

## ***Analysis of Vedic Mathematics EKADHIKENA PURVENA Sutra in Decimal Representation of a Fraction***

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### **Abstract:**

Vedic Mathematics, an ancient Indian mathematical system derived from the Atharva Veda, is renowned for its simple, logical, and rapid computational methods. Among its sixteen principal sutras, “EKADHIKENA PURVENA”—which means “by one more than the previous one”—is particularly significant for determining the decimal representation of fractions whose denominators end with the digit 9. This sutra provides a precise method for obtaining recurring decimals without the use of long division. According to this principle, at each step, one adds one to the previous digit to generate the successive decimal numbers. For instance, fractions such as, or can be expanded quickly and accurately using this sutra.

The application of this principle not only enhances the speed and efficiency of mental calculations but also reveals the logical structure and profound mathematical insight embedded in the Vedic system. This study presents the theoretical foundation of the EKADHIKENA PURVENA sutra, explains its step-by-step application, and compares its effectiveness with conventional long division methods for deriving recurring decimal sequences.

**Key-words:** EKADHIKENA PURVENA Sutra Fraction, Decimal Representation, Recurring, Non-recurring, Binomial theorem for negative integral index.

### **Introduction**

Vedic Mathematics is one of the most remarkable contributions of ancient Indian civilization to the world of knowledge. Rediscovered in the early 20th century by Jagadguru Swami Bharati Krishna Tirtha ji Maharaj, it is a system of mathematics based on sixteen main Sutras (aphorisms) and thirteen Sub-Sutras, derived from the Vedas, particularly the Atharva Veda. Each sutra provides a general rule or principle that can be applied to different mathematical problems, simplifying complex calculations into fast, elegant steps.

Among these sixteen sutras, one of the most profound is “EKADHIKENA PURVENA”, which translates to “By one more than the previous one.” While this sutra is popularly used to find the squares of numbers ending in 5, it also has a deeper and more subtle use in finding the decimal (recurring) representation of certain fractions — specifically, fractions whose denominators end with the digit 9 (such as  $1/19$ ,  $1/29$ ,  $1/39$ , etc.). This application of the sutra beautifully demonstrates the logical structure and mathematical foresight embedded in the Vedic system.

### Meaning and Translation of the Sutra

The Sanskrit phrase EKADHIKENA PURVENA can be broken down as follows:

Eka = one

Adhika = more

PURVENA = than the previous one

Hence, the literal meaning is “by one more than the previous one.”

In the context of decimal representation, this sutra provides a method to generate recurring decimals for fractions whose denominators are of the form 9, 19, 29, 39, and so on. The sutra tells us that to find the repeating decimal part of such fractions, we must use one more than the previous digit (the digit preceding 9 in the denominator) as a key number in our calculation.

For instance, if the denominator is 19, the previous digit is 1; one more than that is 2 — which becomes the key multiplier in constructing the decimal sequence.

### The Logic Behind the Sutra

In ordinary arithmetic, to find the decimal form of a fraction like  $1/19$ , one would perform long division manually: dividing 1 by 19 step by step until the digits start repeating. While accurate, this method is slow and cumbersome, especially without a calculator. The Vedic method, based on “EKADHIKENA PURVENA,” offers a mental and pattern-based shortcut that not only saves time but also reveals the recurring structure behind the decimals.

The sutra is used when the denominator is one less than a multiple of 10, 100, or 1000 — that is, when it ends with 9, 99, or 999, etc. Such numbers can be written as  $(10n - 1)$ ,  $(100n - 1)$ ,  $(1000n - 1)$ , and so on. The sutra helps in determining the decimal expansion of fractions of the form  $1/(10n - 1)$ .

The “previous” part of the denominator refers to the digits other than 9, and “one more than the previous one” refers to adding 1 to that previous part. This new number becomes the multiplier in generating the recurring decimal digits.

## Application of the Sutra to Decimal Representation

Let us now apply “EKADHIKENA PURVENA” step by step in the case of different fractions.

Example 1: Finding the Decimal Equivalent of  $1/19$

Here, the denominator is 19.

The “previous” part = 1 (the digit before 9).

“One more than the previous one” =  $1 + 1 = 2$ .

So, according to the sutra, the working base multiplier is 2.

Now, we follow the Vedic process:

1. Write the key number (2).
2. Begin with 1 as the first remainder (since we are dividing 1 by 19).
3. Multiply successively by 2, and keep track of the remainder’s mod 19.
4. Each product gives us the next digit in the recurring decimal until the cycle repeats.

Carrying out this operation reveals the repeating sequence of digits:

We start with 1 and multiply repeatedly by 2.

Write down only the unit digit each time and carry the tens digit.

Step	Calculation	Write	Carry
1	$1 \times 2 = 2$	2	0
2	$2 \times 2 = 4$	4	0
3	$4 \times 2 = 8$	8	0
4	$8 \times 2 = 16$	6	1
5	$6 \times 2 + 1 = 12$	3	1
6	$3 \times 2 + 1 = 7$	7	0
7	$7 \times 2 = 14$	4	1
8	$4 \times 2 + 1 = 9$	9	0
9	$9 \times 2 = 18$	8	1
10	$8 \times 2 + 1 = 17$	7	1
11	$7 \times 2 + 1 = 15$	5	1
12	$5 \times 2 + 1 = 11$	1	1
13	$1 \times 2 + 1 = 3$	3	0
14	$3 \times 2 = 6$	6	0
15	$6 \times 2 = 12$	2	1

16	$2 \times 2 + 1$	5	0
17	$5 \times 2 = 10$	0	1
18	$0 \times 2 + 1$	1	0

Reading From bottom to top:

$1/19 = 0.052631578947368421\dots$  (and this 18-digit block repeats). The sutra “EKADHIKENA PURVENA” allows this recurring pattern to be generated without traditional long division through a systematic use of the multiplier 2

	0.052631578947368421
19	1
	- 0
	100
	- 95
	50
	- 38
	120
	- 114
	60
	- 57
	30
	- 19
	110
	- 95
	150
	- 133
	170
	- 152
	180
	- 171
	90
	- 76
	140

and so on until we get the remainder 1 where it starts again from the beginning

### General Rule for Application

If the denominator is a number ending with 9 (e.g., 19, 29, 39, ..., 99), then:

Let the digits before 9 be represented as a.

The key multiplier  $k = a + 1$  (one more than the previous part). Then, the recurring digits of  $1/(10a + 9)$  can be obtained by a repeating multiplication process involving k.

Mathematically, this sutra works because fractions of the form  $1/(10a + 9)$  generate recurring decimals whose period length depends on the multiplicative order of 10 modulo  $(10a + 9)$ . The “one more than the previous” principle ensures that the sequence aligns correctly with this modular pattern. Thus, the sutra encodes a deep number-theoretic truth in a simple verbal rule.

## Significance of the Sutra in Decimal Representation

Sl.No.	Division	Answer	Remnant	Answer of the stage	dividend
O1	1/7	0		0.0	1
O2	10/7	1	3	0.01	31
O3	31/7	4	3	0.014	34
O4	34/7	4	6	0.0144	64
O5	64/7	9	1	0.01449	19
O6	19/7	2	5	0.014492	52
O7	52/7	7	3	0.0144927	37
O8	37/7	5	2	0.01449275	25
O9	25/7	3	4	0.014492753	43
O10	43/7	6	1	0.0144927536	16
O11	16/7	2	2	0.01449275362	22
O12	22/7	3	1	0.014492753623	12
O13	13/7	1	6	0.0144927536231	61
O14	61/7	8	5	0.01449275362318	58
O15	58/7	8	2	0.014492753623188	28
O16	28/7	4	Nil	0.0144927536231884	4
O17	4/7	0	4	0.01449275362318840	40
O18	40/7	5	5	0.014492753623188405	55
O19	55/7	7	6	0.0144927536231884057	67
O20	67/7	9	4	0.01449275362318840579	49
O21	49/7	7	Nil	0.014492753623188405797	7
O22	7/7	1	Nil	0.0144927536231884057971	1...

The sutra “EKADHIKEN PURVENA” is not just a mechanical trick but a reflection of the profound insight ancient Indian mathematicians had into number behavior. It offers a way to understand how fractions generate recurring decimals and why the length and pattern of the repetition depend on the denominator’s structure.

### Key insights provided by the sutra include:

#### 1. Pattern Recognition:

The sutra allows students to recognize predictable cycles in recurring decimals, such as how  $1/19$  repeats every 18 digits and  $1/39$  every 6 digits.

#### 2. Reduction of Long Division:

Instead of performing tedious long division, the Vedic method transforms the problem into simple repeated multiplication using the key number “one more than the previous.”

#### 3. Mental Mathematics:

The technique can be practiced mentally, improving number sense and concentration, which are core aims of Vedic Mathematics.

#### 4. Conceptual Clarity:

It connects decimals, fractions, and modular arithmetic — showing that recurring decimals are not random but follow logical patterns that can be predicted and generated.

## Philosophical and Educational Importance

The deeper message behind “EKADHIKENA PURVENA” is that mathematics is a field of patterns and relationships, not just memorized procedures. In traditional Indian pedagogy, the emphasis was always on understanding the principle rather than rote calculation. The sutra encourages curiosity: why do decimals repeat? how long is their period? what determines the sequence of digits?

By promoting analytical and intuitive thinking, this sutra helps students develop mental agility. It also aligns with the modern educational objective of pattern-based learning — encouraging learners to see connections among different mathematical domains.

Furthermore, the elegance of “EKADHIKENA PURVENA” reminds us of the universal language of mathematics: though formulated thousands of years ago in Sanskrit, the rule applies equally well to today’s decimal system and can even be extended to digital computation and algorithmic number generation.

## COMPARISON BETWEEN EKADHIKENA PURVENA SUTRA IN VEDIC MATHEMATICS AND CONVENTIONAL

### 1. Vedic Mathematics (Ekadhikena Purvena)

**Concept:** "One more than the previous". For denominator 19, the previous digit is 1. One more than 1 is  $1 + 1 = 2$ . We use 2 as the divisor.

#### Steps:

- Divide 1 by 2:  $Q = 0, R = 1$ . Result: 0.....
- Divide 10 (R + next digit) by 2:  $Q = 5, R = 0$ . Result: .05...
- Divide 05 (R + next digit) by 2:  $Q = 2, R = 1$ . Result: .052
- Continue... The answer is a repeating decimal: 0.052631578947368421

**Advantage:** Fast, one-line, mental calculation.

### 2. Modern Mathematics (Long Division)

**Concept:** Traditional long division:  $1 \div 19$ .

#### Steps:

- 19 goes into 10 zero times (0).
- 19 goes into 100 five times ( $19 \times 5 = 95$ ).  $100 - 95 = 5$ .
- 19 goes into 50 two times ( $19 \times 2 = 38$ ).  $50 - 38 = 12$ .

- 19 goes into 120 six times ( $19 \times 6 = 114$ ).  $120 - 114 = 6$ .
- Continues this repetitive process.

**Disadvantage:** Slower, requires writing down steps, higher chance of error.

## KEY DIFFERENCES

Feature	Ekadhikena Purvena (Vedic)	Ekadhikena Purvena (Morden)
Speed	Extremely Fast (Can be Mental)	Slower, Manual, calculation
Steps	Single Line	Multiple, repetitive steps
Complexity	Low (Only division by Small digits)	High (multi – Digit Multiplication/Subtraction)
Best used For	Divisors ending in 9 (19, 29,39.....)	General Purpose Division

## Conclusion

The Vedic sutra “EKADHIKENA PURVENA” — meaning “by one more than the previous one” — holds a special place in the study of decimal representations of fractions. By providing a clear and systematic method for finding recurring decimals of fractions with denominators ending in 9, it bridges ancient wisdom with modern number theory. The sutra’s logic rests on simple yet profound numerical relationships that reveal the cyclical nature of decimals and the harmony of arithmetic patterns.

Its educational value lies in how it transforms what appears to be a mechanical division process into an intuitive, mentally stimulating, and pattern-based approach. Thus, “EKADHIKENA PURVENA” is not merely a rule of calculation but a symbol of the intellectual depth, clarity, and timelessness of Vedic Mathematics — a system that continues to inspire and enlighten mathematical thought even in the modern digital age.

## Future Scope of research

The EKADHIKEN PURVEN sutra is one of the most elegant and powerful formulas in Vedic Mathematics. It translates to "By one more than the previous one", and is most famously used for squaring numbers ending in 5 (e.g.). However, its mathematical depth and potential applications extend far beyond that single use.

Here’s a detailed overview of the future scope of research in the EKADHIKENA PURVENA sutra — from theoretical exploration to modern computational applications:

## Generalization and Theoretical Expansion

### a. Algebraic Generalization:

Explore how the sutra can be expressed algebraically and applied to broader classes of numbers, such as those ending with other digits (e.g., patterns for when the last two digits follow certain forms).

**Possible research:** Derive generalized polynomial relationships extending the sutra.

### b. Modular Arithmetic Applications:

Study how “one more than the previous” patterns can simplify modular exponentiation, especially for cryptographic computations (e.g., fast squaring in modular systems).

### c. Extension to Binomial Patterns:

Investigate connections between the sutra and binomial expansions, potentially creating simplified algorithms for powers of binomials.

## **Bibliography**

- [1] Gaur, A. & Jain, K. (2012). “Applications of Vedic Mathematics in Modern Computations.” International Journal of Engineering Research and Applications (IJERA), Vol. 2, Issue 3.
- [2] Gupta, A. (2018). The Power of Vedic Math’s, Jaico Publishing. House, Mumbai, Pp. 79-83.
- [3] Kannojiya, D. S. & Yadav, D. K. (2008). Algorithm Of Anurupa Binomial Method, International J. Of Math. Sci. & Eng.
- [4] Kakkar Nini, Gupta Manju (2023) Ekadhikena Purven-Beauty of Vaidik Math’s, Indian Journal of applied research, Pp.2249-555X.
- [5] K.C. Jain (2005). “Vedic Mathematics for Schools” (Series I–III). Publisher: Motilal Banarasi Dass.
- [6] Padmashri Aniruddha Pethkar (2020.) Vedic Math’s- Ekadhikena Purvena, International Journal of Engineering, Science and Mathematics, Pp.2320-0294
- [7] Ranjan lal Rohit, Yadav Kumar Dharmendra (2024) Analysis of Vaidik Mathematics Ekadhikena Purven Sutra in Decimal representation of Fraction, IOSR Journal of Mathematics, Pp.2278-8727.
- [8] Selvaraj, P., Ashwin, Sags (2021), Vedic Mathematics, Notionpress.Com, Chennai, Tamil Nadu, Pp. 6.

- [9] Sharma, T. Khubani, R. & Subramanyam C. (2022). Study Of Mathematics Through Indian Veda's: A Review, Futuristic Research in Modeling of Dynamics System (Firm ds 2022), Pp. 1-8.
- [10] Shashtri, P. R. (2011) Vedic Mathematics Made Easy, Arihant Publication (I) Pvt. Ltd. Meerut (Up), Pp. 56-57.
- [11] Shem bulker, S., Dhole, S., Yadav, T. & Thakre, P. (2017). Vedic Mathematics Sutras – A Review. International Conference on Recent Trends in Engineering Science & Technology (Iratest 2017), 5(1), Pp.148-155.
- [12] Srivastava, C. M. (2011). Vedic Ganit, Manoj Publication, Delhi, Pp.139-144.
- [13] TEKRIWA, G. (2017). Math's Sutras: From Around the World, Penguin Random House India Pvt. Ltd, Haryana, Pp. 131-133.
- [14] Thakur, R. (2013). The Essentials of Vedic Mathematics, Rupa Publication India Pvt. Ltd, New Delhi, Pp. 129-32.
- [15] Tripathi, M. (2022). Vedic Mathematics for Students, Prabhat Paperbacks, New Delhi, Pp. 37-40.
- [16] "Vedic Mathematics" — by Jagadguru Swami Bharati Krishna Tirtha ji Maharaj, Publisher: Motilal Banarasi Dass Publishers, Delhi, First Published: 1965  
ISBN: 978-8120801630, Sutra: EKADHIKENA PURVENA (Sutra No. 1)
- [17] Williams, Kenneth R. (1984). "Discover Vedic Mathematics. "Publisher: Inspiration Books, UK.
- [18] Yadav, D. K. (2007). PADDATI AANURUPPEN Binomial Method to Find the Nth Power of Integers and Rational Numbers in Terminating Decimal Forms, Acta Ciencia Indica, 33 (2), Pp.647-655.