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METHODOLOGY OF PRACTICAL LESSONS IN PHYSICS TO STUDENTS OF TECHNICAL HIGHER EDUCATION INSTITUTIONS ON THE BASE OF SCIENTIFIC AND EDUCATIONAL METHODS

Ismailov Davron Makhmadalievich
Docent of the "Physics and Electronics"
Department of Karshi Engineering Economics Institute (PhD)

The system of scientific knowledge, the system of scientific and educational methods of knowledge forms a dialectical common unity, that is, in the future engineer, the method forms a system of scientific and educational knowledge, the results of knowledge are used as a means of knowledge, that is, the theory becomes a method. In the study of physical systems, including thermodynamic systems, a set of empirical, theoretical and general knowledge methods is used.

General logical methods include analysis and synthesis, generalization methods, abstraction, deduction and induction methods. Empirical methods include observational methods, experimental-testing methods, for example, calorimetric method, measurements, that is, methods that ensure the transfer of physical experimental and observational data to their quantitative description.

The following tasks are solved in the course of practical exercises in physics:

1) To determine the place of the structure of the foundations of thermodynamics as a system of laws of physics and proven scientific knowledge;

2)To reveal the logical interconnections of the elements of the foundations of thermodynamics as a fundamental physical theory;

3)To determine the logical difference between empirical and theoretical thermodynamic laws;

4) Show the characteristics of models of thermodynamic systems used by students in professional activities.

Before the practical training in physics, the academic group is divided into three subgroups (expert groups): "statistical physics", "thermodynamics" and "independent experts".

Molecular physics studies the structure and properties of matter based on molecular-kinetic concepts. According to these concepts, any solid, liquid or gaseous body consists of small individual particles - molecules. The molecules of any substance are in a disordered state that does not have a clear direction. The speed of this movement depends on the temperature of the substance [2].

The goal of the molecular-kinetic theory is to interpret the properties of bodies observed in direct experience as a general result of the action of molecules. In this

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case, this theory uses a statistical method, dealing not with the movement of individual molecules, but only with average quantities that describe the movement of a very large set of particles. Therefore, the molecular-kinetic theory is also called statistical physics [2].

In general, based on the above-mentioned points, the methods of knowing through reading are the main goal of achieving an empirical basis, a theoretical core, and a dialectical result. If the implementation of actions such as conducting experiments, observation, and synthesis, formalization, and modeling in practical training form an empirical basis, moving from it to the theoretical core involves applying the laws of physics instead. Achieving a dialectical result implies the development of the necessary professional competencies of future engineers through interdisciplinary integrated education [3].

Here are some solutions to molecular physics and thermodynamics:

1. A cylinder with a capacity of 12 liters is filled with nitrogen at $8.1 \cdot 10^6 \frac{N}{m^2}$ pressure and $17^0 C$ temperature. How much nitrogen is in the cylinder?

Given: $V = 12l = 12 \cdot 10^{-3} m^3$, $P = 8.1 \cdot 10^6 Pa$, $T = 273 + 17 = 290K$, $M_{azot} = 28 \cdot 10^{-3} \frac{kg}{mol}$, Must find $m = ?$

Solution: According to the Mendeleev-Klaneyron equation, the mass of nitrogen is $PV = \frac{m}{\mu} RT$, where we calculate $m = \frac{PV\mu}{RT}$. Answer: $m = 1.13kg$

2. If the average quadratic speed of a hydrogen molecule at a pressure of $p = 200\ mm\,simust$ is equal to $2400 m/s$, find the number of hydrogen molecules.

Given: $P = 266.6Pa$, $\vartheta_{kv} = 2{,}4 \cdot 10^3 \frac{m}{s}$. $\mu = 2 \cdot 10^{-3} \frac{kg}{mol}$, Must find: $n = ?$

Solution: From equality of $P = nkT$, $k = \frac{R}{N_A}$: $P = n\frac{R}{N_A}T$, here $n = \frac{PN_A}{RT}$.

If we square $\vartheta_{kv} = \sqrt{\frac{3RT}{\mu}}$ on the other side, $\vartheta_{kv}^2 = \frac{3RT}{\mu}$ is obtained, and if we calculate $RT = \frac{\vartheta_{kv}^2 \mu}{3}$ $n = \frac{3PN_A}{\vartheta_{kv}^2 \mu}$ using the formula, $n = 4.2 \cdot 10^{24} m^3$ comes out.

3. A closed container with a capacity of $1m^3$ contains 0.9 kg of water and 1.6 kg of oxygen. If it is known that water turns completely into steam at a temperature of $500^0 C$, what is the pressure in the container at this temperature?

Given: $V = 1\, m^3$, $m_1 = 1.6\, kg$, $m_2 = 0.9\, kg$, $t = 500^0 C \Rightarrow T = 273 + 500 = 773K$.

Must find $P = ?$

Solution: According to Dalton's law $P = P_1 + P_2$ (a) where P_1 is the normal pressure of oxygen $\left(\mu_1 = 32 \cdot 10^{-3} \frac{kg}{mol}\right)$, P_2 is the normal pressure of water vapor $\left(\mu_2 = 18 \cdot 10^{-3} \frac{kg}{mol}\right)$ is expressed as follows: $P_1 = \frac{m_1 RT}{\mu_1 V}$, $P_2 = \frac{m_2 RT}{\mu_1 V}$ (b). According to (a) from (b) $P = P_1 + P_2 = \frac{m_1 RT}{\mu_1 V} + \frac{m_2 RT}{\mu_2 V} = \frac{RT}{V}\left(\frac{m_1}{\mu_1} + \frac{m_2}{\mu_2}\right)$ and comes $P = 640 \cdot 10^3 \, Pa$.

Quantitative relationships between physical quantities can be studied in the laboratory, and regularities, including the theoretical core, can be determined. Based on these laws, a general theory of physical phenomena and processes develops. Therefore, it is impossible to effectively teach physics without a laboratory. Teaching physics only verbally inevitably leads to formalism and mechanical memorization.

Observing and conducting experiments in physics reflect the emotional and emotional forms of scientific knowledge of reality. However, empirical scientific knowledge is inextricably linked with theoretical scientific knowledge. As a result of empirical and theoretical scientific knowledge, the student experiences objective reality in the form of physical concepts, laws, theories, etc. [5].

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