagne bottle. Despite hydrogen's significantly lower density compared to air, at 14.5 times lighter, the question arises whether the balloon will ascend as expected.

PISA Tasks:

Group 1 Task: Why does the ball not rise?
Group 2 Task: How does HCl affect Zn?
Group 3 Task: Hydrogen, which is 14.5 times lighter than air, is how many times lighter than oxygen and carbon dioxide?

Evaluation Criteria:

1. Solution: A vigorous reaction occurs between concentrated HCl and Zn, resulting in the release of a large amount of heat with hydrogen. As a result, HCl and water evaporate and mix with hydrogen. This mixture makes the balloon heavier than air, causing it not to rise. If the H, coming out of Zn in diluted HCl, is filtered through cotton, the balloon will rise.
2. Solution: $Zn+2HCl=ZnCl_2+H_2$
3. Solution: Hydrogen is 8 times lighter than oxygen and 22 times lighter than CO_2.

In conclusion, directing students to study PISA through the solving of chemical problems and exercises will facilitate a comprehensive advancement of practical chemistry. It will also promote the application of contemporary scientific advancements in industry and various sectors of the economy. This approach will significantly broaden avenues for increasing national wealth and fostering innovative developments. To realize this goal, the primary objective is to cultivate the aforementioned competencies within the school chemistry curriculum. This includes enhancing students' interest in science, organizing excursions to chemical plants and facilities, introducing more cost-effective, practical, and environmentally

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friendly synthetic materials, as well as developing eco-conscious mineral fertilizers and plant protection methods.
Therefore, to comprehend the chemical processes occurring in nature, grasp the scientific principles of modern production, and develop a polytechnic worldview, it is imperative to first master the fundamental and scientific tenets of chemistry.

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