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The role of mathematics in the learning of physics

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Abstract: This article focuses on the fundamental role of mathematics in understanding and learning physics. The complex relationship between mathematics and physics has been the foundation of scientific discovery and technological progress for centuries. This synergy is evident in the formation, description, and interpretation of physical phenomena and laws, and information is given about the role of mathematics in the study of physics.

Key words: mathematics, physics, mechanics, modeling, analysis, empirical laws, integration.

Аннотация: В данной статье основное внимание уделяется фундаментальной роли математики в понимании и изучении физики. Сложные взаимоотношения между математикой и физикой на протяжении веков были основой научных открытий и технического прогресса. Эта синергия проявляется в формировании, описании и интерпретации физических явлений и законов, а также даются сведения о роли математики в изучении физики.

Ключевые слова: математика, физика, механика, моделирование, анализ, эмпирические законы, интегрирование.

Introduction:

Mathematics plays a key role in understanding and learning physics. The complex relationship between mathematics and physics has been the basis of scientific discovery and technological progress for centuries. This synergy is evident in the formulation, description, and interpretation of physical phenomena and laws. The application of mathematical concepts such as calculus, algebra, geometry, and trigonometry allows physicists to describe and quantify the behavior of natural phenomena. From classical mechanics to

quantum physics, mathematics provides the language and tools for modeling, analyzing, and predicting the behavior of particles, waves, and fields. In this context, mathematics is used to express physical principles, derive equations of motion, establish relationships between quantities, and solve complex problems serves as a clear and consistent basis for solving problems. It allows physicists to develop theories, construct mathematical models, and make predictions about the behavior of physical systems. In addition, the symbiotic relationship between mathematics and physics is also common for the development and interpretation of experimental data. Mathematical methods are essential for analyzing data, testing hypotheses, and formulating empirical laws.

Materials and Medhods:

Through mathematical modeling and statistical analysis, physicists can confirm theoretical predictions and refine their understanding of natural phenomena based on experimental evidence. In essence, mathematics is the language of physics, providing a systematic and powerful means of abstracting, quantifying, and reasoning about the physical world. The integration of mathematical methods with physical theories not only enhances our understanding of the natural world, but also fosters innovation, technological advances, and the evolution of scientific thought. As we delve deeper into the role of mathematics in the study of physics, we see the deep connection between abstract mathematical concepts and the material aspects of the physical world. We will open the link. This connection is at the heart of physics education and research and emphasizes the important interplay between mathematical rigor and empirical observations in developing our understanding of the universe. In physics, students apply mathematically constructed theoretical models to the real world should be connected with This project aims to explore the role of mathematics in the teaching and learning of physics in high and secondary schools by examining the relationship between the real world - Theoretical models - Mathematics in physics classes (lectures, problem solving and laboratory work).A preliminary analysis shows that there is some connection between theories and the real world by students and teachers, but the main

part of the discussion in the classroom is about the relationship between theoretical models and mathematics, which provides a connection between theoretical models and mathematics.

Physics is directly related to mathematics. Mathematics is a tool and technique for general and precise expression of results determined by experiment or theoretical method in physics. Therefore, the effectiveness of teaching physics depends on how well students know mathematics. The following table (Table 1) shows the relationship between topics in physics and concepts related to mathematics. In algebra lessons, there is a basic concept called function. Its symbolic representation is y=f(x). The function is given in the form of a table, graph, formula in problems. Therefore, the first part of physics lessons should be started by teaching the concepts of functions, graphs of functions, and operations on vectors, not different sizes. In physics classes, students encounter the concept of vectors for the first time in the topics of speed and force.

In that case, vectors are used in the sense of physical quantities. Magnitudes have directional and numerical values. At this time, students learn concepts such as displacement, parallel lines, location of points on a plane in parallel in geometry lessons. In physics lessons, vector and coordinate methods are widely used to solve problems. The given vectors in the problem do not indicate their position on the object in the drawing, but also show the ways of the correct solution. Vectors show whether a body in motion is in equilibrium or not. At the same time, the drawings in the coordinate system reflect the dynamism of events and the interrelationship between physical quantities. Physical laws are often written analytically, in the form of formulas. Therefore, students have problems in understanding these laws. The graphical method is quite different from the analytical method.

They are as follows:

- shows the sequence of the graphic movement
- clearly shows the dynamics of the process

Mathematics helps us a lot to derive physical formulas, calculate solutions to problems, and calculate relative and absolute errors in the laboratory process.

Mathematics is an important element in the implementation of scientific calculations in the field of physics. Mathematics and physics have a mutually beneficial relationship. For physics practitioners, mathematics provides the structure they use to complete the analysis and calculations to arrive at scientific conclusions. For mathematicians, physics provides a practical application that helps them understand mathematical concepts that they would otherwise use only for theoretical purposes. Types of mathematics used in physics. There are many types of mathematics that you can apply while working in physics.

Physics presents problems to humanity that can be solved by mathematical methods, which causes the emergence of new mathematical concepts. Mathematics gives a lot to physics. With the help of differential and integral calculations, it serves to fully express many laws (Newton's 2nd law, laws of electromagnetic induction). Nowadays, mathematical ideas and methods are rapidly entering the research aspects of many sciences. As a result, new fields of knowledge are being founded. As a result of the rapid development of mathematical knowledge, such disciplines as mathematical biology, mathematical economics, and mathematical linguistics were created. Not only exact sciences, but also archeology and even linguistics and art studies are increasingly in need of mathematical methods of scientific research. The role of mathematics in the implementation of national economic plans is extremely large. It would not be an exaggeration to say that the development of certain sciences has been and continues to be a strong reason for the development of certain sciences. Many examples can be given of how scientists in various fields of science used mathematical apparatus to get out of abstraction in fields that cannot be checked by experiment.

Results and Discussions:

The researches conducted by Uzbek mathematicians on the theory of probability, mathematical statistics, topology, number theory, differential equations, calculation mathematics and the application of mathematics in the national economy and technology are particularly fruitful.

Currently, world-class mathematical research and the use of mathematical methods in the fields of technology and national economy are increasingly gaining momentum. For this reason, it is necessary to pay attention to the modern demand for teaching mathematics in general secondary education, higher and secondary special educational institutions. At the same time, it is permissible to emphasize the reasons why mathematics is needed and why it is necessary to learn it:

- develops snoring;
- sharpens the memory;
- helps to achieve success in terms of goals;
- develops skills to solve everyday problems;
- solving mathematical problems creates psychological stability.

At the same time, consistent teaching of mathematics with natural sciences: physics, chemistry, and technical sciences, students' determination of physical, chemical, and technical processes, their modeling, improvement, etc. in expansion, if students are provided with the emergence and development of humanistic ideas, connecting the rules, laws, and formulas of mathematics with natural sciences will create opportunities to develop students' mathematical abilities.

Conclusion:

The use of intersubject communication in mathematics education is primarily the organization of reserves of mathematical models, that is, their use in the deeper study of other subjects. The reserve of models includes the basic concepts of mathematics, namely: size, number, function, figure , equation, derivative, integral, probability, etc. For example, derivative-mathematics is used to solve various physical, chemical, and technical problems, as well as to study the speed of mechanical movement, speed of reaction, and changes in the flow of charges.

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