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THE IMPORTANCE OF TEACHING THE SECTION "FUNDAMENTALS OF MOLECULAR PHYSICS AND THERMODYNAMICS" IN ACADEMIC LYCEUMS

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ABSTRACT: The article gives an idea of the methods used in teaching the section "Fundamentals of molecular Physics and thermodynamics" in academic lyceums. The article also deals with the teaching of statistical laws in conjunction with the laws of classical mechanics in the study of thermal phenomena. Knowledge of the functions of various states of the system is studied through the concept of internal energy.

KEYWORDS: Thermal phenomena, thermodynamic equilibrium, reversible and irreversible processes, ideal and real models, new pedagogical technologies.

INTRODUCTION

In academic lyceums, the "Fundamentals of Molecular Physics and Thermodynamics" section is also taught as a physics section. One of the main tasks of teaching this section is to increase students' knowledge about the composition and structure of matter, thermal phenomena, consolidate basic knowledge on this section obtained during the nine-year period of study at school, and teach them how to implement them in practice.

During the study of this section of physics, students first get an initial idea of the atom-molecule, and at the next stage they study molecular physics and thermal phenomena, the sizes of molecules depending on their interaction and movement, and using the concepts of "internal energy", "amount of heat", "temperature", as well as the law of conservation and transformation energy in the thermal process, they get an idea of the scientific basis for the transition of the aggregate state of matter from one type of state to the second.

In this section, students learn in detail the basics of molecular kinetic theory, concepts of thermal phenomena, the structure of matter based on the concepts of molecules and their interaction and motion, as well as elements of thermodynamics through the concepts of thermal phenomena.

It is worthnoting that since the concept of "thermal phenomena" is the most fundamental concept in the study of this section, the adoption of molecular-kinetic and thermodynamic methods through thermal phenomena will attract students to a deeper study of the educational material. At the same time, students will learn that there are different methods in science for studying physical phenomena. Therefore, it is necessary to show them the degree of studying the laws of nature by physical methods.

THE MAIN PART

Physics is a natural science that studies the microcosm. But since microparticles and macrobodies are located in quantitative dependence on each other, the molecule cannot be considered directly. However, using different physical models and experimental facts, different scientists discover common patterns of thermal phenomena.

Studying both thermal phenomena and microscopic states in a physics course from a microscopic point of view allows students to familiarize themselves with the fundamental essence of physical phenomena using the example of the laws of classical mechanics, comparing them with new statistical laws and, in particular, with dynamic laws. Thus, new advanced knowledge about the phenomena and laws of nature is constantly being formed in the minds of students.

Along with studying the elements of thermodynamics, students get an idea of the thermodynamic state of the thermal system, its state parameters.

In most cases, only equilibrium states are observed in thermodynamics. For example, in the entire state system, its parameters [P, V, T] do not change over time or change very slowly. The Mendeleev-Clapeyron ideal gas equation of state [$PV = \frac{m}{\mu} RT$] is also relevant only in the equilibrium state of the system. The concept of thermal equilibrium allows us to learn the thermodynamic and molecular-kinetic explanation of temperature and how it changes.

Two empirical laws of thermodynamics are used in the microscopic study of thermal phenomena. The first law of thermodynamics manifests itself in the law of conservation and transformation of energy in thermal processes. From it, you can see two forms of energy transfer (due to heat transfer and performing work on the body). This state opens up to students the process of learning various functions of the state of the system using the concept of internal energy.

To change the state of a system, the first law of thermodynamics is expressed as follows $\Delta U = A^1 + Q$. From this it can be seen that the change in internal energy in a thermodynamic system is equal to the sum of the work of the external forces of the system and the amount of heat transferred to the system Q.

If $A^1 = 0$ and $Q = 0$, then $\Delta U = 0$ and $\Delta U = const$, in an isolated thermodynamic system, the internal energy remains unchanged, constant. These two states are the original expressions of thermodynamics.

In some literature, the first law of thermodynamics is written as

$$Q = \Delta U + A$$

In these cases, it can be defined as follows: the amount of heat supplied to the system is equal to the sum of changes in internal energy due to the work that the system performs against external forces.

Currently, the program created for academic lyceums considers teaching the Second Law of Thermodynamics, a law that is of great importance in the scientific knowledge of the universe and is the law of changing physical processes in various manifestations of energy.

The relevance of teaching this law lies in the fact that it allows you to get acquainted with at least the definition that may be in the plan. Heat cannot spontaneously transfer from a body with a low temperature to a body with a high temperature (Clausius' definition); it is impossible to create a

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perpetual motion machine (Thomson's definition); such a thermodynamic process would be the only result of cooling bodies due to thermal changes.

Later, specific examples should be used to explain thermal, reversible, and irreversible processes to students. For example, during operation, only part of the energy of heat engines is spent on useful work, and the other part is given to cooling. This part of the energy will be a loss for the engine, but without this energy, it will not work.

When disclosing the essence of the laws of thermodynamics to students, it is also necessary to indicate the scope of their application. We know that the law of conservation of energy is relevant for all events in the micro-and macrocosm.

The section "Fundamentals of molecular physics and thermodynamics" opens a great way to the formation of a dialectical-materialistic worldview of students. By studying them, they are convinced of the materiality of the universe.

In the study of molecular physics, model representations and material models of gas, solid, and liquid are widely used. These models abstract away third-party aspects of the phenomenon that are not important for this problem. In the kinetic theory of gases, the molecules of an ideal gas are considered as material points. Collisions of molecules with each other and with the vessel walls are assumed to be elastic.

Model experiments are known to demonstrate the random motion of gas molecules, the dependence of the intensity of their motion on temperature, gas pressure on the vessel wall, gas heating during compression, Brownian motion, and other phenomena.

Magnetic beads placed in a mold can be used as a model of a liquid in which the interaction force between molecules is manifested. As a model of the crystal, tightly packed balls are taken, the accumulation of which can be depicted using a large number of steel balls collected on a flat surface, or bubbles flowing over a soap solution. In all these models, a molecule or atom is considered as balls.

The model of a molecule in the form of balls has a limit of application. These boundaries should be taken into account when studying the location of surfactant molecules at the water boundary, the polarization of molecules and the position of polar molecules in the electric field, and other issues.

In the practice of training, models of crystals are drawn in which atoms or ions are shown as balls of smaller diameter than the distance between their centers. This is wrong. In these models, the balls do not represent either the atomic nuclei that make up the crystal or the particles themselves. Because in fact, the particles touch each other or cover each other. The spatial grid gives an idea of the order of arrangement of particles in crystals. Lattice nodes – are the medium in which particles in a crystal perform vibrational motion near this state. The relative sizes of particles and their relative positions are determined using dense particle location models. We recommend using them in conjunction with spatial grid models.

The concept of the minimum potential energy of a moleculeл Eo allows us to explain the difference in the aggregate states of matter. If $kT > Eeo$, then the force of interaction between the molecules cannot hold them together, and they disperse. This condition corresponds to the gaseous state of the substance. If $EEo > kT$, then the force of interaction of the molecules will be

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greater. These forces counteract the scattering of molecules in all directions. Accordingly, the molecules are in vibrational motion around a certain state of equilibrium, as occurs, for example, in a solid (crystal). During the thermal vibrational motion of particles in the nodes of the crystal lattice, the directions, amplitudes, and phases of the particles do not depend on each other and change irregularly.

Teaching the section “Fundamentals of molecular Physics and Thermodynamics” allows students to apply their knowledge in modern engineering and production. Molecular physics manifests itself in the scientific basis of the materialistic view, whereas thermodynamics manifests itself in heat engineering. Therefore, the scientific achievements made in the field of molecular physics make it possible to create more and more new materials necessary for the national economy. And the ability to apply the laws of thermodynamics allows you to increase the efficiency of heat engines, reduce energy consumption in technological processes and perform other work.

CONCLUSION

In conclusion, we can say that this section of physics, which we have considered, is one of the relatively difficult ones to teach. These difficulties can be alleviated through the use of modern information tools, new pedagogical technologies, and the development of new learning styles.

The analysis of model representations that we see in the study of molecular physics has a didactic meaning and is intended for teachers. Conclusions from this analysis should be used in teaching practice.

Teaching using different models makes it easier for students to gain interest in studying molecular physics and thermodynamics, as well as learning difficulties.

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