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STUDYING THE COURSE OF PHYSICAL CHEMISTRY BASED ON CHEMICAL THERMODYNAMICS AS A SYSTEMIC FACTOR

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ANNOTATION

The article developed the construction of the content and organization of teaching physical chemistry, students of natural science chemical specialties of universities on the basis of chemical thermodynamics, as a system-forming factor.

Keywords: chemical thermodynamics, heat, internal energy, enthalpy, maximum work of an ideal gas, gas expansion.

INTRODUCTION

Higher education is aimed at training specialists of a wide profile, capable of constant creative search and acquisition of new knowledge. The main goal of teaching chemistry is to create a solid foundation of theoretical knowledge in general chemistry, which is necessary for the successful study of other chemical disciplines provided for by the curriculum of the relevant specializations (physical, analytical, colloidal, organic chemistry, etc.), as well as a number of academic disciplines related to chemistry (hydrology, meteorology, crystallography, ecology, biochemistry, biophysics, etc.)

Formation of students' methods of scientific thinking to replenish and apply knowledge in solving research problems.

In the current practice of teaching, the course of practical classes in physical chemistry is built linearly. In a similarly structured course, individual topics form a continuous sequence of topics (chemical thermodynamics, kinetics, equilibrium in solutions of non-electrolytes and electrolytes, etc.), worked out once during the training. With such a structure of presentation, knowledge not properly acquired by students in previous classes cannot be fully used in the study of subsequent topics, which means that the effectiveness of learning decreases. In the study of each subsequent topic, students should actively draw on previously acquired knowledge. However, this does not happen for the reason described above, and also because of the low motivation of students to study the course of physical chemistry. A negative role is also played by the small connectedness of the topics of practical classes. Often the sequence of topics is historically established or arbitrarily chosen by the university. Teachers often do not fully explain to students the goals of studying chemistry in natural science departments and do not show the prospects for studying chemistry.

As a result, students' knowledge of chemistry becomes formal. This is manifested in the fact that: knowledge is formed by memorizing material without understanding its application; there is no correlation of the acquired knowledge with previous ideas and concepts.

Thermodynamics is one of the fundamental sections of the physical chemistry course at the university. Energy changes are the inner essence of chemical processes, allowing a deeper understanding of the pattern of their course.

In this regard, it seems relevant to develop a methodology for conducting practical classes in physical chemistry based on chemical thermodynamics as a system-forming factor.

The main idea of the work is to rethink the content of the course of practical classes in physical chemistry and to develop a new methodological approach to teaching physical chemistry based on chemical thermodynamics as a system-forming factor.

The purpose of this study is to develop the construction of the content and organization of teaching physical chemistry to students of natural science chemical specialties of universities based on chemical thermodynamics as a system-forming factor.

The laws of thermodynamics are empirical, i.e. established by summarizing the experimental data. Originally formulated to describe the operation of heat engines in the middle of the 19th century. Subsequently, their universality was established.

Chemical thermodynamics is a branch of chemistry that studies the energy of chemical reactions, as well as the factors and criteria that determine the direction and completeness of the reaction.

The first law of thermodynamics is a frequent case of one of the most important laws of natural science - the law of conservation and transformation of energy. In relation to the description of the operation of heat engines, he argues that it is impossible to create a heat engine that performs mechanical work without heat consumption. Such a heat engine was called a perpetual motion machine of the 1st kind.

General scientific formulation of the first law of thermodynamics:

The heat absorbed by the system is spent on changing the internal energy and doing work by the system:

$\delta Q = dU + \delta A$

If the only kind of work is the work of expansion forces, then

$\delta Q = dU + PdV$

The most important consequence of the first law of thermodynamics is the Hess law, which makes it possible to calculate the thermal effects of chemical reactions.

Object and methods of research: the process of teaching physical chemistry at the natural science faculties of universities. Practical lessons in physical chemistry based on thermodynamics as a backbone factor.

Results and their discussion: The paper presents logical questions and examples for problems in chemical thermodynamics. These tasks are complex and allow students to prepare for chemistry olympiads. Solving problems makes it possible to apply theoretical knowledge in practice, expand, deepen and systematize them, stimulate the mental activity of students, develop consistency in actions, logic.

1. Questions on the topic "Chemical thermodynamics"

1) What is thermodynamics and what phenomena does it study?
2) Give several formulations of the first law of thermodynamics and show that they do not contradict each other. Why is the first law of thermodynamics called the first law?
3) What is a system? What are its types?
4) Define and give examples of thermodynamic processes: isothermal, isobaric, isochoric and adiabatic.
5) What is the internal energy of the system and what does it consist of?
6) Give the definition of an ideal gas. What is the internal energy of an ideal gas?
7) Why does thermodynamics consider not the absolute value of internal energy, but only its change?
8) What is enthalpy and what is its relationship with internal energy? Why is the difference between enthalpy and internal energy small for condensed systems, but significant for gaseous systems?
9) List the ways of transferring energy from one system to another.
10) What is heat and work?
11) Give the definition of heat capacity specific, atomic, molar (molar)? What is the relationship between molar heat capacities at constant pressure and constant volume?
12) Work is determined by two quantities: the factor of intensity and the factor of capacity (extensity). What will these factors be in the performance of mechanical work, electrical work and the work of expanding gases?
13) What is the maximum work of expansion of an ideal gas? Why doesn't a gas do any work when it expands in a vacuum?
14) Write the equations expressing the maximum work of expansion of an ideal gas in isothermal, isobaric, isochoric and adiabatic processes.
15) Define reversible and irreversible thermodynamic processes. Give examples. Can real natural processes be considered completely reversible?

table

Questions	**Answers**

Students can answer questions in writing or orally (table).

2. Problems in chemical thermodynamics

Example 1. Gas expanding from 10 to 16 liters at a constant pressure of 101.3 103 N/m2 absorbs 126 J of heat. Determine the change in the internal energy of the gas.

Solution:

p1 = p2 = 101.3 103 Pa, V1 = 10 l = 1 10-2 m3,
V2 \u003d 16 l \u003d 16 10-3 m3,
Qp = 126 J.

According to the first law of thermodynamics

□U = Qp-W

The work done by a gas during isobaric expansion can be calculated by the equation:

W=p(V2–V1);

From here:

□U = Qp-p(V2–V1);

□U = 126-101.3 103 (1 10-2 - 16 10-3) = 481.8 J

Answer: 481.8 J

Example 2. Calculate the work of isothermal (27□C) expansion of 1 mole of carbon dioxide from 2.24 to 22.4 liters.

Solution:

n = 1 mol, V1 = 2.24l = 2.24 10-3 m3, V2 = 22.4 10-3 m3, T = 27□C = 300 K

The work of isothermal expansion of the system can be calculated by the equation:

W = nRT 2.3 log(V2 /V1);

W = 1 8.314 300 2.3 lg (22.4 10-3 / 2.24 10-3) = 5736.66 J

Answer: 5736.66 J

Example 3. At 273 K and 1.0133 105 Pa, 5 10-3 m3 of krypton are heated to 873 K at constant volume. Determine the final pressure of the gas and the heat spent on heating.

Solution:

V = 5 10-3 m3, T1 = 273 K, T2 = 873 K, p1 = 1.0133 105 Pa.

The heat spent on heating can be found by the formula:

Qv = nCv(T2 – T1).

The amount of krypton is calculated from the ideal gas equation of state:

pV=nRT; n = p1V/RT1;

n \u003d 1.0133 105 5 10-3 / 8.314 273 \u003d 0.223 mol.

For monatomic gases Cv = 3/2R;

Qv \u003d 0.223 3 / 2 8.314 (873 - 273) \u003d 1668.620 J

The final pressure at constant volume and known temperature can be found using Charles' law:

p1/T1 = p2/T2;

p2 = p1T2/T1;

p2 = 1.0133 105 873/273 = 3.2403 105 Pa

Answer: Qv= 1668.620 J, p2= 3.2403 105 Pa

Example 4. One mole of a monatomic gas taken at 25°C and a pressure of 1.013 105 Pa expanded adiabatically to 0.05 m3. What will be the final pressure and temperature?

Solution:

T1 = 25□C = 298 K, P1 = 1.013□105 Pa, V2 = 0.05 m3.

Initial gas volume (n = 1):

V1 = nRT1/p1 = 1 8.314 298/1.013 105 = 2.445 10-2 m3.

The final pressure and temperature can be found from the adiabatic equation (□ = Cp/Cv for monatomic gases is close to 5/3):

p1V15/3 = p2V25/3,

p2 = p1(V1/ V2)5/3, p2 = 1.013 105 (2.445 10-2/5.000 10-2)5/3 Pa = 0.3 105 Pa

T1V1-1 = T2V2-1, T2 = T1 (V1/ V2)□-1,

T2 = 298 (2.445 10-2/5.000 10-2)5/3 – 1K = 183 K

Answer: p2 \u003d 0.3 105 Pa, T2 \u003d 183 K.

Conclusion: The proposed methodological approach to the creation and use of a system of practical classes in physical chemistry makes it possible to apply it when teaching chemistry at a university. The results are due to the choice of adequate modern research methods, positive values of the effectiveness indicators of the developed approach to teaching physical chemistry.

REFERENCES

1. G.S. Karetnikov, I.V. Kudryashov. Collection of examples and problems in physical chemistry. - M: Higher School, 1991
2. V.V. Eremin, S.I. Kargov, I.A. Uspenskaya, N.E. Kuzmenko, V.V. Lunin. Fundamentals of physical chemistry. Theories and tasks. - M: Exam, 2005.