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A Simple Way of Finding a New Series of Algebraic Formulas and a Discussion Only With Its General Application

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ABSTRACT

In this article, we discuss about a simple way of finding a new series of algebraic Formulas only with its general application. We find new formulas by applying our favourite long Multiplication method. The main basis of these Formulas is digit wise multiplication. Therefore, the new formulas may be named as digital Algebraic formulas.

Key Words: New series of Algebraic formulas, Digital Algebraic formulas, multi-digit, using block symbols, omitting block symbols.

INTRODUCTION

The general algebraic formulas are very familiar to us. We generally use these formulas to find the result very quickly and easily of any unknown numbers. The new formulas also help us to find the result very shortly comparing with other formulas.

The terms of the new formulas are similar with the general Algebraic formulas or in some cases similar with Vedic method. The application of the new formulas are different from the general algebraic formulas and we do not find any concrete vedic algebraic formulas. We only apply a simple and easy technique to find the new series of algebraic formulas for speedy calculation.

Procedure

Let us study how we find the new series of formulas – To understand this, we generally categorized the formulas into (i). squares and (ii). Higher power i.e. formulas of cubes, formulas of 4^{th} power and so on. Now, we learn how we find the formulas of squares – we apply known method to find these formulas, namely, long multiplication method keeping their exact place value using block symbols. In other words, these formulas are the digit -wise multiplicational result of the symbolic same unknown numbers with their respective place value using block symbols. We apply digit- wise multiplication of the symbolic digits (number) by the same symbolic digits (number) viz, ab by ab, abc by abc, abcd by abcd etc and so on (where a,b,c,d etc represents as unknown digit or positive integer) by keeping their exact place value and write the product using block symbols. After adding the various results according to their place value, we find the formulas of squares.

Again, we learn how we find the formulas of higher power i.e. formulas of cubes, 4^{th} power and so on. To find our new formulas, we apply long multiplication method. We multiply the formulas of preceding power by the symbolic same digit number i.e. to find the formulas of cubes, we multiply the formulas of squares and to find the formulas of 4^{th} power, we multiply the formulas of cubes and thus, we find the various formulas of higher power and we may write the formulas of ηth power on two digit numbers.

Formation of new formulas –

Here we apply our technique to find new formulas, if a, b are unknown digits, then we find the various formulas on two digit number.

Formulas of square – if ab is a two digit number then

$abxab=(ab)^2$ or, $(ab)^2=abxab$

$=a^2|ab$

$\quad ab|b^2$

$=a^2|2ab|b^2$

$\therefore (ab)^2 = a^2|2ab|b^2$.

Applying the above formula, we find –

$(ab)^3=(ab)^2 x ab$

$=(a^2|2ab|b^2) x ab$

$=a^3|2a^2b|ab^2$

$a^2b|2ab^2|b^3$

$= a^3|3a^2b|3ab^2|b^3$

$\therefore (ab)^3=a^3|3a^2b|3ab^2|b^3$.

Applying the above formula, we find

$(ab)^4 =(a^3|3a^2b|3ab^2|b^3) x ab$

$=a^4|3a^3b|3a^2b^2|ab^3$

$a^3b|3a^2b^2|3ab^3|a^4$

$= a^4|4a^3b|6a^2b^2|4ab^3|b^4$

$\therefore, (ab)^4= a^4|4a^3b|6a^2b^2|4ab^3|b^4$

Applying the above formula,we find

$(ab)^5 =(a^4|4a^3b|6a^2b^2|4ab^3|b^4) x ab$

$=a^5|4a^4b|6a^3b^2|4a^2b^3|ab^4$

$a^4b|4a^3b^2|6a^2b^3|4ab^4|b^5$

$=a^5|5a^4b|10a^3b^2|10a^2b^3|5ab^4|b^5$

$\therefore (ab)^5 =a^5|5a^4b|10a^3b^2|10a^2b^3|5ab^4|b^5$

Thus, we find the formula of

$(ab)^6=a^6|6.a.^5b|15.a.^4b^2|20.a.^3b^3|15.a.^2b^4|6.a.b^5|b^6$

$(ab)^7=a^7|7a^6b|21a^5b^2|35a^4b^3|35a^3b^4|21a^2b^5|7ab^6|b^7$

And so on.

From the above formulas, we find that if the the power is an odd number then numerical coefficient of the middle two terms are equal and also find that total terms are equal to power(Exponent) plus one.

If we apply ηth power (where 'n' is a natural number) then we find -

$$(ab)^n=a^n|na^{n-1}b|\frac{n(n-1)}{2}a^{n-2}.b^2|\frac{n(n-1)(n-2)}{3.2}a^{n-3}b^3|\frac{n(n-1)(n-2)(n-3)}{4.(3.2)}a^{n-4}b^4|\ldots\ldots\ldots\ldots|b^n.$$

Now, we find the formulas of 3 digit number – If a, b, c are the unknown digit of a 3 digit number, then –

formula for square of 3 digit number –

$(abc)^2 = abc \times abc$

$= a^2|ab|ac$

$ab|b^2|bc$

$ac|\ bc|c^2$

$=a^2|2ab|b^2+2ac|2bc|c^2$

Applying this formula, we find,

$(abc)^3 = (abc)^2 \times abc$

$=(a^2|2ab|b^2+2ac|2bc|c^2) \times abc$

$= a^3|2a^2b|b^2+2a^2c|2abc|ac^2$

$a^2b|2ab^2|b^3+2abc|2b^2c|bc^2$

$a^2c|2abc|b^2c+2ac^2|c^3$

$=a^3|3a^2b|3ab^2+3a^2c|b^3+6abc|3ac^2+3b^2c|3bc^2|c.^3$

And so on.

Here, we find the formulas of four digit number – if a, b, c, d are the digit of a number, then –

formula for square of 4 digit number –

$(abcd)^2 = abcd \times abcd$

$= a^2|ab|ac|ad$

$ab|b^2|bc|bd$

$ac|bc|c^2|cd$

$ad|bd|cd|d^2$

$= a^2|2ab|b^2+2ac|2bc+2ad|c^2+2bd|2cd|d^2$

Applying the above formula, we find

$(abcd)^3 = (abcd)^2 \times abcd$

$=(a^2|2ab|b^2+2ac|2bc+2ad|c^2+2bd|2cd|d^2) \times abcd$

$=a^3|2a^2b|ab^2+2a^2c|2abc+2a^2d|ac^2+2abd|2acd|ad^2$

$a^2b|2ab^2|b^3+2abc|2b^2c+2abd|bc^2+2b^2d|2bcd|bd^2$

$a^2c|2abc|b^2c+2ac^2|2bc^2+2acd|c^3+2bcd|2c^2d|cd^2$

$a^2d|2abd|b^2d+2acd|2bcd+2ad^2|c^2d+2bd^2|2cd^2|d^3$

$=a^3|3a^2b|3ab^2+3a^2c|b^3+3a^2d+6abc|3ac^2+3b^2c+6ab|3bc^2+3b^2d+6acd|c^3+2ad^2+6bcd|3bd^2+3c^2d|3cd^2|d^3$

And so on.

We find some other formula**s** of square**s** -

If a, b, c, d, e are the digits of a number then, the formula of square of 5 digit number –

$(abcde)^2 = abcde \times abcde$

$= a^2|ab|ac|ad|ae$

$ab|b^2|bc|bd|be$

$ac|bc|c^2|cd|ce$

$ad|bd|cd|d^2|de$

$ae|be|ce|de|e^2$

$=a^2|2ab|b^2+2ac|2ad+2bc|c^2+2ae+2bd|2be+2cd|d^2+2ce|2de|e^2$

If a, b, c, d, e, f are the digits of the number then,

The formula of square of 6 digit number –

$(abcdef)^2$ = abcdef x abcdef

= a^2|ab|ac|ad|ae|af

ab|b^2|bc|bd|be|bf

ac|bc|c^2|cd|ce|cf

ad|bd|cd|d^2|de|df

ae|be|ce|de|e^2|ef

af|bf|cf|df|ef|f^2

=a^2|2ab|b^2+2ac|2ad+2bc|c^2+2ae+2bd| 2af+2be+2cd|d^2+2bf+2ce|2de+2ef|e^2+2df |2ef|f^2

And so on.

Application of the formulas -

We only put down the various digits or multi-digit (positive integers) as single digit according to the formula. It is necessary to mention that after multiplication we should keep at least the number of digits in each block according to "raised the power" of the given number in general i.e. in case of finding squares it is at least two digit number (using 'O' zero before the number) and in other formulas of the higher power, we maintain the same rule. But if we apply multi-digit (positive integer) as single digit, it will be double the digits taken in their respective blocks.

(Note: we may follow the present rule of multiplicational result).

After completing the calculation (multiplication) of each block, we generally keep only one digit of one's place in each block starting from rightmost block but in case of multi -digit number as single digit , it is depend upon only the numbers (digits) taken and we forward the other digit or digits as carry over number with the next product (block). Thus, we repeat the process as long as necessary. After final calculation, we put down all the digits in their respective place omitting block symbols and find the actual result.

Explaining with Examples -

It is better to study the formulas with the help of following examples.

Example 1: We find the square of a 2 digit number. Suppose, we want to find square of the number 12.

We know, $(ab)^2$ = a^2|2ab|b^2

Using this formula, We find, Where a = 1, b = 2

$(12)^2$ = 1^2|2.1.2|2^2

= 01|04|04

=0144

Example 2: We find the square of a 3 digit number using 2 digit formula.

Suppose, We want to find the square of the number 101.

We know, $(ab)^2$ = a^2|2ab|b^2

Using this formula, we find, where a=10, b=1

$(101)^2$ = $(10)^2$|2.10.1|1^2

= 0100|20|01

=010201.

Example 3: We find the square of a 4 digit number using 2 digit formula.

Suppose, We want to find the square of the number 2221.

We know, $(ab)^2$ = a^2|2ab|b^2

Using this formula, we find, where a=22, b=21.

$(2221)^2$ = $(22)^2$|2.22.21| $(21)^2$

=0484|0924|0441

(2 digit in each block)

=04932841.

Example 4: We find the square of a 5 digit number using 2 digit formula.

Suppose, We want to find the square of the number 10101.

We know, $(ab)^2$ = a^2|2ab|b^2

Using this formula, we find, where a=101, b=01

$(10101)^2$ = $(101)^2$|2.101.01| $(01)^2$

= 010201|00202|0001

= 0102030201

Example 5: We find the cube of 2 digit number

Suppose, We want to find cube of the number 57.
We know, $(ab)^3 = a^3|2a^2b|3ab^2|b^3$

Using this formula, we find, where a=5, b=7
$(57)^3 = 5^3|3.5^2.7|3.5.7^2|7^3$
$= 125|3.25.7|3.5.49|343$
$= 125|525|735|343$
$=185193.$

Example 6: We find the cube of 3 digit number using 2 digit formulas.
Suppose, We want to find cube of the number 109.

We know, $(ab)^3 = a^3|3a^2b|3ab^2|b^3$

Using this formula, we find, where a=10, b=9
$(109)^3 = (10)^3|3.(10)^2.9|3.10.9^2|9^3$
$=1000|3.100.9|3.10.81|729$
$=1000|2700|2430|729$
$=1295029.$

Example 7: We find the cube of 4 digit number using 2 digit formulas,
Suppose, We want to find cube of the number 2345

We know, $(ab)^3 = a^3|3a^2b|3ab^2 |b^3$
Using this formula, we find, where a=23, b=45
$(2345)^3=(23)^3|3(23)^2.45|3.23.(45)^2|(45)^3$
$=12167|3.529.45|3.23.2025|91125$
$=12167|71415|139725|91125$
$=12895|21|36|25$
$=12895213625.$

Example 8: We find the square of 3 digit number
Suppose, We want to find square of the number 234

We know, $(abc)^2 =a^2|2ab|b^2+2ac|2bc|c^2$
Using this formula, we find, where a=2, b=3, c=4
$(234)^2 =2^2|2.2.3|3^2+2.2.4|2.3.4|4^2$
$=4|12|9+16|24|16$
$=4|12|25|24|16$
$=54756$

Example 9 : We find the cube of 3 digit number.
Suppose, We want to find cube of the number 234

We know,
$(abc)^3=a^3|3a^2b|3ab^2+3a^2c|b^3+6abc|3ac^2+3b^2c|3bc^2|c^3$
Using this formula, we find, where a=2, b=3, c=4

$(234)^3=2^3|3.2^2.3|3.2.3^2+3.2^2.4|3^3+6.2,3.4|3.2.4^2+3.3^2.4|3.3.4^2|4^3$
$=8|3.4.3|3.2.9+3.4.4|27+144|3.2.16+3.9.4|3.3.16|64$
$=8|36|54+48|27+144|96+108|144|64$
$=8|36|102|171|204|144|64$
$=12|8|1|2|9|o|4$
$=12812904$

Example 10: We find the square of 4 digit number, using 4 digit formulas,
Suppose, We want to find square of the number 2345

We know,
$(abcd)^2=a^2|2ab|b^2+2ac|2ad+2bc|c^2+2bd|2cd | d^2$

Using this formula, we find, where a=2, b=3, c=4, d=5.

$(2345)^2=2^2|2.2.3|3^2+2.2.4|2.2.5+2.3.4|4^2+2.3.5|2.4.5|5^2$
$=4|12|9+16|20+24|16+30|40|25$
$=4|12|25|44|46|40|25$
$=5499025.$

Example 11: We find the square of 5 digit number, using 5 digit formula.
Suppose, We want to find square of the number 34567

We know,
$(abcde)^2=a^2|2ab|b^2+2ac|2ad+2bc|c^2+2bd+2ae|2be+2cd| d^2+2ce|2de|e^2$

Using this formula, we find, where a=3, b=4, c=5, d=6, e=7

$(34567)^2=3^2|2.3.4|4^2+2.3.5|2.3.6+2.4.5|5^2+2.4.6+2.3.7|2.4.7+2.5.6|6^2+2.5.7|2.6.7|7^2$

$=9|24|16+30|36+40|25+48+42|56+60|36+70|84|49$

$=9|24|46|76|115|116|106|84|49$

$=1194877489$

Example 12; We want to find 4^{th}power of the number 73

We know,$(ab)^4=a^4|4a^3b|6a^2b^2|4ab^3|b^4$

Using this formula, we find, where a=7, b=3

$(73)^4=7^4|4.7^3.3|6.7^2.3^2|4.7.3^3|3^4$

$= 2401|4.343.3|6.49.9|4.7.27|81$

$=2401|4116|2646|756|81$

$=28398241.$

Example 13;We want to find 5^{th}power of the number 24

We know,

$(ab)^5 =a^5|5a^4b|10a^3b^2|10a^2b^3|5ab^4|b^5$

Using this formula, we find, where a=2, b=4

$(24)^5=2^5|5.2^4.4|10.2^3.4^2|10.2^2.4^3|5.2.4^4|4^5$

$=32|5.16.4|10.8.16|10.4.64|5.2.256|1024$

$=32|320|1280|2560|2560|1024$

$=7962624.$

CONCLUSION

The new formulas are mainly based on the digits of the number. So, one can use this formula easily and comfortably. The formulas give us the result speedier than the other formal methods. These formulas will be very fruitful for the students, teachers and especially for the mankind in the field of multiplication of any number such as decimal, fraction, etc.

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