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USING INEQUALITIES IN SOLVING TRIGONOMETRIC EQUATIONS AND SYSTEMS OF EQUATIONS

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ANNOTATION
We are looking at an inequality which represents the assertion that the square of an arbitrary real number will not be negative. To use this statement effectively, we apply it to subtraction. Where and are real numbers.

Keywords the solution of trigonometric equations is the Cauchy inequality, and the functions are the solution. In the domain of the equation , $f_1(x)=1+\cos(x+3tgx)\geq 0$ va $f_2(x)=\left(tgx-tg^2x\right)^2\geq 0$ are equations that are given in order to be. Then $(a-b)^2\geq 0$ the inequality $a^2+b^2\geq 2ab$ (1) brought to approval. The equal sign is only $a=b$ appropriate. This simple inequality relating the arithmetic mean to the geometric mean is called the Cauchy inequality. In most cases $a+\frac{1}{2}\geq 2(a>0)$ (2) the inequality is also used . In this, the equal sign $a=1$ in is appropriate.

1- example $tg^4x+tg^4y+2ctg^2xctg^2y=3+\sin^2(x+y)$ all satisfying the equation x and y find the pairs.

2- the solution (1) to support the inequality as follows.
$tg^4x+tg^4y+2ctg^2xctg^2y\geq 2tg^2xtg^2y+2ctg^2xctg^2y=2\left[(tgx\cdot tgy)^2+(ctgx\cdot ctgy)^2\right]\geq 4$

3- equal $tg^2x=tg^2y$ sign va $tgx\cdot tgy=ctgx\cdot ctgy$ appropriate when.
$3+\sin^2(x+y)\leq 4$ the equal sign in the inequality $\sin^2(x+y)=1$ when it's done.

Therefore, this equation is equivalent to the following system . $\begin{cases} tg^2x=tg^2y \\ tgxtgy=ctgxctgy \\ \sin^2(x+y)=1 \end{cases}$ yoki $\begin{cases} tg^2x=tg^2y=1 \\ \sin^2(x+y)=1 \end{cases}$

From this $\begin{cases} |tgx|=|tgy|=1 \\ |\sin(x+y)|=1 \end{cases}$

Answer $x_1=\frac{\pi}{4}+\pi k,\ y_1=\frac{\pi}{4}+\pi n; x_2=-\frac{\pi}{4}+\pi n,\ y_2=-\frac{\pi}{4}+\pi l\ (k,m,n,l\in Z)$

Now consider equations with several variables .

$$f_1(x,y,...z)+f_2(x,y,...,z)+...+f_N(x,y,...z)=0 \ (3)$$

Let not every added element on the left side of the equation be negative. Then the sum of several non-negative terms is 0, so each term must be equal to 0. So, if
$f_1(x,y,...z)+f_2(x,y,...,z)+...+f_N(x,y,...z)=0$
lar (3) something related to the domain of the equation $\{x,y,...,z\}$ satisfies the following inequalities in the set, $f_1(x,y,...,z)\geq 0,\ f_2(x,y,...,z)\geq 0,\ f_N(x,y,...,z)\geq 0$ (4)

then the equation in question will be equivalent to the next system in that set. $$\begin{cases} f_1(x,y,...,z)=0, \\ f_2(x,y,...,z)=0, \\ \dots\dots\dots\dots \\ f_N(x,y,...,z)=0 \end{cases} \quad (5)$$

This method can also be used to solve single inequalities with one unknown. Privately, the equation $f_1(x)+f_2(x)=0$ $f_1(x)\geq 0$ and $f_2(x)\geq 0$ is equivalent to the following system provided.

$$\begin{cases} f_1(x)=0, \\ f_2(x)=0 \end{cases}$$

For example, $[\varphi_1(x)]^2+[\varphi_2(x)]^2=0$ the equation is equivalent to the following system

$$\begin{cases} \varphi_1(x)=0 \\ \varphi_2(x)=0 \end{cases}$$

2 example . $1+\cos(x+3tgx)+(tgx-tg^2x)^2=0$ solve the equation.

Solution. In the domain of the equation $f_1(x)=1+\cos(x+3tgx)\geq 0$ and $f_2(x)=(tgx-tg^2x)^2\geq 0$ equation given for

$$\begin{cases} 1+\cos(x+3tgx)=0 \\ tgx-tg^2x=0 \end{cases}$$

system equivalent. From this system we arrive at the following combination of systems .

$$\begin{cases} x+3tgx=\pi+2\pi k, \\ x=\pi n \end{cases} \text{ va } \begin{cases} x+3tgx=\pi+2\pi k, \\ x=\frac{\pi}{4}+\pi n \end{cases}$$

Solution of the first system $x=(2k+1)\pi$

From the second system $\pi=\frac{12}{8k-4n+3}$. This is equality k and n larning is not executed on any integer values because π - is an irrational end.

Javob : $x=(2k+1)\pi, (k=0,\pm1,...)$

It is convenient to use when solving some trigonometric equations and boundedness of functions.

3 is an example. $\sin^5 x+\cos^5 x=1$ solve the equation.

Solution. $\sin^5 x\leq\sin^2 x$ va $\cos^5 x<\cos^2 x$ because $\sin^5 x+\cos^5 x\leq 1$. Equals sign $(\sin^5 x+\cos^5 x=1)$ $\sin^5 x=\sin^2 x$ va $\cos^5 x=\cos^2 x$ is appropriate when. Simultaneous fulfillment of these equalities is impossible. $x=2\pi n,\ n\in Z$ or $x=\frac{\pi}{2}+2\pi k,\ k\in Z.$

Answer: $2\pi n;\ \frac{\pi}{2}+2\pi k;\ k\in Z,\ n\in Z.$

4 is an example. $\sqrt{\cos x}+\sqrt[3]{\sin x}=1$ solve the equation.

Solution. By condition $\cos x\geq 0;\ \sqrt{\cos x}\geq 0.$ Then $0\leq\sqrt[3]{\sin x}\leq 1$ va $0\leq\sin x\leq 1.$

$\sqrt{\cos x} \ge \cos^2 x$ va $\sqrt[3]{\sin x} \ge \sin^2 x$ because $\sqrt{\cos x} + \sqrt[3]{\sin x} \ge 1$.

Equal sign $\begin{cases} \sqrt{\cos x} = \cos^2 x \\ \sqrt[3]{\sin x} = \sin^2 x \end{cases}$ $x = \dfrac{\pi}{2} + 2\pi m,\ m \in Z$ va $x = 2\pi n,\ n \in Z$ in appropriate.

Answer: $\dfrac{\pi}{2} + 2\pi m,\ m \in Z$; $2\pi n,\ n \in Z$

5 is an example. $\sin x + \cos x + \cos 8x = \sqrt{2}$ solve the equation.

Solution. To the left side of the equation $a\sin x + b\cos x = \sqrt{a^2+b^2}\sin(x+\varphi)$ apply the formula and $\sqrt{1+\cos^2 8x}\sin(x+\varphi)$ form that $\cos\varphi = \dfrac{1}{\sqrt{1+\cos^2 8x}}$ va $\sin\varphi = \dfrac{\cos 8x}{\sqrt{1+\cos^2 8x}}$. So we form.

$$\sqrt{1+\cos^2 8x}\sin(x+\varphi) = \sqrt{2}.$$

$$\sqrt{1+\cos^2 8x}\sin(x+\varphi)\sqrt{1+\cos^2 8x} \le \sqrt{2}$$

we can easily see that this is so. Therefore, for this equation to have a root, its roots $1+\cos^2 8x = 2;\ \cos^2 8x = 1$ must satisfy the equation. If $\cos 8x = 1$ if this equation $\sin x + \cos x = \sqrt{2}$ takes the form. Let's form the following system. $\begin{cases} \cos 8x = 1, \\ \sin x + \cos x = \sqrt{2}; \end{cases}$

$$\begin{cases} x = \dfrac{\pi}{4}n,\ n \in Z, \\ \sin\dfrac{\pi}{4} + \cos\dfrac{\pi}{4}n = \sqrt{2}. \end{cases}$$

The second equation is true to the equality $n = 8k+1,\ x = \dfrac{\pi}{4} + 2\pi k,\ k \in Z$ rotates in. This is the solution to this equation. yeah $\cos 8x = 1$ bo ' lsa $x = \dfrac{\pi}{8} + \dfrac{\pi m}{4};\ m \in Z.$ x with these values, equality does not become a proper equality.

Answer: $\dfrac{\pi}{4} + 2\pi k,\ k \in Z.$

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