

# 8

## Decimals



Decimals are another way of writing part of a whole number. In a place value table on moving a digit from the right to the left by one place, its place value becomes ten times. Similarly, on moving a digit from the left to the right by one place, its place value becomes one tenth.

### Decimal fractions

A decimal fraction is a fraction whose denominator is 10 or 100 or 1000 etc.

Thus,  $\frac{1}{10}$ ,  $\frac{17}{100}$ ,  $\frac{37}{1000}$  are all decimal fractions. There is another special way of writing such fractions.

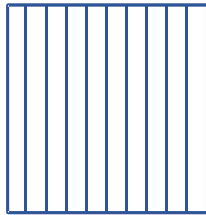


**Do You  
Remember ?**

★ The 'dec' in decimal means ten.

### Tenths

The fraction  $\frac{1}{10}$  names the number one-tenth. If we divide a square into ten equal parts, then each part of the square represents one-tenth. Besides writing as  $\frac{1}{10}$ , one-tenth can also be written as 10%.



One tenth or  $\frac{1}{10}$  or 0.1

The dot written immediately to the right of units place is called the decimal point.

The number written in decimal form are called decimal numbers or simply decimals.

### Hundredths

The number one hundredth can be named by the decimal fraction 0.01. The digit 1 in the hundredths place shows one hundredth and 0 in the tenths place shows 0 tenths. 10 hundredths means 1 tenths and so is written as 0.10.

You know that

$$\frac{46}{100} = \frac{40+6}{100} = \frac{40}{100} + \frac{6}{100} = \frac{4}{10} + \frac{6}{100}$$

Think of  $\frac{46}{100}$  as 4 tenth 6 hundredths

The decimal number for 4 tenths is 0.4

The decimal number for 6 hundredths is 0.06

The decimal number for 4 tenths 6 hundredths or 46 hundredth is 0.46

$$\frac{46}{100} = \frac{4}{10} + \frac{6}{100} = 0.4 + 0.06 = 0.46$$



What is the decimal numbers for :

(i)  $\frac{35}{100}$     (ii)  $\frac{396}{100}$     (iii)  $\frac{4990}{100}$

### Thousandths

The decimal number for one thousandth is 0.001. The digit 1 is in the thousandth place shows one thousandth, 0 in the tenth place shows 0 tenths, 0 in the hundredth place shows 0 hundredths. Similarly, 5 thousandths will be written as 0.005.

$$\frac{29}{1000} = \frac{20+9}{1000} = \frac{20}{1000} + \frac{9}{1000} = \frac{0}{10} + \frac{2}{100} + \frac{9}{1000}$$

Think of  $\frac{29}{1000}$  as 0 tenth, 2 hundredths and 9 thousandths and written as 0.029.

$$\text{Similarly, } \frac{250}{1000} = \frac{200+50+6}{1000} = \frac{200}{1000} + \frac{50}{1000} + \frac{6}{1000} = \frac{2}{10} + \frac{5}{100} + \frac{6}{1000}$$

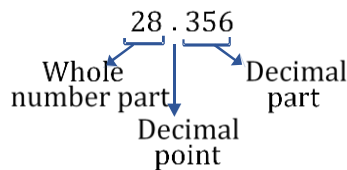
$\frac{256}{1000}$  means 2 tenths, 5 hundredths and 6 thousandths and written as 0.256.

- (i) Any number of zeros may be put to the extreme right of the decimal part of a decimal.

$$\text{Eg. } 0.75 = \frac{75}{100} = \frac{75 \times 10}{100 \times 10} = \frac{750}{1000} = 0.750.$$

Hence, numbers 0.75, 0.750, 0.7500, 0.75000 are called equivalent decimals.

- (ii) A decimal like 28.356 has two parts-whole number part and decimal part. These parts are separated by a dot called the decimal point. The whole number part to the left of the decimal point and the decimal part is to its right.



- (iii) The number of

digits contained in the decimal part of a decimal gives the number of its decimal places.

Eg. the number 7.987 has three decimal places, 8.6252 has four decimal places.

- (iv) Decimals having the same number of decimal places are called like decimals.  
(v) Decimals having different number of decimal places are called unlike decimals.



### Do You Remember ?

- ★ Every fraction is a decimal.



### Building Concepts

1

Write each of the following as decimals:

- (i) Seven-tenths  
(ii) Two tens and nine - tenths  
(iii) One hundred and two ones

**Explanation**

(i)  $\frac{7}{10} = 0.7$

(ii)  $20 + \frac{9}{10} = 20.9$

(iii)  $100 + 2 = 102.0$



The number of digits contained in the decimal part of a decimal is called the number of its decimal places.

SPOT LIGHT

Write the following in decimal forms:

(i)  $\frac{125}{100}$

(ii)  $\frac{15}{10}$

(iii)  $\frac{315625}{1000}$

**Solution**

(i)  $\frac{125}{100} = 1.25$

(ii)  $\frac{15}{10} = 1.5$

(iii)  $\frac{315625}{1000} = 315.625$



- ★ The fractional part in a **decimal** number is usually written to the right of the **decimal point**.

**Place value**

The following chart shows the place value of each digit in 3675.476:

Digit place value	Value of the digit
3 Thousands	3000
6 Hundreds	600
7 Tens	70
5 Ones	5
4 Tenths	$\frac{4}{10}$
7 Hundredths	$\frac{7}{100}$
6 Thousandths	$\frac{6}{1000}$



**Building  
Concepts**

2

Write the following in the standard form as decimals. Also write them in words in both the ways.

(i)  $4000 + 700 + 30 + 0 + \frac{4}{10} + \frac{9}{100} + \frac{0}{1000}$

(ii)  $46000 + 900 + 40 + 6 + \frac{3}{10} + \frac{6}{100} + \frac{5}{1000}$

(iii)  $900 + 0 + 5 + \frac{1}{10} + \frac{0}{100} + \frac{0}{1000} + \frac{8}{10000}$

**Explanation**

(i)  $4000 + 700 + 30 + 0 + \frac{4}{10} + \frac{9}{100} + \frac{0}{1000}$

$= 4730.490$

In words :- Four thousand seven hundred thirty point four nine zero.

or

Four thousand seven hundred thirty and four hundred ninety thousandths.

(ii)  $46000 + 900 + 40 + 6 + \frac{3}{10} + \frac{6}{100} + \frac{5}{1000}$

$= 46946.365$

In words:- Forty six thousand nine hundred forty six point three six five.

or

Forty six thousand nine hundred forty six and three hundred sixty five thousandths.

(iii)  $900 + 0 + 5 + \frac{1}{10} + \frac{0}{100} + \frac{0}{1000} + \frac{8}{10000}$

$= 905.1008$

In words:- Nine hundred five point one zero zero eight.

or

Nine hundred five and one thousand eight ten thousandths.



**Numerical  
Ability**

2

Write the following in decimal notation and expanded form.

(i) **Thirty-three hundredths**

(ii) **Five hundred eighty -three thousandths**

**Solution**

(i) Thirty - three hundredths  $= \frac{33}{100} = 0.33$

Expanded form  $= \frac{3}{10} + \frac{3}{100}$

(ii) Five hundred eighty - three thousandths  $= \frac{583}{1000} = 0.583$

Expanded form  $= \frac{5}{10} + \frac{8}{100} + \frac{3}{1000}$

**Be Alert !**

Some common mistakes to avoid.

★  $0.35 \neq \frac{35}{10}$ ;  $0.35 = \frac{35}{100}$

**Check your Answers****1**

(i) 0.35

(ii) 3.96

(iii) 49.9

**Check your Concepts****2**

Write the following in decimal notation and expanded form:

1. Thirty-seven hundred and forty-eight hundredths.
2. Two hundred sixteen point one one one two.
3. Twenty-eight and seventeen ten thousandths.
4. Seventy-one hundred and twelve thousandths.

**Comparison of Decimals**

While comparing two decimal numbers:

- (i) The decimal fraction with the greater integral part will be greater.
- (ii) If the integral part of two decimal fractions are the same, then beginning from the tenth place, the decimal fraction with the greater digit in the same place is greater.

**Building Concepts****3**

- (i) Which decimal fraction is greater?  
0.293 or 0.027
- (ii) Which decimal fraction is smaller?  
7.692 or 7.648
- (iii) Arrange 448.7, 4.4487, 4.4587, 4.444 and 44.87 in descending order.

**Explanation**

- (i) The integral parts of both numbers are 0. Let us now compare the digit in the tenths place. The digits in the tenths place are 2 and 0.  
As  $2 > 0$   
 $\therefore 0.293 > 0.027$ .
- (ii) The integral part of both the numbers are 7. Again, the digit in the tenths places are equal.  
Now, compare the digits in the hundredths place. The digits are 9 and 4.  
As  $9 > 4$   
 $\therefore 7.692 > 7.648$ .



In the decimal numeration system, the place value of a digit is decreased ten times from left to right ( $\rightarrow$ ) and is increased ten times from right to left ( $\leftarrow$ ).

**SPOT LIGHT**

- (iii) First write the decimals in a place-value chart. The greatest integral part is 448, followed by 44, after which there are three decimals with the same integral part. Here, 4.444 is the smallest decimal. Moving left to right after decimal point, we find  $4.444 < 4.4487 < 4.4587$ . Thus,  
 $448.7 > 44.87 > 4.4587 > 4.4487 > 4.444$



**In each of the following pairs of decimal numbers, state which number is greater.**

**(i) 539.2, 97.654**

**(ii) 238.587, 238.589**

**Solution**

- (i) The whole number part of 539.2 is 539 and that of 97.654 is 97.  
 Since,  $539 > 97$ , so  $539.2 > 97.654$
- (ii) In the two numbers  
 (a) Whole number parts are equal.  
 (b) In both numbers, digit at the tenths place is 5.  
 (c) In both numbers, digit at the hundredths place is 8.  
 (d) We compare the thousandths digits.  
 Since,  $7 < 9$ , so  $238.587 < 238.589$



**Write the decimal numbers 3.05, 3.5, 4.8, 3.079, 6 in order of size starting with the largest.**

**Solution**

The numbers starting with the largest are:

6 ← Put the largest whole number first

4.8

3.5 ← Put the largest 'tenth' first

3.079 ← Put the largest 'hundredth' first

3.05

$6 > 4.8 > 3.5 > 3.079 > 3.05$  largest to smallest.

**Conversion of decimal fractions to fractions**

To convert a decimal fraction into a fraction, follow the steps given below.

**Step-1 :** Count the number of decimal places in the decimal fraction.

**Step-2 :** Ignore the decimal point. Write all the digits as the numerator of the fraction.

**Step-3 :** Write as many zeroes after 1 in the denominator, as there were decimal places in the decimal fraction.

**Step-4 :** Reduce the fraction to its simplest form.



### Building Concepts

4

Convert the following into a fraction.

- (i) 7.258                      (ii) 94.62

### Explanation

- (i) Decimal fraction = 7.258

Decimal places = 3

Thus numerator = 7258

Denominator = 1000

$$\text{Fraction} = \frac{7258}{1000} = \frac{3629}{500}$$

- (ii) Decimal fraction = 94.62

Decimal places = 2

Thus numerator = 9462

Denominator = 100

$$\text{Fraction} = \frac{9462}{100} = \frac{4731}{50}$$



### Do You Remember ?

- ★ Some decimal expansions go on forever. For example,  $\frac{1}{3} = 0.333\dots$ , where the '...' means that the 3's never end.

### Conversion by long division method

**Step-1 :** Convert the dividend to a suitable equivalent decimal.

**Step-2 :** When the digit to the right of decimal point is brought down, a decimal point is to be placed in the quotient.



### Numerical Ability

5

Convert the following

- (i)  $\frac{8}{25}$                       (ii)  $13\frac{13}{40}$  into a decimal fraction.



### Solution

- (i) 8 unit = 800 hundredths or  $8 = 8.00$

$$\begin{array}{r}
 .32 \\
 25 \overline{) 8.00} \leftarrow 8 \text{ wholes} \\
 \underline{- 0} \\
 80 \leftarrow 80 \text{ tenths} \\
 \underline{- 75} \\
 50 \leftarrow 50 \text{ hundredths} \\
 \underline{- 50} \\
 0
 \end{array}$$



The number of digits in the decimal part of a decimal fraction is referred to as the number of decimal places.

SPOT LIGHT

$$\therefore \frac{8}{25} = 0.32$$

- (ii)  $13\frac{13}{40} = \frac{533}{40}$

$$\begin{array}{r}
 40 \overline{) 533} \leftarrow 13.325 \\
 \underline{- 40} \\
 133 \\
 \underline{- 120} \\
 130 \\
 \underline{- 120} \\
 100 \\
 \underline{- 80} \\
 200 \\
 \underline{- 200} \\
 0
 \end{array}$$

### Addition of decimals

While adding two or more decimals, follow the steps given below.

**Step-1 :** Convert the decimal fractions into like decimal fractions.

**Step-2 :** Arrange the decimal fractions vertically with all the digits in the correct place according to the place value of the digits in the decimal fraction. This will result the decimal points of all the decimal fractions to fall in one vertical line. Then add as the case may be.



Add the following:

(i) 0.9999, 9.999, 99.9, 999.99

(ii) 278.9, 4516.57, 18.7264, 7.76

(iii) 14.79, 0.798, 39.599, 10.7

**Explanation**

000.9999	0278.9	14.79
009.999	4516.57	00.798
(i) 099.9	(ii) 0018.7264	(iii) 39.599
+999.99	+0007.76	+10.7
1110.8889	4821.9564	65.887



**Find the sum in each of the following:**

**(i)  $7.283 + 592.732$**

**(ii)  $15 + 0.632 + 13.8$**

**Solution**

$$\begin{array}{r} 7.283 \\ +592.732 \\ \hline 600.015 \end{array}$$

$$\begin{array}{r} 15.000 \\ 0.632 \\ +13.800 \\ \hline 29.432 \end{array}$$



**Find the sum of**

**(i)  $0.71$  and  $0.86$**

**(ii)  $15.1, 315.23, 53.036$**

**Solution**

$$\begin{array}{r} 0.71 \\ +0.86 \\ \hline 1.57 \end{array}$$

$$\begin{array}{r} 15.100 \\ 315.230 \\ +53.036 \\ \hline 383.366 \end{array}$$



★  $14.89 + 10.01 \neq 14.81$ ;  $14.89 + 10.01 = 24.90$

**Subtraction of decimals**

While subtracting two or more decimals, follow the steps given below.

**Step-1 :** Convert the decimal fractions into like decimal fractions.

**Step-2 :** Arrange the decimal fractions vertically with all the digits in the correct place according to the place value of the digits in the decimal fraction. This will result the decimal points of all the decimal fractions to fall in one vertical line. Then subtract, as the case may be.

**Building Concepts** **6**

Subtract the following

- (i)  $67.46 - 43.21$   
 (ii)  $600.431 - 100.00$   
 (iii)  $117.462 - 19.364$

**Explanation**

$$\begin{array}{r} 67.46 \\ -43.21 \\ \hline 24.25 \end{array} \quad \begin{array}{r} 600.431 \\ -100.00 \\ \hline 500.431 \end{array} \quad \begin{array}{r} 117.462 \\ -19.364 \\ \hline 98.098 \end{array}$$

**Numerical Ability** **8**

- (i) **Subtract:**  $483.742 - 48.732$   
 (ii) **Solve:**  $7.983 + 4.6429 - 5.7893$

**Solution**

$$\begin{array}{r} 483.742 \\ -48.732 \\ \hline 435.010 \end{array}$$

$$\begin{array}{r} 7.983 + 4.6429 - 5.7893 \\ \text{First add} \quad \begin{array}{r} 7.9830 \\ +4.6429 \\ \hline 12.6259 \end{array} \\ \text{Now subtract} \quad \begin{array}{r} 12.6259 \\ -5.7893 \\ \hline 6.8366 \end{array} \end{array}$$

**Numerical Ability** **9**

- Subtract:** (i)  $49.497$  from  $637.652$       (ii)  $78.34$  from  $95.2$

**Solution**

$$\begin{array}{r} 637.652 \\ -49.497 \\ \hline 588.155 \end{array}$$

$$\begin{array}{r} 95.20 \\ -78.34 \\ \hline 16.86 \end{array}$$

**Quick Tips**

- ★ While doing **subtraction** the smaller number is written under the bigger number.
- ★ While doing addition and subtraction, the numbers are written in such a way that the decimals are in the same vertical line.

The weight of the baby is 3.509 kg. This means that the baby weighs 3 kg, 500g, and 9 mg.

SPOT LIGHT

**Conversion of units**

Rs. 1 = 100 paise

1 Paise = Rs.  $\frac{1}{100}$ 

1 Km = 1000 m

1 m =  $\frac{1}{1000}$  Km

10 mm (millimeters) = 1 cm (centimeter)

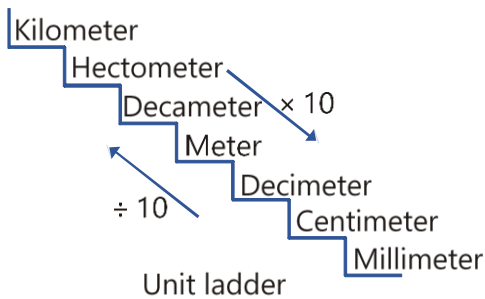
10 centimeters (cm) = 1 decimeter (dm)

10 decimeters (dm) = 1 meter (m) = 100 cm = 1000 mm

10 meters (m) = 1 decameter (dam)

10 decameters (dam) = 1 hectometer (hm) = 100 m

10 hectometer = 1 Kilometer (Km) = 1000 m



10 decimeters = 1 meter

1 decimeter =  $\frac{1}{10}$  of a meter or 0.1 meter

1000 milligrams = 1 gram

1000 grams = 1 Kilogram

1 Milligram =  $\frac{1}{1000}$  of a gram1 gram =  $\frac{1}{1000}$  Kilogram

1000 millilitres (ml) = 1 litre (l)

1 ml =  $\frac{1}{1000}$  litre = 0.001 l**Express :****(i) 8 paise and Rs.15.36 in Rs.****(ii) 1033 m – 428 cm in meter****(iii) 778 g + 1.939 kg in kg****(iv) 4169 g – 0.798 kg in kg**

**Explanation**

- (i) 8 Paise and Rs. 15.36 =  $8 + 15.36 \times 100$   
 $(\because 100 \text{ Paise} = 1 \text{ Rupee})$   
 $= 8 + 1536 = 1544 \text{ Paise}$   
 or  $\frac{1544}{100} = \text{Rs. } 15.44$
- (ii)  $1033 \text{ m} - 428 \text{ cm}$   
 $= 1033 \text{ m} - \frac{428}{100} \text{ m}$   
 $(\because 1 \text{ m} = 100 \text{ cm})$   
 $= 1033 \text{ m} - 4.28 \text{ m} = (1033.00 - 4.28) \text{ m}$   
 $= 1028.72 \text{ m}$
- (iii)  $778 \text{ g} + 1.939 \text{ kg}$   
 $= \frac{778}{1000} \text{ kg} + 1.939 \text{ kg} = 0.778 \text{ kg} + 1.939 \text{ kg}$   
 $= 2.717 \text{ kg}$
- (iv)  $4169 \text{ g} - 0.798 \text{ kg} = \frac{4169}{1000} \text{ kg} - 0.798 \text{ kg}$   
 $= 4.169 \text{ kg} - 0.798 \text{ kg}$   
 $= 3.371 \text{ kg}$



**Express as rupees using decimals.**

- (i) 5 paise                      (ii) 75 paise

**Solution**

We know that there are 100 paise in 1 rupee.

- (i)  $5 \text{ paise} = \frac{5}{100} \text{ rupees} = \text{Rs. } 0.05$
- (ii)  $75 \text{ paise} = \frac{75}{100} \text{ rupees} = \text{Rs. } 0.75$



**Express as meters using decimals.**

- (i) 15 cm                      (ii) 2 m 45 cm

**Solution**

$1 \text{ m} = 100 \text{ cm}$

- (i)  $15 \text{ cm} = \frac{15}{100} \text{ m} = 0.15 \text{ m}$
- (ii)  $2 \text{ m } 45 \text{ cm} = \left( 2 + \frac{45}{100} \right) \text{ m} = 2.45 \text{ m}$



### Quick Tips

★  $1 \text{ km} = 1000\text{m} = 100000 \text{ cm}$



### Check your Answers

2

$$1. \quad 3700 \frac{48}{100} = 3700.48 = 3 \times 1000 + 7 \times 100 + \frac{4}{10} + \frac{8}{100}$$

$$2. \quad 216.1112 = 2 \times 100 + 1 \times 10 + 6 + \frac{1}{10} + \frac{1}{100} + \frac{1}{1000} + \frac{2}{10000}$$

$$3. \quad 28 \frac{17}{10000} = 28.0017 = 2 \times 10 + 8 + \frac{1}{1000} + \frac{7}{10000}$$

$$4. \quad 7100 \frac{12}{1000} = 7100.012 = 7 \times 1000 + 1 \times 100 + \frac{1}{100} + \frac{2}{1000}$$



### Check your Concepts

3

Convert the followings in meters.

(i) 50 decameters

(ii) 10 hectometers

(iii) 49 decimeters

(iv) 62 centimeters

### Word Problems

When you get a word problem that involves adding or subtracting decimals, it's usually a good idea to rewrite all the numbers with the same number of decimal places, so you don't get confused.

### KEYWORDS AND PHRASES

Addition	Subtraction
Sum	Difference
Added to	Minus
Increased by	Decreased by
Total	Less
All together	Less than
More than	
Combine	



**Rani had Rs 18.50. She bought one ice-cream for Rs. 11.75. How much money does she have now?**

**Explanation**

Money with Rani = Rs. 18.50

Money spent for an ice cream = Rs. 11.75

The money left with Rani will be the difference of these two.

Hence, the money left is Rs 6.75

$$\begin{array}{r} 18.50 \\ -11.75 \\ \hline 6.75 \end{array}$$



**By how much does the sum of 34.07 and 15.239 exceeds the sum of 16.40 and 27.08?**

**Solution**

Sum of 34.07 and 15.239

$$= 34.070 + 15.239 = 49.309$$

$$\text{and sum of } 16.40 \text{ and } 27.08 = 16.40 + 27.08 = 43.48$$

∴ difference between their sums

$$= 49.309 - 43.48 = 49.309 - 43.480 = 5.829$$



**Amit bought a Maths book for Rs. 45.60 and a geometry box for Rs. 62.55. What is the total amount spent by Amit?**

**Solution**

Money spent on Maths book = Rs. 45.60

Money spent on Geometry box = Rs. 62.55

∴ Total amount spent = Rs. 45.60 + Rs. 62.55 = Rs. 108.15

$$\begin{array}{r} 45.60 \\ + 62.55 \\ \hline 108.15 \end{array}$$



**Priya travelled 8 km 95 m in the first hour, 6 km 298 m in the second hour and 7 km 9 m in the third hour. Find the total distance travelled by her in three hours.**

**Solution**

Distance travelled in first hour = 8 km 95 m = 8.095 km

Distance travelled in second hour = 6 km 298 m = 6.298 km

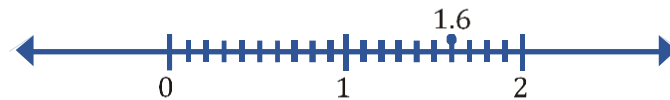
Distance travelled in third hour = 7 km 9 m = 7.009 km

∴ Total distance travelled in 3 hours = 8.095 km + 6.298 km + 7.009 km = 21.402 km

$$\begin{array}{r} 8.095 \\ 6.298 \\ + 7.009 \\ \hline 21.402 \end{array}$$

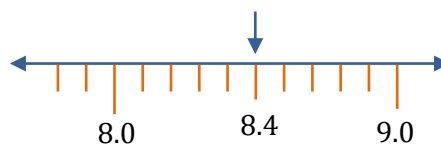
## Number line

Draw number line and divide the distance between any two divisions in 10 equal parts as shown below:

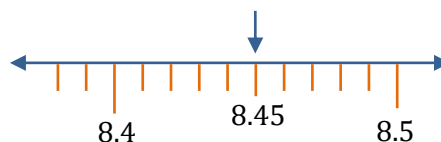


Let us locate a point corresponding to 1.6 on the number line. We know that 1.6 is more than 1 and less than 2. There is one complete whole number and six tenths in it. From 0, we move one complete step towards right and then six small parts towards right and shade the point which represent 1.6.

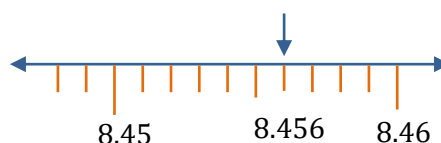
To represent a decimal on a number line, divide each segment of the number line into ten equal parts. E.g. To represent 8.4 on a number line, divide the segment between 8 and 9 into ten equal parts.



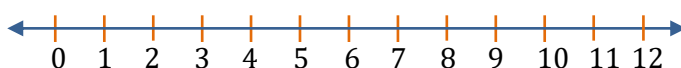
The arrow is four parts to the right of 8 where it points at 8.4. Likewise, to represent 8.45 on a number line, divide the segment between 8.4 and 8.5 into ten equal parts.



The arrow is five parts to the right of 8.4 where it points at 8.45. Similarly, we can represent 8.456 on a number line by dividing the segment between 8.45 and 8.46 into ten equal parts.



**Between which two whole numbers on the number line do the given numbers lie?  
Which of these whole numbers is nearer the number?**



(i) 0.8

(ii) 5.1

(iii) 2.6



### Explanation

- (i) 0.8 exists between 0 and 1, and is nearer to 1.
- (ii) 5.1 exists between 5 and 6, and is nearer to 5.
- (iii) 2.6 exists between 2 and 3, and is nearer to 3.



**Numerical**

Ability

15



All decimals can be represented on the number line.

SPOT LIGHT

Show the following numbers on the number line.

(i) 0.2

(ii) 1.9

### Solution

- (i) Since space between 0 and 1 is divided into 10 equal parts therefore, each part is equal to one - tenth. Now, 0.2 is the second point between 0 and 1



- (ii) Since space between 1 and 2 is divided into 10 equal parts therefore, each part is equal to one - tenth. Now, 1.9 is the ninth point between 1 and 2



Check your  
**Answers**

3

(i) 500 m

(ii) 1000 m

(iii) 4.9 m

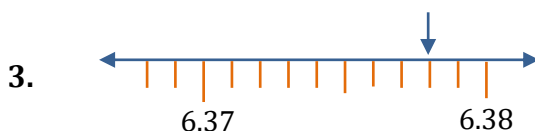
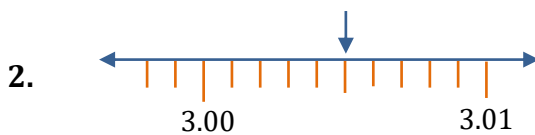
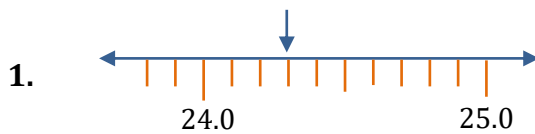
(iv) 0.62 m



Check your  
**Concepts**

4

Write the decimal number that the arrow points at in the following diagrams:



Check your  
**Answers**

4

1. 24.3

2. 3.005

3. 6.378

## MEMORY MAP

