THE IMPORTANCE OF PRACTICAL TRAINING IN TEACHING THE SUBJECT OF ELECTRICITY AND MAGNETISM

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Annotation. This article discusses the significant role of problem-solving in the study of physics. It presents the most important general methods and approaches to solving problems that help teachers develop students' physical thinking, provide them with relevant practical knowledge and skills, and use instructional time efficiently. Several problems related to the topic "Electric Charges. Coulomb's Law. Electric Field Intensity" within the Electromagnetism section are classified into different categories, and their solutions are provided.

Keywords: physics, methodology, thinking, skills, method, approach, electromagnetism, electric charge, Coulomb's law, electric field intensity, classification, qualitative problems, computational problems, experimental problems, graphical problems.

Problem-solving plays a crucial role in the study of physics. Without solving problems, mastering a physics course is considered difficult. For this reason, great importance is attached to problem-solving activities in almost all educational institutions. Nevertheless, many pupils and students often experience difficulties in solving physics problems. The main reason for this is not only the complexity of such practical activities, but also shortcomings in the selection of problems and in the methodology of teaching problem-solving within the physics course.

Many teachers follow the principle that the more problems - especially difficult ones - are solved, the better the learning outcomes will be. However, this approach often creates difficulties for learners. As a result, when they fail to solve the given problems, they may lose confidence in their abilities, and their interest in the subject gradually declines. Consequently, the idea that physics is a difficult subject becomes firmly rooted in their minds.

Therefore, we as teachers need to develop more accessible and effective methods of teaching problem-solving for learners. This article introduces the most important general methods and approaches to problem-solving that help develop students' physical thinking, provide them with the necessary practical knowledge and skills, and

save instructional time. These methods include the classification of physics problems into specific categories.

Purposeful and active thinking aimed at achieving a defined objective constitutes the essence of problem-solving. In methodological and educational literature, exercises selected for a specific purpose - such as studying physical phenomena, forming scientific concepts, developing students' physical thinking, and enabling them to apply acquired knowledge - are referred to as problems. Problem-solving also serves many other purposes, such as students' moral and intellectual development, assessment of their knowledge, and evaluation of their skills and competencies.

Physics problems can be classified according to various criteria, such as their content, instructional purpose, level of application, solution methods, degree of difficulty, and other characteristics. These classifications include qualitative problems, computational problems, experimental problems, and graphical problems.

Based on their content, problems can also be divided according to the branches of physics to which they belong. For example, there may be problems related to mechanics, molecular physics, electromagnetism, and other fields.

As an illustration, let us classify several problems related to the topic "Electric Charges. Coulomb's Law. Electric Field Intensity" within the Electromagnetism section and examine their solutions.

Qualitative Problem

If the distance between two electric charges is reduced by a factor of three, how does the force of interaction between them change?

Solution and Explanation:

According to Coulomb's law, the magnitude of the electrostatic force between two point charges is given by

$$F = k \frac{q_1 \cdot q_2}{\varepsilon r^2}$$

where r is the distance between the charges. The force is inversely proportional to the square of the distance between them.

If the distance is reduced threefold, then

$$\frac{F_2}{F_1} = \frac{k \dfrac{q_1 \cdot q_2}{\varepsilon r_2^2}}{k \dfrac{q_1' \cdot q_2'}{\varepsilon r_1^2}} = \frac{r_1^2}{r_2^2} = \frac{1}{\dfrac{1}{9}} = 9$$

$$F_2 = 9F_1$$

Thus, the force of interaction increases by a factor of nine.

Experimental Problem

A pendulum consists of a small metal sphere suspended by a weightless, inextensible, and non-conductive string. The sphere is positively charged. A second negatively charged sphere is placed directly below the first one so that both spheres lie along the same vertical line. How does the period of oscillation of the pendulum change?

Solution and Explanation:

Since the charges are opposite, an additional electrostatic force of attraction acts on the suspended sphere in the downward direction. This force adds to the gravitational force acting on the pendulum bob.

As a result, the effective restoring force increases, which is equivalent to an increase in the effective gravitational acceleration acting on the system.

The period of a simple pendulum is given by $T = 2\pi\sqrt{\dfrac{l}{g_{eff}}}$

Where g_{eff} is the effective acceleration? Since g_{eff} increases due to the additional electrostatic attraction, the period T decreases.

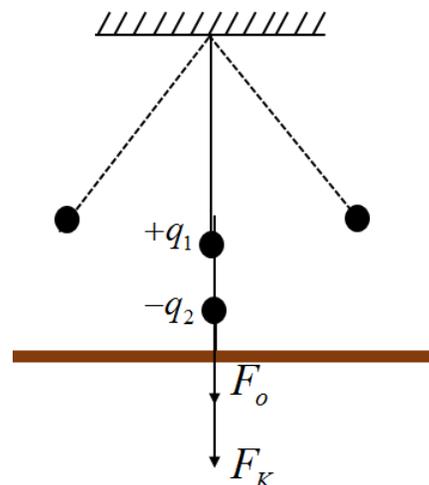**Answer:** The period of oscillation decreases.

Computational Problem

If the radius of the electron orbit is $0{,}5\cdot10^{-10}\,m$ with what force does the nucleus of a hydrogen atom attract the electron?

Solution:

The force of attraction between the positively charged nucleus (proton) and the electron is determined by Coulomb's law:

$$F = \frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{r^2}$$

$$F = \frac{1{,}6\cdot10^{-19}\,Cl\cdot1{,}6\cdot10^{-19}\,Cl}{4\cdot3{,}14\cdot8{,}85\cdot10^{-12}\,\dfrac{Cl^2}{N\cdot m^2}\cdot1\cdot\left(0{,}5\cdot10^{-10}\,m\right)^2} = 0{,}092\cdot10^{-6}\,N$$

Answer: The nucleus attracts the electron with a force of approximately $F = 9,2 \cdot 10^{-6} N$

Problem-solving also has significant educational and developmental value. Through problems, students can be introduced not only to new progressive ideas and perspectives but also to the discoveries of scientists from our country. Additionally, solving problems serves as an effective tool for cultivating diligence, courage, willpower, and character in students.

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