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FIND THE LENGTHS OF TWO TRAJECTORIES THAT DIVIDE AN ARBITRARY TRIANGLE INTO THREE EQUAL ANGLES

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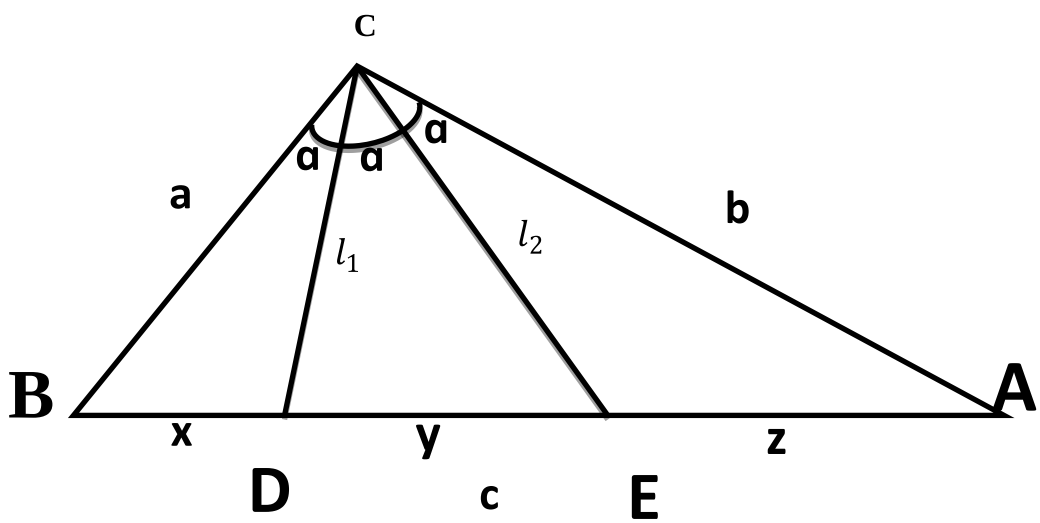
ABSTRACT

In this paper, the angle of a triangle can be divided into 3 equal parts, and it is given to find 2 tresektrissa of different lengths coming out of one angle.

KEYWORDS: *Triangle, Angle, Triangle Surface, Bisector Ratio, Sin a Cos 2 a, Sin2 a, Triangle Ratio And Sides Ratio.*

INTRODUCTION

If we are given two sides of an arbitrary triangle ABC and one angle between them.Find two tresektrissa l_1 and l_2 that divide one of the angles of the triangle into three equal parts.



The sides of a triangleBC=a ,AC= b ,AB=c sides and< BCA=3 ɑ let's say. Here are two bicyclesAB sidex , y and z to lengths. AB=c= =x+y+zget.TriangleBCE Let us give this formula when the angle of a triangle is equal to two.

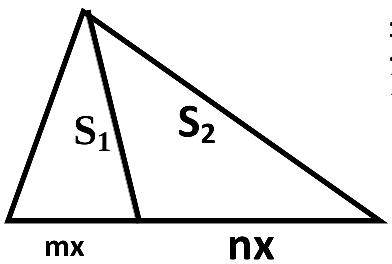
$\frac{a}{x} = \frac{l_2}{y}$

TriangleDAC and for these formulas, l_1 va l_2Let's simplify them.

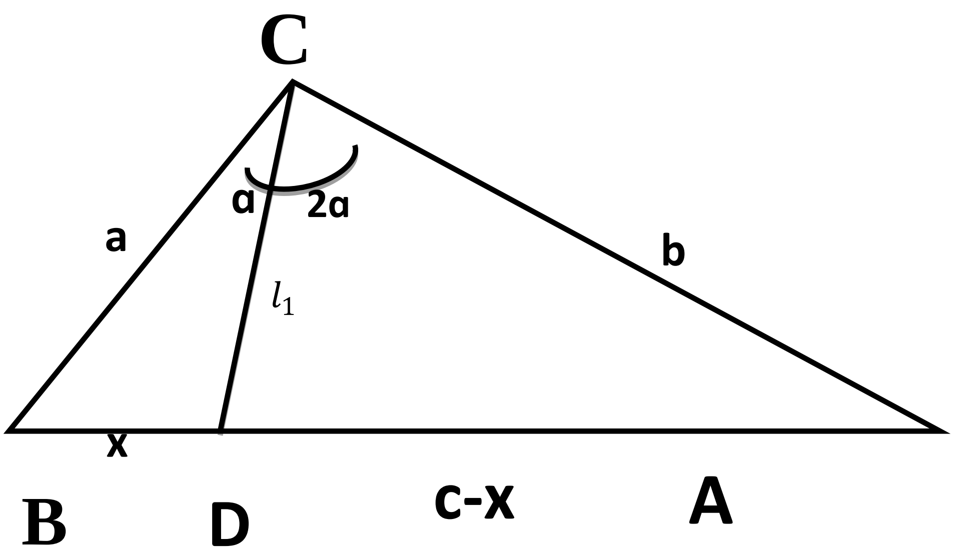
$\frac{l_1}{y} = \frac{b}{z}$

$l_1 = b\frac{y}{z} l_2 = a \frac{y}{x}$

Now we find that x, y, and z are the sides of a and b and the 3 ɑ between them. To do this, we need this formula.The side of a triangle has the same proportion as the opposite side of the straight line from the end of the triangle..



$\frac{S_1}{S_2} = \frac{m}{n}$So based on this formula we get the ratio of the triangles BCD and CAD.



$\frac{S_{BDC}}{S_{CDA}} = \frac{x}{c-x}$

Now we write this on the surfaces of a triangle, come to the following formula, and simplify it by finding the x by shortening the denominator.

$\frac{\frac{1}{2} a l_1 \sin a}{\frac{1}{2} l_1\ b\ \sin 2a} = \frac{x}{c-x} \frac{a \sin a}{2\ b\ \sin a \cos a} = \frac{x}{c-x} \frac{a}{2\ b\ \cos a} = \frac{x}{c-x}$

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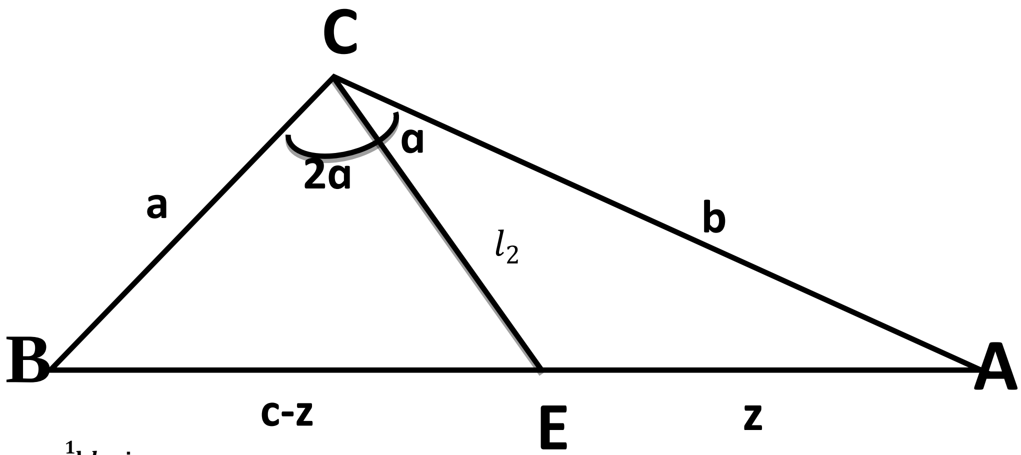
a (c-x) = 2b x cos a **ac – ax = 2bxcos a**

ac= ax+2bx cos a **x (a+2b cos a) = ac**

x=$\frac{a\,c}{a+2bcosa}$

So we found x and now we can find z in the same way.



$\frac{S_{CEA}}{S_{BCE}} = \frac{z}{c-z}\frac{\frac{1}{2}bl_2 \sin a}{\frac{1}{2}al_2\ sin2a} = \frac{z}{c-z}\frac{b}{2\ a\ cosa} = \frac{z}{c-z}$

b(c-z) = 2 a z cos a **bc – bz = 2az cos$a$**

z=$\frac{bc}{b+2a\ cosa}$

So we found z, now we just have to find y. For this**y= c-(x+z)**we use.

y=c-x-z

y=c-$\frac{a\,c}{a+2bcosa}$ **-** $\frac{b}{b+2a\ cosa}$ **y=c(1-**$\frac{a}{a+2bcosa}$ **-** $\frac{b}{b+2a\ cosa}$**)**

y=c($\frac{(a+2bcosa)(b+2a\ cosa)-a(b+2a\ cosa)-b(a+2bcosa)}{(a+2bcosa)(b+2a\ cosa)}$**)**

Now we can just simplify the image by opening the parentheses and narrowing down the similar terms.

y= c ($\frac{ab+2a^2cosa+2b^2\ cosa+4ab\ cos^2 a-ab-2a^2cosa-ab-2b^2\ cosa}{(a+2bcosa)(b+2a\ cosa)}$**)**

y= c ($\frac{4ab\ cos^2 a-ab}{(a+2bcosa)(b+2a\ cosa)}$**)** **y=** $\frac{abc(4\ cos^2 a-1)}{(a+2bcosa)(b+2a\ cosa)}$

So we found x, y, and z by the sides a, b, and the angle cosa

$l_1$and$l_2$by shortening similar terms by placing them in place to find them

$l_1$and$l_2$we can find.

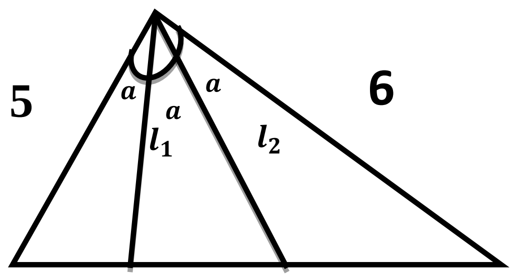
$l_1 = b\frac{y}{z}\ l_2 = a\ \frac{y}{x}$

$$\boldsymbol{l_1} = \mathrm{b}\frac{\frac{\mathrm{abc}(4\,cos^2\,a-1)}{(\mathrm{a}+2bcosa)(b+2\mathrm{a}\,cosa)}}{\frac{bc}{b+2\mathrm{a}\,cosa}}\quad \boldsymbol{l_1} = \frac{\mathrm{ab}(\,4cos^2\,a-1)}{\mathrm{a}+2bcosa}$$

$$\boldsymbol{l_2} = \mathrm{a}\frac{\frac{\mathrm{abc}(4\,cos^2\,a-1)}{(\mathrm{a}+2bcosa)(b+2\mathrm{a}\,cosa)}}{\frac{\mathrm{a}\,c}{\mathrm{a}+2bcosa}}\quad \boldsymbol{l_2} = \frac{\mathrm{ab}(4\,cos^2\,a-1)}{b+2\mathrm{a}\,cosa}$$

So we have found l_1 and l_2, now that we are working on examples of these formulas and checking that the faces of the three triangles separated by these tresektrissa must be equal to the faces of the common triangles.

Example 1: If the sides of a triangle are 5cm, 6cm and the angle between them is given by 10 ˚, and find the angular tresektrissa that divide this angle into three equal parts.



a=5 **b=6** **3α = 10** equal .

The face of a triangle

$S=\frac{1}{2}5 \cdot 6\sin 10^o=$

$= 15\sin 10^o$

$$\boldsymbol{l_1} = \frac{\mathrm{ab}(4\,cos^2\,a-1)}{\mathrm{a}+2bcosa} = \frac{5\cdot 6(4\,cos^2\frac{10}{3}-1)}{5+12cos\frac{10}{3}} = \frac{30(4\,cos^2\frac{10}{3}-1)}{5+12cos\frac{10}{3}}$$

$$\boldsymbol{l_2} = \frac{\mathrm{ab}(4\,cos^2\,a-1)}{b+2\mathrm{a}\,cosa} = \frac{30(4\,cos^2\frac{10}{3}-1)}{6+10cos\frac{10}{3}}$$

Now let's use these tresektrissa to check that the sum of the three triangles is equal to the total area of the triangle.

$15\sin 10^o = S_1 + S_2 + S_3 S_1 = \frac{1}{2}a\, l_1 \sin\frac{10}{3} S_2 = \frac{1}{2}\, l_1 l_2 \sin\frac{10}{3} \qquad S_3 = \frac{1}{2}\, b l_2 \sin\frac{10}{3}$

$S = \frac{1}{2}5\cdot\frac{30(4\,cos^2\frac{10}{3}-1)}{5+12cos\frac{10}{3}}\sin\frac{10}{3} + \frac{1}{2}\frac{30(4\,cos^2\frac{10}{3}-1)}{5+12cos\frac{10}{3}}\cdot\frac{30(4\,cos^2\frac{10}{3}-1)}{6+10cos\frac{10}{3}}\sin\frac{10}{3} +$

$+\frac{1}{2}\,6\cdot\frac{30(4\,cos^2\frac{10}{3}-1)}{6+10cos\frac{10}{3}}\sin\frac{10}{3}$

Andy$\frac{1}{2}\cdot 30\cdot\sin\frac{10}{3}\cdot(4\,cos^2\,\frac{10}{3}-1)$out of parentheses.

$$\mathbf{S=15}\cdot\sin\frac{10}{3}\cdot(4\,cos^2\,\frac{10}{3}-1)\left(\frac{5}{5+12cos\frac{10}{3}} + \frac{30(4\,cos^2\frac{10}{3}-1)}{(5+12cos\frac{10}{3})(6+10cos\frac{10}{3})} + \frac{6}{6+10cos\frac{10}{3}}\right)$$

$$\mathbf{S=15}\cdot\sin\frac{10}{3}\cdot(4\,cos^2\,\frac{10}{3}-1)\left(\frac{5(6+10cos\frac{10}{3})+30\left(4\,cos^2\frac{10}{3}-1\right)+6\,(5+12cos\frac{10}{3})}{(5+12cos\frac{10}{3})(6+10cos\frac{10}{3})}\right)$$

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$$\mathbf{S=15\cdot\sin\frac{10}{3}\cdot\left(4\cos^2\frac{10}{3}-1\right)\left(\frac{30+50\cos\frac{10}{3}+120\cos^2\frac{10}{3}-30+30+72\cos\frac{10}{3}}{30+50\cos\frac{10}{3}+72\cos\frac{10}{3}+120\cos^2\frac{10}{3}}\right)}$$

$$\mathbf{S=15\cdot\sin\frac{10}{3}\cdot\left(4\cos^2\frac{10}{3}-1\right)\left(\frac{120\cos^2\frac{10}{3}+122\cos\frac{10}{3}+30}{120\cos^2\frac{10}{3}+122\cos\frac{10}{3}+30}\right)=15\cdot\sin\frac{10}{3}\cdot\left(4\cos^2\frac{10}{3}-1\right)\cdot 1}$$

Now let's add an extra formula here.

$\sin 3\alpha=\sin(2\alpha+\alpha)=\sin 2\alpha\cdot\cos\alpha+\sin\alpha\cdot\cos 2\alpha=2\sin\alpha\cdot\cos\alpha\cdot\cos\alpha+\sin\alpha\cdot(2\cos^2\alpha-1)=$ $2\sin\alpha\cdot\cos^2\alpha+2\sin\alpha\cdot\cos^2\alpha-\sin\alpha=4\sin\alpha\cdot\cos^2\alpha-\sin\alpha=$

$=\sin\alpha\,(4\cos^2\alpha-1)$

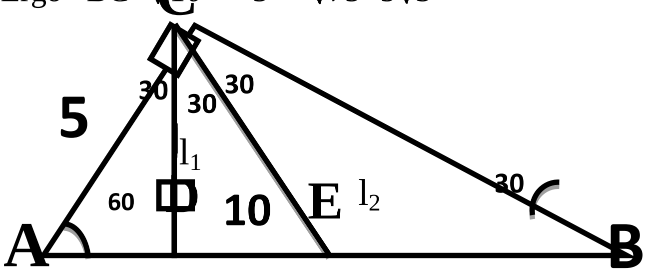
So $\sin\frac{10}{3}\cdot\left(4\cos^2\frac{10}{3}-1\right)=\sin 3\cdot\frac{10}{3}=\sin\ 10^\circ$

$S=15\sin\ 10^\circ$ proved to be equal.

For example -2 :If the catheter of a right triangleAC=5 smandhypotenuse

AB=10 smis equal to, C find the tresektrissa that divide the angle into three equal angles?

Ergo $BC=\sqrt{10^2-5^2}=\sqrt{75}=5\sqrt{3}$



$\sin B=\frac{5}{10}$ $\sin B=\frac{1}{2}$ $<B=30^\circ$,

$<A=60^\circ$ equally

Ergo $<A=<E$ from equality $AC=CE=l_2=5$ it turns out that,

$\sin B=\frac{l_1}{BC}$ which is derived from the triangular CDB and is calculated by putting it in place l_1 let's find $l_1=BC\cdot\sin B=5\sqrt{3}\cdot\sin 30^\circ=\frac{5\sqrt{3}}{2}$ equality arises .Now created in the beginning l_1 and l_2 let's recalculate and check for equality. Here $\alpha=30^\circ$ equal.

$$l_1=\frac{ab(4\cos^2\alpha-1)}{a+2b\cos\alpha}=\frac{5\cdot5\sqrt{3}(4\cos^2 30^\circ-1)}{5+2\cdot5\sqrt{3}\cos 30^\circ}=\frac{25\sqrt{3}(4\cdot\frac{3}{4}-1)}{5+10\sqrt{3}\cdot\frac{\sqrt{3}}{2}}=\frac{50\sqrt{3}}{20}=\frac{5\sqrt{3}}{2}$$

$$l_2=\frac{ab(4\cos^2\alpha-1)}{b+2a\cos\alpha}=\frac{5\cdot5\sqrt{3}(4\cos^2 30^\circ-1)}{5\sqrt{3}+2\cdot5\cos 30^\circ}=\frac{25\sqrt{3}(4\cdot\frac{3}{4}-1)}{5\sqrt{3}+5\sqrt{3}}=\frac{50\sqrt{3}}{10\sqrt{3}}=5$$

It follows that the formulas we have created are correct.

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