

# Vedic Mathematics Tricks and Shortcuts

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Vedic Mathematics is a system of mathematics which was invented by Indian mathematician **Jagadguru Shri Bharathi Krishna Tirthaji Maharaj** in the period between A.D. 1911 and 1918.

It consists of 16 Sutras (methods) and 13 sub-sutras (Sub methods). Vedic Mathematics's methods are highly efficient when it comes to calculation of regular arithmetics like subtraction, multiplication, division of numbers and polynomials, squares, square roots, cubes, cube roots, solving equation, partial fractions, derivatives, conics, etc.

## Vinculum Numbers / Vinculum Process:

Vinculum Process forms the very basic requisites for Vedic Mathematics.

Vinculum is a Sanskrit word which means a line i.e. bar over number i.e. negative digits. Vinculum numbers are numbers which have atleast 1 digit as a negative digit.

Vinculum numbers/digits are also called as Bar numbers/digits.

Eg: Vinculum number converted to normal number using Place Value concept.

The image shows three handwritten equations on a black background with yellow text. Each equation shows a Vinculum number (a number with a bar over one or more digits) being converted to a normal number by adding and subtracting place values. The first equation is  $234\bar{5} = 2000 + 300 + 40 - 5 = 2335$ . The second equation is  $23\bar{4}5 = 2000 + 300 - 40 + 5 = 2265$ . The third equation is  $23\bar{4}\bar{5} = 2000 + 300 - 40 - 5 = 2255$ .

Another Method of **Conversion of Vinculum number to Normal number:**

Follow R -> L approach.

1. Find 1st Bar digit and takes is 10's complement.
2. a) If next digit is again Bar digit then take its 9's complement. Continue taking 9's complement till non-bar digit is obtained.  
b) Decrement non-bar digit by 1.
1. Continue (1) & (2) till complete number is covered.

**Conversion of Normal number to Vinculum number:**

Follow R -> L approach.

1. Find 1st digit > 5 & take its 10's complement with a bar over it.
2. a) If next digit is again  $\geq 5$ , take its 9's complement with a bar over it & continue this till a digit <5 is obtained.  
b) Increment <5 digit by 1.
1. Continue (1) & (2) till complete number is covered.

Conversion of Vinculum numbers to Normal numbers and vice versa is very important for other concepts of Vedic Mathematics.

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## Subtraction using Vinculum:

Handwritten examples of subtraction using Vinculum:

$$\begin{array}{r} 783 \\ - 348 \\ \hline 44\bar{5} \\ = 435 \end{array}$$
$$\begin{array}{r} 623 \\ - 376 \\ \hline 35\bar{3} \\ = 247 \end{array}$$
$$\begin{array}{r} 19083 \\ - 1831 \\ \hline 18852 \\ = 17252 \end{array}$$
$$\begin{array}{r} 11111 \\ - 9876 \\ \hline 1\bar{8}\bar{7}\bar{6}\bar{5} \\ = 1235 \end{array}$$

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(More examples on <http://mathlearners.com/vedic-mathematics/basic-requisites/>)

## Nikhilam Navatascaramam Dastah:

Popularly called as **Nikhilam** Sutra and English it means as 'All from 9 and last from 10'.

Nikhilam Sutra in Multiplication is used whenever the numbers are closer to power of 10 i.e. 10, 100, 1000, ....

This creates 3 groups:

1. Numbers are less than power of 10 i.e. 10, 100, 1000, ....
2. Numbers are more than power of 10 i.e. 10, 100, 1000, ....
3. Numbers are present on either side of power of 10 i.e. 10, 100, 1000, ....

Multiplication of numbers just\* less than power of 10 (Nikhilam Method)

Example 1:

$$\begin{array}{r} 94 \quad -6 \\ \times 96 \quad -4 \\ \hline 90 \overline{) 24} \\ = 9024 \end{array}$$

1. Both the numbers are closer to 10 power (**base 100**)
2. 94 is 6 less than 100 & 96 is 4 less than 100.
3.  $(-6) \times (-4) = 24$
4.  $94 - 4$  OR  $96 - 6 = 90$
5. Final Answer: 9024

Example 2:

$$\begin{array}{r} 88 \quad -12 \\ \times 86 \quad -14 \\ \hline 74 \overline{) 68} \\ = 7568 \end{array}$$

1. Both the numbers are closer to 10 power (**base 100**)
2. 88 is 12 less than 100 & 86 is 14 less than 100.
3.  $(-12) \times (-14) = 168$  (Since base is 100, we need to have **ONLY 2 digits, so carry forward 1. Use 168**)
4.  $88 - 14$  OR  $86 - 12 = 74$
5. Add 1 (**carry forward**) to 74 = 75
6. Final Answer: 7568

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Multiplication of numbers just\* greater than power of 10  
(Nikhilam Method)

$$\begin{array}{r} 103 \quad +3 \\ \times 108 \quad +8 \\ \hline 111 \quad | \quad 24 \\ = 11124 \quad // \end{array}$$

1. Both the numbers are closer to 10 power **(base 100)**
2. 103 is 3 more than 100 & 108 is 8 more than 100.
3.  $(+3) \times (+8) = 24$
4.  $103+8$  OR  $108+3 = 111$
5. Final Answer: 11124

$$\begin{array}{r} 110 \quad +10 \\ \times 112 \quad +12 \\ \hline 122 \quad | \quad 120 \\ = 12320 \quad // \end{array}$$

1. Both the numbers are closer to 10 power **(base 100)**
2. 110 is 10 more than 100 & 112 is 12 more than 100.
3.  $(+10) \times (+12) = 120$  (Since base is 100, carry forward 1. Use 120)
4.  $110+12$  OR  $112+10 = 122$
5. Add 1 (carry forward) to 122 = 123
6. Final Answer: 12320

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Multiplication of numbers closer to\* & present either side of power of 10  
(Nikhilam Method)

$$\begin{array}{r} 93 \quad -7 \\ \times 103 \quad +3 \\ \hline 96 \quad | \quad 21 \\ = 9621 \\ = 9579 \quad // \end{array}$$

1. Both the numbers are closer to 10 power **(base 100)**
2. 93 is 7 less than 100 & 103 is 3 more than 100.
3.  $(-7) \times (+3) = -21$
4.  $93+3$  OR  $103-7 = 96$
5. Final Answer: 9579 (Using Vinculum)

$$\begin{array}{r} 115 \quad +15 \\ \times 85 \quad -15 \\ \hline 100 \quad | \quad 25 \\ = 9825 \\ = 9775 \quad // \end{array}$$

1. Both the numbers are closer to 10 power **(base 100)**
2. 115 is 15 more than 100 & 85 is 15 less than 100.
3.  $(+15) \times (-15) = -225$  (Since base is 100, carry forward 2. Use -225)
4.  $115-15$  OR  $85+15 = 100$
5. Add -2 (carry forward) to 100 = 98
6. Final Answer: 9775 (Using Vinculum)

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## Urdhva Tiryakbhyam (Vertically and Crosswise):

Commonly called as Urdhva Tiryak Sutra used in multiplication and its a General method which can be applied to any types of numbers.

### Multiplication of Two 2digit numbers

Process: (Left -> Right)

1. Vertical Multiplication of 1st digits of 2 numbers.
2. Crosswise Addition (Crosswise Multiplication and adding them).
3. Vertical Multiplication of last digits of 2 numbers.



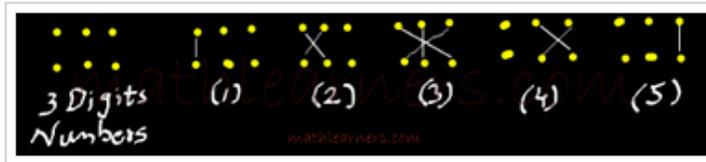
Formula :

$$(ax+b)(cx+d) = acx^2 + (ad+bc)x + bd$$

### Multiplication of Two 3digit numbers

Process: (Left -> Right)

1. Vertical Multiplication of 1st digits of 2 numbers.
2. Crosswise Addition of 1st 2 digits 2 numbers.
3. Crosswise Addition of all 3 digits of both the numbers.
4. Crosswise Addition of last 2 digits 2 numbers.
5. Vertical Multiplication of last digits 2 numbers.



Formula :

$$(ax^2+bx+c)(dx^2+ex+f) = adx^4 + (ae+bd)x^3 + (af+be+cd)x^2 + (bf+ce)x + cf$$

Example:

The example shows the multiplication of 145 by 373. The steps are: 1x3, 1x7+3x4, 1x3+4x7+5x3, 4x3+7x5, 5x3. The intermediate results are 3, 19, 46, 47, 15. The final result is 54085.

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## Nikhilam Sutra:

**Nikhilam Sutra in Division** is applied when divisor is closer to and slightly lesser than power of 10.

### Examples:

#  $12/9$  (See Below)

1. 9 is 1(deficiency) less than 10(nearest power of 10).
2. Split Dividend in 2 parts (Quotient & Remainder) in such a way Remainder to have same digits as that of Divisor. In this case its 1.
3. Take 1 as it is down.
4. Multiply the above deficiency (1) with the 1 and put below 2 and add them column wise.
5. Thus Quotient=1 & Remainder=3.

#  $3483/99$  (See Below)

1. 99 is 01(deficiency) less than 100(nearest power of 10).
2. Split Dividend in 2 parts (Quotient & Remainder) in such a way Remainder to have same digits as that of Divisor. In this case its 2.
3. Take 3 as it is down.
4. Multiply the above deficiency (01) with the 3 and put them below 4 and 8(as shown), add 1st column ( $4+0=4$ ).
5. Multiply the above deficiency (01) with the 4 now and put in next columns (as shown), add 1st column ( $8+3+0=11$ ).
6. Repeat this process till a number comes in last column. In this example a number (4) has appeared in last column so stop here.
7. Thus Quotient=35 & Remainder=18.

The image shows three examples of division using the Nikhilam Sutra method on a blackboard background. Each example is separated by a vertical line.

- Example 1:**  $12 \div 9$ . The divisor 9 is 1 less than 10. The dividend 12 is split into 1 and 2. A deficiency of 1 is taken down. It is multiplied by 1 and added to the 2, resulting in 3. The final result is Quotient = 1, Remainder = 3.
- Example 2:**  $243 \div 9$ . The divisor 9 is 1 less than 10. The dividend 243 is split into 24 and 3. A deficiency of 1 is taken down. It is multiplied by 24 to get 24, which is added to the 3 to get 27. The final result is Quotient = 27, Remainder = 0.
- Example 3:**  $3483 \div 99$ . The divisor 99 is 01 less than 100. The dividend 3483 is split into 34 and 83. A deficiency of 01 is taken down. It is multiplied by 34 to get 34, which is added to the 83 to get 117. Then, the deficiency 01 is multiplied by 117 to get 117, which is added to the 117 to get 234. The final result is Quotient = 35, Remainder = 18.

Also, if deficiency has bigger digits like 6, 7, 8 and 9 then apply Vinculum and then apply Nikhilam Sutra on that.

Instead of Quotients and Remainders, division answers can be obtained in decimal format as well.

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## Paravartya Yogayat Sutra (Transpose and Apply):

**Paravartya Sutra** can be applied for division whenever divisor is closer and slightly greater than power of 10.

Process almost remains same as that of Division's Nikhilam Sutra except 1<sup>st</sup> digit of divisor is discarded and other digits are transposed.

Example:

The image shows two examples of division using the Paravartya Sutra on a blackboard background. The first example is  $6534 \div 123$ . The divisor 123 is written with a bar over the 2 and 3. The dividend 6534 is written as 65/34. The process involves transposing the digits of the divisor to the right of the dividend. The steps shown are:  $65 \overline{) 34}$ , then  $12 \overline{) 18}$ , then  $14 \overline{) 21}$ , and finally  $67 \overline{) 25}$ . The result is  $Q = 53$  and  $R = 15$ . The second example is  $13999 \div 1112$ . The divisor 1112 is written with a bar over the 1, 1, and 2. The dividend 13999 is written as 13/999. The process involves transposing the digits of the divisor to the right of the dividend. The steps shown are:  $13 \overline{) 999}$ , then  $11 \overline{) 12}$ , then  $22 \overline{) 4}$ , and finally  $12 \overline{) 655}$ . The result is  $Q = 12$  and  $R = 655$ . A watermark 'mathlearners.com' is visible at the bottom right of the board.

## Ekadhikena Purvena Sutra:

**Ekadhikena Purvena** is used to find square of number which end with 5.

The image shows three examples of squaring numbers ending in 5 using the Ekadhikena Purvena Sutra on a blackboard background. The first example is  $25^2$ . The number 25 is written with a diagonal line through it. The digits 2 and 5 are separated. The calculation is  $2 \times 3 = 6$  and  $5^2 = 25$ , resulting in  $625$ . The second example is  $85^2$ . The number 85 is written with a diagonal line through it. The digits 8 and 5 are separated. The calculation is  $8 \times 9 = 72$  and  $5^2 = 25$ , resulting in  $7225$ . The third example is  $195^2$ . The number 195 is written with a diagonal line through it. The digits 19 and 5 are separated. The calculation is  $19 \times 20 = 380$  and  $5^2 = 25$ , resulting in  $38025$ . A watermark 'mathlearners.com' is visible in the background.

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## Yavadunam Sutra:

**Yavadunam** is used to find square of a number which is closer to power of 10.

- $93^2 = (93-7)/7^2 = 86/49 = 8649$
- $89^2 = (89-11)/11^2 = 78/121 = 7921$
- $113^2 = (113+13)/13^2 = 126/169 = 12769$
- $1002^2 = (1002+2)/2^2 = 1004/004 = 1004004$

**Yavadunam** can be used to find cube of a number but condition remains same i.e. number should be closer to power of 10.

The image shows two examples of finding cubes using the Yavadunam sutra. The first example is for  $103^3$ . It shows the calculation:  $103^3 = 103 + (3 \times 2) \quad | \quad 9 \times 3 \quad | \quad 3^3$ , which simplifies to  $109 \quad | \quad 27 \quad | \quad 27$ , resulting in  $1092727$ . The second example is for  $996^3$ . It shows the calculation:  $996^3 = 996 + (-4 \times 2) \quad | \quad -12 \times -4 \quad | \quad (-4)^3$ , which simplifies to  $988 \quad | \quad 048 \quad | \quad 064$ , resulting in  $988048064$ . Both examples include detailed text explanations of the steps and the final answers.

**Example 1:  $103^3$**

103 is 3 more than 100, Multiply the excess (3) with 2  
And add the product with that number. = 109  
Now Multiply the Original Excess(3) with New Excess (9) = 27  
Take cube of Original Excess.  
Since base 100 is used, number of digits in each group should be 2, else carry forward.  
Final Answer: 1092727

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**Example 2:  $996^3$**

• 996 is 4 less than 1000 multiply the deficiency (-4) with 2 and add the product with that number. = 988  
• Now Multiply the Original deficiency(-4) with New deficiency (-12) = +048  
• Take cube of Original Excess. (-064). Convert the bar number to normal number using Vinculum.  
• Since base 1000 is used, number of digits in each group should be 3, else carry forward/prefix with 0.  
• Final Answer: 98,80,48,936

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## Square root of a perfect Square:

Examples:

### Square root of 2209

1. Number ends with 9, Since it's a perfect square, square root will end with 3 or 7.
2. Need to find 2 perfect squares (In Multiplies of 10) between which 2209 exists.  
Numbers are 1600( $40^2$ ) and 2500( $50^2$ ).
3. Find to whom 2209 is closer. 2209 is closer to 2500. Therefore squareroot is nearer to 50  
Now from Step 2, possibilities are 43 or 47 out of which 47 is closer to 50
4. Hence squareroot = 47.

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## Square root of 7056

1. Number ends with 6, So square root ends with 4 or 6.
2. Perfect squares (In Multiplies of 10) between which 7056 exists are  $6400(80^2)$  and  $8100(90^2)$ . 7056 is closer to 6400. Therefore squareroot is nearer to 80
3. Now from Step 2, possibilities are 84 or 86 out of which 84 is closer to 80
4. Hence squareroot = 84.

## Cube Root of a Perfect Cube (Max 6 digits):

Cubes from 1- 10:

Number	Cube	Cube ends with
1	1	<b>1</b>
2	8	<b>8</b> (Compliment of 2)
3	27	<b>7</b> (Compliment of 3)
4	64	<b>4</b>
5	125	<b>5</b>
6	216	<b>6</b>
7	343	<b>3</b> (Compliment of 7)
8	512	<b>2</b> (Compliment of 8)
9	729	<b>9</b>
10	1000	<b>0</b>

Thus as seen cubes have distinct ending, there is no overlapping. Thus, if the given number is perfect cube, then the last digit will help to find the cube root.

## Cube root of 1728:

1. Group the numbers from R -> L in the group of 3. So we have 1,728.
2. Last group (728) ends with 8, so cube root will end in 2.
3. 1<sup>st</sup> group is 1. Find perfect cube root  $\leq 1$  i.e. 1 and its cube root is 1.
4. Answer is 12.

## Cube root of 300763:

1. Group the numbers from R -> L in the group of 3. So we have 300,763.
2. Last group (763) ends with 3, so cube root will end in 7.
3. 1<sup>st</sup> group is 300. Find perfect cube  $\leq 300$  i.e. 216 and its cube root is 6.
4. Answer is 67.