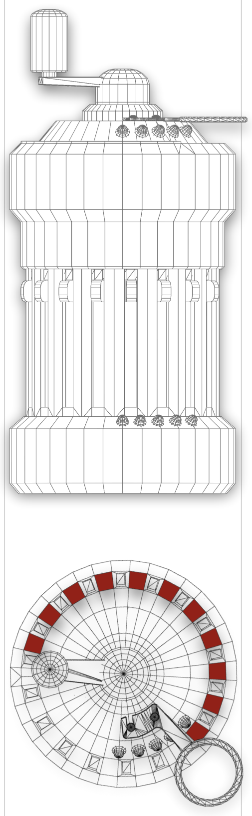
CURTA

ALGORITHMS

GEOMETRY



a **Calculation of area** from co-ordinates (shoelace method)

b **Sides of a triangle -** Pythagoras theorem

c **Distance between two points -** Pythagoras theorem

d **Calculation of co-ordinates**

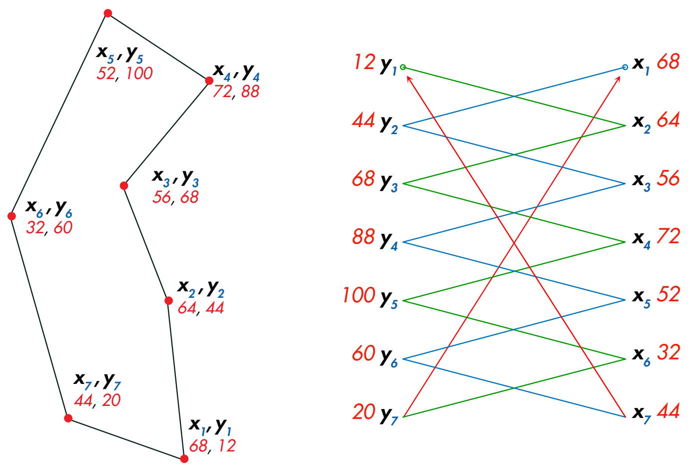
e **Determination of a side** of an obtuse - angled triangle

4a

Calculation of area from co-ordinates (shoelace method)

The area to be computed is defined by the following co-ordinates which are juxtaposed for the purpose of calculation: $2S = \sum (y_{n+1} - y_{n-1}) x_n$ (x axis) $2S = \sum (x_{n+1} - x_{n-1}) y_n$ (y axis)
If the number of points is even, in practice we enter the last point twice. Depending on the order chosen in which to traverse the points,it may occur that the final result is negative.
The correct result in this case is the complement of this number.

	S = ?	Setting	Carriage/Inverter	Turns	Counter	Product
		Clear	⬆		Clear	Clear
1	Develop y_1 in CR		2 1	3 +	1 2	
2	Set x_2 (64) in SR. It must be multiplied by $(y_1 - y_3)$ thus change it to 68 in CR	6 4	2 1	11 +	6 8	3 5 8 4
3	Same way for the points following the path of the "shoelace"	7 2	3 < 1	+ 14 −	1 0 0	5 8 8 8
		3 2	3 2	2 + −	2 0	3 3 2 8
		6 8	2 1	6 +	4 4	4 9 6 0
		5 6	2 1	8 +	8 8	7 4 2 4
		5 2	2 1	10 −	6 0	5 9 6 8
4	Result: 2S = 3856 Area = 1928	4 4	2 1	2 + 5 −	1 2	3 8 5 6



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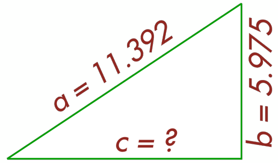
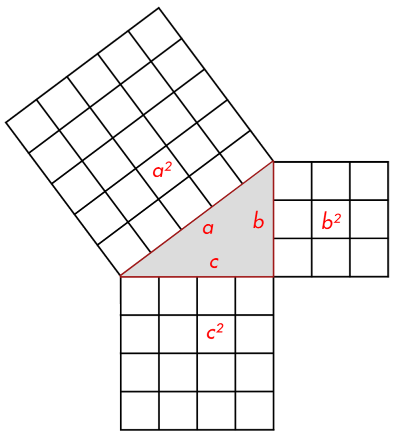
4b

Sides of a triangle - Pythagoras' theorem

The operation consist of finding c = √ (a² ± b²)



	c = √ (11.392² – 5.975²)	Setting	Carriage/Inverter	Turns	Counter	Product
	c = √ (a² ± b²)	Clear	↑		Clear	Clear
1	Set a Develop a in CR. In PR: a²	1 1.3 9 2 8 7 6 5 4 3 2 1	6 5 < 3 > 1	16 +	1 1.3 9 2	1 2 9.7 7 7 6 6 4 11 10 9 8 7 6 ▲ 4 3 2 ▲
2			↓		Clear	
3	Set b Develop b in CR. In PR, the radicand: a² — b² Décimal rule, dpSR + dpCR = dpR, 3 + 3 = 6	5.9 7 5 8 7 6 5 4 3 2 1	6 5 4 < > 1	26 —	5.9 7 5	9 4.0 7 7 0 3 9 11 10 9 8 7 6 5 ▲ 3 2 ▲
4					Clear	
5	 Calculate the square root √ (a² — b²) with Töpler's method (or other…) Here: the same method as 6c Result: 9.699	1 1 1 3 3 3 5 5 5 7 7 7 9 1 9 9 1 1 3 1 1 - 3 5 3 3 - 5 7 5 5 - 7 9 7 7 - 8 1 8 9 - 9 3 9 9 1 9 3 9 8 8 7 6 5 4 3 2 1	6 5 4 3 2	— - - - - - - - - - +	9.6 9 9	1 6 1 5 5 8 - 4 2 1 7 5 - 2 2 7 9 - 0 3 4 0 3 8 4 0 1 4 6 4 6 2 3 4 5 2 3 2 5 8 3 5 6 4 3 8 9 9 9 9 9 9 8 7 0 3 9 6 4 3 8 11 10 9 8 7 6 5 ▲ 3 2 1

Source: " Curta Calculating techniques" / Bernard Stabile - 2023

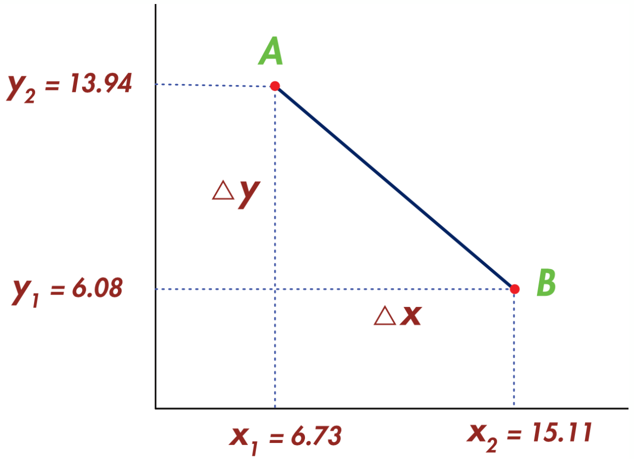
4C

Distance between two points - Pythagoras' theorem

$\Delta x = x_2 - x_1$

$\Delta y = y_2 - y_1$

$AB^2 = \Delta x^2 + \Delta y^2$; $AB = \sqrt{(\Delta x^2 + \Delta y^2)}$



$\sqrt{(8.38^2 + 7.86^2)}$		Setting	Carriage/Inverter	Turns	Counter	Product
	$AB = \sqrt{(\Delta x^2 + \Delta y^2)}$	Clear	↑		Clear	Clear
1	Set x_2	15.11	1	+	1	15.11
2	Set x_1 Calculate Δx. Subtraction. Note the result	6.73	1	−		8.38
3						Clear
4	Set y_2	13.94	1	+	1	15.11
5	Set y_1 Calculate Δy. Subtraction. Note the result	6.08	1	−		7.86
6						Clear

4C ↓

4c

	$\sqrt{(8.38^2 + 7.86^2)}$	Setting	Carriage/Inverter	Turns	Counter	Product
7	Set Δx Calculate Δx^2 Develop Δx in CR	8.38	6 < 4 3 2 1	19 +	8.38	70.2244
8					Clear	
9	Set Δy Calculate $AB^2 = \Delta x^2 + \Delta y^2$ Develop Δy in CR	7.86	6 > 4 3 2 1	21 +	7.86	132.004
10			⬇		Clear	
11	Calculate AB with Herman's reverse method (or other…) Here: the same method as 2g Set the first approximation R: 11.5 Calculate R^2	11.5	6 < 4 3 2 1	7 −	11.5	9 9 9 9 7 5 4
12	Set 2R Calculate $N - R^2 \div 2R$ Division by subtractive method. (See 1Cc) Result: 11.4893	23	6 5 4 > > 1	+ 20 −	11.4893	1

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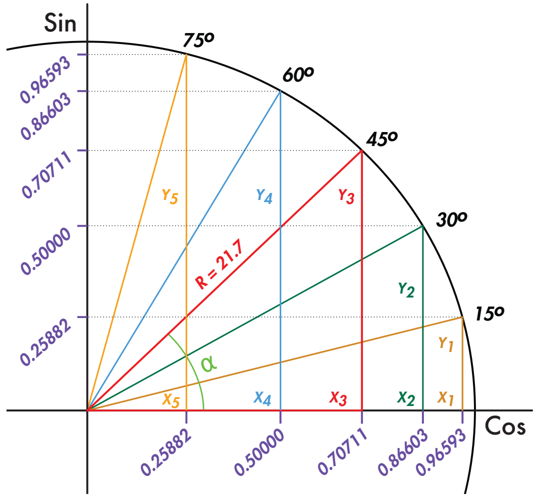
Calculation of co-ordinates

$X_n = R \times \cos \alpha$

$Y_n = R \times \sin \alpha$



	(X1, Y1) (X2 Y2) (X3, Y3) (X4, Y4) (X5, Y5)	Setting	Carriage/Inverter	Turns	Counter	Product
		Clear	↑		Clear	Clear
1	Set R Develop cos 15º/sin 75º in CR. We obtain X_1 and Y_5 : 20.960681	2 1.7 8 7 6 5 4 3 2 1	6 5 < 3 > 1	32 −	0.9 6 5 9 3	2 0.9 6 0 6 8 1 11 10 9 8 7 6 ▲ 4 3 2 ▲
2	Develop cos 30º/sin 60º in CR. We obtain X_2 and Y_4 : 18.792851	2 1.7	6 5 < 3 > 1	+ 10 −	0.8 6 6 0 3	1 8.7 9 2 8 5 1 11 10 9 8 7 6 ▲ 4 3 2 ▲
3	Develop cos 45º/sin 45º in CR. We obtain X_3 and Y_3 : 15.344287	2 1.7	6 5 < 3 > 1	+ 9 −	0.7 0 7 1 1	1 5.3 4 4 2 8 7 11 10 9 8 7 6 ▲ 4 3 2 ▲
4	Develop cos 60º/sin 60º in CR. We obtain X_4 and Y_2 : 10.85	2 1.7	6 5 4 3 2 1	+ 10 −	0.5	1 0.8 5 11 10 9 8 7 6 ▲ 4 3 2 1
5	Develop cos 75º/sin 75º in CR. We obtain X_5 and Y_1 : 5.616394	2 1.7	6 5 < 3 > 1	+ 10 −	0.2 5 8 8 2	5.6 1 6 3 9 4 11 10 9 8 7 6 ▲ 4 3 2 ▲

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4e

Determination of a side of an obtuse angled triangle

The classical formula:

$c^2 = a^2 + b^2 - 2a \times b \times \cos\alpha$

is computationally incovenient

due to the large size of numbers involved.

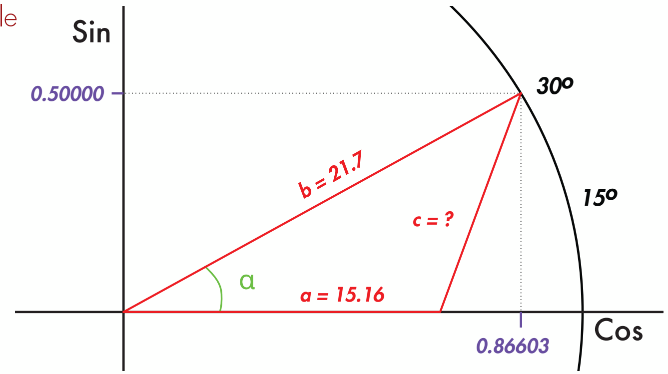
The best method is as follows:

Compute the values of sin α, cos α (see the shema)

Compute x cos α and ± b ± a x sin α

Then Pythagoras' theorem:

$c = \sqrt{(a \times \sin\alpha)^2 + (\pm b \pm a \times \sin\alpha)^2}$



	a = 15.16, b = 21.7, α = 30º	Setting	Carriage/Inverter	Turns	Counter	Product
	$c = \sqrt{(a \times \sin\alpha)^2 + (\pm b \pm a \times \sin\alpha)^2}$	Clear	↑		Clear	Clear
1	Set a Calculate a x sin α Develop sin 30º in CR. Note the result	1 5.1 6	6 **5** 4 3 2 1	5 +	0.5	7.5 8
2	Calculate a x cos α Develop cos 30º in CR	1 5.1 6	6 5 < 3 > 1	18 +	0.8 6 6 0 3	1 3.1 2 9 0 1 4 8
3	Set b to correspond with the number in PR (Carriage 6). Negative turn If b < a x cos α, set directly the result in RR If b > a x cos α a complement appear in PR (underflow, like here)	2 1.7	**6** 5 4 3 2 1	–	9 8 6 6 0 3	9 9 9 1 4 2 9 0 1 4 8
4	Calculate b – a x cos α Set the complement (8.57) With a positive turn, check if 0000… or 9999… appears in PR	8.5 7	6	+	0.8 6 6 0 3	9 9 9 9 9 9 9 0 1 4 8
5					Clear	Clear

4e ↓

4e

	a = 15.16, b = 21.7, α = 30°	Setting	Carriage/Inverter	Turns	Counter	Product
6	Multiply the complement by itself	8.57	6 > 4 3 2 1	20 +	8.57	73.4449
7					Clear	
8	Calculate $c^2 = (a \times \sin \alpha)^2 + (b - a \times \cos \alpha)^2$ Set $a \times \sin \alpha$ (The number noted) and multiply it by itself	7.58	6 5 4 > 2 1	20 +	7.58	130.9013
9			↓		Clear	
10	Calculate c with Herman's reverse method (or other…) Here: the same method as **2**g Set the first approximation R: 11.5 Calculate R^2	11.5	6 < 4 3 2 1	7 −	11.5	9 9 9 8 6 5 1 3
11	Set 2R Calculate $N - R^2 \div 2R$ Division by subtractive method. (See **1**Cc) Result: 11.4413	23	6 5 4 > > 1	+ 8 −	11.4413	14

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