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L-Sign Theorem for Repeating Non-Terminating Problem in Division

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Abstract
An L-Sign theory is established for this problem in this study because there is no decimal theory for repeating and non-terminating problems, which could lead to incomplete actual results. This theory is better suited for repeating and never-ending problems. The data which does not give complete real result by decimal division method like 10/3, 5/11, 22/7[approximation of π(Pi)] and many more like these, is divided by this L-sign method to get the complete real result, along with this the reality of these results has been checked by various methods. In this paper, the L-Sign Theorem has been explained with an example to prove its usefulness, which is capable of solving repeating and non-terminating problems. Mathematical procedures with other numbers of results obtained from the L-Sign Theorem can also be done easily under certain rules, which are mentioned in this paper.
Keywords- *Decimal division method, End of Remainder, Repeating Non Terminating Problem*

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I. Introduction

The golden history of mathematics in the field of education, in which after the discovery of the decimal theory, our access to the smallest scale of any numbers has been made easy, as well as we have been able to study to the minimum level of any number or quantity. With the discovery of this decimal principle, its drawbacks also began to appear, such as numbers whose division by this method shows the repetition of one or more numbers after the decimal, such as 3. 33333… and $0.4545\overline{45}$ etc. In these situations, we generally carry forward our calculations by taking numbers to 1, 2 or more places after the decimal, this value is close to the real value but cannot be the complete real value. Therefore, the L-Sign Theorem gives the absolute real value of the data by solving problems of such repeating numbers.

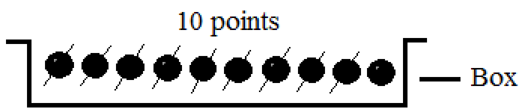
L-Sign theorem

Such figures, which are divided by the decimal division method, there is repetition of one or more digits after the decimal and the result is endless, apart from this, the remainder is also repeated in these numbers.

Starting from multiplying those figures by L-Sign division method at the level of the primary remainder by 10 (i.e. dividing the remainder into 10 times lower value part) the remainder obtained successively as 10 11 12... (i.e. Multiplying by increasing order of numbers) must result in a remainder multiplied at one level by a number which is equal to the divisor,some of its factor, its multiple or factor of its multiple.
That will be the last level of the remainder and in that level the remainder will be completely divided by the divisor and the obtained quotient will be the absolute real value of the given figure.

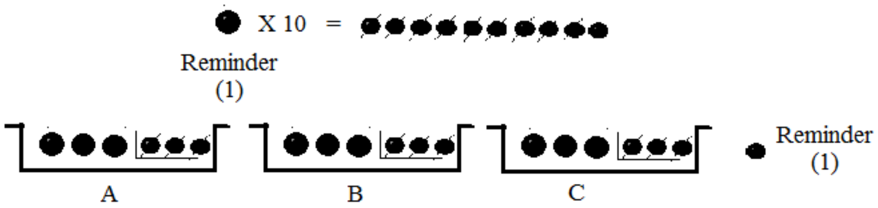
II. Point-Box Analysis to Understand the L-Sign Division Method

Through this process, trying to understand the process and behavior of the L-Sign division method, 10/3 is used as a figure.
For this, we will take 10 points in a box, then divide it into three equal parts and keep it in three different boxes.

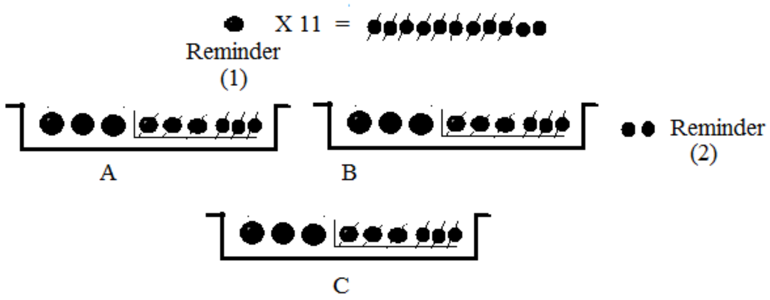


Now after dividing the above 10 points by L-Sign method (in 3 equal parts) we will keep them in three different boxes.

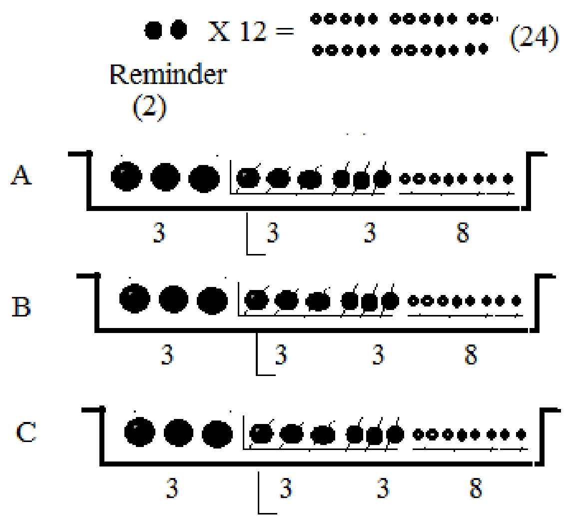
In the first phase, 3-3 points will come in all the three boxes, that means total 9 points, and 1 point will be left out as remainder.



In the second step, the 1 point left as the remainder is broken into 10 small pieces, and again it is kept equally in all the three boxes.



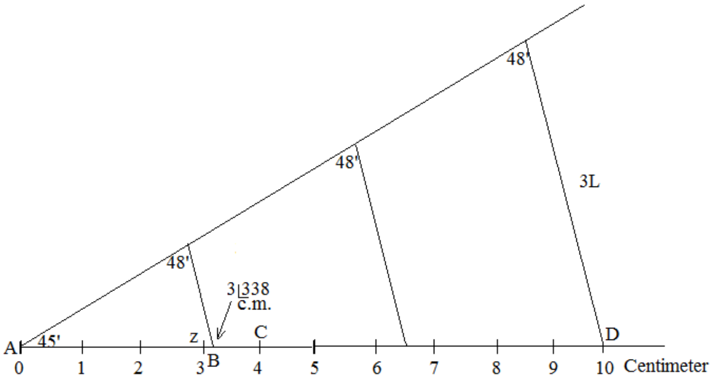
In the second step, it was seen that after breaking the remaining 1 point into 10 pieces and keeping it again in equal number of three boxes, one piece was again saved as a remainder.
Now in this step, according to the L-Sign method, it will again be broken into 11 small pieces and placed in equal numbers in all the three boxes.
In the third step, after breaking the remainder 1 into 11 pieces and keeping it equal again in all the three boxes, there will again be 3-3 points in all the boxes, and out of them 2 points are saved as remainder.
Now in this step it will again be divided each into 12 smaller pieces according to L-Sign procedure and divided into 3 parts and placed in all the three boxes (A, B, C).



So 10/3= 3∟338

In this step, the remaining 2 points were broken into 12 times smaller pieces, so total 24 pieces were obtained, now it is divided into 8-8 numbers in all the three boxes. Thus in each box the result will be as 3∟338. Therefore, on dividing 10 points into three equal parts, get 3∟338 by L-Sign method.

L-Sign theorem (to understand division method) works on number line
Behavior of L-Sign Division Method on Number Line:
In this process, first divide 10 cm in the number line into 3 equal parts.

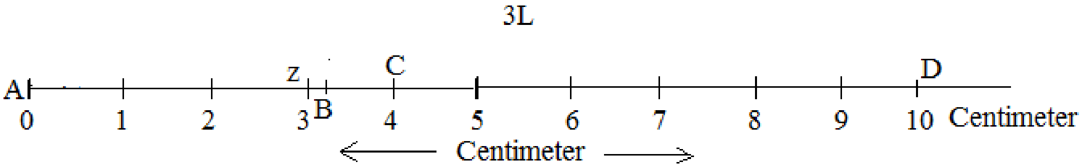


$$AB = \frac{10\,cm}{3\,cm} = 3\llcorner 338\ (L - sign\ cm)$$
$$AD = 10\,cm$$
$$AB = \frac{AD}{3}$$

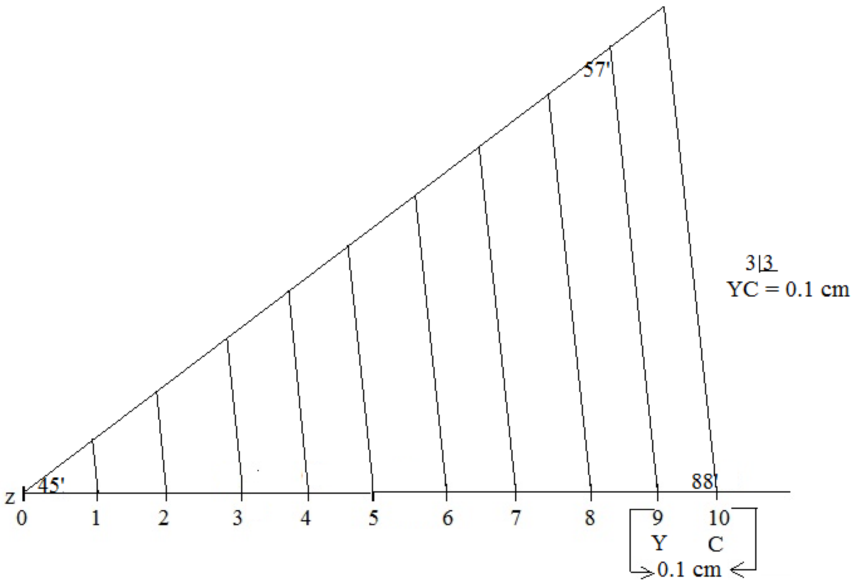
Let us see in the above picture that by dividing 10 cm in the number line into 3 equal parts by geometry method, that fixed point B can be obtained, which represents the length of one part cent percent.
And that point will also be located between 3 and 3.5 cm i.e

$$AB = \frac{AD}{3} = \frac{10}{3} = 3\llcorner 338\ (L - Sign\ cm)$$

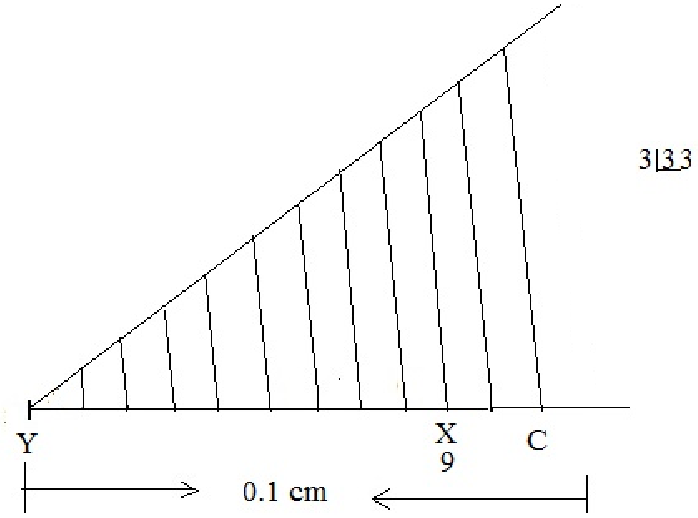
If this point is to be represented numerically by decimal method then in the form of 10/ 3=3.3333… that fixed point B will never be reached.
While by L-Sign method that point B can be reached numerically as
Step 1: In the first step, mark 3 cm in the number line.



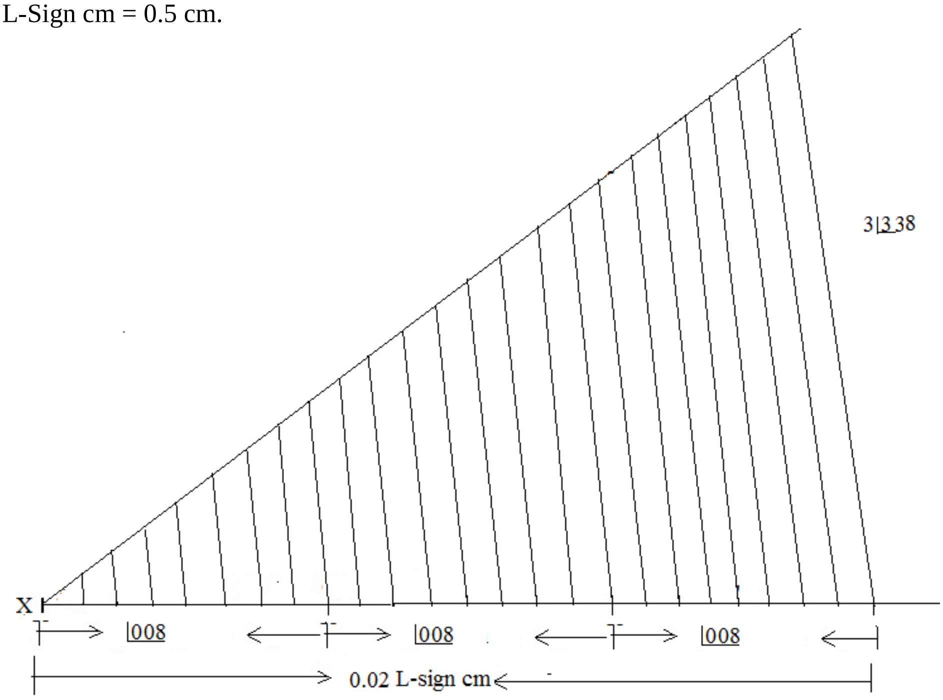
Step 2: It is seen in step one that the distance between point A and point Z in the number line is 3 cm, which has been marked.
Scale 1 cm = 10 cm



After the above procedure it is observed that the distance of ZY i.e. 0.9 cm will be divided into 3 equal parts i.e. point 0.3, 0.3, and 0.3
But the distance YC = 0.1 cm will be left again.
Step 3: Now in this step the remaining 0.1 cm i.e. YC distance is divided into 11 parts according to L-Sign method.
Scale 0.1 centimeter = 11 centimeters



It has seen that after dividing 0.1 centimeter i.e. YC into 11 equal parts, out of that 9 parts i.e. the distance from Y to X was again divided into three equal sections 0.03, 0.03, 0.03 L-Sign cm. And the distance from X to C i.e. two segments of length .01 and 0.01 L-Sign cm, will be left again
Step 4: Now the remaining 2 sections i.e. the length of XC will again be divided into 12 equal parts.
Scale- 0.01 L-Sign cm = 0.5 cm.



In the above picture the remaining 0.02 L-Sign centimeter length divided into 24 equal parts by geometry method (according to L-Sign method). Now this 24 again divided into three equal parts i.e.∟008 L-Sign cm × 3. Dividing 10 cm of all the process into 3 equal parts, the length of one part is 3∟338 L-Sign cm. Which is the fixed point B on the number line that represents this length.
That means AB =3∟338 L-Sign cm.

L-Sign number and Co L-Sign number

L-Sign number - Such rational numbers whose result of division cannot be determined by the decimal method and which can give a completely accurate result only by the L-Sign division method, are called L-Sign numbers.

Example- $\frac{10}{3}, \frac{5}{11}, \frac{10}{9}, \frac{8}{7}, \frac{50}{52}$, this and many other such numbers

Co-L-Sign number - Such rational number whose result can be obtained by both decimal and L-Sign division method.

Example-

Numbers	Decimal method	L-Sign division method
$\frac{13}{4}$	3.25	3.256
$\frac{11}{4}$	2.75	2.756
$\frac{21}{20}$	1.05	$1\llcorner 0\overline{56}$
$\frac{17}{16}$	1.0625	$1\llcorner 06\overline{11}\ 5\ \overline{10}$
$\frac{9}{8}$	1.125	$1\llcorner 129$

Convert L-Sign results to L-Sign numbers/rational numbers/fundamental numbers

Example- 10/ 3= $3\llcorner 338$

5/6 = $\llcorner 838$

I. $3\llcorner 338$ - First of all write all the digits of the number in the increasing order of the base in fractional form.

$$\frac{3}{1}+\frac{3}{10}+\frac{3}{110}+\frac{8}{1320}$$
$$\frac{3960+396+36+8}{1320}=\frac{4400}{1320}$$

After adding all the fractions in order of their base, we get 4400/1320, simplify or divide this number

$$\frac{4400}{1320}=3.3333\ldots\ldots = 3.\overline{3}=3\frac{3}{9}= \frac{30}{9}= \frac{10}{3}$$

Or,

$$\frac{4400}{1320}=\frac{10}{3}$$

II.

$$\frac{5}{6}=\llcorner 838$$
$$\frac{8}{10}+\frac{3}{110}+\frac{8}{1320}$$
$$=\frac{1056+36+8}{1320}=\frac{1100}{1320}$$
$$\frac{1100}{1320}=0.83333\ldots.\ \ 0.8\overline{3}$$
$$0.8\overline{3}= \frac{83-8}{90}=\frac{75}{90}=\frac{5}{6}$$

Or

$$\frac{1100}{1320}= \frac{5}{6}$$

III. Rules for L-Sign theorem

General rules

- The results obtained by this method will be used in place of decimals with the L symbol, such as $3\llcorner 338$, where this symbol will be the indicator of the base of the numbers coming after it, i.e. 10, 11, 12, 13 ... i.e. increasing order.
- This method will be used for numbers that do not yield 100% accurate results by dividing by the decimal system, such as 10/3, 22/7. ... These numbers are called L-Sign numbers.
- The value of some numbers or some figures can be obtained by both the sign and decimal methods like 13/4, 17/16, 21/20. .. There can be many numbers which can be called co-L-Sign numbers.
- In the results obtained by L-Sign method, due to increasing order of numbers after the L-Sign, there can be 1, 2 or more digits at the same place after the L-Sign, e.g. 5/7= $0\llcorner 716\overline{11}2$. Here at the base place of 13

there is a 2 digit number i.e. 11, in such a situation these numbers will be displayed by putting a small line above them (like$\overline{11}$).

- L-Sign number or the results obtained by this method is a derivative, which is obtained as a result of mathematical procedures of any numbers or figures.
- Any calculation or any result obtained by the L-Sign method is denoted by adding the word L-Sign with the units related to the calculation, such as L-Sign meter, L-Sign centimeter, L-Sign kilometer etc.

Operating rules of mathematical operations

Laws of Addition-

- In the sum of two or more L-Sign numbers or L-Sign results, the numbers after the L-Sign will be calculated following the basic rules of summation in increasing base order.

Example –

$$\begin{array}{rrl} & 12/7= & 1\llcorner 716\overline{11}2 \\ + & 10/3= & 3\llcorner 338 \\ \hline 12/7+10/3 = & 106/21= & 5\llcorner 052\overline{11}2 \end{array}$$

In the above example, we see from the right side, since the base number of 2 is 14, the answer will be two only. And the number of base of 13 is$\overline{11}$ and since $\overline{11}$<13, therefore $\overline{11}$ will be written as$\overline{11}$. Then 6+8 = 14, but since the base of the numbers is 12, 14 will be 2, and there will be 1 unit of 12 is carry.

After that 3+1+1(carry) =5 will be written as 5 because here the base is 11 and 5<11. Then 7+3= 10 will be written as 0 because here the base of the numbers is 10 so there will be a unit carry (10) thus the result will be $5\llcorner 052\,\overline{11}2$.

- Addition of L-Sign result to a whole number

If we add 32 and $3\llcorner 338$, we will get -

$$\begin{array}{rr} & 32\llcorner 000 \\ + & 3\llcorner 338 \\ \hline & 35\llcorner 338 \end{array}$$

Since there is nothing after the decimal or L-Sign in 32, therefore, sum will be as per rule of sum.

- Sum of L-Sign result to number with 1 digit after decimal

Example -

$$\begin{array}{rl} & 32.5 \\ + & 3\llcorner 338 \\ \hline & 35\llcorner 838 \end{array}$$

Since the base of the first digit after the (L) sign in L-Sign results is 10, the number with 1 digit after the decimal point will be calculated using the normal addition rule.

- Sum of the L-Sign result with a number with two or more digits after the decimal point.

$$\begin{array}{rl} & 5.24 \\ + & 3\llcorner 338 \end{array}$$

In this situation addition cannot be done because in both the numbers (.) and (L) there is a difference in the base of the numbers after one number, but such numbers can be added by changing the L-Sign results from (5.24).

$$\begin{array}{rl} 5.24 = 524/100 = & 5\llcorner 244\overline{10}59 \\ + & 3\llcorner 338 \\ \hline & 8\llcorner 580\,\overline{10}59 \end{array}$$

Law of subtraction

When the subtraction between two L-Sign results is taken, they will be in ascending order of numbers based on the general rule of subtraction as follows.

$$\begin{array}{rl} 106/21 = & 5\llcorner 052\overline{11}2 \\ + 10/2 = & 3\llcorner 338 \\ \hline 12/7 = & 1\llcorner 716\overline{11}2 \end{array}$$

In the above example we see from the right side, the base number of 2 is 14, and there is zero to subtract, so 2-0=2. Then $\overline{11}$ - 0 = $\overline{11}$ only because the base of $\overline{11}$ is 13 and 11<13. Again on moving to the right there are 12 base places it should be 2-8 but 2<8 so here one unit of 12 has to be "reverse carry" then 12+ 2= 14 and 14-8=6. Again going to the right we have to do 5-3, here today due to giving one unit from 5 to 1 unit it has become 5-1=4 so 4-3=1. Similarly next step is base 10 place where 0-3 is to be done it will be 10-3=7 and finally get $1\llcorner 716\overline{11}2$.
Subtract with Whole number (integer) of L-Sign results, number and with 1 digit after decimal and number with two or more digits after decimal can be converted to L-Sign result and following the order of increasing base, calculations can be done by common subtraction rule.

IV. Conclusion

In this paper, it has been clarified from various experiments and working rules that such data which do not give 100% exact actual result by decimal division method, can be obtained by dividing using L-sign method, and the result obtained is Mathematical operations can be performed with other numbers.

Apart from this, in this paper, by explaining the behavior of L-Sign Division Method in detail by number line, its various rules have been arranged, which is useful for performing mathematical operations of common numbers with L-Sign results.

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