



Logic Behind Some Sutras in Vedic Mathematics

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ABSTRACT

Vedic math gives Sutras (formulas) that are time saving while doing calculations. In this paper we give the logic behind some of these Sutras(formulas) .

KEYWORDS

Sutra, Vedic mathematics, Dwandwa

Introduction :

Vedic mathematics is claimed to be developed from ancient Vedic texts by Bharti Krishna Tirthaji in his book [1]. In this book he has discussed sixteen Sutras(formulas) and thirteen subsutras(corollaries). These formulas (Sutras) are used by students and teachers for quick calculations. In this paper we try to explain logic behind a few sutras, namely Ekadhikina Purvena, Nikhilam Navatashcaramam Dashatah, Urdhava – Tirayagbyham.

Ekadhikina Purvena means one more than the previous one.

This formula is used if we are squaring a number with 5 at unit place. So square of a two digit number with 5 at unit place say 35 is product of 3(digit at tenth place) multiplied with one more than itself i.e. 4 and result written on left followed by 25.

$$(35)^2 = 3 \times 4/25 = 1225$$

Explanation : If a two digit number $10x + 5$ is squared

$$(10x + 5)^2 = 100x^2 + 100x + 25$$

$$= 100x(x + 1) + 25$$

= x multiplied with $(x + 1)$ (one more than x) with zero at tenth and unit place + 25

= $x(x + 1)$ on left and 25 on right

$$= x(x + 1)25$$

Square of any number

We evaluate Dwandwa (duplex) of any number

Dwandwa of one digit number is its square i.e. $Dx = x^2$

Dwandwa of two digit number xy is $2xy$.e. $Dxy = 2xy$

Dwandwa of three digit number xyz is $2xz + y^2$ i.e. $Dxyz = 2xz + y^2$

Dwandwa of four digit number $xyzt$ is $2xt + 2yz$ i.e. $Dxyzt = 2xt + 2yz$

Rule for square of two digit number $(xy)^2 = Dx/Dxy/Dy = x^2/2xy/y^2$

$$(53)^2 = 5^2/2 \times 5 \times 3/3^2 = 25/30/9 = 25+3/0/9 = 28/0/9 = 2809$$

Explanation : $(10x + y)^2 = 100x^2 + 2xy(10) + y^2 = x^2/2xy/y^2 = Dx/Dxy/Dy$

Similarly square of three and higher digit numbers is calculated.

Nikhilam Navatashcaramam Dashatah means all from 9 and last from 10.

If a positive number is subtracted from a multiple of 10 say 457 is subtracted from 1000, the result would be obtained by subtracting each digit starting from extreme left from 9 and last digit from 10.

$$1000 - 457 = 9-4/9-5/10-7 = 543$$

Explanation : 9910
 $\begin{array}{r} 1\Phi\Phi\Phi \\ - 457 \\ \hline 543 \end{array}$

Urdhava Tirayagbyham : This sutra means vertically and crosswise

If we multiply two digit numbers close to 100 and less 100, say 98×97 , we write the numbers one below the other on left and their difference from 100 as two digit number on right.

$$\begin{array}{r} 98 \ 02 \\ 97 \ 03 \end{array}$$

We multiply the numbers on right vertically and write the answer below it on right hand side. We subtract the numbers crosswise either $98 - 03$ or $97 - 02$ to get same answer i.e 95 and write it on the left .

$$\begin{array}{r} 98 \ 02 \\ \swarrow \ \uparrow \\ 97 \ 03 \end{array} \quad (i)$$

$$95 \ 06$$

Explanation : Let two numbers be $100 - n_1$ and $100 - n_2$ which are close to hundred and less than 100.

$0 \leq n_1, n_2 \leq 9$. We take Their product

$$\begin{aligned} (100 - n_1)(100 - n_2) &= 10000 - 100n_1 - 100n_2 + n_1n_2 \\ &= 100(100 - n_1 - n_2) + n_1n_2 \\ &= 100[(100 - n_1) - n_2] + n_1n_2 \end{aligned}$$

OR

$$100 [(100 - n_2) - n_1] + n_1 n_2$$

$$= [\text{First number} - (100 - \text{second number})] \text{ multiplied by } 100 \\ + (100 - \text{first number}) \times (100 - \text{second number})$$

OR

$$= [\text{Second number} - (100 - \text{first number})] \text{ multiplied by } 100 +$$

$$(100 - \text{first number}) \times (100 - \text{second number})$$

= First bracket term is same as number obtained in (i) by crosswise subtraction and Second bracket term is same as number obtained in (i) by vertical multiplication.

Hence we see that these sutras are logically designed to save time while doing calculations .

REFERENCES

1. "Vedic Mathematics" Jagadguru Swami Sri Bharti Krishna Tirtha ji Maharaj, 1965, Motilal Banarsidas, New Delhi. | 2. " The power of vedic maths" Atul Gupta, Jaico Publishing House. | 3. " Vedic Mathematics made easy" , Dhawal Bhatia, Jaico Publishing House. |