VECTORS IN SPACE

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ABSTRACT

The topic of vectors in space is one of the important sections of analytical geometry and linear algebra. Vectors are used to determine the mutual location of points, directions, planes and straight lines in space. Spatial vectors are represented in a three-dimensional coordinate system, and mathematical operations are performed using their components. This article extensively covers the concept of a vector in space, its main elements, expression in coordinates, operations performed on vectors, as well as scalar, vector and mixed products. It also considers the geometric and practical significance of vectors, their application in physics, mechanics and engineering. The article serves to develop spatial imagination and logical thinking in students and reveals the importance of vector theory in solving complex geometric problems..

The concept of a vector occupies an important place in modern mathematics and physics. In particular, the theory of vectors in space is a key tool in the analysis of three-dimensional objects and phenomena. With the help of vectors in space, physical quantities such as the location of points, the direction of forces, velocity and acceleration are determined. Therefore, the topic of vectors in space occupies an important place in school and higher education mathematics courses.

A vector is a mathematical object that has length (modulus) and direction. Vectors in space are located in three-dimensional space, and are usually represented by the x, y and z axes. Spatial vectors are geometrically represented as directed sections. The starting point and ending point of a vector determine its direction.

If the starting point of a vector is $A(x_1, y_1, z_1)$ and the ending point is $B(x_2, y_2, z_2)$, then the coordinates of the vector are defined as follows:

$\overrightarrow{AB}(x_2 - x_1,\ y_2 - y_1, z_2 - z_1)$

This representation makes it easier to perform algebraic operations on vectors. The operations of addition, subtraction, and multiplication are performed using the coordinates of vectors in space.

The following basic operations are performed on vectors in space:

$\vec{a} + \vec{b}(a_1 + b_1,\ a^2 + b_2, a_3 + b_3)$

When two vectors are added, their corresponding components are added:

When a vector is multiplied by a number, all its components are multiplied by that number. This operation changes the vector's modulus while preserving its direction.

Opposite vector

If a vector is equal in modulus but opposite in direction, it is called an opposite vector.

Scalar product

The scalar product of two spatial vectors is defined by the following formula:

$\vec{a}\vec{b} = a_1b_1 + a_2b_2 + a_3b_3$

The scalar product allows you to determine the angle between vectors. If the scalar product is zero, the vectors are perpendicular to each other.

As a result of vector multiplication, a new vector is formed. This vector is perpendicular to both given vectors. Vector multiplication is used to determine plane and normal vectors in space.

The complex product of three spatial vectors is used to determine the volume of a parallelepiped in space. If the complex product is zero, the vectors lie in the same plane.

The theory of vectors in space is widely used in the following areas:

In physics - in expressing forces, velocities and impulses

In mechanics - in analyzing motions

In engineering - in calculating structures

In computer graphics - in 3D modeling

In these areas, vectors allow you to accurately describe spatial processes.

In short, the topic of vectors in space serves as the basis for mathematical analysis and applied sciences. Vectors are used to determine the location, motion, and interaction of objects in space. Operations performed on vectors, scalar and vector products, are important tools for solving complex problems. Therefore, a deep study of the theory of vectors in space helps to strengthen mathematical knowledge.

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