



$\frac{3}{4}$

**13**

Decimals

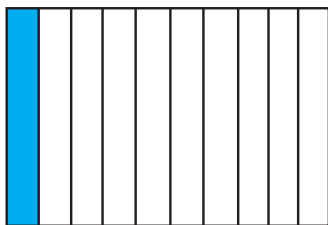
By studying this lesson, you will be able to,

- recognize decimal numbers,
- compare decimal numbers and
- add decimal numbers having two decimal places.

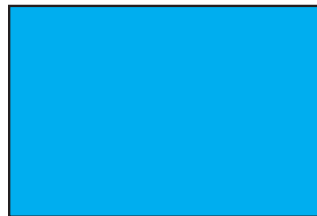
13.1 Introduction to decimals

When we divide 1 into 10 equal parts, one part is equal to $\frac{1}{10}$. We learnt this in the lesson on fractions.

Likewise, 1 is ten $\frac{1}{10}$ s.



The coloured quantity is $\frac{1}{10}$.



1 is ten $\frac{1}{10}$ s.

Another way to write $\frac{1}{10}$ is 0.1. That is, $0.1 = \frac{1}{10}$

We read 0.1 as “zero point one”.

Likewise, $\frac{2}{10}$ is two $\frac{1}{10}$ s. That is, $0.2 = \frac{2}{10}$

0.2 is read as “zero point two”.

So, $0.3 = \frac{3}{10}$, $0.4 = \frac{4}{10}$, $0.5 = \frac{5}{10}$, $0.6 = \frac{6}{10}$, $0.7 = \frac{7}{10}$, $0.8 = \frac{8}{10}$ and $0.9 = \frac{9}{10}$.



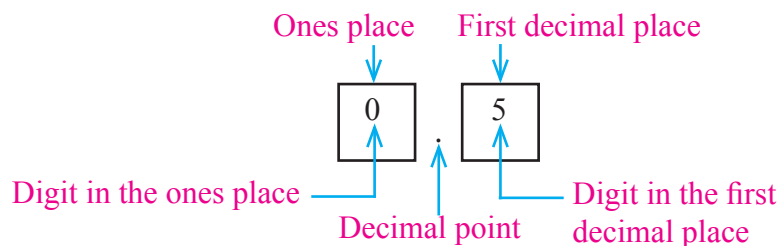
Each of the digits in a whole number occupies a place. We learnt about this in the lesson on place value.

Let us now name the places occupied by the digits in each of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9.

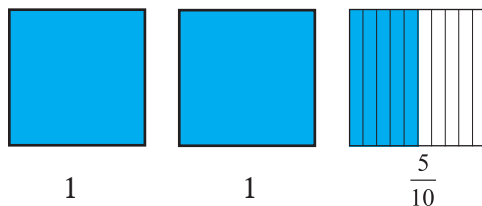
In these numbers, the place where 0 is written is the ones place. The dot that appears after 0 is called the decimal point. The place of the digit that appears soon after the decimal point is called the first decimal place. The place value corresponding to the first decimal place is $\frac{1}{10}$.

Let us consider the number 0.5.

The figure below shows the place each digit in 0.5 occupies. These places are indicated by squares.



Let us consider the number 2.5.

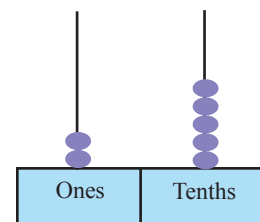


$$2.5 = \text{Two ones} + \text{Five } \frac{1}{10}\text{s}$$

$$2.5 = 2 + 0.5$$

Let us represent 2.5 using the abacus.

The ones place of 2.5 is occupied by 2. The value represented by 2 is two ones, that is, two. The first decimal place of 2.5 is occupied by 5. The value represented by 5 is five. That is $\frac{5}{10}$ or 0.5.





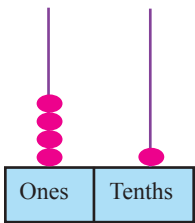
Exercises 13.1

(1) Fill in the blanks of the table below.

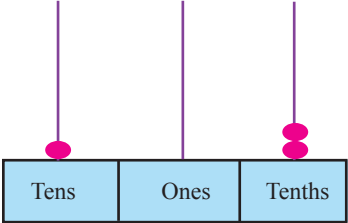
Number	In words
1.8
25.7
10.6
.....	Sixty nine point four
18.2
.....	Three hundred and ninety six point seven

(2) Write down the value represented by each abacus below.

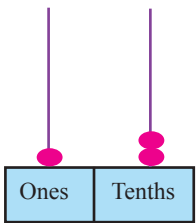
(i)



(ii)



(iii)



(3) (a) Represent each of the numbers below on an abacus.

(i) 0.7

(ii) 9.6

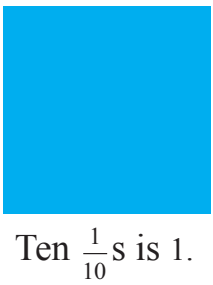
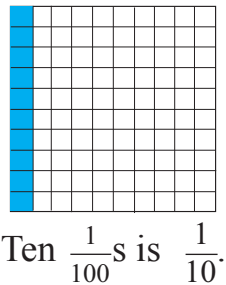
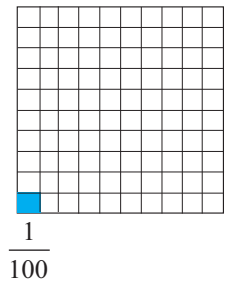
(iii) 9.9

(iv) 15.2

(b) Write down the value represented by each digit in each of the numbers given above.

13.2 More on introduction to decimals

When we divide 1 into 100 equal parts, one part is $\frac{1}{100}$. We learnt this in the lesson on fractions.





Using decimal places, $\frac{1}{100}$ is written as 0.01. That $0.01 = \frac{1}{100}$.

We read 0.01 as "**zero point zero one**".

Likewise, four $\frac{1}{100}$ s is $\frac{4}{100}$. Using decimal places $\frac{4}{100}$ is written as 0.04.

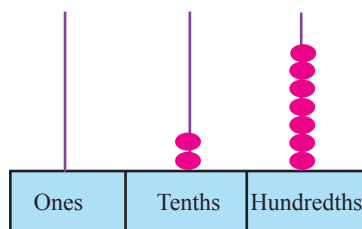
We read 0.04 as "zero point zero four".

Let us consider $\frac{27}{100}$.

$$\frac{27}{100} = \frac{20}{100} + \frac{7}{100} = \frac{2}{10} + \frac{7}{100} = \text{Two } \frac{1}{10}\text{s} + \text{Seven } \frac{1}{100}\text{s} = 0.2 + 0.07$$

Using decimal places, write $\frac{27}{100}$ as 0.27. We read 0.27 as "zero point two seven".

Let us represent 0.27 on an abacus.



Likewise, $\frac{45}{100} = 0.45$ and $\frac{67}{100} = 0.67$.

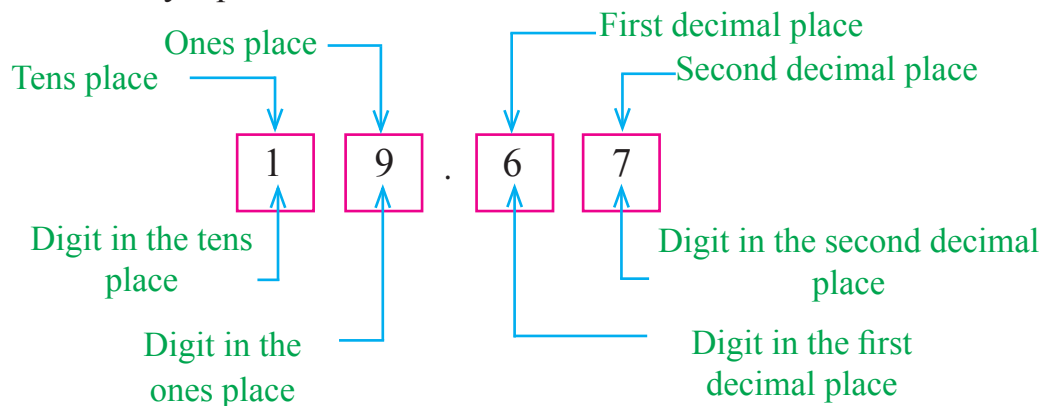
The place occupied by the digit that comes after the digit in the first decimal place is called **the second decimal place**. The **place value** corresponding to the second decimal place is $\frac{1}{100}$.



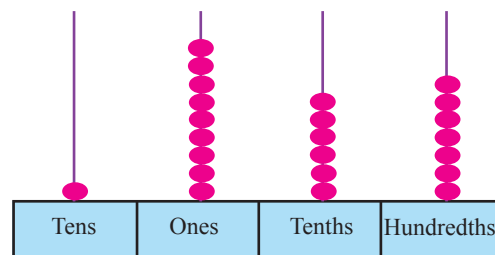
Let us find the value represented by each digit of a number with two decimal places.

Let us consider the number 19.67.

The place of each digit in the number 19.67 is shown below. These are indicated by squares.



Let us represent 19.67 on an abacus.



The place 1 appears in 19.67 is the tens place. The value represented by $1 = 10 \times 1 = 10$

The place 9 appears in 19.67 is the ones place. The value represented by $9 = 1 \times 9 = 9$

The place 6 appears in 19.67 is the first decimal place. The value represented by $6 = \text{Six } \frac{1}{10} \text{ s} = \frac{6}{10} = 0.6$

The place 7 appears in 19.67 is the second decimal place. The value represented by $7 = \text{Seven } \frac{1}{100} \text{ s} = \frac{7}{100} = 0.07$

The part of the number that appears to the left of the decimal point is called the **whole number part**. For example 19 is the whole number part of 19.67.



Example 1

Complete the following table.

Number	Digit	Name of the position of the digit	Value represented by the digit.
1.3	3	First decimal place	Three $\frac{1}{10}$ s = $\frac{3}{10}$
1.28	8	Second decimal place	Eight $\frac{1}{100}$ s = $\frac{8}{100}$
14.65	4	Ones place	4 ones = 4
25.39	9	Second decimal place	Nine $\frac{1}{100}$ s = $\frac{9}{100}$
1991.06	0	First decimal place	Zero $\frac{1}{10}$ s = 0



Activity 1

(1) Represent each of the numbers below on an abacus.

- (i) 0.21 (ii) 6.78 (iii) 9.99 (iv) 10.01 (v) 112.65

Exercise 13.2

(1) Write down each fraction below, using decimal places.

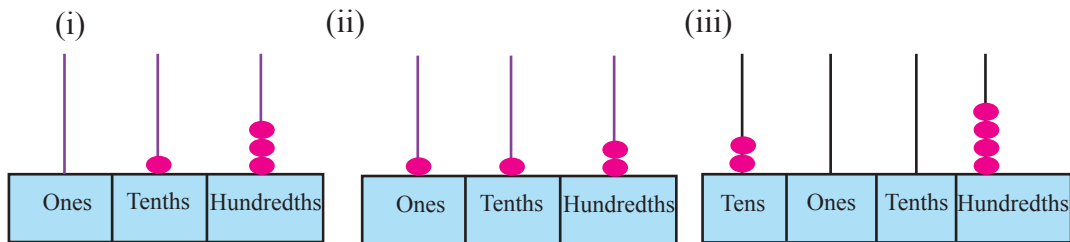
- (i) $\frac{4}{10}$ (ii) $\frac{28}{100}$ (iii) $\frac{7}{10}$ (iv) $\frac{9}{100}$ (v) $\frac{30}{100}$ (vi) $\frac{8}{10}$

(2) Write down the numbers below in words.

- (i) 0.1 (ii) 0.52 (iii) 12.7 (iv) 18.3 (v) 8.99



(3) Write down the number represented by each abacus below.



(4) The numbers below are given in words. Write them using digits.

- (i) Zero point two one
- (ii) One point one
- (iii) Hundred and two point zero two
- (iv) Seventeen point one seven
- (v) Ten point eight five

(5) Complete the following table.

Number	Digit	Name of the position of the digit	Value represented by the digit
2.73	2		
0.61	6		
21.17	7		
1.03	0		
2.0	0		
145.91	9		

13.3 Comparison of decimals

Comparison of decimals using fractions



$$\frac{1}{10} = 0.1$$



$$\frac{2}{10} = 0.2$$

We know $\frac{1}{10} < \frac{2}{10}$. We learnt this in the lesson on fractions.

That is, 0.1 is less than 0.2.



Let us now try to find the greater number from 0.7 and 0.5.

$$\frac{7}{10} = 0.7 \text{ and } \frac{5}{10} = 0.5$$

Since $\frac{7}{10} > \frac{5}{10}$, $0.7 > 0.5$.

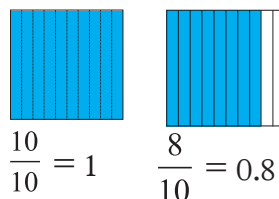
That is 0.7 is greater than 0.5.

Let us compare 1 and 0.8.

$$1 = \frac{10}{10} \text{ and } 0.8 = \frac{8}{10}$$

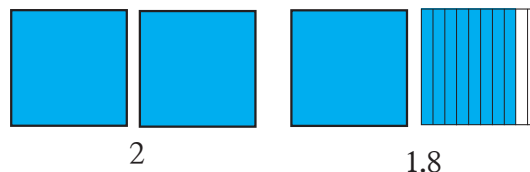
Since $\frac{10}{10} > \frac{8}{10}$, we have $1.0 > 0.8$

That is 1 is greater than 0.8.



Let us compare 2 and 1.8.

From the figure, it is clear that $2 > 1.8$.



So far we have learnt how to compare parts of ten. Let us now learn how to compare parts of hundred.

Let us compare 0.23 and 0.52.

$$0.23 = \frac{23}{100} \text{ and } 0.52 = \frac{52}{100}$$

Since $\frac{23}{100} < \frac{52}{100}$, we have $0.23 < 0.52$. That is 0.52 is greater than 0.23.

Let us compare 0.3 and 0.32.

$$0.3 = \frac{3}{10} \text{ and } 0.32 = \frac{32}{100}$$

To compare $\frac{3}{10}$ and $\frac{32}{100}$, we need to express them as fractions having the same denominator.

$$\frac{3}{10} = \frac{3 \times 10}{10 \times 10} = \frac{30}{100}$$



That is, $\frac{30}{100}$ is a fraction equivalent to $\frac{3}{10}$.

Since $\frac{30}{100} < \frac{32}{100}$, we get $0.30 < 0.32$

That is, $0.3 < 0.32$

● Another method of comparing decimals

We can compare decimals using the values of its digits.

When comparing two decimal numbers the number having the greater whole number part, is the greater number of the two. If both numbers have the same whole number part, then we need to compare the digits in their decimal places.

Then the number having the greater digit in the first decimal place is the greater number of the two. If both numbers have the same digit in the first decimal place, then we need to compare the digits in the second decimal place. Then the number having the greater digit in the second decimal place is the greater number of the two.

Example 1

Write down the numbers 4.15, 3.76 and 3.52 in ascending order.

Of these three numbers, the number with the greatest whole number part is 4.15. Therefore the greatest number out of the given three numbers is 4.15.

The whole number parts of both 3.76 and 3.52 are the same. So let us compare the digits in the first decimal place.

In 3.76 the digit in the first decimal place is 7. In 3.52 the digit in the first decimal place is 5. Since $7 > 5$, we have $3.76 > 3.52$.

Therefore the above numbers written in ascending order is 3.52, 3.76, 4.15.



Example 2

Find the greater number from 8.76 and 8.72.

The whole number parts of both 8.76 and 8.72 are the same. The digit in the first decimal place of both numbers is 7. So let us compare the digit in the second decimal place.

In 8.76, the digit in the second decimal place is 6. In 8.72, the digit in the second decimal place is 2. Since $6 > 2$, we have $8.76 > 8.72$. Therefore, the greater number is 8.76.

Example 3

Write down the numbers 0.3, 0.33 and 0.03 in ascending order.

Since $0.3 = 0.30$, let us consider 0.30, 0.33 and 0.03.

- The whole number parts of all these numbers are equal.
- The number with the smallest digit in the first decimal place is 0.03, and therefore, it is the smallest.
- The digit in the first decimal place of 0.33 and 0.30 is the same. Of these two, 0.33 is the one with the greater digit in the second decimal place.

Therefore, $0.33 > 0.3$

- Therefore, 0.03, 0.30, 0.33 are in ascending order.

Exercise 13.3

(1) Out of each pair of numbers below, write down the greater number.

- | | | |
|--------------------|-------------------|---------------------|
| (i) 0.1 and 0.5 | (ii) 0.06 and 0.6 | (iii) 2.35 and 2.53 |
| (iv) 3.05 and 3.51 | (v) 7.1 and 7.09 | (vi) 2.58 and 5.21 |

(2) For each pair of decimals below, fill in the blank using one of the symbols $<$, $>$ or $=$.

- | | | |
|----------------------|---------------------|-----------------------|
| (i) 0.05 0.50 | (ii) 0.7 0.70 | (iii) 2.81 3.18 |
| (iv) 4.04 4.40 | (v) 1.2 1.20 | (vi) 2.85 2.82 |



(3) Arrange the numbers below in ascending order.

(i) 0.25, 0.5, 0.52, 2.05

(ii) 2.35, 3.78, 1.23, 4.35

(iii) 0.04, 4, 4.04, 0.44


(iv) 1.31, 1.33, 3.13, 3.03


13.4 Adding decimal numbers

Let us add 0.3 and 0.2.



This figure represents one unit divided into 10 equal parts.

 represents $\frac{1}{10}$, that is 0.1.

 represents $\frac{2}{10}$, that is 0.2 and

 represents $\frac{3}{10}$, that is 0.3.

Therefore,



$$\frac{2}{10} + \frac{3}{10} = \frac{5}{10}$$

$$0.2 + 0.3 = 0.5$$

0.2 and 0.3 can be added in the following way.

$$\begin{array}{r} 0.2 \\ + 0.3 \\ \hline 0.5 \end{array}$$

As shown, the two numbers are written in such a way that the digits corresponding to each place are aligned in the same column and the decimal points are also aligned in one column. Once the two numbers are written down in this manner, we can add the digits in the same place separately.



Find the sum,
$$\begin{array}{r} 2.57 \\ + 1.68 \\ \hline \hline \end{array}$$

Let us explain this addition using the following steps.

Ones	Tenths	Hundredths
2	5	7
+	1	6
		8
		5
		15

Step 1 - Let us add the $\frac{1}{100}$ s.

$$7 + 8 = 15.$$

Fifteen $\frac{1}{100}$ s is $\frac{10}{100} + \frac{5}{100}$.

That is, one $\frac{1}{10}$ s and five $\frac{1}{100}$ s

Let us represent the five $\frac{1}{100}$ s in the second decimal place by the digit 5 and take one $\frac{1}{10}$ s to the first decimal place.

Ones	Tenths	Hundredths
12	5	7
+	1	6
		8
	2	5
	12	

Step 2 - Let us add the $\frac{1}{10}$ s.

$$1 + 5 + 6 = 12$$

Twelve $\frac{1}{10}$ s is 1 ones and two $\frac{1}{10}$ s.

Let us represent the two $\frac{1}{10}$ s in the first decimal place by the digit 2 and take one 1 to the ones place.

Ones	Tenths	Hundredths
12	5	7
+	1	6
		8
4	2	5
12	15	

Step 3 -

Let us write the decimal point of the result such that all the decimal points are in the same column. Let us add the digits in the ones place.

$$1 + 2 + 1 = 4$$

That is, four ones.

Let us write 4 in the ones place.

Therefore, the answer is 4.25.



Let us add 5.7 to 2.53.

Let us add the numbers by writing them with the digits corresponding to each place aligned in the same column. Since there is a digit in the second decimal place of 2.53, we write 5.7 as 5.70 in the addition.

$$\begin{array}{r} 5.70 \\ + 2.53 \\ \hline 8.23 \end{array}$$

Exercise 13.4

(1) Find the value.

(i)	(ii)	(iii)	(iv)	(v)
$\begin{array}{r} 0.1 \\ + 0.3 \\ \hline \end{array}$	$\begin{array}{r} 0.71 \\ + 0.23 \\ \hline \end{array}$	$\begin{array}{r} 2.71 \\ + 5.16 \\ \hline \end{array}$	$\begin{array}{r} 5.32 \\ + 1.83 \\ \hline \end{array}$	$\begin{array}{r} 2.7 \\ + 3.85 \\ \hline \end{array}$
(vi)	(vii)	(viii)	(ix)	(x)
$\begin{array}{r} 1.8 \\ + 0.2 \\ \hline \end{array}$	$\begin{array}{r} 18.35 \\ + 35.26 \\ \hline \end{array}$	$\begin{array}{r} 1.28 \\ + 3.84 \\ \hline \end{array}$	$\begin{array}{r} 3.88 \\ + 9.52 \\ \hline \end{array}$	$\begin{array}{r} 5.96 \\ + 4.04 \\ \hline \end{array}$

(2) The electricity consumption of a household in the first two weeks of last month was 45.7 units. The electricity consumption in the last two weeks was 50.3 units. What is the total electricity consumption during the last month?

13.5 Subtraction of decimals

Let us find the value of $0.7 - 0.3$.

$\begin{array}{r} 0.7 \\ - 0.3 \\ \hline 0.4 \end{array}$ Subtracting is done by writing the digits in the ones place in one column, the decimal points in one column and the digits in the first decimal place in one column.



Find the value of $3.65 - 1.98$.

Let us explain this subtraction using the following steps.

	Ones	Tenths	Hundredths
	3	⁵ 6	¹⁵ 5
–	1	9	8
			7

Step 1 - Let us subtract the $\frac{1}{100}$ s.

5 is less than 8.

Let us bring one $\frac{1}{10}$ s to the second decimal place.

Then, there are five $\frac{1}{10}$ s remaining in the first decimal place.

One $\frac{1}{10}$ s is ten $\frac{1}{100}$ s.

$10+5=15$. That is, there are fifteen $\frac{1}{100}$ s in the second decimal place now.

When eight $\frac{1}{100}$ s are subtracted from fifteen $\frac{1}{100}$ s, there are seven $\frac{1}{100}$ s remaining.

Let us represent the seven $\frac{1}{100}$ s in the second decimal place by the digit 7.

	Ones	Tenths	Hundredths
	3	⁸ 6	¹⁵ 5
–	1	9	8
		6	7

Step 2 - Let us subtract the $\frac{1}{10}$ s.

5 is less than 9.

Let us bring one unit from the three units in the ones place to the first decimal place. One unit is ten $\frac{1}{10}$ s

Then there are fifteen $\frac{1}{10}$ s.

When nine $\frac{1}{10}$ s are subtracted from fifteen $\frac{1}{10}$ s there are six $\frac{1}{10}$ s remaining.

Let us represent the six $\frac{1}{10}$ s in the first decimal place by the digit 6.

 $\frac{3}{4}$ 

	Ones	Tenths	Hundredths
	² 3	⁸ 6	¹⁵ 5
–	1	9	8
	1	6	7

Step 3 -

Let us write the decimal point of the result such that all the decimal points are in the same column.
Let us subtract the ones.

$$2 - 1 = 1$$

That is, one ones.

Let us write 1 in the ones place.

Then the answer is 1.67.

Example 1

Find the value of $12.7 - 8.53$.

12.70	Let us write the digits of a particular place in the same column and subtract. When 12.7 is written as 12.70 the number of decimal places in both numbers is the same.
– 8.53	
<u>4.17</u>	
<u><u>4.17</u></u>	

Exercise 13.5

(1) Find the value.

(i)	(ii)	(iii)	(iv)	(v)
0.9	3.6	2.3	8.39	2.85
– 0.5	– 2.5	– 1.7	– 2.21	– 1.08
<u><u> </u></u>	<u><u> </u></u>	<u><u> </u></u>	<u><u> </u></u>	<u><u> </u></u>

(vi)	(vii)	(viii)	(ix)	(x)
15.08	15.08	7.22	80.01	2.08
– 1.79	– 0.84	– 5.34	– 19.99	– 1.99
<u><u> </u></u>	<u><u> </u></u>	<u><u> </u></u>	<u><u> </u></u>	<u><u> </u></u>



- (2) Nimal and Sunil inherited 0.75 of the total land owned by their father. If Nimal inherited 0.48 of the total land, how much of the land did Sunil inherit?
- (3) A reservoir was filled to 0.7 of its total capacity. 0.15 of its total capacity was used to produce electricity. Of the total capacity, how much water is now left in the reservoir?

Summary

- In a decimal number, the place occupied by the digit that appears just after the decimal point is the first decimal place.
- The place occupied by the digit that appears just after the first decimal place is the second decimal place.
- Decimal numbers can be compared either by writing them as fractions or by comparing the values of the digits in the corresponding places of the two numbers.
- When adding and subtracting decimals, the mathematical operation should be performed by considering for each number, the value represented by the digit in each of the places of the number.