ABOUT THE METHODS OF SOLVING GEOMETRIC PROBLEMS AT THE SCHOOL LEVEL

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Annotasiya: Ushbu maqolada turlicha qiiyinchilikdagi ba’zi masalalarni yechish o’rganilgan bo’lib, ularni o’rganish va yechish orqali umumta’lim maktabi bitiruvchilarida geometrik masalalarni mustaqil yechish ko’nikmalarini shakllantirish hamda geometrik masalalarni yechishda asosiy tushunchalar, teoremalar va formulalarni birgalikda qo’llashga doir turli usullar bilan tanishtirish maqsad qilingan.

Tayanch so’zlar: teorema, formula, bissektrisa, mediana, balandlik, dioganal, urunma, perpendikulyar, burchak, qavariq.

ABOUT METHODS FOR SOLVING GEOMETRIC PROBLEMS AT THE SCHOOL STAGE

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Annotation: this article explores the solution of some problems of varying severity, and through their study and solution, it is aimed to develop the skills of independent solution of geometric problems in graduates of Secondary School, as well as to familiarize themselves with various methods related to the joint application of basic concepts, theorems and formulas in solving geometric problems.

Keywords: theorem, formula, bisector, median, height, dioganal, urunma, perpendicular, angle, convex.

О МЕТОДАХ РЕШЕНИЯ ГЕОМЕТРИЧЕСКИХ ЗАДАЧ НА ШКОЛЬНОМ ЭТАПЕ

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Аннотация: В данной статье изучено решение некоторых задач с различной наклонностью, целью изучения и решения которых является формирование у выпускников общеобразовательных школ навыков самостоятельного решения геометрических задач, а также ознакомление с различными методами совместного применения основных понятий, теорем и формул при решении геометрических задач.
Ключевые слова: теорема, формула, биссектриса, медиана, высота, Диоген, умножение, перпендикуляр, угол, выпуклость.

Solving some geometric problems of varying difficulty requires the joint application of the basic theorems and formulas of geometry (planimetry). Engaging in the study and solution of this type of issue helps teachers, students and students to strengthen their knowledge, skills and abilities. Below we will study several geometric issues of this type.

Issue 1. Is that the square of the bisector of the angle of the Triangle is equal to the subtraction of the product of the cuts that we separate from the integer against the bisector by the product of the integers attached to it, i.e.

$l^2 = ab - a_1b_1$ prove equality.

Solution: we look at the triangles ACD and BCD (fig. 1):

1) according to the cosine theorem $b_1^2 = b^2 + l_c^2 - 2bl_c cos\alpha$,

$a_1^2 = a^2 + l_c^2 - 2al_c cos\alpha$, in this $\alpha = \frac{\angle C}{2}$ From this

$\frac{2bl_c\cos\alpha}{2al_c\cos\alpha}=\frac{b^2+l_c^2-b_1^2}{a^2+l_c^2-a_1^2}$, that is

$l_c^2(b-a)=ab(b-a)-(ab_1^2-a_1^2b)$

(A)

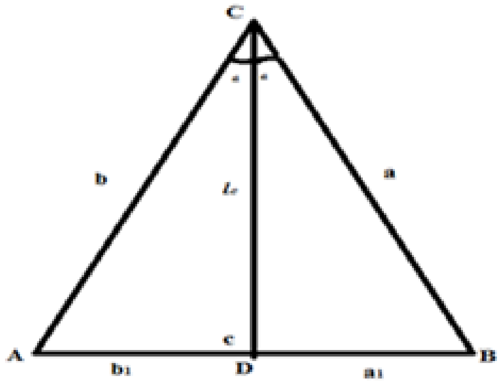

fig.1

2) According to the property of the bisector of the Triangle $\frac{a}{b}=\frac{a_1}{b_1}$ that is $ab_1=ba_1$. Without it $ab_1^2-a_1^2b=a_1bb_1-a_1b_1a=a_1b_1(b-a)$ and (a) equality

$l_c^2(b-a)=ab(b-a)-a_1b_1(b-a)$ comes to view or if $b\neq a$ if, $l_c^2=ab-a_1b_1$. If a = b, then $b_1=a_1=\frac{c}{2}$, $b_1^2=a^2-\frac{c^2}{4}$ and $l_c^2=a^2-\frac{c^2}{4}$.

Say, $l^2=ab-a_1b_1$ appropriate.

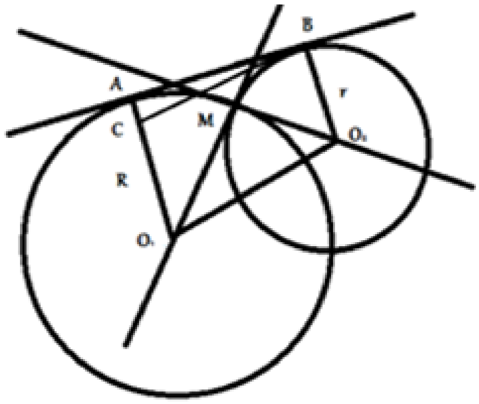

fig.2

Issue 2. Two circles intersect at a right angle (that is, their attempts through one of the points of intersection are mutually perpendicular). If the radii of the circles are R and r, Find the cross section (length)of the total attempt of these circles.

Solution: O_1 and O_2 are given centers of circles, M-one of their intersection points, AB - let it be a common attempt (fig.2)

From the intersection of circles at a right angle, it follows that O_1M is perpendicular to O_2M.

Therefore $O_1O_2=\sqrt{R^2+r^2}$

Let R > r . We pass BC parallel to O_1O_2 and look at ΔABC ($\angle A=90^0$). According to the Pythagorean theorem

AB=$\sqrt{BC^2-AC^2}$=$\sqrt{R^2+r^2-(R-r)^2}$=$\sqrt{2Rr}$.

If $R=r$, then

AB= O_1O_2=R$\sqrt{2}$. So, AB=$\sqrt{2Rr}$.

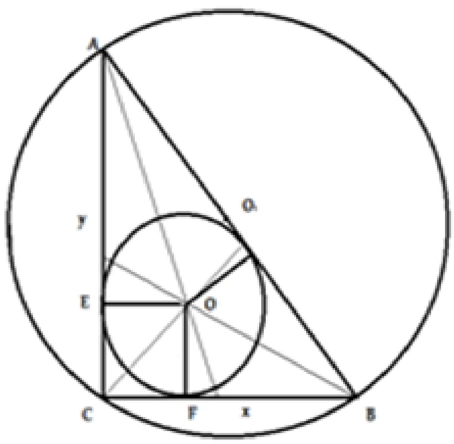

fig.3

Issue 3. The sides of a triangle are 25, 24, and 7. Determine the faces of the circles drawn inside and outside it.

Solution: It is convenient to solve the problem in the following order:

1) Let's mark the sides of the triangle with a, b, c.

Suppose a=7, b=24, c=25.

2) We determine the type of ΔABC: $a^2+b^2=625$ and $c^2=625$, that is, since $a^2+b^2=c^2$, according to the reverse theorem of the Pythagorean theorem, ΔABC is right-angled (fig. 3) .

3) The center of the circle drawn outside the triangle is O_1 - at the point of intersection of the middle perpendiculars transferred to the sides of the triangle. In a right-angled triangle, the center of the inscribed circle is the center of the hypotenuse, that is, R=$\frac{c}{2}$=12,5.

4) The center O of the circle inscribed in the triangle is at the point where the bisectors of the triangle intersect.

5) *BD=BF=x, AE=AF=y*, according to the property of cross-sections of attempts made from a point outside the circle.

6). *BC=a=7* or *r+x=7* according to the condition. *AC=b=24* or *r+y=24* by adding these equalities *2r+(x+y)=31* or *2r+AB =31*, *2r+25=31*. From this *r=3.*

7). Let S_1-inscribed and S_2-external be the faces of circles.

Then $S_1=\pi r^2=9\pi$ (sq. unit.) $S2=\pi R^2=12{,}5^2\pi=\frac{625}{4}\pi$ (sq. unit.).

Note: R and r radii can be found using the formulas $R=\frac{abc}{2ab}=\frac{c}{2}=12{,}5$ and

$S_{\Delta ABC}=pr:\quad R=\frac{abc}{2ab}=\frac{c}{2}=12{,}5,\ r=\frac{S}{p}=\frac{ab}{a+b+c}=\frac{168}{56}=3.$

Issue 4. A triangle ABC with face equal to 1 is given. (figure 4). The medians of the triangle are AK, BL and CN, respectively, and points Q and R are taken

$\frac{AP}{PK}=1,\ \frac{BQ}{QL}=\frac{1}{2},\ \frac{CR}{RN}=\frac{5}{4}$. Find the face of triangle PQR.

Solution: Let the point O be the point of intersection of the medians of the triangle ABC. In that case

$S_{\Delta AOB}=S_{\Delta BOC}=S_{\Delta AOC}=S_{\Delta ABC}=\frac{1}{3}$

Let's look at the triangle ΔPOQ. In this

$OP=\frac{2}{3}AK-\frac{1}{2}AK=\frac{1}{6}AK$

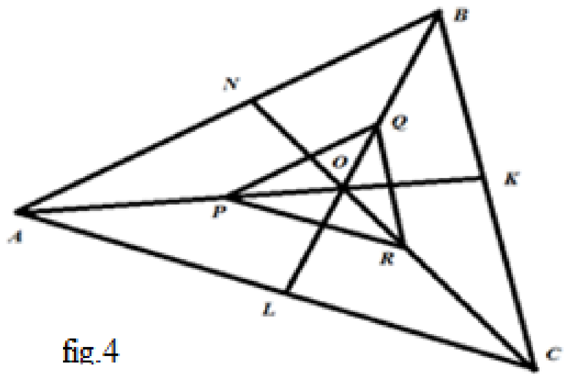

fig.4

$OQ = \frac{2}{3}BL - \frac{1}{3}BL = \frac{1}{3}BL$. And $S_{\Delta POQ} = \frac{1}{2}OP \cdot OQ \sin \angle POQ$, $S_{\Delta AOB} = \frac{1}{2}OA \cdot OB \sin \angle AOB$, if it is taken into account that $\frac{S_{\Delta POQ}}{S_{\Delta AOB}} = \frac{OP \cdot OQ}{OA \cdot OB} = \frac{\frac{1}{6}AK \cdot \frac{1}{3}BL}{\frac{2}{3}AK \cdot \frac{2}{3}BL} = \frac{1}{8}$. From this $S_{\Delta OPQ} = \frac{1}{8}S_{\Delta AOB}$ we will have.

Similarly, we have $S_{\Delta OPQ} = \frac{1}{12}S_{\Delta BOC}$, $S_{\Delta POR} = \frac{1}{24}S_{\Delta AOC}$

Therefore $S_{\Delta PQR} = \frac{1}{3}(\frac{1}{8} + \frac{1}{12} + \frac{1}{24}) = \frac{1}{12}$ (sq. unit).

Issue 5. Find the ratio of the radii of the inner and outer circles of an equilateral triangle with the base α -acute angle.

Solution: ΔABC is an equilateral triangle.

Let ∠A =∠C= α . (fig. 5). We can define AC=b. According to the theorem of sines $\frac{b}{\sin\alpha} = R$. Here, R is the radius of the outer circle. Since the angles at the base of the triangle are equal to α ,

$\angle B = 180^0 - 2\alpha$ and

$sinB = sin(180^0 - \alpha) = sin2\alpha$. So,

$R = \frac{b}{\sin\alpha}$.

Now let point O be the center of the inscribed circle. Then ∠OAD $= \frac{\alpha}{2}$. that is why $r = OD = AD\ tg\frac{\alpha}{2} = \frac{b}{2}tg\frac{\alpha}{2}$. From this

$\frac{r}{R} = sin2\alpha tg\frac{\alpha}{2}$

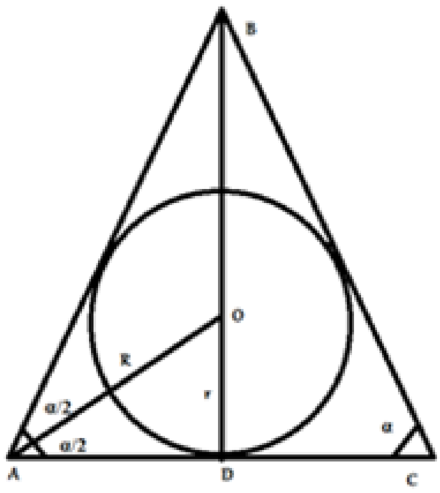

fig.5

Issue 6. The sides of triangle ABC are equal to a, b, c. Find its m_a , m_b , m_c - medians (figure 6).

Solution: Method 1. m_b=BB_1 to find the median, we continue it to the B_1D-section equal to BB_1 and connect point D with points A and C. The resulting quadrilateral ABCD is a parallelogram because the diagonals AC and BD are bisected at the point of intersection. The sum of the squares of the diagonals of a parallelogram is equal to the sum of the squares of its sides, i.e. $b^2+(2m_b)^2=2a^2+2c^2$. From this

$$m_b=\frac{1}{2}\sqrt{2a^2+2c^2-b^2}.$$

Similarly, the medians m_a and m_c are found.

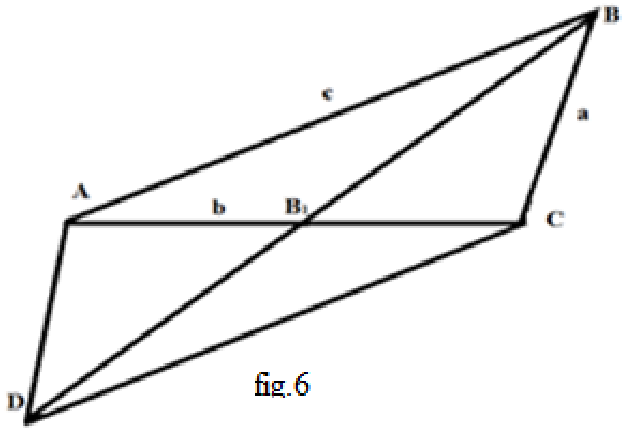

fig.6

Method 2. Let $\angle AB_1B=\alpha$. Then $\angle BB_1C=180^0-\alpha$. According to the theorem of cosines

$$c^2=\frac{b^2}{4}+m_b^2-2m_b\frac{b}{2}cos\alpha,$$

$$a^2=\frac{b^2}{4}+m_b^2-2m_b\frac{b}{2}cos(180^0-\alpha)$$

Adding these equations,

Considering that $cos(180^0-\alpha)=-cos\alpha$,

$a^2+c^2=\frac{b^2}{2}+2m_b^2$. From this $m_b=\frac{1}{2}\sqrt{2a^2+2c^2-b^2}$.

In conclusion, we can say that it is not difficult to understand that the study of geometric problems with a high degree of complexity, including the solution of the geometric problems presented in this article, lies in the expansion of the basic methods and substitution formulas. In this process, it is important to correctly imagine the shape of the geometric figure (shape) given in the problem and reflect it in the drawing and to be able to use its properties correctly, and by strengthening the acquired knowledge, one or the other the ability to solve problems develops. There are also many complex problems related to other topics of geometry[1-16], regularly continuing to solve them for a certain period of time helps to develop mathematical ability.

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