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Research Paper

Multiplication of Large Numbers with the Help of a New Series of Algebraic Formulas

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ABSTRACT

In this article, we introduce a new concept of multiplication with the help of a new series of Algebraic formulas. We apply these formulas to multiply large numbers using multi-digit as single digit. These formulas act as multipurpose use to find faster result of any number. The new formulas negate some present rule of multiplicational result and tell us to follow the rule of multiplication of decimal numbers in case of general multiplication also. This series of formulas are one of the best formulas to multiply any large number in the world of multiplication.

Keywords: Two step method, new series of algebraic formulas, multiplication of large numbers, split the number.

INTRODUCTION

Multiplication is a necessary mathematical operation in our daily life. In worldwide, we apply various formulas or methods to multiply numbers, objects etc. to find our result. Here, we apply simple and easy formulas or methods to multiply large numbers within a short time.

These formulas are newly introduced. So, we discuss the main points about the formulas and thereafter write them-

We generally split the numbers into various (vertical) parts to apply our choiceful formula. These new algebraic formulas are named as two step method because it contain two parts or steps, namely, step1 and Step2. After adding step1 and step2, we find final result.

Step 1:- These parts contain the direct multiplicational result of vertical digit or digits applying the rule sum of the digits of multiplicand and multiplier are equal to total digits of the products and we put them only as digits of the number in their respective places. In present system, we generally neglect ‘zero’ or ‘zeros’ before the number whereas the new formulas tell to keep or put ‘zero’ or ‘zeros’ like the multiplication of decimal numbers, to find equal number of digits in the product.

(NB- we may use block symbols for step 1 also)

Step 2:- This part contains the product of crosswise multiplication of the vertical digit or digits applying block symbols. We generally put symbolic ‘0’ (zero) in our formulas on the block of one’s place. When we take single digit as a digit then it is only 1(one)zero on one’s place but in case of multi-digit as single digit it is depend upon the number of digits taken i.e., if 2 digit as a digit then it will be 2 zeros and if 3 digit it will be 3 zeros and so on.

We can categorized the series into– (1) Formulas of squares and (2)Formulas of cubes and higher power.

1. Formulas of Squares-

$(ab)^2 = a^2b^2 + 2ab/0$

$(abc)^2 = a^2b^2c^2 + 2ab/2ac/2bc/0$

$(abcd)^2 = a^2b^2c^2d^2 + 2ab/2ac/2bc + 2ad/2bd/2cd/0$

$(abcde)^2 = a^2b^2c^2d^2e^2 + 2ab/2ac/2bc+2ad/2bd+2ae/2cd+2be/2ce/2de/0$.

And so on

2. Formulas of cubes and higher power-

$(ab)^3 = a^3b^3+3a^2b/3ab^2/0$

$(ab)^4 = a^4b^4+4a^3b/6a^2b^2+4ab^3/0$

$(ab)^5 = a^5b^5+5a^4b/10a^3b^2/10a^2b^3/5ab^4/0$

And so on

$(abc)^3 = a^3b^3c^3+3a^2b/3ab^2+3a^2c/6abc/3ac^2+3b^2c/3bc^2/0$

$(abcd)^3=a^3b^3c^3d^3+3a^2b/3ab^2+3a^2c/3a^2d+6abc/3ac^2+3b^2c+6abd/3bc^2+3b^2d+6acd/3ad^2+6bcd/3bd^2+3c^2d/3cd^2/0$

And so on

Application of these formulas-

Here, we discuss about the application of these formulas under two headings- namely (1)General Application and (2) Special Application.

1. General Application- We generally use these formulas for finding squares, cubes and for higher power of any number. We may apply single digit as a digit or multi-digit as single digit on these formulas to find faster result. Here we apply multi-digit as single digit to find the result of large numbers.

Rules for General Application-

To apply multi-digit as single digit, we must split the number taking equal number of vertical digits for each parts from right to left without thinking of last part of the extreme left.

In case of decimal number, we split the number ignoring the decimal point and put the decimal point only on the result as per rule.

It is easier to understand this application with the help of examples-

Example: Find $(2545)^2$ or multiply 2545 by 2545 using 2 digit formula.

We split or pair the number 2545as 25 and 45

We know $(ab)^2 = a^2b^2+2ab/0$

Applying above formula, we find where a=25, b=45

$(2545)^2 = (25)^2(45)^2 + 2.25.45/00$ (As b = 2 digit)

= 06252025 + 2250/00

= 06252025 + 225000

= 06477025

Example: Find $(2340.07)^2$ or multiply 2340.07 by 2340.07 using 2 digit formula.

We split the number 2340.07 as 234 and 007 ignoring decimal point

We know $(ab)^2 = a^2b^2+2ab/0$

Applying above formula, we find,where a=234, b=007

$(2340.07)^2 = (234)^2(007)^2 + 2.234.007/000$ (As b = 3 digit)

= 054756000049 + 003276/000

= 054756000049 + 003276000

= 05475927.6049 (using decimal point)

Example: Find $(10101)^2$ or multiply 10101 by 10101 using 3 digit formula.

We split the number 10101 as 1, 01 and 01

We know $(abc)^2 = a^2b^2 c^2+2ab/2ac/2bc/0$

Applying above formula, we find where a=1, b=01, c = 01

$(10101)^2 = (1)^2(01)^2 (01)^2 + 2.1.01/2.1.01/2.01.01/00$

= 0100010001 + 0002/0002/0002/00

= 0100010001 + 0002/02/02/00

= 0100010001 + 0002020200

= 0102030201

Example: Find $(23456.789)^2$ or multiply 23456.789 by 23456.789 using 3 digit formula.

We split the number 23456.789 as 23, 456 and 789

We know $(abc)^2 = a^2b^2 c^2 + 2ab/2ac/2bc/0$

Applying above formula, we find, where a=23, b=456, c=789

$(23456.789)^2 = (23)^2 (456)^2 (789)^2 + 2.23.456/2.23.789/2.456.789/000$

= 0529207936622521 + 020976/036294/719568/000
= 0529207936622521 + 021013 /013/568/000
= 0529207936622521 + 021013013568000
= 055022095.190521 (using decimal point)

Example: Find $(23456789)^2$ or multiply 23456789 by 23456789 using 4 digit formula.
We split the number 23456789 as 23, 45,67 and 89
We know $(abcd)^2 = a^2b^2c^2\ d^2 + 2ab/2ac/2bc+2ad/2bd/2cd/0$
Applying above formula, we find where a=23, b=45, c=67, d=89
$(23456.789)^2= (23)^2\ (45)^2\ (67)^2\ (89)^2 + 2.23.45/2.23.67/2.45.67+2.23.89/2.45.89/2.67.89/00$
= 0529202544897921 + 2070/3082/6030+4094/8010/11926/00
=0529202544897921 + 2070/3082/10124/8010/11926/00
=0529202544897921 + 2101/94/05/29/26/00
= 0529202544897921 + 21019405292600
= 0550221950190521

Now, we apply the formulas of cubes and higher power-
Example: Find $(2345)^3$ or Find 2345×2345×2345 using 2 digit formula-
We split the number 2345 as 23 and 45
We know, $(ab)^3 = a^3b^3 +3a^2b/3ab^2/0$
Applying above formula, where a=23, b=45
$(2345)^3 = (23)^3\ (45)^3 + 3.(23)^2.(45)/3.23.(45)^2/00$ (As b =2 digit)
= 012167091125 + 3.0529.45/3.23.2025/00
= 012167091125 + 071415/139725/00
= 012167091125 + 072812/25/00
= 012167091125 + 0728122500
= 012895213625

Example: Find $(2345)^4$ or Find 2345×2345×2345×2345 using 2 digit formula-
We split the number 2345 as 23 and 45
We know, $(ab)^4 = a^4b^4 +4a^3b/6a^2b^2/4ab^3/0$
Applying above formula, where a=23, b=45
$(2345)^4= (23)^4\ (45)^4 + 4.(23)^3.(45)/6.(23)^2.(45)^2/4.23.(45)^3/00$ (As b =2 digit)
= 0027984104100625 + 4.012167.45/6.0529.2025/4.23.091125/00
= 0027984104100625 + 2190060/6427350/8383500/00
=0027984104100625 + 2255171/85/00/00
=0027984104100625 + 2255171850000
=0030239275950625

Example: Find $(2345)^5$ or Find 2345×2345×2345×2345×2345 using 2 digit formula.
We split the number 2345 as 23 and 45
We know, $(ab)^5 = a^5b^5 + 5a^4b/10a^3b^2/10a^2b^3/5ab^4/0$
Applying above formula, we find, where a=23, b=45
$(2345)^5 = (23)^5\ (45)^5 + 5.(23)^4.45/10.(23)^3.(45)^2/10.(23)^2.(45)^3/5.23.(45)^4/00$
= 64363430184528125 +5.279841.45/10.12167.2025/10.529.91125/5.23.4100625/00
= 64363430184528125 + 62964225/246381750/482051250/471571875/00
= 64363430184528125 + 65476719/19/68/75/00
= 64363430184528125 + 6547671919687500
= 70911102104215625

Example: Find $(123456)^3$ or Find 123456×123456×123456 using 3 digit formula.
We know, $(abc)^3 = a^3b^3c^3 + 3a^2b/3ab^2 + 3a^2c/6abc/3ac^2 + 3b^2c/3bc^2/0$
Applying above formula, we find, where a=12, b=34, c=56
$(123456)^3=(12)^3(34)^3(56)^3+3.(12)^2.34/3.12.(34)^2+3(12)^2.56/6.12.34.56/3.12.(56)^2+3.(34)^2.56/3.34.(56)^2/00$
=001728039304175616+3.144.34/3.12.1156+3.144.56/6.12.34.56/3.12.3136+3.1156.56/3.34.3136/00
=001728039304175616+14688/41616+24192/137088/112896+194208/319872/00

= 001728039304175616+14688/65808/137088/307104/319872/00
= 001728039304175616+15360/09/91/02/72/00
= 001728039304175616+153600991027200
= 001881640295202816

2. Special Application:- These formulas are applicable for various purposes but here we apply the formulas of squares for general multiplication and multiplication of decimal numbers.

How we can use the formulas of squares- In case of finding squares, the multiplicand and multiplier are the same number or simply to say, vertical digits are same but in general multiplication or multiplication of decimal numbers, the multiplicand and multiplier may be different types of number i.e., unsimilar or one may have larger digits than the other.

We know that incase of finding squares, vertical digits are same number so we generally use (a, a)(b,b),(c, c) etc and find the vertical products as a^2,b^2,c^2 etc and crosswise or horizontal products as ab+ab= 2ab, ac+ac= 2ac, bc+bc= 2bc etc and so on. Thus, we may seem (apply) vertical digits as (a,a), (b,b), (c,c) etc or if we apply(a_1, a_2), (b_1, b_2), (c_1, c_2) etc then also we seem (write) the vertical product as a^2, b^2, c^2 etc or crosswise product as a_1 b_2 + a_2,b_1,=2ab, $a_1c_2+a_2c_1$=2ac, $b_1c_2+b_2c_1$ = 2bc etc ignoring the product a_1a_2, b_1b_2, c_1c_2 or $a_1b_2+a_2b_1$, a_1c_2 +a_2c_1, b_1c_2 + b_2c_1, etc for balancing with the formulas.

Rules for Application-

1. If there are dissimilarities between the number of digits of multiplicand and multiplier, then we put zero or zeroes, if necessary, before or after (decimal number) the number to equalise vertical digits or aligning the digits for easy application of the formulas. When we put zero or zeroes before or after the number it must be cancelled from the result.
2. If we apply multi-digit as single digit, then we must take equal number of vertical digits for each part from right to left except last part of the left which is depend only on the rest number of the digits of the number given or taken.
3. We must keep equal number of digits in each block which are taken for each part from right side when we add results of the blocks as per formula.

General Multiplication –

We apply our formulas of squares for general multiplication with the help of following examples-

Example: Multiply 32457 by 3546 using 2 digits formula.
We rewrite the number as 32457×03546
We split the numbers 32457 as 324, 57 and 03546 as 035, 46.
We know, $(ab)^2 = a^2b^2 + 2ab/0$ or apply $(ab)^2 = a^2/b^2 + 2ab/0$
Applying above formula, we find, where a_1 = 324, a_2 = 035, b_1 = 57, b_2 = 46
32457×03546 = 324.035/57.46 + (324.46 +035.57)/00 (b = 2digit)
= 011340/2622+(14904+1995)/00
= 0113402622+16899/00
= 0113402622+1689900
= 0115092522

Example: Multiply 324560 by 304256 using 2 digits formula.
We split the numbers 324560 as 324, 560 and 304256 as 304, 256.
We know, $(ab)^2 = a^2b^2 + 2ab/0$ or apply $(ab)^2 = a^2/b^2 + 2ab/0$
Applying above formula, we find, where a_1 = 324, a_2 = 304, b_1 = 560, b_2 = 256
324560×304,256 = 324.304/560.256+(324.256+304.560)/000 (b = 2digit)
= 098496/143360+(082944+170240)/000
= 098496143360+253184000
= 098749327360

Example: Multiply 32458 by 2587 using 3 digits formula.
We rewrite the number as 32458 × 02587

We split the numbers 32458 as 3, 24, 58 and 02587 as 0, 25, 87.
We know, $(abc^2)^2 = a^2b^2c^2 + 2ab/2ac/2bc/0$
Applying above formula, we find, where $a_1 = 3$, $a_2 = 0$, $b_1 = 24$, $b_2 = 25$, $c_1= 58$, $c_2 = 87$
32458×02587 = 3.0/24.25/58.87 + (3.25+0.24)/3.87 +0.58/24.87+25.58/00
= 00/0600/5046 + (75+00)/261+00/2088+1450/00
= 0006005046 + 75/261/3538/00
= 0006005046 + 77/96/38/00
= 0006005046 + 77963800
= 0083968846
= 083968846 (withdrawing '0')

Example: Multiply 324560 by 304256 using 3 digits formula.
We split the numbers 324560 as 32, 45, 60 and 304256 as 30, 42, 56.
We know, $(abc^2)^2 = a^2b^2c^2 + 2ab/2ac/2bc/0$
Applying above formula, we find, where $a_1 = 32$, $a_2 = 30$, $b_1 = 45$, $b_2 = 42$, $c_1= 60$, $c_2 = 56$.
324560×304256 = 32.30/45.42/60.56 +(32.42 + 30.45)/32.56 + 30.60/45.56 + 42.60/00
= 0960/1890/3360 + (1344 + 1350/1792 + 1800/2520 + 2520/00
= 096018903360 + 2694/3592/5040/00
= 096018903360 +2730/42/40/00
= 096018903360 + 2730424000
= 098749327360

Example: Multiply 6235789004 by 523063007 using 4 digits formula-
We split the numbers 6235789004 as 6235, 78, 90, 04 and 523063007 as 523, 06, 30, 07.
We know, $(abcd)^2 = a^2b^2c^2\ d^2 + 2ab/2ac/2bc+2ad/2bd/2cd/0$
Applying above formula, we find, where $a_1 = 6235$, $a_2 = 523$, $b_1 = 78$, $b_2 = 06$, $c_1= 90$, $c_2 = 30$, $d_1= 04$, $d_2 = 07$.
6235789004×523063007=6235.523/78.06/90.30/04.07+(6235.06+523.78)/6235.30+523.90/ 6235.07+523.04+78.30+06.90/78.07+06.04/90.07+30.04/00
=3260905/0468/2700/0028+(37410+40794)/187050 +47070/ 43645+2092+2340+0540/0546+0024/0630+0120/00
=3260905046827000028+78204/234120/48617/0570/0750/00
=3260905046827000028+80550/06/22/77/50/00

=3260905046827000028+805500622775000
=3261710547449775028

Multiplication of Decimal Numbers-

We apply our formulas of squares to multiply decimal numbers in the following examples-
Example: Multiply the decimal number 25.20 by 12.40 using 2 digits formula.
We split the number 25.20 as 25, 20 and 12.40 as 12, 40 ignoring decimal point.
We Know, $(ab)^2 = a^2b^2 + 2ab/0$
Applying above formula, we find, where $a_1 = 25$, $a_2 = 12$, $b_1 = 20$, $b_2 = 40$
25.20×12.40 = 25.12/20.40+(25.40+12.20)/00 (b= 2digit)
= 0300/0800+(1000+0240)/00
= 03000800+1240/00
= 03000800+124000
= 0312.4800

Example: Multiply 56 by 15.25 using 2 digit formula.
We rewrite the number as 56.00×15.25
We split the number 56.00 as 56, 00 and 15.25 as15, 25 ignoring decimal point.
We Know, $(ab)^2 = a^2b^2 + 2ab/0$
Applying above formula, we find, where $a_1 = 56$, $a_2 = 15$, $b_1 = 00$, $b_2 = 25$.
56.00×15.25 = 56.15/00.25+(56.25+15.00)/00
= 0840/0000 +(1400+0000)/00
= 08400000 + 1400/00
= 08400000 + 140000
= 0854·0000 (putting decimal point)
= 0854·00 (withdrawing '00')

Example: Multiply 257.253by 321.5 using 3 digit formulae.
We rewrite the number 257.253×321.500
We split the number 257.253 as 25, 72, 53 and 321.500 as 32, 15, 00
We know, $(abc)^2 = a^2b^2 + 2ab/2ac/2bc/0$

Applying above formula, we find, where a_1 = 25, a_2 = 32, b_1 = 72, b_2 = 15, c_1= 53, c_2 = 00.
257.253×321.500
=25.32/72.15/53.00+(25.15+32.72)/25.00+32.53/72.00+15.53/00
= 0800/1080/0000+(0375+2304)/0000+1696/0000+0795/00
= 080010800000+2679/1696/0795/00
= 080010800000+2696/03/95/00
= 080010800000+2696039500
= 082706.839500 (Putting decimal point)
= 082706.8395 (withdrawing ‘00’)

Example: Multiply 1025.31 by 2515.5 using 3 digit formulae.
We rewrite the number 1025.31× 2515.50
We split the number 1025.31 as 10, 25, 31 and 2515.50 as 25, 15, 50
We know, $(abc)^2 = a^2b^2 + 2ab/2ac/2bc/0$
Applying above formula, we find, where a_1 = 10, a_2 = 25, b_1 = 25, b_2 = 15, c_1= 31, c_2 = 50.
1025.31×2515.50 = 10.25/25.15/31.50+(10.15+25.25)/10.50+25.31/25.50+15.31/00
= 0250/0375/1550+(0150+0625/0500+0775/1250+0465/00
= 025003751550+0775/1275/1715/00
= 025003751550+0787/92/15/00
= 025003751550+0787921500
= 02579167.3050 (putting decimal point)
= 02579167.305 (withdrawing ‘0’)

CONCLUSION

This series of Algebraic formulas are very fruitful for multiplication of any digit numbers. It is to be remembered that if we use calculator to using these formulas, we have to put zero or zeroes before the product for step 1. These formulas are very faster than any other formal method of multiplication and we can verify the result easily. These formulas will be very beneficial for mankind.

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