

Circle & Triangle Solution

“CiTri” Solves 22 multiple equations

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HP-50g

First: Store the “CITRI.hp” directory as a soft menu key as shown. This will install all program files that are required:

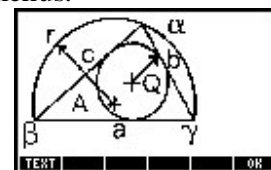


Execute “CITRI” and it will open the directory as shown:



“CiTri” key will start the program that solves for 7 unknown variables from any 3 known variables. The program solves 22 multiple equations to determine the unknown variables. The variables are defined in the “PIC” and “LVARI” soft keys menus.

“Pic” key will show two different views of the geometry, small and large views of the same geometry. (To better view the image select the “Pic” image and the “TOOL” button and “VIEW” soft key)



“LVARI” key lists all the variables



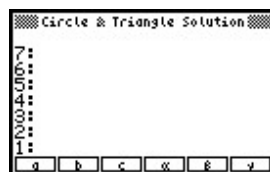
“SeeEQ” key will show the 22 equation to be solved. (View in graphic window: Use the up arrow key and select an equation, select “VIEW” soft key)

Running the program, “CiTri” – solution examples

To run the program, press the “CiTri” soft menu key. You will now have the MES menu corresponding to the circle & triangle solutions. Examples are listed See example 1 & 2).



“CiTri” start program



Enter data



Solution window

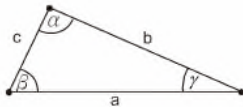


Solution Equations

Functions of a Circle & Oblique Angle Triangle

All 22 equations and 10 variables are as follows:

Sine rule
“a, b & c” sides
of triangle



Tangent rule
“ α , β , & γ ” angles
of triangle

Cosine rule

“r” radius of
larger circle

“A” = Area of
triangle

Half angle rule
“Q” = radius of
small circle

“s” = Semi-perimeter
of triangle

“ α ” = Interior angles of triangle

“A” = Area of triangle

“A” = Heron’s formula

$$\frac{\sin(\alpha)}{a} = \frac{\sin(\gamma)}{c}$$

$$\frac{\sin(\beta)}{b} = \frac{\sin(\gamma)}{c}$$

$$\frac{\sin(\alpha)}{a} = \frac{\sin(\beta)}{b}$$

$$\frac{a+b}{a-b} = \frac{\tan\left(\frac{\alpha+\beta}{2}\right)}{\tan\left(\frac{\alpha-\beta}{2}\right)}$$

$$\frac{a+c}{a-c} = \frac{\tan\left(\frac{\alpha+\gamma}{2}\right)}{\tan\left(\frac{\alpha-\gamma}{2}\right)}$$

$$\frac{b+c}{b-c} = \frac{\tan\left(\frac{\beta+\gamma}{2}\right)}{\tan\left(\frac{\beta-\gamma}{2}\right)}$$

$$a^2 = b^2 + c^2 - 2 \cdot b \cdot c \cdot \cos(\alpha)$$

$$b^2 = a^2 + c^2 - 2 \cdot a \cdot c \cdot \cos(\beta)$$

$$c^2 = a^2 + b^2 - 2 \cdot a \cdot b \cdot \cos(\gamma)$$

$$r = \frac{1}{2} \cdot \frac{a}{\sin(\alpha)}$$

$$r = \frac{1}{2} \cdot \frac{b}{\sin(\beta)}$$

$$r = \frac{1}{2} \cdot \frac{c}{\sin(\gamma)}$$

$$A = \frac{1}{2} \cdot b \cdot c \cdot \sin(\alpha)$$

$$A = \frac{1}{2} \cdot a \cdot c \cdot \sin(\beta)$$

$$A = \frac{1}{2} \cdot a \cdot b \cdot \sin(\gamma)$$

$$\tan\left(\frac{\alpha}{2}\right) = \frac{Q}{s-a}$$

$$\tan\left(\frac{\beta}{2}\right) = \frac{Q}{s-b}$$

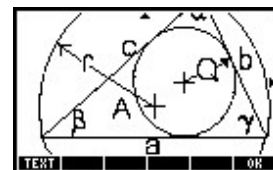
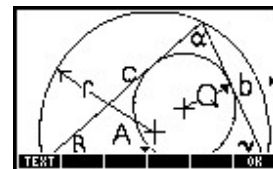
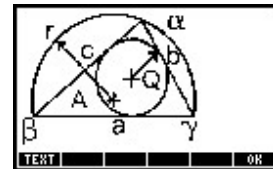
$$\tan\left(\frac{\gamma}{2}\right) = \frac{Q}{s-c}$$

$$s = \frac{a+b+c}{2}$$

$$\alpha + \beta + \gamma = 180$$

$$A = Q \cdot s$$

$$A = \sqrt{s \cdot (s-a) \cdot (s-b) \cdot (s-c)}$$



Example 1 - Circle / Right triangle, “CiTri”

Use $a = 3$, $b = 4$, $c = 5$.

3[a] 4 [b] 5[c]

“L-arrow” [α]

“L-arrow” [β]

“L-arrow” [γ]

“NXT”

“L-arrow” [A]

“L-arrow” [s]

“L-arrow” [r]

“L-arrow” [Q]

“NXT” “NXT”

“R-arrow” [All]

“EQNS”

Here is the solution sequence:

To enter data

The result is α : 36.8698976458

The result is β : 53.1301023541.

The result is γ : 90.

To move to the next variables menu.

The result is A.

The result is s.

The result is r.

The result is Q.

To move to the next variables menu.

Solve for all variables at once

Show equations for variables

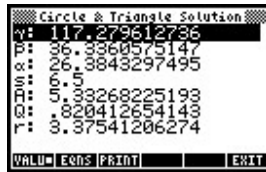
DEG XYZ HEX R= 'N' \US Math1 CITRI2 03 08 MAY:08 7: 6: 5: 4: 3: 2: 1: CITRI	RAD XYZ HEX R= 'N' \US Math1 CITRI2 04 45 MAY:07 7: 6: 5: 4: 3: 2: 1: CITRI Psc SeeEQ EQ LVARITITLE	Circle & Triangle Solution 7: 6: 5: 4: 3: 2: 1: a b c α β γ	DEG XYZ HEX R= 'N' \US Math1 CITRI2 11:30 MAY:08 7: 6: 5: 4: 3: 2: 1: a b c α β γ
DEG XYZ HEX R= 'N' \US Math1 CITRI2 11:32 MAY:08 7: 6: 5: 4: 3: 2: 1: A s r Q ALL	DEG XYZ HEX R= 'N' \US Math1 CITRI2 03:10 MAY:08 7: 6: 5: 4: 3: 2: 1: A s r Q ALL	Circle & Triangle Solution 7: 6: 5: 4: 3: 2: 1: a b c α β γ	Circle & Triangle Solution 7: 6: 5: 4: 3: 2: 1: a b c α β γ

Example 2 - Circle / triangle, “CiTri”

Use $a = 3$, $b = 4$, $c = 6$. The solution procedure used here consists of solving for all variables at once, and then recalling the solutions to the stack:

“VAR” “CiTri”	To clear up data and re-start MES
3[a] 4 [b] 6[c]	To enter data
“NXT”	To move to the next variables menu.
“L-arrow” “ALL”	Solve for all the unknown variables at once
“R-arrow” “ALL”	Show the solution for unknown variables

The solution is:



At the bottom of the screen, you will have the soft menu keys:

“VALUE” “EQNS” “PRINT” & “EXIT”

The square dot in “VALUE” indicates that the values of the variables, rather than the equations from which they were solved, are shown in the display. To see the equations used in the solution of each variable, press the “EQNS” soft menu key.

The soft menu key “PRINT” is used to print the screen in a printer, if available.

And “EXIT” returns you to the MES environment for a new solution, if needed. To return to normal calculator display, press the “VAR” key.

“EXIT”



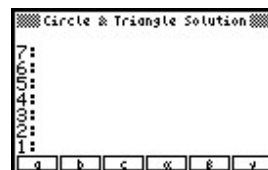
“All”



“VAR” key



“CiTri” key and you are ready to start a new problem.



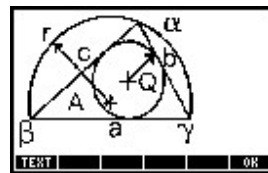
Practice Examples – Circle & Triangle solutions

The following table of “circle & triangle” solutions shows the data input in bold face and the solution in italics. Try running the “CiTri” program with these inputs to verify the solutions. Remember to press the “VAR” key and “CiTri” key at the end of each solution to clear up variables and start the MES solution again. Otherwise, you may carry over information from the previous solution that may wreck havoc with your current calculations.

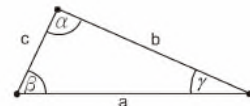
a	b	c	$\alpha(^{\circ})$	$\beta(^{\circ})$	$\gamma(^{\circ})$	s	A	Q	r
3	4	5	90	53.13	36.87	6	6	1	2.5
2.5	6.9837	7.2	20.229	75	84.771	8.342	8.6933	1.042	3.615
7.2	8.5	14.262	22.616	27	130.38	14.98	23.309	1.5556	9.361
21.92	17.5	13.2	90	52.98	37.03	26.31	115.5	4.399	10.96
41.92	23	29.6	75	32	73	47.262	328.81	6.957	21.701
10.27	3.26	10.5	77	18	85	12.014	16.661	1.387	5.27
17	25	32	31.79	50.78	97.44	37	210.71	5.695	16.1357
20	30	35	86.417	58.811	34.772	42.5	299.43	7.045	17.534



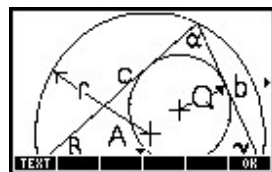
Variables



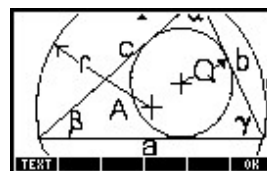
Pic small view



Solve triangle only



Pic large view up



Pic large view down