МЕДИЦИНА, ПЕДАГОГИКА И ТЕХНОЛОГИЯ: ТЕОРИЯ И ПРАКТИКА
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APPLICATION OF ELEMENTS OF TRIGONOMETRY IN SOLUTION OF TRIANGLES

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ANNOTATION

This in the article of geometry school in the chair important role who plays trigonometry department triangles to solve circle applications viewed Triangles in solving three element giving , his the rest elements to find issues seen Such issues in solving in trigonometry equivalent ratios support unknown elements to determine method such as practical issues solve viewed

Key words : Sinuses theorem , Cosines theorem , Molweide formula , triangles in solving three in case issues .

THE USE OF TRIGONOMETRY ELEMENTS IN SOLVING TRIANGLES

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ABSTRACT

This paper discusses the implementation of the trigonometry section, which plays an important role in the school geometry course concerning the solution of triangles. When solving triangles, problems are constructed to find the rest of its elements, giving three of its elements. When solving triangles, problems are constructed to find the rest of its elements, giving three of its elements. When solving such problems, it is possible to solve practical problems, such as the method of determining equivalent ratios and unknown elements in trigonometry.

Keywords: The sine theorem, the cosine theorem, the Mollweide formula, three-case problems in solving triangles.

INTRODUCTION

of trigonometry appear to be in practice calculations , exactly different geometric forms elements in finding given elements enough quantity according to this elements to determine necessity the need with depend In ancient times Ancient in Greece one row astronomical issues solve with depends calculations during trigonometry field development important contribution added of trigonometry in the

X- IX and XIII centuries Central Asia and Caucasian regions of scientists scientific works and created works main important have

Science next development era that's it showed that trigonometric functions only work in release not but count in geometry solve for necessary which hardware functions ; as well as this functions mechanics and in physics periodic processes also important in learning role plays So so , trigonometric functions to the theory based on without analytical geometry direction appear it has been . Trigonometric of functions geometric theory trigonometry practical to issues application to do more suitable will come

MAIN PART

of the problem from the content come until it comes out triangles in solving geometric apparently except of the matter to the classification have to be no doubt These are as follows to the circumstances is divided into :

first case . Of the triangle two corner and one given a linear element let it be ;

Second case Of the triangle one corner and two given a linear element let it be ;

Third case Of the triangle three given a linear element let it be

Triangles to solve circle issues solve method according to the first in the case issues directly row equivalent proportions tools with will be solved . Second in case issues trigonometric to Eqs to the system is brought . This in the case in matters of the triangle again one second corner to find need will be Otherwise in other words $\alpha+\beta+\gamma=\pi$ relationship will be done . Third in case in matters of the triangle two corner is found . In general so to speak , on condition the given element is a triangle corner element if not , that is triangle sides when given, the problem becomes simpler .

Issue 1. ABC in a triangle $(b<c)$ $a=78,\ R=65,\ r=28$ is equal to if , then b and c find the

This is the third issue in case is an issue . Sinuses from the theorem $\sin\alpha=\frac{78}{130}=\frac{3}{5}\left(\frac{a}{2R}=\frac{3}{5}\right)$ relationships we can From this $\cos\alpha=\frac{4}{5}$ $\left(\alpha<90^0\right)$ and $tg\frac{\alpha}{2}=\frac{1}{3}$, but $\frac{P}{2}-a=\frac{r}{tg\frac{\alpha}{2}}$ from $\frac{P}{2}-a=84$, $P=162$, $P=324$ from that $b+c=246$ is taken . Secondly $bc=\frac{2S}{\sin\alpha}=\frac{\Pr}{\sin\alpha}=15120.$

So,

$$\begin{cases} b+c=246, \\ bc=15120. \end{cases}$$

$b<c$ that it was for $b=120,\ c=126$ come comes out

If $\alpha>90^0$ if so , then equations system for real didn't happen solution come comes out

Reminder . $\sin\alpha=\frac{3}{5}$ and $\cos\alpha=-\frac{4}{5}$ from being $tg\frac{\alpha}{2}=3$ is equal to . $\frac{P}{2}-a=\frac{28}{3}$ and $\cos\alpha=-\frac{4}{5}$ from being $\frac{P}{2}=\frac{28+234}{3}=\frac{262}{3}$. From this $P=a+b+c=\frac{524}{3}$ and $b+c=\frac{524}{3}-78=\frac{290}{3}$. $bc=\frac{\Pr}{\sin\alpha}=\frac{524\cdot 28\cdot 5}{3\cdot 3}=\frac{73360}{9}$;

$$z^2-\frac{290}{3}z+\frac{73360}{9}=0,$$

$$z_{1,2}=\frac{145\pm\sqrt{-52335}}{3}, z_1=b, z_2=c; b,c\in\mathbb{C}.$$

Issue 2. In the triangle $R^2+4\sqrt{3}S=b^2+c^2$ relationship it is appropriate . Of the triangle a side opposite α find the angle .

This issue is also third in case is an issue . $2S=bc\sin\alpha$ and $b^2+c^2=a^2+2bc\cos\alpha$ known in formulas S and b^2+c^2 of value given to the relationship if you put it , then

$$R^2+2\sqrt{3}bc\sin\alpha=a^2+2bc\cos\alpha$$

is taken . Here a,b,c line elements corner to the element if we replace (i.e $a=2R\sin\alpha,\ a=2R\sin\alpha,\ c=2R\sin\gamma$), then :

$$R^2+8\sqrt{3}R^2\sin\alpha\sin\beta\sin\gamma=4R^2\sin^2\alpha+8\sin\beta\sin\gamma\cos\alpha$$

or R^2 abbreviated to :

$$1+8\sqrt{3}\sin\alpha\sin\beta\sin\gamma=4\sin^2\alpha+8\sin\beta\sin\gamma\cos\alpha.$$

From this

$$1-4\sin^2\alpha=8\sin\beta\sin\gamma\left(\cos\alpha-\sqrt{3}\sin\alpha\right);$$

$$\frac{1}{4}-\sin^2\alpha=4\sin\beta\sin\gamma\left(\frac{1}{2}\cos\alpha-\frac{\sqrt{3}}{2}\sin\alpha\right)$$

or

$$\left(\frac{1}{2}-\sin\alpha\right)\left(\frac{1}{2}+\sin\frac{\alpha}{2}\right)=4\sin\beta\sin\gamma\left(\sin 30^0\cos\alpha-\cos 30^0\sin\alpha\right),$$

or

$$\left(\sin 30^0-\sin\alpha\right)\left(\sin 30^0+\sin\frac{\alpha}{2}\right)=4\sin\beta\sin\gamma\sin\left(30^0-\alpha\right),$$

or

$$2\sin\frac{30^0-\alpha}{2}\cos\frac{30^0+\alpha}{2}\cdot 2\sin\frac{30^0+\alpha}{2}\cos\frac{30^0-\alpha}{2}=4\sin\beta\sin\gamma\sin\left(30^0-\alpha\right),$$

$$2\sin\frac{30^0-\alpha}{2}\cos\frac{30^0-\alpha}{2}\cdot 2\sin\frac{30^0+\alpha}{2}\cos\frac{30^0+\alpha}{2}=4\sin\beta\sin\gamma\sin\left(30^0-\alpha\right).$$

From this $\sin\left(30^0-\alpha\right)=0$ and $\sin\left(30^0+\alpha\right)=4\sin\beta\sin\gamma$ is taken .

1) $\sin\left(30^0-\alpha\right)=0$ from

$$\alpha=30^0 \qquad (2)$$

come comes out

2)

$$\sin\left(30^0+\alpha\right)=4\sin\beta\sin\gamma \qquad (3)$$

from being $\alpha=30^0$ if , is given relationship β and γ of each how in value (as well as a,b of each how in the value of) is appropriate will be

(3) according to the formula α of value β and γ of to the value of depends has been without countless will $\sin\beta>0,$ be $\sin\gamma>0$ from being $\sin\left(30^0+\alpha\right)>0,$ ie $\beta<150^0$ will be (3) formula from exchange after :

$$\sin\left(30^0+\alpha\right)=4\sin\beta\sin\left(\alpha+\beta\right);$$

$$\sin 30^0\cos\alpha+\cos 30^0\sin\alpha=4\sin\beta\left(\sin\alpha\cos\beta+\cos\alpha\sin\beta\right);$$

$$\frac{1}{2}\cos\alpha+\frac{\sqrt{3}}{2}\sin\alpha=4\sin\beta\sin\alpha\cos\beta+4\sin^2\beta\cos\alpha;$$

$$\cos\alpha+\sqrt{3}\sin\alpha=8\sin\beta\sin\alpha\cos\beta+8\sin^2\beta\cos\alpha;$$

$$\left(1-8\sin^2\beta\right)\cos\alpha=\left(4\sin 2\beta-\sqrt{3}\right)\sin\alpha$$

or

$$tg\alpha=\frac{1-8\sin^2\beta}{4\sin 2\beta-\sqrt{3}}=\frac{1-4\left(1-\cos 2\beta\right)}{4\sin 2\beta-\sqrt{3}}=\frac{4\cos 2\beta-3}{4\sin 2\beta-\sqrt{3}}. \qquad (4)$$

Fraction photo the most big or the denominator the most small was without (4) fraction the most big to value achieves Accordingly , $\cos 2\beta$ of the most big value

$\cos 2\beta = 0$ that it was for if we put it in (4) , $tg\frac{\alpha}{2} = -\frac{1}{\sqrt{3}}$ and $\alpha = 150^0$ is equal to will be

Issue 3. In the triangle $\alpha = 43^0$ when $2S = ab\sqrt{\sin^2\alpha + \sin^2\beta + \sin\alpha\sin\beta}$ relationship appropriate if , of the triangle the rest find the angles .

This issue is the first become belongs to This problem in 2 ways we solve :

Method 1 . Triangle face :

$$S = \frac{ab\sin\gamma}{2}.$$

That's a given to the relationship put and then him ab we reduce to :

$$\sin^2\gamma = \sin^2\alpha + \sin^2\beta + \sin\alpha\sin\beta \qquad (5)$$

or

$$\sin^2\gamma - \sin^2\beta = \sin\alpha(\sin\alpha + \sin\beta).$$

one on the left squares the difference to the lifters separate we write :

$$2\sin\frac{\gamma+\beta}{2}\cos\frac{\gamma-\beta}{2}\cdot 2\cos\frac{\gamma+\beta}{2}\sin\frac{\gamma-\beta}{2} = \sin\alpha(\sin\alpha + \sin\beta)$$

or

$$\sin(\gamma+\beta)\sin(\gamma-\beta) = \sin\alpha(\sin\alpha + \sin\beta). \qquad (6)$$

$$\sin(\gamma+\beta) = \sin\alpha$$

and put it in (6) :

$$\sin(\gamma-\beta) = \sin\alpha + \sin\beta.$$

the left side of this $\sin(\gamma+\beta)$ ni , right by $\sin\alpha$ the subtract :

$$\sin(\gamma-\beta) - \sin(\gamma+\beta) = \sin\alpha + \sin\beta - \sin\alpha$$

or

$$-2\sin\beta\cos\gamma = \sin\beta \text{ or } \sin\beta(1 + 2\sin\gamma) = 0.$$

In this $\sin\beta \neq 0$ from being $1 + 2\cos\gamma = 0,\ \cos\gamma = -\frac{1}{2}.$

But $\gamma < 180^0$ from being $\gamma = 120^0$ is , from which :

$\beta = 180^0 - 120^0 - 43^0 = 17^0$. So, $\beta = 17^0$.

Method 2 . (5) is $4R^2$ if we increase to (in this case R external circle radius),

$$4R^2\sin^2\gamma = 4R^2\sin^2\alpha + 4R^2\sin^2\beta + 4R^2\sin\alpha\sin\beta$$

become

$\frac{a}{\sin\alpha}=\frac{b}{\sin\beta}=\frac{c}{\sin\gamma}=2R$ from

$\frac{a^2}{\sin^2\alpha}=4R^2, \frac{b^2}{\sin^2\beta}=4R^2, \frac{c^2}{\sin^2\gamma}=4R^2$

or

$\sin^2\alpha=\frac{a^2}{4R^2}, \sin^2\beta=\frac{b^2}{4R^2}, \sin^2\gamma=\frac{c^2}{4R^2}$

come comes out

Let's put these in (5) :

$$\frac{c^2}{4R^2}=\frac{a^2}{4R^2}+\frac{b^2}{4R^2}+\frac{a}{2R}\cdot\frac{b}{2R}$$

or

$$c^2=a^2+b^2+ab. \qquad (7)$$

Then look cosines from the theorem $c^2=a^2+b^2-2ab\cos\gamma$ equation (7) . compare :

$$ab=-2ab\cos\gamma \text{ or } \cos\gamma=-\frac{1}{2},$$

so $\gamma=120^0$ become $\beta=17^0$.

Issue 4. Triangle sides between

$$a+c=2b \qquad (8)$$

relationship there is and

$$tg\frac{\gamma}{2}=\frac{2}{5}, \qquad (9)$$

$tg\frac{\alpha}{2}$, $tg\frac{\beta}{2}$ of functions values define

This issue is second become belongs to do it in 2 ways we solve :

Method 1. Molweide formula by :

$$\frac{a+c}{b}=\frac{\cos\frac{\alpha-\gamma}{2}}{\sin\frac{\beta}{2}}=\frac{\cos\frac{\alpha}{2}\cos\frac{\gamma}{2}+\sin\frac{\alpha}{2}\sin\frac{\gamma}{2}}{\cos\frac{\alpha}{2}\cos\frac{\gamma}{2}-\sin\frac{\alpha}{2}\sin\frac{\gamma}{2}}=\frac{1+tg\frac{\alpha}{2}tg\frac{\gamma}{2}}{1-tg\frac{\alpha}{2}tg\frac{\gamma}{2}}. \qquad (10)$$

According to (8). $\frac{a+c}{b}=2$ write that can So,

$$\frac{1+tg\frac{\alpha}{2}tg\frac{\gamma}{2}}{1-tg\frac{\alpha}{2}tg\frac{\gamma}{2}}=2.$$

in (9). $tg\frac{\gamma}{2}$ of value if we write :

$$\frac{1+\frac{5}{2}tg\frac{\gamma}{2}}{1-\frac{2}{5}tg\frac{\gamma}{2}}=2 \text{ or } \frac{5+2tg\frac{\gamma}{2}}{5-2tg\frac{\gamma}{2}}=2.$$

From this :

$$tg\frac{\alpha}{2}=\frac{5}{6}. \qquad (11)$$

Now $tg\frac{\beta}{2}$ the we find that for as follows to replace let's see :

$$tg\frac{\gamma}{2}=ctg\frac{\alpha+\beta}{2}=\frac{1-tg\frac{\alpha}{2}tg\frac{\beta}{2}}{1+tg\frac{\alpha}{2}tg\frac{\beta}{2}}. \qquad (12)$$

Condition according to $tg\frac{\gamma}{2}=\frac{2}{5}$ is equal to . So,

$$\frac{1-tg\frac{\alpha}{2}tg\frac{\beta}{2}}{1+tg\frac{\alpha}{2}tg\frac{\beta}{2}}=\frac{2}{5}$$

from this $tg\frac{\beta}{2}=\frac{18}{35}$.

Method 2 . Half corner tangent formula

$$tg\frac{\alpha}{2}=\sqrt{\frac{(P-2b)(P-2c)}{P(P-2a)}} \text{ and } tg\frac{\gamma}{2}=\sqrt{\frac{(P-2a)(P-2b)}{P(P-2c)}}$$

from $tg\frac{\alpha}{2}tg\frac{\gamma}{2}=\frac{P-2b}{P}=\frac{a+c-b}{a+c+b}$ will be

From this given a must according to

$$\frac{2}{5}tg\frac{\alpha}{2}=\frac{2b-b}{2b+b}=\frac{1}{3}$$

or $tg\frac{\alpha}{2}=\frac{5}{6}$ comes out $tg\frac{\beta}{2}$ and that 's it road we find

Issue 5. If $\alpha,\ \beta$ and γ are triangular corners if $\cos\frac{\alpha}{2},\ \cos\frac{\beta}{2}$ and $\cos\frac{\gamma}{2}$ cuts triangle sides to be show me

This is the third issue become belongs to become him as follows we solve :

$\sin\frac{\alpha}{2}<1,\ \sin\frac{\beta}{2}<1$ from being

$$\cos\frac{\gamma}{2}=\cos\left(90^0-\frac{\alpha+\beta}{2}\right)=\sin\frac{\alpha+\beta}{2}=\sin\frac{\alpha}{2}\cos\frac{\beta}{2}+\sin\frac{\beta}{2}\cos\frac{\alpha}{2}.$$

come comes out , that is one side the other 2 sides from the assembly line small from being , this from cuts triangle to make possible come comes out

CONCLUSION

Current in the day elementary mathematics of science separately indispensable part of trigonometry another sciences with mutually dependence , wide branching , science and technology development in development each in step to trigonometry face we will come That is from mathematics except another sciences in learning this department of science deep demands to know .

Department of trigonometry each bilaterally and deep study in this direction addition scientific and methodical materials through mathematician knowledge and skills expand to the goal according to will be

Geometry school in the chair another fields such as theory in trigonometry in practice application to achieve , that is issues solve qualification it is required to acquire . But in practice this in the field many to difficulties face will come .

Like this practical also trigometric in problems issues in solving row equivalent of proportions application reach important role plays

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