# Solving Mathematical Problems through Vedic Mathematics

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**Abstract:**
*India has been an epicenter of higher learning from time immemorial. Traditionally, a student was assigned to the gurus for divine enlightenment. People from all over the world aspired to join Indian education institute like Nalanda, Taxila etc. With the passage of time, things changed and education sector too took a twist. Globalization, industrialization and consumerism greatly influenced learning process in India. Consequently, new parameters entered into education sector which bring with them new challenges as well as opportunities and India lost its grandeur of ancient learning like the Vedas. The present paper is an endeavour to reintegrate Indian wisdom instilled in the Vedas especially in case of Mathematics. The paper discusses certain implications of Vedic mathematics in multiplications. It also explores how it can be helpful for students and how new innovation can be experimented or regenerated in case of the existing methods. The paper aims at inculcating mathematical skills in ordinary Indians and providing them a broader point of view in their minds by chiseling their mathematical astuteness.*

**Keyword:** *Mathematics, ICT, Multiplication, Digit, Vedic*

## 1. Solving Mathematical Problems through Vedic Mathematics

India has been an epicenter of higher learning from time immemorial. Traditionally, a student was assigned to the gurus for divine enlightenment. People from all over the world aspired to join Indian education institute like Nalanda, Taxila etc. With the passage of time, things changed and education sector too took a twist. Globalization, industrialization and consumerism greatly influenced learning process in India. Consequently, new parameters entered into education sector which bring with them new challenges as well as opportunities and India lost its grandeur of ancient learning like the Vedas.The beginning of Hindu philosophy is considered to be with the creation of the Vedas between 2500 BC and 600BC. These are four books of knowledge-Rig, Yajur, Sama and Atharva. The most prominent is Rig Veda while the others are rules of ritual, techniques of meditations and magical incantations.

Indian culture is established on the strong foundations of ancient rich concepts directly derived from the Vedas. It is further enriched by many outside interactions. Because of its accretive nature, it always assimilated new reforms. Young Indian mythologist Amish Tripathi categorically resonates, “What is it that makes India special? What is it about our ancient culture that still animates how we live today? What can we learn from our ancestors? And equally importantly, in what way can we be critical of our ancestors?” (Introduction Immortal India, xxv). Acknowledging its universal acclaim. Raja Rao gives a live glimpse of it:

> *If I were to look over the whole world to find out the country most richly endowed with all the wealth, power and beauty that nature can bestow- in some ways a very paradise on earth- I should point to India…if I were asked under what sky the human mind has most fully developed some of its choicest gifts, has most deeply pondered on the greatest problems of life and had found solutions to some of them, I should point to India. (Max Mueller qtd in Raja Rao’s The Meaning of India, 17)*

This adoration for India by Mueller gives a gist of what Matthew Arnold believes in the "…harmonious expansion of all the powers which make the beauty and worth of human nature..." (48) India along with her cultural identity.

However, People from the Vedic period cannot be termed as mathematicians by professions; they were priests/ pandits/ rishis who made use of mathematics for carrying out their religious rituals. Thus emphasis was not given on the proofs but used as properties/sutras. This ancient store house of knowledge was founded on sixteen Sutras or word formulae. This mathematical insight was unlocked between 1911 and 1918 by Sri Bharati Krisna Tirthaji (1884-1960). Vast knowledge of mathematics was also used in fields of astronomical and astrological topics like calculation of year duration, eclipses, zodiac signs etc. these formulae describe the way the mind naturally works and are therefore can be very handy for the students while deciphering tangled web of Mathematics and that too in indigenous way.

No mathematical texts are available from the early period of the Vedic Mathematics as in those days information was transferred orally and was recited number of times so that they are well remembered. But still they used mathematics on large basis and used mathematical knowledge for carrying out their rituals.

- As stated in Rigveda, like Babylonians, they were able to independently predict the date of solar eclipse.
- Vedic people did name very large numbers (upto till $10^{62}$) and surprisingly they used all these big numbers just for their rituals. For one of the ritual, one of the Rishi counts till $10^{12}$.

The SulbhaSutras are considered as only source of ancient Indian Mathematics from Vedic Period and was written in the period 800 BC – 200 BC. But again it was used for carrying out rituals. Sulbasutras is a list of rules for carrying out fire altars. These Sulbasutras had good amount of Geometry which was required as altars were needed to be in specific shapes and dimensions like length, height, area, etc. and also were required to convert 1 shape of altar to another to maintain similar properties like area.
Sulbasutras were written by

1. Baudhayana (arnd 800BC)
2. Manava (arnd 750BC)
3. Apastamba (arnd 600BC)
4. Katyayana (arnd 200BC)

Mathematics involved in Sulbasutras as follows:

## 2. Geometric figures and their inter conversions

Many geometrical figures (probably 1st time) were seen in Sulbasutras for carrying out their rituals in the form of Altars. These included circle, square, rectangle, trapezium, isosceles trapezium, isosceles triangle, rhombus, etc. Also their conversion, keeping the areas same, like square to circle, rectangle to square, square to circle, circle to square, etc. were seen.
And hence in these conversions, value of pi was also calculated.

**Example:** Conversion of circle to square keeping area constant.
Constructing a square of side 13/15 times the diameter of the given circle
This corresponds to taking $\boldsymbol{\pi = 4 \times (13/15)^2 = 676/225 = 3.00444.}$
More correct value of pi was calculated as **3.125 by Manava**.

- Pythagorus Theorem:

Baudhayana clearly knew the Pythagorus theorem and the Pythagorus Triples and he commented as
**"The rope which is stretched across the diagonal of a square produces an area double the size of the original square"**.

Katyayana gave more general version of Pythagorus theorem:
**"The rope which is stretched along the length of the diagonal of a rectangle produces an area which the vertical and horizontal sides make together".**
In Sulbasutras frequent usage of Pythagorean triples were observed like (3, 4, 5), (5, 12, 13), (12, 16, 20), (8, 15, 17), etc.

- **Irrational Numbers**

Calculation of Irrational numbers was also seen in Sulbasutras.
Eg: Squareroot of 2(irrational number). It was stated as "Increase a unit length by its third and this third by its own fourth less the thirty-fourth part of that fourth".
$\sqrt{2} = 1 + 1/3 + 1/(3 \times 4) - 1/(3 \times 4 \times 34) = 577/408 =$ **1.4142**

The most striking attribute of the Vedic system is considered to its unification and coherence. The whole system appears to be compact and unified. It is fully interconnected and there appears to be nothing loose. The general multiplication method, for example, is easily reversed to prove one line divisions and the simple squaring method can be reversed to give one line square root and all these things are equally comprehensible. This unifying quality is highly satiating. It paves the way for easy, interesting and innovative Mathematics.

In the Vedic system of Mathematics intricate problems can be solved instantly. These methods are common methods which had been applied by the laymen in India in ancient time but now forgotten. These methods are more suitable for us and are easy in comparison to the modern European methods. Moreover these are complementary, direct and comprehensible. Since Indian way of learning has been oral and emphasis lies on mental ability, this mode of learning saves time. Besides, the students can evolve their own simplified and varied methods. This paves the way for innovation, creativity and pragmatism.

The following is a demonstration for implication of the Vedic Mathematics especially in case of Multiplication:

## 3. Multiplication

The case how **Vertically and Crosswise** multiplications can be conducted:
**Example: I: 88 x 98**
Suppose you want to multiply 88 by 98. It appears complex but it can be solved easily through the following method:
Since 88 and 98 are close to 100 and 88 is 12 below 100 and 98 is 2 below 100.
The sum set can be imagined:

**88-12**
**X**
**98-2**
**86 24**

The 86 comes from subtracting crosswise:
88-2=86 (or 98-12=86: you can subtract either way.) we always get the same answer. And 24 in the answer is just 12 x 2: you multiply vertically. So 88x 98= 8624.

**Multiplication numbers just over 100**
**Example II: 105 x 103**
We have 105 x 103= 10815
The answer is in two segments: 108 and 15
108 is just 105+3 or 103 +5 and 15 is 5 x 3
Likewise 109 x 104= 11336

Or 109+4 =113 and 9 x 4= 36

**An instant way of Squaring numbers that end in 5**

**Example III: 65 x 65**

We get 65 x 65= 4225

We get answer in two parts 42 and 25. The last part shall always be 25. The first part is the first number multiplied by the 'one more' number which is 7 or 6 x 7= 42

$$\textbf{So } 65^2 = 42\ 25$$

Identically $95^2 = 9025$

**4. Method for multiplying numbers where the first figures are the same and the last figures add up to 10**

**Example IV: 52 x 58**

The answer is 52 x 59= 3016

Both numbers start with 5 and the last figures- 2 and 8 add up to 10.

So we multiply 5 by 6 (the next number) to get 30 for the first part of the answer

And we multiply the figures 2 x 8= 16 to get the last part of the answer.

Multiplying a number by 11:

To multiply any 2 figure number by 11 we just put the total of the two figures between the 2 figures.

**Example V**

16 x 11= 176

Outer figures in 176 are 16 being multiplied and the middle figure is 6 and1 added up

There is a method that can be applied for the multiplication of numbers with the same base. By base I mean both the numbers have to be 100+ something or 200+ something or 10+ something like that. For example, if we want to multiply 14 x17, 104 x 102 or 212 x 205 we can apply this method. Lets do the first example.

**Example V1**

14 x 17, here base of both the numbers are the same, ie. 10. The first number is 4 more than 10 and the second is 7 more than 10. For convenience we call these as the deviations. Hence the deviations of 14 and 17 from 10 are 4 and 7 respectively.

**Step 1:** Add the deviation of one number with the other number. That means; either

```
14 +     or     17 +
 7               4
21              21
```

in both case it the same answer 21.

**Step 2:** Since the base is 10 multiply the above sum with 10.

21 x 10 = 210

**Step 3:** Multiply the deviations.

4 x 7 = 28

**Step 4:** Add the answers in Step 2 and Step 3.

```
210 +
 28
238
```

So we got the answer

14 x 17 = 238

Here I've elaborately explained things, but one you practice the method; it's all a mental calculation. Now let us go through the second example.

**Example VII**

102 x 104 . Here base is 100, deviations are 2 and 4 respectively.
So deviation of one number plus the other number is 106.
The product of this sum with base is 10600.
The product of deviations is 8. Now add 10600 + 8.
Therefore: 102 x 104 = 10608
In both the examples I've deliberately taken the base as either 10 or 100. But what if the base is 20, 30 or 400 or something like that. See the following example.

**Example 3**

212 x 205, here base of both the numbers are 200. (100 x 2). Hence the deviations are 12 and 5 respectively.
Step 1: Add the deviation of one number with the other number. That means; either

```
212 +     or      205 +
  5                12
217              217
```

Step 2: Since the base is 200 multiply the above sum with 200.

217 x 200 = 43400
Step : 3 Multiply the deviations.
12 x 5 = 60
Step: 4 Add the answers in Step 2 and Step 3.

```
43400 +
   60
43460
```

Therefore
212 x 205 = 43460

(Tip: To multiply a number with 200, put two zeros to twice the number)
In succinct we may conclude that India had e very impressive way of resolving Mathematical problems. We just need to explore and find out these hidden treasure of our ancient Vedas.

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