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Education

MULTIPLICATION AND DIVISION OF DECIMAL NUMBERS WITH THE VEDIC METHOD

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ABSTRACT This paper demonstrates the significance of Ancient and Vedic mathematics and how it makes the calculation much easier and takes less time than the usual method present. The data for the analysis has been primarily collected from students of different ages and studying different subjects. Some of them are studying in high school and intermediate, some are graduates, and some of them are postgraduates. Also, we have collected data from the students preparing for competitive examinations. After the analysis is carried out, we come to know that our data is significant and it is true that Vedic mathematics actually increases the speed of fundamental mathematical calculations. Many children and adults experience feelings of anxiety, apprehension, tension or discomfort when confronted by a maths problem. In 2022,36% of fourth grade students performed at or above the NAEP Proficient level on the mathematics assessment. Scientist are explored the nature and resolution of 'mathematics'. From NAS (National Achievement Survey) it is observed that many students consider Mathematics a very difficult subject in comparison with other subjects. Some students encounter difficulties with basic arithmetical operations for which they are unable to perform simple addition, subtraction, multiplication and division. We can also observe that, when we deal with decimal number system, that is a very tedious work for many of us. In view of this, immediate attention has been shifted towards vedic and ancient mathematics in school education for developing logical thinking through easy steps. A system like Vedic mathematics has manifold applications and hence there is a large scope of sharing the concept of Vedic mathematics with students all over the world. By adopting the methods of Vedic mathematics, we can solve the numerical problems within seconds which may be very useful to crack any entrance exam of private or government sectors.

KEYWORDS : Decimal Number System, Multiplication, Division

INTRODUCTION

Vedic Mathematics by the Jagadguru Śankarācārya (Jagadguru Swāmī Śri Bhārati Krṣṇa Tirthajī Mahārāja) of Govardhana Peetha is a monumental work. In his deep-layer explorations of cryptic Vedic mysteries relating specially to their calculus of short hand formulae and their neat and ready application to practical problems. Vedic Maths is India's gift to the World just like Yoga and Ayurveda. By learning Vedic Math, you will be able to calculate much faster compared to the traditional system.

Mathematics, the study of abstract patterns, is regarded as an important body of knowledge. Carl Friedrich Gauss, the great German scientist and mathematician, held mathematics to be the "queen of the sciences." The Pythagoreans felt that "all is number." Jyotish Vedangasays,

यथाशिखामयूराणां,नागानांमणयोयथा/तद्वद्वेदाङ्गशास्त्राणांगणितंमूर्धनिस्थितम्//

"Like the crest of a peacock, like the gem on the head of a snake, so is mathematics at the head of all knowledge."

The essential role of mathematics in all the sciences can be explained by recognizing that life is structured in layers: from stars and planets to animals and plants, to molecules, atoms, and fundamental particles. Physics describes regularities in the behaviour of physical phenomena; chemistry studies how atoms and molecules interact with one another; and biology investigates the laws governing living systems. Mathematics, in contrast, studies abstract objects—numbers and their operations, geometrical shapes and their properties. Numbers, functions, circles, and squares are not concrete physical objects as organisms, cells, and molecules are. They are more abstract even than the unseen forces of physics, which nevertheless influence matter in a direct and measurable way.

Vedic mathematics approach to mathematical calculation helps the students to increase their listening skills, increase concentration power, increase brain development, increase learning ability, and moreover quick and accuracy in calculation. It has been designed in a way that calculations are carried out mentally. Sutras techniques reduce time, area and power consumption. The main beauty of it is to reduce complex calculations into simple one. In this paper, we discuss how this Vedic method of calculation simplifies the multiplication and division of decimal numbers, which horrifies many of the students.

DecimalNumbersMultiplicationAndDivision

A decimal number is another form of a fractional number. It has two parts, one the integral or whole number part and the decimal or fractional part.

It is believed that the decimal system or place value system is as old as Veda because the following sloka defines the properties of zero.

ॐपूर्णमदःपूर्णमिदंपूर्णात्पूर्णमुदच्यते/पूर्णस्यपूर्णमादायपूर्णमेवावशिष्यते//ॐशान्तिःशान्तिःशान्तिः//

This sloka in Yajur Veda (Brihadaranayak Upanishad, panchamadhyaya) defines the fullness of the universe, "that is complete and this is also complete, when complete is added to complete becomes complete and complete is subtracted from complete remains complete."

Nothingness is otherwise known as complete in itself and denotes zero, because zero has no beginning or end. This word purna is a word derived from the shape of the full moon (purnima), which is a complete circle or shape of zero. This means that the ancient Indians were very much aware of the ZERO. This sloka defines the nature of zero:

- Zero plus zero = zero,
- Zero minus zero = zero,
- पूर्णमदः-पूर्णम्+अदः- The creater (god) is complete,
- पूर्णमिदं:-पूर्णम्+इदं:- The creation is also complete.

2nd sloka: अंकानांबामतोगति/ (Number always moves from left). (Pingala's छन्द-सास्त्र)

Example: काम: Using ka, ta, pa, ya, di sutra ka denotes 1 and ma denotes 5, Value of काम becomes 51,

3rd sloka:

एकंदशशतंचैवसहस्रमयुतंतथा|लक्षंचनियुतंचैवकोटिर्बुदमेवच||वृन्दंखर्वोनिखर्वश्चशङ्खःपद्मश्चसागरः|अन्त्यं मध्यंपरार्धश्चदशवृद्ध्यायथाक्रमम्||

एकम्१|दश १०|शतम्१००|सहस्रम्१,०००|अयुतम्१०,०००|लक्षम्१,००,०००|नियुतम्१०,००,०००| कोटिः१,००,००,०००| अर्बुदम्१०,००,००,०००|वृन्दम्१,००,००,००,०००|खर्वः१०,००,००,००,०००| निखर्वः १,००,००,००,००,०००| शङ्खः १०,००,००,००,००,०००| पद्मः १,००,००,००,००,००,०००| सागरः १०, ००, ००, ००, ००, ००, ०००| अन्त्यम् १, ००, ००, ००, ००, ००, ००, ०००| मध्यम् १०,००,००,००,००,००,००,०००| परार्धम्१,००,००,००,००,००,००,००,०००|

(संस्कृतभारतीपुस्तकेप्राप्तम्)

एकं च दशं च शतं च सहस्रं च अयुतं च नियुतं च प्रयुतं च अर्बुदं च न्यर्बुदं च समुद्रं च मध्यं च अन्तश्च परार्धश्च।"

एकं=1=10^0, दशं=10=10^1, शतं=100=10^2, सहस्रं=1000=10^3, अयुतं=10,000=10^4, नियुतं=1,00,000=10^5, प्रयुतं=10,00,00,000=10^6, अर्बुदं=1,00,00,000=10^7, न्यर्बुदं=10, 00,00,000=10^8, समुद्रं=1,00,00,00,000=10^9, मध्यं=10,00,00,00,000=10^{10} अन्तः=1,00,00,00,00,000=10^{11}, परार्धः=10,00,00,00,00,000=10^{12}/" Further developments of Aryabhata 1. He says कोटि=1, 00, 00,000=10^7. अर्बुदम्=10, 00, 00,000 = 10^8. वृन्दं=1,00,00,00,000=10^9. Later on Mahaviracharya wrote Ganitha Sarasangaraha, and named the value up to 10^{23}. He gave the name अर्बुद for 10^{10}= (10, 00, 00, 00, 000). न्यर्बुदम्=10^{11} (1,00,00,00,00,000), खर्वम्=10^{12}, महाखर्वम्=10^{13}, पद्मम्=10^{14}, महापद्मम्=10^{15}, क्षोणी=10^{16}, महाक्षोणी=10^{17}, शङ्खम्=10^{18}, महाशङ्खम्=10^{19}, क्षिति=10^{20}, महाक्षिति=10^{21}, क्षोभम् =10^{22}, महाक्षोभम्=10^{23}/ (तैत्तिरीयसंहिताinयजुर्वेदसंहिताप्राप्तम्)

The above sloka defines about the name of the place value of numbers from unit place to ten to the power of 16 which is known as parardha and this sloka defines that every succeeding number is ten time.

Example-1)

$$0.38 = \frac{3}{10} + \frac{8}{100},$$

Example-2)

$$27.627 = 27 + \frac{6}{10} + \frac{2}{100} + \frac{7}{1000}$$

For multiplication of decimal numbers, we follow Vedic multiplication sutras and the second principle the number of decimal digits at the answer is equal to the sum of the number of decimal digits in the products side.

Some examples of multiplications are given below:

Example-1) $0.8 \times 0.6 = 0.48,$

Method: $\frac{8}{10} \times \frac{6}{10} = 8 \times 10^{-1} \times 6 \times 10^{-1} = 8 \times 6 \times 10^{-2} = 48 \times \frac{1}{100} = \frac{48}{100} = 0.48,$

Sum of decimal digits in left hand side = number of decimal digits in right hand side.

Example-2) $0.52 \times 0.56 = 0.2912,$

Method: $\frac{52}{100} \times \frac{56}{100} = 52 \times 10^{-2} \times 56 \times 10^{-2} = 52 \times 56 \times 10^{-4} = 2912 \times \frac{1}{10000} = \frac{2912}{10000} = 0.2912.$

Sum of decimal digits in left hand side = number of decimal digits in right hand side.

Example-3) $12.3 \times 1.04 = 12.792,$

Method: $\frac{123}{10} \times \frac{104}{100}$ $123 \times 10^{-1} \times 104 \times 10^{-2}$ $123 \times 104 \times 10^{-3}$ $12792 \times \frac{1}{1000}$ $\frac{12792}{1000}$ 12.792.

123×104 $(123 + 4) / (23 \times 4)$ 12792,

Sum of decimal digits in left hand side = number of decimal digits in right hand side.

Example-4 $1.0003 \times 1.12 = 1.120336,$

Method: $\frac{10003}{10000} \times \frac{112}{100} = 10003 \times 10^{-4} \times 112 \times 10^{-2} = 10003 \times 112 \times 10^{-6}$

$= 1120336 \times \frac{1}{10^6} = \frac{1120336}{1000000} = 1.120336,$ (Six digits in the decimal parts)

$10003 \times 112 = (10^4 + 3) \times (10^2 + 12)$ {Using formula $(x + a)(y + b)$}

$= 10^6 + 12 \times 10^4 + 3 \times 10^2 + 36$

$= 1000000 + 120000 + 300 + 36 = 1120336,$

10003-------(3) ×112----------(12)	10003 + 12
1120336	11203/ (3×12)

Sum of decimal digits in left hand side = number of decimal digits in right hand side.

Example-5)

Product Of Three Decimal Numbers Using Algebraic Formula

$$(x + a)(x + b)(x + c)(x + d) = x^4 + x^3(x + a + b + c + d) + x^2(x^2 + ab + ac + ad + bc + bd) + x(abc + abd + bcd + acd) + abcd,$$

$0.96 \times 9.5 \times 0.098 \times 0.87 = 0.7775712,$

Method: $96 \times 95 \times 98 \times 87 = (100 - 4)(100 - 5)(100 - 2)(100 - 13)$

$= (96 - 5 - 2 - 13)$ /{(−4)(−5) + (−5)(−2) + (−2)(−13) + (−4)(−13) + (−4)(−2) + (−5)(−13)/{(−4) × (−5) × (−2) + (−5) × (−2) × (−13) + (−4) × (−2) × (−13) + (−4) × (−5) × (−13)} / {(−4)(−5)(−2)(−13)

$= 76 / (20 + 10 + 26 + 52 + 8 + 65) / (-40 - 130 - 104 - 260) / 520$

$= 76 / 181 / (-534) / 520 = 77 / 75 / 66 / 520 = 77757120,,$

Sum of decimal digits in left hand side = 8, so, the answer becomes 0.77757120, Answer of the product of the decimal numbers

Sum of decimal digits in left hand side = 8, so, the answer becomes 0.77757120, Answer of the product of the decimal numbers = 0.77757120 = 0.7775712.

Example-7) $10.4 \times 0.56 = \frac{11.648}{2} = 5.824,$

Method:

$10.4 \times 0.56 = 10.4 \times \frac{1.12}{2} = \frac{104}{10} \times \frac{112}{200} = 11648 \times \frac{1}{2000} = \frac{5824}{1000} = 5.824,$

Sum of decimal digits in left hand side = number of decimal digits in right hand side=3.

Division Of Decimal Numbers.

For division of decimal numbers we follow Vedic division sutras and the second principle the number of decimal digits at the answer is equal to the difference between the number of digits in numerator and the number of digits in denominator.

Decimal digits will be equal to the resulting answer if is subtraction is positive and if the subtraction is negative after division place zero at the right side.

1) $\frac{0.48}{0.2} = 2.4.$

Ignoring the decimal point divide 48 by 2,

Number of decimal digits in right side = (*number of decimal digits in numerator − number of decimal digits in denominator*)

2) $\frac{12.56}{4} = 3.14$

Ignoring the decimal point divide 1256 by 4,

Number of decimal digits in right side = (*number of decimal digits in numerator − number of decimal digits in denominator*)

3) $\frac{3.246}{0.05} = 64.92$

Ignoring the decimal point divide 3246 by 5,

Number of decimal digits in right side = (*number of decimal digits in numerator − number of decimal digits in denominator*); (3 − 1 = 2).

Number of zeros just after the decimal number in denominator reduces the decimal digits by one.

4) $\frac{437.69}{0.005} = 87538$

Ignoring the decimal point divide 43769 by 5,

Ignoring the decimal point divide 43769 by 5,

Number of decimal digits in right side = (*number of decimal digits in numerator − number of decimal digits in denominator*); (2 − 3 = −1)

$\frac{437.69}{0.005} = \left(\frac{43769}{10^2}\right) / \left(\frac{5}{10^3}\right) = \left(\frac{43769}{5}\right) \times \left(\frac{10^3}{10^2}\right) = \left(\frac{43769 \times 2}{10}\right) \times 10^{(3-2)} = (8753.8) \times 10 = 87538.$

As, after dividing 43769 by 5 we get 8753.8 so, multiply this number by 10 so the answer becomes 87538.

5) $\frac{56}{0.014} =$

Ignoring the decimal point divide 56 by 14, $\frac{56}{14} = 4$

Number of decimal digits in right side = (*number of decimal digits in numerator − number of decimal digits in denominator*); (0 − 3 = −3)

As the resulting number is $-ve = -3$, so, place 3 zeros after 4 to get the answer.

Methodology-

$\frac{56}{0.014} = \left(\frac{56}{10^0}\right) / \left(\frac{14}{10^3}\right) = \left(\frac{56}{14}\right) \times \left(\frac{10^3}{10^0}\right) = (4) \times 10^{(3-0)} = (4) \times 10^3 = 4000,$

6) $\frac{1.155}{0.021} = 55$

Ignoring the decimal point divide 1155 by 21, $\frac{1155}{21} = 55,$

Number of decimal digits in right side = (*number of decimal digits in numerator − number of decimal digits in denominator*); (3 − 3 = 0)

Answer is 55 without decimal digit.

Methodology-

$\frac{1.155}{0.021} = \left(\frac{1155}{10^3}\right) / \left(\frac{21}{10^3}\right) = \left(\frac{1155}{21}\right) \times \left(\frac{10^3}{10^3}\right) = (55) \times 10^{(3-3)} = (55) \times 10^0 = 55,$

7) $\frac{13.65}{0.000273} =$

Ignoring the decimal point divide 1365 by 273, $\frac{1365}{273}$ 5

Number of decimal digits in right side

(number of decimal digits in numerator −

number of decimal digits in denominator); $(2-6 \quad -4)$

As the resulting number is $-ve \quad -4$, so, place 4 zeros after 5 to get the answer.

Methodology:

$$\frac{13.65}{0.000273} = \left(\frac{1365}{10^2}\right)/\left(\frac{273}{10^6}\right) = \left(\frac{1365}{273}\right) \times \left(\frac{10^6}{10^2}\right) = (5) \times 10^{(6-2)} = (5) \times 10^4 = 50000.$$

CONCLUSION

Thus, we see that Vedic Mathematics offers a new approach to resolve the current crisis in mathematics offers a new approach to resolve the current crisis in mathematics education. A systematic investigation of Vedic Mathematics will amazingly be valuable for understudies and specialists. The Vedic Mathematics discovered by Bharati Krishna Tirtha can be used in high school mathematics for speedy calculations and this branch need further intensive research to give it shape of systematic branch of knowledge.

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