THE CONCEPT OF COMPLEX NUMBERS

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Abstract. Social studies help to strengthen students' memory and expand their arithmetical knowledge. That is why it is important to have deep knowledge about every formula and topics related to mathematics. In this article, the concept of complex numbers is described in detail, and the formulas involving these numbers are presented.

Key words: complex numbers, combination, fractional numbers, abstract numbers, problems, etc.

Complex numbers are the combination of real and imaginary numbers. The real part can be expressed by an integer or decimal, while the imaginary part has a square that is negative. Complex numbers arise from the need to express negative numbers' roots, which real numbers can't do. This is why they reflect all the roots of polynomials. Their use extends to different scientific branches, ranging from mathematics to engineering. Complex numbers can also represent electromagnetic waves and electric currents, so they are essential in the field of electronics and telecommunications. Its mathematical formula is a + b i, where a and b are real numbers, and i is the imaginary number. This expression is known as binomial form because of the two parts that make it up.

French mathematician René Descartes was the first to emphasize the imaginary nature of numbers, positing that "one can imagine as many (numbers) as already mentioned in each equation, but sometimes, there is no quantity that matches what we imagine." However, the conceptualization of complex numbers dates back to the 16th century with the contribution of Italian mathematician Gerolamo Cardano, who proved that having a negative term inside a square root can lead to the solution of an equation. Up until then, it was thought to be impossible to find the square root of a negative number. Later, in the 18th century, mathematician Carl Friedrich Gauss consolidated Cardano's premises, in addition to developing a treatise on complex numbers in a plane and thereby established the modern bases of the term.

While their day-to-day application is not as direct as that of real numbers, their imaginary component makes complex numbers important as they make it possible to work very precisely in specific areas of science and physics. This is the case with measuring electromagnetic fields, which consist of electrical and magnetic components and require pairs of real numbers to describe them. These pairs can be seen as a complex number, hence their importance. Any numerical category (whether natural, integer, or rational) can be represented graphically on a line. In the case of real numbers, they cover the line completely, and every number corresponds to a place on the line (also called the real line). Complex numbers leave the line to fill a plane called the complex plane. In this case, complex numbers are represented on Cartesian axes, where the X axis is called the real axis and Y the imaginary axis. The formula for complex numbers, a + bi, is represented by the point or end (a,b), called the affix, or by a vector with the origin (0,0).

It is known that when solving quadratic equations, sometimes the discriminant consists of a negative number: 2 D b - 4 as < 0. In this case, the given quadratic equation does not have a real root. Because it makes no sense to extract square roots from negative real numbers. To solve a quadratic equation, the discriminant of which is a negative number, it is necessary to expand the concept of numbers. In this case, it is appropriate to add a new number i whose square is equal to -1 to the set of real numbers. It is accepted to call this number an abstract unit. Then the following equality holds:

$$i^2=-1$$

The number i gives the possibility to enter the product of the form bi and the sum a+ ib. Definition: an expression in the form a+bi is called a complex number. Here, a and b are arbitrary real numbers, and i is an abstract unit. The number a is called the real part of the complex number a+bi, and the product bi is called the abstract part, and the number b is called the coefficient of the abstract part. For example, for the complex number 5+2i, the number 5 is the real part, and 2i is the abstract part, its coefficient is 2; The real part of the number 0+7i consists of 0, the abstract part is 7i, and the coefficient of the abstract part is 7; The real part of the number 6-0i is 6, the abstract part is 0i, and the coefficient of the abstract part is 0. When complex numbers were introduced, ideas and concepts in algebra, hydrodynamics of theoretical physics, theory of elementary particles, etc. became simpler. Definition: If the real parts of two complex numbers are equal and the coefficients of their abstract parts are also equal, these numbers are called mutually equal, that is, if a=c and b=d, the following equality holds:

$$a+bi=c+di$$

Order ("big" or "small") relationships cannot be determined between two complex numbers.

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