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THE ROLE OF MATHEMATICAL OLYMPIADS IN THE DEVELOPMENT OF INDIVIDUAL CONSCIOUSNESS

Abstract*: The article reveals the importance of the emergence of mathematical Olympiads and the development of the scientific consciousness of the younger generation of the peoples of the world through mathematical Olympiads in modern times, as well as the role of mathematical.*

Key words*: Mathematical Olympiad, snowball, inequality, function, logo, set, competition, model.*
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Introduction

A look at history: The highest mountain range in Greece is called Olympus. The highest peak on the list is 2917 m. called The Olympics are a product of the highly developed culture of ancient Greece. In addition to sports games such as running, javelin and sprinting, boxing, there were debates in the field of mental activity. Winners in both categories are especially honored. In particular, the famous mathematician and philosopher Pythagoras is known to have been an Olympic champion in boxing.

In general, in the life of mathematicians, competition - who will take the "kid" in solving the problem - is one of the most significant factors. A letter written by the famous mathematician Giyosiddin Jamshid al-Kashi, who lived and worked in Samarkand, to his father in Kashan (Iran) has been preserved. It is clear from its content that at the scientific meeting (seminar in modern language) chaired by Ulugbek, scientists discussed various issues, the seminar was attended by students of madrassas, who were able to demonstrate their abilities, that is, such seminars was also a peculiar Olympiad for the sciences.

The main part

Mathematical tournaments became popular in Italy in the 17th century. Winning the tournament was a great achievement, and mathematicians kept secret new ways to solve problems. The desire to win such a tournament encouraged Italian mathematicians Fiori, Ferro and Tatal to find the rule for solving the apparent $x^3 + px + q = 0$ cube equation, and Tatal won several tournaments using his own formula. But another Italian mathematician, J. Carlano (1501-1576, the inventor of the so-called "snowmobile" mechanism, a physician, a universal scientist who wrote pamphlets on various fields) repeatedly begged. when asked, Tatal tells him the formula on condition of anonymity. But Cardano was very fond of writing books, and in his treatise on mathematics he used the formula for solving cubic equations

$$x=\sqrt[3]{-\frac{q}{2}+\sqrt{\frac{q^2}{4}+\frac{p^3}{27}}}+\sqrt[3]{-\frac{q}{2}-\sqrt{\frac{q^2}{4}+\frac{p^3}{27}}}\qquad (*)$$

declares (*). Because of this, (*) is still called the Cardano formula. Although Cardano has rightly resented Tatal for a lifetime, the math tournaments will soon be over and mathematicians will be able to announce new formulas sooner rather than later.

Mathematical competitions are reborn in another form — the Olympics — as a means of engaging children in mathematics. We think it was first held in Hungary in 1894. Here are some of those Olympic issues:

1. Prove that for all values of x and y, the expressions 2x + 3y and 9x + 5y are divisible by 17 without remainder at the same time. (example: in private x = 4; y = 3)

2. The circle and the points P and Q are given inside it. The problem of how the points P and Q are located is not solved.

3. The difference of the sides of a triangle is an arithmetic progression equal to d. If the face of a triangle is S, find its sides and angles. Solve the problem in the special case where d = 1 and S = 6.

Over the centuries, as the scientific thinking of mankind has increased, so has the level of the Science Olympiads. In today's age of technology, the Olympics are organized in the form of competitions, which are rich in debates, discussions and debates, selecting people with strong knowledge in all areas. Students are ready for any challenge to prove their knowledge. Academician Sadi Hasanovich Sirojiddinov (1920-1988) was the first initiator, organizer and leader of the Student Mathematical Olympiads in Uzbekistan. By uniting young talented scientists around the teacher, he has worked hard for many years to ensure that the Olympics are effective and that the real winners are the right ones to choose the strongest. No matter how busy they were, they had the opportunity to choose the judges of the Olympiads, to get acquainted with the issues, to meet with the students, to talk, to congratulate the winners. Especially noteworthy is the work of our teacher in 1978 in conducting the Mathematical Olympiad in Tashkent in collaboration with his teacher, academician, famous mathematician of the XX century AN Kolmogorov.

One of the peculiarities of the Olympic Games is that they are non-standard, and their solutions require original thinking and ingenuity. This is achieved through long-term work, independent thinking on issues, even days and months of thinking and managing. Here are some examples of international and national Olympic issues, and some of them are my own ideas. Try to solve these problems independently, and if some problems do not arise, look for solutions only after you have spent all your resources. Then these issues will leave a deep imprint in your memory.

Problems and solutions.

Issue 1. (1959, International Mathematical Olympiad in Brasov and Bucharest, Romania)

Prove that $\frac{21n+4}{14n+3}$ is an irreducible fraction at any natural value of n.

Solution: Method 1. For a given fraction to be irreducible, the image and denominator of the fraction must be EKUBi 1. We use the Euclidean algorithm to find the image and denominator of the fraction.

```
 - 21n+4 | 14n+3
   14n+3 |   1
 - 14n+3 | 7n+1
   14n+2 |   2
       1  —EKUB(21n+4;14n+3)
```

EKUB(21n+4;14n+3)=1,hence, the given fraction is not reduced.

Method 2. $\frac{21n+4}{14n+3}=\frac{3}{2}+\frac{1}{2(14n+3)}$; from 2 (14n + 3)> 0 at arbitrary $n\in N$, hence the fraction is not reduced.

Issue 2. (1959, International Mathematical Olympiad in Brasov and Bucharest, Romania).

Draw a quadratic equation with respect to $\cos 2x$ whose roots are the same as the roots of Equation $a\cos^2 x+b\cos x+c=0$. Where a, b, c, are real numbers.

Solution: We square both parts of equation $a\cos^2 x+c=-b\cos x$. Here we use $2\cos^2 x=\cos 2x+1$ equations.

$$\frac{a^2}{4}(\cos^2 2x+2\cos 2x+1)+2ac(\cos 2x+1)+c^2=b^2(\cos 2x+1)$$

$$a^2\cos^2 2x+2a^2\cos 2x+a^2+8ac\cos 2x+8ac+c^2-b^2\cos 2x-b^2=0$$ In this case

$$a^2\cos^2 2x+(2a^2+8ac-b^2)\cos 2x+a^2+8ac+c^2-b^2=0.$$

The equation we are looking for in the form.

Issue 3. (1960, Romania, Sinai and Bucharest International Mathematical Olympiads).

All three-digit numbers that are divisible by 11 without remainder are considered. We denote any of them by N. Find all Ns whose division $\frac{N}{11}$ is equal to the sum of the squares of the numbers N.

Solution:

$\overline{abc}$ for a number to be divisible by 11, according to the division rule by 11, a + c-b must be divisible by 11 or equal to 0. So a-b + c = 0 or a-b + c =11 and conditionally

$$\overline{abc} = 100a + 10b + c = 11(a^2 + b^2 + c^2)$$

It follows that:

$$\begin{cases} a - b + c = 11 \\ 99a + 11b + a - b + c = 11\cdot(a^2 + b^2 + c^2) \\ 99a + 11b + 11 = 11\cdot(a^2 + b^2 + c^2) \\ 9a + b + 1 = (a^2 + b^2 + c^2) \end{cases}$$

$$\begin{cases} 9a + b + 1 = 11\cdot(a^2 + b^2 + c^2) \\ a - b + c = 11 \end{cases}$$

Where b = a + c-11 and

$10a+c-10=a^2+(a+c-11)^2+c^2$ or

$-32a+2a^2+2c^2+2ac-23c+131=0$. It follows that: c is an odd number c=2n+1

$a^2-(15-2n)a+4n^2-19n+55=0$

$$a = \frac{15 - 2n \pm \sqrt{5 + 16n - 12n^2}}{2}$$ from here

$D=5+16n-12n^2 \geq 0$

So, $n_1 = \frac{4+\sqrt{31}}{6}; n_2 = \frac{4-\sqrt{31}}{2}$

We set the solutions of $n_2 < n < n_1$ n to the inequality.

$\frac{4-\sqrt{31}}{2} < n < \frac{4+\sqrt{31}}{6} < 2$ is formed.

Here n is an integer and $n \geq 0$ means n = 0 or $n = 1 \cdot n = 0$

When $a = \frac{15 \pm \sqrt{5}}{2}$ n = 1, a = 8 and a = 5

If a = 5, then c = 3, b = -3 no way, if a = 8 then c = 3, b = 0 the numbers we are looking for a = 8, b = 0, c = 3 550 and 803, when we look at the solution of the problem, we are sure that no other number will satisfy.

So the answer is 550 and 803.

Issue 4. (Problem at the International Mathematical Olympiad in Prague, Czechoslovakia, 1962). Find all the real roots of equation $\cos^2 x + \cos^2 2x + \cos^2 3x = 1$.

Solution:

$$2\cos^2 x = 1 + \cos 2x$$

$$2\cos^2 2x = 1 + \cos 4x$$

$$\cos 2x + \cos 4x + 2\cos^2 3x = 0$$

according to the formula for the sum of cosines

$$2\cos 3x \cdot \cos x + 2\cos^2 3x = o$$

or

$$2\cos 3x(\cos x + \cos 3x) = 0$$

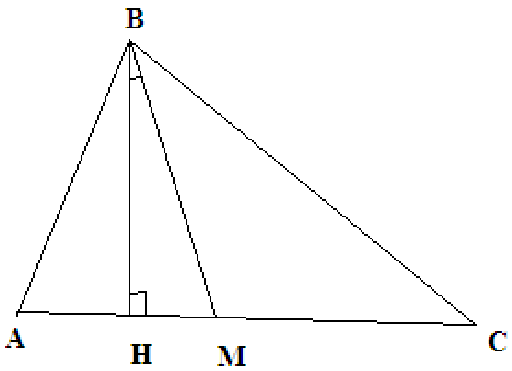
$$2\cos 3x \cdot 2\cos 2x \cdot \cos x = 0$$

Solving the final equation, we obtain the following result.

$$x_1 = \frac{\pi}{2} + k\pi; x_2 = \frac{\pi}{4} + \frac{\pi}{2}k;$$

$$x_3 = \frac{\pi}{6} + \frac{\pi}{3}k, k \in Z$$

Issue 5. (2013. Fergana, Regional Olympiad)



The median of height BH and BM is plotted on the triangle ABC . If AB=1, BC=2 and AM=BM, calculate the angle $\angle MBH$.

Solution: enter the notation: AH = x; HC = y

Depending on the height,

$\left(\frac{1}{2}\right)^2 = \frac{x}{y}$; hence y = 4x

Here is a right triangle ABH and BHC with which BH has a common balance

Since BM-median AC is equal to two and AM = BM, CM = MA = MB. We know that AC = AH + HC = x + y = 5x; AH = x, then HM = 1.5x; BM = 2.5x;

$$\alpha = \angle MBH$$

$\sin\alpha = \frac{HM}{BM} = \frac{1{,}5x}{2{,}5x} = \frac{15}{25} = \frac{3}{5} = 0{,}6$ here $\arcsin\alpha$ $\left[-\frac{\pi}{2}; \frac{\pi}{2}\right]$ since it is determined in the interval, we determine the solution by the $\arccos\alpha$ defined in the positive interval. Using the formula $\cos\alpha = \pm\sqrt{1-\sin^2 x}$, we find that from this, $\alpha = \arccos 0{,}8$.

Answer: $\alpha = \arccos 0{,}8$

Example 6. Simplify:

$$\cos\alpha - \frac{1}{2}\cos 3\alpha - \frac{1}{2}\cos 5\alpha$$

Solution:

We use the formula for multiplying the sum of trigonometric functions.

$$\cos\alpha-\frac{1}{2}(\cos3\alpha+\cos5\alpha)=\cos\alpha-\frac{1}{2}\left[2\cos\frac{3\alpha+5\alpha}{2}\cos\frac{3\alpha-5\alpha}{2}\right]=$$
$$=\cos\alpha-\cos4\alpha\cos\alpha=\{kosinus-juft,\Rightarrow\cos(-\alpha)=\cos\alpha\}=\cos\alpha(1-\cos4\alpha)=$$
$$=\begin{Bmatrix}\cos4\alpha=\cos^2 2\alpha-\sin^2 2\alpha\\ 1=\sin^2 2\alpha+\cos^2 2\alpha\end{Bmatrix}\Rightarrow\cos\alpha(\sin^2 2\alpha+\cos^2 2\alpha-(\cos^2 2\alpha-\sin^2 2\alpha))=$$
$$=\cos\alpha(2\sin^2 2\alpha)=2\cos\alpha(2\cos\alpha\sin\alpha)^2=2\cdot4\cos\alpha\cdot\cos^2\alpha\sin^2\alpha=8\sin^2\alpha\cos^3\alpha$$

Example 7. Solve the inequality: $\log_x(2+x) > \log_{x^2}(x^2+2x)$

Solution: the domain of the equation $x\neq 1$; $x>0$; $x^2>0$; $2+x>0$; $x>-2$; $x^2+2x>0$; $x(x+2)>0$; $x<-2$; $x>0$

We summarize all the resulting solutions: $x\in(0;1)\cup(1;\infty)$.

1) $0<x<1$. $\log_x(2+x)-\log_{x^2}(x^2+2x)>0$

$$\log_x\sqrt{\frac{x+2}{x}}>\log_x 1 \qquad \begin{matrix}\frac{x+2}{x}<1;\\ \frac{2}{x}<0;\\ x<0\end{matrix}$$

The solution x <0 does not satisfy the condition 0 <x <1, so there is no solution.

2) $x>1$; $$\log_x\sqrt{\frac{x+2}{x}}>\log_x 1 \qquad \begin{matrix}\frac{x+2}{x}>1;\\ \frac{2}{x}>0;\\ x>0\end{matrix}$$

If we generalize the condition x> 1 with the solution x> 0, the solution of the given inequality x> 1. According to the domain of the equation , the general answer is:

x> 1.

Example 8. Find the product of the roots of the equation: $|x-2|+|x+3|+|x|=7$

Solution: We use the interval method:

1) $x\le-3$; $-x+2-x-3-x=7$; $3x=8$ $x=-\frac{8}{3}$ does not apply to a given interval, which means that there is no solution in that interval.

2) $-3\le x\le0$ $-x+2+x+3-x=7$ $x=-2$ belongs to a given interval, hence the solution in this interval is x = -2.

3) $0\le x\le2$ $-x+2+x+3+x=7$ $x=2$ belongs to a given interval, so the solution in this interval is x = 2

4) $x\ge2$ $x-2+x+3+x=7$ $3x=6$, $x=2$ belongs to a given interval, so the solution in this interval is again x = 2

Answer: $x_1\cdot x_2=-4$

Conclusion

In conclusion, any Olympiad is an important factor in further improving the knowledge of students, primarily through competition. Mathematical Olympiads, on the other hand, not only develop knowledge but also creative thinking, forcing children to think deeply and deeply. Therefore, if more frequent math Olympiads were organized in schools, colleges and universities, and students were rewarded, we would pave the way for competitive young people who will make a worthy contribution to the development of our country in the future to take part in international competitions.

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