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A Study based on Uses of Vedic Mathematical Sutras

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Abstract Vedic Mathematics is mainly based on sixteen word formulae which are known as sutras and their thirteen corollaries which are known as sub Sutras. All these sutras and their corollaries are in Sanskrit and claimed to be discovered from Vedas by Sri Bharti Krishna Tirtha in early twentieth century. The Mathematical calculations and operations based on these Vedic mathematical sutras and sub sutras are claimed to have ability to solve a variety of mathematical problems. In this paper, we have considered some algebraic problems and apply Vedic mathematical sutras to solve them.

Keywords Vedic Mathematics, sutras, sub Sutras

Introduction

Vedic mathematics consists of a set of rules based on Vedic sutras and sub sutras, applicable for solving various mathematical problems of arithmetic, geometry, algebra, trigonometry etc. These sutras and sub sutras are set of word formulae and each of them describes the steps or logic involved while solving a particular mathematical problems, which is usually considered as difficult or cumbersome in traditional method. Vedic mathematics based methods can reduce the time required for basic mathematical operations like addition, subtraction, multiplication and division of arithmetical expressions as well as algebraic expressions. Moreover, these methods can also be used effectively for finding square, square root, cube and cube root of a number. The sixteen sutras and thirteen sub sutras along with their brief meanings are enlisted below.

Sixteen Sutras

1. (Anurupye) Shunyamanyat – If one is in ratio, the other is zero.
2. Chalana-Kalanabyham – Differences and Similarities.
3. Ekadhikina Purvena – By one more than the previous One.
4. Ekanyunena Purvena – By one less than the previous one.
5. Gunakasamuchyah – The factors of the sum is equal to the sum of the factors.
6. Gunitasamuchyah – The product of the sum is equal to the sum of the product.
7. Nikhilam Navatashcaramam Dashatah – All from 9 and last from 10.
8. Paraavartya Yojayet – Transpose and adjust.
9. Puranapuranabyham – By the completion or noncompletion.
10. Sankalana- vyavakalanabhyam – By addition and by subtraction.
11. Shesanyankena Charamena – The remainders by the last digit.
12. Shunyam Saamyasamuccaye – When the sum is the same that sum is zero.
13. Sopaantyadvayamantyam – The ultimate and twice the penultimate.
14. Urdhva-tiryagbhyam – Vertically and crosswise.
15. Vyashtisamanstih – Part and Whole.

16. Yaavadunam – Whatever the extent of its deficiency.

Thirteen Sub Sutras

1. Anurupyena–proportionality
2. Sesasamjnah–Remainder remains constant
3. Adyamadyenantya-mantyena–the first by the first and the last by the last
4. Kevalaih Saptakam Gunyat–For 7 the Multiplicand is 143
5. Vestanam–By Osculation
6. Yavadunam Tavadunam–Lessen by the Deficiency
7. Yavadunam Tavadunikrtya Varganca Yojayet–what ever the deficiency subtract that deficit from the number and write along side the square of that deficit'
8. Antyayor Dasakepi–Last Totalling 10
9. Antyayoreva–only the last terms
10. Samuccayagunitah–The Sum of the coefficients in the product
11. Lopana Sthapanabhyam–by alternate elimination and retention
12. Vilokanam–Observation
13. Gunita Samuccayah: Samuccaya Gunitah–The Product of the Sum is equal to the Sum of the Products

Uses of Vedic Mathematics sutras

Since last two decades, many usages of vedic mathematics sutras and sub sutras are being observed by researchers. Available literature shows that vadic mathematical methods are very useful where the fast calculations and short tricks are required. We have considered here the following three school level mathematical problems to solve them with the help of vedic mathematical sutras:

(i) The Vedic mathematics sutra 'Lopana Sthapanabhyam' means 'by alternate elimination and retention' employed to factorize the general quadratic expression $ax^2 + by^2 + cz^2 + dxy + eyz + fxz + g$.

Example 1: Factorize $f = 2x^2 + 12y^2 - 3z^2 + 11xy - 5yz - 5xz + 3x - 13y + 26z - 35$

Put $y = z = 0$ i.e. eliminate y and z and retain x and constant term, then

$$f(x,0,0) = 2x^2 + 3x - 35 = (2x - 7)(x + 5)$$

Put $x = z = 0$ i.e. eliminate x and z and retain y and constant term, then

$$f(0,y,0) = 12y^2 - 13y - 35 = (3y - 7)(4y + 5)$$

Put $x = y = 0$ i.e. eliminate x and y and retain z and constant term, then

$$f(0,0,z) = -3z^2 + 26z - 35 = (z - 7)(-3z + 5)$$

Hence the factor of the given expression is: $f(x,y,z) = (2x + 3y + z - 7)(x + 4y - 3z + 5)$

(ii) Vedic mathematical Sutras/calculations are applicable to calculate the area or volume of given shape where dimensions are given in mixed units such as feet and inches, yards and feet etc.. We have applied the Sutra 'Adyamadyenantya-mantyena' means 'the first by the first and the last by the last' to calculate the area of rectangle, without converting its sides into single unit.

Example 2: Consider a rectangle whose sides are 7ft. 3 inches and 5ft. 9 inches, then

Area = $7'3''$ x $5'9''$

= (7x12+3)(5x12+9) Sq. inches, since $1' = 12''$

= $(7x + 3)(5x + 9)$ where x = 1 ft.=12 inches

= $35x^2 + 78x + 27$

If we write 78 = 6x12+6 = 6*x*+6, then

Area = $35x^2 + (6x + 6)x + 27$

= $41x^2 + 6x + 27$

= $41x^2 + 6x12 + 27$ = 41 Sq ft 99 Sq inches

(iii) We have discussed the implementation of Vedic Sutras 'Lopana-Sthapana', 'Sankalana Vyavakalanakam' and 'Adyamadya' to find H.C.F. of algebraic expressions.

Let F and G are two given expressions and H is their H.C.F. If P and Q be the quotients when F and G are divided by H. i.e. F/H = P and G/H = Q which gives F = PH and G = QH

further, F+G = PH+QH = (P+Q)H and F-G = PH-QH = (P-Q)H, which gives F±G= (P±Q)H
If we use AF and BG in place of F and G then we have, AF±BG = (AP±BQ)H.
The values of A and B have to be chosen in such a way that the highest power and the constant term in the given expressions are removed. Let us consider an example to explain the method.

Example 3
$F = x^3 + 6x^2 + 11x + 6$, $G = x^3 - x^2 - 10x - 8$
$F - G = 7x^2 + 21x + 14 = 7(x^2 + 3x + 2)$, divide by 7 gives $(x^2 + 3x + 2)$
$4F - 3G = 7x^3 + 21x^2 + 14x = 7x(x^2 + 3x + 2)$ divide by $7x$ gives $(x^2 + 3x + 2)$
Hence the H.C.F. is $(x^2 + 3x + 2)$.

Conclusion

The above discussion shows that different types of school level algebraic problems can be solved in a simplified manner with the help of Vedic mathematical sutras. Application of Vedic mathematics to different streams of modern mathematics had been researched by numerous authors and researchers, but still there is a huge scope for further investigation.

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