7

Coursebook

Maths

Lower Secondary

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Support Deep Learning Approach

Include Problems Based on

Problem Solving Skills

Reasoning Skills

Critical Thinking Skills

Application Skills

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Introduction

Welcome to **Maths Lower Secondary 7: Coursebook.** Our series invites students to explore mathematics at a deeper and more challenging level, equipping them with the knowledge and skills needed for success in secondary school and beyond.

Aligned with the Merdeka Curriculum (Kurikulum Merdeka), our books are designed to do more than teach procedures. They cultivate problem-solving abilities, strengthen reasoning skills, and sharpen critical thinking. Each chapter encourages students to connect new ideas with what they already know, analyse situations, and apply mathematics to both familiar and new contexts.

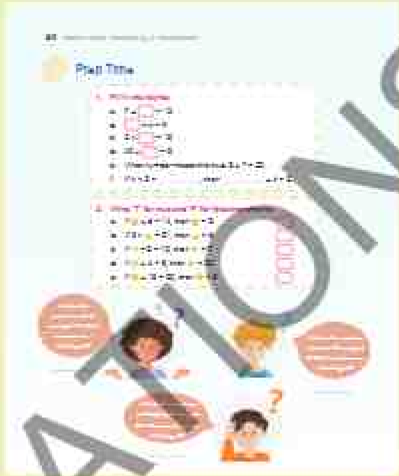
Our approach promotes application skills by linking concepts to real-life problems, enabling students to see the value of mathematics in everyday decision-making and future learning. The coursebook also supports deep learning, where students go beyond memorising formulas to explore, connect, and apply ideas in ways that are meaningful and lasting.

We hope the Maths Lower Secondary 7: Coursebook becomes a valuable companion on each learner's journey, inspiring curiosity, building confidence, and developing a strong foundation in mathematical thinking that will prepare them for higher studies and lifelong learning.

— The Publisher

Key Features of the Series

Prep Time



helps students recall prior knowledge and prepares them for new learning.

Maths Gem

Maths Gem

The letter **Z** comes from the German word *Zahlen*, which means *numbers*.

shares interesting facts and stories that reveal the wonders of mathematics.

Take Note!

Take Note!

The number 0 is neither positive nor negative.

highlights the most important points students should remember in the lesson.

Self-Reflection

invites students to review their progress and evaluate their learning.

Tick It Smart

strengthens understanding by guiding students to choose the correct ideas.

Think Sharp

encourages students to think quickly and accurately, sharpening their skills.

Values in Action

links maths with meaningful values, giving students space for reflection.

Maths Meets Life

shows students how mathematical ideas relate to everyday experiences.

Maths Lab Work

offers hands-on activities in pairs or groups to make learning more engaging and effective.

Contents

Chapter 1

Integers and Fractions

David is playing outside on a cold winter day. He looks at his watch and sees that the temperature is –3 °C. What does the –3 mean? How many degrees colder than zero is it?

Learning Objectives

- Count, write, and compare integers and fractions
- Identify rational numbers
- Apply the properties of arithmetic operations
- Apply the correct order of operations in calculations

Maths Terminology

- Index
- Negative
- Positive
- Rational numbers

Prep Time

Imagine you are playing a snake board game.
You started at position 0 and your card says: "Go forward 3 spaces".

1. Where would you be now?
2. How many spaces have you moved?

0 → Go forward 3 spaces → ____

↓

Go forward 5 spaces → ____ → Go forward 8 spaces

↓

____ → Go backward 4 spaces → ____

↓

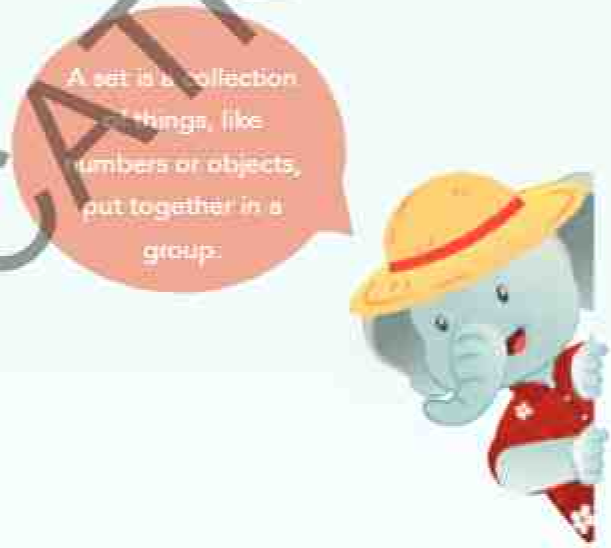
Go backward 5 spaces → Now, what number are you stepping on?

Whole Numbers

One of the greatest contributions to mathematics was the invention of zero (0). The symbol 0 was introduced to represent the idea of nothing. On its own, zero means nothing, but when written with other digits, such as 1, 2, or 3, it allows us to form larger numbers like 10, 20, and 30.

The earliest numbers used were the natural numbers (**N**). With the invention of zero, mathematicians extended the natural numbers to form a new set called the whole numbers (**W**).

N = the set of natural numbers = {1, 2, 3, ...}
W = the set of whole numbers = {0, 1, 2, 3, ...}

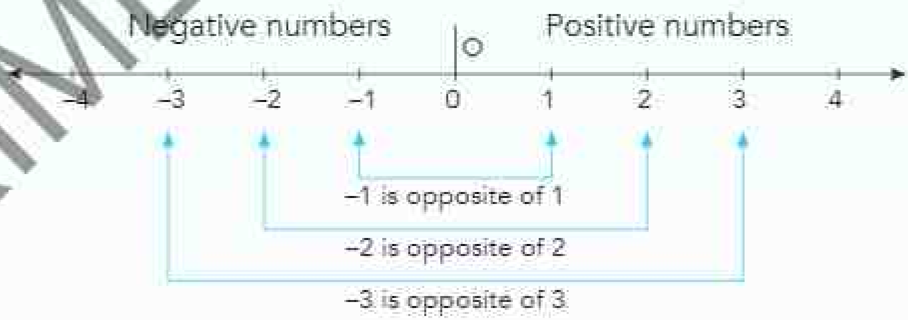


Whole numbers (**W**) are just natural numbers (**N**) with one extra number. That extra number is 0.

Thus, every natural number is also a whole number, but not every whole number is a natural number.

Negative Numbers

Subtraction is the opposite of addition. The sign – is the opposite of the sign +. So, –1 is the opposite of +1. Since 1 – 0 = 1, we can also write 0 – 1 = –1. This is how we got the predecessor of 0 as –1.



On the number line, the predecessor of a number is shown to its left. For example, to the left of point O (which represents 0), we mark a point one unit away and label it –1.

Similarly, 0 – 2 gives the number –2. This number is located opposite to 2 (with 0 as the base point). The number –3 is opposite to 3, and so on.

Now, we can extend the number line to the left of point O representing the number 0. This is where we put the negative numbers: –1, –2, –3, and so on. The number line keeps going forever to the left, getting smaller and smaller.

Integers

When we add negative numbers to the whole numbers, we get a bigger set of numbers. This set is called integers and is written with the symbol **Z**. We write it like this:

$$Z = \{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$$

The dots at the left and right ends show that the negative and positive numbers continue without limit. By convention, positive numbers +1, +2, +3, ... are written simply as 1, 2, 3, ...

Maths Gem

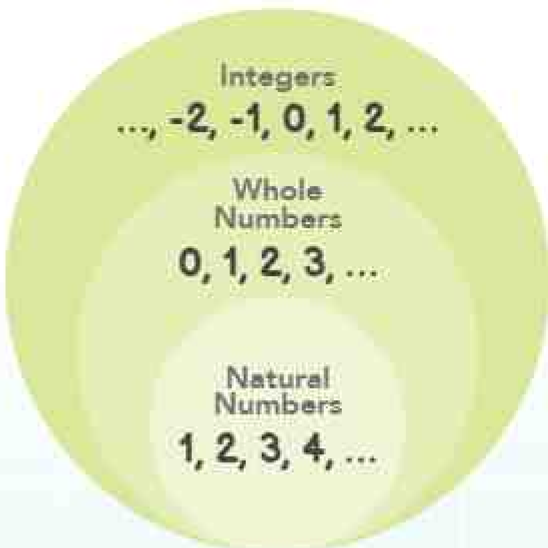
The letter Z comes from the German word *Zahlen*, which means *numbers*.

Positive numbers are called positive integers.

Negative numbers are called negative integers.

Positive and negative numbers together are known as directed numbers.

As a set, **Z** is larger than the set of whole numbers because it includes both whole numbers and negative integers.



Let us see how we use directed numbers in our daily lives. Directed numbers are used to represent quantities that are opposite in nature. Movements in opposite directions, actions with opposite results, and statements with opposite meanings all make use of positive and negative numbers. Some examples are given below.

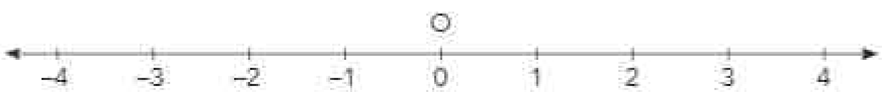
Take Note!

The number 0 is neither positive nor negative.

Positive Numbers	Negative Numbers
Moving upward	Moving downward
Moving right	Moving left
Climbing up	Climbing down
Going north	Going south
Temperature above 0 °C	Temperature below 0 °C
Earning	Spending
Moving forward	Moving backward
Deposit	Withdrawal
Increase	Decrease
Profit	Loss
Height above sea level	Depth below sea level

Comparing Integers

Look at the number line with all the integers marked on it. The point labelled O in the centre represents the number 0.

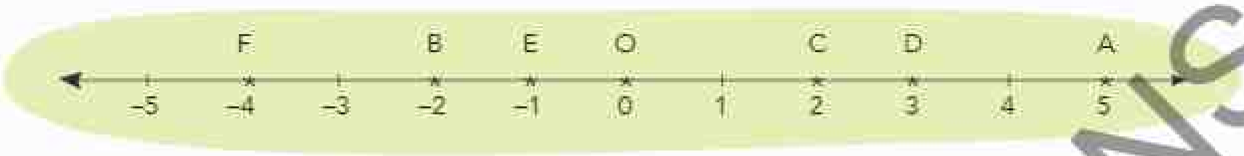


The marks on the number line above do not mean that –4 and 4 are the endpoints. The arrows on both ends indicate that the number line continues endlessly in both directions.

In ascending order, we write: ... –4 < –3 < –2 < –1 < 0 < 1 < 2 < 3 < 4 < ....
In descending order, we write: ... 4 > 3 > 2 > 1 > 0 > –1 > –2 > –3 > –4 > ....

Example 1 : Write 5, –2, 2, 3, –1, –4, 0 in ascending and descending order.

Solution : Draw a number line with the centre point O representing the number 0.



Let us mark the points that represent the given numbers.

Number 5 is represented by A, while –2 by B, 2 by C, 3 by D, –1 by E, –4 by F, and 0 by O.

Since numbers increase from left to right on a number line, point F (–4) lies to the left of B (–2). Therefore, –4 < –2.

Similarly, –2 < –1, –1 < 0, 0 < 2, 2 < 3, 3 < 5.

We have –4 < –2 < –1 < 0 < 2 < 3 < 5 as the ascending order.

Reversing this, we get the descending order:

5 > 3 > 2 > 0 > –1 > –2 > –4.

Exercise 1.1

1. Write the opposite of each statement.

a. Gaining 570 points in a game

b. Multiplying a number by 2

c. A rise in the price of Rp2,000 per kg

d. Losing 10 kg in weight

e. The river is 4 m above normal level

2. Write the integer that represents each statement.

a. A deposit of Rp50,000 in a bank account

b. A loss of Rp25,000 from selling a book

c. The temperature of Hokkaido is 10 °C below zero

d. The base of a ship is 900 m below sea level

e. An increase of 15 marks compared to the last exam

3. Fill in the blanks with the appropriate directed number.

Statement	Directed Number
A decrease of Rp200,000 per gram in the price of gold	–Rp200,000
5 °C below freezing point	
Luna's monthly income has increased by Rp500,000	
A rise of 6 m in sea level during the full moon	

4. Compare the following using less than (<) or greater than (>).

a. –38 ☐ –20

b. –500 ☐ –501

c. 0 ☐ –15

d. –100 ☐ 100

5. Arrange the following numbers in ascending and descending order.

	List of Numbers	Ascending	Descending
a.	30, –25, –5, 0, 48, –40		
b.	–15, –18, –2, 3, 10, –4		
c.	100, –100, 200, –250, –300		
d.	45, –23, 78, –87, 0, –78		

Fractions

Ms Wulan bought two packets, each containing six chocolates, for her two children: Laras and Dinda. When the 12 chocolates were shared between the two children, each received six chocolates, which is half of the total.

Then, Laras and Dinda's friend Ryan came over to play. They decided to share their chocolates equally with Ryan. Each person received four chocolates, which is one-third of the total.

A moment later, another friend Anna came to join them.
In the end, the 12 chocolates were shared among four people, with each receiving three chocolates, which is one-fourth of the total.

Half of a unit means dividing one whole into two equal parts and taking one of those parts.

Mathematically, this is written as $\frac{\text{one}}{\text{two}}$, i.e. $\frac{1}{2}$.

Similarly, one-third is written as $\frac{\text{one}}{\text{three}}$, i.e. $\frac{1}{3}$, and one-fourth is written as $\frac{\text{one}}{\text{four}}$, i.e. $\frac{1}{4}$.

The numbers $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ represent parts of one whole unit and are known as fractions.

Each fraction contains two natural numbers, one written above the other and separated by a horizontal line.
The number above the line is called the numerator, and the number below the line is called the denominator. Together, the numerator and denominator form a fraction.

$$\frac{\text{Numerator}}{\text{Denominator}} \rightarrow \text{Fraction}$$

Take Note!

We cannot use 0 as a denominator because division by 0 is not possible. However, 0 can be the numerator. In that case, the fraction equals to 0.

Types of Fractions

Proper Fractions

Fractions in which the numerator is smaller than the denominator are called proper fractions.

For example: $\frac{1}{2}, \frac{3}{5}, \frac{8}{9}, \frac{99}{100}$

All proper fractions are less than 1.

Improper Fractions

A fraction is called an improper fraction when its numerator is equal to or greater than its denominator.

Case 1: When numerator = denominator

For example: $\frac{1}{1}, \frac{2}{2}, \frac{3}{3}, \frac{4}{4}$

All of these have a value of 1.

Case 2: When numerator > denominator

For example: $\frac{2}{1}, \frac{3}{2}, \frac{4}{3}, \frac{6}{2}, \frac{18}{7}, \frac{100}{9}, \frac{200}{61}, \frac{200}{10}$

All of these have values greater than 1.

Thus, the value of an improper fraction is either equal to 1 or greater than 1.

Mixed Fractions

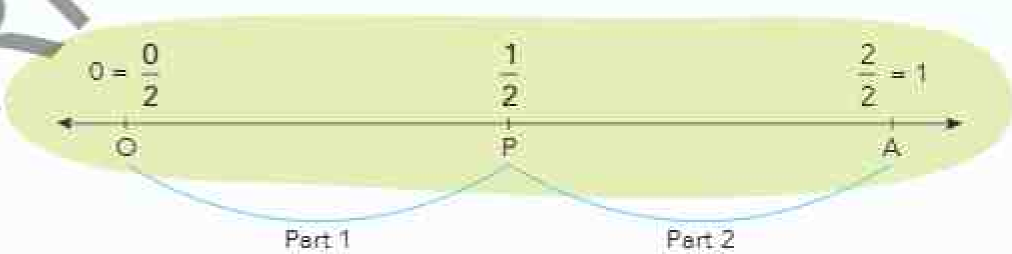
A mixed fraction (or mixed number) is a combination of a whole number and a proper fraction.

For example: $1\frac{1}{2}, 1\frac{1}{3}, 2\frac{4}{7}$

Representing a Fraction on a Number Line

We know that a number line is a line marked with integers. Each integer is represented by a point on the line. Between any two integers there is a gap containing many points that we cannot see with the naked eye. If we use a magnifying glass, the gaps become visible and many more points that we can mark. Let us mark some of these points.

Take a number line with point O representing 0. The left side of the line contains negative integers, and the right side contains positive integers. Here, we are considering a small portion OA of the line whose length is one unit.



Let P divide OA into two equal parts, OP and PA.

Therefore, OP will be half of OA, so P represents the number $\frac{1}{2}$, and A represents the number $\frac{2}{2}$ or 1 whole.

To show $\frac{1}{3}$ on the number line, divide OA into three equal parts by the points A_1 and A_2.

Here, A_1 represents the number $\frac{1}{3}$, and A_2 represents the number $\frac{2}{3}$.

Between two integers, there is not always another integer. For example, there is no integer between 4 and 5. But with fractions, it is different. Between any two fractions, we can always find another fraction.

Example 2 : Represent $\frac{5}{7}$ on the number line.

Solution :

Step 1. Draw a number line with O representing the number 0, mark point A at a unit distance.

Step 2. Divide OA into seven equal parts using the points from A_1 to A_6. The seven equal parts are: OA_1, A_1A_2, A_2A_3, A_3A_4, A_4A_5, A_5A_6, and A_6A.

Step 3. Point A_5 represents the fraction $\frac{5}{7}$.

Comparing Fractions

Citra got 9 out of 10 marks in her first Mathematics unit test. In her second unit test, she got 19 out of 20. She thinks she has not improved because she lost one mark in both tests. But, did she actually not improve in the second test? Let us compare.

Her marks can be written as the fractions $\frac{9}{10}$ and $\frac{19}{20}$.

To compare them, they should first be converted to like fractions (fractions with the same denominator).

We have $\frac{9}{10} = \frac{9 \times 2}{10 \times 2} = \frac{18}{20}$.

Now, $\frac{18}{20}$ and $\frac{19}{20}$ can be compared easily because they have the same denominator.

Since $\frac{19}{20} > \frac{18}{20}$, we can say that her performance in the second unit test has improved.

Comparing Two Like Fractions (Same Denominator)

When two fractions have the same denominator, the one with the greater numerator is the greater fraction.

For example: $\frac{19}{20} > \frac{18}{20}$, $\frac{61}{100} > \frac{59}{100}$, $\frac{89}{120} > \frac{80}{120}$

Take Note!

Same denominator?

Compare the numerators.

Comparing Two Fractions with the Same Numerator

When two fractions have the same numerator, the fraction with the greater denominator is smaller and the fraction with the smaller denominator is greater.

For example: $\frac{1}{4} < \frac{1}{3}$, because 4 > 3

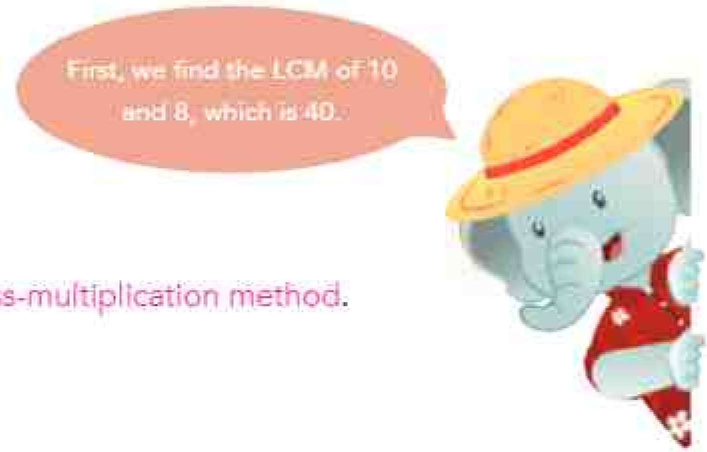
$\frac{5}{6} > \frac{5}{9}$, because 6 < 9

Comparing Fractions When Both Numerators and Denominators Are Different

We compare such fractions by converting them into like fractions. This can be done by finding equivalent fractions with a common denominator. The common denominator is the lowest common multiple (LCM) of both denominators.

Let us compare $\frac{9}{10}$ and $\frac{5}{8}$.

We have $\frac{9}{10} = \frac{9 \times 4}{10 \times 4} = \frac{36}{40}$ and $\frac{5}{8} = \frac{5 \times 5}{8 \times 5} = \frac{25}{40}$.



Since $\frac{36}{40} > \frac{25}{40}$, we can say $\frac{9}{10} > \frac{5}{8}$.

We can also compare two fractions by using the cross-multiplication method.

Let us compare $\frac{2}{5}$ and $\frac{4}{11}$.

Cross-multiply the fractions $\frac{2}{5} \times \frac{4}{11}$

The results are 2 × 11 = 22 and 5 × 4 = 20.

Since 22 > 20, we have $\frac{2}{5} > \frac{4}{11}$.

Arranging Fractions in Ascending or Descending Order

When we need to arrange more than two fractions in order, we can follow these steps.

Step 1. Convert all numbers into proper or improper fractions.

Step 2. Find a common denominator for all the fractions so they can be compared easily.

Step 3. Arrange the fractions.

Example 3 : Arrange $\frac{9}{8}, \frac{7}{9}, 2, 5\frac{1}{3}, \frac{29}{6}$ in ascending and descending order.

Solution : First, convert the mixed fraction into an improper fraction: $5\frac{1}{3} = \frac{16}{3}$.

Now, we have $\frac{9}{8}, \frac{7}{9}, \frac{2}{1}, \frac{16}{3}, \frac{29}{6}$.

Next, find the LCM of all the denominators (8, 9, 1, 3, 6). Using factor method: LCM = 72.

Now, convert all the fractions to have the same denominator.

$\frac{9}{8} = \frac{9 \times 9}{8 \times 9} = \frac{81}{72}$ $\frac{2}{1} = \frac{2 \times 72}{1 \times 72} = \frac{144}{72}$ $\frac{29}{6} = \frac{29 \times 12}{6 \times 12} = \frac{348}{72}$

$\frac{7}{9} = \frac{7 \times 8}{9 \times 8} = \frac{56}{72}$ $\frac{16}{3} = \frac{16 \times 24}{3 \times 24} = \frac{384}{72}$

Arrange the fractions in ascending order: $\frac{56}{72} < \frac{81}{72} < \frac{144}{72} < \frac{348}{72} < \frac{384}{72}$.

Which gives: $\frac{7}{9} < \frac{9}{8} < 2 < \frac{29}{6} < 5\frac{1}{3}$.

Arrange the fractions in descending order: $5\frac{1}{3} > \frac{29}{6} > 2 > \frac{9}{8} > \frac{7}{9}$.

Exercise 1.2

1. **Write the following as fractions.**

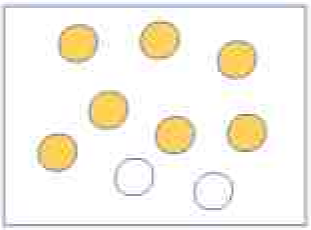
a. four-ninths

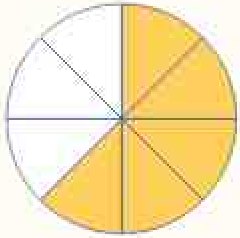
b. three-hundredths

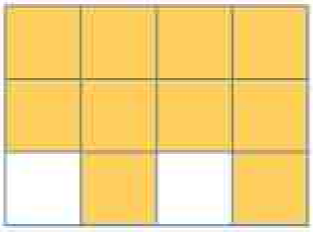
c. seven-elevenths

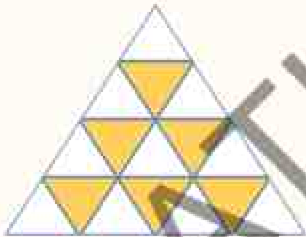
d. thirty-seven thousandths

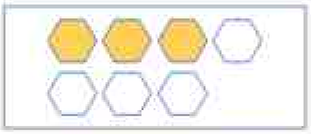
2. Fill in the boxes with the fractions represented by the shaded parts of the figures.

a.  □

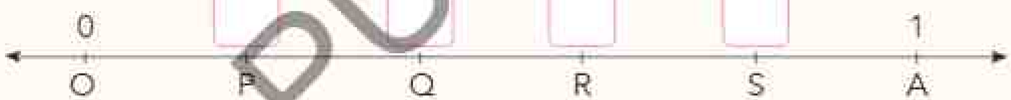
d.  □

b.  □

e.  □

c.  □

3. Fill in the boxes to show what points P, Q, R, and S represent in the figure.



4. Separate the following into groups of proper fractions, improper fractions, and mixed fractions.

$$\frac{6}{1},\ 8\frac{3}{4},\ \frac{1}{7},\ 5\frac{2}{3},\ \frac{13}{14},\ \frac{1}{5},\ \frac{3}{2},\ 2\frac{1}{2},\ \frac{15}{7},\ \frac{20}{9},\ \frac{100}{77},\ \frac{7}{10}$$

Proper fractions : ______________________

Improper fractions : ______________________

Mixed fractions : ______________________

5. Fill in the box with the correct sign <, >, or =.

a. $\frac{17}{20}$ □ $\frac{4}{5}$ b. $3\frac{1}{4}$ □ $\frac{13}{4}$ c. $\frac{51}{10}$ □ 3 d. $\frac{3}{5}$ □ $\frac{5}{3}$

Rational Numbers

A rational number is a number that can be written as $\frac{p}{q}$ ($q \neq 0$), where p and q are integers.

Examples of rational numbers are $\frac{2}{7}, \frac{-4}{3}, \frac{-6}{7}, \frac{11}{-8}$, and $\frac{-6}{-5}$.

In a rational number written as $\frac{p}{q}$, p is called the numerator and q is the denominator.

All integers are rational numbers because every integer can be written in the form $\frac{p}{q}$, where $q = 1$.

For example: $5 = \frac{5}{1}$ and $-10 = \frac{-10}{1}$

Zero can also be written as $\frac{0}{1}$; therefore, 0 is also a rational number.

When a rational number is written in decimal form, the decimal either terminates or repeats in a pattern.

For example, $-\frac{1}{2} = -0.5$ is a terminating decimal, while $\frac{1}{3} = 0.33333\ldots$ is a repeating decimal.

Take Note!

All fractions are rational numbers, but not all rational numbers can be written as fractions.

Addition of Integers

We have been adding both small and large whole numbers, such as 5 + 3 or 325 + 154. Now, we are going to learn how to add integers, including adding a negative integer to a positive integer and adding two negative integers.

Addition of Positive and Negative Integers

Let us find 5 + (–3).

Adding –3 to 5 is like earning 5 points in a quiz and then making a mistake that costs you 3 points. In this case, your total score is 2 points. So, 5 + (–3) = 2.

Another way to explain this concept:

Let +5 be represented by a movement of 5 steps upward, and

–3 be represented by a movement of 3 steps downward.

So, 5 + (–3) means 5 steps upward, followed by 3 steps downward.

Thus, 5 + (–3) = 2.