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METHODOLOGY FOR SOLVING VARIOUS TYPES OF PROBLEMS CONCERNING THE LAWS OF DYNAMICS IN GENERAL SECONDARY SCHOOLS

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Abstract: This article provides a simpler and more understandable explanation of the methods for solving various types of problems related to the laws of dynamics in general secondary schools. The article will help develop problem-solving methods in this area.

Keywords: Qualitative problem, graphic problem, experimental problem, experiment, motion, speed, acceleration.

Physics is a science that studies the laws of nature, and one of its main branches is mechanics, in particular dynamics.

Dynamics is a branch that studies the relationship between the motion of bodies and the forces that cause this motion, and is based on Newton's laws. Teaching the laws of dynamics in general secondary schools plays an important role not only in forming students' theoretical knowledge, but also in developing their logical thinking, physical thinking, and the ability to independently overcome problem situations. In the educational process, theoretical knowledge is transformed into practical skills by solving problems based on the laws of dynamics. However, it is observed that students face many difficulties in this area. In particular, the lack of a methodological approach to working with the interaction of forces, the influence of mass on motion, acceleration, and other physical quantities creates problems.

From this point of view, one of the urgent issues is to develop a methodology for analyzing problems related to the laws of dynamics and methods for solving them, and to convey them to students in a simple and understandable way. The effectiveness of physics lessons can be increased by classifying different types of problems and developing methods for solving them based on an individual and group approach. The main goal of this work is to study the methodology for solving problems based on the laws of dynamics, identify their types and approaches adapted to the level of knowledge of students. This not only increases students' interest in physics, but also forms their ability to analyze and understand physical phenomena in real life.

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Qualitative problems (or theoretical problems) help to understand the basic laws of physics and develop logical thinking. Such problems usually do not require precise calculations, but rather explain the essence of physical phenomena. Qualitative problems clearly explain physical phenomena and their laws to students, teach them to apply theoretical knowledge in practice, cultivate the correct attitude towards calculation problems, teach them to start solving any problem by analyzing its physical content. Qualitative problems are given in order to consolidate the material covered in the lesson.

Problem - 1. If a book on the table does not move, what forces act on it?

What does it mean if we push the book, but it Explanation:

The book is acted upon by the force of gravity downward and the reaction force of the table upward. If we push the book, it initially moves, but the friction force acts and stops it.

Problem - 2. Under what conditions does a car move in a straight line and in a straight line?

What causes a car to accelerate or decelerate?

Explanation:

A car moves in a straight line only when all forces are in balance. If the engine’s thrust is greater than friction and air resistance, it accelerates. When the brakes are applied, the friction of the brakes creates a force opposing the motion and the car slows down.

Problem - 3. Under what forces does a cyclist moving in a circle act?

Why can turning at high speed be dangerous?

Explanation:eventually stops?

The bicycle turns under the influence of the centripetal force. If this force disappears, the cyclist's movement will continue along a straight line, as a result of which he may fall.

Experimental problems. Experimental problems in physics are problems that are carried out in a laboratory setting and are aimed at practical verification and confirmation of physical laws. These problems help to study physical phenomena through experiments, understand measurement methods, and develop scientific thinking. One of the most effective ways to connect theory with practice is to solve experimental problems. A characteristic feature of experimental problems is that laboratory or demonstration experiments are used to solve them. In the process of solving experimental problems, students' activity and independence increase.

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Because they do not get the necessary information to solve the problem ready-made from a textbook or a set of problems, but from physical measurements that they perform themselves. Another advantage of experimental problems is that these problems cannot be solved without sufficient thinking. That is, students must extensively discuss the phenomena occurring in the experiment. Because in experimental problems, unlike in laboratory work, the theory is not given, the procedure for performing the work is not shown. It is sufficient to provide the necessary equipment and materials, and ask for the information that needs to be found.

As we said above, students learn from a series of thoughts and considerations what physical phenomenon is involved in the experiment, what physical law is being expressed. And finally, they derive the final expression for the physical quantity that needs to be found in the experimental problem. Analyzing the final expression, they obtain the quantities necessary to solve the problem by directly measuring them. Let's see what has been said in the following simple experimental problem:

Problem - 1. Given instruments: metric tape, chronometer (stopwatch), rope, weights.

Task: Perform an experiment on the free fall of a weight and determine its acceleration of free fall.

Solution method: Measure the height, measure the time of the weight's fall with a stopwatch and calculate it according to the formula $g = \frac{2h}{t^2}$

Problem - 2. Equipment provided: dynamometer, suspended load, scales.

Task: Determine the relationship between mass and force and verify the formula for gravitational force through experiment.

Solution: Measure the gravitational force of objects of different masses suspended from a dynamometer and compare the results.

Problem - 3. Equipment provided: Use a dynamic cart and a pulling load.

Solution: Measure the acceleration of the cart under the influence of various forces.

Check using the formula F=ma.

As the force increases, the acceleration also increases, and as the mass increases, the acceleration decreases.

Graphic problems. With the help of these graphic problems, the basic laws of dynamics can be understood more easily and clearly. By correctly understanding and analyzing graphs, it is possible to better understand physical phenomena. In the process of solving graphic problems, students deeply master the basics of physics. In the process of solving graphic problems in the lesson and in the process of independently completing homework, students see the interrelationships of physics and mathematics in practice. Graphic problems also develop students' thinking skills.

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Problem - 1. The mass of an object is given and the force acting on it is measured at different values. It is necessary to measure the acceleration of the object and obtain a graph between force and acceleration.

If the mass of the object is constant in the relationship between force and acceleration, the graph will be straight. Based on the formula F = ma.

Problem - 2. The object is moving at the same speed. Construct a graph between speed and time. Draw a graph.

If the object moves at a constant speed, the graph will be a straight line.

A straight line on the graph indicates that the speed is constant.

Problem - 3: Determine the graphical relationship between the force applied to an object and the time of movement. Draw a graph:

If the force does not change over time, the graph of the relationship between force and acceleration will be constant. If the force changes over time (for example, increases), the graph will be curved.

In conclusion, problems based on the laws of dynamics are the main tool for understanding Newton's laws and applying them to real-life situations.

The division of problems into types (simple, complex, graphical, experimentally based) serves to develop students' abilities at different levels.

Methodological approaches - form students' independent thinking skills through step-by-step problem solving, the use of graphic images, and physical modeling.

It is important to explain problems related to the laws of dynamics using various methodological methods in order to increase students' motivation, develop creativity, and ensure interdisciplinary connections.

Innovative approaches (interactive lessons, digital platforms, problem-solving based on experiments) increase students' interest in the subject and encourage them to apply theoretical knowledge in practice.

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