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Methodology of Conducting Physics Laboratory and Practical Courses to Students of Technical Higher Education Institutions

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Abstract: Higher Education Institution is aimed at forming a system of scientific knowledge, skills and their use in future engineers, which allows students not only to apply the acquired knowledge in practice, but also to acquire scientific methods of scientific knowledge, for example, experiment, practical or laboratory, independently acquire new knowledge, process and allows storage

Keywords: engineers, laboratory

The general physics course at the Technical Higher Education Institution is aimed at forming a system of scientific knowledge, skills and their use in future engineers, which allows students not only to apply the acquired knowledge in practice, but also to acquire scientific methods of scientific knowledge, for example, experiment, practical or laboratory, independently acquire new knowledge, process and allows storage [1]. It is in physical education that the future engineer's preparation for professional activity is based on conducting experiments using scientific methods of scientific knowledge in laboratory and practical production conditions[1].

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[2].

Here are some solutions to molecular physics and thermodynamics:

1. Find the specific heat capacity of oxygen when 1) $V = const$ and 2) $P = const$

For oxygen, it is necessary to find the specific heat capacity C for a) $V = const$ and b) $P = const$ cases.

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Solution: For the case $V = const$, $C_v = \frac{i}{2}R$, here for i=5 $C_v = \frac{5}{2}\cdot 8.31 = 2.5\cdot 8.31 = 20.8\frac{J}{mol\cdot K}$, $C = \mu c$, or because of $c = \frac{C}{\mu}$: $C_v = \frac{c_v}{\mu} = \frac{20.8}{32\cdot 10^{-3}} = 650\frac{J}{kg\cdot K}$. It is calculated in the same way: $C_p = C_v + R$ or $C_p = \frac{C_v\mu + R}{\mu} = 910\frac{J}{kg\cdot K}$.

2. Hydrogen $6.5\ g$ with a temperature of $27^0 C$ at a pressure of $P = const$ has expanded twice due to the external heat. Find 1) the work of gas expansion, 2) the change in the internal energy of the gas, 3) the amount of heat transferred to the gas.

Given: $m = 6.5\cdot 10^{-3} kg$, $T = 700K$, $V_2 = 2V$, $P = const$

Must find $A = ?$, $\Delta W = ?$, $Q = ?$.

Solution: First we find A as follows: $dA = PdV$ or if we integrate, $A = \int_V^{2V} PdV = P(2V - V) = PV$. According to the equation of state $PV = \frac{m}{\mu}RT$ $A = \frac{m}{\mu}RT = \frac{6.5\cdot 10^{-3}}{2\cdot 10^{-3}} 8.31\cdot 300 = 8.1kJ$, now we write the following for the internal energy change: $\Delta W = \frac{i}{2}\frac{m}{\mu}R\Delta T$ (a). Here i = 5 and because of $P = const$, for $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ *yoki* $\frac{V_2}{T_1} = \frac{T_2}{T_1} = 2$, $T_2 = 2T_1$ and $\Delta T = T_2 - T_1 = 2T_1 - T_1 = T_1$ then from (a) $\Delta W = \frac{5}{2}\frac{m}{\mu}RT_1$.

We count: $\Delta W = 2.5\cdot \frac{6.5\cdot 10^{-3}}{2\cdot 10^{-3}} 8.31\cdot 300 = 2.5\cdot 8.1\cdot 10^3 = 20.25kJ$ and finally $Q = \Delta W + A = 20.25\cdot 10^3 + 8.1\cdot 10^3 = 28.35\cdot 10^3 J$.

3. An ideal heat engine operating on the Carnot cycle does $7.35\cdot 10^{-3}$ J work in each cycle. The temperature of the heater is $100^0 C$, the temperature of the cooler is $0^0 C$ 1) Find the useful efficiency of the machine, 2) the amount of heat the machine receives from the heater in one cycle, 3) the amount of heat it gives to the cooler in one cycle.

Given: $A = 73.5\cdot 10^3 J$ $T_1 = 373K$, $T_2 = 273K$

Must find: $\eta = ?$, $Q_1 = ?$, $Q_2 = ?$

Solution: $\eta = \frac{T_1 - T_2}{T_1}$ here $\eta = \frac{373 - 273}{373}\cdot 100\% = 26.8\%$. Secondly: $\eta = \frac{A}{Q_1}$,

$$Q_1 = \frac{A}{\eta} = \frac{73\cdot 5\cdot 10^3}{0.268} = 274kJ.\ Q_2 = Q_1 - A = 274\cdot 10^3 - 75\cdot 5\cdot 10^3 = 200\ kJ.$$

Methods used in physics practical training: "Blitz - inquiry", "Discussion" and "Projecting" [3].
It is important to use interactive methods in practical training. These methods provide an

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opportunity to search by topic, text, section. Develops concepts such as systematic thinking, structuring, and analysis. First, students get acquainted with the requirements and rules of the method, and then in small groups they formalize the table of the method [4].

Students should understand and understand that the laws of physics are based on scientific evidence established through experience. Scientific evidence is gathered as a result of observation, that is, an empirical basis. But they should not be limited or restricted by these alone. This is the first step in learning by reading. Experimentation then leads to the development of concepts that give way to qualitative descriptions in numerical form. In the process of conducting an experiment, it is necessary to determine the quantitative connections between physical quantities in order to draw general conclusions from the observations, to determine the causes of the phenomenon. By identifying such a connection, a physical law is discovered. When a physical law is found, there is no need to conduct a physical experiment in each individual case, it is enough to perform the appropriate calculation [5].

Any scientific knowledge is the study of an object, phenomenon, process at an empirical and theoretical stage. From an epistemological point of view, performing laboratory work in physics corresponds to the empirical stage of scientific knowledge. In the process of doing laboratory work in physics, students encounter relevant real phenomena on the object of study based on the observation of physical laws and appropriate measurements [6].

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.

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