



## Precise-Rewritten method

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Bhava Nath Dahal · September 25, 2016

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## Breaking Classical Rules in Trigonometry: Exact Trigonometric Values

Classically, we can determine few of the trigonometric values exactly. Under Precise-Rewritten method, we can determine exact trigonometric values of any angle (integer or decimal). Precise-Rewritten method is simple for learning and determining the exact trigonometric values. In this article, we shall discuss the method for exact value of Sin 20 degrees.

### New method

Classically, trigonometric values were based on few of the exact radicals and other were interpolation of known exact values. In this new method, named as 'Precise-Rewritten method', the target angle is rewritten in the half of right-angle pattern. As the name of method suggest, it rewrite the angle as  $45 - (22.5 + (11.25))$  for 11.25 degrees. The trigonometric value may be 'exact value in radicals' or may be accurate for user-defined precise level.

### Concept of centrals

For Precise-Rewritten method, we just need simple understanding of 'centrals'. Starting from 90 degrees, it's half is 45- first central. Half of 45 is 22.5 - second central, 11.25 is third central and so on. In the example of Sin 20, following picture may describe the Precise-Rewritten method in single shot. For this:

- Calculate centrals starting from 45 degrees. This is the first central in all cases.
- Add or subtract second central (i.e. 22.5) to the cumulative of the first central (which is 45) towards our target angle (20 degree in our case, so, we subtracted).
- Repeat the process of adding or subtracting of next central with earlier cumulative angle until we reached to the target angle or if we obtain repeating pattern. In case, we could not obtain target angle or unable to fixed any repeating pattern, the process requires to repeat until user-defined precision level (say 15 digits accurate after decimal etc).

### Concept of sign

In each step of above process, divide earlier central with current central. The answer is always either +2 or -2.

- In the first row of first central 45 degrees, write the quotient dividing 90 by this first central. This is always +2.
- In each step of calculation, find the sign (+ or -) in quotient of +2 or -2. This is critical for our calculation of trigonometric values.

### Details

Classically, we can determine few of the trigonometric values exactly. Under Precise-Rewritten method, we can determine exact trigonometric values of any angle (integer or decimal). Precise-Rewritten method is simple for learning and determining the exact trigonometric values. In this article, we shall discuss the method for exact value of Sin 20 degrees.

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- Each step, please care the pattern of repetition. The process has shown as follows:



Target angle

20

Centrals

	90	Sign
	45	2
	-22.5	-2
	-11.25	2
	5.625	-2
	2.8125	2
	1.40625	2
	-0.703125	-2
	-0.3515625	2
	-0.17578125	2
	0.0878906250	-2
	0.0439453125	2
	0.0219726563	2
	-0.0109863281	-2

$$\sin 20 = \sqrt{2 - \sqrt{2 + \sqrt{2 - \sqrt{2 + \sqrt{2}}}}}$$

#### Conversion of Rewritten angles into chord

In each step of calculation, we obtained either +2 or -2. Now convert this +2 into  $+\sqrt{2}$  and convert -2 by  $-\sqrt{2}$ . Merge the whole result of  $+\sqrt{2}$  or  $-\sqrt{2}$ . This is the chord length of double angle of our target angle.

#### Halving the Chord

Once we obtained the chord length of double angle in a unit circle, this is major input for all trigonometric values. For Sine of an angle, half of chord of double angle is Sine of that angle. Precise-Rewritten method determines the length of chord for double angle. In above case, the result is chord for 40 degrees. Halving chord and angle both, that will be Sine of half angle. Therefore, in our case, the result is Sin 20 degree.

#### Request from the author

This article or books in this series may be beneficial to the scholars. However, due to my low skill in mathematics and modern technologies, I need remarkable support to professional supervision, quality control, formatting, copy-editing etc. I am afraid, the concept I could contribute may be lost without good support for professionals or professional institution. I request someone mathematicians or mathematics institution or universities to support and supervise these works.

Reference: Exact Values in Trigonometry: Five New Techniques (Vol I) or Precise-Rewritten method: Exact Values in Trigonometry (Vol II).

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Joe Zbiciak · November 24, 2016

This sounds an awful lot like [CORDIC](#).

45	45	2
-22.5	22.5	-2
-11.25	11.25	2
5.625	16.875	-2
2.8125	19.6875	2
1.40625	21.09375	2
-0.703125	20.390625	-2
-0.3515625	20.0390625	2
-0.17578125	19.86328125	2
0.0878906250	19.9511718750	-2
0.0439453125	19.9951171875	2
0.0219726563	20.0170898438	2
-0.0109863281	20.0061035156	-2

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Bhava Nath Dahal is an admin.

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**Bhava Nath Dahal** · November 24, 2016

Thanks. That is not similar to CORDIC. Exactly, I do not understand what is CORDIC too. You have not seen the bar (overline). Overline makes it as closed form.

I am not a mathematician and my English expression is awkward too. Hence, you are requested to assist for copy edit the detail, if you have time or willingness to support.



Reply



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**Ravi Shankar** · November 29, 2016

Hi Dahal, will be happy to help you publish.



Reply



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### About the Author

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Breaking Classical Rules in Mathematics



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