

## **VEDIC VINCULUM PROBLEMS WHEN THERE ARISE CARRY NUMBERS**

**D. N. GARAIN\* AND SANJEEV KUMAR\*\***

**\*Head, University Department of Mathematics,  
S. K. M. University, Dumka, Jharkhand, India.**

**\*\*Research Scholar, S. K. M. University, Dumka, Jharkhand, India.**

**(Received On: 02-07-18; Revised & Accepted On: 05-08-18)**

---

### **ABSTRACT**

*Vinculum makes the digits over five to less than five. So during the process of addition and multiplication the probability of appearance of carry number is very less. Many authors have worked on the problems of vinculum but they have not touched the problem when carry number appears. In the present study, we have tried to solve all those problems when carry numbers appear during the solution of vinculum problems.*

**Keywords:** Vinculum, Vedic mathematics, Carry number.

**Mathematics Subject Classification:** 01A32, 97A30, 97A80.

---

### **1. INTRODUCTION**

In Vedic Mathematics ‘Vinculum’ is an ingenious device to reduce single digit larger than 5. A digit larger than five creates problem in calculations by creating carry number. If all the digits are less than five then calculation becomes easier and probability of appearance of carry number is very less. With this idea the concept of vinculum was entered in Vedic mathematical calculations of numbers.

Kenneth R William (2003), in his book “Astronomical Applications of Vedic Mathematics” has not used carry number in the case of multiplication of numbers with vinculum digits rather he has changed the vinculum digits into non-vinculum and then performed the multiplication. Similar case is found in the book “vertically and crosswise” written by Nicholas, Williams and Pickles (1999).

Kenneth R William (2005), in his book “Vedic Mathematics Teacher’s Manual” has mentioned the subtraction of two numbers and then he has changed the digits above number five into vinculum. But he has not performed subtraction of number which contains vinculum in their digits.

Garain and Kumar (2018) studied “Algebraic representation of Vinculum and generalized rule for Vinculum Structure. They framed the generalized rule for removing and imposing vinculum on the digit of a number.

As the concept of vinculum make a digit over 5 to less than 5. So during the process of addition and multiplication, the chance of appearance of carry number is very less.

Now, we shall try to solve all those problem of vinculum in which chance of appearance of carry number is possible.

Here, we’ll try to find addition, subtraction and multiplication in which vinculum is involved. Also, we’ll deal the same problems by removing vinculum.

---

**Corresponding Author: Sanjeev Kumar\*\***

**\*\*Research Scholar, S. K. M. University, Dumka, Jharkhand, India.**

## 2. SOME OPERATIONS OF NUMBERS HAVING VINCULUM IN THEIR DIGITS

### (A) Addition:

#### Type – I

##### Calculation with Vinculum

(i) Evaluate:

$$\begin{array}{r} 4 \quad \overline{3} \\ + \quad 2 \quad 5 \\ \hline 6 \quad 2 \end{array}$$

$$\therefore \overline{3} = -3 \quad \text{and} \quad 5 + \overline{3} = 5 - 3 = 2$$

(ii) Evaluate:

$$\begin{array}{r} 3 \quad \overline{4} \\ + \quad 1 \quad 2 \\ \hline 4 \quad 2 \end{array}$$

By removing the vinculum in  $4\overline{2}$ .

$$\therefore 4\overline{2} = 4 - 1/10 - 2 = 38$$

(iii) Evaluate:

$$\begin{array}{r} 3 \quad 4 \quad \overline{2} \\ + \quad 4 \quad 0 \quad 1 \\ \hline 7 \quad 4 \quad \overline{1} \end{array}$$

By removing the vinculum in  $74\overline{1}$ .

$$\therefore 74\overline{1} = 7/4 - 1/10 - 1 = 739$$

(iv) Evaluate:

$$\begin{array}{r} 3 \quad \overline{4} \quad 4 \\ + \quad 4 \quad 3 \quad 2 \\ \hline 7 \quad \overline{1} \quad 6 \end{array}$$

By removing the vinculum in  $7\overline{1}6$ .

$$\therefore 7\overline{1}6 = 7 - 1/10 - 1/6 = 696$$

##### Calculation by removing Vinculum

$$\begin{array}{r} 4 \quad \overline{3} \\ + \quad 2 \quad 5 \\ \hline \end{array}$$

By removing the vinculum in  $4\overline{3}$ .

$$\therefore 4\overline{3} = 4 - 1/10 - 3 = 37$$

Then,

$$\begin{array}{r} 3 \quad 7 \\ + \quad 2 \quad 5 \\ \hline 6 \quad 2 \end{array}$$

$$\begin{array}{r} 3 \quad \overline{4} \\ + \quad 1 \quad 2 \\ \hline \end{array}$$

By removing the vinculum in  $3\overline{4}$ .

$$\therefore 3\overline{4} = 3 - 1/10 - 4 = 26$$

Then,

$$\begin{array}{r} 2 \quad 6 \\ + \quad 1 \quad 2 \\ \hline 3 \quad 8 \end{array}$$

$$\begin{array}{r} 3 \quad 4 \quad \overline{2} \\ + \quad 4 \quad 0 \quad 1 \\ \hline \end{array}$$

By removing the vinculum in  $34\overline{2}$ .

$$\therefore 34\overline{2} = 3/4 - 1/10 - 2 = 338$$

Then,

$$\begin{array}{r} 3 \quad 3 \quad 8 \\ + \quad 4 \quad 0 \quad 1 \\ \hline 7 \quad 3 \quad 9 \end{array}$$

$$\begin{array}{r} 3 \quad \overline{4} \quad 4 \\ + \quad 4 \quad 3 \quad 2 \\ \hline \end{array}$$

By removing the vinculum in  $3\overline{4}4$ .

$$\therefore 3\overline{4}4 = 3 - 1/10 - 4/4 = 264$$

Then,

$$\begin{array}{r} 2 \quad 6 \quad 4 \\ + \quad 4 \quad 3 \quad 2 \\ \hline 6 \quad 9 \quad 6 \end{array}$$

(v) Evaluate:

$$\begin{array}{r} 4 \quad \overline{2} \quad \overline{3} \\ + \quad \overline{2} \quad \overline{5} \quad \overline{1} \\ \hline 6 \quad \overline{3} \quad \overline{2} \end{array}$$

$$\therefore \overline{3} + 1 = -3 + 1 = -2 = \overline{2} \text{ and } \overline{2} + 5 = -2 + 5 = 3$$

By removing the vinculum in  $6\overline{3}\overline{2}$ .

$$\therefore 6\overline{3}\overline{2} = 6/3 - 1/10 - 2 \\ = 628$$

$$\begin{array}{r} 4 \quad \overline{2} \quad \overline{3} \\ + \quad \overline{2} \quad \overline{5} \quad \overline{1} \\ \hline \end{array}$$

By removing the vinculum in  $4\overline{2}\overline{3}$ .

$$\therefore 4\overline{2}\overline{3} = 4 - 1/10 - 2/\overline{3} = 3/8/\overline{3} \\ = 3/8 - 1/10 - 3 = 377$$

Then,

$$\begin{array}{r} 3 \quad \overline{7} \quad \overline{7} \\ + \quad \overline{2} \quad \overline{5} \quad \overline{1} \\ \hline 6 \quad \overline{2} \quad \overline{8} \end{array}$$

## Type – II

### Calculation with Vinculum

(i) Evaluate:

$$\begin{array}{r} 7 \quad \overline{2} \\ + \quad \overline{8} \quad \overline{3} \\ \hline 15 \quad \overline{1} \end{array}$$

$$\therefore \overline{3} = -3 \text{ and } 2 + \overline{3} = 2 + (-3) = 2 - 3 = -1 = \overline{1}$$

By removing the vinculum in  $15\overline{1}$ .

$$\therefore 15\overline{1} = 1/5 - 1/10 - 1$$

$$= 149$$

### Calculation by removing Vinculum

$$\begin{array}{r} 7 \quad \overline{2} \\ + \quad \overline{8} \quad \overline{3} \\ \hline \end{array}$$

By removing the vinculum in  $8\overline{3}$ .

$$\therefore 8\overline{3} = 8 - 1/10 - 3 = 77$$

Then,

$$\begin{array}{r} 7 \quad \overline{2} \\ + \quad \overline{7} \quad \overline{7} \\ \hline 14 \quad \overline{9} \end{array}$$

(ii) Evaluate:

$$\begin{array}{r} 8 \quad \overline{9} \\ + \quad \overline{5} \quad \overline{4} \\ \hline 13 \quad \overline{5} \end{array}$$

$$\begin{array}{r} 8 \quad \overline{9} \\ + \quad \overline{5} \quad \overline{4} \\ \hline \end{array}$$

By removing the vinculum in  $5\overline{4}$ .

$$\therefore 5\overline{4} = 5 - 1/10 - 4 = 46$$

Then,

$$\begin{array}{r} 8 \quad \overline{9} \\ + \quad \overline{4} \quad \overline{6} \\ \hline 13 \quad \overline{5} \end{array}$$

(iii) Evaluate:

$$\begin{array}{r} 2 \quad \overline{4} \quad \overline{3} \\ + \quad \overline{5} \quad \overline{2} \quad \overline{4} \\ \hline 7 \quad \overline{6} \quad \overline{1} \end{array}$$

$$\therefore \overline{4} = -4 \text{ and } 3 + \overline{4} = 3 + (-4) = 3 - 4 = -1 = \overline{1}$$

By removing the vinculum in  $7\overline{6}\overline{1}$ .

$$\therefore 7\overline{6}\overline{1} = 7/6 - 1/10 - 1$$

$$= 759$$

$$\begin{array}{r} 2 \quad \overline{4} \quad \overline{3} \\ + \quad \overline{5} \quad \overline{2} \quad \overline{4} \\ \hline \end{array}$$

By removing the vinculum in  $5\overline{2}\overline{4}$ .

$$\therefore 5\overline{2}\overline{4} = 5/2 - 1/10 - 4 = 516$$

Then,

$$\begin{array}{r} 2 \quad \overline{4} \quad \overline{3} \\ + \quad \overline{5} \quad \overline{1} \quad \overline{6} \\ \hline 7 \quad \overline{5} \quad \overline{9} \end{array}$$

(iv) Evaluate:

$$\begin{array}{r} 7 \quad 2 \quad 0 \\ 5 \quad \overline{4} \quad 3 \\ + \quad \overline{12} \quad \overline{2} \quad 3 \\ \hline \end{array}$$

By removing the vinculum in  $12\overline{2}3$ .

$$\therefore 12\overline{2}3 = 1/2 - 1/10 - 2/3 \\ = 1183$$

(v) Evaluate:

$$\begin{array}{r} 8 \quad 9 \quad 2 \\ 5 \quad \overline{3} \quad \overline{4} \\ + \quad \overline{13} \quad 6 \quad \overline{2} \\ \hline \end{array}$$

By removing the vinculum in  $136\overline{2}$ .

$$\therefore 136\overline{2} = 1/3 - 6/10 - 2 \\ = 1358$$

### Type – III

#### Calculation with Vinculum

(i) Evaluate:

$$\begin{array}{r} 6 \quad \overline{2} \\ 5 \quad \overline{4} \\ + \quad \overline{11} \quad \overline{6} \\ \hline \end{array}$$

$$\therefore \overline{2} + \overline{4} = -2 + (-4) = -2 - 4 = -6 = \overline{6}.$$

By removing the vinculum in  $11\overline{6}$ .

$$\therefore 11\overline{6} = 1/1 - 1/10 - 6 \\ = 104$$

(ii) Evaluate:

$$\begin{array}{r} 9 \quad \overline{3} \quad \overline{2} \\ 4 \quad \overline{4} \quad 6 \\ + \quad \overline{13} \quad \overline{7} \quad 4 \\ \hline \end{array}$$

$$\therefore \overline{2} + 6 = -2 + 6 = 4 \text{ and } \overline{3} + \overline{4} = -3 + (-4) = -3 - 4 = -7 = \overline{7}$$

By removing the vinculum in  $13\overline{7}4$

$$\therefore 13\overline{7}4 = 1/3 - 1/10 - 7/4 \\ = 1234$$

$$\begin{array}{r} 7 \quad 2 \quad 0 \\ 5 \quad \overline{4} \quad 3 \\ + \quad \overline{12} \quad \overline{2} \quad 3 \\ \hline \end{array}$$

By removing the vinculum in  $5\overline{4}3$ .

$$\therefore 5\overline{4}3 = 5 - 1/10 - 4/3 = 463$$

Then,

$$\begin{array}{r} 7 \quad 2 \quad 0 \\ 4 \quad 6 \quad 3 \\ \hline 11 \quad 8 \quad 3 \end{array}$$

$$\begin{array}{r} 8 \quad 9 \quad 2 \\ 5 \quad \overline{3} \quad \overline{4} \\ + \quad \overline{13} \quad 6 \quad \overline{2} \\ \hline \end{array}$$

By removing the vinculum in  $5\overline{3}4$ .

$$\therefore 5\overline{3}4 = 5 - 1/10 - 3/4 = 4/7 - 4/4 \\ = 4/7 - 1/10 - 4 = 466$$

Then,

$$\begin{array}{r} 8 \quad 9 \quad 2 \\ 4 \quad 6 \quad 6 \\ + \quad \overline{13} \quad 5 \quad 8 \\ \hline \end{array}$$

#### Calculation by removing Vinculum

$$\begin{array}{r} 6 \quad \overline{2} \\ 5 \quad \overline{4} \\ + \quad \overline{11} \quad \overline{6} \\ \hline \end{array}$$

By removing the vinculum in  $\overline{6}2$  and  $5\overline{4}$

$$\therefore \overline{6}2 = 6 - 1/10 - 2 = 58$$

$$\text{and } 5\overline{4} = 5 - 1/10 - 4 = 46$$

Then,

$$\begin{array}{r} 5 \quad 8 \\ 4 \quad 6 \\ + \quad \overline{10} \quad 4 \\ \hline \end{array}$$

$$\begin{array}{r} 9 \quad \overline{3} \quad \overline{2} \\ 4 \quad \overline{4} \quad 6 \\ + \quad \overline{13} \quad \overline{7} \quad 4 \\ \hline \end{array}$$

By removing the vinculum in  $9\overline{3}2$  and  $4\overline{4}6$

$$\therefore 9\overline{3}2 = 9 - 1/10 - 3/2 = 8/7 - 2/2 \\ = 8/7 - 1/10 - 2 = 868$$

$$\text{and } 4\overline{4}6 = 4 - 1/10 - 4/6 = 366$$

Then,

$$\begin{array}{r} 8 \quad 6 \quad 8 \\ 3 \quad 6 \quad 6 \\ + \quad \overline{12} \quad 3 \quad 4 \\ \hline \end{array}$$

(iii) Evaluate:

$$\begin{array}{r} 6 \quad 2 \quad \overline{3} \\ 8 \quad \overline{4} \quad \overline{1} \\ + \quad \overline{14} \quad \overline{2} \quad \overline{4} \end{array}$$

By removing the vinculum in  $14\overline{24}$ .

$$\begin{aligned} \therefore 14\overline{24} &= 1/4 - 1/10 - 2/\overline{4} \\ &= 1/3/8/\overline{4} \\ &= 1/3/8 - 1/10 - 4 \\ &= 1376 \end{aligned}$$

(iv) Evaluate:

$$\begin{array}{r} 8 \quad \overline{3} \quad 0 \\ 3 \quad 2 \quad \overline{4} \\ + \quad \overline{11} \quad \overline{1} \quad \overline{4} \end{array}$$

By removing the vinculum in  $11\overline{14}$ .

$$\begin{aligned} \therefore 11\overline{14} &= 1/1 - 1/10 - 1/\overline{4} \\ &= 1/0/9/\overline{4} \\ &= 1/0/9 - 1/10 - 4 \\ &= 1086 \end{aligned}$$

(v) Evaluate:

$$\begin{array}{r} 2 \quad 4 \quad \overline{1} \\ 4 \quad \overline{3} \quad 0 \\ + \quad \overline{6} \quad \overline{1} \quad \overline{1} \end{array}$$

By removing the vinculum in  $61\overline{1}$ .

$$\begin{aligned} \therefore 61\overline{1} &= 6/1 - 1/10 - 1 \\ &= 609 \end{aligned}$$

#### Type – IV

##### Calculation with Vinculum

(i) Evaluate:

$$\begin{array}{r} 7 \quad 5 \quad \overline{3} \\ 2 \quad \overline{4} \quad \overline{1} \\ 9 \quad \overline{2} \quad \overline{4} \\ + \quad \overline{18} \quad \overline{1} \quad \overline{8} \end{array}$$

$$\therefore \overline{3} + \overline{1} + \overline{4} = -3 + (-1) + (-4) = -3 - 1 - 4 = -8 = \overline{8}$$

By removing the vinculum in  $18\overline{18}$ ,

$$\begin{array}{r} 6 \quad 2 \quad \overline{3} \\ 8 \quad \overline{4} \quad \overline{1} \\ + \quad \overline{14} \quad \overline{2} \quad \overline{4} \end{array}$$

By removing the vinculum in  $62\overline{3}$  and  $8\overline{41}$ .

$$\begin{aligned} \therefore 62\overline{3} &= 6/2 - 1/10 - 3 = 617 \\ \text{and } 8\overline{41} &= 8 - 1/10 - 4/\overline{1} = 7/6/\overline{1} \\ &= 7/6 - 1/10 - 1 = 759 \end{aligned}$$

Then,

$$\begin{array}{r} 6 \quad 1 \quad 7 \\ 7 \quad 5 \quad 9 \\ + \quad \overline{13} \quad \overline{7} \quad \overline{6} \end{array}$$

$$\begin{array}{r} 8 \quad \overline{3} \quad 0 \\ 3 \quad 2 \quad \overline{4} \\ + \quad \overline{11} \quad \overline{1} \quad \overline{4} \end{array}$$

By removing the vinculum in  $8\overline{30}$  and  $32\overline{4}$ .

$$\begin{aligned} \therefore 8\overline{30} &= 8 - 1/10 - 3/0 = 770 \\ \text{and } 32\overline{4} &= 3/2 - 1/10 - 4 = 316 \end{aligned}$$

Then,

$$\begin{array}{r} 7 \quad 7 \quad 0 \\ 3 \quad 1 \quad 6 \\ + \quad \overline{10} \quad \overline{8} \quad \overline{6} \end{array}$$

$$\begin{array}{r} 2 \quad 4 \quad \overline{1} \\ 4 \quad \overline{3} \quad 0 \\ + \quad \overline{6} \quad \overline{1} \quad \overline{1} \end{array}$$

By removing the vinculum in  $24\overline{1}$  and  $4\overline{30}$ .

$$\begin{aligned} \therefore 24\overline{1} &= 2/4 - 1/10 - 1 = 239 \\ \text{and } 4\overline{30} &= 4 - 1/10 - 3/0 = 370 \end{aligned}$$

Then,

$$\begin{array}{r} 2 \quad 3 \quad 9 \\ 3 \quad 7 \quad 0 \\ + \quad \overline{6} \quad \overline{0} \quad \overline{9} \end{array}$$

##### Calculation by removing Vinculum

$$\begin{array}{r} 7 \quad 5 \quad \overline{3} \\ 2 \quad \overline{4} \quad \overline{1} \\ 9 \quad \overline{2} \quad \overline{4} \\ + \quad \overline{18} \quad \overline{1} \quad \overline{8} \end{array}$$

By removing the vinculum in  $75\overline{3}$ ,  $24\overline{1}$  and  $92\overline{4}$ .

$$\begin{aligned}\therefore 18\overline{18} &= 1/8-1/10-1/\overline{8} \\ &= 1/7/9/\overline{8} \\ &= 1/7/9-1/10-8 \\ &= 1782\end{aligned}$$

(ii) Evaluate:

$$\begin{array}{r} 3 \quad \overline{4} \quad \overline{3} \\ 6 \quad \overline{3} \quad 5 \\ 8 \quad \overline{1} \quad \overline{4} \\ + \overline{17} \quad \overline{8} \quad \overline{2} \end{array}$$

By removing the vinculum in  $17\overline{82}$ .

$$\begin{aligned}\therefore 17\overline{82} &= 1/7-1/10-8/\overline{2} \\ &= 1/6/2/\overline{2} \\ &= 1/6/2-1/10-2 \\ &= 1618\end{aligned}$$

(iii) Evaluate:

$$\begin{array}{r} 3 \quad \overline{4} \quad \overline{4} \\ 7 \quad \overline{1} \quad \overline{3} \\ 8 \quad \overline{3} \quad 2 \\ 5 \quad \overline{4} \quad \overline{3} \\ + \overline{22} \quad \overline{2} \quad \overline{8} \end{array}$$

$$\begin{aligned}\therefore \overline{4} + \overline{1} + \overline{3} + \overline{4} &= -4 + (-1) + (-3) + (-4) = -4 - 1 - 3 - 4 \\ &= -12 = \overline{12} = \overline{12}\end{aligned}$$

Here, carry number =  $\overline{1}$

$$\therefore 3 + 7 + 8 + 5 + \overline{1} = 23 + (-1) = 23 - 1 = 22$$

By removing the vinculum in  $22\overline{28}$ .

$$\begin{aligned}\therefore 22\overline{28} &= 2/2-1/10-2/\overline{8} \\ &= 2/1/8/\overline{8} \\ &= 2/1/8-1/10-8 \\ &= 2172\end{aligned}$$

$$\begin{aligned}\therefore 75\overline{3} &= 7/5-1/10-3 = 747, \\ 24\overline{1} &= 2-1/10-4/\overline{1} = 1/6/\overline{1} \\ &= 1/6-1/10-1 = 159 \\ \text{and } 92\overline{4} &= 9-1/10-2/\overline{4} = 8/8/\overline{4} \\ &= 8/8-1/10-4 = 876\end{aligned}$$

Then,

$$\begin{array}{r} 7 \quad 4 \quad 7 \\ 1 \quad 5 \quad 9 \\ 8 \quad 7 \quad 6 \\ + \overline{17} \quad \overline{8} \quad \overline{2} \end{array}$$

$$\begin{array}{r} 3 \quad \overline{4} \quad \overline{3} \\ 6 \quad \overline{3} \quad 5 \\ 8 \quad \overline{1} \quad \overline{4} \\ + \overline{17} \quad \overline{8} \quad \overline{2} \end{array}$$

By removing the vinculum in  $34\overline{3}$ ,  $6\overline{35}$  and  $8\overline{14}$ .

$$\begin{aligned}\therefore 34\overline{3} &= 3-1/10-4/\overline{3} = 2/6-1/10-3 = 257 \\ 6\overline{35} &= 6-1/10-3/5 = 575 \\ \text{and } 8\overline{14} &= 8-1/10-1/\overline{4} = 7/9-1/10-4 \\ &= 786\end{aligned}$$

Then,

$$\begin{array}{r} 2 \quad 5 \quad 7 \\ 5 \quad 7 \quad 5 \\ 7 \quad 8 \quad 6 \\ + \overline{16} \quad \overline{1} \quad \overline{8} \end{array}$$

$$\begin{array}{r} 3 \quad \overline{4} \quad \overline{4} \\ 7 \quad \overline{1} \quad \overline{3} \\ 8 \quad \overline{3} \quad 2 \\ 5 \quad \overline{4} \quad \overline{3} \\ + \overline{22} \quad \overline{2} \quad \overline{8} \end{array}$$

By removing the vinculum in  $34\overline{4}$ ,  $7\overline{13}$ ,  $8\overline{32}$  and  $54\overline{3}$ .

$$\begin{aligned}\therefore 34\overline{4} &= 3-1/10-4/\overline{4} = 2/6-1/10-4 = 256 \\ 7\overline{13} &= 7-1/10-1/\overline{3} = 6/9-1/10-3 = 687\end{aligned}$$

$$8\overline{32} = 8-1/10-3/2 = 772$$

$$\begin{aligned}\text{and } 54\overline{3} &= 5-1/10-4/\overline{3} = 4/6-1/10-3 \\ &= 457\end{aligned}$$

Then,

$$\begin{array}{r} 2 \ 5 \ 6 \\ 6 \ 8 \ 7 \\ 7 \ 7 \ 2 \\ + 4 \ 5 \ 7 \\ \hline 21 \ 7 \ 2 \end{array}$$

(iv) Evaluate:

$$\begin{array}{r} 2 \ \overline{3} \ 8 \ \overline{1} \ \overline{4} \\ 4 \ \overline{4} \ 0 \ \overline{3} \ 6 \\ 3 \ \overline{2} \ \overline{3} \ 4 \ \overline{3} \\ + 7 \ \overline{4} \ \overline{4} \ \overline{4} \ \overline{2} \\ \hline 15 \ \overline{3} \ 1 \ \overline{4} \ \overline{3} \end{array}$$

By removing the vinculum in  $15\overline{3}1\overline{4}\overline{3}$ .

$$\begin{aligned} \therefore 15\overline{3}1\overline{4}\overline{3} &= 1/5-1/10-3/1-1/10-4/\overline{3} \\ &= 1/4/7/0/6/\overline{3} \\ &= 1/4/7/0/6-1/10-3 \\ &= 147057 \end{aligned}$$

$$\begin{array}{r} 2 \ \overline{3} \ 8 \ \overline{1} \ \overline{4} \\ 4 \ \overline{4} \ 0 \ \overline{3} \ 6 \\ 3 \ \overline{2} \ \overline{3} \ 4 \ \overline{3} \\ + 7 \ \overline{4} \ \overline{4} \ \overline{4} \ \overline{2} \\ \hline \end{array}$$

By removing the vinculum in  $2\overline{3}8\overline{1}\overline{4}$ ,

$$\begin{aligned} 440\overline{3}6, 32\overline{3}4\overline{3} \text{ and } 7444\overline{2} \\ \therefore 2\overline{3}8\overline{1}\overline{4} &= 2-1/10-3/8-1/10-1/\overline{4} \\ &= 1/7/7/9-1/10-4 = 17786 \\ 440\overline{3}6 &= 4-1/10-4/0-1/10-3/6 \\ &= 3/6/\overline{1}/7/6 = 3/6-1/10-1/7/6 \\ &= 35976 \\ 32\overline{3}4\overline{3} &= 3-1/10-2/\overline{3}/4-1/10-3 \\ &= 2/8-1/10-3/3/7 = 27737 \\ \text{and } 7444\overline{2} &= 7-1/10-4/\overline{4}/\overline{4}/\overline{2} \\ &= 6/6-1/10-4/\overline{4}/\overline{2} \\ &= 6/5/6-1/10-4/\overline{2} \\ &= 6/5/5/6-1/10-2 = 65558 \end{aligned}$$

Then,

$$\begin{array}{r} 1 \ 7 \ 7 \ 8 \ 6 \\ 3 \ 5 \ 9 \ 7 \ 6 \\ 2 \ 7 \ 7 \ 3 \ 7 \\ + 6 \ 5 \ 5 \ 5 \ 8 \\ \hline 14 \ 7 \ 0 \ 5 \ 7 \end{array}$$

## (B) Subtraction:

### Type – I

#### Calculation with Vinculum

(i) Evaluate:

$$\begin{array}{r} 5 \ \overline{4} \\ 2 \ 8 \\ - 2 \ \overline{2} \\ \hline \end{array}$$

$$\therefore \overline{4}-8 = -4-8 = -12 = \overline{12} = \overline{1}\ \overline{2}$$

Here, carry number =  $\overline{1}$  and  $5-2+\overline{1} = 5-2-1 = 2$

By removing the vinculum in  $\overline{22}$ .

$$\therefore \overline{22} = 2-1/10-2$$

$$= 18$$

#### Calculation by removing Vinculum

$$\begin{array}{r} 5 \ \overline{4} \\ 2 \ 8 \\ - \hline \end{array}$$

By removing the vinculum in  $5\overline{4}$ .

$$\therefore 5\overline{4} = 5-1/10-4 = 46$$

Then,

$$\begin{array}{r} 4 \ 6 \\ 2 \ 8 \\ - 1 \ 8 \\ \hline \end{array}$$

(ii) Evaluate:

$$\begin{array}{r} 4 \quad \overline{3} \\ - \quad \overline{2 \quad 9} \\ \hline 1 \quad \overline{2} \end{array}$$

By removing the vinculum in  $\overline{12}$ .

$$\therefore \overline{12} = 1 - 1/10 - 2 \\ = 08$$

(iii) Evaluate:

$$\begin{array}{r} 5 \quad 7 \quad \overline{2} \\ - \quad \overline{1 \quad 3 \quad 9} \\ \hline 4 \quad 3 \quad \overline{1} \end{array}$$

By removing the vinculum in  $\overline{431}$ .

$$\therefore \overline{431} = 4/3 - 1/10 - 1 \\ = 429$$

(iv) Evaluate:

$$\begin{array}{r} 5 \quad \overline{4} \quad 1 \\ - \quad \overline{3 \quad 9 \quad 4} \\ \hline 1 \quad \overline{3} \quad \overline{3} \end{array}$$

By removing the vinculum in  $\overline{133}$ .

$$\therefore \overline{133} = 1 - 1/10 - 3/3 = 0/7 - 1/10 - 3 \\ = 067$$

(v) Evaluate:

$$\begin{array}{r} 9 \quad \overline{3} \quad \overline{2} \\ - \quad \overline{4 \quad 8 \quad 0} \\ \hline 4 \quad \overline{1} \quad \overline{2} \end{array}$$

$$\therefore \overline{2} - 0 = -2 - 0 = -2 = \overline{2} \quad \text{and} \quad \overline{3} - 8 = -3 - 8 = -11 = \overline{11} = \overline{1} \quad \overline{1}$$

By removing the vinculum in  $\overline{412}$ .

$$\therefore \overline{412} = 4 - 1/10 - 1/2 = 3/9 - 1/10 - 2 \\ = 388$$

$$\begin{array}{r} 4 \quad \overline{3} \\ - \quad \overline{2 \quad 9} \\ \hline \end{array}$$

By removing the vinculum in  $\overline{43}$ .

$$\therefore \overline{43} = 4 - 1/10 - 3 = 37$$

Then,

$$\begin{array}{r} 3 \quad 7 \\ - \quad \overline{2 \quad 9} \\ \hline 0 \quad 8 \end{array}$$

$$\begin{array}{r} 5 \quad 7 \quad \overline{2} \\ - \quad \overline{1 \quad 3 \quad 9} \\ \hline \end{array}$$

By removing the vinculum in  $\overline{572}$ .

$$\therefore \overline{572} = 5/7 - 1/10 - 2 = 568$$

Then,

$$\begin{array}{r} 5 \quad 6 \quad 8 \\ - \quad \overline{1 \quad 3 \quad 9} \\ \hline 4 \quad 2 \quad 9 \end{array}$$

$$\begin{array}{r} 5 \quad \overline{4} \quad 1 \\ - \quad \overline{3 \quad 9 \quad 4} \\ \hline \end{array}$$

By removing the vinculum in  $\overline{541}$ .

$$\therefore \overline{541} = 5 - 1/10 - 4/1 = 461$$

Then,

$$\begin{array}{r} 4 \quad 6 \quad 1 \\ - \quad \overline{3 \quad 9 \quad 4} \\ \hline 0 \quad 6 \quad 7 \end{array}$$

$$\begin{array}{r} 9 \quad \overline{3} \quad \overline{2} \\ - \quad \overline{4 \quad 8 \quad 0} \\ \hline \end{array}$$

By removing the vinculum in  $\overline{932}$ .

$$\therefore \overline{932} = 9 - 1/10 - 3/2 = 8/7/2 \\ = 8/7 - 1/10 - 2 = 868$$

Then,

$$\begin{array}{r} 8 \quad 6 \quad 8 \\ - \quad \overline{4 \quad 8 \quad 0} \\ \hline 3 \quad 8 \quad 8 \end{array}$$



## Type – II

### Calculation with Vinculum

(i) Evaluate:

$$\begin{array}{r} 7 \quad 8 \\ 3 \quad \overline{4} \\ - \\ 5 \quad 2 \end{array}$$

$$\therefore \overline{4} = -4 \quad \text{and} \quad 8 - \overline{4} = 8 - (-4) = 8 + 4 = 12$$

(ii) Evaluate:

$$\begin{array}{r} 7 \quad 8 \quad 9 \\ 3 \quad 5 \quad \overline{4} \\ - \\ 4 \quad 4 \quad 3 \end{array}$$

(iii) Evaluate:

$$\begin{array}{r} 5 \quad 8 \quad 2 \\ 1 \quad \overline{4} \quad 6 \\ - \\ 5 \quad 2 \quad \overline{4} \end{array}$$

By removing the vinculum in  $52\overline{4}$ .

$$\therefore 52\overline{4} = 5/2 - 1/10 - 4 = 516$$

(iv) Evaluate:

$$\begin{array}{r} 8 \quad 9 \quad 2 \\ 5 \quad \overline{3} \quad \overline{4} \\ - \\ 4 \quad 2 \quad 6 \end{array}$$

### Calculation by removing Vinculum

$$\begin{array}{r} 7 \quad 8 \\ 3 \quad \overline{4} \\ - \end{array}$$

By removing the vinculum in  $3\overline{4}$ .

$$\therefore 3\overline{4} = 3 - 1/10 - 4 = 26$$

Then,

$$\begin{array}{r} 7 \quad 8 \\ 2 \quad 6 \\ - \\ 5 \quad 2 \end{array}$$

$$\begin{array}{r} 7 \quad 8 \quad 9 \\ 3 \quad 5 \quad \overline{4} \\ - \end{array}$$

By removing the vinculum in  $35\overline{4}$ .

$$\therefore 35\overline{4} = 3/5 - 1/10 - 4 = 346$$

Then,

$$\begin{array}{r} 7 \quad 8 \quad 9 \\ 3 \quad 4 \quad 6 \\ - \\ 4 \quad 4 \quad 3 \end{array}$$

$$\begin{array}{r} 5 \quad 8 \quad 2 \\ 1 \quad \overline{4} \quad 6 \\ - \end{array}$$

By removing the vinculum in  $1\overline{4}6$ .

$$\therefore 1\overline{4}6 = 1 - 1/10 - 4/6 = 066$$

Then,

$$\begin{array}{r} 5 \quad 8 \quad 2 \\ 0 \quad 6 \quad 6 \\ - \\ 5 \quad 1 \quad 6 \end{array}$$

$$\begin{array}{r} 8 \quad 9 \quad 2 \\ 5 \quad \overline{3} \quad \overline{4} \\ - \end{array}$$

By removing the vinculum in  $5\overline{3}\overline{4}$ .

$$\therefore 5\overline{3}\overline{4} = 5 - 1/10 - 3/\overline{4} = 4/7/\overline{4} = 4/7 - 1/10 - 4 = 466$$

Then,

$$\begin{array}{r} 8 \quad 9 \quad 2 \\ 4 \quad 6 \quad 6 \\ - \\ 4 \quad 2 \quad 6 \end{array}$$

### Type – III

#### Calculation with Vinculum

(i) Evaluate:

$$\begin{array}{r} 9 \quad \overline{2} \\ 5 \quad \overline{4} \\ - \\ 4 \quad 2 \end{array}$$

$$\therefore \overline{2} - \overline{4} = -2 - (-4) = -2 + 4 = 2.$$

(ii) Evaluate:

$$\begin{array}{r} 9 \quad \overline{3} \quad \overline{2} \\ 4 \quad \overline{4} \quad 6 \\ - \\ 5 \quad 1 \quad \overline{8} \end{array}$$

$$\therefore \overline{2} - 6 = -2 - 6 = -8 = \overline{8} \text{ and } \overline{3} - \overline{4} = -3 - (-4) = -3 + 4 = 1$$

By removing the vinculum in  $51\overline{8}$

$$\therefore 51\overline{8} = 5/1-1/10-8 = 502$$

(iii) Evaluate:

$$\begin{array}{r} 6 \quad 2 \quad \overline{3} \\ 3 \quad \overline{4} \quad \overline{1} \\ - \\ 3 \quad 6 \quad \overline{2} \end{array}$$

By removing the vinculum in  $36\overline{2}$ .

$$\therefore 36\overline{2} = 3/6-1/10-2 = 358$$

(iv) Evaluate:

$$\begin{array}{r} 9 \quad \overline{3} \quad 0 \\ 7 \quad 4 \quad \overline{4} \\ - \\ 2 \quad \overline{7} \quad 4 \end{array}$$

By removing the vinculum in  $2\overline{7}4$ .

$$\therefore 2\overline{7}4 = 2-1/10-7/4 = 134$$

#### Calculation by removing Vinculum

$$\begin{array}{r} 9 \quad \overline{2} \\ 5 \quad \overline{4} \\ - \end{array}$$

By removing the vinculum in  $9\overline{2}$  and  $5\overline{4}$

$$\therefore 9\overline{2} = 9-1/10-2 = 88$$

$$\text{and } 5\overline{4} = 5-1/10-4 = 46$$

Then,

$$\begin{array}{r} 8 \quad 8 \\ 4 \quad 6 \\ - \\ 4 \quad 2 \end{array}$$

$$\begin{array}{r} 9 \quad \overline{3} \quad \overline{2} \\ 4 \quad \overline{4} \quad 6 \\ - \end{array}$$

By removing the vinculum in  $9\overline{3}\overline{2}$  and  $4\overline{4}6$

$$\therefore 9\overline{3}\overline{2} = 9-1/10-3/\overline{2} = 8/7/\overline{2} = 8/7-1/10-2 = 868$$

$$\text{and } 4\overline{4}6 = 4-1/10-4/6 = 366$$

Then,

$$\begin{array}{r} 8 \quad 6 \quad 8 \\ 3 \quad 6 \quad 6 \\ - \\ 5 \quad 0 \quad 2 \end{array}$$

$$\begin{array}{r} 6 \quad 2 \quad \overline{3} \\ 3 \quad \overline{4} \quad \overline{1} \\ - \end{array}$$

By removing the vinculum in  $62\overline{3}$

and  $34\overline{1}$ .

$$\therefore 62\overline{3} = 6/2-1/10-3 = 617$$

$$\text{and } 34\overline{1} = 3-1/10-4/\overline{1} = 2/6/\overline{1} = 2/6-1/10-1 = 259$$

Then,

$$\begin{array}{r} 6 \quad 1 \quad 7 \\ 2 \quad 5 \quad 9 \\ - \\ 3 \quad 5 \quad 8 \end{array}$$

$$\begin{array}{r} 9 \quad \overline{3} \quad 0 \\ 7 \quad 4 \quad \overline{4} \\ - \end{array}$$

By removing the vinculum in  $9\overline{3}0$  and  $74\overline{4}$ .

$$\therefore 9\overline{3}0 = 9-1/10-3/0 = 870$$

$$\text{and } 7\overline{44} = 7/4 - 1/10 - 4 = 736$$

Then,

$$\begin{array}{r} 8 \quad 7 \quad 0 \\ 7 \quad 3 \quad 6 \\ - \\ 1 \quad 3 \quad 4 \end{array}$$

$$\begin{array}{r} 7 \quad \overline{4} \quad \overline{1} \\ 4 \quad \overline{3} \quad \overline{2} \\ - \end{array}$$

(v) Evaluate:

$$\begin{array}{r} 7 \quad \overline{4} \quad \overline{1} \\ 4 \quad \overline{3} \quad \overline{2} \\ - \\ 3 \quad \overline{1} \quad 1 \end{array}$$

By removing the vinculum in  $3\overline{1}1$ .

$$\therefore 3\overline{1}1 = 3 - 1/10 - 1/1 \\ = 291$$

By removing the vinculum in  $7\overline{4}\overline{1}$

and  $4\overline{3}\overline{2}$ .

$$\therefore 7\overline{4}\overline{1} = 7 - 1/10 - 4/\overline{1} = 6/6 - 1/10 - 1 = 659$$

$$\text{and } 4\overline{3}\overline{2} = 4 - 1/10 - 3/\overline{2} = 3/7 - 1/10 - 2 \\ = 368$$

Then,

$$\begin{array}{r} 6 \quad 5 \quad 9 \\ 3 \quad 6 \quad 8 \\ - \\ 2 \quad 9 \quad 1 \end{array}$$

### (C) Multiplication:

#### Calculation with Vinculum

(i) Evaluate:

$$\begin{array}{r} 3 \quad \overline{4} \\ \times 3 \\ \hline 8 \quad \overline{2} \end{array}$$

$$\therefore 3 \times \overline{4} = 3 \times -4 = -12 = \overline{12} = \overline{1}\overline{2}$$

$$\text{and } 3 \times 3 + \overline{1} = 9 + (-1) = 9 - 1 = 8$$

By removing the vinculum in  $8\overline{2}$ .

$$\therefore 8\overline{2} = 8 - 1/10 - 2 = 78$$

(ii) Evaluate:

$$\begin{array}{r} 8 \quad \overline{4} \\ \times 6 \quad \overline{3} \\ \hline \overline{2} \quad \overline{3} \quad 2 \\ 4 \quad 6 \quad \overline{4} \quad 0 \\ \hline 4 \quad 4 \quad \overline{7} \quad 2 \end{array}$$

$$\therefore \overline{3} \times \overline{4} = -3 \times (-4) = 12$$

By removing the vinculum in

$$\therefore 44\overline{7}2 = 4/4 - 1/10 - 7/2 \\ = 4332$$

#### Calculation by removing Vinculum

$$\begin{array}{r} 3 \quad \overline{4} \\ \times 3 \\ \hline \end{array}$$

By removing the vinculum in  $3\overline{4}$

$$\therefore 3\overline{4} = 3 - 1/10 - 4 = 26$$

Then,

$$\begin{array}{r} 2 \quad 6 \\ \times 3 \\ \hline 7 \quad 8 \end{array}$$

$$\begin{array}{r} 8 \quad \overline{4} \\ \times 6 \quad \overline{3} \\ \hline \end{array}$$

By removing the vinculum in  $8\overline{4}$  and  $\overline{63}$

$$\therefore 8\overline{4} = 8 - 1/10 - 4 = 76$$

$$\text{and } \overline{63} = 6 - 1/10 - 3 = 57$$

Then,

$$\begin{array}{r} 7 \quad 6 \\ \times 5 \quad 7 \\ \hline 5 \quad 3 \quad 2 \\ 3 \quad 8 \quad 0 \quad 0 \\ \hline 4 \quad 3 \quad 3 \quad 2 \end{array}$$

(iii) Evaluate:

$$\begin{array}{r} 3 \ 2 \ \overline{4} \\ \times 3 \ \overline{2} \\ \hline \overline{6} \ \overline{4} \ 8 \\ 9 \ 5 \ \overline{2} \ 0 \\ \hline 9 \ \overline{1} \ \overline{6} \ 8 \end{array}$$

By removing the vinculum in  $9\overline{1}\overline{6}8$ .

$$\begin{aligned} \therefore 9\overline{1}\overline{6}8 &= 9-1/10-1/\overline{6}/8 \\ &= 8/9/\overline{6}/8 \\ &= 8/9-1/10-6/8 \\ &= 8848 \end{aligned}$$

$$\begin{array}{r} 3 \ 2 \ \overline{4} \\ \times 3 \ \overline{2} \\ \hline \end{array}$$

By removing the vinculum in  $32\overline{4}$  and  $3\overline{2}$ .

$$\therefore 32\overline{4} = 3/2-1/10-4 = 316$$

$$\text{and } 3\overline{2} = 3-1/10-2 = 28$$

Then,

$$\begin{array}{r} 3 \ 1 \ 6 \\ \times 2 \ 8 \\ \hline 2 \ 5 \ 2 \ 8 \\ 6 \ 3 \ 2 \ 0 \\ \hline 8 \ 8 \ 4 \ 8 \end{array}$$

(iv) Evaluate:

$$\begin{array}{r} 5 \ \overline{4} \ 3 \\ \times 5 \ \overline{4} \\ \hline \overline{1} \ \overline{9} \ 5 \ \overline{2} \\ 2 \ 4 \ \overline{9} \ 5 \ 0 \\ \hline 2 \ 2 \ \overline{7} \ 0 \ \overline{2} \end{array}$$

By removing the vinculum in  $22\overline{7}0\overline{2}$ .

$$\begin{aligned} \therefore 22\overline{7}0\overline{2} &= 2/2-1/10-7/0-1/10-2 \\ &= 2/1/3/\overline{1}/8 \\ &= 2/1/3-1/10-1/8 \\ &= 21298 \end{aligned}$$

$$\begin{array}{r} 5 \ \overline{4} \ 3 \\ \times 5 \ \overline{4} \\ \hline \end{array}$$

By removing the vinculum in  $5\overline{4}3$  and  $5\overline{4}$

$$\therefore 5\overline{4}3 = 5-1/10-4/3 = 463$$

$$\text{and } 5\overline{4} = 5-1/10-4 = 46$$

Then,

$$\begin{array}{r} 4 \ 6 \ 3 \\ \times 4 \ 6 \\ \hline 2 \ 7 \ 7 \ 8 \\ 1 \ 8 \ 5 \ 2 \ 0 \\ \hline 2 \ 1 \ 2 \ 9 \ 8 \end{array}$$

(v) Evaluate:

$$\begin{array}{r} 3 \ 4 \ \overline{2} \\ \times 4 \ \overline{1} \ \overline{4} \\ \hline \overline{1} \ \overline{3} \ \overline{6} \ 8 \\ \overline{3} \ \overline{4} \ 2 \ 0 \\ 1 \ 3 \ 6 \ \overline{8} \ 0 \ 0 \\ \hline 1 \ 3 \ 1 \ \overline{5} \ \overline{4} \ 8 \end{array}$$

By removing the vinculum in  $131\overline{5}4\overline{8}$ .

$$\begin{aligned} \therefore 131\overline{5}4\overline{8} &= 1/3/1-1/10-5/\overline{4}/8 \\ &= 1/3/0/5/\overline{4}/8 \\ &= 1/3/0/5-1/10-4/8 \\ &= 130468 \end{aligned}$$

$$\begin{array}{r} 3 \ 4 \ \overline{2} \\ \times 4 \ \overline{1} \ \overline{4} \\ \hline \end{array}$$

By removing the vinculum in  $34\overline{2}$  and  $4\overline{1}\overline{4}$

$$\therefore 34\overline{2} = 3/4-1/10-2 = 338$$

$$\text{and } 4\overline{1}\overline{4} = 4-1/10-1/\overline{4} = 3/9-1/10-4 = 386$$

Then,

$$\begin{array}{r}
 3 \ 3 \ 8 \\
 \times 3 \ 8 \ 6 \\
 \hline
 2 \ 0 \ 2 \ 8 \\
 2 \ 7 \ 0 \ 4 \ 0 \\
 1 \ 0 \ 1 \ 4 \ 0 \ 0 \\
 \hline
 1 \ 3 \ 0 \ 4 \ 6 \ 8
 \end{array}$$

### 3. VERTICALLY AND CROSSWISE VEDIC METHOD FOR MULTIPLICATION IN VINCULUM NUMBERS

For vertically and crosswise product of  $m\bar{n}$  and  $p\bar{q}\bar{r}$ , we have to make number of digits of two number to be same. For this we include 0 (Zero) at hundreds place of  $m\bar{n}$  and  $m\bar{n}$  is written as  $0m\bar{n}$ . Multiplication is written as –

$$\begin{array}{r}
 p \ \bar{q} \ \bar{r} \\
 \times 0 \ m \ \bar{n} \\
 \hline
 \end{array}$$

Multiplication process is as follow

(i) Step – 1. 
$$\begin{array}{r}
 p \ \bar{q} \ \left( \bar{r} \right) \\
 0 \ m \ \left( \bar{n} \right)
 \end{array} = \bar{r} \times \bar{n} = ab$$

$$a, b \in \mathbb{N} \cup \{0\}, ab = 1 \times b + 10 \times a$$

Here, a be the carry number and b is included in the result.

(ii) Step – 2. 
$$\begin{array}{r}
 p \ \left( \bar{q} \ \bar{r} \right) \\
 0 \ \left( m \ \bar{n} \right)
 \end{array} = \bar{n} \times \bar{q} + \bar{r} \times m = cd$$

$$\text{and } cd + a = ef$$

Here, e be the carry number and f is included in the result left to b of step – 1.

(iii) Step – 3. 
$$\begin{array}{r}
 p \ \bar{q} \ \bar{r} \\
 0 \ m \ \bar{n}
 \end{array} = \bar{n} \times p + \bar{r} \times 0 + \bar{q} \times \bar{n} = gh$$

$$\text{and } gh + e = ij$$

Here, i be the carry number and j is included in the result left to f of step – 2.

(iv) Step – 4. 
$$\begin{array}{r}
 p \ \bar{q} \\
 0 \ m
 \end{array} \bar{r} = m \times p + \bar{q} \times 0 = kl$$

$$\text{and } kl + i = st$$

Here, s be the carry number and t is included in the result left to j of step – 3.

(v) Step – 5. 
$$\begin{array}{r}
 p \\
 0
 \end{array} \bar{q} \ \bar{r} = p \times 0 = 0$$

$$\text{and } 0 + s = s$$

Here, s is included in the result left to t of step – 4.

Hence,

$$\therefore m\bar{n} \times p\bar{q}\bar{r} = stifb$$

Example – Evaluate:  $6\bar{3} \times 32\bar{4}$

We write

$$\begin{array}{r}
 3 \ \bar{2} \ \bar{4} \\
 \times 0 \ 6 \ \bar{3} \\
 \hline
 \end{array}$$

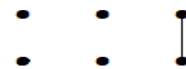


Fig.-1



Fig.-2

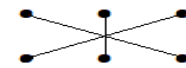


Fig.-3



Fig.-4

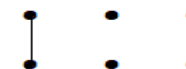


Fig.-5

$$(i) \text{ Step - 1. } \begin{array}{r} 3 \quad \overline{2} \quad \overline{4} \\ 0 \quad 6 \quad \overline{3} \end{array} = \overline{4} \times \overline{3} = 12$$

Here, 1 be the carry number and 2 is included in the result.

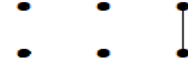


Fig.-6

$$(ii) \text{ Step - 2. } \begin{array}{r} 3 \quad \overline{2} \quad \overline{4} \\ 0 \quad 6 \quad \overline{3} \end{array} = \overline{3} \times \overline{2} + \overline{4} \times 6 = \overline{18}$$

$$\text{and } \overline{18} + 1 = \overline{17}$$

Here,  $\overline{1}$  be the carry number and  $\overline{7}$  is included in the result left to 2 of step - 1.



Fig.-7

$$(iii) \text{ Step - 3. } \begin{array}{r} 3 \quad \overline{2} \quad \overline{4} \\ 0 \quad 6 \quad \overline{3} \end{array} = \overline{3} \times 3 + \overline{4} \times 0 + 6 \times \overline{2} = \overline{21}$$

$$\text{and } \overline{21} + \overline{1} = \overline{22}$$

Here,  $\overline{2}$  be the carry number and  $\overline{2}$  is included in the result left to  $\overline{7}$  of step - 2.

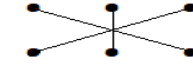


Fig.-8

$$(iv) \text{ Step - 4. } \begin{array}{r} 3 \quad \overline{2} \\ 0 \quad 6 \end{array} \begin{array}{r} \overline{4} \\ \overline{3} \end{array} = 6 \times 3 + \overline{2} \times 0 = 18$$

$$\text{and } 18 + \overline{2} = 16$$

Here, 1 be the carry number and 6 is included in the result left to  $\overline{2}$  of step - 3.

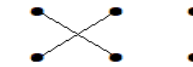


Fig.-9

$$(v) \text{ Step - 5. } \begin{array}{r} 3 \\ 0 \end{array} \begin{array}{r} \overline{2} \quad \overline{4} \\ 6 \quad \overline{3} \end{array} = 3 \times 0 = 0$$

$$\text{and } 0 + 1 = 1$$

Here, 1 is included in the result left to 6 of step - 4.



Fig.-10

Hence,

$$\therefore 6\overline{3} \times 3\overline{2}\overline{4} = 16\overline{2}\overline{7}2$$

By removing the vinculum in  $16\overline{2}\overline{7}2$

$$\therefore 16\overline{2}\overline{7}2 = 1/6-1/10-2/\overline{7}/2 = 1/5/8/\overline{7}/2 = 1/5/8-1/10-7/2 = 15732.$$

In short we may calculate this multiplication with the help of above process as follow step -

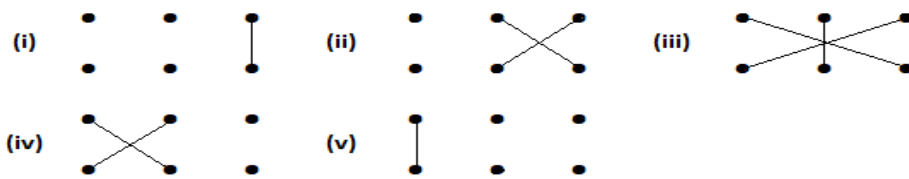


Fig.-11

$$\begin{array}{r} 3 \quad \overline{2} \quad \overline{4} \\ \times 0 \quad 6 \quad \overline{3} \\ \hline 1 \quad 6 \quad \overline{2} \quad \overline{7} \quad 2 \end{array}$$

$$\therefore \text{ Answer } = 16\overline{2}\overline{7}2$$

By removing the vinculum in  $16\overline{2}\overline{7}2$

$$\therefore 16\overline{2}\overline{7}2 = 1/6-1/10-2/\overline{7}/2 = 1/5/8/\overline{7}/2 = 1/5/8-1/10-7/2 = 15732.$$

#### Multiplication with vinculum Method:

$$\begin{array}{r} 3 \quad \overline{2} \quad \overline{4} \\ \times \quad 6 \quad \overline{3} \\ \hline \overline{9} \quad 7 \quad 2 \\ 1 \quad 7 \quad \overline{4} \quad \overline{4} \quad 0 \\ \hline 1 \quad 6 \quad \overline{3} \quad 3 \quad 2 \end{array}$$

By removing the vinculum in  $16\overline{3}32$ .

$$\therefore 16\overline{3}32 = 1/6-1/10-3/3/2 = 15732$$

**Example – Evaluate:**  $8\overline{4} \times 6\overline{3}$

Multiplication process is done by following steps -



Fig.-12

$$\begin{array}{r} 8 \quad \overline{4} \\ \times \quad 6 \quad \overline{3} \\ \hline 44 \quad \overline{7} \quad 2 \end{array}$$

$$\therefore \text{Answer} = 44\overline{7}2.$$

#### 4. CONCLUSION

We have performed addition, subtraction and multiplication of numbers with involvement of vinculum in which carry number appears. During the process by vertically and crosswise Vedic method it becomes simpler.

#### REFERENCES

1. Garain, D.N. and Kumar, Sanjeev "Algebraic representation of Vinculum and generalized rule for Vinculum Structure", International Journal of Mathematical Archive, 9 (6), (2018) 48 – 51.
2. Nicholas, A.P. William, K.R. and Pickles, j. Vertically and Crosswise, Motilal Banarsidass Publishers Private Limited, Delhi, 4 - 7. (1999).
3. Jagadguru Śaṅkarācārya Śrī Bhāratī Kṛṣṇa Tīrthajī Mahārāja and Agrawala, V.S. Vedic mathematics, Motilal Banarsidass Publishers Private Limited, Delhi, (1965) 33 – 44.
4. Ginsburg, Jekuthial and Smith, David Eugene "New Light on our numerals", Bulletin of the American Mathematical society, Second Series, 23(8), (1917) 366 – 369.
5. Williams, K.R. Vedic Mathematics Teacher's Manual (Intermediate level), Motilal Banarsidass Publisher Private Limited, Delhi, (2005) 24 – 26.
6. Williams, K.R. Astronomical Applications of Vedic Mathematics, Motilal Banarsidass Publisher Private Limited, Delhi, (2003) 4 – 7.

Source of support: Nil, Conflict of interest: None Declared.

[Copy right © 2018. This is an Open Access article distributed under the terms of the International Journal of Mathematical Archive (IJMA), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.]