MATHEMATICS
Secondary ONE
Year 2021

SCHOOL OF SCIENCE AND TECHNOLOGY, SINGAPORE

Name: ( ) **Class:**

Unit 1 Numbers and Their Operations Part 2

Enduring Understanding
Students will understand that:

- Index **notation** concisely represents the operation of 'multiplying by itself'.
- Representing numbers in its **equivalent** prime factorisation form enables us to find LCM and HCF of two (or more) numbers
- Negative numbers enables us to **measure** the opposite property of real-world objects and situations.
- **Notations** such as >, <, ≥, ≤ help to represent the relationship between two numbers concisely and precisely.
- A number line is a **diagram** that serves as an abstraction for real numbers

Essential Questions

- Why do we need negative numbers?
- Why do we express a number in terms of its prime factorisation?
- How do we represent the operation of 'multiplying by itself' concisely?
- How do we represent the set of real numbers in the form of a diagram?

Resources

- Textbook: *Think! Mathematics New Syllabus Mathematics 1B (8^{th} edition)* **Chapters 2-3**
- SLS

Unit Checklist

Lessons 4–9

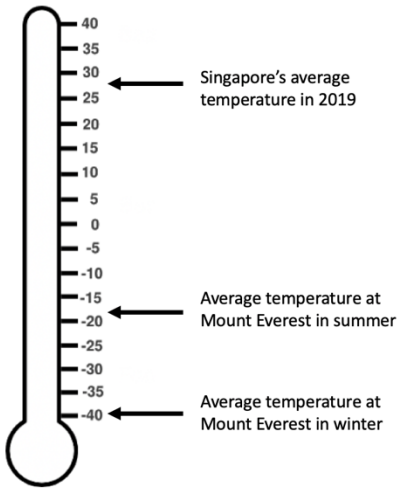
Cognitive Level	Know, Understand, Demonstrate	Checklist
Level 0: Memorisation	Define and give examples of rational and irrational numbers	
	Define and give examples of terminating, recurring and non-recurring decimals	
Level 1: Procedural tasks without connections	Carry out four operations involving negative numbers (including fractions, mixed numbers and decimals)	
	Evaluate negative square roots of positive numbers and cube roots of negative numbers	

Lessons 10–12

Cognitive Level	Know, Understand, Demonstrate	Checklist
Level 0: Memorisation	Understand the difference between approximation and estimation	
Level 1: Procedural tasks without connections	State the number of significant figures of a given number	
Level 2: Procedural tasks with connections	Approximate a given value to a given degree of accuracy	
	Estimate a given value to an appropriate degree of accuracy	
Level 3: Problem solving	Solve problems involving approximation in real-world contexts	
	Solve problems involving estimation in real-world contexts	

Lesson 4: Negative Numbers

(I) Negative Numbers



In 2019, the average temperature in Singapore was 28°C.
At Mount Everest, the temperature averages -40°C in winter and -19°C even in summer!

-40 and -19 (read as "negative forty" and "negative nineteen") are called **negative numbers**.

Negative numbers are numbers that are _____.

Examples of negative numbers in real-life situations

a) The average temperature at Mount Everest in winter is -40°C. This means that the temperature is _____ below 0°C.

b) The temperature recorded at Antartica was -89°C while the temperature recorded at the Death Valley in California was 57°C. The difference in temperature is _____°C.

c) If –5 represents 5m below sea level, then +15 represents _____ above / below sea level.

d) If a latitude of +90 means that North Pole is 90° **north** of the equator, a latitude of –90 means that South Pole is 90° _____ of the equator.

Big Idea:

(II) Integers

Integers are _____ or _____ whole numbers.

Examples: …, -3, -2, -1, 0, 1, 2, 3, …

Is 0 a positive integer? Is 0 a negative integer?

Example

$$-3,\ 2021,\ 0,\ -0.5,\ 1.333,\ -4.3,\ \frac{3}{5},\ -17,\ 4,\ -\frac{1}{3}$$

From the given numbers, list the numbers that are

a) Positive integers: _____

b) Negative integers: _____

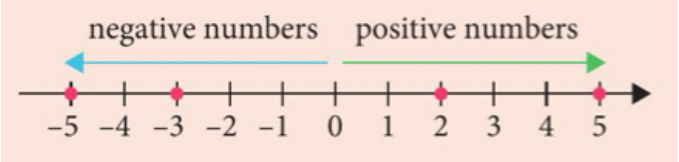
c) Positive numbers: _____

d) Negative numbers: _____

Is -3 bigger or smaller than -17?

(III) Number line

We can represent numbers on a number line.



Numbers increase from left to right.

Big Idea:

Hence, since 5 is **on the right of** 2, 5 is **greater than** 2.
Similarly, since 5 is **on the right of** –3, 5 is **greater than** –3.
We can represent "more than" with the symbol ">", i.e. 5 > 2, 5 > –3.

On the other hand, since 1 is **on the left of** 4, 1 is **smaller than** 4.
Similarly, since –5 is **on the left of** –1, –5 is **smaller than** –1.
We can represent "less than" with the symbol "<", i.e. 1 < 4, –5 < –1.

Symbol	Means…
<	
>	
≤	
≥	

Big Idea:

Classwork

1. Fill in each box with '>' or '<'.

   a) 13 ☐ –13

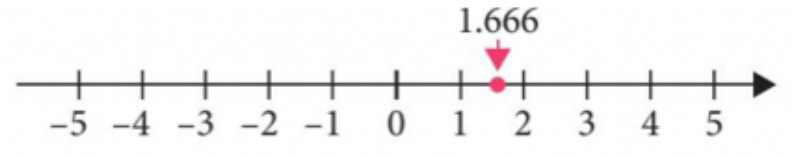
   b) –23 ☐ –27

   c) $(-12)^2$ ☐ –200

   d) $-\sqrt{169}$ ☐ $\sqrt[3]{216}$

2. Use a dot to represent the following numbers on the number line. The first one has been done for you.

$$1.666, \frac{11}{4}, -\sqrt{4}, 4.5, -3$$



3. Using a number line, arrange the following in ascending order: –5.3, 0.5, $-\frac{15}{7}$, 7.

Assignment 2A

Textbook: *Shinglee New Syllabus Mathematics (8th Edition) Textbook Secondary 1A*

Basic

- Textbook 1A Exercise 2A (page 35): Questions 3, 4(a), 5(a)

Intermediate

- Textbook 1A Exercise 2A (page 35): Questions 7, 8(b), 8(c)

Advanced

- Textbook 1A Exercise 2A (page 35): Questions 10, 11

Lesson 5: Addition and Subtraction involving Negative Numbers

In this section, we will learn how to add and subtract negative numbers.

To represent the number 2, we use two  discs as shown: 

To represent the number –2, we use two  discs as shown: 

(I) Addition of two negative integers

What is (-2) + (-3) equal to?

a) Represent –2 with two  discs.

b) Add three more  discs.

a)	b) Add three (-1) discs
	 (-2) + (-3) =

Example

1. (i) (-4) + (-3) = (ii) 4 + 3 =	2. (i) (-5) + (-6) = (ii) 5 + 6 =

What do you notice about the absolute value of the result in (i) and (ii)?

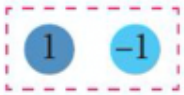
Practice

1. $(-6) + (-3) = -(6+3)$ $=$	2. $(-9) + (-11) = -($ $)$ $=$
3. $-21 + (-30) =$	4. $(-54) + (-39) =$

(II) Zero Pair

Suppose you have \$1, but you owe your friend \$1. In actual fact, how much is your overall balance?

When we put one 1 disc and one −1 disc together, we call it a **zero pair**. The overall value is 0.



(III) Subtraction between two positive integers

What is 2 – 5 equal to?

a) Represent 2 with two 1 discs.
b) We do not have five 1 discs to subtract or *take away*. Hence, we add three zero pairs.
c) Take away five 1 discs.

a)	b) Add three zero pairs	c) Take away five (1) discs
1 1	1 1	2 – 5 =

Example

1. (i) 3 – 4 = (ii) 4 – 3 =	2. (i) 1– 6 = (ii) 6 – 1 =

What do you notice about the absolute value of the result in (i) and (ii)?

Practice

1. $4 - 7 = -(7 - 4)$ $=$	1. $6 - 12 = -($ $)$ $=$
3. $21 - 53 =$	4. $14.5 - 30 =$

(IV) Addition of a positive and negative integer

What is 5 + (–2) equal to?

a) Represent 5 with five 1 discs.
b) Add two -1 discs.
c) Remove two zero pairs.

a)	b) Add two (-1) discs	c) Remove two zero pairs
		5 + (–2) =

Example

1. (i) 6 + (–2) = (ii) 6 – 2 =	2. (i) 4 + (–3) = (ii) 4 – 3 =

What do you notice about the results in (i) and (ii)?

Practice

1. $7 + (-6) = \ 7 - 6$ $=$	1. $45 + (-17) =$
3. $12 + (-21) =$	4. $-92 + 47 =$

(V) Subtraction of a negative integer

What is 5 – (–2) equal to?

a) Represent 5 with five 1 discs.

b) We do not have two −1 discs to subtract or *take away*. Hence, we add two zero pairs.

c) Take away two −1 discs.

a)	b) Add two zero pairs	c) Take away two (–1) discs
		5 – (–2) =

Example

1. (i) 6 – (–2) = (ii) 6 + 2 =	2. (i) 4 – (–3) = (ii) 4 + 3 =

What do you notice about the results in (i) and (ii)?

Practice

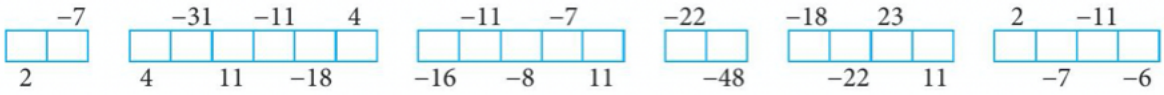
1. $7-(-6)=\ 7+6$ $=$	1. $16-(-35)=$
3. $-23-(-33)=$	4. $-7-(-5)=$

Activity

Source: 1A Textbook p44

Why should we not have a conversation near the Merlion? Find the value of each of the following and write the letter in the box above/below the answer to find out.

A $-5-6$	**T** $0+(-8)$	**P** $-47+16$	**O** $5-27$
S $0-(-4)$	**Y** $-88+70$	**N** $-38-10$	**E** $2-9$
D $5+(-11)$	**R** $-6-(-17)$	**U** $9-(-14)$	**H** $8+(-6)$
W $-7-9$			



Assignment 2B

Textbook: *Shinglee New Syllabus Mathematics (8th Edition) Textbook Secondary 1A*

Basic

- Textbook 1A Exercise 2B (page 45): Questions 7, 8

Intermediate

- Textbook 1A Exercise 2B (page 45): Questions 9(a), 9(c), 10(a), 10(c), 11(a), 11(c), 11(e)
- Textbook 1A Exercise 2B (page 45): Questions 12(a), 12(c), 13(a), 13(c)

Advanced

- Textbook 1A Exercise 2B (page 45): Questions 16

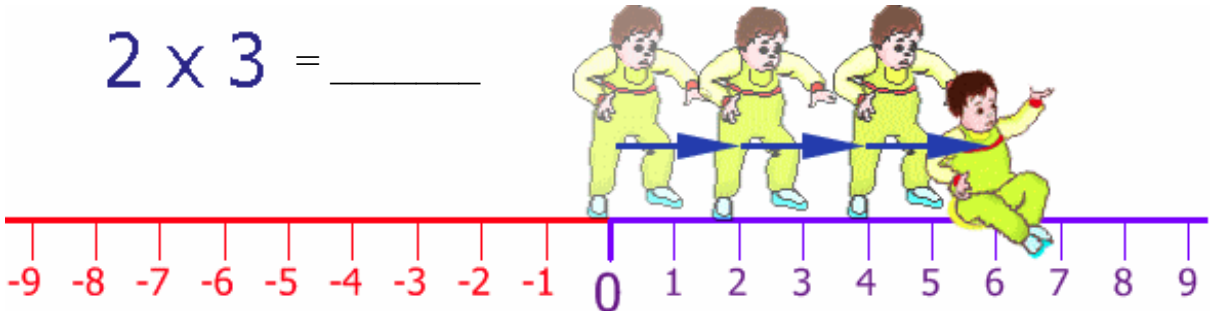
Lesson 6: Multiplication and Division involving Negative Numbers

Adapted from tinyurl.com/mathisfunproductoftwonegatives

(I) Multiplication between two positive integers

Baby Mohan is taking his first steps.

He takes 2 steps x 3 times = 6 steps in the positive direction.

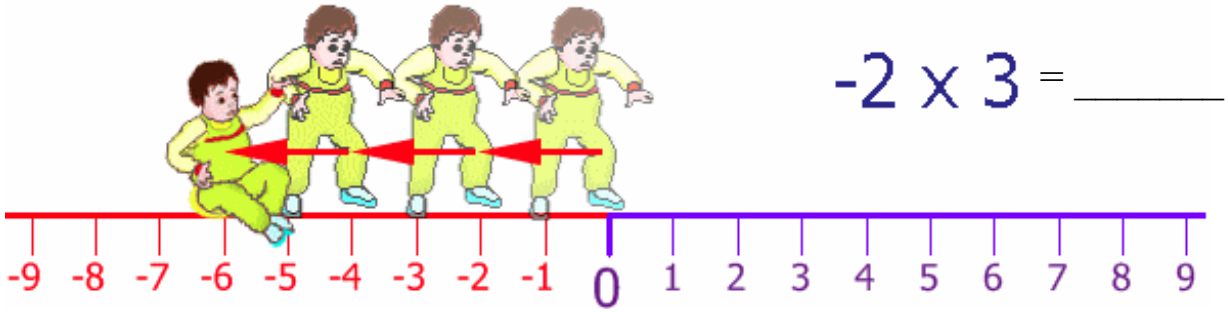


positive number × *positive* number = *positive* number	$2 \times 3 = 6$

(II) Multiplication between a positive and negative integer

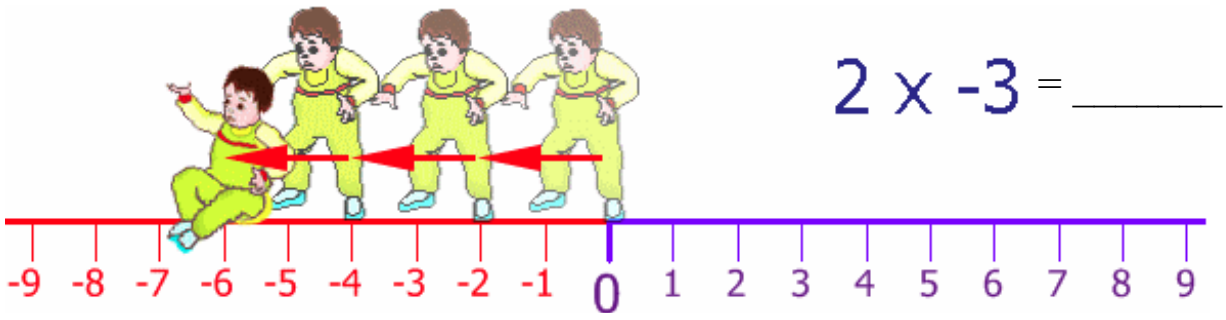
Baby Mohan can also step backwards. His Dad puts him back at the start.

He steps backwards 2 steps x 3 times = 6 steps in the negative direction.



Again, his Dad puts him back at the start, but turns him to face the other way.

Baby Mohan takes 2 steps forwards (for him!) x 3 times = 6 steps in the negative direction.



positive number × *negative* number = _____ number	$(-2) \times 3 = -6$
negative number × *positive* number = _____ number	$3 \times (-2) = -6$

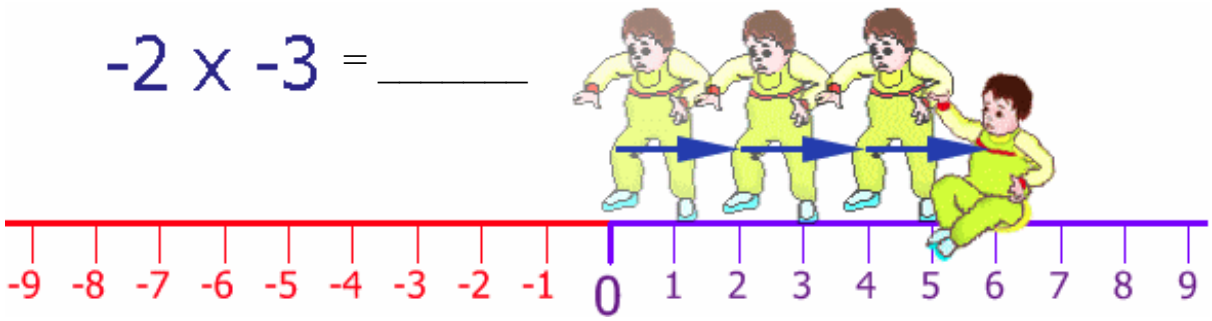
Practice

(a) $4 \times (-2) = -($ $\times$ $)$	(b) $(-2) \times 2021 =$
(c) $3(-9) =$	(d) $-5(23) =$

(III) Multiplication between two negative integers

Once more, his Dad puts him back at the start, and still turns him to face the other way.

While facing in the negative direction, Baby Mohan takes 2 steps backwards x 3 times.
He ends up taking 6 steps in the positive direction.



negative number × *negative* number = _____ number	$(-2) \times (-3) = -6$

Practice

(a) $-7 \times (-8) =$	(b) $(-3)^2 =$
(c) $-5(-6) =$	(d) $(-4)^3 =$

In general,

	Example
positive number × *positive* number = *positive* number	$2 \times 3 = 6$
positive number × *negative* number = _____ number	$2 \times (-3) = -6$
negative number × *positive* number = _____ number	$(-3) \times 2 = -6$ $(-2) \times 3 = -6$
negative number × *negative* number = _____ number	$(-3) \times (-2) = 6$

Extension

Go to any of below websites and in your own words, explain why the product of two negative numbers gives a positive number.

- **https://tinyurl.com/mathisfunproductoftwonegatives** [Basic-Intermediate]
- **https://tinyurl.com/youtubeproductoftwonegatives** [Basic-Intermediate]
- **https://tinyurl.com/khanacadproductoftwonegatives** [Advanced]

(IV) Division involving negative integers

In primary school, we have learnt that $\mathbf{6} \div \frac{3}{4} = \mathbf{6} \times \frac{4}{3} = \frac{\mathbf{6}\times 4}{3} = 8$.

The **reciprocal** of $\frac{3}{4}$ is $\frac{4}{3}$.

When we divide by a fraction $\frac{a}{b}$, it is equivalent to multiplying the reciprocal of the fraction.

$$P \div \frac{a}{b} = P \times \frac{b}{a}$$

Similarly, $(-\mathbf{6}) \div \frac{3}{4} = (-\mathbf{6}) \times \frac{4}{3} = \frac{(-\mathbf{6})\times 4}{3} = -8$.

Classwork

Tier A

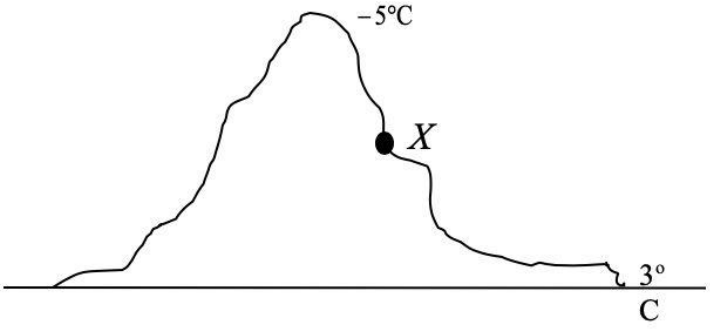
(a) $(-6) \div 3 =$	(b) $(-120) \div 10 =$
(c) $20 \div (-4) =$	(d) $-21 \div (-7) =$
(e) $\frac{-16}{4} =$	(f) $(-36) \times 2 \div (-8) =$

Tier B

(a) $12 \times (-3) + (-11) \times 6$	(b) $48 \div 6 - [-25 \times (-4)]$
(c) $(-3^3) - [-\sqrt[3]{64} + 40 \times (-2)]$	(d) $(-4)^3 + [-(-20) - 4] \div (-4) \times (-2)^2$

Tier C

The temperature at the base and top of a mountain are $3^{o}C$ and $-5°C$ respectively. The point X is exactly halfway mark of the mountain.



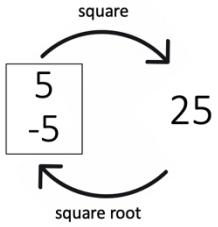
Assuming that the temperature decreases uniformly with height, find

(a) Find the difference in temperature at the top and at the base of the mountain.

(b) Find the temperature at point X.

Lesson 7: Square and cube roots revisited

(I) Square root



Example

$(5)^2 =$

$(-5)^2 =$

In Lesson 2, we have learnt $5^2 = 5 \times 5 = 25$, hence $\sqrt{25} = 5$. $\sqrt{25}$ is called the **positive square root of 25**.

Big Idea:

Hence, since $5^2 = 25$ and $(-5)^2 = 25$, then 25 has two square roots:

- **positive** square root of 25, written as $\sqrt{25} = 5$
- **negative** square root of 25, written as $-\sqrt{25} = -5$

We can combine both the positive and negative square roots by writing $\pm\sqrt{25}$ to denote $\sqrt{25}$ or $-\sqrt{25}$.

Practice

1. Find the square roots of 36.	2. Find the square roots of 64.
3. Find the negative square root of 9.	4. $\sqrt{49}$

Is it possible to obtain the square roots of a negative number, e.g. $\sqrt{-16}$? Explain your answer.

(II) Cube root

In Lesson 2, we have learnt $5^3 = 5 \times 5 \times 5 = 125$, hence $\sqrt[3]{125} = 5$.

Example

$(-5)^3 =$

Hence, since $(-5)^3$ is not the same as 5^3, then 125 has **only a positive cube root** and it is possible to obtain the cube root of a negative number.

Practice

1. $\sqrt[3]{64}$	2. $\sqrt[3]{-125}$
3. $-\sqrt[3]{1000}$	4. $-\sqrt[3]{-27}$

Assignment 2C

Textbook: *Shinglee New Syllabus Mathematics (8th Edition) Textbook Secondary 1A*

Basic

- Textbook 1A Exercise 2C (page 51): Questions 1, 5, 8

Intermediate

- Textbook 1A Exercise 2C (page 51): Questions 14, 15

Advanced

- Textbook 1A Exercise 2C (page 51): Questions 18, 20

Lesson 8: Fractions, mixed numbers and decimals

In primary school, we have learnt about **proper fractions** (e.g. $\frac{1}{4}$), **improper fractions** (e.g. $\frac{7}{3}$), and **mixed numbers** (e.g.$3\frac{2}{5}$).

These numbers can be extended to include **negative fractions** (e.g. $-\frac{5}{4}$), and **negative mixed numbers** (e.g. $6\frac{1}{10}$).

Example

1. Is $-\frac{\mathbf{3}}{\mathbf{4}}$ the same as $\frac{\mathbf{-3}}{\mathbf{4}}$ or $\frac{\mathbf{3}}{\mathbf{-4}}$?

2. Is $\frac{\mathbf{1}}{\mathbf{5}}$ the same as $\frac{\mathbf{2}}{\mathbf{10}}$?

Big Idea:

(I) Adding and subtracting fractions and mixed numbers

Without using a calculator, evaluate the following.

1. $6\frac{1}{5}+(-2\frac{2}{10})$	2. $-3\frac{1}{3}+(-\frac{1}{4})$
3. $-\frac{7}{4}-\frac{5}{6}-(-1\frac{1}{3})$	4. $\frac{5}{9}-3\frac{1}{6}-(-\frac{4}{3})$

(II) Multiplying and dividing fractions and mixed numbers

Tier A

Without using a calculator, evaluate the following.

1. $1\frac{7}{15} \times 2\frac{3}{11}$	2. $\frac{11}{19} \times 1\frac{9}{22}$
3. $2\frac{2}{9} \div \frac{10}{22}$	4. $6\frac{3}{7} \div 5$

Tier B

Without using a calculator, evaluate the following.

1. $3\frac{2}{3} \div (-2\frac{4}{9})$	2. $[-\frac{3}{4} + \left(-\frac{5}{2}\right)] \div \frac{2}{13}$

3. $-2\frac{4}{5} \times [-\frac{5}{2} + \left(-\frac{3}{2}\right)^2]$	4. $-\frac{9}{14} \times [\left(-1\frac{3}{2}\right)^2 - 2\frac{5}{6}]$

(III) Decimals

Without using a calculator, evaluate the following.

1. $7.2 - 3.4 \div 0.2$	2. 12.34×5.6

Lesson 9: Rational, irrational and real numbers

(I) Rational and irrational numbers

A **rational number** is a number that can be expressed in the form of $\frac{a}{b}$, where *a* and *b* are integers, where $b \neq 0$.

In other words, a number is rational if it can be written as a fraction where both the numerator and denominator are integers.

On the other hand, **irrational numbers** are numbers that <u>cannot</u> be expressed in the form of $\frac{a}{b}$, where *a* and *b* are integers, where $b \neq 0$.

<u>Activity</u>

Big Idea:

1. Classify these numbers as either rational or irrational numbers.

$$2, \frac{1}{3}, -\frac{5}{8}, \sqrt{3}, 0.6, \pi, 0.\dot{3}, \frac{6}{3}, \frac{\sqrt{7}}{2}, -2021$$

Rational numbers	Irrational numbers

2. Based on your answers above, answer the following questions.

a) Are all integers rational numbers? Explain.

b) Are all decimals rational numbers? Explain.

c) Are all square and cube roots irrational numbers? Explain.

(II) Real numbers

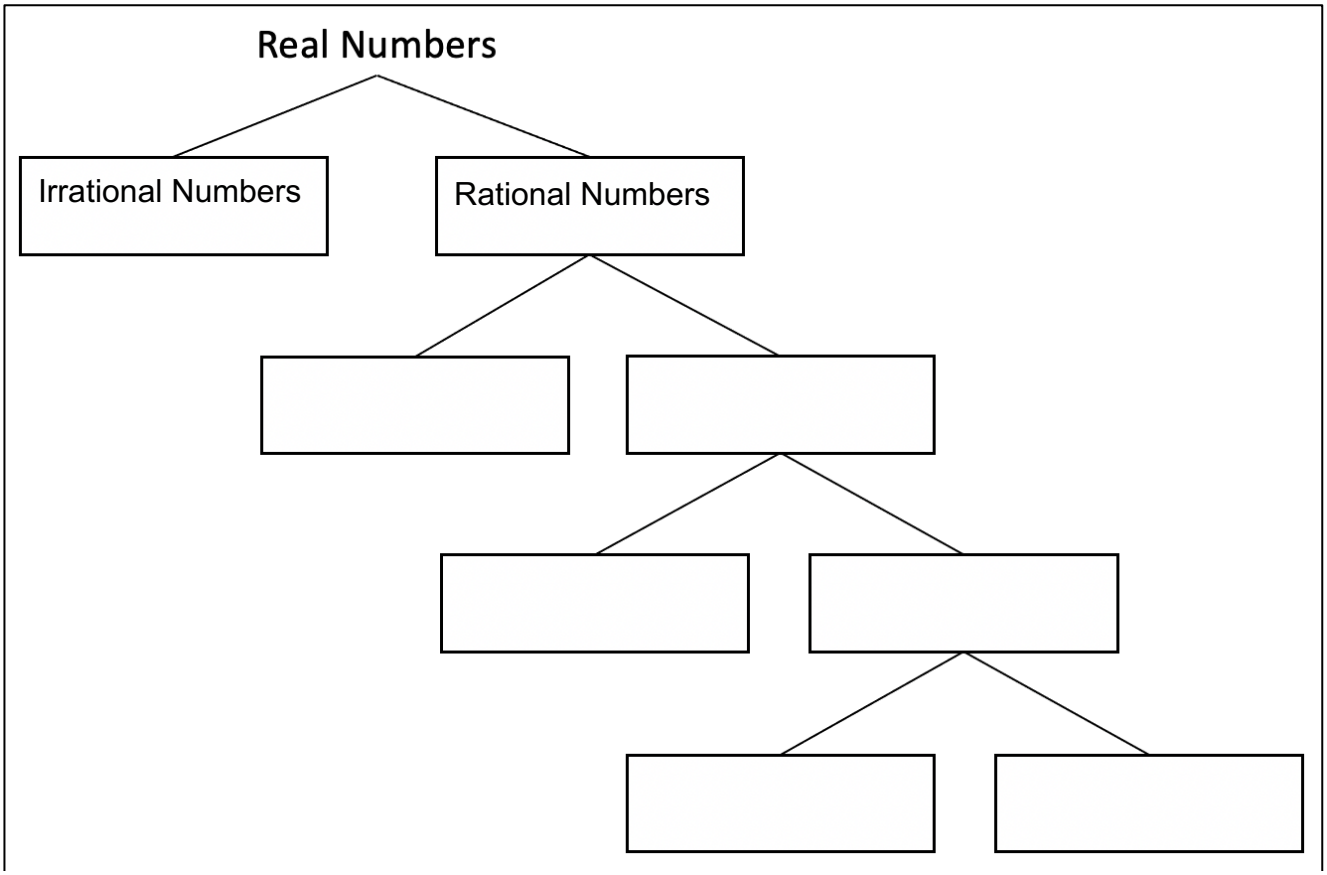
Real numbers are made up of rational and irrational numbers.

Activity: Numbers Family Tree

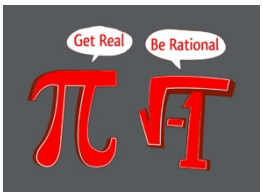
Can you fill in the blanks with the different types of numbers?

- Integers
- Zero
- Whole numbers
- Positive integers
- Negative integers
- Non-integer rational numbers

Tip: Think of the definition and some examples for each category of numbers.



Extension: Imaginary Numbers



When you key in $\sqrt{-1}$ into your calculator, you would obtain a "Math Error". However, $\sqrt{-1}$ actually exists – it is called an **imaginary number**.

View the following video to learn more about imaginary numbers.

- **https://tinyurl.com/introtoimaginarynumbers**

Sypnosis of video:
00:16 Rational numbers
00:23 Irrational numbers
1:20 roots of a quadratic equations
2:51 negative 1 – unit imaginary number
3:53 imaginary roots of a quadratic equation

(III) Terminating, recurring, and non-recurring decimals

Activity

Using a calculator, evaluate the following by writing down all the numbers displayed in the calculator.

Group 1	Group 2	Group 3
$\frac{7}{4} =$	$\frac{1}{3} =$	$\sqrt{2} =$
$-3\frac{1}{8} =$	$-\frac{123}{99} =$	$-\sqrt{5} =$
$\frac{63}{64} =$	$\frac{22}{7} =$	$\pi =$

1. a) Are the numbers in Group 1 rational or irrational numbers? Explain.
   b) What do you notice about the decimal representations (i.e. the calculator values) of the numbers in Group 1?

2. a) Are the numbers in Group 2 rational or irrational numbers? Explain.
   b) What do you notice about the decimal representations of the numbers in Group 2?

3. a) Are the numbers in Group 3 rational or irrational numbers? Explain.
   b) What do you notice about the decimal representations of the numbers in Group 3?

Real numbers can be written as decimal representations, which can be classified into three types.

- **Terminating decimals**, i.e. the digits after the decimal point terminate
- **Recurring (or repeating) decimals**, i.e. the digits after the decimal point repeat themselves indefinitely.
- **Non-terminating and non-recurring decimals**, i.e. the digits after the decimal point do not repeat but they continue indefinitely.

Classwork

Tier A

Use a calculator to evaluate the following. Leave your answer correct to 3 decimal places.

1. $\frac{3.2\pi+4.3^2}{\sqrt{47.5}-2\frac{3}{4}}$

2. $\frac{\pi\times(-0.7)^2}{\sqrt[3]{2.4^2+3^3}}$

Assignment 2D

Textbook: *Shinglee New Syllabus Mathematics (8th Edition) Textbook Secondary 1A*

Basic

- Textbook 1A Exercise 2D (page 65): Questions 1(b), 1(d), 2(b), 2(d), 3(b), 3(d),
- Textbook 1A Exercise 2D (page 65): Questions 4(a), 4(c), 4(e), 6(d), 6(h), 7(a), 8(a)

Intermediate

- Textbook 1A Exercise 2D (page 65): Questions 9(b), 9(d), 10, 11(b), 11(d), 13(b), 13(d)
- Textbook 1A Exercise 2D (page 65): Questions 14(b), 14(d), 15(b), 15(d)

Advanced

- Textbook 1A Exercise 2D (page 65): Questions 18, 19

Lesson 10: Approximation

(I) Difference between approximation and estimation

Activity

Changi Airport Handles Record 62.2 Million Passengers

Changi Airport handled a record of 62,219,573 passengers in 2017, a 6.0% increase over 2016. This makes the airport the 6th busiest airport in the world by passenger traffic in 2017. The airport has won over 557 awards since its opening in 1981, with 26 "Best Airport" awards in 2017 alone. Currently, it has four terminals, which brings its total annual handling capacity to 85 million passengers.

1. Which numbers in the article are **actual** values? _____

2. Which numbers in the article are **approximate** values? _____

3. Which numbers in the article are **estimate** values? _____

4. Why does the article mention “over 557 awards” instead of specifying the actual number of awards won?

_____

_____

5. Why does the title of the article use 62.2 million passengers instead of 62219573 passengers?

_____

_____

6. Explain the difference between approximation and estimation in your own words.

_____

_____

(II) Rounding off

To round off a number to a required number of decimal places, e.g. 2 decimal places, we consider the digit to the right of the digit in the second decimal place.

- If the digit is 5 or more, we round _____
- If the digit is less than 5, we round _____

Class Work

Tier A

1. Round off 3 409 725 to the nearest
(a) 10, (b) 100, (c) 1000, (d) 10 000

2. Correct 96.482 to
(a) 1 decimal place, (b) the nearest whole number.

3. Using a calculator, evaluate the following and give answers correct to 3 decimal places.
(a) $\sqrt[3]{-20} + 3 \times \sqrt{48}$ (b) $\sqrt{\frac{(-1.18)^3 \times (-293)}{\pi}}$

Tier B

4. If an integer is rounded to the nearest 10, it becomes 90.
(a) Write down all the possible values of the integer.
(b) List the value(s) in (a) which is/are prime.

5. If an integer is rounded to the nearest 100, it becomes 2800. Find

   (a) the maximum possible value of the integer,
   (b) the minimum possible value of the integer.

6. Leonard says that 8.395 is equal to 8.4 when rounded off to 2 decimal places because he thinks that 8.40 is the same as 8.4. Do you agree? Explain your answer.

(III) Significant Figures

Example

Newspaper A reported that Changi Airport handled a record of 62 219 573 passengers in 2017.
Newspaper B reported that Changi Airport handled a record of 62 000 000 passengers in 2017.

1. Which newspaper reported a more accurate number? Why?

2. Does accuracy depend on the number of digits a number has? Explain.

Significant figures are used to reflect the degree of accuracy.

A number is more accurate when it is given to a greater number of significant figures.

How many significant figures does 62 219 573 have?

How do we know how many significant figures 62 219 573 have?

(IV) Five rules to identify digits which are significant

Rules		Example	Number of significant figures
1.	All non-zero digits are significant. The first non-zero digit is the first significant figure.	7258	
		83.761	
		4.5	
2.	Zeros between non-zero digits are significant.	5062	
		302.008	
		70.8001	
3.	In a decimal, all zeros before a non-zero digit are not significant.	0.0057	
		0.021	
		0.10908	
4.	In a decimal, zeros after a non-zero digit are significant.	0.10	
		0.0500	
		41.0340	
5.	Zeros at the end of a whole number may or may not be significant.	7500 (correct to nearest 100)	
		7500 (correct to nearest 10)	
		7500 (correct to nearest 1)	

(V) Rounding off to a given number of significant figures

When we round off a number to a given number of significant figures, e.g. to 3 significant figures, we consider the fourth significant figure.

1. Correct 25 932 to an accuracy of
   (a) 2 significant figures _____
   (b) 3 significant figures _____

2. Correct 0.0012504 to an accuracy of
   (a) 2 significant figures _____
   (b) 3 significant figures _____

3. Correct 0.0060195 to an accuracy of
   (a) 3 significant figures _____
   (b) 4 significant figures _____

4. Correct 0.9999 to an accuracy of
   (a) 3 significant figures _____

5, The number of people at a concert is stated as 21 200, correct to 3 significant figures. What is the largest and the smallest possible number of people at the concert?

Assignment 3A

Textbook: Shinglee New Syllabus Mathematics (8th Edition) Textbook Secondary IA

Basic

- Textbook IA Exercise 3A (page 79): Questions 1, 2, 6(a), 6(b), 6(e), 6(f)

Intermediate

- Textbook IA Exercise 3A (page 79): Questions 8, 1 1

Advanced

- Textbook IA Exercise 3A (page 79): Questions 14, 15, 16

Lesson 11: Approximation and approximation errors in real-world contexts

Activity

Nurul, Kishan and Esther wants to run for President of the Mathematics Society. The table below shows the votes they received during the election.

Candidate	Number of Votes	Percentage of votes	Percentage of votes
Nurul	187	62.3%	(to 4 s.f.)
Kishan	52	17.3%	(to 4 s.f.)
Esther	61	20.3%	(to 4 s.f.)
Total	**300**	**99.9%**	(to 3 s.f.)

1. The total percentage of votes is only 99.9%. What has happened to the missing 0.1% of the votes?

2. In the last column in the table,
   a) Calculate the percentage of votes for each candidate correct to 4 significant figures.
   b) Round off the total percentage to 3 significant figures.

If **intermediate values are non-exact**,

- present intermediate values to 4 or 5 significant figures (for presentation purposes)
- use calculator values to compute next step in working (for accuracy purposes)
- leave final answer to 3 significant figures

This is to avoid follow-through errors.

Practice

1. The area of a square is 131 cm^2. Find (i) the length, and (ii) the perimeter of the square.

2. The circumference of a circle is 136m. Find (i) the radius, and (ii) the area of the circle.

Note:

In Question 1, we avoid writing $\sqrt{131} \approx 11.4$ because we do not know how accurate 11.4 cm is.

Instead, we always **specify the degree of accuracy**, such as the number of significant figures or decimal places. E.g. $\sqrt{131} = 11.4$ (to 3 s.f.) or $\sqrt{131} = 11.45$ (to 2 decimal places).

However, we use the ≈ sign when we **estimate an unknown quantity** in real life, especially when the actual value is not known and we are unable to specify the degree of accuracy, e.g. distance ≈ 10 km (or estimated distance = 10 km).

Lesson 12: Estimation and estimation errors in real-world contexts

In previous sections, we have learnt how to ***approximate* a given number** to a certain degree of accuracy.

In this section, we learn how to ***estimate* an unknown quantity** in real life.

We estimate because we do not need an exact answer.

- If a hamburger costs $4.25, fries cost $0.99, and you've got a five dollar note and a two dollar note, you know you can afford the meal without calculating the exact amount.

- If you're painting a living room, you don't need to figure the amount of paint to the teaspoon.

- Sometimes you don't have any paper or pencil or a calculator with you, or it's hard to calculate an exact answer mentally.

- Sometimes, we may key in the wrong value when using a calculator and obtain a wrong answer. We can use estimation to check if your answer is reasonable or obviously wrong.

When asked to estimate a calculation, we work to **one more significant figure** than we are required to give.

Classwork

Tier A

1. Joyce used a calculator to evaluate 31.5 + 9.87 – 2.1 and obtained the answer 392.7.
   i) Without doing actual calculation, use estimation to check whether Joyce's answer is reasonable.

   ii) Use a calculator to evaluate the actual answer. Is your estimated value close to the actual value?

2. Estimate 798×195. Firhan used a calculator and obtained the answer 15 561. Is his answer reasonable?

Tier B

3. A pair of earrings costs 25 000 Indonesian Rupiah (Rp).
   The conversion rate is Rp 1000 = S$0.095 992.
   Without using a calculator, estimate the price of the pair of earrings in S$.

4. Without using a calculator, decide which option gives the better value for money.

5. Estimate the value of the following:

a) $\frac{31.98+8.036}{48.109-29.989\times 0.0995}$ (b) $\sqrt{\frac{15.908\times 80.817}{4.001}}$

Assignment 3B

Textbook: Shinglee New Syllabus Mathematics (8th Edition) Textbook Secondary 1A

Basic

- Textbook IA Exercise 3B (page 87): Questions 4, 5, 6, 7

Intermediate

- Textbook IA Exercise 3B (page 87): Questions 11, 12, 15

Advanced

- Textbook IA Exercise 3B (page 87): Questions 17, 18