# CHAPTER 1

# Rational Numbers

## What will you learn?

- Integers
- Basic Arithmetic Operations Involving Integers
- Positive and Negative Fractions
- Positive and Negative Decimals
- Rational Numbers

## Why study this chapter?

Numbers play an important role in business and commerce, banking, engineering and others. Discuss the importance of numbers in these fields.

The World Climate Summit in Paris in 2015 discussed the issue of global warming. Global warming has caused the global average temperature to rise and consequently the glaciers in the North and South Poles have melted.

Today, the average temperature at the North and South Poles is below 0°C.

How is the value of temperature below 0°C represented as a number?

If one day, the temperature at the North and South Poles rises until 0°C, predict the impact on the Earth.

## Walking through Time

| | | | | |
|---|---|---|---|---|
| 251 | | 𝍠 | 𝍡 | 𝍩 |
| 4069 | 𝍡 | | 𝍢 | 𝍣 |
| -703 | | 𝍤 | | 𝍥 |

As early as 200 B.C., the Chinese had used bamboo rods to represent positive numbers and negative numbers. They used red rods to represent positive numbers and black rods to represent negative numbers. Negative numbers did not appear in Europe until the 15th century.

For more information:

http://goo.gl/X7Kr81

## Word Link

| | |
|---|---|
| • Identity Law | • *Hukum Identiti* |
| • Distributive Law | • *Hukum Kalis Agihan* |
| • Associative Law | • *Hukum Kalis Sekutuan* |
| • Commutative Law | • *Hukum Kalis Tukar Tertib* |
| • integer | • *integer* |
| • rational number | • *nombor nisbah* |
| • fraction | • *pecahan* |
| • decimal | • *perpuluhan* |
| • zero | • *sifar* |

*Open the folder downloaded from page vii for the audio of Word Link.*

# 1.1 Integers

## What are positive numbers and negative numbers?

**LEARNING STANDARDS**

Recognise positive and negative numbers based on real-life situations.

In our daily lives, we often encounter situations involving two opposite changes like moving towards right or towards left; going up or going down; working with values that are more than or less than zero; and adjusting to an increase or decrease of a value.

These situations can be represented using positive numbers and negative numbers. For instance,


- A lift going up two floors is written as +2 or 2.
- A lift going down one floor is written as –1.

- The temperature of 45°C at a desert is written as +45 or 45.

- The temperature of a glacier which is 10°C below 0°C is written as –10.

Numbers written with the '+' sign or without any sign like +2, +45 or 2, 45 are known as **positive numbers**.

Numbers written with the '–' sign like –1, –10 are known as **negative numbers**.


**Example 1**

Car $A$ moves 40 m towards the right while car $B$ moves 50 m towards the left. Represent the movements of car $A$ and car $B$ using a positive number or a negative number.


***Solution***

Assume that moving towards the right is represented by a positive number and moving towards the left is represented by a negative number.

Thus, the movement of car $A$, 40 m towards the right, is represented as 40 or +40; the movement of car $B$, 50 m towards the left, is represented as –50.

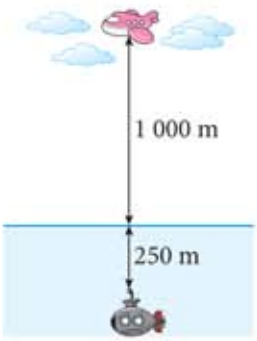
**Think Smart**

Can the movement towards left be represented with a positive number whereas the movement towards right be represented with a negative number? Explain.

## Self Practice 1.1a

1. For each of the following situations, represent the two opposite changes using a positive number and a negative number.

(a)




(b)


## What are integers?

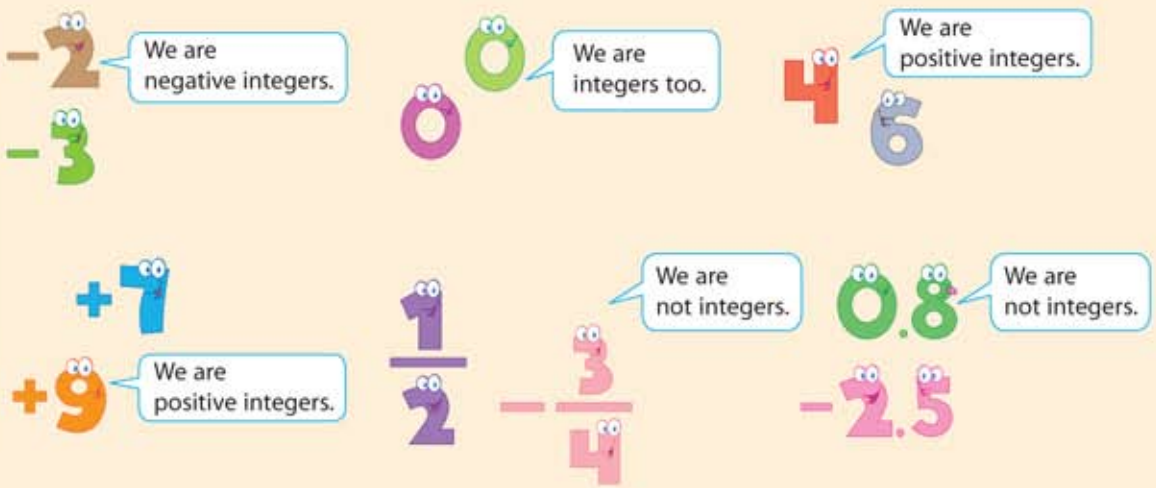
**LEARNING STANDARDS**

Recognise and describe integers.

### Exploration Activity 1

Group

**Aim:** To recognise and describe integers.
**Instruction:** Perform the activity in groups of four.




1. Study the diagrams above carefully.
2. Discuss with your friends and explain how you would describe the meaning of integers.

From the results of Exploration Activity 1, it is found that **integers** are groups of numbers which include positive and negative whole numbers as well as zero.

**Example 2**

Determine whether each of the following numbers is an integer.

$15,\ 23,\ -3.4,\ -76,\ 0,\ \frac{1}{2},\ 6,\ 0.88,\ -\frac{4}{5},\ 301,\ -239$

***Solution***

Integer: $15, 23, -76, 0, 6, 301, -239$ Non-integer: $-3.4, \frac{1}{2}, 0.88, -\frac{4}{5}$

**Self Practice 1.1b**

**1.** In the following table, mark '✓' for numbers which are integers and mark '✗' for numbers which are non-integers.

| $\frac{3}{4}$ | $-24$ | 35 | 6.7 | $-29$ | 900 | $-4.34$ | 72 | $-\frac{1}{2}$ | 0 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

**2.** Copy the diagram on the right. Select integers from the following list of numbers and write them in the diagram.

$0.25,\ \frac{1}{3},\ 48,\ -12,\ -2.8,\ -\frac{2}{7},\ 0,\ 59,\ 458,\ -6$


## How do you represent integers on a number line?

## Exploration Activity 2

Flip Classroom

**LEARNING STANDARDS**

Represent integers on number lines and make connections between the values and positions of the integers with respect to other integers on the number line.

**Aim:** To explore the representation of integers on a number line.

**Instruction:**
- Explore by yourself before the lesson begins and discuss in groups of four during the lesson.
- Open the folder downloaded from page vii.

1. Open the file *Integer number line.ggb* using *GeoGebra*.
2. Click and drag the red point on the number line to define an integer on the number line.
3. Observe the position of the defined integer on the number line in relation to the position of zero.

4. Answer the following questions based on the information obtained from the screen displayed.
   (a) Describe the value of integer 10 as compared to zero.
   (b) How do you determine the positions of negative numbers like –1, –2 and –3 on a number line?
   (c) How do you represent 1, 2, 3, –1, –2 and –3 on a number line?

From the results of Exploration Activity 2, it is found that **positive integers** are integers more than zero whereas **negative integers** are integers less than zero.

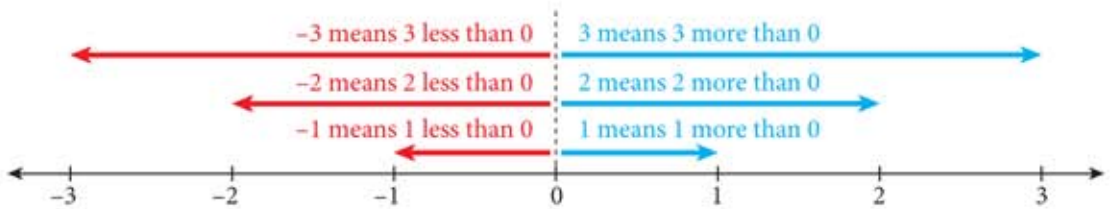
If the direction towards right is assumed as positive and the direction towards left is assumed as negative, thus we can conclude that

(i) for a positive integer, the more the number is greater than 0, the further its position to the right on the number line and the greater will be its value.

(ii) for a negative integer, the more the number is less than 0, the further its position to the left on the number line and the lesser will be its value.

**Flashback**

On a number line, the numbers in the positive direction are always greater than the numbers in the negative direction.

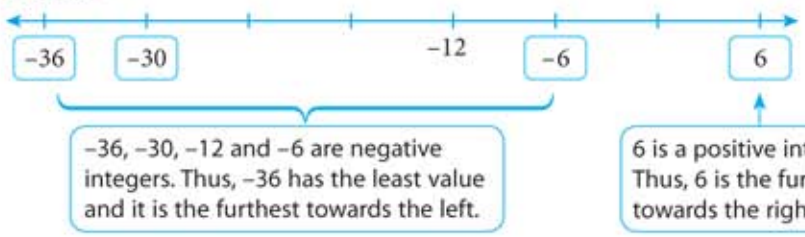



**Example 3**

Complete the number line using the following numbers.

–30, 6, –6, –36


**Solution**




**Did You Know**

The lowest temperature ever recorded was about –93°C in the Antarctic in August, 2010.

## Self Practice 1.1c

1. For each of the following, determine and mark the positions of the given integers on a number line.
   (a) –5, 5, 1 and –3 (b) 0, –8, 2 and –10
2. Complete each of the following number lines.
   (a)


   (b)



## How do you compare and arrange integers in order?

Based on the positions of integers given on a number line, we can compare the respective values of the integers and hence arrange the integers in ascending order or descending order.

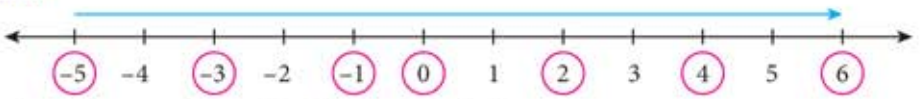
**LEARNING STANDARDS**
Compare and arrange integers in order.

### Example 4

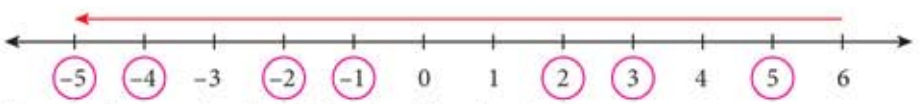
(a) Compare and arrange –3, 4, 2, –5, 6, 0, –1 in ascending order.
(b) Compare and arrange –4, 3, 2, 5, –2, –1, –5 in descending order.

**SMART TIPS**
A positive number always has a larger value than a negative number.

*Solution*

(a)


Ascending order: –5, –3, –1, 0, 2, 4, 6

(b)


Descending order: 5, 3, 2, –1, –2, –4, –5

## Self Practice 1.1d

1. Compare and arrange –4, 3, 1, –6, 5, 0, –2 in ascending order.
2. Compare and arrange –5, –3, 3, 4, –4, 2, –1 in descending order.

## Mastery Q 1.1

*Open the folder downloaded from page vii for extra questions of Mastery Q 1.1.*

1. (a) If +20 represents 20 m above sea level, then –20 represents ____.
   (b) If +90 represents a movement of 90 m to the north, then –90 represents ____.

(c) If +800 represents RM800 being credited into a savings account, then RM800 being debited into a savings account is represented as _____.

(d) If +1 000 represents a profit of RM1 000, then a loss of RM1 000 is represented as _____.

2. State the following numbers using '+' or '–'.
   (a) 80 less than zero
   (b) 76 more than zero

3. List all integers
   (a) from –8 to 4
   (b) from –12 to –2

4. Determine whether each of the following numbers is an integer.
   –14, 3.9, 12, –26, 85, 0, –2

5. Compare and arrange the following values of temperature in the order beginning from the coldest temperature.
   –3°C, 2°C, –4°C, 1°C, 4°C

## 1.2 Basic Arithmetic Operations Involving Integers

### How do you add and subtract integers?

**LEARNING STANDARDS**

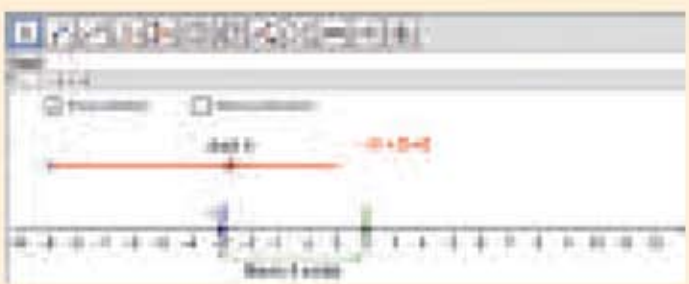
Add and subtract integers using number lines or other appropriate methods. Hence, make generalisation about addition and subtraction of integers.

### Exploration Activity 3

Aim: To explore addition and subtraction of integers on a number line.

Instruction:
- Explore by yourself before the lesson begins and discuss in groups of four during the lesson.
- Open the folder downloaded from page vii.

1. Open the file *Add subtract integers.ggb* using *GeoGebra*. The screen shows the following display.

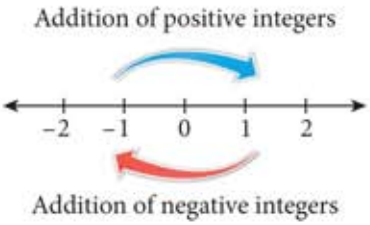


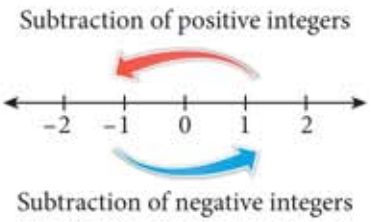
2. Click and drag the red slider and the blue point displayed on the screen.
3. Observe the movement of other points on the display in relation to addition and subtraction of integers.
4. Present and discuss the findings with your friends during the lesson.
5. Make a generalisation regarding the addition and subtraction of integers.

From the results of Exploration Activity 3, it is found that on a number line,

(a) addition of
  (i) positive integers is represented by moving towards the right
  (ii) negative integers is represented by moving towards the left

(b) subtraction of
  (i) positive integers is represented by moving towards the left
  (ii) negative integers is represented by moving towards the right




## Example 5

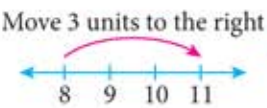
Solve

(a) $8 + (+3)$
(b) $5 + (-2)$
(c) $2 - (+4)$
(d) $-1 - (-4)$

Scan the QR Code or visit https://youtu.be/q5ogKyt0cYA to learn about other examples of addition and subtraction of integers.

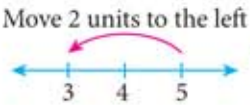
### Solution

(a) $8 + (+3)$
$= 8 + 3$
$= 11$



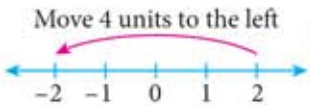

Addition of positive integers is represented by moving towards the right.

(b) $5 + (-2)$
$= 5 - 2$
$= 3$



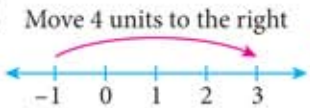

Addition of negative integers is represented by moving towards the left.

(c) $2 - (+4)$
$= 2 - 4$
$= -2$




Subtraction of positive integers is represented by moving towards the left.

(d) $-1 - (-4)$
$= -1 + 4$
$= 3$




Subtraction of negative integers is represented by moving towards the right.

### Alternative Method

**Coloured chips method**

Yellow chips, (+), represent positive integers and red chips, (−), represent negative integers.

For Example 5(b):


Thus, $5 + (-2) = 3$

## Self Practice 1.2a

**1.** Solve each of the following:

(a) $6 + (+2)$
(b) $-4 + (-3)$
(c) $3 - (+2)$
(d) $-2 - (-4)$
(e) $-8 + (-2)$
(f) $6 - (+3)$
(g) $9 + (+4)$
(h) $-5 - (-3)$

## How do you multiply and divide integers?

**LEARNING STANDARDS**

Multiply and divide integers using various methods. Hence make generalisation about multiplication and division of integers.

# Exploration Activity 4

Aim: To explore the multiplication and division of integers.

Instruction:
- Explore by yourself before the lesson begins and discuss in groups of four during the lesson.
- Open the folder downloaded from page vii.

1. Open and print the file *Multiplication of integers table.pdf* as shown in the diagram.
2. Complete the purple region for the multiplication of positive integers that you have learnt.
3. Complete the other regions in the table according to the patterns of the numbers shown.
4. Present your findings about the patterns of multiplication of integers shown.
5. Discuss with your friends about the patterns of division of integers.
6. Make a generalisation regarding the multiplication and division of integers.

| × | −5 | −4 | −3 | −2 | −1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| −5 | | | | | | 0 | | | | | |
| −4 | | | | | | 0 | | | | | |
| −3 | | | | | | 0 | | | | | |
| −2 | | | | | | 0 | | | | −8 | |
| −1 | | | | | | 0 | | | | −4 | −5 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | | | | | −1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 2 | | | | −4 | −2 | 0 | 2 | 4 | 6 | 8 | 10 |
| 3 | | | | | | 0 | | | | | 15 |
| 4 | | | | | | 0 | | | | | |
| 5 | | | | | | 0 | | | | | |

From the results of Exploration Activity 4, it is found that

| Operation | Sign of the product |
|---|---|
| (+) × (+) | + |
| (+) × (−) | − |
| (−) × (+) | − |
| (−) × (−) | + |

| Operation | Sign of the quotient |
|---|---|
| (+) ÷ (+) | + |
| (+) ÷ (−) | − |
| (−) ÷ (+) | − |
| (−) ÷ (−) | + |

In general, the rules of multiplication and division of integers can be summarized as follows.

The product or quotient of two integers with the same signs is a positive integer.

The product or quotient of two integers with different signs is a negative integer.

**SMART TIPS**

Other than addition and subtraction of integers, coloured chips can also be used to perform multiplication and division of integers. Visit the site below for further information.

www.goo.gl/7j6CTd

**Example 6**

Evaluate each of the following:

(a) $-5 \times (-4)$ (b) $-6 \times 4$ (c) $6 \div (-2)$ (d) $-12 \div (-2)$

***Solution***

(a) $-5 \times (-4)$
$= +(5 \times 4)$
$= 20$

(b) $-6 \times 4$
$= -(6 \times 4)$
$= -24$

(c) $6 \div (-2)$
$= -(6 \div 2)$
$= -3$

(d) $-12 \div (-2)$
$= +(12 \div 2)$
$= 6$

**Self Practice 1.2b**

**1.** Solve each of the following:

(a) $-6 \times (-3)$ (b) $-7 \times 2$ (c) $4 \times (-8)$ (d) $8 \times (-6)$
(e) $-12 \div 3$ (f) $-18 \div (-6)$ (g) $15 \div (-5)$ (h) $-20 \div 4$

## How do you perform computations involving combined basic arithmetic operations of integer?

**LEARNING STANDARDS**

Perform computations involving combined basic arithmetic operations of integers by following the order of operations.

When performing a computation involving combined operations of integers, follow the order of operations below.

Brackets ( ) → × or ÷ → + or –

From left to right (× or ÷)

From left to right (+ or –)

**Example 7**

Solve each of the following:

(a) $-8 \times (-2 + 3)$ (b) $7 + 2(-3)$

(c) $4 - 12 \div (-2) + (-1)$ (d) $\dfrac{-12 + (-16)}{-22 - (-24)}$

***Solution***

(a) $-8 \times (-2 + 3)$
$= -8 \times (1)$
$= -8$

(b) $7 + 2(-3)$
$= 7 + 2 \times (-3)$
$= 7 + (-6)$
$= 7 - 6$
$= 1$

(c) $4 - 12 \div (-2) + (-1)$
$= 4 - (-6) - 1$
$= 4 + 6 - 1$
$= 9$

(d) $\dfrac{-12 + (-16)}{-22 - (-24)}$
$= \dfrac{-12 - 16}{-22 + 24}$
$= \dfrac{-28}{2}$
$= -14$

**SMART TIPS**

Brackets are also a notation for multiplication.

**Smart**

For Example 7(a), press (–) 8 × ( (–) 2 + 3 ) =

For Example 7(d), press ( (–) 1 2 + (–) 1 6 ) ÷ ( (–) 2 2 – (–) 2 4 ) =

## Self Practice 1.2c

1. Evaluate each of the following:

(a) $-9 \times (-4 + 6)$ (b) $8 + (-4) \times 8$ (c) $4 - 15 \div (-3) + (-8)$

(d) $\dfrac{-14 + (-22)}{-23 - (-35)}$ (e) $-12 - 15 \times (-3) - (-6)$ (f) $\dfrac{-6 + (-8) \times (-5)}{-27 - (-38)}$

## How do you describe the laws of arithmetic operations?

### Exploration Activity 5

Flip Classroom

**Aim:** To explore the rules of arithmetic operations.

**Instruction:**
- Explore by yourself before the lesson begins and discuss in groups of four during the lesson.
- Open the folder downloaded from page vii.

1. Open the file *Laws of arithmetic.pdf* and print the printout as shown in the diagram.
2. Complete the given table.
3. Compare your results and discuss with the members from the other groups.
4. Make a conclusion about the rules of arithmetic operations.

**LEARNING STANDARDS**

Describe the laws of arithmetic operations which are Identity Law, Commutative Law, Associative Law and Distributive Law.

From the results of Exploration Activity 5, it is found that

(i) for all values of $a$ and $b$,

$$a + b = b + a$$
$$a \times b = b \times a$$

Addition and multiplication are said to obey the **Commutative Law**.

(ii) for all values of $a$, $b$ and $c$,

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

Addition and multiplication are said to obey the **Associative Law**.

(iii) for all values of $a$, $b$ and $c$,

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

Addition and subtraction are said to obey the **Distributive Law**.

(iv) for all values of $a$,

$$a + 0 = a \qquad a + (-a) = 0$$
$$a \times 0 = 0 \qquad a \times \frac{1}{a} = 1$$
$$a \times 1 = a$$

These statements are known as the **Identity Law**.

## How do you perform computations efficiently?

**LEARNING STANDARDS**

Perform efficient computations using the laws of basic arithmetic operations.

The laws of arithmetic operations you have just learnt can be used to perform computations more efficiently.

**Example 8**

Solve each of the following using efficient computations.
(a) $29 + 38 + 2$ (b) $2 \times 24 \times 5$ (c) $7 \times 3040$

***Solution***

(a) $29 + 38 + 2$
$= 29 + (38 + 2)$ ← Associative Law
$= 29 + 40$
$= 69$

(b) $2 \times 24 \times 5$
$= 24 \times 2 \times 5$ ← Commutative Law
$= 24 \times (2 \times 5)$ ← Associative Law
$= 24 \times 10$
$= 240$

(c) $7 \times 3040$
$= 7 \times (3000 + 40)$
$= 7 \times 3000 + 7 \times 40$ ← Distributive Law
$= 21000 + 280$
$= 21280$

**Self Practice 1.2d**

**1.** Using laws of arithmetic operations that you have learnt, solve each of the following using efficient computations.
(a) $356 + 61 + 9$ (b) $20 \times 567 \times 5$ (c) $89 \times 5080$
(d) $6 \times 200 + 6 \times 25 + 6 \times 5$ (e) $26 \times 3 - 24 \times 3$ (f) $899 \times 5$

## How do you solve problems?

**LEARNING STANDARDS**

Solve problems involving integers.

MATHEMATICS APPLICATION TEST

Luqman's credit card account showed a balance of debts of RM230 at one time. He had used his credit card to pay for three books each costing RM120. A week later, his credit card account was charged an interest of RM3 and Luqman made a payment of RM400 to his account. Explain whether Luqman had cleared his debts.

***Solution***

Total account balance $= -230$ ← Account balance means debt and is written using the '–' sign.

Total payment for books using credit card $= 3 \times (-120)$
$= -360$

Interest charged $= -3$
Payment to account $= +400$

***Check***

Account balance = 230
Total expenses
= 3(120)
= 360
Interest charged = 3
Payment = 400
Account balance
= 230 + 360 + 3 – 400
= RM193

Final credit card account balance $= -230 + (-360) + (-3) + 400$
$= -230 - 360 - 3 + 400$
$= -193$

Luqman had not cleared his debts because his credit card account still showed a balance of debts of RM193.

## Self Practice 1.2e

1. A shop made a profit of RM16 800 in the first year and incurred a loss of RM6 500 each year for the next two consecutive years. In the fourth year, the loss incurred was twice the loss incurred in the second year. How much was the profit or loss of the shop at the end of those four years?

2. From 7:00 p.m. to 5:00 a.m. of the next day, the temperature in Kuching dropped by 4°C. The temperature then rose by 8°C at 11:00 a.m. and continued rising by 2°C three hours later. If the temperature in Kuching at 11:00 a.m. was 30°C, calculate the temperature at
   (a) 7:00 p.m. of the first day
   (b) 2:00 p.m. of the second day

## Mastery Q 1.2

*Open the folder downloaded from page vii for extra questions of Mastery Q 1.2.*

1. Using the following numbers, write five calculations that give an answer of –14.
   –12, 6, 2, –3, –2, 8, 11, 5, 15

2. For each of the following, fill in the empty boxes with suitable operations '+', '–', '×' or '÷'.
   (a) $-8 \square (-6) = -3 \times (-6 \square 10)$
   (b) $5 + (-9) \square 3 = -5 \square (-7)$

3. Complete each of the following number patterns.
   (a) $-9, -7, \square, -3, \square, 1, \square$
   (b) $-2, 4, \square, 16, -32, \square, \square$

4. The temperature in a town at a certain time was 12°C. The temperature dropped until –6°C. The temperature then rose by 3°C and finally dropped by 8°C. Determine
   (a) the change in temperature of the town,
   (b) the final temperature of the town.

5. A diver was at 50 m below sea level. The diver swam up 2 m every 5 seconds. Explain whether the diver would have reached the sea surface after 2 minutes.

6. The current account of Encik Hafidz showed a balance of RM1 238. He signed two payment cheques of RM890 and RM1 730 respectively.
   (a) Determine whether the RM890 cheque or the RM1 730 cheque would bounce when the cheques were credited.
   (b) How much would Encik Hafidz have to top up in his account so that both cheques that he signed would not bounce when they are credited?

## 1.3 Positive and Negative Fractions

**How do you represent positive and negative fractions on a number line?**

**LEARNING STANDARDS**

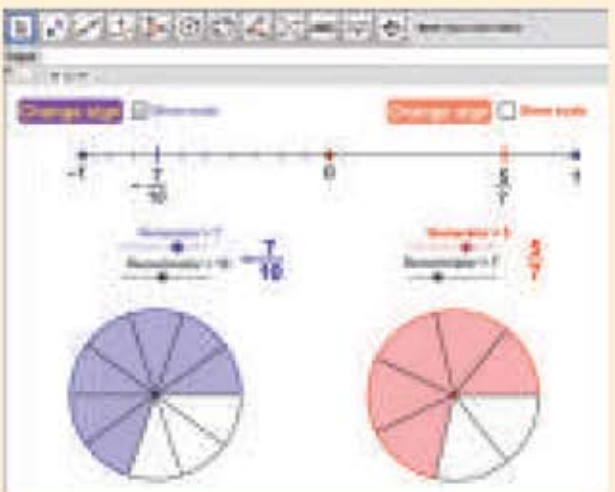
Represent positive and negative fractions on number lines.

## Exploration Activity 6

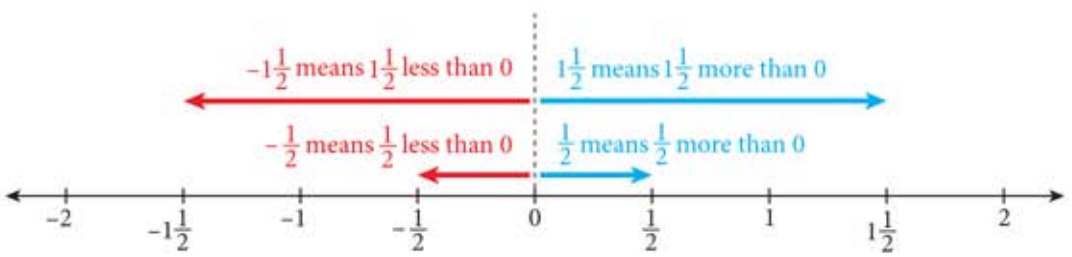
Aim: To explore the representation of positive and negative fractions on a number line.

Instruction:
- Explore by yourself before the lesson begins and discuss in groups of four during the lesson.
- Open the folder downloaded from page vii.

1. Open the file *Fraction number line.ggb* using *GeoGebra*.
2. Click and drag the slider 'Numerator' and 'Denominator' to define a fraction.
3. Click at the button 'Change sign' to interchange between positive and negative.
4. Observe the position of the fraction defined on the number line.
5. Discuss the methods used to determine the position of a fraction on a number line.



Representation of fractions on a number line is the same as that of integers. **Positive fractions** are fractions more than zero whereas **negative fractions** are fractions less than zero.



**Example 9**

Represent the following fractions on a number line.

$\frac{1}{2}, \frac{1}{4}, -\frac{3}{4}, -\frac{1}{2}$

**SMART TIPS**

- Positive fractions are on the right of zero.
- Negative fractions are on the left of zero.

***Solution***


**Self Practice 1.3a**

**1.** Represent the following fractions on a number line.

(a) $\frac{1}{10}, -\frac{3}{5}, \frac{1}{2}, -\frac{1}{5}$

(b) $-\frac{1}{3}, \frac{1}{6}, \frac{1}{2}, -1\frac{2}{3}$

## How do you compare and arrange positive and negative fractions in order?

**LEARNING STANDARDS**

Compare and arrange positive and negative fractions in order.

The values of two or more fractions can be compared by equating the denominator first. Subsequently the fractions can be arranged in ascending order or descending order.

**Example 10**

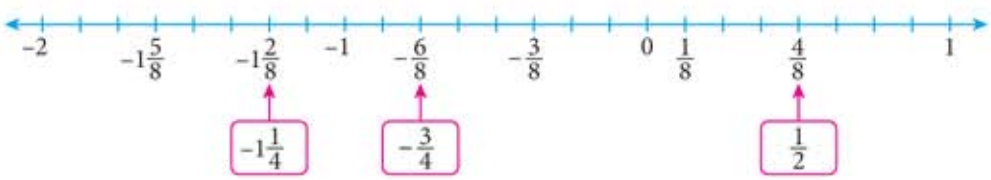
Compare and arrange the following fractions in ascending order.

$\frac{1}{8}, -\frac{3}{4}, -1\frac{1}{4}, \frac{1}{2}, -1\frac{5}{8}, -\frac{3}{8}$

***Solution***

$\frac{1}{8}, -\frac{3}{4}, -1\frac{1}{4}, \frac{1}{2}, -1\frac{5}{8}, -\frac{3}{8}$

$\frac{1}{8}, -\frac{6}{8}, -1\frac{2}{8}, \frac{4}{8}, -1\frac{5}{8}, -\frac{3}{8}$




Hence, the fractions arranged in ascending order are

$-1\frac{5}{8}, -1\frac{1}{4}, -\frac{3}{4}, -\frac{3}{8}, \frac{1}{8}, \frac{1}{2}$

## Self Practice 1.3b

1. Compare and arrange the following fractions in ascending order.

   (a) $-\frac{5}{6}, -\frac{1}{4}, \frac{3}{8}, -\frac{5}{12}, \frac{7}{24}$ (b) $\frac{1}{3}, -\frac{5}{6}, \frac{5}{8}, -\frac{2}{3}, -\frac{13}{18}, -\frac{15}{24}$

2. Compare and arrange the following fractions in descending order.

   (a) $\frac{3}{5}, -\frac{7}{20}, -\frac{5}{12}, -\frac{1}{8}, \frac{5}{6}$ (b) $-\frac{1}{2}, \frac{2}{9}, -\frac{5}{9}, -\frac{7}{12}, -\frac{7}{18}, \frac{11}{18}$

## How do you perform computations involving combined basic arithmetic operations of positive and negative fractions?

**LEARNING STANDARDS**

Perform computations involving combined basic arithmetic operations of positive and negative fractions by following the order of operations.

### Example 11

Solve

(a) $1\frac{2}{3} \times \left(\frac{2}{5} - \frac{5}{6}\right)$ (b) $\frac{5}{8} + 1\frac{1}{3} \div \left(-\frac{5}{6}\right)$

**Solution**

(a) $1\frac{2}{3} \times \left(\frac{2}{5} - \frac{5}{6}\right)$

$= \frac{5}{3} \times \left(\frac{12 - 25}{30}\right)$ ← Calculation in the brackets is performed first.

$= \frac{5^{1}}{3} \times \left(-\frac{13}{\cancel{30}_{6}}\right)$

$= -\frac{13}{18}$

(b) $\frac{5}{8} + 1\frac{1}{3} \div \left(-\frac{5}{6}\right)$ ← Division is performed first.

$= \frac{5}{8} + \frac{4}{\cancel{3}_{1}} \times \left(-\frac{\overset{2}{\cancel{6}}}{5}\right)$ ← Change ÷ to × and the reciprocal of $-\frac{5}{6}$ is $-\frac{6}{5}$.

$= \frac{5}{8} + \left(-\frac{8}{5}\right)$

$= \frac{25}{40} - \frac{64}{40}$

$= -\frac{39}{40}$

Follow the order of operations

( )

↓

× or ÷

↓

+ or −

## Self Practice 1.3c

1. Evaluate each of the following.

   (a) $1\frac{1}{6} \times \left(\frac{3}{4} + \frac{1}{5}\right)$ (b) $-\frac{5}{6} + 1\frac{2}{3} \div \left(-\frac{3}{7}\right)$ (c) $-2\frac{1}{2} \div \left(-3\frac{1}{3}\right) + \left(-\frac{1}{6}\right)$

   (d) $-6 \times \left(3\frac{2}{7} - 4\frac{1}{2}\right)$ (e) $-\frac{1}{3} + 2\frac{5}{6} - \frac{3}{8} \times 1\frac{2}{3}$ (f) $-\frac{1}{4} + \left(-\frac{4}{5}\right) \times 2\frac{1}{6} - \frac{5}{16}$

## How do you solve problems?

**LEARNING STANDARDS**

Solve problems involving positive and negative fractions.

**MATHEMATICS APPLICATION TASK**

A mathematics quiz contains 20 questions. A score of 2 marks is awarded for every correct answer and a score of $-\frac{1}{2}$ mark is given for every incorrect answer. Mei Ling participated in the quiz and answered all the questions. Her score for incorrect answers was $-4$. What was the total score Mei Ling obtained in the quiz?

***Solution***

**Understanding the problem**

- A score of 2 marks is awarded for every correct answer.
- A score of $-\frac{1}{2}$ mark is given for every incorrect answer.
- Score for incorrect answers $= -4$
- Find the total score obtained.

**Think Smart**

$-\frac{1}{2}$ is given for every incorrect answer. What does it mean by $-\frac{1}{2}$?

**Devising a plan**

- $+2$ represents the score for every correct answer.
- $-\frac{1}{2}$ represents the score for every incorrect answer.
- Find the total number of incorrect answers using division.
- Find the total score using multiplication and addition.

**Implementing the strategy**

$$\text{Number of incorrect answers} = -4 \div \left(-\frac{1}{2}\right)$$
$$= 8$$

$$\text{Total score} = (20 - 8) \times 2 + (-4)$$
$$= 12 \times 2 - 4$$
$$= 24 - 4$$
$$= 20$$

**Doing reflection**

$$\text{Total score for correct answers} = 12 \times 2$$
$$= 24$$

$$\text{Total score for incorrect answers} = \overset{4}{\cancel{8}} \times \left(-\frac{1}{\cancel{2}_{1}}\right)$$
$$= -4$$

$$\text{Total score obtained} = 24 + (-4)$$
$$= 20$$

**SMART TIPS**

Problem-solving steps:

Understanding the problem
↓
Devising a plan
↓
Implementing the strategy
↓
Doing reflection

## Self Practice 1.3d

1. A baker usually uses $3\frac{3}{4}$ cups of sugar to bake a sponge cake. He reduces the amount of sugar by $1\frac{1}{2}$ cups for a less-sweet sponge cake. A customer orders 3 sponge cakes and 5 less-sweet sponge cakes. How many cups of sugar are required to bake the cakes the customer has ordered?

2. Adam had RM40. Susan gave $\frac{1}{3}$ of her money to Adam. After giving $\frac{1}{8}$ of his money to Gopal, Adam still had RM350. Find the total amount Susan had originally.

## Mastery Q 1.3

*Open the folder downloaded from page vii for extra questions of Mastery Q 1.3.*

1. Using **three** different fractions and **two** different operations (+, −, ×, ÷), write three calculations which give an answer of $-\frac{1}{2}$.

2. For each of the following number patterns, complete it using a suitable fraction.

   (a) $-\frac{1}{3}, \frac{1}{6}, \square, 1\frac{1}{6}$

   (b) $-\frac{5}{8}, \frac{5}{24}, -\frac{5}{72}, \square$

3. For each of the following, complete it using a suitable fraction.

   (a) $-\frac{1}{3} - \frac{5}{6} = \frac{1}{2} \times \left(\square\right)$

   (b) $-\frac{2}{3} + \frac{5}{8} = \frac{1}{3} \div \left(\square\right)$

4. The water level in a tank was $2\frac{2}{5}$ m at 4:00 p.m. The water level dropped by $\frac{1}{6}$ m every hour for 5 subsequent hours. When it was towards 12:00 midnight, the water level rose by $1\frac{2}{3}$ m. Calculate the water level at midnight.

5. Container $A$ contains 60 m$l$ of water. $\frac{3}{8}$ of the water in container $B$ is poured into container $A$. $\frac{5}{12}$ of the water in container $A$ is then poured into an empty container $C$. If container $C$ contains 45 m$l$ of water now, find the volume of water in container $B$.

## 1.4 Positive and Negative Decimals

**How do you represent positive and negative decimals on a number line?**

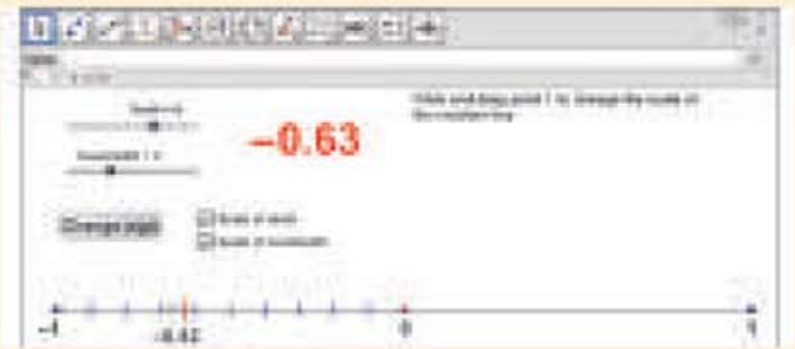
**LEARNING STANDARDS**

Represent positive and negative decimals on number lines.

### Exploration Activity 7

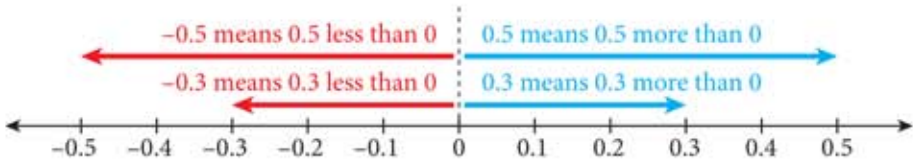
Aim: To explore the representation of positive and negative decimals on a number line.

Instruction:
- Explore by yourself before the lesson begins and discuss in groups of four during the lesson.
- Open the folder downloaded from page vii.




1. Open the file *Decimal number line.ggb* using *GeoGebra*.
2. Click and drag the slider 'Tenth' and 'Hundredth' to define a decimal.
3. Click at the button 'Change Sign' to interchange between positive and negative.
4. Observe the position of the decimal defined on the number line.
5. Discuss the position of a decimal on a number line.

Representation of decimals on a number line is the same as that of integers and fractions. **Positive decimals** are decimals more than zero whereas **negative decimals** are decimals less than zero.



**Example 12**

Represent the following decimals on a number line.

0.7, −0.5, −0.8, 0.2, −1.3

***Solution***


**Self Practice 1.4a**

**1.** For each of the following, represent the decimals on a number line.

(a) 0.6, −0.7, 0.2, −0.3 (b) 0.7, −0.4, 0.3, −1.3

**2.** The diagram below shows a straight line of length 10 cm representing a number line. Copy the diagram and represent the following decimals on the number line.

(a) −1.46, −1.84, −1.20, −1.62


(b) −0.25, −0.08, −0.39, −0.17


## How do you compare and arrange positive and negative decimals in order?

**LEARNING STANDARDS**

Compare and arrange positive and negative decimals in order.

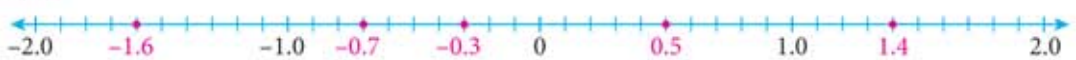
The values of two or more decimals can be compared and arranged in ascending order or descending order.

**Example 13**

Compare and arrange the following decimals in descending order.

−1.6, 0.5, −0.3, 1.4, −0.7

***Solution***




The decimals arranged in descending order are 1.4, 0.5, −0.3, −0.7, −1.6

**Self Practice 1.4b**

**1.** Compare and arrange each of the following in ascending order.

(a) −1.23, −1.48, 0.34, −0.034, 1.034

(b) −1.456, −1.546, 1.456, −1.654, 1.564

**2.** Compare and arrange each of the following in descending order.

(a) −2.005, −2.505, −2.052, 2.522, 2.452

(b) 0.065, −0.647, −0.639, −0.068, 0.621

## How do you perform computations involving combined basic arithmetic operations of positive and negative decimals?

**LEARNING STANDARDS**

Perform computations involving combined basic arithmetic operations of positive and negative decimals by following the order of operations.

### Example 14

Evaluate each of the following:

(a) $3.5 - (-6.5) \times 0.2$

(b) $(7.23 + 2.77) \div (-0.8)$

(c) $-3.7 + (4.25 + 2.85) \times 0.3$

***Solution***

(a) $3.5 - (-6.5) \times 0.2 = 3.5 - (-1.3)$
$= 3.5 + 1.3$
$= 4.8$

Multiplication is performed first.

(b) $(7.23 + 2.77) \div (-0.8) = 10.0 \div (-0.8)$
$= -12.5$

Calculation in the brackets is performed first.

(c) $-3.7 + (4.25 + 2.85) \times 0.3 = -3.7 + (7.1 \times 0.3)$
$= -3.7 + 2.13$
$= -1.57$

Calculation in the brackets is performed first followed by multiplication.

Follow the order of operations
( )
↓
× or ÷
↓
+ or −

### Self Practice 1.4c

**1.** Evaluate each of the following:

(a) $4.7 - 7.8 \times 0.3$

(b) $(8.36 + 3.89) \div (-0.28)$

(c) $-3.48 + (7.36 + 1.24) \times 0.6$

(d) $0.36 - (-8.67) \div (-0.3) + 0.82$

(e) $-2.65 - \dfrac{1.44}{-1.2} + 3.22$

(f) $2.34 + 3.1 \times (-0.1) + 0.2$

## How do you solve problems?

**LEARNING STANDARDS**

Solve problems involving positive and negative decimals.

MATHEMATICS APPLICATION TEST

The price of the stock of a company was RM2.05 at a certain time. The price hiked by RM0.32, then subsequently dropped RM0.28 every hour for the next three hours. Calculate the final price of the stock.

*Solution*

**Understanding the problem**

- Price of stock was RM2.05.
- Price of stock hiked by RM0.32.
- Price of stock dropped RM0.28 every hour for the next three hours.
- Calculate the final price of the stock.

**Devising a plan**

- Increase in price is written as +0.32.
- Decrease in price is written as −0.28.
- Use multiplication and addition.

**Implementing the strategy**

The final price of the stock $= 2.05 + 0.32 + 3 \times (-0.28)$
$= 2.37 + (-0.84)$
$= 2.37 - 0.84$
$= 1.53$

The final price of the stock was RM1.53.

**Doing reflection**

RM2.05 + RM0.32 − 3 × RM0.28
= RM2.37 − RM0.84
= RM1.53

**Communication Corner**


Explain the importance of negative numbers in monetary finance.

## Self Practice 1.4d

1. Aisah bought a shirt for RM19.90 and two pairs of long trousers of the same price. When she paid RM55 to the cashier, she was told that the amount was not enough. Aisah then paid another RM10 and received a change of RM5.40. Calculate the price of a pair of long trousers that she bought.
2. The average temperature in Kuala Lumpur was 30.5°C on a certain day. The average temperature then rose by 1.8°C every day for two consecutive days and then dropped by 1.3°C every day for another three consecutive days. Calculate the average temperature in Kuala Lumpur during those five days.

## Mastery Q 1.4

*Open the folder downloaded from page vii for extra questions of Mastery Q 1.4.*

1. Using **three** different decimals and **two** different operations (+, −, ×, ÷), write three calculations which each gives an answer of −2.5.

2. For each of the following number patterns, complete it using suitable decimals.
   (a) $-1.2, -0.9, \square, -0.3, \square$
   (b) $-2.1, \square, -8.4, 16.8, \square$

3. For each of the following, complete it using a suitable decimal.
   (a) $3.2 \times (-2.1) + 5.8 = 0.5 \times (\square)$
   (b) $-5.12 - (-2.4) \div (-0.5) = 1.6 \times (\square)$

4. Ramesh bought 63 oranges for RM34.65. The oranges were packed in small packets with 3 oranges in each packet. Calculate the price Ramesh sold for each packet of oranges if he had
   (a) incurred a loss of RM19.95
   (b) made a profit of RM51.45
   after he sold all the oranges.

5. A fish is at 1.34 m below sea level while a bird is at 4.32 m above sea level. A turtle is below sea level at a vertical distance that is twice the distance between the fish and the bird. Calculate the vertical distance between the bird and the turtle.

## 1.5 Rational Numbers

**LEARNING STANDARDS**
Recognise and describe rational numbers.

### What are rational numbers?

### Exploration Activity 8

Group

**Aim:** To recognise and describe rational numbers.
**Instruction:** Perform the activity in groups of four.

1. You are given some number cards as follows.

| | | | | | |
|---|---|---|---|---|---|
| 0.3 | $-1.25$ | $1\frac{1}{3}$ | 5 | $-8$ | $-2\frac{2}{5}$ |

2. Discuss how you would write these numbers in the form of $\frac{p}{q}$ such that $p$ and $q$ are integers.
3. What are your conclusions?

Numbers that can be written in fractional form, that is $\frac{p}{q}$, such that $p$ and $q$ are integers, $q \neq 0$, are known as **rational numbers**.

**Think Smart**
Explain why a rational number $\frac{p}{q}$ is subjected to the condition $q \neq 0$.

**Example 15**

Determine whether $1\frac{4}{5}$, $\frac{3}{4}$, $-9$ and $3.5$ are rational numbers.

***Solution***

$1\frac{4}{5} = \frac{9}{5}$, $\frac{3}{4}$, $-9 = \frac{-9}{1}$, $3.5 = 3\frac{5}{10} = 3\frac{1}{2} = \frac{7}{2}$

All the numbers can be written in the form of $\frac{p}{q}$.

Thus, $1\frac{4}{5}$, $\frac{3}{4}$, $-9$ and $3.5$ are rational numbers.

**Think Smart**

Is 3.141592654... a rational number? Explain.

**Self Practice 1.5a**

**1.** Determine whether the following numbers are rational numbers. Explain your answer.

$$\frac{-2}{4},\quad \frac{8}{7},\quad \frac{-1.2}{1.5},\quad 7.65,\quad 2\frac{2}{5},\quad -4.2$$

## How do you perform computations involving combined basic arithmetic operations of rational numbers?

**LEARNING STANDARDS**

Perform computations involving combined basic arithmetic operations of rational numbers by following the order of operations.

**Example 16**

Solve each of the following:

(a) $-0.4 + 1\frac{1}{2} \times \left(-\frac{1}{8}\right)$ (b) $\left[18 \times \left(-\frac{7}{12}\right) + 1.5\right] \div 0.3$

***Solution***

(a) $-0.4 + 1\frac{1}{2} \times \left(-\frac{1}{8}\right)$

$= -\frac{4}{10} + \frac{3}{2} \times \left(-\frac{1}{8}\right)$ ← Convert decimals into fractions first.

$= -\frac{4}{10} + \left(-\frac{3}{16}\right)$

$= -\frac{32}{80} - \frac{15}{80}$

$= -\frac{47}{80}$

Follow the order of operations
( )
↓
× or ÷
↓
+ or −

(b) $\left[18 \times \left(-\frac{7}{12}\right) + 1.5\right] \div 0.3$

$= \left[\frac{\overset{3}{\cancel{18}}}{1} \times \left(-\frac{7}{\cancel{12}_{2}}\right) + \frac{3}{2}\right] \div \frac{3}{10}$

$= \left(-\frac{21}{2} + \frac{3}{2}\right) \div \frac{3}{10}$

$= -\frac{18}{2} \div \frac{3}{10}$

$= -\frac{\overset{3}{\cancel{9}}}{1} \times \frac{10}{\cancel{3}_{1}}$

$= -30$

## Self Practice 1.5b

1. Evaluate each of the following:

   (a) $-0.6 + \frac{3}{4} \times \left(-1\frac{3}{5}\right)$

   (b) $\left(-\frac{17}{20} + 0.8\right) \div \left(\frac{1}{2} - 1.3\right)$

   (c) $1.125 + 1\frac{2}{3} - 2\frac{5}{6} \times \left(-\frac{8}{27}\right)$

   (d) $-3.25 \div \frac{13}{15} - \left(-2\frac{1}{6}\right) \times 0.25$

## How do you solve problems?

MATHEMATICS APPLICATION TIPS

Noriah has a savings of RM120. She donates $\frac{3}{8}$ of her savings to flood victims. She then buys a pair of school shoes for RM25.60. Calculate the balance she still has.

***Solution***

$$\text{Amount donated} = \frac{3}{8} \times \text{RM}120.00$$
$$= \text{RM}45.00$$

$$\text{Balance she still has} = \text{RM}120.00 - \text{RM}45.00 - \text{RM}25.60$$
$$= \text{RM}49.40$$

**LEARNING STANDARDS**

Solve problems involving rational numbers.

**Career in Mathematics**

An accountant uses the knowledge of rational numbers to do efficient computations.

## Self Practice 1.5c

1. A company donates to charity every year as its contribution to society. If the company makes a profit in that year, $\frac{2}{9}$ of the profit will be allocated for donation.
   If the company incurs a loss, the company will also allocate 0.05 of the loss for donation. If the company makes a profit of RM43.2 million in a certain year and incurs a loss of RM2.5 million and RM6.5 million respectively in two consecutive years, calculate the total donations the company would have allocated for charity in those three years.

2. A roll of ribbon is used to tie 12 gifts which will be given to teachers on Teacher's Day. Every gift requires a length of 1.85 m. After tying all the gifts, it was found that $\frac{2}{3}$ of the ribbon had been used. The remaining ribbon was cut into 12 pieces of the same length. Calculate the length of each piece of ribbon that had been cut.

## Mastery Q 1.5

*Open the folder downloaded from page vii for extra questions of Mastery Q 1.5.*

**1.** Evaluate each of the following.

(a) $2.5 + (-8) \div \frac{6}{5} \times 3.5$

(b) $\left(\frac{1}{4} + 3.2 \times 2\right) - \left(5.4 - \frac{2}{3} \div 0.04\right)$

**2.** For each of the following number patterns, complete it using suitable rational numbers.

(a) $-2.4, -\frac{7}{2}, -4.6, \square, \square$

(b) $-\frac{1}{2}, -0.25, \square, -\frac{1}{16}, -0.03125$

**3.** For each of the following, complete it using a suitable rational number.

(a) $6.8 \div \frac{2}{5} - 4.62 = \square \times 0.01$

(b) $3.76 + \frac{3}{4} \times (-4.5) = \square \times 0.5$

**4.** Ishak, Jia Kang and Suresh went mountain-climbing together. At a certain instance, Ishak was at a level 1.45 m higher than Jia Kang while Suresh was at a level $2\frac{1}{3}$ m lower than Jia Kang. Ishak, Jia Kang and Suresh had climbed 1.25 m, 0.5 m and $3\frac{3}{4}$ m respectively. Find the positions of Jia Kang and Suresh now with reference to the position of Ishak.

## SUMMARY

**RATIONAL NUMBERS**

**Integers**

- Positive integers 1, 2, 3, 4, ...
- Zero, 0
- Negative integers ..., −4, −3, −2, −1

**Fractions**

- Positive fractions
  Example: $\frac{1}{2}, \frac{7}{4}, 1\frac{1}{5}$
- Negative fractions
  Example: $-\frac{1}{3}, -\frac{9}{2}, -4\frac{1}{2}$

**Decimals**

- Positive decimals
  Example: 0.5, 4.3, 3.24
- Negative decimals
  Example: −0.1, −5.5, −7.65

| At the end of this chapter, I can... | Very good | Work harder |
|---|---|---|
| recognise positive and negative numbers based on real-life situations. | | |
| recognise and describe integers and rational numbers. | | |
| represent integers, positive fractions, negative fractions, positive decimals and negative decimals on number lines. | | |
| compare and arrange integers, positive fractions, negative fractions, positive decimals and negative decimals in order. | | |
| add and subtract integers using number lines or other appropriate methods. Hence, make generalisation about addition and subtraction of integers. | | |
| multiply and divide integers using various methods. Hence make generalisation about multiplication and division of integers. | | |
| perform computations involving combined basic arithmetic operations of integers, positive and negative fractions, positive and negative decimals and rational numbers by following the order of operations. | | |
| describe the laws of arithmetic operations which are Identity Law, Commutative Law, Associative Law and Distributive Law. | | |
| perform efficient computations using the laws of basic arithmetic operations. | | |
| solve problems involving integers, positive and negative fractions, positive and negative decimals and rational numbers. | | |

# Let's PRACTISE

## Test Yourself

**1.** From the following, choose the correct calculation step for

$$5(-3 + 10) \times 2.4 \div \frac{3}{4}$$

**A** $5(-7) \times 3.2$

**B** $35 \times 2.4 \times \frac{4}{3}$

**C** $35 \times 2.4 \times \frac{3}{4}$

**D** $-35 \times 3.2$

**2.** Determine the number with a larger value without making any calculations.

(a) $-\frac{1}{2}, \frac{1}{100}$ (b) $-4.3, -4.5$ (c) $2\frac{2}{5}, 2.5$

**3.**

| Team | Goals scored | Goals conceded | Goal difference |
|---|---|---|---|
| Tiger | 20 | 17 | 3 |
| Eagle | 16 | 18 | |

The table shows the number of goals scored and the number of goals conceded for two soccer teams. Find the goal difference for the Eagle Team.

**4.** A treasure chest hidden in the year 56 B.C. was found in the year 292 A.D. For how many years was the treasure chest hidden?

## Self Mastery

**5.** When doing charity work, Ali gives rice, sugar and biscuits to 80 fire victims. If each victim gets 2 kg of rice, $\frac{1}{2}$ kg of sugar and 0.4 kg of biscuits and these alms are equally transported using three vans, explain how you would find the mass of alms transported by a van. Give your answer correct to two decimal places.

**6.** Fill in the boxes with '+' or '–' so that the answer obtained has the largest value.

(a) $\frac{1}{2}$ ☐ $-5$ ☐ $4.3$ (b) $-4.2$ ☐ $\frac{1}{2}$ ☐ $-4$

**7.** The temperature of a place at sea level is 8°C. The temperature will drop by 3°C for every km above sea level. Calculate the temperature of the place at 5 km above sea level.

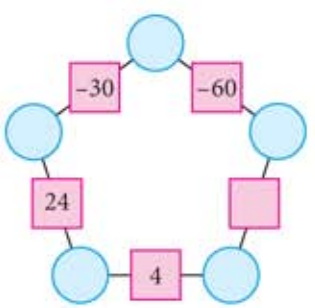
**8.** Sheila was at point $O$ at a certain instance. She moved 1.85 m towards the left and then moved 4 steps measuring 0.65 m each towards the right. Calculate the position of Sheila now from point $O$.

## Challenge Yourself

**9.** Jasmin moves 9.5 m towards east, then she moves 10.7 m towards west and then 6.8 m towards east. Describe the movement of Jasmin so that she can go back to her original position.

**10.** A lift was at level H at a certain instance. The lift went up two floors for a height of 9.8 m. The lift then went down 5 floors. Calculate the distance of the lift from level H now.

**11.** In the diagram, numbers in two collinear circles will multiply to give the product in the collinear middle square box. Complete the empty spaces with suitable rational numbers.



## ASSIGNMENT

Negative numbers are used in the making of glasses to correct eyesight problems. Get information from valid sources such as conducting interviews with an optician, referring to reading materials or exploring other suitable sources. Write a report to explain how negative numbers are used in making the lenses of glasses.

## Exploring MATHEMATICS

Do you know that positive and negative numbers can be generated using a spreadsheet program? Follow the steps as follows to generate a particular list of numbers.

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | −6 | 2 | 10 | 18 | 26 | 34 | | |
| 2 | −8 | | | | | | | |
| 3 | −10 | | | | | | | |
| 4 | −12 | | | | | | | |
| 5 | −14 | | | | | | | |
| 6 | −16 | | | | | | | |
| 7 | | | | | | | | |

1. Run a suitable spreadsheet program.
2. Type −6 into cell A1, as shown in the diagram.
3. Select cell A2 and type =A1-2.
4. Select cell A2 and drag the fill handle at the lower right corner down. Describe what you observe.
5. Select cell B1 and type =A1+8.
6. Select cell B1 and drag the fill handle at the lower right corner to the right. Describe what you observe.
7. Change the number in cell A1 to another number. Describe what you observe.
8. Explain how you can generate other lists of numbers.