GOVERNMENT OF TAMILNADU

VII STANDARD

MATHEMATICS

Term - I

Volume-2

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Department of School Education

Untouchability is Inhuman and a Crime

Mathematics is a unique symbolic language in which the whole world works and acts accordingly. This text book is an attempt to make learning of Mathematics easy for the students community.

Mathematics is not about numbers, equations, computations or algorithms; it is about understanding

— William Paul Thurston

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The main goal of Mathematics in School Education is to mathematise the child's thought process. It will be useful to know how to mathematise than to know a lot of Mathematics.

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Chapter 1

NUMBER SYSTEM

$a \times (b+c) = (a \times b) + (a \times c)$

ID45NR

Learning objectives

- To understand the concept of addition and subtraction of integers.
- To understand the concept of multiplication and division of integers.
- To understand the properties of four fundamental operations applied to integers.
- To solve applied problems using the four fundamental operations on integers.

Recap

Integers are a collection of natural numbers, zero and negative numbers.

We denote this collection by $\mathbb{Z}$.

Negative integers are represented on the number line to the left of zero and positive integers to the right of zero.

Fig. 1.1

Every integer on this number line is placed in an increasing order from left to right.

The integers at each point A, B, C, D in the figure given below are $A = +3$, $B = +7$, $D = -1$ and $C = -5$.

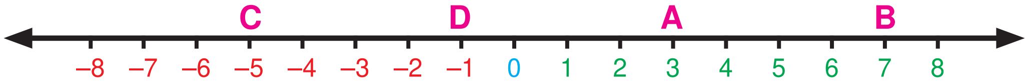


Fig. 1.2

Try these

1. Write the following integers in ascending order:
   –5, 0, 2, 4, –6, 10, –10
2. If the integers –15, 12, –17, 5, –1, –5, 6 are marked on the number line then the integer on the extreme left is ____________.
3. Complete the following pattern:
   50, ___, 30, 20, _____, 0, -10, ____, ____, -40, ____, ____.
4. Compare the given numbers and write "<", ">" or "=" in the boxes.
   (a) –65 ☐ 65 (b) 0 ☐ 1000 (c) –2018 ☐ –2018
5. Write the given integers in descending order :
   –27, 19, 0, 12, –4, –22, 47, 3, –9, –35

1.1 Introduction

In class VI, we studied how to compare and arrange integers. Now, let us try to add and subtract integers.

We know 7–5 = 2. But, what is 5–7? Let us try to take away 7 from 5 using the number line. As the integers on the number line increases from left to right, we should move to the left of zero to do this subtraction.

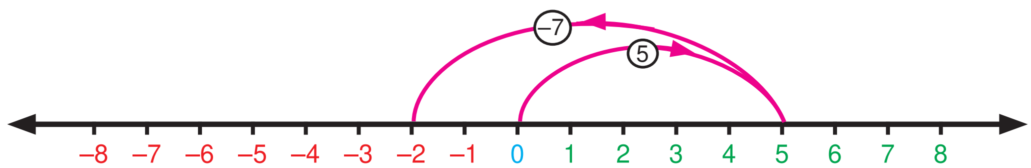
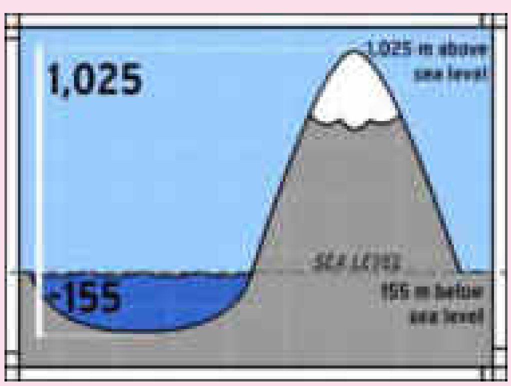


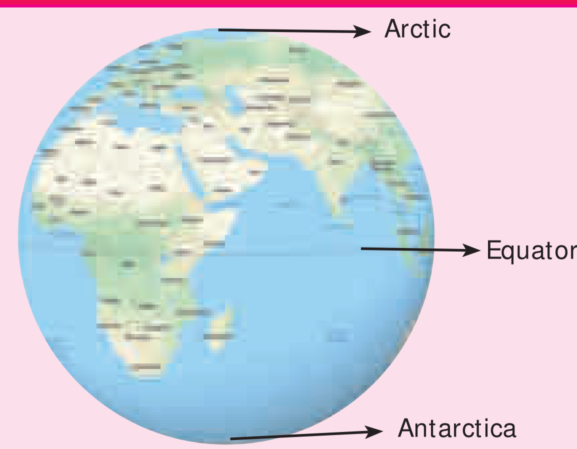
Fig. 1.3

Is it really necessary to do this? Have you come across any such situations in life? Yes, there are situations like increase or decrease in temperature, amount deposited and withdrawn from an account, profit and loss in a business are all instances where integers are involved.

MATHEMATICS ALIVE – NUMBER SYSTEM IN REAL LIFE



Mountain, below and above sea level.



Termperature is < 0°C in Antarctica and Arctic, >0°C in Equator.

1.2 Addition of Integers

The number line is a simple tool to visualise addition of integers. Let us do an activity with the number line.

Imagine that the number line is a road with markers on it. We are allowed to step forward or backward on this road. One step taken is equal to one unit of number. Initially we start at zero and face positive direction. We step forward for positive integers and backward for negative integers. We maintain the same positive direction for addition operation.

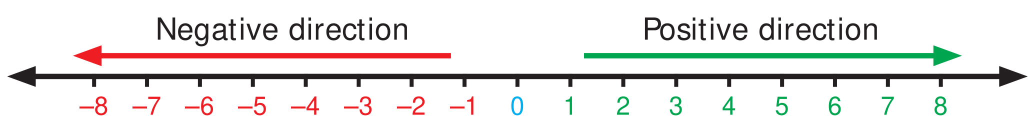


Fig. 1.4

To add (+5) and (–3), We start at zero facing positive direction and move five steps forward to represent (+5). Since the operation is addition we maintain the same direction and move three units backward to represent (–3). We land at +2. So, (+5)+(–3)=2. This is shown in Fig.1.5.

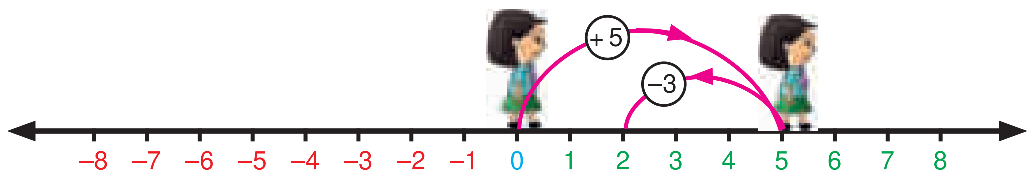


Fig. 1.5

Proceeding in the same way let us try another example. Find the sum of (–6) and (–4). We start at zero facing positive direction continuing in the same direction and move 6 units backward to represent (–6) and in the same direction move 4 units backward to represent (–4). We land at (–10).

Therefore, (–6)+(–4)=–10

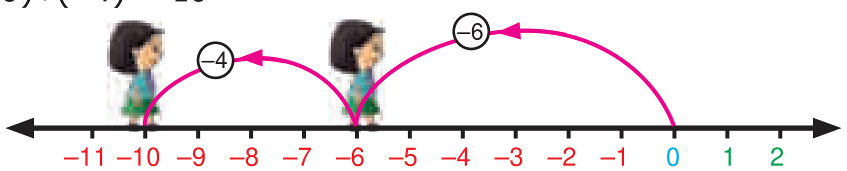


Fig. 1.6

Try this

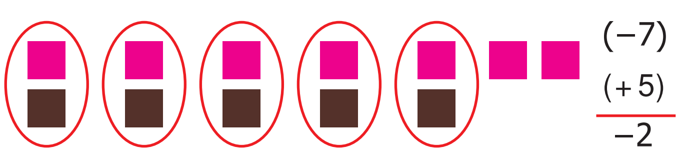
Find the value of the following using the number line activity:

(i) (–4) + (+3) (ii) (–4) + (–3) (iii) (+4) + (–3)

Activity

There are two bowls with tokens of two different colours brown and pink. Let us denote one brown token by (+1) and one pink token by (–1). A pair of tokens, brown (+1) and pink (–1), will denote zero [1+(–1)=0]

To add two integers, we pick the required number of tokens and form possible zero pairs. The remaining number of tokens left after pairing is the sum of the two integers.



To add (–7) and (+5) we pick 7 pink tokens and 5 brown tokens. We form zero pairs from the tokens as above. We can form 5 zero pairs. Then we are left with 2 pink tokens. Hence, $(-7)+(+5)=-2$.

(−3) (+) (−4) = −7

To add (−3) and (−4) we pick 3 pink tokens first and 4 pink tokens later. The total number of tokens is 7 pink tokens. There are no zero pairs. So, the sum of (−3) and (−4) is (−7). Teacher can give different integers and ask them to add using tokens.

Note

1. When we add two integers of the same sign the sum will also be an integer of the same sign. When we add two integers of different sign, the sum will be the difference between the two integers and have the sign of the integer with greater value.
2. The integer wihtout sign represents positive interger.

Example 1.1

Add the following integers using number line (i) 10 and −15 (ii) −7 and −9

Solution Let us add the intergers using number line

(i) 10 and −15

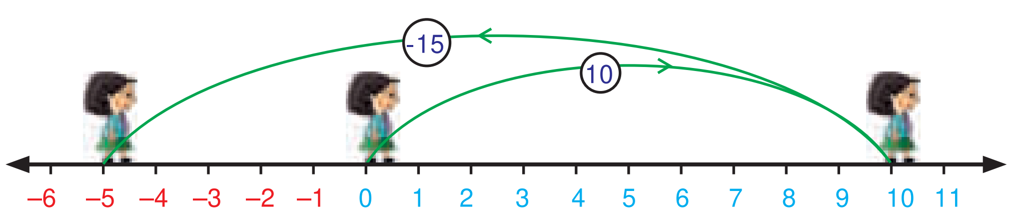


Fig. 1.7

On the number line we first start at zero facing positive direction and move 10 steps forward, reaching 10. Then we move 15 steps backward to represent −15 and reach at −5. Thus, we get 10 + (−15) = −5.

(ii) −7 and −9

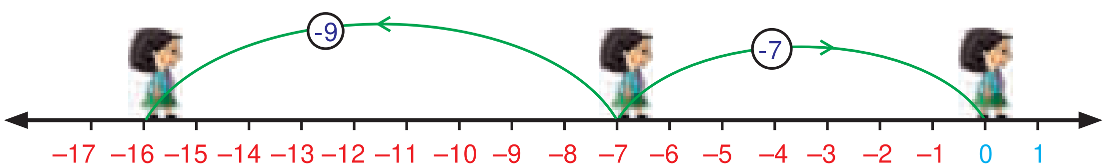


Fig. 1.8

On the number line we first start at zero facing positive direction and move 7 steps backward, reaching –7. Then we move 9 steps backward to represent –9 and reach at –16. Thus, we get (–7) + (–9) = –16.

Example 1.2

Add (i) (–40) and (30) (ii) 60 and (–50)

Solution (i) (–40) and (30)

–40 + 30 = –10

(ii) 60 and (–50)

60 + (–50) = 60 – 50 = 10

Example 1.3

Add: (i) (–70) and (–12) (ii) 103 and 39.

Solution (i) (–70) + (–12) = –70 – 12 = – 82

(ii) 103 + 39 = 142

Example 1.4

A submarine is at 32 feet below the sea level. Then it moves up 8 feet. Find the depth of the submarine.

Solution A submarine is 32 feet below sea level.

Therefore, it is represented by –32

Next it moves up 8 feet.

Moves above is represented as +8

The depth of the submarine = –32 + 8 = –24

Therefore, the submarine is located at 24 feet below the sea level.

Example 1.5

Sita saved ₹ 225.00 and she has spent ₹ 400 on credit basis for the purchase of stationery. Find her due amount.

Solution The amount Sita has ₹ 225

The amount spent for stationery on credit = ₹ 400

The due amount to be paid = ₹ 225 – ₹ 400 = – ₹ 175

Therefore, Sita has to pay ₹ 175

Example 1.6

From the ground floor a man went up six floors and came down six floors. In which floor is he now?

Solution Starting point = Ground floor

Number of floors climbed up = +6

Number of floors climbed down = –6

Now the landing point = +6 – 6 = 0 (ground floor)

1.2.1 Properties of Addition

In class VI, we have studied that the collection of whole numbers is closed under the addition operation. The sum of two whole numbers is always a whole number. Does this property hold for the collection of integers also?

Complete the given table and check whether the sum of two integers is an integer or not?

(i) $7+(-5)=$	(ii) $(-6)+(-13)=$	(iii) $25+9=$
(iv) $(-12)+4=$	(v) $41+32=$	(vi) $(-19)+(-15)=$
(vii) $52+(-15)=$	(viii) $(-7)+0=$	(ix) $0+12=$
(x) $14+0=$	(xi) $(-6)+(-6)=$	(xii) $(-27)+0=$

We observe that in all the above cases the sum of two integers is an integer. Since addition of integers is an integer, we say that integers are closed under addition. This property is known as "closure property" of integers on addition.

Therefore, for any two integers a, b; $a+b$ is also an interger.

We observe one more property of integers. The order in which we add two integers does not matter. For example, $12+(-13)$ is the same as $(-13)+(12)$. Also $(-7)+(-5)$ is the same as $(-5)+(-7)$.

This property is known as "commutative property" of integers.

Therefore, for any two integers a, b; $a+b = b+a$.

What happens when we add three integers? For example, will $(-7)+(-2)+(-9)$ give the same value when they are added in any way of grouping.

Let us check by grouping the integers as [(–7)+(–2)]+ (–9) and (–7) + [(–2) + (–9)]. First let us find the value of [(–7)+(–2)]+ (–9).

$[(-7)+(-2)]+(-9) = (-9) + (-9) = -9 - 9 = -18$

Let us illustrate this with the number line : $[(-7)+(-2)]+(-9)$ can be represented as

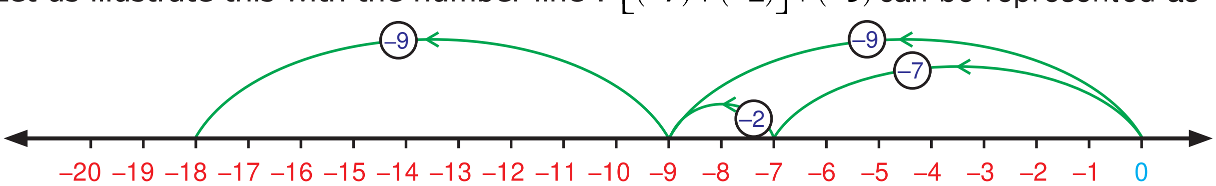


Fig. 1.9

$$[(-7)+(-2)]+(-9)=(-18)$$

Then we will find the value of (–7) + [(–2) + (–9)]

$(-7) + [(-2) + (-9)] = (-7) + (-11) = -7 - 11 = -18$

(–7) + [(–2) + (–9)] can be represented on the number line as below.

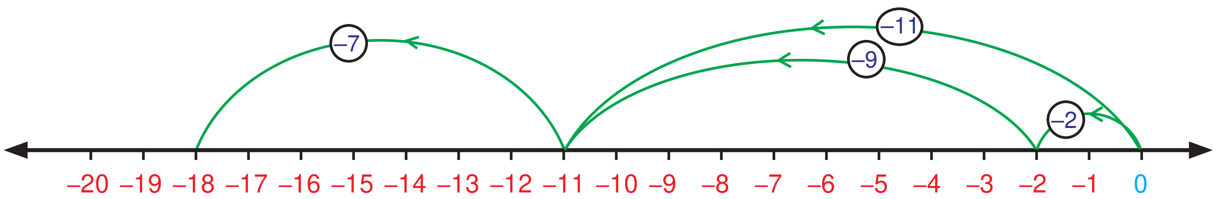


Fig. 1.10

$$(-7)+[(-2)+(-9)]=(-18)$$

We reach the same number –18 in both the cases. Hence, regrouping of integers does not change the value of the sum. This property is known as "associative property" under addition.

Therefore, for any three integers a, b, c; $a+(b+c)=(a+b)+c$

The collection of integers has positive, negative integers and zero. Have you noticed that zero is neither positive nor negative integer. What happens when we add zero to an integer?

For example, we observe that 7+0=7, (–3)+0 = (–3), (–27)+0 = (–27), (–79)+0 = (–79), 0+(–69) = (–69), 0+(–85) = (–85).

From the above it is clear that whenever zero is added to an integer, we get the same integer. Due to this property, zero is called the identity with respect to addition or "additive identity" of the collection of integers.

Therefore, for any integers a, $a+0=a=0+a$

The additive identity zero separates the number line into positive and negative integers. We have +1 and–1,+5 and –5,–15 and +15, etc. on opposite sides of the number line that are equidistant from zero. Such integers on either side of zero are called "opposites" of each other. In fact, we find that the "opposites" added together always give the value zero.

For example, $(-15)+15=0$, $21+(-21)=0$. This property of integers is named as "additive inverse". (–15) is the additive inverse of 15 because their sum is zero. In the same way, 21 is the additive inverse of -21. Either of the pair of opposites is known as the "additive inverse" of the other.

Therefore, for any integer a, $-a$ is the additive inverse.

$a+(-a)=0=(-a)+a$

Try these

1. Fill in the blanks:

   (i) $20+(-11)=\_\_\_+20$ (ii) $(-5)+(-8)=(-8)+\_\_\_$ (iii) $(-3)+12=\_\_\_+(-3)$

2. Say true or false.

   (i) $(-11)+(-8)=(-8)+(-11)$ (ii) $-7+2=2+(-7)$ (iii) $(-33)+8=8+(-33)$

3. Verify the following:

   (i) $[(-2)+(-9)]+6=(-2)+[(-9)+6]$ (ii) $[7+(-8)]+(-5)=7+[(-8)+(-5)]$

   (iii) $[(-11)+5]+(-14)=(-11)+[5+(-14)]$

   (iv) $(-5)+[(-32)+(-2)]=[(-5)+(-32)]+(-2)$

4. Find the missing integers:

   (i) 0 95 (ii) $-611+\_\_\_\_\_=-611$

   (iii) _____+0=______ (iv) $0+(-140)=\_\_\_\_\_$

5. Complete the following:

   (i) $-603+603=\_\_\_$ (ii) $9847+(-9847)=\_\_\_$ (iii) $1652+\_\_\_=0$

   (iv) $-777+\_\_\_=0$ (v) $\_\_\_+5281=0$

Example 1.7 (i) Are 120 + 51 and 51 + 120 equal?

(ii) Are $(-5)+[(-4)+(-3)]$ and $[(-5)+(-4)]+(-3)$ equal?

Solution

(i) When we add, 120 + 51 = 171 ; 51 + 120 = 171

In both the cases we get same answer. This means that integers can be added in any order. Hence, addition of integers is commutative.

(ii) $(-5)+[(-4)+(-3)]$ and $[(-5)+(-4)]+(-3)$

In $(-5)+[(-4)+(-3)]$, (-4) and (-3) are added first and their result is then added with (-5).

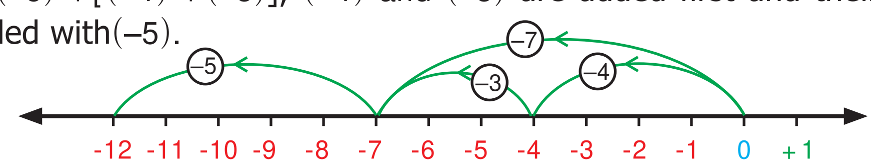


Fig. 1.11

$$(-5)+[(-4)+(-3)]=-12$$

Whereas in $[(-5)+(-4)]+(-3)$, (-4) and (-3) are added first and then the result is added with (-5)

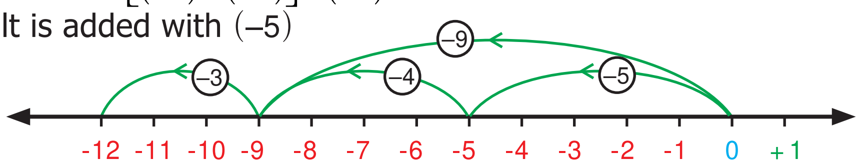


Fig. 1.12

$$[(-5)+(-4)]+(-3)=-12$$

In both the cases, we get -12

That is $(-5)+[(-4)+(-3)]=[(-5)+(-4)]+(-3)$

So, addition is associative.

Example 1.8 Find the missing integers (i) $0+(-2345)=\_\_\_\_\_\_$ (ii) $23479+\_\_\_\_\_=0$

Solution (i) $0+(-2345)=-2345$

(ii) $23479+(-23479)=0$

Therefore, additive inverse of 23479 is -23479

Example 1.9

Mention the property for the following equations:

(i) $(-45)+(-12)=-57$

(ii) $(-15)+7=(7)+(-15)$

(iii) $-10+3=-7$

(iv) $(-7)+(-5)=(-5)+(-7)$

(v) $(-7)+[(-4)+(-3)]=[(-7)+(-4)]+(-3)$

(vi) $0+(-7245)=-7245$

Solution

(i) Closure Property

(ii) Commutative Property

(iii) Closure Property

(iv) Commutative Property

(v) Associative Property

(vi) Additive Identity

Exercise 1.1

1. Fill in the blanks

(i) $(-30)+\_\_\_\_ = 60$

(ii) $(-5)+\_\_\_\_ = -100$

(iii) $(-52)+(-52)=\_\_\_\_$

(iv) $\_\_\_\_+(-22)=0$

(v) $\_\_\_\_+(-70) = 70$

(vi) $20+80+\_\_\_\_=0$

(vii) $75+(-25)=\_\_\_\_$

(viii) $171+\_\_\_\_=0$

(ix) $[(-3)+(-12)]+(-77)=\_\_\_\_+[(-12)+(-77)]$

(x) $(-42)+[\_\_\_\_+(-23)]=[\_\_\_\_+15]+\_\_\_\_$.

2. Say true or false.

(i) The additive inverse of (–32) is (–32)

(ii) $(-90)+(-30) = 60$

(iii) $(-125)+25 = -100$

3. Add the following

(i) 8 and –12 using number line

(ii) (–3) and (–5) using number line

(iii) $(-100)+(-10)$

(iv) $20+(-72)$

(v) $82+(-75)$

(vi) $-48+(-15)$

(vii) $-225+(-63)$

4. Thenmalar appeared for competitive exam which has negative scoring of 1 mark for each incorrect answer. In paper I she answered 25 questions incorrectly and in paper II, 13 questions incorrectly. Find the total reduction of marks.

5. In a quiz competition, Team A scored +30,–20, 0 and team B scored –20, 0, +30 in three successive rounds. Which team will win? Can we say that we can add integers in any order?

6. Are $(11+7)+10$ and $11+(7+10)$ equal? Mention the property.

7. Find 5 pairs of integers that add up to 2.