International Journal of Mathematics Trends and Technology
ISSN: 2231-5373/ https://doi.org/10.14445/22315373/IJMTT-V68I9P512

Volume 68 Issue 9, 79-86, September 2022

Original Article

Generalization of Yavadunam Sutra for Finding the n^{th} Power of any Number

Shivani Khare

Department of Mathematics and Statistics, Dr. Harisingh Gour Vishwavidyalaya, Sagar, Madhya Pradesh-470003, India.

Received: 09 August 2022 Revised: 11 September 2022 Accepted: 21 September 2022 Published: 30 September 2022

Abstract *- In this paper, we generalize the Yadadunam process for finding the n^{th} power of any number. First, we define the application of the Yavadunam sutra for calculating the fourth and fifth power of any number. Further, we generalize the Yavaduman process for finding the n^{th} power of any number.*

Keywords *- Vedic Mathematics, Yavadunam Sutra.*

1. Introduction

By Sri Bharati Krishna Tirthaji between 1911 and 1918, Vedic Mathematics was rediscovered as a primaeval form of Mathematics [1]. Considering his study, fully mathematics originated from sixteen sutras. In Indian Mathematics called "Vedic Mathematics" since it originates from the Vedas, Vedic Mathematics is a pool of primaeval skills and methods for solving arithmetic problems quickly and more effectively [2]. As per Atharva Veda, other sciences such as engineering, mathematics, sculpture, and medicine are also contained within it. A Vedic term means 'Knowledge' in Sanskrit.
It can sometimes be intricate and difficult to decipher mathematical steps, and implement systematic mathematical principles. While numerical calculations can be completed very easily using Vedic Mathematics for Common Techniques (a collection of relevant information) and Unambiguous Methods (a reference to unambiguous information collections), these techniques are based upon Vedic Mathematics for Common Techniques which contain fully relevant information. Although the unadventurous technique takes many steps to solve the problem, Vedic Mathematics offers its solution in a single line. As a primaeval method, it includes cubing, square, and cube roots, squaring, multiplication, and cubing. Even repetitive auxiliary fractions and decimals can be handled by Vedic Mathematics.

The text of Bharathi Krishna Thirthaji has been extended by several British mathematicians in the last few decades, including Andrew Nicholas, Kenneth Williams, and Jeremy Pickles [4]. In order to improve the speed of essential mathematical calculation, few studies have been conducted on Vedic Mathematics. It is sometimes possible to perform rapid calculations with Vedic mathematics techniques [6-12]. Mathematics techniques used in Vedic culture focus on proficiency in quick arithmetic as well as aptitude or reasoning.

In the Vedic literature, the Yavadunam sutra has been given for finding the cube of any number. Hence, inspired by the above discussion, we will generalize the Yavadunam process for finding the nth power of any number.

The paper is organized as follows: In section 2 some preliminary results are discussed. The main results of the paper are described in section 3. Finally, we conclude the findings of the presented paper in section 4.

2. Preliminary Results

Before going to the main results, we write here some basic results.

Digits	Cube	Forth Power
1	1	1
2	8	16
3	27	81
4	64	256
5	125	625
6	216	1296
7	343	2401

8	512	4096
9	729	6561
10	1000	10000

3. Generalization of Yavadunam Sutras for finding the power of any digit

In the Vedic literature, the Yavadunam sutra is given for finding the cube of any number. Here we will generalize the Yavadunam process for finding the nth power of any number.

Yavadunam Sutra: Whatever the magnitude of its insufficiency.

3.1. The Yavadunam Sutra for the fourth power

Here, the fourth power of any number will be calculated using Yavadunam Sutras, i.e., by deficiency.
Consider the digit 12.
To find the fourth power of the number 12, we follow the following steps.

Write 12= (10+2). Here the base is 10, and the excess is 2.

Step 1- Add thrice of excess, i.e., 3 (2) = 6, to 12.

$12+6=18$

Step 2- Multiply 6 by the square of excess.

$6(2)^2 = 24.$

Step 3- Multiply 4 by the cube of the original excess.

$4(2)^3 = 32$

Step 4- Write the fourth power of the original excess

$2^4=16.$

Since we consider 10 as the base, therefore the fourth power of the number 12 is given by

$(12)^4 = (10+2)^4$

$12+ 3(2) =18$

$6 \times 2 \times 2 = 24$

$4 \times 2 \times 2 \times 2 = 32$

$2^4=16$

=18 | 24 | 32 |16

=18 | 24 | 32 | 6

1

=18 | 24 | 3 | 6

3

=18 | 7 | 3 | 6

2

=20736.

Here we consider a few more examples,

Example 1:

$(13)^4 = (10+3)^4$

Step 1: 13+ 3(3) =22.

Step 2: 6 × 3 ×3 = 54.

Step 3: 4 ×3 × 3 ×3 = 108.

Step 4: 3^4=81.

Therefore,

$(13)^4$ =22 | 54 | 108 | 81

= 22 | 54 | 108 | 1

8

= 22 | 54 | 6 | 1

11

= 22 | 5 | 6 | 1

6

= 28561.

Example 2:

$(97)^4 = (100-3)^4$

Step 1: 97+ 3(-3) = 97-9=88

Step 2: 6 ×-3 × -3 = 54

Step 3: 4 ×-3 × -3 × -3 = -108

Step 4: $(-3)^4$=81

Therefore,

$(97)^4$=88 | 54 | $\overline{108}$ | 81

= 88 | 54 | $\overline{108}$ | 81

= 88 | 54 | 892 | 81

$\bar{1}$

= 88 | 44 | 892 | 81

= 88 | 44 | 92 | 81

8

=88529281.

3.2. The Yavadunam Sutra for the fifth power

Here, the fifth power of any number will be calculated using Yavadunam Sutras, i.e., by deficiency.

Consider the digit 12. To find the fourth power of the number 12, we follow the following steps.

Write 12= (10+2). Here the base is 10, and the excess is 2.

Step 1- Write 12= (10+2). Here the base is 10, and the excess is 2.

Step 2- Add fourth of excess, i.e., 4 (2) = 8, to 12.

12+8=20

Step 3- Multiply 10 by the square of excess.

$10\ (2)^2 = 40.$

Step 4- Multiply 10 by the cube of the original excess.

$10\ (2)^3 = 80.$

Step 5- Multiply 5 by the fourth power of the original excess.

$5\ (2)^4 = 80.$

Step 6- Write a fifth power of the original excess

$2^5=32.$

Since we consider 10 as the base, therefore the fifth power of the number 12 is given by

$(12)^5 = (10+2)^5.$

= 20 | 40 | 80 | 80 | 32

= 20 | 40 | 80 | 80 | 2

3

= 20 | 40 | 80 | 3 | 2

8

= 20 | 40 | 8 | 3 | 2

8

= 20 | 8 | 8 | 3 | 2

4

=248832

Example 1:

$(13)^5 = (10+3)^5$

Step 1: 13+ 4(3) =25.

Step 2: 10 × 3 ×3 = 90.

Step 3: 10 ×3 × 3 ×3 = 270.

Step 4-: 5 × 3 ×3 × 3 × 3 = 405.

Step 5: $(3)^5$ =243

Therefore,

25 | 90 | 270 | 405 | 243

= 25 | 90 | 270 | 405 | 3

24

=25 | 90 | 270 | 9 | 3

42

= 25 | 90 | 312 | 9 | 3

=25 | 90 | 2 | 9 | 3

31

=25 | 121 | 2 | 9 | 3

=25 | 1 | 2 | 9 | 3

12

=371293.

Example 2:

$(97)^5 = (100-3)^5$

Step 1: 97+ 4(-3) = 85.

Step 2: 10 × -3 × -3 = 90.

Step 3: 10 × -3 × -3 × -3 = -270.

Step 4: 5 × -3 × -3 × -3 × -3 = 405.

Step 5: $(-3)^5$=-243.

Therefore,

85| 90 | $\overline{270}$ | 405 | $\overline{243}$

= 85 | 90 | $\overline{270}$ | 405 | 757.

$\overline{1}$

= 85 | 90 | $\overline{270}$ | 395 | 757

7

= 85 | 90 | $\overline{270}$ | 402 | 57

4

= 85 | 90 |$\overline{266}$ | 02 | 57

= 85 | 90 | 734 | 02 | 57

$\overline{1}$

= 85 | 80 | 734 | 02 |57

= 85 | 80 | 34 | 02 | 57

7

= 85 | 87 | 34 | 02 | 57

=8587340257.

3.3. Generalization of Yavadunam Sutras for finding the nth power of any number

To find the nth power of any number, first, we consider bases like 10, 100, 1000, etc. And write the number in the form of base plus excess. Let base is denoted by a and excess is b. Then, to calculate $(a+b)^n$, we have,

$$a + (n-1)b, \qquad (1)$$

$$\binom{n}{2} b^2 , \qquad (2)$$

$$\binom{n}{3} b^3, \qquad (3)$$

....

....

....

$\binom{n}{r} b^r$, (r)

....

$\binom{n}{n} b^n$, (n)

Finally, we add the above-all equations,

Equation (1) | Equation (2) | Equation (3)...| Equation (r) |... Equation (n) (*)

Therefore equation (*) represents the nth power of any number.

4. Conclusion

In this paper, we find the high power of any number by using Yavadunam sutras. Firstly, we have described the process of Yavadunam sutras for finding the fourth power of the number. Further, we find the fifth power of the number by using Yavaduanm Sutra. Finally, we generalize the Yavadunam process for finding the nth power of any number.

References

[1] Tirthaji, Bharati Krishna, "Vedic Mathematics: Motilal Banarasidass." *New Delhi*, 1965.

[2] VedicMaths.Org, 2004. http://www.vedicmaths.org

[3] K. S. Shukla, "Vedic Mathematics—The Illusive Title of Swamiji's Book." *Mathematical Education*, vol. 5, no. 3, 1989.

[4] K. Williams, Discover Vedic Mathematics Skelmersdale: Inspiration Books, 1984.

[5] B. Dhaval, "Vedic Mathematics Made Easy," *New Delhi: Jaico Publishing House*, 2015.

[6] K. Krishna Prasad, "An Empirical Study on Role of Vedic Mathematics in Improving the Speed of Basic Mathematical Operations," *International Journal of Management, IT and Engineering*, vol. 6, no. 1, pp. 161-171, 2016.

[7] S. G. Dani, "Myths and Reality: on Vedic Mathematics," *Frontline*, vol. 10, no. 2, pp. 90-92, 1993.

[8] Shembalkar, Sayali, Et Al., "Vedic Mathematics Sutras," *A Review, International Conference on Recent Trends in Engineering Science and Technology (ICRTEST),"* 2017.

[9] Kapoor, Sant Kumar, "Vedic Mathematics Skills," *Lotus Press*, 2006.

[10] Bathia, Dhaval, "Vedic Mathematics Made Easy," *Jaico Publishing House*, 2005.

[11] Thakur, Rajesh Kumar, "The Essentials of Vedic Mathematics," *Rupa Publications India*, 2013.

[12] Kumar, G. Ganesh, and V. Charishma, "Design of High Speed Vedic Multiplier Using Vedic Mathematics Techniques," *International Journal of Scientific and Research Publications*, vol. 2, no. 3, 2012.

[13] A. Kumar, "Vedic Mathematics Sutra: Upkar Prakasan," 2010.

[14] Parajuli, Krishna Kanta, "Square Roots in Vedic Mathematics," *In Mathematics Education Forum Chitwan*, vol. 4, no. 4, pp. 64-71, 2019.

[15] Amit. Goel, "Learn and Teach Mathematics," Authors Press, 2006.

[16] Khare, S., & Gangele, R, "Comparative Study of Traditional and Vedic Mathematics Methods for the Study of Analytical Conics," *Research Review International Journal of Multidisciplinary*, vol. 7, no. 8, pp. 49–53, 2022. https://doi.org/10.31305/rrijm.2022.v07.i08.007.

[17] Shivani Khare, "Applicability of Vedic Sutras to Study the Recurring Decimals," 2022. https://doi.org/10.5281/zenodo.7082694

[18] Shivani Khare, "Vedic Sutras to Find The Cube of Any Digit By Considering Any Working Base", *IJRAR - International Journal of Research and Analytical Reviews* , E-ISSN 2348-1269, P- ISSN 2349-5138, vol. 9, no. 3, pp. 869-874, 2022. Available at : http://www.ijrar.org/IJRAR22C2596.pdf .

[19] Garain, D. N., and Sanjeev Kumar, "Japanese vs Vedic Methods for Multiplication," *International Journal of Mathematics Trends and Technology*, vol. 54, no. 3, pp. 228-235, 2018. Crossref, https://doi.org/10.14445/22315373/IJMTT-V54P525.

[20] Garain, D. N., and Sanjeev Kumar, "Analytical Discussion for Existence of Idea of Calculus in Vedic and Post Vedic Periods," *International Journal of Mathematics Trends and Technology (IJMTT)*, vol. 61, no. 2, pp. 85-88. 2018. Crossref, https://doi.org/10.14445/22315373/IJMTT-V61P512.

[21] Kahar, Dravik KishorBhai, and Harsh Mehta, "High Speed Vedic Multiplier Used Vedic Mathematics," *2017 International Conference on Intelligent Computing and Control Systems (ICICCS)*, IEEE, 2017.

[22] Nicholas, Andrew P., Kenneth R. Williams, and Jeremy Pickles, “Vertically and Crosswise: Applications of The Vedic Mathematics o Sutra,” *Motilal Banarsidass Publication ,* vol. 6, 2003.

[23] Glover, James T, “Vedic mathematics for schools,” *Motilal Banarsidass Publication*, vol. 2, 2001.

[24] Toro, Suyash, et al, "Division Operation Based on Vedic Mathematics, " *2016 IEEE International Conference on Advances in Electronics, Communication and Computer Technology (ICAECCT)*, IEEE, 2016.

[25] Kapoor, Sant Kumar, “ Vedic Mathematics Skills,” *Lotus Press*, 2006.