"METHODS OF SOLVING OF THE TRIGONOMETRIC EQUATIONS"

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Abstract: *The article provides a brief historical overview of the history of the origin of trigonometric functions. The period of trigonometric functions, the domain of definition, the formulas for converting trigonometric expressions from addition to multiplication are presented, and ways to solve examples of them are explained.*

Keywords: *trigonometry, function, period, trigonometric sum, domain of definition, argument, homogeneous equations, degree reduction.*

In the centuries before our era, trigonometry arose in connection with the needs of astronomy, geodesy and construction, that is, it had only a geometric nature and mainly represented the "calculation of chords". Over time, some analytical ideas began to interfere with it. In the first half of the 18th century, a sharp turn occurred, after which trigonometry took a new direction and switched to mathematical analysis.

Historically, trigonometric equations and inequalities occupied a special place in the school curriculum. Even the Greeks considered trigonometry the most important of the sciences. Therefore, we, without arguing with the ancient Greeks, consider trigonometry to be one of the most important sections of the school course and the entire discipline of mathematics in general.

For several decades, trigonometry did not exist as a separate subject in the school mathematics course, it gradually spread not only to the basic school geometry and algebra, but also to the beginning of algebra and mathematical analysis.

Trigonometric equations are one of the most difficult topics in the school mathematics course. Trigonometric equations arise when solving problems in planimetry, astronomy, physics and other areas. Trigonometric equations and inequalities are also found among the tasks of centralized testing from year to year.

The most important difference between trigonometric equations and algebraic equations is that algebraic equations have a finite number of roots, while trigonometric equations have an infinite number of solutions, which greatly complicates the selection of roots. Another distinctive feature of trigonometric equations is the non-specific form of writing the answer.

Based on educational, scientific and methodological literature, there are general methodological rules that you should pay attention to when presenting the main theoretical information on trigonometric equations and inequalities in the school mathematics course.

The practical significance of this work is that it can be used as a teaching aid for school teachers in planning and conducting trigonometry lessons.

Elementary trigonometric equations are equations of the form $f(kx + b) = a$, where $f(x)$ are the trigonometric functions: $sinx$, $cosx$, tgx , $ctgx$.

Elementary trigonometric equations have an infinite number of roots.

The general formula for finding all the roots of the equation is given by sin x = a , |a| ≤ 1 x = arcsin a + 2πn , n ∈ Z.

Here n can take any integer value, each of which corresponds to a specific root of the equation in this formula. Also, in other formulas for solving elementary trigonometric equations, n is called a parameter. They are usually written as n ∈ Z, and thus the parameter n can take any integer value.

The solutions of the equation cos x = a , |a| ≤ 1 are found by the following formula: x = ± arccos a + πn , $n\epsilon Z$. The solutions of the equation tg x = a are found by the following formula x = arctg a + πn , $n\epsilon Z$. The solutions of the equation ctg x = a are found by the following formula x = arcctg a + πn , $n\epsilon Z$.

Special attention should be paid to some special cases of elementary trigonometric equations, in which the solution can be written without using general formulas:

sin x = 0 , x = πn , n ∈ Z, sin x = 1 , x = + 2πn , n ∈ Z, sin x = -1 , x = − + 2πn , n ∈ Z, cos x = 0 , x = + πn , n ∈ Z, c$\frac{\pi}{2}$os x = 1 , x = 2πn , n ∈ Z, cos x = -1 , x = π + 2πn , n ∈ Z, tg x = 0 , x = πn , n ∈ Z, tg x = 1 , x = $\frac{\pi}{2}$ π+ πn , $\frac{\pi}{2}$ n ∈ Z,

tg x = -1 , x = − $\frac{\pi}{2}$ πn , n ∈ Z, ctg x = 0 , x = + πn , n ∈ Z, ctg x = 1 , x = + πn , n ∈ Z, ctg x = -1 , x = − + πn , n ∈Z. $\frac{\pi}{2}$ $\frac{\pi}{2}$ $\frac{\pi}{4}$ $\frac{\pi}{4}$

These equations should be given special attention, as they can be used to solve other trigonometric equations. It is good if students have schemes for solving each of the simplest equations.

Periodicity

The period of trigonometric functions plays an important role in solving trigonometric equations. Therefore, students should know two useful theorems:

Theorem. If T is the primary period of the function $f(x)$, then the number T/k is the primary period of the function $f(kx + b)$. A function is called dimensional if there are natural numbers m and n such that the periods $m = n = T$.

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Theorem. If (x) and (x) are periodic functions and are comparable, then they have a common period $m = n = T$, which is the period of the function $(x) + (x)$.

Any real number corresponds to a point on the unit circle. The coordinates of this point are the cosine and sine of the given real number. Since the coordinates of any point on the unit circle can always be determined, for any real x, the corresponding value of $sinx$ and $cosx$ can be found, that is, any real value of $y = sinx$ and $y = cosx$ is determined.

By defining the domain of the functions $y = tgx$, it is necessary to show that if $x = \pi/2 + \pi n$, the side of these angles is the tangent axis. Therefore, it is impossible to determine the corresponding value of the function $y = tgx$ for these values of the argument.

Formulas for converting trigonometric expressions from addition to multiplication The following formulas are used to solve trigonometric equations:

$$sinx + siny = 2\,sin\frac{x+y}{2}\cdot cos\frac{x-y}{2};$$
$$sinx - siny = 2\,sin\frac{x-y}{2}\cdot cos\frac{x+y}{2};$$
$$cosx + cosy = 2\,cos\frac{x+y}{2}\cdot cos\frac{x-y}{2};$$
$$cosx - cosy = -2\,sin\frac{x+y}{2}\cdot sin\frac{x-y}{2};$$
$$tg\,x + tgy = \frac{sin\,(x+y)}{cosxcosy};$$
$$tg\,x - tgy = \frac{sin\,(x-y)}{cosxcosy};$$
$$ctg\,x + ctgy = \frac{sin\,(x+y)}{sinxsiny};$$
$$ctg\,x - ctgy = \frac{sin\,(x-y)}{sinxsiny}.$$

Having familiarized ourselves with the relevant methodological literature on these issues, we can conclude that the ability and skills to solve trigonometric equations and inequalities in the school algebra course are very important, and their development requires great effort from the mathematics teacher.

The teacher himself must have sufficient knowledge of the methods for developing skills and competencies in solving trigonometric equations and inequalities.

Obviously, it is almost impossible to achieve the set goal using only the tools and methods proposed by the authors of modern textbooks.

This is due to the individual characteristics of students.

Indeed, depending on the level of their basic knowledge of trigonometry, a range of opportunities for studying equations and inequalities of different levels is built.

Therefore, the teacher faces a very difficult task of identifying the ideas of the material being studied based on the methods of solving the problems under consideration, their subsequent generalization and systematization.

This is important both for the conscious assimilation of the theory by students and for mastering a number of general methods for solving mathematical problems.

Advanced pedagogical technologies, such as those used in the article, and scientific research involving trigonometric functions are widely covered in the articles.

It should also be noted that solving trigonometric equations not only creates the necessary conditions for systematizing students' knowledge of trigonometric material, but also provides an effective connection with the algebraic material being studied.

This is one of the properties of the material associated with the study of trigonometric equations.

These properties should be taken into account by the teacher when developing a methodology for teaching schoolchildren to solve trigonometric equations.

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