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"PHYSICAL EXPERIMENT IN TEACHING PHYSICS"

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The laws of physics are based on empirically established facts. And often the interpretation of the same facts changes in the course of the historical development of physics. Facts accumulate from observations. But at the same time it should not focus only on them. This is only the first step to knowledge. Then the experiment and the development of concepts come that allow qualitative characteristics in the form of numbers. Consequently, without experiment there is not, and cannot be, rational teaching of physics; one verbal teaching of physics inevitably leads to formalism and mechanical learning. The first thoughts of the teacher should be directed to the student seeing the experience and doing it himself, seeing the device in the teacher's hands and holding it in his own hands.

A demonstration experiment is one of the components of an educational physical experiment and is a reproduction of physical phenomena by a teacher on a demonstration table using special instruments. It refers to illustrative empirical teaching methods. [3]

The value of a demonstration physical experiment is that:

- students get acquainted with the experimental method of knowledge in physics, with the role of experiment in physical research (as a result, they form a scientific worldview);

- some experimental skills are formed in students: observe phenomena, put forward hypotheses, plan an experiment, analyze results, establish relationships between quantities, draw conclusions, etc.

The demonstration experiment, being a means of clarity, contributes to the organization of students' perception of educational material, its understanding and memorization; allows you to carry out polytechnic training of students; promotes increased interest in the study of physics and the creation of learning motivation. But when a teacher conducts a demonstration experiment, students only passively observe the experience conducted by the teacher, while they themselves do nothing with their own hands. Therefore, it is necessary to have an independent experiment of students in physics. This is achieved when students perform a laboratory physical experiment, when they assemble the facilities themselves, carry out measurements of physical quantities, and perform experiments. Laboratory classes arouse great interest among students, which is quite natural, since the student’s knowledge of the surrounding world takes place on the basis of his own experience and feelings. [4]

The importance of laboratory studies in physics lies in the fact that students form an idea of the role and place of an experiment in cognition. When students perform experiments, experimental skills are formed, which include both intellectual and practical skills. The first group includes the skills: to determine the purpose of the experiment, put forward hypotheses, select instruments, plan an experiment, calculate errors, analyze results, and issue a report on the work done. The second group includes skills: to assemble an experimental setup, observe, measure, experiment. In addition, the value of a laboratory experiment is that when it is performed, students develop important personal qualities such as accuracy in working with instruments; the observance of cleanliness and order in the workplace, in the records that are made during the experiment, organization, perseverance in obtaining a result. They form a certain culture of mental and physical labor. [5]

Frontal laboratory work is a type of practical work when all students in a class simultaneously perform the same type of experiment using the same equipment. Accordingly, in the office should be 15-20 sets of instruments for frontal laboratory work. The names of frontal laboratory work are given in the curriculum. There are many of them, they are provided for almost every topic of the physics course. Before carrying out the work, the teacher identifies the students' readiness to consciously do the work, determines its purpose together with them, and discusses the progress of the work, the rules for working with the instruments, methods for calculating measurement errors. Frontal laboratory works are not very complex in content, are closely related chronologically to the material under study and are designed, as a rule, for one lesson. Descriptions of laboratory work can be found in school textbooks on physics.

The physical workshop is conducted with the aim of repeating, deepening, expanding and generalizing the knowledge gained from various topics of the course in physics; development and improvement of experimental skills in students through the use of more sophisticated equipment, more complex experiment; the formation of their independence in solving problems associated with the experiment. The physical workshop is not related in time to the material under study, it is conducted, as a rule, at the end of the school year, sometimes at the end of the first and second half of the year and includes a series of experiments on a particular topic. Physical practical work students perform in a

group of 2-4 people on a variety of equipment; in the next classes, there is a change of work, which is done according to a specially drawn up schedule. Drawing up a schedule, take into account the number of students in the class, the number of practical work, the availability of equipment. For each job, the teacher must make a statement that should contain: name, purpose, list of instruments and equipment, a brief theory, a description of the instruments unknown to the student, a plan for completing the work. After the work, students should submit a report, which should contain: job name, work goal, instrument list, installation diagram or figure, work execution plan, results table, formulas from which values were calculated, measurement error calculations, and conclusions. [6]

Interesting experiments in physics can not only illustrate various physical processes, but also stimulate cognitive activity and the desire to learn. An interesting confirmation of the existence of inertia is an ordinary top. Each particle of the top moves in a circle in a plane perpendicular to the axis of rotation. According to the law of inertia, the particle at each moment of time tends to descend from the circle on a straight line tangent to the circle. But every tangent is located in the same plane as the circle itself; therefore, each particle tends to move so that all the time to remain in a plane perpendicular to the axis of rotation. It follows that all planes in the top are perpendicular to the axis of rotation, tend to maintain their position in space, and therefore the common perpendicular to them, i.e. the axis of rotation itself, also seeks to maintain its balance, the top seems to resist trying to overturn it. The more massive the top and the faster it rotates, the more stubbornly it counteracts the rollover. So in the laboratory, you can do the following experiment. Take a centrifugal machine and strengthen the disk on it (disk siren). Put a candle on the edge of the disk and cover it with a conical vessel to demonstrate the hydrostatic paradox. Secure the vessel to the disk with wire. Why does the candle flame deviate from the axis of rotation when the disk is rotated?

Answer: cold, denser air moves away from the axis of rotation, and warm, less dense, approaches, which explains the deflection of the flame.

The force of gravity with which the bodies are attracted to the Earth must be distinguished from the weight of the body. The concept of weight is widely used in everyday life. The weight of a body is the force with which a body, due to its attraction to the Earth, acts on a support or suspension. It is assumed that the body is motionless relative to the support or suspension. Let the body lie on a horizontal table fixed relative to the Earth. The reference system associated with the Earth will be considered inertial. The force with which the Earth or another planet acts on all bodies near its surface is called gravity. Gravity is directly proportional to body weight. Now it is clear to you why a body with a larger mass is heavier, because the Earth attracts it with greater force. Gravity acts on the body vertically downwards. The following experiments can be used to test the theory: Take a disk made of metal (plywood or plastic) with a diameter of 10 cm. Cut a piece of paper according to its size. In one hand, take a paper disk, and in the other metal (plywood or plastic) and allow them to fall freely from the same height. Why metal disc will fall faster than paper? Put the paper disk on the metal and let them fall freely. Why in this case they fall at the same time? [1]

Answer: Two forces act on each disk: the force of gravity and the force of air resistance. At the beginning of the motion, the resultant of these forces is directed downwards, more for a metal disk, so it will move with greater acceleration. But with increasing speed, the air resistance force will increase and become equal to gravity. As a result, both disks will move uniformly, but the metal disk will move with greater speed. (A similar situation occurs when the parachutist is in a state of free flight: jumping out of an airplane, he has a relatively low speed and then accelerates to about 50 m / s, these two forces are balanced and he falls at a constant speed).

In the second case, the air resistance will overcome only the metal disk, and the force of gravity gives the bodies equal accelerations regardless of their masses.

Take two sheets of paper of the same size and weight. Crumple one sheet. Simultaneously release the sheets from the same height. Why does the crumpled sheet fall faster?

Answer: A crumpled piece of paper falls faster, as it is affected by less air resistance.

Friction is a type of interaction between bodies. It occurs when two bodies come into contact. Friction, like all other types of interaction, obeys Newton's third law: if a friction force acts on one of the bodies, then the force of the same magnitude, but in the opposite direction, acts on the second body. The forces of friction, as well as the elastic forces, have an electromagnetic nature. They arise as a result of the interaction between atoms and molecules of contiguous bodies. Dry friction forces are the forces that arise when two solid bodies come into contact in the absence of a liquid or gaseous layer between them. They are always directed tangentially to touching surfaces. Dry friction that occurs when bodies are relatively at rest is called resting friction. The force of static friction is always equal in magnitude to the external force and directed in the opposite direction.

Here is an experience showing what happens if the action of the friction force is small. Take a silk thread. We tie its end to knots to any load and pull the second end of the thread. The knots will be untied. Or there is an even more difficult experience to explain. Take a ruler and place it horizontally on your index fingers. Slowly move your fingers to the center of the ruler. Why does the ruler move one by one, then by another finger? [2]

Answer: The force of pressure from the ruler to the fingers changes with movement. Thus, the friction force between the fingers and the ruler also changes. If one finger is closer to the center, then pressure acts more on it. Between it and the ruler, there is a large pressure force, so the second finger moves, and so on.

Already in the definition of physics as a science, there is a combination of both theoretical and practical parts in it. It is considered important that, in the process

of teaching physics, a teacher can demonstrate as fully as possible to his students the interrelation of these parts. After all, when students feel this relationship, they will be able to give the correct theoretical explanation to many processes occurring around them in everyday life, in nature. This may be an indicator of fairly complete ownership of the material. What forms of practical training can be offered in addition to the teacher's story? First of all, of course, students observe the demonstration of experiments conducted by the teacher in the classroom while explaining new material or repeating the lessons, one can also offer experiments conducted by the students themselves in the classroom during the lessons in the course of frontal laboratory work under the direct supervision of the teacher. [7]

You can also offer:

1) experiments conducted by the students themselves in the classroom during a physical workshop;

2) demonstration experiments conducted by students in response;

3) experiments conducted by students outside the school on the teacher's homework; 4) observations of short-term and long-term phenomena of nature, technology and life, conducted by students at home on the special assignments of the teacher.

Experience not only teaches, it fascinates the student, makes better understand the phenomenon that he demonstrates. After all, it is known that a person interested in the final result achieves success. So in this case, having interested the student, we will continue the craving for knowledge.

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ФУНДАМЕНТАЛЬНЫЕ СВОЙСТВА ЭЛЕКТРОПРОВОДНЫХ ТОРОИДАЛЬНЫХ ТОКОВЫХ СТРУКТУР.

Показано существование внешнего магнитного поля и структура внутреннего магнитного поля в тороидальных структурах с полоидальным током.

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Ключевые слова: торы, внешнее магнитное поле, удержание термоядерной плазмы.
Keywords: tori, external magnetic field, confinement of thermonuclear plasma.

16 января 2000 года сделано большое научное открытие - впервые в электродинамике численно рассчитано и экспериментально измерено внешнее магнитное поле (МП) электропроводных тороидальных структур с полоидальным током (Рис.1). Ранее, в классической электродинамике, это считалось невозможным. Историю открытия и его возможные последствия можно узнать на сайтах http://thermonuclear.narod.ru и http://thermonuclear.ru – там раскрыты все Ноу-хау. Стрелками, обозначенными **i,** показаны векторы элементов тока. Рассматривались торы с отношением R / r ≈ 1 и R / r ≈ 2. Результаты расчетов выведены в виде графиков Кантора. Линии на графиках показывают сечение поверхностей уровня равной напряженности МП. Графики – в условных единицах. Направление вектора напряженности МП – перпендикулярно к плоскости изображения, так как силовые линии МП имеют исключительно азимутальную (или тангенциальную или касательную к окружности, которая лежит в плоскости XY и с центром на оси Z) составляющую.

Вначале рассчитывалось МП внутри тора. Тор с отношением R / r ≈ 1 (Рис.1).

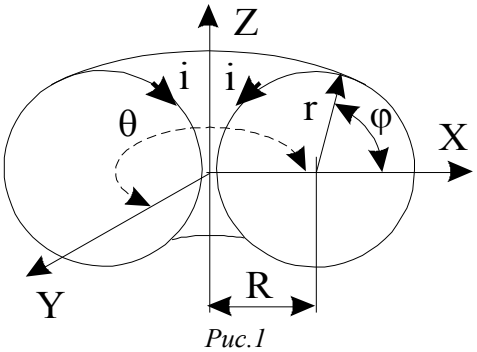

Рис.1