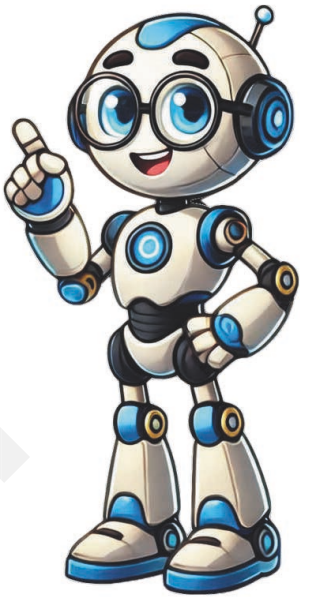
2
Chapter

Fractions and Decimals

We'll cover the following key points:

- → Types of fractions
- → Addition of fractions
- → Subtraction of fractions
- → Multiplication of fractions
- → Division of fractions
- → Decimals
- → Whole number and decimals
- → Expanded form of decimal
- → Addition and subtraction of decimal
- → Multiplication and division of decimals



Hi, I'm EeeBee

Do you Remember fundamental concept in previous class.

In class 5th we learnt

- → Multiplication of Decimals
- → Division of a Decimal by another Decimal

Still curious? Talk to me by scanning the QR code.

Learning Outcomes

By the end of this chapter, students will be able to:

- Define and identify fractions and decimals and distinguish them from other types of numbers, including whole numbers and integers.
- Represent fractions and decimals on a number line accurately and understand their relative positions.
- Convert between fractions and decimals, including converting terminating and repeating decimals into fractions and vice versa.
- Simplify fractions to their simplest form by finding and dividing both the numerator and denominator by their greatest common divisor (GCD).
- Perform operations (addition, subtraction, multiplication, and division) on fractions, including finding common denominators for addition and subtraction and applying appropriate methods for multiplication and division.
- Perform operations (addition, subtraction, multiplication, and division) on decimals, including aligning the decimal points and applying place value concepts in operations.

Mind Map

FRACTION AND DECIMALS

Multiplication of fractions

i. Multiplication of fraction by a whole number

e.g., $\frac{3}{5} \times 15 = 9$

ii. Fraction as an operator 'of'

e.g., $\frac{1}{2}$ of $6 = \frac{1}{2} \times 6 = 3$

iii. Multiplication of a fraction by a fraction

$$\frac{\text{Numerator} \times \text{Numerator}}{\text{Denominator} \times \text{Denominator}}$$

e.g., $\frac{6}{7} \times \frac{14}{3} = \frac{4}{1} = 4$

Division of fractions

i. Division of whole number by a fraction

e.g., $3 \div \frac{1}{2} = 3 \times \frac{2}{1} = \frac{6}{1}$

ii. Reciprocal of a fraction

$\frac{3}{5} \xrightarrow{\text{reciprocal}} \frac{5}{3}$

iii. Division of fraction by a whole number

e.g., $\frac{12}{5} \div 3 = \frac{12}{5} \times \frac{1}{3} = \frac{4}{5}$

iv. Division of a fraction by another fraction

e.g., $\frac{35}{8} \div \frac{7}{2} = \frac{35}{8} \times \frac{2}{7} = \frac{5}{4}$

Multiplication of decimal numbers

Multiplication of decimal numbers by 10, 100 and 1000

- $0.2 \times 6 = 1.2$
- $20.1 \times 4 = 80.4$
- $1.3 \times 10 = 13$
- $24.63 \times 100 = 2463$
- $1.0378 \times 1000 = 1037.8$

Division of Decimal Numbers

i. Division of Decimals by Decimals →

- $\frac{9.5}{1.9} = 5$
- $\frac{1.44}{1.2} = 1.2$

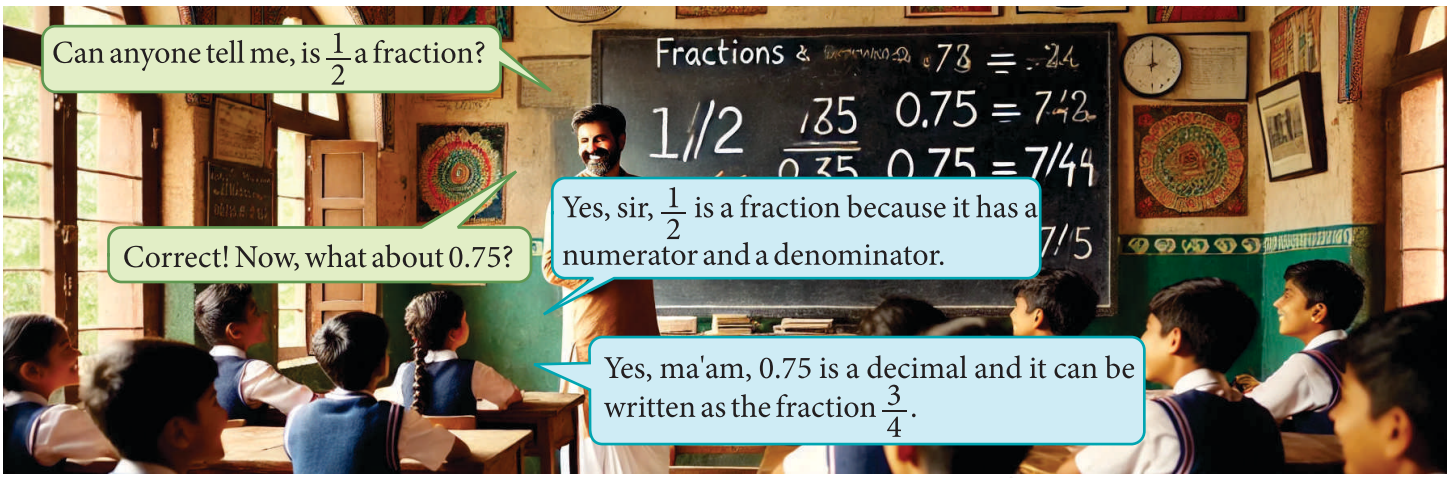
ii. Division by 10, 100 and 1000

e.g.,

- $\frac{31.5}{10} = 3.15$
- $\frac{31.5}{100} = 0.315$
- $\frac{31.5}{1000} = 0.0315$

Based on NCERT*

Introduction

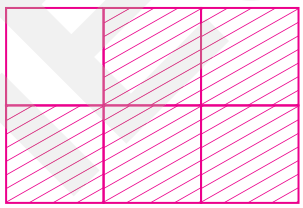


We have learnt about fractions in earlier classes. Its study is very useful when we have to divide some things in equal parts. Consider you ordered a pizza at home. Suddenly six more friends come at right time to get share in the same pizza. So, what you generally do is you divide the pizza in seven equal parts without doing any calculations.

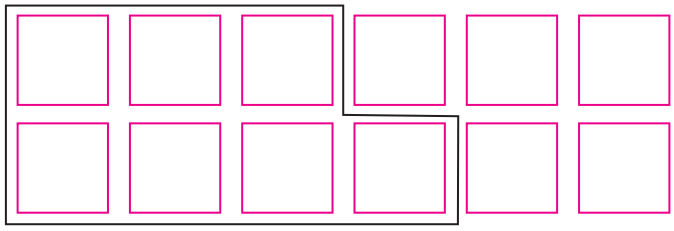
It is the real life situation where the fractions are useful. Let us read some technical things about fractions. Let's start with the things we read in earlier classes.

A fraction is a number representing part of a whole. The whole may be a single object or a group of objects. Fractions can be represented by block diagrams as follows:

This is 1 or whole



This is one-sixth or $\frac{1}{6}$ parts of a whole.



This is seven-twelfth or $\frac{7}{12}$ of a group.

A fraction is expressed as a number of the form $\frac{p}{q}$, where p and q are whole numbers and $q \neq 0$. Here, p is the numerator and q is the denominator of the fraction $\frac{p}{q}$.

For Example :

$\frac{2}{7}$ is a fraction whose numerator is 2 and denominator is 7.

$\frac{9}{5}$ is a fraction whose numerator is 9 and denominator is 5.

Check Your Progress

Experiential Learning

1. Write a fraction for each of the following and also show it with block diagram:
   (*i*) One-fifth (*ii*) Five-seventh (*iii*) Two-eleventh (*iv*) Four-ninth
2. I ate 7 out of 62 oranges. What fraction of oranges are left?
3. Try to pronounce the following mixed fractions:
   (*i*) $4\frac{7}{9}$ (*ii*) $5\frac{8}{15}$ (*iii*) $2\frac{3}{10}$ (*iv*) $11\frac{2}{9}$

Types of Fractions

Let us study about different types of fractions.

Proper Fraction : A proper fraction is a fraction whose numerator is less than its denominator.

For example : $\frac{3}{4}, \frac{6}{7}, \frac{12}{25}$ are all proper fractions.

Improper Fraction : An improper fraction is a fraction whose numerator is more than or equal to its denominator.

For example : $\frac{23}{17}, \frac{15}{14}, \frac{11}{9}$ are all improper fractions.

Mixed Fraction : A fraction when expressed as a combination of a natural number and a proper fraction is called a mixed fraction.

For example : $3\frac{2}{5}, 4\frac{3}{7}, 2\frac{1}{9}$ are all mixed fractions.

Pronunciation of a mixed fraction

A mixed fraction like $2\frac{3}{8}$ is pronounced as two and three-eighth.

Example 1: Convert each of the following into an improper fraction .

(*I*) $5\frac{2}{7}$ (*ii*) $3\frac{7}{8}$

Solution : (*i*) $5\frac{2}{7} = \frac{5\times 7+2}{7} = \frac{37}{7}$ (*ii*) $3\frac{7}{8} = \frac{3\times 8+7}{8} = \frac{31}{8}$

Example 2: Convert each of the following into a mixed fraction:

(*I*) $\frac{19}{8}$ (*ii*) $\frac{111}{13}$

Solution : (*i*) $\frac{19}{8} = 2\frac{3}{8}$

$$\begin{array}{r} 2 \\ 8\overline{)\,19} \\ -\,16 \\ \hline 3 \end{array}$$

(*ii*) $\frac{111}{13} = 8\frac{7}{13}$

$$\begin{array}{r} 8 \\ 13\overline{)\,111} \\ -\,104 \\ \hline 7 \end{array}$$

Decimal Fraction : A decimal fraction is a fraction whose denominator is any of the numbers 10, 100, 1000, etc.

For example : $\frac{2}{10}, \frac{35}{100}, \frac{39}{1000}$ are all decimal fractions.

Vulgar Fraction : A vulgar fraction is a fraction whose denominator is a natural number other than 10, 100, 1000, etc.

For example : $\frac{2}{9}, \frac{15}{29}, \frac{27}{50}, \frac{81}{193}$.

Equivalent Fractions : Two or more fractions which represent the same part of a whole are called equivalent fractions. Equivalent fractions can be obtained by multiplying or dividing both the numerator and the denominator of a fraction by the same non-zero number.

For example :

1. $\frac{3\times2}{5\times2} = \frac{6}{10}$, $\frac{3\times3}{5\times3} = \frac{9}{15}$, $\frac{3\times4}{5\times4} = \frac{12}{20}$ Thus, $\frac{6}{10}, \frac{9}{15}, \frac{12}{20}$ are equivalent fractions of $\frac{3}{5}$.
2. $\frac{18}{24} = \frac{18\div6}{24\div6} = \frac{3}{4}$, $\frac{15}{20} = \frac{15\div5}{20\div5} = \frac{3}{4}$, Thus $\frac{18}{24}$ and $\frac{15}{20}$ are equivalent fraction of $\frac{3}{4}$.

Check Your Progress

Experiential Learning

Select the correct answer .

1. Which of the following is an improper fraction?
   (*i*) $\frac{4}{5}$ (*ii*) $2\frac{5}{7}$ (*iii*) $\frac{11}{9}$ (*iv*) $\frac{1}{2}$
2. Which of the following are like fractions ?
   (*i*) $\frac{3}{9}, \frac{7}{11}$ (*ii*) $\frac{2}{7}, \frac{4}{7}$ (*iii*) $\frac{3}{2}, \frac{5}{7}$ (*iv*) $3\frac{1}{5}, 2\frac{1}{9}$

Like Fractions : The fractions having the same denominator but different numerators are called like fractions.

For example : $\frac{3}{22}, \frac{7}{22}, \frac{9}{22}, \frac{17}{22}$ are like fractions.

Unlike Fractions : The fractions having different denominators are called unlike fractions.

For example : $\frac{3}{7}, \frac{9}{13}, \frac{27}{35}, \frac{31}{34}, \frac{49}{55}$ are unlike fractions.

Conversion of unlike fractions into like fractions

Unlike fractions can be converted into like fractions by doing the following steps:

Working Rules

Step 1 : Find the LCM of the denominators of the given fractions.

Step 2 : Convert each of the given fractions into an equivalent fraction with denominator equal to the LCM of the denominators of the given fractions.

The conversion of unlike fractions into like fractions is useful when these have to be added or subtracted.

Example 3 : Convert $\frac{2}{7}, \frac{9}{14}, \frac{11}{35}$ into like fractions.

Solution : The LCM of 7, 14 and 35 is 70.

$$\frac{2}{7} = \frac{2\times10}{7\times10} = \frac{20}{70}, \frac{9}{14} = \frac{9\times5}{14\times5} = \frac{45}{70}, \text{ and } \frac{11}{35} = \frac{11\times2}{35\times2} = \frac{22}{70}$$

Thus, $\frac{20}{70}, \frac{45}{70}$ and $\frac{22}{70}$ are like fractions.

Simplest Form of a Fraction

A fraction is said to be in the simplest (or lowest) form if its numerator and denominator have no common factor other than 1.

Example 4 : Reduce $\frac{128}{160}$ to its simplest form.

Solution : The first step is to find the HCF of 128 and 160

$$128 = 2\times2\times2\times2\times2\times2\times2$$

$$160 = 2\times2\times2\times2\times2\times5$$

Thus, HCF (128, 160) $= 2\times2\times2\times2\times2 = 32$

Thus, the simplest form of $\frac{128}{160} = \frac{128 \div 32}{160 \div 32} = \frac{4}{5}$

Comparison of Fractions

Fractions having the same numerators but different denominators

When two fractions have the same numerator but different denominators, then the fraction having smaller denominator is the greater of the two.

For example : 1. $\frac{5}{6} > \frac{5}{7}$ 2. $\frac{14}{19} > \frac{14}{21}$

Fractions having the same denominator but different numerators

When fractions have the same denominator but different numerators, then the fraction having greater numerator is the greater of the two.

For example : 1. $\frac{4}{7} > \frac{3}{7}$ 2. $\frac{2}{15} < \frac{7}{15}$

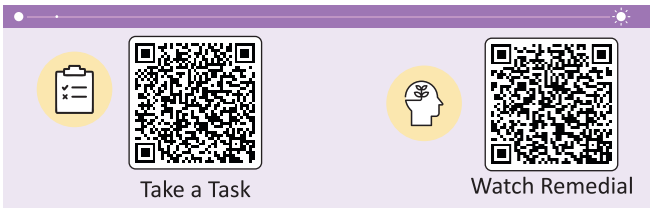
Fractions having unequal numerators and unequal denominators.

1. When fractions have unequal numerators and unequal denominators , we have to make, their denominators equal. It can be done in two ways.

   (*i*) By equalising the denominator by multiplying the denominator of other fraction in numerator and denominator of other fraction. This can be applied when we are comparing two fractions.

   For example : $\frac{2}{5}$ and $\frac{7}{8}$

   $\frac{2}{5} \times \frac{8}{8} = \frac{16}{40}$, $\frac{7}{8} \times \frac{5}{5} = \frac{35}{40}$

   On comparing the numerator of new fractions obtained, we can find which one is greater . In the given example $\frac{16}{40} < \frac{35}{40}$ i.e. $\frac{2}{5} < \frac{7}{8}$.

   (*ii*) By taking the L.C.M. and then multiplying a number to numerator and denominator to make the denominator equal to L.C.M. Then on comparing the numerators, we can find out which one is greater. This method is used to compare any number of fractions.

Example 5 : Arrange $\frac{11}{28}, \frac{7}{10}, \frac{1}{5}, \frac{3}{7}$ in ascending order.

Solution : $\therefore$ L.C.M. of 28, 10, 5 and $7 = 2 \times 7 \times 5 \times 2 = 140$

2	28, 10, 5, 7
7	14, 5, 5, 7
5	2, 5, 5, 1
2	2, 1, 1, 1
	1, 1, 1, 1

Now $\frac{11}{28} = \frac{11 \times 5}{28 \times 5} = \frac{55}{140}$

$\frac{7}{10} = \frac{7 \times 14}{10 \times 14} = \frac{98}{140}$

$\frac{1}{5} = \frac{1 \times 28}{5 \times 28} = \frac{28}{140}$, $\frac{3}{7} = \frac{3 \times 20}{7 \times 20} = \frac{60}{140}$

Since $28 < 55 < 60 < 98$

Therefore, we have $\frac{28}{140} < \frac{55}{140} < \frac{60}{140} < \frac{98}{140}$, i.e. $\frac{1}{5} < \frac{11}{28} < \frac{3}{7} < \frac{7}{10}$

Thus, the given fractions in ascending order are $\frac{1}{5} < \frac{11}{28} < \frac{3}{7} < \frac{7}{10}$

Exercise 2.1

1. Express as directed:

(*i*) $\frac{17}{5}$ a fraction as with denominator 25 (*ii*) $7\frac{5}{14}$ as an improper fraction

(*iii*) $\frac{20}{6}$ as a mixed fraction (*iv*) $\frac{9}{5}$ as a fraction with numerator 54

2. Compare the following fractions:

(*i*) $\frac{4}{11}, \frac{2}{13}$ (*ii*) $\frac{5}{8}, \frac{15}{18}$ (*iii*) $\frac{11}{13}, \frac{13}{14}$ (*iv*) $\frac{55}{71}, \frac{45}{47}$

3. Arrange the following fractions in ascending order:

(*I*) $\frac{4}{5}, \frac{7}{15}, \frac{3}{10}, \frac{1}{2}$ (*ii*) $1\frac{2}{5}, 2\frac{1}{4}, 1\frac{1}{2}, 2\frac{1}{3}$

4. Arrange the following fractions in descending order:

(*i*) $\frac{4}{7}, \frac{8}{5}, \frac{3}{35}, \frac{5}{28}$ (*ii*) $2\frac{3}{5}, 2\frac{7}{18}, 3\frac{5}{6}, 2\frac{1}{3}$ (*iii*) $\frac{5}{8}, \frac{3}{5}, \frac{7}{12}, \frac{8}{15}$ (*iv*) $\frac{4}{5}, \frac{7}{9}, \frac{3}{20}, \frac{23}{45}$

Operations on Fractions

There are four kinds of mathematical operations that can be done on fractions.

Addition of Fractions

For addition of two fractions, we have to follow these steps :

1. Express each fraction with the positive denominator.
2. If the denominators of the fraction are same, add their numerators and divide by the common denominator.
3. If the denominators of the fractions are different, then express them as equivalent fraction with the same denominator.

   Then add their numerators and divide by the common denominator of the equivalent fraction.
4. Change the result into standard form, if it is required.

Case I : When rational numbers have the same denominators.

Example 6 : Add $\frac{5}{7}$ and $\frac{7}{7}$.

Solution : $\frac{5}{7} + \frac{7}{7} = \frac{5+7}{7} = \frac{12}{7}$

Example 7 : Add $\frac{3}{8}$ and $\frac{15}{8}$.

Solution : $\frac{3}{8} + \frac{15}{8} = \frac{3+15}{8}$

$= \frac{18}{8} = \frac{9}{4}$

Case II : When one denominator is a multiple of the other denominator.

Example 8 : Add $\frac{7}{26}$ and $\frac{5}{13}$.

Solution : $\frac{7}{26} + \frac{5}{13} = \frac{7}{26} + \frac{5 \times 2}{13 \times 2}$ (26 is a multiple of 13)

$= \frac{7}{26} + \frac{10}{26} = \frac{7+10}{26} = \frac{17}{26}$

Case III : When the denominators are co-primes.

Example 9 : Find the sum of $\frac{1}{7}$ and $\frac{1}{5}$.

Solution : $\frac{1}{7} + \frac{1}{5} = \frac{1 \times 5}{7 \times 5} + \frac{1 \times 7}{5 \times 7}$ (L.C.M. of 7 and 5 = 35)

$= \frac{5}{35} + \frac{7}{35} = \frac{5+7}{35} = \frac{12}{35}$

Case IV : When denominators have a common factor.

Example 10 : Find $\frac{5}{14}+\frac{8}{21}$.

Solution : L.C.M. of 14 and 21 is 42.

$$\frac{5}{14}=\frac{5\times3}{14\times3}=\frac{15}{42}\ ,\ \frac{8}{21}=\frac{8\times2}{21\times2}=\frac{16}{42}$$

Now, $$\frac{5}{14}+\frac{8}{21}=\frac{15}{42}+\frac{16}{42}=\frac{15+16}{42}=\frac{31}{42}$$

Subtraction of Fractions

For subtracting the factions we have to follow same steps as described in addition. The only difference is the minus sign.

Case I : When the fractions have same denominator.

To find the difference of two like fractions, subtract the smaller numerator from the greater numerator. Write the number obtained as the numerator of the required fraction. Retain the common denominator.

$$\text{Difference of two like fractions} = \frac{\text{Greater numerator} - \text{Smaller numerator}}{\text{Common denominator}}$$

Example 11: Subtract $\frac{5}{11}$ from $\frac{7}{11}$.

Solution : $\frac{7}{11}-\frac{5}{11}=\frac{7-5}{11}=\frac{2}{11}$

Example 12 : Subtract $\frac{7}{15}$ from $\frac{8}{15}$.

Solution : $\frac{8}{15}-\frac{7}{15}=\frac{8-7}{15}=\frac{1}{15}$

Case II : When the fractions have unequal denominators.

To subtract a fraction from another unlike fraction, first convert both of them into equivalent like fractions and then subtract.

Example 13 : Find the difference between $\frac{9}{11}$ and $\frac{4}{15}$.

Solution: The L.C.M. of 11 and 15 = 165.

$$\therefore\ \frac{9}{11}=\frac{9\times15}{11\times15}=\frac{135}{165}\ \text{and}\ \frac{4}{15}=\frac{4\times11}{15\times11}=\frac{44}{165}$$

$$\therefore\ \frac{9}{11}-\frac{4}{15}=\frac{135}{165}-\frac{44}{165}=\frac{135-44}{165}=\frac{91}{165}$$

Shortcut method:

$$\frac{9}{11}-\frac{4}{15}=\frac{9\times15-4\times11}{165}$$

$$=\frac{135-44}{165}=\frac{91}{165}$$

Example 14 : Sunita completed a job in $\frac{3}{5}$ hour where Sanjana completed the same job in $\frac{7}{10}$ hour. Who worked longer and by what fraction? **Problem Solving**

Solution : We need to compare $\frac{3}{5}$ and $\frac{7}{10}$ to find who worked longer changing them into like fraction, we get $\frac{3}{5} \times \frac{10}{10} = \frac{30}{50}$ and $\frac{7}{10} \times \frac{5}{5} = \frac{35}{50}$

$\therefore \quad \frac{30}{50} < \frac{35}{50}$ or $\frac{3}{5} < \frac{7}{10}$

Thus, Sanjana worked longer.

Difference between $\frac{7}{10}$ and $\frac{3}{5} = \frac{7}{10} - \frac{3}{5} = \frac{(7 \times 1) - (3 \times 2)}{10} = \frac{1}{10}$

Hence, Sanjana worked longer and she took $\frac{1}{10}$ hour more time than Sunita.

Example15 : What should be added to $2\frac{4}{5}$ to get $5\frac{2}{3}$?

Solution : Let x be added to $2\frac{4}{5}$ to get $5\frac{2}{3}$.

Then, $2\frac{4}{5} + x = 5\frac{2}{3}$

$\Rightarrow \quad \frac{14}{5} + x = \frac{17}{3}$

$\Rightarrow \quad x = \frac{17}{3} - \frac{14}{5}$

$\Rightarrow \quad = \frac{17 \times 5 - 14 \times 3}{15} = \frac{85 - 42}{15} = \frac{43}{15} = 2\frac{13}{15}$

Hence, the required number to be added is $2\frac{13}{15}$.

Exercise 2.2

1. Find the sum of the following fractions:

(*i*) $\frac{2}{27} + \frac{5}{27}$ (*ii*) $\frac{5}{9} + \frac{3}{7}$ (*iii*) $\frac{5}{12} + \frac{1}{6}$

(*iv*) $\frac{9}{26} + \frac{7}{13} + \frac{11}{39}$ (*v*) $2 + 5\frac{1}{5}$ (*vi*) $21\frac{1}{4} + 3\frac{1}{3} + 10\frac{1}{2}$

2. Find the difference of the following fractions:

(*i*) $\frac{4}{7} - \frac{8}{35}$ (*ii*) $\frac{15}{11} - \frac{7}{11}$ (*iii*) $\frac{2}{15} - \frac{1}{20}$ (*iv*) $\frac{3}{5} - \frac{4}{7}$

(*v*) $3\frac{1}{2} - 2\frac{1}{5}$ (*vi*) $3 - 2\frac{1}{3}$ (*vii*) $8\frac{5}{9} - 7\frac{7}{15}$ (*viii*) $3\frac{5}{9} - 2\frac{2}{7}$

3. Simplify the following expressions:

(*i*) $\frac{1}{36} - \frac{2}{9} + \frac{5}{12}$ (*ii*) $8\frac{11}{16} - 4\frac{1}{4} - 3\frac{2}{3}$ (*iii*) $2\frac{1}{4} + \frac{7}{8} - 1\frac{1}{2}$ (*iv*) $4\frac{2}{3} - 3\frac{1}{4} + 2\frac{1}{6}$

4. A piece of rope 40 *m* long is cut into three pieces. If the length of two pieces is $7\frac{1}{2}$ *m* and $8\frac{1}{5}$ *m* respectively, then find the length of the third piece.

5. Sunita bought $2\frac{1}{2}$ kg of mangoes and $5\frac{1}{3}$ kg of watermelon. What is the total weight of fruits purchased by her?

6. Tanay spends $\frac{2}{7}$ of his leisure time reading storybooks and $\frac{3}{14}$ playing football and rest of the time watching TV. Find the fraction of his leisure time spent watching TV.

HOTS (Higher Order Thinking Skills)

Experiential Learning

1. What should be added to $2\frac{2}{5}$ to get $3\frac{8}{15}$?
2. What should be subtracted from $7\frac{3}{8}$ to get $3\frac{7}{20}$?
3. Four bottles of milk contain $3\frac{1}{4}$ L, 5 L, $7\frac{1}{2}$ L, and $5\frac{1}{3}$ L of milk respectively. These bottles are emptied in an empty can. How much milk is there in the can?

Multiplication of Fractions

Case I : Multiplication of a Fraction By a Whole Number.

1. To multiply a proper or an improper fraction by a whole number, multiply the numerator of the fraction by the whole number, keeping the denominator same.
2. To multiply a mixed fraction by a whole number, first convert the mixed fraction into an improper fraction and then multiply.

For example : (*i*) $\frac{5}{6} \times 8 = \frac{5}{\cancel{6}_{3}} \times \cancel{8}^{4} = \frac{20}{3} = 6\frac{2}{3}$ (*ii*) $\frac{3}{5} \times 4 = \frac{3 \times 4}{5} = \frac{12}{5} = 2\frac{2}{5}$

(*iii*) $\frac{11}{7} \times 6 = \frac{11 \times 6}{7} = \frac{66}{7} = 9\frac{3}{7}$

Case II : Multiplication of a Fraction By a Fraction.

To multiply a fraction by another fraction, multiply corresponding numerators and denominators. That is,

$$\text{Product of fractions} = \frac{\text{Product of numerators}}{\text{Product of denominators}}$$

For example : 1. $\frac{3}{8} \times \frac{3}{5} = \frac{3 \times 3}{8 \times 5} = \frac{9}{40}$ 2. $\frac{5}{2} \times \frac{7}{3} = \frac{5 \times 7}{2 \times 3} = \frac{35}{6} = 5\frac{5}{6}$

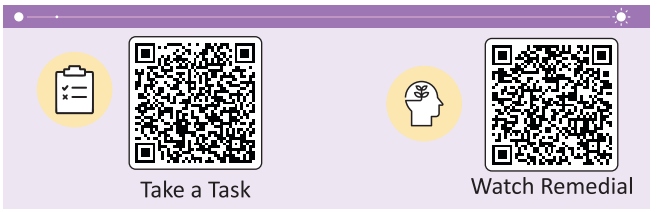
Fraction as an operator 'of'

In the figure given alongside, two shaded portions of $\frac{1}{2}$ have been combined and the result is one fully shaded part.

So, 2 of $\frac{1}{2}$ means 1. Also, $2 \times \frac{1}{2} = \frac{2 \times 1}{2} = 1$

$\therefore$ 2 of $\frac{1}{2} = 2 \times \frac{1}{2} = 1$

Thus, we see that 'of' represents multiplication.



Example 16 : Find the product of : (*i*) $\frac{4}{5}$ by $\frac{2}{9}$ (*ii*) $11\frac{1}{7} \times 2\frac{1}{2}$ (*iii*) $\frac{12}{11} \times 9$ (*iv*) $5\frac{3}{4} \times 12$

Solution : (*i*) $\frac{4}{5} \times \frac{2}{9} = \frac{8}{45}$ (*ii*) $11\frac{1}{7} \times 2\frac{1}{2} = \frac{\cancel{78}^{39}}{7} \times \frac{5}{\cancel{2}_{1}} = \frac{39 \times 5}{7 \times 1} = \frac{195}{7} = 27\frac{6}{7}$

(*iii*) $\frac{12}{11} \times 9 = \frac{12 \times 9}{11} = \frac{108}{11} = 9\frac{9}{11}$ (*iv*) $5\frac{3}{4} \times 12 = \frac{23}{\cancel{4}_{1}} \times \cancel{12}^{3} = 23 \times 3 = 69$

Example 17 : Simplify the following expressions:

$(i)\ \frac{12}{15}\times\frac{16}{24}\times\frac{30}{60}\times\frac{1}{2}$ $(ii)\ 1\frac{1}{2}\times3\frac{1}{3}\times\frac{3}{4}\times2$

Solution : $(i)\ \frac{12}{15}\times\frac{16}{24}\times\frac{30}{60}\times\frac{1}{2}=\frac{\cancel{12}^{1}\times\cancel{16}^{\cancel{8}\,\cancel{4}\,2}\times\cancel{30}^{1}\times1}{15\times\cancel{24}_{\cancel{2}}\times\cancel{60}_{\cancel{2}}\times\cancel{2}}=\frac{2}{15}$

$(ii)\ 1\frac{1}{2}\times3\frac{1}{3}\times\frac{3}{4}\times2=\frac{3}{2}\times\frac{10}{3}\times\frac{3}{4}\times2=\frac{\cancel{3}\times\cancel{10}^{5}\times3\times\cancel{2}}{2\times\cancel{3}\times\cancel{4}_{\cancel{2}}}=\frac{5\times3}{2}=\frac{15}{2}=7\frac{1}{2}$

Example 18 : Find: $(i)\ \frac{1}{2}$ of 94 $(ii)\ \frac{4}{5}$ of 75

Solution : $(i)\ \frac{1}{2}$ of $94=\frac{1}{2}\times94=\frac{1\times\cancel{94}^{47}}{2}=47$

$(ii)\ \frac{4}{5}$ of $75=\frac{4}{5}\times75=\frac{4\times\cancel{75}^{15}}{\cancel{5}_{1}}=4\times15=60$

Check Your Progress

Experiential Learning

1. Find the product of $\frac{36}{25}$ and $\frac{20}{45}$.
2. Simplify : $\frac{12}{15}\times\frac{25}{16}\times\frac{18}{12}$.
3. Sonal had $\frac{2}{3}$ of a cake and she ate $\frac{3}{5}$ of it. How much cake is left ?

Example 19 : Find the following fractions:

$(i)\ \frac{5}{8}$ of ₹32 $(ii)\ \frac{3}{4}$ of a year. $(iii)\ \frac{4}{9}$ of 360°

Solution : $(i)\ \frac{5}{8}$ of $₹32=\frac{5}{8}\times₹32=₹\left(\frac{5}{8}\times32\right)=₹\left(\frac{5\times\cancel{32}^{4}}{\cancel{8}_{1}}\right)=₹(5\times4)=₹20$

$(ii)\ \frac{3}{4}$ of a year $=\frac{3}{4}$ of 12 months $=\left(\frac{3}{4}\times12\right)$ months $=\left(\frac{3\times\cancel{12}^{3}}{\cancel{4}_{1}}\right)$ months

$=(3\times3)$ months $=9$ months

$(iii)\ \frac{4}{9}$ of $360°=\left(\frac{4}{9}\times360°\right)=\left(\frac{4\times\cancel{360}^{40}}{\cancel{9}_{1}}\right)^{\circ}=(4\times40)°=160°$

Example 20 : A car runs 18 km using 1 litre of diesel. How much distance will it cover using $4\frac{4}{9}$ litres of diesel ?

Solution: Distance covered by the car using 1 litres of diesel = 18 km

$\therefore$ Distance covered by the car using $4\frac{4}{9}$ litres of diesel = $\left(18 \times 4\frac{4}{9}\right)$ km

$= \left(18 \times \frac{40}{9}\right)$ km $= \left(\frac{\cancel{18}^{2} \times 40}{\cancel{9}_{1}}\right)$ km $= (2 \times 40)$km $= 80$ km.

Reciprocal of a Fraction

(*i*) The non-zero numbers whose product with each other is 1 are called reciprocals of each other. For example : 5 and $\frac{1}{5}$ are reciprocals of each other because $5 \times \frac{1}{5} = 1$.

(*ii*) Two fractions are said to be reciprocal of each other, if their product is 1. If $\frac{a}{b}$ is a non-zero fraction, then its reciprocal is $\frac{b}{a}$.

(*iii*) Reciprocal of zero does not exist because division by zero is not possible.

(*iv*) Reciprocal of a proper fraction is an improper fraction and reciprocal of an improper fraction is a proper fraction.

For example : Reciprocal of $\frac{5}{11}$ is $\frac{11}{5}$ and reciprocal of $\frac{11}{5}$ is $\frac{5}{11}$.

Example 21 : Write down the reciprocals of the following fractions:

(*i*) $\frac{8}{15}$ (*ii*) $\frac{2}{9}$ (*iii*) 7

Solution : (*i*) The reciprocal of $\frac{8}{15}$ is $\frac{15}{8}$. $\left[\because \frac{8}{15} \times \frac{15}{8} = 1\right]$

(*ii*) The reciprocal of $\frac{2}{9}$ is $\frac{9}{2}$. $\left[\because \frac{2}{9} \times \frac{9}{2} = 1\right]$

(*iii*) The reciprocal of 7 is $\frac{1}{7}$. $\left[\because 7 \times \frac{1}{7} = 1\right]$

Exercise 2.3

1. Multiply the following:

(i) $\frac{2}{30} \times 9$ (ii) $2\frac{4}{5} \times 45$ (iii) $\frac{26}{17} \times \frac{136}{39}$

2. Simplify:

(i) $\frac{2}{3} \times \frac{3}{4} \times \frac{5}{6} \times \frac{4}{9}$ (ii) $\frac{6}{28} \times \frac{35}{15} \times \frac{16}{18}$ (iii) $2\frac{3}{8} \times \frac{27}{19} \times \frac{7}{9}$

(iv) $5\frac{3}{5} \times \frac{12}{27} \times 3 \times \frac{9}{2}$ (v) $2\frac{1}{7} \times \frac{5}{7} \times \frac{49}{46} \times 1\frac{5}{18}$ (vi) $2\frac{1}{3} \times 1\frac{1}{4} \times 3\frac{1}{9} \times 1\frac{1}{2}$

3. Find the following:

(i) $\frac{3}{8}$ of 56 (ii) $\frac{7}{12}$ of 96 (iii) $\frac{5}{8}$ of 10

(iv) $\frac{2}{3}$ of $\frac{1}{2}$ (v) $\frac{2}{9}$ of $1\frac{3}{4}$ (vi) $\frac{1}{4}$

4. Tomatoes are being sold at ₹$18\frac{3}{4}$ per kg. What is the cost of $3\frac{1}{5}$ kg of tomatoes?

5. Sunita walks $\frac{6}{7}$ km in 1 hour. Find the distance she will cover in $2\frac{5}{8}$ hours.

6. Vihaan reads a storybook for $\frac{3}{5}$ hours in a day. He reads the entire book in 25 days. How many hours did he take to read the entire book?

7. A container can hold $4\frac{2}{5}$ litres of water. How much water will be there in 30 such containers?

8. A rectangular field is $28\frac{3}{5}$ m long and $15\frac{5}{11}$ m wide. Find its area.

9. A bag contains 48 kg of wheat. A family consumed $\frac{5}{6}$ of it. How much wheat is left in the bag?

10. There are 48 students in a class. $\frac{1}{3}$ of them are girls. How many boys are there in the class?

HOTS (Higher Order Thinking Skills)

Experiential Learning

1. A total of 25 boards are stacked on the top of each other. The thickness of each board is $2\frac{3}{4}$ cm. How high is the stack?
2. The length of a running track is 850 m. Ranjan covered $\frac{11}{17}$ of the track by running and the rest by walking. Find the distance he covered by walking.
3. An iceberg $40\frac{1}{5}$ metres in height is floating on water. If $\frac{1}{3}$ of its height is under water, then what is the height of the iceberg visible above water?

Division of Fractions

Case I : Division of a Whole Number By a Fraction.

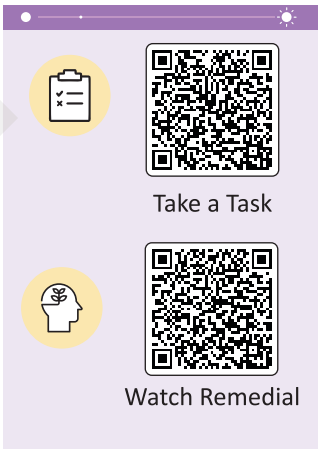
To divide a whole number by any fraction, multiply that whole number by the reciprocal of that fraction.

For example : $6 \div \frac{4}{7} = \cancel{6}^{3} \times \frac{7}{\cancel{4}_{2}} = \frac{21}{2} = 10\frac{1}{2}$

To divide a whole number by a mixed fraction, first convert the mixed fraction into the improper fraction and then solve it.

For example : $4 \div 2\frac{2}{5} = 4 \div \frac{12}{5} = 4 \times \frac{5}{12} = \frac{\cancel{4}^{1} \times 5}{\cancel{12}_{3}} = \frac{5}{3} = 1\frac{2}{3}$

Example 22 : Divide the following: (*i*) 8 by $\frac{14}{15}$ (*ii*) 10 by $3\frac{1}{3}$



Solution : (*i*) $8 \div \frac{14}{15} = 8 \times \frac{15}{14} = \frac{\cancel{8}^{4} \times 15}{\cancel{14}_{7}} = \frac{60}{7} = 8\frac{4}{7}$

(*ii*) $10 \div 3\frac{1}{3} = 10 \div \frac{10}{3} = 10 \times \frac{3}{10} = 3$

Case II : Division of a Fraction by a Natural Number.

To divide a fraction by a natural number, multiply the fraction by the reciprocal of the natural number.

For example : $\frac{3}{4} \div 5 = \frac{3}{4} \times \frac{1}{5} = \frac{3}{4 \times 5} = \frac{3}{20}$

To divide a mixed fraction by a natural number, first convert the mixed fraction into an improper fraction and then solve it.

For example : $3\frac{4}{7} \div 5 = \frac{25}{7} \div 5 = \frac{25}{7} \times \frac{1}{5} = \frac{\cancel{25}^{5}}{7 \times \cancel{5}_{1}} = \frac{5}{7}$

Example 23 : Divide the following:

(*i*) $\frac{2}{7}$ by 8 (*ii*) $\frac{15}{4}$ by 25

Solution : (*i*) $\frac{2}{7} \div 8 = \frac{2}{7} \times \frac{1}{8} = \frac{\cancel{2}^{1}}{7 \times \cancel{8}_{4}} = \frac{1}{7 \times 4} = \frac{1}{28}$

(*ii*) $\frac{15}{4} \div 25 = \frac{15}{4} \times \frac{1}{25} = \frac{\cancel{15}^{3}}{4 \times \cancel{25}_{5}} = \frac{3}{4 \times 5} = \frac{3}{20}$

Case III : Division of a Fraction by Another Fraction.

To divide a fraction by another fraction, multiply the first fraction by the reciprocal of the second fraction.

If $\frac{a}{b}$ and $\frac{c}{d}$ are two fractions, then $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$.

Example 24 : Divide the following :

(*i*) $\frac{2}{5}$ by $\frac{2}{3}$ (*ii*) $10\frac{1}{4}$ by $5\frac{2}{5}$

Solution : (*i*) $\frac{2}{5} \div \frac{2}{3} = \frac{2}{5} \times \frac{3}{2} = \frac{\cancel{2}^{1} \times 3}{5 \times \cancel{2}_{1}} = \frac{1 \times 3}{5} = \frac{3}{5}$.

(*ii*) $10\frac{1}{4}$ by $5\frac{2}{5} = \frac{41}{4} \div \frac{27}{5} = \frac{41}{4} \times \frac{5}{27} = \frac{41 \times 5}{4 \times 27} = \frac{205}{108} = 1\frac{97}{108}$.

Example 25 : The cost of 1 kg of sugar is ₹$23\frac{4}{5}$. How many kg of sugar be bought for ₹476 ?

Solution : Cost of 1 kg of sugar = ₹$23\frac{4}{5}$ = ₹$\frac{119}{5}$

Problem Solving

Total amount = ₹476

∴ Number of kg of sugar that can be bought

= Total amount ÷ Cost of 1 kg of sugar = ₹476 ÷ ₹ $\frac{119}{5}$

$= 476 \div \frac{119}{5} = 476 \times \frac{5}{119} = 4 \times 5 = 20$

Hence, 20 kg of sugar can be bought for ₹476.

Example 26 : The weight of 9 boxes is $41\frac{5}{8}$ kg. Find the weight of one box.

Solution : Weight of 9 boxes = $41\frac{5}{8}$ kg

Weight of 1 box = $\left(41\frac{5}{8} \div 9\right)$ kg = $\left(\frac{333}{8} \div 9\right)$ kg = $\left(\frac{333}{8} \times \frac{1}{9}\right)$ kg

$= \left(\frac{\cancel{333}^{37}}{8} \times \frac{1}{\cancel{9}_{1}}\right)$ kg = $\frac{37}{8}$ kg = $4\frac{5}{8}$ kg

Hence, the weight of one box is $4\frac{5}{8}$ kg.

Example 27 : Anil spent $\frac{2}{5}$ of his pocket money and had ₹180 left. Find the amount Anil received as pocket money.

Solution : Suppose Anil's pocket money was ₹x.

He spent $\frac{2}{5}$ of ₹$x = \frac{2}{5} \times$ ₹$x =$ ₹ $\frac{2x}{5}$

Money left with him = ₹x – ₹ $\frac{2x}{5}$

$\Rightarrow$ ₹180 = ₹$\left(x - \frac{2x}{5}\right)$ [Given]

$\Rightarrow \quad 180 = \frac{5x - 2x}{5} = \frac{3x}{5}$

$\Rightarrow \quad x = \frac{180 \times 5}{3} = 300$

Hence, Anil received ₹300 as pocket money.

Exercise 2.4

1. Find the reciprocal of each of the following fractions:

(*i*) $\frac{2}{5}$ (*ii*) $\frac{3}{8}$ (*iii*) $4\frac{8}{15}$ (*iv*) 6

2. Divide the following:

(*i*) 25 by $\frac{5}{3}$ (*ii*) 4 by $\frac{36}{15}$ (*iii*) 20 by $5\frac{5}{6}$ (*iv*) $\frac{2}{13}$ by 5

3. The cost of $3\frac{1}{3}$ kg potatoes is ₹20. How much will $5\frac{2}{3}$ kg potatoes cost?

4. The area of a rectangular field is $321\frac{5}{8}$ m^2. If its length is $20\frac{3}{4}$ m. Find its breadth.

5. If $\frac{2}{3}$ m of cloth is shared equally by 10 people, calculate the length of cloth received by each person.

6. A fruit seller bought 300 fruits. Out of these, $\frac{2}{5}$ of the fruits were mangoes and the rest were apples. $\frac{2}{15}$ of the apples were rotten. He sold the good apples at ₹$4\frac{1}{13}$ each. How much money did he receive on selling the good apples ?

We have learnt earlier that the place value of a digit increases ten times as it moves one step towards left.

For example :

The place value of 4 in 8354 is 4 units or 4

The place value of 4 in 8345 is 4 tens or 40

The place value of 4 in 8435 is 4 hundreds or 400.

Look at the place value of 5:

REMEMBER

When the digit moves one step to the right, the place value becomes $\frac{1}{10}$ (one-tenth).

Number	Place value of 5
3529	500
4258	50
9225	5

The place value of a digit becomes $\frac{1}{10}$ (one-tenth) when it moves a step towards right.

From the above, we conclude that :

$$\text{One hundred} = \frac{1}{10} \text{ of one thousand}$$

$$\text{One ten} = \frac{1}{10} \text{ of one hundred}$$

$$\text{One unit} = \frac{1}{10} \text{ of one ten}$$

Take a Task

Watch Remedial

Division of a Unit in Ten Equal Parts

Now study the following to learn what is $\frac{1}{10}$ of a unit:

$\frac{1}{10}$

The above figure is divided into ten equal parts and one part is shaded. The shaded part represents one-tenth of the whole figure. It is written as $\frac{1}{10}$.

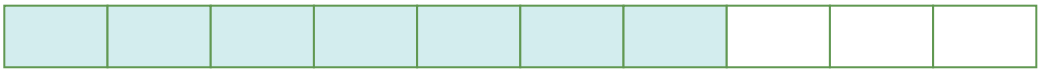
$\frac{1}{10}$ is also written as **.1**, which is read as **'decimal one'** or **'point one'**.

The dot on the left side of one stands for decimal point. Thus **ones = 10 tenths**

The following figure is divided into ten equal parts and four parts are shaded. The shaded parts represent three-tenths of the whole figure. It is written as $\frac{3}{10}$ [$\frac{3}{10}$ is also written as **.3** and is read as '**decimal three**' or '**point three**'].

$\frac{3}{10}$ 

The figure given below is divided into ten equal

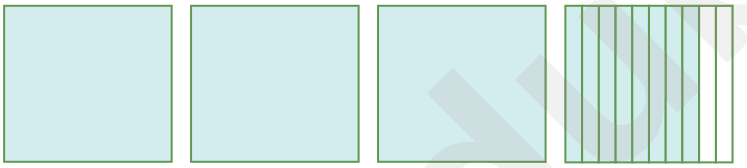
$\frac{7}{10}$ 

How many parts are shaded?

What fraction of the whole figure is represented by the shaded parts?

We can write the fraction $\frac{7}{10}$ using decimal point as .7

.1, .3, .7 etc., are called **decimal numbers** or simply **decimals**.



Whole number part → **3 . 8** → Decimal part

↑

Decimal point

Therefore, decimal fraction consists of two parts, i.e., whole number part and decimal part and they are separated by the decimal point.

Note

1. If there is no whole number part in a number, then write 0 on the left of the decimal point.
2. 0.1, 0.7, 3.8 etc. are **decimal numbers** whereas $\frac{3}{10}$, $\frac{7}{10}$, $\frac{38}{10}$ etc. are decimal fractions.
3. Like whole numbers we can show decimals on a place value table :

Tens 10	Ones 1	Decimal	Tenths $\frac{1}{10}$
1	8	.	8

Write :
.1 as 0.1
.3 as 0.3
.7 as 0.7
etc.

It is written as $18\frac{5}{10}$ or **18.5** and is read as **eighteen and five tenths**.

or **eighteen decimal five** or **eighteen point five**.

Representation of Decimals on Number Line

We have learnt the representation of whole numbers and fractions on a number line. Now, we shall explain the method of representing decimal numbers on number line.

Let us represent 1.3 on a number line.

1.3 is more than 1 and less than 2.

1.3 is 1 + 0.3 i.e. 1 + 3 tenths.

Draw a number line and mark whole numbers 0, 1, 2, 3, ... on it.

Divide the portion between 1 and 2 into 10 equal parts and take 3 parts for 3 tenths or 0.3. Mark it as A . In the above figure A represents the number 1.3.

Example 28 : Mark the following decimals in place value table:

(*i*) 0.8 (*ii*) 69.4 (*iii*) 405.3

Solution :

Place Value Table

Number	Hundreds 100	Tens 10	Ones 1	Decimal	Tenths $\frac{1}{10}$
0.3			0	·	8
69.4		6	9	·	4
405.3	4	0	5	·	3

Example 29 : Write the following in decimal notation:

(*i*) seven tenths (*ii*) Nine and 3 tenths (*iii*) $17\frac{1}{10}$

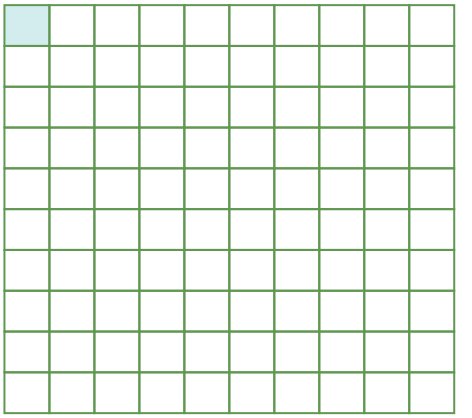
Solution : (*i*) 0.7 (*ii*) 9.3 (*iii*) 17.1

Example 30 : Write the following as fractions. Reduce them to lowest terms :

(*i*) 1.0 (*ii*) 3.8 (*iii*) 21.2

Solution : (*i*) $1.0 = 1$ (*ii*) $3.8 = 3\frac{8}{10} = 3\frac{4}{5}$ (*iii*) $21.2 = 21\frac{2}{10} = 21\frac{1}{5}$

Division of A Unit in Hundred Equal Parts



The given figure is divided into 100 equal parts. One part is shaded. The shaded part represents one-hundredth of the whole figure. It is written as $\frac{1}{1000}$.

$\frac{1}{1000}$ is also written as 0.01 and is read as '**one hundredth**' or '**zero decimal zero one**' or '**zero point zero one**'.

Similarly, if a figure is divided into 100 equal parts and 7 parts are shaded, then the shaded parts are represented by the fraction $\frac{7}{100}$.

$\frac{7}{100}$ is written by using decimal point, as 0.07.

0.07 is read as '**seven hundredths**' or '**zero decimal zero seven**' or '**zero point zero seven**'.

Similarly, $\frac{28}{100}, \frac{65}{100}, \frac{83}{100}$ are written as 0.28, 0.65, 0.83 respectively when expressed in decimal notation.

Division of A Unit in Thousand Equal Parts

In an object is divided into 1000 equal parts, then its each part is one-thousandth of the whole.

One-thousandth is written as $\frac{1}{1000}$.

In decimal system $\frac{1}{1000}$ is written as 0.001.

REMEMBER

1. The denominator of each decimal fraction is a multiple of 10.
2. The number of digits in the decimal number after the decimal point is the same as the number of zeros in the denominator of the decimal fraction.

Note

1. The digits after the decimal point are read one by one.
2. 0.8 is read as zero point eight.
3. 0.15 is read as zero point one five and not as zero point fifteen.
4. 0.329 is read as zero point three two nine.

Example 31 : Write the following decimals in words :

(*i*) 0.03 (*ii*) 17.37 (*iii*) 10.07 (iv) 5.008

Solution : (*i*) Zero point zero three (*ii*) Seventeen point three seven

(*iii*) Ten point zero seven (*iv*) Five point zero zero eight

Example 32 : Place values of digits of numbers are given below. Write them in decimal form:

(*i*) 8 tenths, 4 ones, 2 tens, 9 hundredths

(*ii*) 6 hundredths, 3 thousandths, 2 ones

(*iii*) 6 ones, 4 hundreds, 9 tenths, 5 hundredths, 1 thousandth

Solution :

Hundreds 100	Tens 10	Ones 1	Decimal	Tenths $\frac{1}{10}$	Hundreds $\frac{1}{10}$	Thousands $\frac{1}{10}$	Number
	2	4	·	8	9		25.39
		2	·	0	6	3	2.023
4	0	6	·	9	5	1	306.951

Example 33 : Write in the form of decimal fractions :

(*i*) 0.17 (*ii*) 0.028 (*iii*) 2.231

Solution : (*i*) $0.17 = 17 \text{ hundredths} = \frac{17}{100}$ (*ii*) $0.028 = 28 \text{ thousandths} = \frac{28}{1000}$

(*iii*) $2.231 = 2 + \frac{231}{1000} = \frac{2231}{1000}$

Exercise 2.5

1. Write the following decimals in place value table:

(*i*) 0.8 (*ii*) 3.4 (*iii*) 58.3 (*iv*) 130.9

2. Write the following in decimal notation:

(*i*) $\frac{5}{10}$ (*ii*) $\frac{9}{17}$ (*iii*) $\frac{2}{13}$ (*iv*) $\frac{4}{9}$ (*v*) $\frac{2}{5}$

3. Write in decimal notation:

(*i*) $28\frac{4}{10}$ (*ii*) $25\frac{7}{10}$ (*iii*) $7\frac{8}{10}$ (*iv*) $4\frac{2}{5}$ (*v*) $6\frac{1}{2}$

4. Write the following in decimal fractions:

(*i*) 0.42 (*ii*) 0.6 (*iii*) 0.8 (*iv*) 0.4 (*v*) 2.7

5. Read and write in words the following numbers:

(*i*) 13.6 (*ii*) 39.3 (*iii*) 7.18 (*iv*) 815.6

6. Express in decimals :

(*i*) $\frac{14}{100}$ (*ii*) $\frac{58}{100}$ (*iii*) $\frac{3}{100}$ (*iv*) $\frac{6}{100}$ (*v*) $4\frac{16}{100}$

(*vi*) $29\frac{7}{100}$ (*vii*) $\frac{324}{1000}$ (*viii*) $\frac{96}{1000}$ (*ix*) $\frac{3}{1000}$ (*x*) $3\frac{918}{1000}$

7. Write in words:

(*i*) 0.48 (*ii*) 0.87 (*iii*) 0.06 (*iv*) 18.80 (*v*) 7.07

(*vi*) 103.22 (*vii*) 0.898 (*viii*) 0.069 (*ix*) 0.004 (*x*) 44.858

8. Write in the form of decimal fractions:

(*i*) 0.36 (*ii*) 0.02 (*iii*) 40.86 (*iv*) 7.07 (*v*) 0.384

(*vi*) 0.065 (*vii*) 0.002 (*viii*) 16.065 (*ix*) 98.005

Expanded Form of Decimal

Let us study the following examples :

(a) $538 = 500 + 30 + 8$

(b) $34.5 = 30 + 4 + \frac{5}{10} = 30 + 4 + 0.5$

(c) $98.85 = 90 + 8 + \frac{8}{10} + \frac{5}{100} = 90 + 8 + 0.8 + 0.05$

(d) $59.08 = 50 + 9 + \frac{0}{10} + \frac{8}{100} = 50 + 9 + \frac{8}{100} = 40 + 9 + 0.08$

Example 34 : Write in the expanded form :

(*i*) 75.98 (*ii*) 59.809

Solution : (*i*) $75.98 = 70 + 5 + \frac{9}{10} + \frac{8}{100} = 70 + 5 + 0.9 + 0.08$

(*ii*) $59.809 = 50 + 9 + \frac{8}{10} + \frac{0}{100} + \frac{9}{1000}$

$= 50 + 9 + \frac{8}{10} + \frac{9}{1000} = 50 + 9 + 0.8 + 0.009$

Example 35 : Write in decimals :

(*i*) $7 + \frac{3}{10} + \frac{4}{100}$ (*ii*) $90 + \frac{3}{10} + \frac{7}{1000}$

Solution : (*i*) $7 + \frac{3}{10} + \frac{4}{100} = 7.34$

(*ii*) $90 + \frac{3}{10} + \frac{7}{1000} = 90 + \frac{3}{10} + \frac{0}{100} + \frac{7}{1000} = 90.307$

Order Relation in Decimal Numbers

Example 36 : Which is greater of 58.32 and 49.53?

Solution : The given decimals have whole number parts, so we compare the whole number parts only.

In 58.32, the whole number part is 58.

In 49.53, the whole number part is 49.

Since $58 > 49$

$\therefore \quad 58.32 > 49.53$

REMEMBER

If decimals have whole number parts, then compare whole number parts only.

Example 37 : Which is smaller of 0.59 and 0.96?

Solution : Here the whole number part in each decimal is zero, i.e. the whole number parts are equal.

So we compare the decimal parts.

$0.59 = 5$ tenths $+ 9$ hundredths

$0.96 = 9$ tenths $+ 6$ hundredths

Since 5 tenths $<$ 9 tenths

$0.59 < 0.96$

REMEMBER

If decimals have equal whole number parts, then compare decimal parts.

Conversion of Unlike Decimals into Like Decimals

Let us consider unlike decimals 0.7 and 0.28.

The number of decimal places in 0.7 is 1.

The number of decimal places in 0.28 is 2.

To convert 0.7 and 0.28 into like decimals, we should have two decimal places in 0.7.

To convert 0.7 into an equivalent decimal number, we add as many zeros to the right of 7 as we please. So the number which is equivalent to 0.7 and has two decimal places will be 0.70.

Thus 0.70 and 28 are like decimals.

Some examples of like decimals obtained from unlike decimals are given below :

Unlike decimals	Like decimals
(a) 5.08, 3.1	5.08, 3.10
(b) 8.25, 0.309	8.250, 0.309
(c) 7.8, 3.29, 0.605	7.800, 3.290, 0.605

REMEMBER

Number of decimal places are same in like decimals.

Example 38 : Arrange the following decimal numbers in descending order :

3.2, 0.67 and 2.893.

Solution : The largest number is 3.2. The next number smaller than 3.2 is 2.893, and 0.67 is smaller than 2.893.

Hence, the given decimal number in descending order are: 3.2, 2.893, 0.67.

Example 39 : Arrange the following decimal numbers in ascending order:

4.04, 3.95, 0.786 and 0.9.

Solution : The smallest number is 0.786. The next number greater than 0.786 is 0.9. The other numbers in ascending order are 3.95 and 4.04.

Hence the given decimal numbers in ascending order are:

0.786, 0.9, 3.95, 4.04.

Exercise 2.6

1. Write the following in the expanded form :

(*i*) 2.084 (*ii*) 97.837 (*iii*) 619.092 (*iv*) 0.95 (*v*) 87.779

(*vi*) 502.93

2. Fill in the place holders:

(*i*) $.569 = 5 + \frac{5}{\square} + \frac{9}{100}$

(*ii*) $34.808 = 30 + \square + \frac{8}{10} + \frac{8}{\square}$

(*iii*) $3.095 = 3 + \frac{9}{\square} + \frac{5}{\square}$

(*iv*) $68.807 = 60 + 8 + \frac{8}{\square} + \frac{7}{\square}$

3. Write in decimal form:

(*i*) $20 + 6 + \frac{7}{10} + \frac{9}{100}$

(*ii*) $3 + \frac{2}{10} + \frac{9}{100} + \frac{7}{1000}$

(*iii*) $7 + \frac{3}{10} + \frac{2}{1000}$

(*iv*) $90 + 8 + \frac{3}{100} + \frac{7}{1000}$

4. Fill in the blanks by using > or < to complete the following sentence:

(*i*) 38.35 ___ 8.29 (*ii*) 80.695 ___ 80.92 (*iii*) 5.6 ___ 0.983

(*iv*) 2.32 ___ 17.5 (*v*) 0.49 ___ 0.6 (*vi*) 0.6 ___ 0.48

5. Convert each of the following groups of unlike decimals into like decimals:

(*i*) 7.8, 7.83 (*ii*) 3.02, 2.3 (*iii*) 0.6, 0.429 (*iv*) 5.002, 3.04

(*v*) 2.468, 5.3, 3.51 (*vi*) 0.5, 6.8, 13.804

6. Arrange the following in descending order :

(*i*) 0.3, 1.6, 0.23 and 0.89 (*ii*) 1.12, 4.35, 0.69 and 0.239

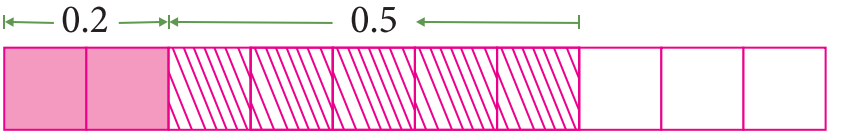
(*iii*) 0.6, 2.65, 0.398 and 3.43 (*iv*) 0.7, 1.78, 0.381 and 5.35

7. Arrange the following in ascending order :

(*i*) 0.3, 1.6, 0.23 and 0.89 (*ii*) 1.12, 4.35, 0.69 and 0.239

(*iii*) 0.6, 2.65, 0.398 and 3.43 (*iv*) 0.7, 1.78, 0.381 and 5.35

Addition of decimal Numbers



The above figure is divided into ten equal parts. Each part represents $\frac{1}{10}$ or 0.1 of the whole figure. Two parts are shaded by one colour and five parts are shaded by another colour. Total number of shaded parts is seven.

2 shaded parts + 5 shaded parts = 7 shaded parts or 0.2 + 0.5 = 0.7

We can add decimal numbers as under:

$$0.2 + 0.5 = 2 \text{ tenths} + \text{tenths} = 7 \text{ tenths} = \frac{7}{10} = 0.7$$

Similarly, 0.14 and 0.05 can be added as follows :

$$\begin{array}{r} 0.14 \\ +\ 0.05 \\ \hline 0.19 \end{array}$$

Example 40 : Add 0.8 and 0.9.

Solution : Write in columns and add.

$$\begin{array}{r} 0.8 \\ +\ 0.9 \\ \hline 1.7 \end{array}$$

Example 41 : Add 5.7 and 2.56.

Solution :

$$\begin{array}{rcl} 5.7 & = & 5 + .70 \\ +\ 2.56 & = & 2 + .56 \\ \hline 8.26 & = & 7 + 1.26 \end{array}$$

i.e., 7 + 1.26 = 8.26

REMEMBER

Add decimal parts to decimal parts and whole numbers to whole numbers.

Properties of Addition of Decimals

Decimal numbers and whole numbers have the same properties of addition.

(a) The sum of a decimal number and 0 is the same decimal number.

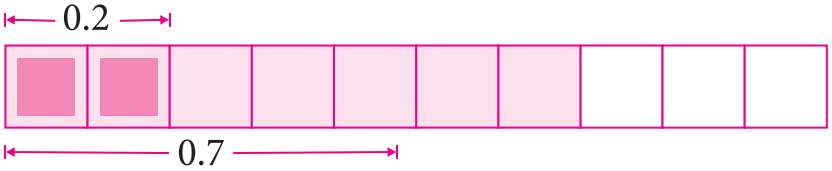
(*i*) 3.06 + 0 = 3.06 (*ii*) 64.98 + 0 = 64.98

(b) Change of order of decimal numbers does not change their sum.

(i) 3.29 + 16.8 = 16.8 + 3.29 (*ii*) 18.28 + 1.005 = 1.005 + 18.28

Addition and subtraction of decimal

The figure given below is divided into 10 equal parts. Each part represents $\frac{1}{10}$ or 0.1 of the whole figure. Seven parts representing 0.7 have been shaded and then out of these seven parts two parts representing 0.2 are double shaded. Then remaining shaded parts are five which represent 0.5 of the whole figure.



7 shaded parts – 2 shaded parts = 5 shaded parts

or 0.7 – 0.2 = 0.5

We can subtract decimal numbers as under:

0.7 – 0.2 = 7 tenths – 2 tenths = 5 tenths = 0.5

Similarly, 0.16 can be subtracted from 0.58 as follows:

$$\begin{array}{r} 0.58 \\ -\ 0.16 \\ \hline 0.42 \\ \hline \end{array}$$

Take a Task

Watch Remedial

Example 42 : Subtract 0.4 from 2.3

Solution :

$$\begin{array}{r} 2\,.\,3 \\ -\ 0\,.\,4 \\ \hline 1\,.\,9 \\ \hline \end{array}$$

Solution :

Example 43 : Subtract 14.69 from 63.2

$$\begin{array}{r} 63\,.\,20 \\ -\ 14\,.\,69 \\ \hline 48\,.\,51 \\ \hline \end{array}$$

Exercise 2.7

1. Add following :

(*i*) $\begin{array}{r} 0.3 \\ +\ 0.6 \\ \hline \\ \hline \end{array}$ (*ii*) $\begin{array}{r} 0.8 \\ +\ 0.4 \\ \hline \\ \hline \end{array}$ (*iii*) $\begin{array}{r} 0.2 \\ +\ 0.8 \\ \hline \\ \hline \end{array}$ (*iv*) $\begin{array}{r} 0.4 \\ +\ 0.6 \\ \hline \\ \hline \end{array}$

(*v*) $\begin{array}{r} 0.64 \\ +\ 2.83 \\ \hline \\ \hline \end{array}$ (*vi*) $\begin{array}{r} 4.39 \\ +\ 6.95 \\ \hline \\ \hline \end{array}$ (*vii*) $\begin{array}{r} 48.2 \\ +\ 5.68 \\ \hline \\ \hline \end{array}$ (*viii*) $\begin{array}{r} 36.088 \\ +\ 47.92 \\ \hline \\ \hline \end{array}$

2. Add the following:

(*i*) 29.65 and 98.7 (*ii*) 37.856 and 15.09

(*iii*) 35.24, 27.083 and 6.241 (*iv*) 58.02, 146.2 and 0.834

3. Subtract :

(*i*) 0.9 − 0.3 = ____

(*ii*) 1.8 − 0.7 = ____

(*iii*) 2.7 − 0.9 = ____

(*iv*) 18.69 − 2.97 = ____

(*v*) 54.66 − 54.31 = ____

(*vi*) 37.00 − 28.29 = ____

(*vii*) 56.23 − 27.5 = ____

(*viii*) 108.3 − 68.09 = ____

4. Simply the following :

(*i*) 8.24 – 2.17 (*ii*) 64.02 – 49.87 (*iii*) 40 – 18.6

(*iv*) 200 – 35.82 (*v*) 91.004 – 62.9 (*vi*) 208 – 023 – 96.8

5. Subtract the sum of 4.39 and 7.06 from 16.

Multiplication and division of Decimals

Example 44 : Multiply :

(*i*) 0.693×10 (*ii*) 5.92×10 (*iii*) 39.2×10

Solution : (*i*) $0.692 \times 10 = \frac{692}{1000} \times 10 = \frac{692}{100} = 6.92$

(*ii*) $5.92 \times 10 = \frac{592}{100} \times 10 = \frac{592}{10} = 59.2$

Example 45 : Multiply :

(*i*) 8.562×100 (*ii*) 45.63×100

Solution : (*i*) $8.563 \times 100 = \frac{8563}{1000} \times 100 = \frac{8563}{10} = 856.3$

(*ii*) $45.63 \times 100 = \frac{4563}{100} \times 100 = \frac{4563}{1} = 4563$

Multiplication of a Decimal Number

Example 46 : Multiply :

(*i*) 2.3 by 4 (*ii*) 5.16 by 3

Solution : (*i*) $\underset{\text{1 decimal place}}{2.3} \times 4 = \frac{23}{10} \times 4$

$$= \frac{23 \times 4}{10 \times 1} = \frac{92}{10} = \underset{\text{1 decimal place}}{9.2}$$

(*ii*) $\underset{\text{1 decimal place}}{5.16} \times 3 = \frac{516}{100} \times 3$

$$= \frac{516 \times 3}{100 \times 3} = \frac{1548}{100} = \underset{\text{1 decimal place}}{15.48}$$

Example 47 : Divide :

(*i*) 345 ÷ 100 (*ii*) 34.5 ÷ 100

Solution : (*i*) $345 \div 100 = \frac{345}{1} \times \frac{1}{100} = \frac{345}{100} = 3.45$

(*ii*) $34.5 \div 100 = \frac{345}{10} \times \frac{1}{100} = \frac{345}{1000} = 0.345$

Example 48 : Divide :

(*i*) 45900 ÷ 1000 (*ii*) 4590 ÷ 1000

Solution : (*i*) $45900 \div 1000 = \frac{45900}{1000} = 45.900$

(*ii*) $4590 \div 1000 = \frac{4590}{1000} = 4.590$

Division of a decimal number by 10, 100, 1000

Example 49 : Divide :

(*i*) 5.4 by 2 $= \frac{54}{10} \div 2$ (*ii*) 4.8 by 3 $= \frac{48}{10} \div 3$

Solution : (*i*) $5.4 \div 2 = \frac{54}{10 \times 2} = \frac{27}{10} = 2.7$ (*ii*) $4.8 \div 3 = \frac{48}{10 \times 3} = \frac{16}{10} = 1.6$

Exercise 2.8

1. Multiply by 10 :

(*i*) 7.43 (*ii*) 93.9 (*iii*) 0.453 (*iv*) 38.07

2. Multiply by 100:

(*i*) 96.703 (*ii*) 50.85 (*iii*) 0.384 (*iv*) 7.3

3. Multiply by 1000:

(*i*) 38.789 (*ii*) 30.37 (*iii*) 0.098 (*iv*) 9.1

4. Multiply:

(*i*) 43.2 by 4 (*ii*) 23.08 by 8 (*iii*) 52.89 by 9

5. Divide by 10:

(*i*) 86.95 (*ii*) 378 (*iii*) 7.2 (*iv*) 0.55

6. Divide by 100:

(*i*) 686 (*ii*) 53 (*iii*) 47.9 (*iv*) 2.5

7. Divide by 1000:

(*i*) 8585 (*ii*) 709 (*iii*) 36 (*iv*) 630

8. Divide:

(*i*) 78.4 by 4 (*ii*) 31.2 by 3 (*iii*) 105.25 by (*iv*) 13.84 by 8

Example 50 : Mahesh travelled 125.5 km by train and 14.25 km by bus.How much distance did he cover?

Solution :

Journey by train = 125.500 km

Total distance covered = 14.250 km

Total distance covered = 139.750 km

Example 51 : The maximum temperature of Delhi on Monday was 38.5°C and on Tuesday it was 46.1°C. Find the difference in temperature.

Solution : We subtract 38.5°C from 46.1°C

$$\begin{array}{r} 46.1 \\ -\ 38.5 \\ \hline 7.6 \end{array}$$

∴ Difference in temperature = 7.6°C

Example 52 : A car goes 15.6 km in one litre of petrol. How many kilometres will it go in 4 litres of petrol?

Solution : Distance covered in 1 litre of petrol = 15.6 km

Distance covered in 4 litres of petrol = 15.6 × 4 km = 62.4 km

Example 53 : It costs ₹48.5 to buy 1 m cloth. How much money will Shivani pay to buy 8 m cloth?

Solution : Cost of 1 m cloth = ₹48.35

Cost of 8 m cloth = ₹48.35 × 8 = ₹386.80

Example 54 : If 5.580 kg potatoes cost ₹9, how much potatoes can Sunita buy for one rupee?

Solution : Potatoes bought for ₹9 = 5.580 kg

Potatoes bought for ₹ = 5.580/9 kg = 0.620 kg = 620 g

Exercise 2.9

1. Rubi bought 2.38 m dress material for her brother and 7.75 m for herself. How much dress material did she buy?
2. Kunal and Rashmi bought 69.9 kg and 37.65 kg wheat respectively. Who bought more quantify of wheat and how much?
3. the height of a mango tree is 7.04 m and that of an orange tree is 3.5 m. How much higher is the mango tree?
4. Ajit got ₹25.80 from mother and ₹80.05 from father. How much money did he get?
5. the normal temperature of human being is 98.6°F. If the temperature of a person was 103°F, how much was it above normal?
6. School is 50 km from his home. His father leaves him at a distance of 12.500 km from home from where he takes his school bus. How much distance does he travel by bus?
7. Radhika travels 25 km 500 m by bus, 12 km 30 m by scooter and some distance on foot. How much distance does she walk if she travels in all 40 km?
8. Soni put 15.800 *l* milk equally in 4 pots. How much milk did she put in each pot?

Chapter-end Exercise

Gap Analyzer™

A. Multiple Choice Questions (MCQ's)

Tick (✓) the correct potion:

1. $\frac{1}{5} \times 3\frac{1}{5}$ is equal to:

   (a) $\frac{10}{25}$ ☐ (b) $\frac{12}{25}$ ☐ (c) $\frac{16}{25}$ ☐ (d) $\frac{20}{25}$ ☐

2. $3\frac{3}{4} - \frac{3}{4}$ is equal to:

   (a) 3 ☐ (b) 4 ☐ (c) 5 ☐ (d) $\frac{45}{16}$ ☐

3. The ascending arrangement of $\frac{2}{3}, \frac{6}{7}, \frac{13}{21}$ is :

   (a) $\frac{13}{21}, \frac{2}{3}, \frac{6}{7}$ ☐ (b) $\frac{6}{7}, \frac{13}{21}, \frac{2}{3}$ ☐

   (c) $\frac{2}{3}, \frac{6}{7}, \frac{13}{21}$ ☐ (d) $\frac{6}{7}, \frac{2}{3}, \frac{13}{21}$ ☐

4. 8.25 is equal to:

   (a) $8\frac{1}{2}$ ☐ (b) $8\frac{2}{5}$ ☐ (c) $8\frac{1}{4}$ ☐ (d) $8\frac{3}{4}$ ☐

B. Solve the following:

(i) $2\frac{2}{3} + 3\frac{1}{2}$ (ii) $2 - \frac{3}{5}$ (iii) $3\frac{1}{4} \times -4\frac{1}{3}$

C. Find the reciprocal of:

(i) $\frac{4}{3} \times \frac{-7}{5}$ (ii) $-3 + \frac{1}{4}$ (iii) $\frac{-2}{5} \times \frac{7}{8}$

D. Arrange the following in ascending order:

(i) $\frac{-3}{2}, \frac{1}{4}, \frac{16}{17}, \frac{3}{5}$ (ii) $\frac{-18}{23}, \frac{-13}{46}, \frac{16}{23}, \frac{9}{92}$

Custom Learning Path

Scan to Create Your Own Learning Path

E. Simplify :

(i) 7 – 0.3 + 2.5 – 0.03 (ii) 12.5 – 2.3 + 5 + 3 – 4.3 (iii) 13.5 – 3.3 + 2.5 – 5

HOTS (Higher Order Thinking Skills)

Experiential Learning

1. A rectangular block of length $6\frac{1}{4}\,cm$ and $3\frac{2}{3}\,cm$ of width is noted. Find the perimeter and area of the rectangular block.
2. Write the following decimal fractions in expanded form :

   0.321; 0.024; 0.135
3. For the fraction 2/5, write one-place decimal, two-places decimal and three-places decimal.

Assertion and Reason

In each of the following questions, an Assertion (A) and a corresponding Reason (R) supporting it is given.
Study both the statements and state which of the following is correct:
(*a*) Both A and R are true and R is the correct explanation of A.
(*b*) Both A and R are true but R is not the correct explanation of A.
(*c*) A is true but R is false.
(*d*) A is false but R is true.

1. **Assertion (A) :** The reciprocal of $3\frac{1}{7}$ is $\frac{22}{7}$.

   Reason (R) : Reciprocal of zero does not exist.
2. **Assertion (A) :** $\frac{3}{4}$ of $\frac{2}{3}$ is equal to $\frac{1}{4}$.

   Reason (R) : The value of $\frac{7}{10}+\frac{2}{5}+\frac{3}{2}$ is $\frac{1}{5}$.
3. **Assertion (A) :** $3\frac{1}{7}\times 5\frac{2}{3}-4\frac{1}{5}\times 2\frac{2}{3}$ is equal to $6\frac{64}{105}$.

   Reason (R) : A square of $\frac{8}{11}$ is equal to $\frac{2}{11}$.
4. **Assertion (A) :** The product of 1.28 and 4.2 is equal to 5.376.

   Reason (R) : 282.25 ÷ 25 is equal to 11.29.
5. **Assertion (A) :** The national number for the decimal number 0.4 is $\frac{2}{5}$.

   Reason (R) : Multiplying 4.32 by 0.012, we get 0.05234.