

Understanding NUMBERS

(A course on Mathematics)



As per
the New Curriculum
published by the Council for
the Indian School Certificate
Examinations for the Upper
Primary Level

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impression

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published by the **Council for**
the Indian School Certificate
Examinations for the **Upper**
Primary Level

Understanding Numbers

(A course on Mathematics)

Class 7



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UNDERSTANDING NUMBERS (CLASS 7)

First Edition 2017

Reprint Edition 2018

ISBN: 978-93-5259-607-2

PRODUCT CODE: MDS2UNN070MATAA17ICN

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Preface

Understanding Numbers is a series of ten textbooks of mathematics for classes Primer A, Primer B, 1 to 8 as per the **New Curriculum** published by the **Council for the Indian School Certificate Examinations**.

Systematically laid down, this series is a result of years of research and analysis, to help students encourage the study of mathematics in the best interactive form. It contains ample practice material, attractive illustrations, and real life examples for the students to relate the topics with their everyday life.

Special care has been taken while teaching topics like geometry and probability to the students.

Salient features of this series are as follows:

- **Practice Time** (in Primer A, Primer B, classes 1 and 2)
- **Mixed Practice** (in classes 3 to 8) after select chapters to consolidate concepts and develop calculation skills
- **Revision Exercise** containing objective type questions for quick assessment of student's understanding
- **Challenge Me!** to help students develop skills for solving tricky questions
- **Remember** to help students easily recapitulate the key concepts and new facts
- **Fun Activities** to help students understand mathematics in a play-way manner
- **Points to Remember** is a summary of the concepts studied in the chapter

Features like **Do You know?**, **Explore More** as well as **Maths & Mathematicians** have also been added from classes 6 to 8.

Teacher's Support Components

(available for Teachers of User Schools ONLY) comprises

- **Teacher's support book** containing Photocopiable Worksheets, Lesson Plans and much more
- **Web support** at www.websupport.madhubunbooks.com containing worksheets that can be downloaded
- **CD** containing Interactive exercises

It is hoped that students will enjoy learning from this series.

—The Publisher

Curriculum

Number System

- Multiplication and division of integers
- Properties of operations on integers: Commutativity, associativity, existence of identity and inverse and distributivity
- Problem solving using operations on integers
- Solution of word problems involving integers (all operations)
- Introduction to rational numbers (with representation on number line)
- Word problems on rational numbers (all operations)
- Decimal representation of rational numbers
- Problem solving using operations on rational numbers and decimal fractions
- Fraction as an operator
- Reciprocal of a fraction
- Multiplication and division of decimal fractions
- Exponents only natural numbers.
- Laws of exponents (through observing patterns to arrive at generalisation.)
- Application of laws of exponents in simple daily life problems
- Revision idea of sets
- Equal, equivalent, universal sets
- Cardinal property of sets

Ratio and Proportion

- Ratio and proportion (revision)
- Unitary method continued, consolidation, general expression for unitary method
- Percentage- an introduction.
- Understanding percentage as a fraction with denominator 100
- Converting fractions and decimals into percentage and vice-versa.
- Application to profit and loss (single transaction only)
- Application to simple interest (time period in complete years).
- Speed, distance, time

Algebra

- Terms related to algebra like constants, variable, terms, coefficient of terms, like and unlike terms, etc.
- Generate algebraic expressions
- Performs operations (addition and subtraction) on algebraic expressions with integral coefficients only
- Simple linear equations in one variable (in contextual problems) with two operations.
- Inequalities and solution of simple inequalities in one variable

Geometry

(i) Understanding shapes:

- Pairs of angles (linear, supplementary, complementary, adjacent, vertically opposite)
- Properties of parallel lines with transversal (alternate, corresponding, interior, exterior angles)

(ii) Properties of triangles:

- Angle sum property
- Exterior angle property
- Pythagoras Theorem (Verification only)

(iii) Symmetry

- Recalling reflection symmetry
- Idea of rotational symmetry, observations of rotational symmetry of 2-D objects. (90° , 120° , 180°)

(iv) Representing 3-D in 2-D:

- Identification and counting of vertices, edges, faces, nets (for cubes, cuboids, and cylinders, cones).
- Mapping the space around approximately through visual estimation.

(v) Congruence

- Congruence through superimposition
- Extend congruence to simple geometrical shapes e.g. triangles, circles.
- Criteria of congruence

(vi) Construction

- Construction of a line parallel to a given line from a point outside it
- Construction of simple triangles.

Mensuration

- Revision of perimeter and Idea of Circumference of Circle
- Area
 - Concept of measurement using a basic unit area of a square, rectangle, triangle, parallelogram and circle, rings and combined figures.

Data Handling

- Collection and organisation of data – choosing the data to collect for a hypothesis testing
- Mean, median and mode of ungrouped data – understanding what they represent
- Constructing and interpreting bar graphs
- Feel of probability using data through experiments. Notion of chance in events like tossing coins, dice etc. Tabulating and counting occurrences of 1 through 6 in a number of throws. Comparing the observation with that for a coin. Observing strings of throws, notion of randomness.

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Integers



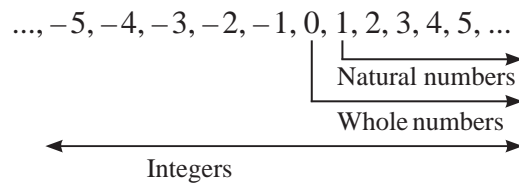
INTRODUCTION

In class VI, we have studied about natural numbers, whole numbers, and integers, representation of integers on the number line, their ordering and comparison. We also learnt the addition and subtraction of integers. In this class, we shall learn multiplication, division and other properties of integers. Before proceeding further, let us recall briefly what we have learnt earlier.

Counting numbers 1, 2, 3, 4, ... are called **natural numbers**.

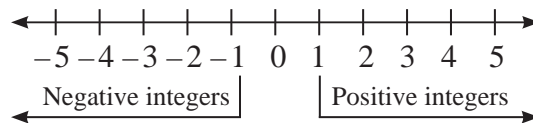
All counting numbers along with 0 are called **whole numbers**, that is, numbers 0, 1, 2, 3, 4, ... are called whole numbers.

Now, consider the following numbers:



Thus, the system of whole numbers together with the negative numbers is called **integers**.

We can represent the integers on a number line. Some integers represented on the number line are shown below.



More About Integers

Note the following important points about integers.

- -1 is the greatest negative integer.
- 1 is the smallest positive integer.
- 0 (zero) is an integer which is neither positive nor negative.
- On the number line, numbers to the right of zero are positive integers and numbers to the left of zero are negative integers.



Absolute Value of Integers

For any integer a , the absolute value (modulus) of a is a itself, that is

$$|a| = |-a| = a.$$

Absolute value or the Modulus of a is denoted by $|a|$.

Example Write the absolute value of the following:

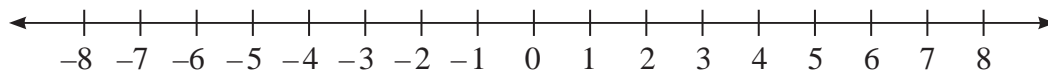
(a) -9 (b) $12 - 3$ (c) $5 - 9$

Solution (a) $|-9| = 9$ (b) $|12 - 3| = |9| = 9$ (c) $|5 - 9| = |-4| = 4$

Comparing and Ordering of Integers

An integer a is greater than integer b , if a lies on the right of b on the number line.

Example Compare: (a) -5 and 4 (b) 6 and 3 (c) -8 and -4



Solution (a) Since -5 lies to the left of 4 on the number line, so $-5 < 4$.
(b) Since 6 lies to the right of 3 on the number line, so $6 > 3$.
(c) Since -8 lies to the left of -4 on the number line, so $-8 < -4$.

Example Arrange $-4, -1, 0, 2, 8, -3, -7, 5$ in ascending order.

Solution The given numbers in ascending order will be written as $-7, -4, -3, -1, 0, 2, 5, 8$.

Exercise 1.1

- Write the integers between
 - 0 and 5
 - -1 and 3
 - -6 and -2
- Which of the following is a greater integer?
 - 0 or 8
 - -3 or 4
 - -8 or -11
- Represent the following integers on the number line:
 - two more than -9
 - four less than 12
 - five less than -8
- Write the absolute value of:
 - 0
 - -5
 - 1
 - 9
- Arrange the following integers in ascending order:
 - $5, -12, 0, -9$
 - $3, -1, 31, -19$
- Arrange the following integers in descending order:
 - $-2, -7, 0, 10$
 - $-1, 2, 4, 0$

ADDITION AND SUBTRACTION OF INTEGERS

- While adding two integers of the same sign, we simply add the numbers and put the same sign with the resultant.

For example, $(+9) + (+6) = 15$

$$(-9) + (-6) = -15$$





- While adding two integers of opposite signs we subtract the numbers and put the sign of the greater number with the resultant.

For example, $(+9) + (-6) = 3$
 $(-9) + 6 = -3$

- When two opposite (a positive and a negative) signs are given together, the result is a negative sign.

For example, $(-9) - (+6) = -9 - 6 = -15$
 $(-9) + (-6) = -9 - 6 = -15$

- When two negative signs are given together the result is a positive sign.

For example, $(-9) - (-6) = -9 + 6 = -3$
 $(-6) - (-9) = -6 + 9 = +3$

Example Find the sum of

(a) 65 and (-90) (b) -155 and -30

Solution (a) $65 + (-90) = 65 - 90 = -25$
 (b) $-155 + (-30) = -155 - 30 = -185$

Example Subtract

(a) 82 from -100 (b) -25 from (-45)

Solution (a) $-100 - 82 = -182$ (b) $-45 - (-25) = -45 + 25 = -20$

Properties of Addition and Subtraction of Integers

Closure property

Observe the following:

- $7 + 3 = 10$, is an integer
- $7 - 3 = 4$, is an integer
- $-8 - 5 = -13$, is an integer
- $-6 + 1 = -5$, is an integer

We noticed that the sum or difference of two integers is also an integer.

So, we can say that integers are closed under addition and subtraction.

Thus, if a and b are two integers, then $a + b$ or $a - b$ is also an integer.

Commutative property

Observe the following:

- $7 + 3 = 3 + 7 = 10$
- $(-8) + (-5) = (-5) + (-8) = -13$
- $-6 + 1 = 1 + (-6) = -5$
- $7 + (-3) = -3 + 7 = 4$
- $(-5) - (-4) \neq (-4) - (-5)$

The sum of the integers doesn't change if we change the order of the integers but the difference of the integers may vary if we change the order of the integers.

So, we can say that integers are always commutative under addition but the same can't be said about subtraction.

That is, if a and b are two integers, then $a + b = b + a$ and $a - b \neq b - a$.

Associative property

Observe the following:

- $(2 + 5) + 1 = 2 + (5 + 1)$
- $(-3 + 1) + 5 = -3 + (1 + 5)$
- $(-2 - 5) - 1 \neq -2 - (5 - 1)$
- $(8 - 3) - 4 \neq 8 - (3 - 4)$



The sum of the integers doesn't change if we change the order of the group but the difference of the integers may vary if we change the order of the group.

So, we can say that integers, are always associative under addition but the same can't be said about subtraction. That is, if a , b , and c are three integers, then $(a + b) + c = a + (b + c)$ and $(a - b) - c \neq a - (b - c)$.

Additive identity

Observe the following:

- $5 + 0 = 5$
- $0 + 2 = 2$
- $(-3) + 0 = -3$
- $0 + (-8) = -8$
- $0 - (+2) = -2$
- $0 - (-8) = 8$

The sum of any integer and zero (0) is the integer itself but the difference of an integer with zero (0) may not always be the same integer.

So, we can say that zero (0) is the additive identity of integers.

That is, if a is an integer, then $a + 0 = 0 + a = a$

Additive inverse

Observe the following:

- $5 + (-5) = 0$
- $(-6) + 6 = 0$

The sum of a number and its negative is zero (0).

So, we can say that if a is an integer, then $-a$ is the additive inverse of a .

Successor

Observe the following:

- $5 + 1 = 6$, successor of 5
- $-9 + 1 = -8$ successor of -9

If 1 is added to an integer, we get its successor.

That is, if a is an integer, then $a + 1$ is always the successor of a .

Predecessor

Observe the following:

- $5 - 1 = 4$, predecessor of 5
- $-9 - 1 = -10$, predecessor of -9

If 1 is subtracted from an integer, we get its predecessor.

That is, if a is an integer, then $a - 1$ is always the predecessor of a .

Exercise 1.2

1. Write the absolute value of the following:

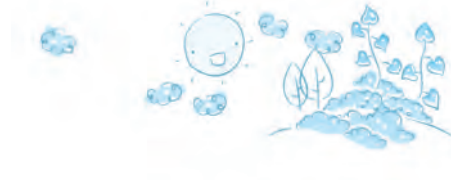
- a. 0
- b. 6
- c. -4
- d. -9
- e. $5 - 0$
- f. $0 - 9$
- g. $8 + 2$
- h. $-2 - 7$

2. Using the number line, write the integer which is

- a. 3 more than 4
- b. 6 less than -4
- c. 9 less than 2
- d. 8 more than -9

3. Write a pair of integers whose

- a. sum is 6
- b. difference is -10
- c. sum is 0
- d. difference is -7



4. Write the additive inverse of the following:
- a. 5 b. -7 c. -9 d. -255
5. Add the following integers:
- a. -498, 320 b. 265, -65 c. 99005, -360 d. -15, -265
- e. 1935, -289, -81 f. -50, -45, -72, -82
6. Find the sum of the following:
- a. $(-1) + (-304) + 304 + (-304) + 10$ b. $1142 + 512 + (-256) + (-128) + 64$
- c. $200 + (-66) + (-43)$ d. $(-913) + (-18) + 9 + (-81)$
7. In four rounds of a quiz competition, a team scored 6, 10, 9, and -3 marks. Find the final score of the team.
8. Subtract the sum of 60 and 269 from -35.
9. Subtract -7 from 5. Also, subtract 5 from -7. Are the two results the same?
10. Fill in the blanks to make each of the following statements true:
- a. _____ + 16 = 0 b. $(-3) + 4 = 4 + \text{_____}$
- c. $63 + \text{_____} = -63$ d. $(-6) + (7) + (-8) = (-8) + (-6) + \text{_____}$
- e. $0 - 9 = \text{_____}$ f. _____ + (-5) = (-7) + (-5)

MULTIPLICATION OF INTEGERS

We know that $3 + 3 + 3 + 3 = 12$ or $4 \times 3 = 12$
 $6 + 6 + 6 + 6 = 24$ or $4 \times 6 = 24$
 $(-6) + (-6) + (-6) + (-6) = -24$ or $4 \times (-6) = -24$

Further, we know that $4 \times 3 = 3 \times 4$

- To find the product of two integers with unlike signs, we find the product of their absolute values and assign negative (-) sign to the product.

Example Find the product of $30 \times (-5)$.
Solution $30 \times 5 = 150$ since $|30| = 30$, $|5| = 5$
 Hence, $30 \times (-5) = -(30 \times 5) = -150$

- To find the product of two integers with like sign, we find the product of their absolute values and assign positive (+) sign to the product.

Example Find the product of 35×5 .
Solution $35 \times 5 = |35| \times |5| = 175$
 Hence, $35 \times 5 = 175$

- If the number of negative integers in a product is even, then the product is positive. If the number of negative integers in a product is odd, then the product is negative.

Example $(-6) \times (-6) \times (-6) \times (-6) \times (-6) \times (-6) = 46656$ (Here, -6 is occurring six times or an even number of times, so the product is positive).
 $(-6) \times (-6) \times (-6) = -216$ (Here, -6 is occurring three times or an odd number of times, so the product is negative).



Example Find the products of the following:

(a) $(-5) \times (-6) \times (-2)$

(b) $(-3) \times (-1) \times (-4) \times (-7)$

Solution (a) $(-5) \times (-6) \times (-2) = -60$

(b) $(-3) \times (-1) \times (-4) \times (-7) = 84$

Properties of Multiplication of Integers

Closure property

Observe the following:

- $75 \times 2 = 150$
- $7 \times (-3) = -21$
- $(-8) \times (-5) = 40$
- $-6 \times 1 = -6$

The product of two integers is an integer.

We can say that the integers are closed under multiplication.

That is, if a and b are two integers, then $a \times b$ is an integer.

Commutative property

Observe the following:

- $7 \times 3 = 3 \times 7 = 21$
- $(-8) \times (-5) = (-5) \times (-8) = 40$
- $-6 \times 1 = 1 \times (-6) = -6$
- $7 \times (-3) = -3 \times 7 = -21$

The product of two integers doesn't change if we change the order of the integers.

We can say that the integers are always commutative under multiplication.

That is, if a and b are two integers, then $a \times b = b \times a$

Associative property

Observe the following:

- $(2 \times 5) \times 1 = 2 \times (5 \times 1)$
- $(-3 \times 1) \times 5 = -3 \times (1 \times 5)$
- $[(-2) \times (-5)] \times (-1) = -2 \times [(-5) \times (-1)]$

The product of the integers doesn't change if we change the order of the group.

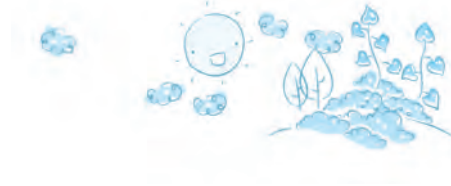
We can say that the integers are always associative under multiplication.

That is, if a , b , and c are three integers, then $(a \times b) \times c = a \times (b \times c)$

Multiplicative identity

Observe the following:

- $5 \times 1 = 5$
- $1 \times 8 = 8$
- $-9 \times 1 = -9$
- $1 \times (-3) = -3$



The product of any integer with one (1) is the integer itself.

We can say that one (1) is the multiplicative identity of integers.

That is, if a is an integer, then $a \times 1 = 1 \times a = a$

Multiplicative inverse

Observe the following:

- $5 \times \frac{1}{5} = 1$
- $\frac{1}{8} \times 8 = 1$
- $-9 \times \left(\frac{-1}{9}\right) = 1$
- $-\frac{1}{3} \times (-3) = 1$

The product of any integer with its reciprocal is always 1.

We can say that $\frac{1}{a}$ is the multiplicative inverse of a .

That is, if a is an integer, then $a \times \frac{1}{a} = \frac{1}{a} \times a = 1$

Distributive property

- Over addition: $5 \times (1 + 6) = (5 \times 1) + (5 \times 6)$
- Over subtraction: $5 \times (1 - 6) = (5 \times 1) - (5 \times 6)$

We can say that integers possess distributive property over addition and subtraction.

That is, if a , b , and c are three integers, then $a \times (b + c) = a \times b + a \times c$ and $a \times (b - c) = a \times b - a \times c$

Example Find the product using the associative property of integers:

(a) $(-14) \times 25 \times (-8)$ (b) $(-30) \times 5 \times (-2) \times (-4)$

Solution (a) $(-14) \times 25 \times (-8) = (-14) \times [25 \times (-8)]$
 $= -14 \times (-200)$
 $= 2800$

(b) $(-30) \times 5 \times (-2) \times (-4) = (-30) \times (-10) \times (-4)$
 $= 300 \times (-4)$
 $= -1200$

Example Solve the following using any suitable property of integers:

(a) 52×6 (b) 99×7

Solution (a) $52 \times 6 = (50 + 2) \times 6$
 $= 50 \times 6 + 2 \times 6$
 $= 300 + 12$
 $= 312$

(b) $99 \times 7 = (100 - 1) \times 7$
 $= 100 \times 7 - 1 \times 7$
 $= 700 - 7$
 $= 693$



DIVISION OF INTEGERS

We know that the division operation is the inverse of multiplication. The rules for the division of integers are also obtained from the rules for the multiplication of integers.

Multiplication fact

$$6 \times 4 = 24$$

$$(-3) \times (-6) = 18$$

$$36 \times (-3) = -108$$

Corresponding division facts

$$24 \div 6 = 4; 24 \div 4 = 6$$

$$18 \div (-3) = -6; 18 \div (-6) = -3$$

$$-108 \div 36 = -3; -108 \div (-3) = 36$$

Thus, we note the following:

- If both the dividend and the divisor are of the same sign (like sign, that is, both are positive or both are negative), the quotient is always positive.
- If the dividend and the divisor are of opposite signs, then the quotient is negative.

Properties of Division

Closure property

Observe the following:

- $8 \div 2 = 4$
- $5 \div 3 = \frac{5}{3}$ is not an integer.
- $-8 \div 5 = \frac{-8}{5}$ is not an integer.

The quotient of two integers is not always an integer.

We can say that the integers are not closed under division.

That is, if a and b are two integers, then $a \div b$ is not always an integer.

Commutative property

Observe the following:

- $7 \div 3 \neq 3 \div 7$
- $(-8) \div (-5) \neq (-5) \div (-8)$
- $-6 \div 1 \neq 1 \div (-6)$

The quotient of integers change if we change the order of integers.

We can say that the integers are not commutative under division.

That is, if a and b are two integers, then $a \div b \neq b \div a$.

Associative property

Observe the following:

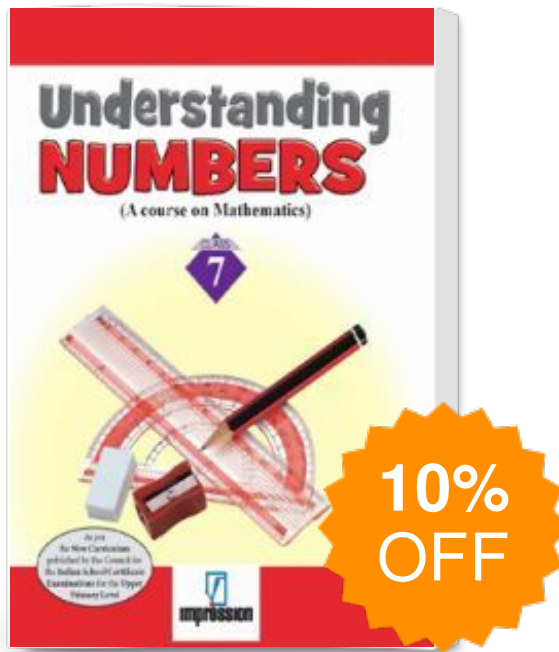
- $(2 \div 5) \div 1 \neq 2 \div (5 \div 1)$
- $(-3 \div 1) \div 5 \neq -3 \div (1 \div 5)$

The quotient of the integers change if we change the order of the group.

We can say that the integers are not associative under division.

That is, if a , b , and c are three integers, then $(a \div b) \div c \neq a \div (b \div c)$

Understanding Numbers For Class - 7



Publisher : Madhubun Books

ISBN : 9789352596072

Author : C. Sailaja, Smita
Ratish, Lata Wishram

Type the URL : <http://www.kopykitab.com/product/20473>



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