Mathematical Calculations in the Mind

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Introduction

As the speeding technique comes into mind the very first thought is that of Vedic mathematics.As Vedic mathematics is solely based on various techniques which helps in enhancing the speed with which the calculations are done.In this research paper, there are 2 such Vedic mathematics techniques which are being explored with algebraic proof and relevance to be used in the real world and calculate in the mind.The speed up sutras (formula) which are useful and to be explored in the paper further are :

-Ekadhikena Purvena
-Urdhva - tiryagbhyam
-Yavadunam Tavadunikrtya Varganca Yojayet
-Antyayor Dasakepi

- **Vedic Mathematics history**

The Sanskrit word Veda is gotten from the root Vid, meaning to know without limit. The word Veda covers all Veda-sakhas known to mankind. The Veda is a vault of all information, fathomless, ever revealing as it is delved deeper.Vedic Mathematics is an ancient system of calculations which was "rediscovered" from the Vedas somewhere in the range of 1911 and 1918 by Sri Bharati Krishna Tirthaji Maharaj (1884–1960). As indicated by Tirthaji, all of Vedic arithmetic based on 16 Sutras (aphorisms) and 13 sub sutra (Corollaries). These formulae are planned to depict the manner in which the brain normally works, and are consequently expected to be an extraordinary assistance in guiding the understudy to the suitable strategy for arrangement. None of these sutras has ever been found in Vedic writing, nor are its techniques steady with known scientific information from the Vedic period.

- **Importance for the students**

Vedic mathematics Encourages students to apply the sutras to precise issues including normal deduction, which, simultaneously, improves instinct that is the main concern of the dominance of the scientific prodigies of the past and the present, for example, Aryabhatta, Srinivasa Ramanujan, and so forth. One line, mental and too quick strategies alongside brisk cross checking systems.Converts a repetitive subject into a fun loving and joyful one which understudies learn with smiles.Constant articulation of an understudy's innovativeness, and is seen as simpler to learn.Ensure both speed and precision, carefully dependent on balanced and coherent thinking through utilisation of the sutras prompting improvement in the computational aptitudes of the students in a wide region of issues.The Sutras apply to and covers pretty much every part of Mathematics. They apply even to complex issues including countless numerical activities.

1.Ekadhikena Purvena

The Sutra (Formula) means "By more than the previous one ".This might seem to be confusing while hearing but it is very easy to understand.The formula can be use to solve two types of calculations:

- Squaring the number ending in 5
- Fractions whose denominators are ending in 9

1.1 Squares of the number ending in 5

Now relate the sutra to the 'squaring of numbers ending in 5'. Consider the example 35^2.

Here the number is 35. The task is to find out the square of the number. For the number 35, the last digit is 5 and the 'previous' digit is 3. Hence, 'one more than the previous one', that is, 3+1=4. The Sutra, in this context, gives the procedure to multiply the previous digit 3 by one more than itself, that is, by 4. It becomes the L.H.S of the result, that is, 3 X 4 = 12. The R.H.S of the result is 5^2, that is, 25.

Thus 25^2 =3X4/25=1225.

In the same way,
65^2 =6X7/25=4225;
105^2 = 10X11/25 = 11025;
135^2 = 13X14/25 = 18225;

Algebraic proof:

Consider $(ax + b)^2 = a^2 . x^2 + 2abx + b^2$.

$$(10a + 5)^2 = a^2 * 10^2 + 2 * 10a * 5 + 5^2$$

$$= a^2 * 10^2 + a * 10^2 + 5^2$$

$$= 10^2(a^2 + a) + 5^2$$

$$= a(a + 1) * 10^2 + 25$$

Clearly 10a + 5 represents two-digit numbers 35, 45, 55, -------,85 for the values a = 1, 2, 3, -- 2 ----,9 respectively. In such a case the number (10a + 5) is of the form whose L.H.S is **a (a + 1)** and R.H.S is 25, that is, **a (a + 1) / 25**. Thus any such two digit number gives the result in the same fashion.

2.Urdhva - tiryagbhyam

It is the general recipe pertinent to all instances of increase and furthermore in the division of a huge number by another huge number. It implies:

Ex.1: Find the product12X13

i) The right hand most digit of the multiplicand, the first number (12) i.e.,2 is multiplied by the right hand most digit of the multiplier, the second number (13)i.e., 3. The product 2 X3 = 6 forms the right hand most part of the answer.

ii) Now, diagonally multiply the first digit of the multiplicand (12) i.e., 2 and second digit of the multiplier (13)i.e., 1 (answer 2 X 1=2); then multiply the second digit of the multiplicand i.e.,3 and first digit of the multiplier i.e., 1 (answer 1 X 3 = 3); add these two i.e.,2+3= 5. It gives the next, i.e., second digit of the answer. Hence second digit of the answer is 5.

iii) Now, multiply the second digit of the multiplicand i.e., 1 and second digit of the multiplier, 1 vertically, i.e., 1 X 1 = 1. It gives the left hand most part of the answer.

Thus the answer is 156.

Ex.2: 32 X 24

- Step (i) : 2X4=8
- Step (ii) : 3X4=12;2X2=4;12+4=16.
- Here 6 is to be retained. 1 is to be carried out to left side.
- Step (iii) : 3X2=6.The digits 1 of 16istobeadded. i.e., 6 + 1 = 7.
- Thus 32 X 24 = 768

Note :

1. We can get the product in urdhva - tiryak procedure from left to right or right to left.
2. The similar kind of procedure can be applied even for numbers having more digits.
3. urdhva –tiryak procedure of multiplication can be impact fully used in products regarding algebra.

3.Yavadunam Tavadunikrtya Varganca Yojayet

The significance of the Sutra is 'what ever the deficiency subtract that deficit from the number and write along side the square of that deficit'.This Sutra can be pertinent to acquire squares of numbers near bases of forces of 10.

3.1 Values which are near or less than the bases

There are different examples provided with the different base values to understand more quicker and easily.

Eg 1: 8^2 Here base is 10.

- The answer is separated in to two parts by a '/'
- Note that deficit is 10 - 8 = 2
- Multiply the deficit by itself or square it
- 2^2 = 4. As the deficiency is 2, subtract it from the number i.e., 8–2 = 6.
- Now put 6 on the left and 4 on the right side of the vertical line or slash i.e., 6/4.
- Hence 64 is answer.

Eg. 2: 98^2 Here base is 100.

- The answer is separated into two parts : '/'
- Note that deficit is 100 - 98 = 2
- Multiply the deficit by itself or square it
- 2^2 = 4. As the deficiency is 2, subtract it from the number i.e., 98–2 = 96.
- Now put 96 on the left and 04 on the right side of the vertical line or slash i.e., 96/04. (04, since the base is 100)
- Hence 9604 is answer.

Eg. 3: 996^2 Base is 1000

- Deficit is 1000 - 996 = 4.
- Square of it is 16.

- Deficiency subtracted from 996 gives 996 - 4 = 992
- Answer is 992 / 016 [since base is 1000]

Eg. 4: 9989^2 Base is 10,000

- Deficit = 10000 - 9989 = 11.
- Square of deficit = 11^2 = 121.
- Deficiency subtracted from number = 9989 - 11 = 9978.
- Answer is 9978 / 0121 [since base is 10,000].

3.1.2 Numbers which are greater than the base power of 10

Eg.1: 16^2

- Rather than subtracting the deficiency from the number we must add and proceed as in Method-1.
- for 16^2 , base is 10, surplus is 6.
- Surplus added to the number = 16+6 = 22. Square of surplus = 6^2 = 36
- Answer is 25 / 6 = 256 (always remember that if you get a value like 36 so you will add the left term to the 22 which makes it 25).

Eg.2: 112^2

- Base = 100, Surplus = 12,
- Square of surplus = 12^2 = 144
- add surplus to number = 112 + 12 = 124.
- Answer is 124 / 144 = 12544

3.2 Cubing of the number

The cube of the number 106.

Steps with explanation :

For 106, Base is 100. The surplus is 6. Here we add double of the surplus i.e. 106+12 = 118. (remember, in squaring, we immediately add the surplus).This makes the left-hand -most part of the answer. For example, answer proceeds like 116 / - - - - -

- Put down the new surplus i.e. 118-100=18 multiplied by the initial surplus.i.e. 6=108.Since base is 100, we write 108 in carried over form 108 .As this is middle portion of the answer, the answer proceeds like 118 / 108 /- - - -
- Write down the cube of initial surplus i.e. 6^3 = 216 as the last portion i.e. right hand side last portion of the answer.Since base is 100, write 216 as 216 as 2 is to be carried over. Answer is 118 / 108 / 216 .
- Now proceeding from right to left and adjusting the carried over, 119 / 10 / 16 = 1191016.

Eg.1: 102^3 =(102+4)/6X2/2^3

- 106 =12=08
- 1061208
  Observe initial surplus = 2, next surplus =6 and base = 100.

4.Antyayor Dasakepi

The Antyayor Dasakepi means numbers of which the last digits added up give 10,For eg. the formula works in multiplication of numbers for example: 25 and 25, 47 and 43, 62 and 68, 116 and 114. Note that in each case the sum of the last digit of first number to the last digit of second number is 10. Further the portion of digits or numbers left wards to the last digits remain the same. At that instant use Ekadhikena on left hand side digits. Multiplication of the last digits gives the right hand part of the answer.

Eg.1: 47X43

- See the end digits sum 7 + 3 = 10 ; then by the sutras antyayor dasakepi and ekadhikena we have the answer.

- 47 x 43 = (4 + 1) x 4/ 7 x 3 = 20 / 21 = 2021.

Eg.2: 62 x 68

- 2 + 8 = 10, L.H.S. portion remains the same i.e.,, 6. Ekadhikena of 6 gives 7.

- 62 x 68 = (6 x 7)/ (2 x 8) = 42 / 16 = 4216.

Conclusion

This research paper has compiled some of the extensive and very less time-consuming which can be analysed, thus can be used in the day-to-day calculations.These techniques are not only useful for students but also for the adults who are working as an employee in some company or are the owner of the business.The methods discussed are intended for any reader with some basic mathematical background. That is why the serious mathematical issues, higher level mathematical problems are not taken up in this volume, even though many aspects like fundamental operations are being considered. The in-depth analysis of 4 sutras (formulas) which is been done in this paper is chosen after a lot of extensive research for the suitability of the quick calculations topic. An impartial reader can easily experience the beauty, charm and resourcefulness in Vedic Mathematics systems. I feel that the reader can enjoy the diversity and simplicity in Vedic Mathematics while applying the methods against the conventional textbook methods. The reader can also compare and contrast both the methods. I would personally like to thank the reader of the research paper.

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