

MATHEMATICS

GRADE 8

TEACHERS GUIDE

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UNIT 1

RATIONAL NUMBERS

Total allotted period :30 periods

Introduction

In the previous grade the students have learnt about the set of natural numbers, whole numbers, and integers and their basic properties. In this unit we introduce the set of numbers which contains the other set of numbers, that is rational number. The unit gives much emphasis to the definition of rational numbers, representation of rational numbers on a number line, relationship among $\mathbb{N}$, $\mathbb{W}$, $\mathbb{Z}$, and $\mathbb{Q}$, absolute value of rational numbers, comparing rational numbers, ordering rational numbers, addition of rational numbers, subtraction of rational numbers, multiplication of rational numbers, division of rational numbers, application in sharing among friends, and application in calculating interest and loans.

Unit Outcomes

At the end of this unit, students will be able to:

- ❖ Define and represent rational numbers as fractions.
- ❖ Show the relationship among $\mathbb{W}$, $\mathbb{Z}$ and $\mathbb{Q}$.
- ❖ Order rational numbers
- ❖ Solve problems involving Addition, Subtraction, Multiplication and Division of rational numbers.
- ❖ Apply Rational Numbers to solve practical problems.
- ❖ Aware the four operations as they relate to Rational Numbers.

Suggested teaching Aids in unit 1

You know that students learn in a variety of different ways. Some are visually oriented and more inclined to acquire information from photographs or

videos. Others do best when they hear instructions rather than read them. Teachers use teaching aids to provide these different ways of learning. Therefore, you can present these topics using Venn diagrams, number lines, thermometer, fractional bars and grids model to understand about rational numbers.

1.1 The Concept of Rational Numbers On The Number Line

Period Allotted: 6 periods

Competencies:

At the end of this sub-topic, students should:

- ❖ Describe the concept of Rational Numbers practically
- ❖ Express Rational Numbers as fractions.

1.1.1. Representation of Rational Numbers on a number line

Allotted Period: 3 periods

Introduction:

To begin, it is better to motivate the students by giving an insight of the course, the unit. how they will be manipulating specific kinds of numbers, that are related to their real life activities. After that, describe how mathematicians classify numbers and what kinds of major classifications exist. After these discussions you are continue to discuss the group activity. The purpose of group activity 1.1 is more to rehearse the lower grade concepts that are related to the unit. Let each student do Group Work 1.1 with group and you should give much emphasis on the ways developing numbers. The answer to Group work 1.1 is as follows.

Teaching notes

The purpose of the teaching notes is to provide the teacher information to use activities, opening problems and group-works to motivate and guide students rather than lecturing.

Students are expected to have some background on the concept of natural numbers, whole numbers, and integers from the previous grades. For the purpose of revision, you can ask different questions like the following:

- 1) Group the following numbers are natural number, whole number, integer or not
 a) $\frac{12}{4}$ b) $\frac{-36}{3}$ c) $\frac{0}{7}$ d) $\frac{37}{13}$
- 2) Between what consecutive integers the following rational numbers exist?
 a) $\frac{5}{2}$ b) $\frac{-3}{2}$ c) $\frac{3}{4}$ d) $\frac{-5}{7}$
- 3) Change the following improper fractions to mixed fractions.
 a) $\frac{12}{7}$ b) $\frac{25}{6}$ c) $\frac{19}{7}$
- 4) Change the following mixed fractions to improper fractions.
 a) $3\frac{2}{3}$ b) $2\frac{4}{7}$
- 5) Represent the following rational numbers on a number line.
 a) $\frac{7}{6}$ b) $\frac{-8}{3}$ c) $\frac{3}{5}$

Answer to Group Work 1.1

1a: 1, 2, 3, 4, 5, 6, 7, 8, and 9

b: 0

c: ...-3, -2, -1

2a: integers

3: any number that can be expressed in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$, is called a rational number.

4: Given: total number of toys = 5

Total amount in Birr = 22.

Let x be the amount spent for each pet. Then

$$5x = 22$$

$$\frac{1}{5} \times 5x = 22 \times \frac{1}{5}$$

$x = \frac{22}{5}$. This means the amount spent for each toy is Birr 4 and 40 cents.

Following these discussion, you are continue to discuss the idea of fraction, its type and define what a rational number is? And relate the definition with fractions and decimals. You can use similar examples to the examples given in the student textbook. The possible answer to exercise 1.1 are as follows.

Answer to Exercise 1.1

1: a number line between 1 and 3.5 divides into 3 equal parts, each part represents $\frac{1}{2}$. Then when we add $\frac{1}{2}$, starting from 1 until we get point B, that is 2

2: a) between 0 and 1

b) between 1 and 2

c) between -1 and 0

d) between -2 and -1

3) Divide the numerator by the denominator. The quotient uses as the whole number part, the remainder uses as the numerator and the denominator uses as the denominator of the proper fraction.

a) $32 \div 5 = 6$ remainder 2

$$\text{Therefore, } \frac{32}{5} = 6\frac{2}{5}$$

b) $27 \div 10 = 2$ remainder 7

$$\text{Therefore, } -\frac{27}{10} = -2\frac{7}{10}$$

c) $7 \div 3 = 2$ remainder 1

$$\text{Therefore, } \frac{7}{3} = 2\frac{1}{3}$$

4) First determine between what consecutive integers the given rational numbers exist.

a) $\frac{5}{6}$ is between 0 and 1 on a number line, and divide a number line between 0 and 1 into 6 equal parts, the fifth part represents $\frac{5}{6}$ of the 6 equal parts.



- b) $\frac{3}{5}$ is between 0 and 1, and divide a number line between 0 and 1 into 5 equal parts, the third part represents $\frac{3}{5}$ of the 5 equal parts.



Figure 1.2

- c) $-\frac{5}{6}$ is between -1 and 0 , and divide a number line between -1 and 0 into 6 equal parts. The fifth part represents $-\frac{5}{6}$ of the 6 equal parts



Figure 1.3

- d) $-\frac{8}{5}$ is improper fraction, then first change into mixed fraction.
 $-\frac{8}{5} = -1\frac{3}{5}$ and it is between -2 and -1 on a number line. Divide a number line between -2 and -1 into 5 equal parts. The third part represents $-\frac{8}{5}$.

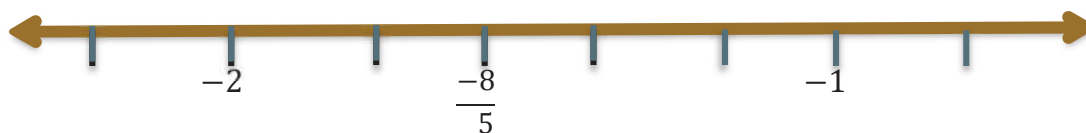


Figure 1.4

- e) $2\frac{2}{5}$ is between 2 and 3. Divide a number line between 2 and 3 into 5 equal parts. The second part represents $2\frac{2}{5}$.

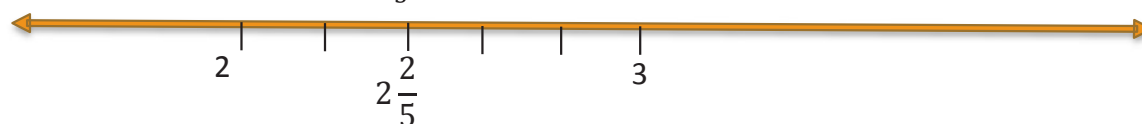


figure 1.5

5) To the left of -8.8

6) a) $-\frac{4}{5}$

b) $\frac{2}{3}$

c) $-2\frac{3}{5}$

d) $3\frac{4}{7}$

Teachers' are strongly advised to discuss and workout difficult questions as far as possible. The class should not be teacher centred. Following these exercise, you are continue the sub-section.

Dear teacher, please give the following questions for slow learners and fast learners.

For slow learners

- 1) Describe Natural numbers, Whole numbers, and Integers by your own words.
- 2) Group the following numbers are Natural numbers, Whole numbers, and Integers or not.

a) $\frac{15}{3}$

b) $\frac{13}{12}$

c) $\frac{-18}{6}$

$\frac{0}{13}$

For fast learners

- 1) Describe how to represent a rational number on a number line.
- 2) Represent the following rational numbers on a number line.

a) $\frac{35}{12}$

b) $\frac{-21}{8}$

1.1.2. Relationship Among W, $\mathbb{Z}$ and $\mathbb{Q}$

Allotted period: 2 periods

Competencies:

At the end of this sub – topic students should be able to:

- ❖ Describe the relationship among the sets W, $\mathbb{Z}$ and $\mathbb{Q}$

The teacher may begin the subtopic by encourage the students to answer the question like:

- a) Solomon says the number 0 belongs only to the set of rational numbers. Explain his error.
- b) Is it possible for a number to be a rational number that is not an integer but is a whole number? Explain.

These questions help the teacher to understand the level of the student's critical thinking and critique reasoning. After giving a brief summary about the relationship among $\mathbb{N}$, $\mathbb{W}$, $\mathbb{Z}$, and $\mathbb{Q}$ and you should allow enough time for the student to discuss the relationship among $\mathbb{N}$, $\mathbb{W}$, $\mathbb{Z}$, and $\mathbb{Q}$. Give exercise 1.2 as a home work in order to analyse their knowledge of the relationship among $\mathbb{N}$, $\mathbb{W}$, $\mathbb{Z}$, and $\mathbb{Q}$. And can give marks and record it.

Answers to Exercise 1.2

- 1) 0 is not only rational number. It is an integer and also whole number.
2) a) True b) True c) False

1.1.3. Absolute Value of Rational numbers

Period Allotted: 3 periods

Competency: -

After completing this sub-topic, students should be able to:

- ❖ Determine the absolute value of a rational numbers.

Dear teacher before discussing to section 1.1.3 directly, ask your students orally to answer activity 1.1. This activity is used to introduce the concept of absolute value.

Answer for Activity 1.1

The distance from 0 and 5 is 5 units and from 0 and -5 is also 5 units, the only difference is the direction with related to 0.

Here you strongly advised to deal with absolute value of a rational number as **the concept is new**, otherwise students will face problems in understanding meaning of absolute value and solving absolute value equations. By using simpler examples, guide your students work continuously and compare it with the competency to determine whether the student has achieved the minimum required level. So give enough time for the students to discuss exercise 1.3 and come up with their own solutions. You should also give feedback for their questions and answers timely and explicitly.

Answers to exercise 1.3

1:

x	-7	$\frac{3}{5}$	0	$-2\frac{5}{9}$ or $2\frac{5}{9}$	$-\frac{2}{3}$
$ x $	7	$\frac{3}{5}$	0	$2\frac{5}{9}$	$\frac{2}{3}$

2) a. 3.5 and -3.5

b. $\frac{4}{7}$ and $-\frac{4}{7}$

c. $\frac{11}{6}$ and $-\frac{11}{6}$

d. $3\frac{2}{5}$ and $-3\frac{2}{5}$

3a) 10

b) 12

c) $3\frac{2}{5}$

d) 3

e) $\frac{1}{13}$

4) a) $5x - |x - 3|, x = -5$

t

$$5 \times (-5) - |-5 - 3|$$

$$= -25 - |-8|$$

$$= -25 - 8$$

$$= -33$$

b) $|x| - x + 9, x = 3$

$$= |3| - 3 + 9$$

$$= 3 + 6$$

$$= 9$$

c) $|x + y| - |x|, x = -3$ and $y = 6$

$$= |-3 + 6| - |-3|$$

$$= |3| - 3$$

$$= 3 - 3$$

$$= 0$$

d) $|x| + |y|, x = 5$ and $y = -10$

$$= |5| + |-10|$$

$$= 5 + 10$$

$$= 15$$

$$\begin{aligned} \text{e) } -3|x+6|, x &= -5 \\ &= -3|-5+6| \\ &= -3|1| \\ &= -3 \end{aligned}$$

$$\begin{aligned} \text{f) } \frac{|x|-|5y|}{|x+y|}, x &= 4 \text{ and } y = 8 \\ &= \frac{|4|-|5 \times 8|}{|4+8|} \\ &= \frac{|4|-|40|}{|12|} \\ &= \frac{-36}{12} \\ &= -3 \end{aligned}$$

$$5 \text{ a) } x = 8 \text{ or } x = -8$$

$$\text{b) } x = \frac{3}{5} \text{ or } x = -\frac{3}{5}$$

$$6 \text{ a) } x = 6 \text{ or } x = -6$$

$$\text{b) } x = -6 \text{ or } x = 0$$

$$\begin{aligned} \text{c) } 3-2|x-5| &= 9 \\ -2|x-5| &= 9-3 \\ -2|x-5| &= 6 \\ |x-5| &= -3 \end{aligned}$$

No solution, because absolute value cannot be negative

$$\begin{aligned} \text{d) } |5x-3| &= \frac{5}{2} \\ 5x-3 &= \frac{5}{2} \quad \text{or} \quad 5x-3 = -\frac{5}{2} \\ 5x &= \frac{5}{2} + 3 \quad 5x = -\frac{5}{2} + 3 \\ 5x &= \frac{5}{2} + \frac{6}{2} \quad 5x = -\frac{5}{2} + \frac{6}{2} \\ 5x &= \frac{11}{2} \quad 5x = \frac{1}{2} \\ x &= \frac{11}{10} \quad x = \frac{1}{10} \end{aligned}$$

$$\text{e) } 3|x-5| = 3\frac{2}{3}$$

$$|x-5| = \frac{11}{9}$$

$$x-5 = \frac{11}{9} \quad \text{or} \quad x-5 = -\frac{11}{9}$$

$$x = \frac{11}{9} + 5 \quad x = -\frac{11}{9} + 5$$

$$x = \frac{56}{9} \quad x = \frac{34}{9}$$

Assessment

Dear teacher you are strongly advised to guide students by grouping them in two groups such as slow learners, and fast learners. Simple problems and difficult problems are respectively to be solved to slow learners and fast learners. using such a steep the slow learners will be pushed up to fast learners, you can give the following additional questions.

For slow learners

- 1) What is the distance between 0 and -17 ?
- 2) Find the opposite of the following rational numbers.
 - a) -18
 - b) $\frac{11}{5}$
 - c) $\frac{0}{7}$
- 3) Solve the following absolute value equations.
 - a) $|x| = 9$
 - b) $|x-3| = 7$
 - c) $|x+4| = 3$

For fast learners

- 1) Evaluate $\frac{|2x| - |3x-y|}{|2x-3y|}$, $x = 5$ and $y = 3$
- 2) Solve the following absolute value equations.
 - a) $3+2|x+5| = 7$
 - b) $3|x-2| = 8$
 - c) $4-3|x+7| = 3$

1.2. Comparing and Ordering Rational numbers

Period Allotted: 6 periods

Competency:

At the end of this sub-topic students should:

❖ Compare and order Rational Numbers

In the previous sections students have studied about rational numbers and how to locate rational numbers on the number line. You may start the lesson by a quick revision on definition of rational numbers, locating rational numbers on the number line and guide students to extend this idea for comparing rational numbers using number line. The sub-topic is divided into two subtopics. The first subtopic is Comparing rational numbers and the second subtopic is ordering rational numbers. To assess students background on comparison, you can give activity 1.2 to do with groups and encourage each group to come up with answers and reasons.

1.2.1. Comparing Rational numbers

Period Allotted: 5 periods

Students understand the given lesson differently at different level. Therefore, in order to ensure that all students can fully participate in their learning, you may give various techniques such as class work, group discussion and quiz. These helps to check students how much they achieved. You can start this lesson by giving different examples.

Example: Compare the following pair of numbers by using the symbols

$<$, $>$ or $=$.

a) 13 _____ 21

e) 11.23 _____ 8.67

b) $\frac{17}{8}$ _____ $\frac{13}{8}$

f) $\frac{12}{7}$ _____ $\frac{15}{10}$

c) $3\frac{2}{7}$ _____ $3\frac{4}{9}$

Answer to Activity 1.2

- a) < b) > c) < d) =

After completing the given activity, examples, and short note, you can give exercise 1.4 as a class work or homework. Finally, proper feedback must be given for each question.

Answers to exercise 1.4

- 1) a) True b) False c) False d) False
 e) True f) True g) False h) True
- 2) a) < b) = c) > d) < e) = f) >
- 3) a) 3.5 b) $\frac{5}{7}$ c) $2\frac{5}{7}$ d) -9 e) -1.5
- 4) a) < b) < c) > d) >

1.2.2. Ordering Rational Numbers

Allotted Period: 3 periods

Before you discuss the order of rational numbers, first you may remind the students how to compare the fractions like $\frac{5}{7}$ and $\frac{6}{7}$, $\frac{5}{7}$ and $\frac{5}{9}$, and the decimals 0.35 and 0.371. At this moment, you can observe the students understanding and making generalizations on comparing two rational numbers. Then you can explain to the student what is meant by ordering. After giving a brief explanation, you should allow enough time to discuss ordering of rational numbers. You give exercise 1.5 as a home work in order to analyse their knowledge of ordering of rational numbers.

Answers to exercise 1.5

- 1 a) $-5\frac{2}{3} < \frac{3}{25} < \frac{4}{9} < \frac{23}{15} < \frac{11}{7}$
 b) $-12.51 < 5.24 < 6.75 < 8.13 < 12.42$
 c) $\frac{5}{13} < \frac{11}{9} < 3.92 < 4.73 < 4\frac{6}{7}$ [Convert each number to the same notation, either in fraction form or decimal form and then compare]

2 a) $23.86 > 15.02 > 13.72 > 13.05$

b) $2\frac{7}{9} > 2\frac{4}{9} > \frac{21}{12} > \frac{9}{7} > \frac{13}{16}$

c) $4.23 > 3\frac{5}{6} > 3.73 > \frac{18}{5} > 3.2$

3 a) Rahel's plant

b) $-2.2 < -1\frac{7}{10} < 1.7 < 3\frac{1}{4}$

Assessment

Dear teacher, at this time you have analysed the understanding of your students. Please assess your students. Give different problems to compare and order rational numbers using $<$, $>$, or $=$ and check their work.

For slow learners

1) Compare the following rational numbers by using the symbols $<$, $>$ or $=$.

a) 7.25 _____ 9.13

c) $2\frac{1}{3}$ _____ $3\frac{1}{2}$

b) $\frac{3}{7}$ _____ $\frac{2}{5}$

d) 2.75 _____ $2\frac{3}{4}$

2) Arrange the following rational numbers in:

i) Ascending order

ii) Descending order

a) $12.32, 35.74, 17.4, 21.78$

b) $\frac{12}{7}, \frac{9}{5}, \frac{7}{3}, 2\frac{3}{4}$

c) $3.42, 3\frac{2}{3}, \frac{13}{4}, 4.38$

For fast learners

1) Compare the following rational numbers by using the symbols $<$, $>$ or $=$

a) $|2\frac{3}{7}|$ ----- $|-2\frac{3}{7}|$

b) 13.67 ----- $\frac{37}{3}$

2) Arrange the following rational numbers in:

i) Ascending order

ii) Descending order

a) $15.67, 12\frac{3}{7}, \frac{23}{4}, 21.54$

1.3. Operations and properties of Rational Numbers

Period Allotted: 14 periods

Competencies:

After completing this sub-topic, students should:

- ❖ Add rational numbers.
- ❖ Subtract rational numbers.
- ❖ Multiply rational numbers.
- ❖ Divide rational numbers.

Use the opening problem to assess the background and the initiation the students have to continue the topic. It is better to use performance assessment methods such as engaging students in debate on real life problem like the opening problem given here.

The intention of the assessment is to provide a tool for the identification of students who are experiencing major difficulty. Such an assessment is effective for planning a remedial program. Assessment should provide the teacher with a valuable profile of each student's strengths and weakness, and so enable the teacher to direct her/his teaching at the identified weaknesses.

Opening questions

For integers and decimals, we can rely on our calculators to add, subtract, multiply, and divide them. However, basic calculators can't give us answers in fractions. Therefore, we need to be able to perform fractions by hand.

Dear teacher please give the following expressions to discuss how to perform the given operations.

1) $\frac{6}{10} + \frac{3}{10}$

2) $\frac{3}{4} + \frac{9}{7}$

3) $\frac{12}{9} - \frac{2}{3}$

4) $\frac{4}{9} \times \frac{3}{5}$

5) $\frac{7}{9} \div \frac{5}{4}$

1.3.1. Addition of rational numbers

You can start this sub-topic by recalling addition of integers using a number line. After that divide students into groups and let them discuss by stating and showing the **rule for addition** of two rational numbers using examples.

- If the signs of the addends are different
 - i) Take the sign of the addend with the greater absolute value.
 - ii) Take the absolute values of both numbers and subtract the addend with smaller absolute value from the addend with greater absolute value.
- If both rational numbers are negative
 - i) Decide (put) the sign first.
 - ii) Take the sum of the absolute values of the addend.

And ask your students to find addition of rational numbers using

- a) The above properties of addition
- b) Fractional bars and
- c) Using scientific calculator.

For instance, the sum of $\frac{3}{8} + \frac{2}{8}$ using fractional bars.

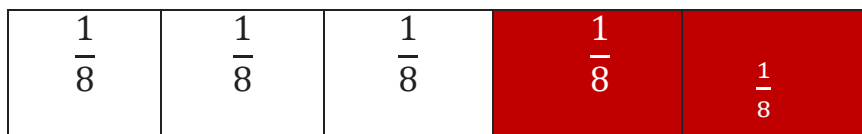


Figure 1.6

Answer to Activity 1.3

- 1) The students know how to represent rational numbers on a number line.
 - a) move 6 units from zero to the right side and back 3 units from 6, then we get 3.

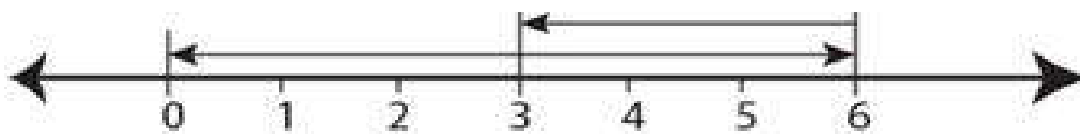


Figure 1.7

Therefore, $6 + (-3) = 3$

b) move 9 units from zero to the left side of zero and back 5 units to zero, then we get -4.

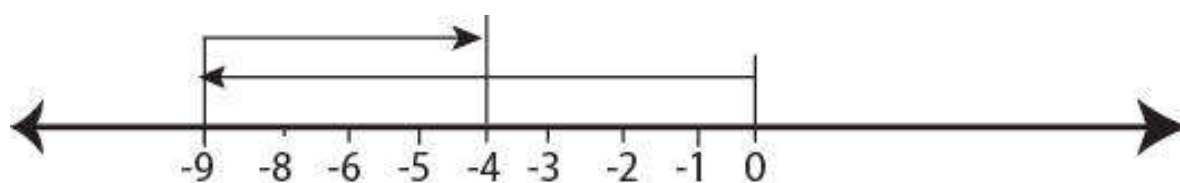


Figure 1.8

Therefore, $-9 + 5 = -4$

c) move 2 units from zero to the right side of zero and back 4 units from 2, then we get -2

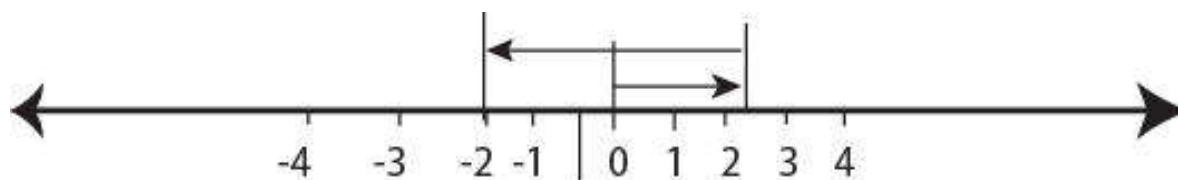


Figure 1.9

Therefore, $2 + (-4) = -2$

d) Move 6 units from zero to the right side and back 6 units, then we get 0.

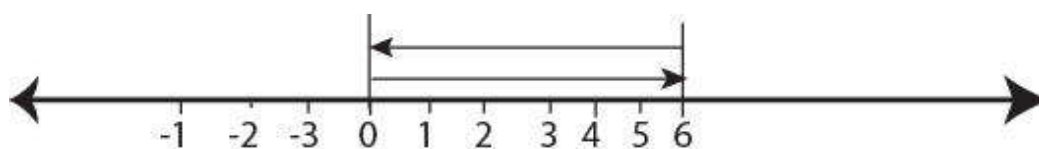


figure 1.10

Therefore, $6 + (-6) = 0$

- 2) Divide the fraction bar in to 6 equal parts and shade 3 of them with grey colour and 2 of them with red colour as shown below.

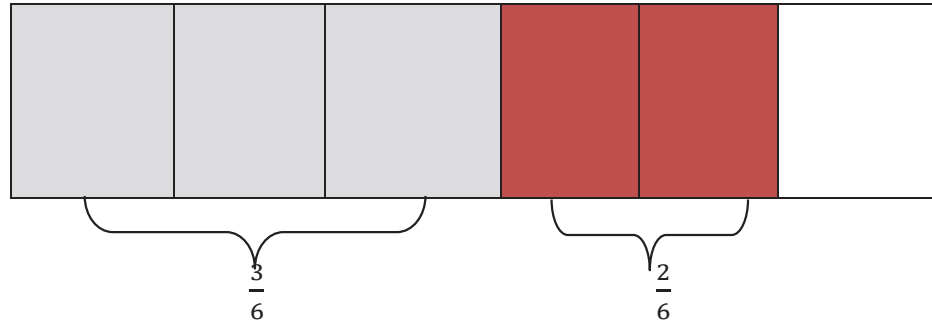


Figure 1.11

How many parts of the fraction bar is shaded? 5, This implies that $\frac{3}{6} + \frac{2}{6} = \frac{5}{6}$

Answer to exercise 1.6

1.a. $\frac{13}{5} + \frac{21}{5} = \frac{13+21}{5} = \frac{34}{5}$

b. $\frac{5}{6} + \frac{3}{8}$

first change to fractions with the same denominator

LCM (6,8) is 24

Then $\frac{5}{6} \times \frac{4}{4} + \frac{3}{8} \times \frac{3}{3} = \frac{20}{24} + \frac{9}{24} = \frac{29}{24}$

c. $\frac{3}{5} + 2\frac{3}{5} = \frac{3}{5} + \frac{2 \times 5 + 3}{5} = \frac{3}{5} + \frac{13}{5} = \frac{16}{5}$

d. $2\frac{1}{3} + \frac{3}{8} + 3\frac{5}{6} = \frac{7}{3} + \frac{3}{8} + \frac{23}{6} = \frac{56}{24} + \frac{9}{24} + \frac{92}{24} = \frac{157}{24}$

e. $\left| -\frac{2}{5} + \frac{3}{8} \right| + \left| \frac{4}{7} + \frac{2}{7} \right| = \left| -\frac{16}{40} + \frac{15}{40} \right| + \left| \frac{4+2}{7} \right|$
 $= \left| \frac{-16+15}{40} \right| + \left| \frac{6}{7} \right|$

$$\begin{aligned}
 &= \left| \frac{-1}{40} \right| + \left| \frac{6}{7} \right| \\
 &= \frac{1}{40} + \frac{6}{7} \\
 &= \frac{7}{280} + \frac{240}{280} \\
 &= \frac{7+240}{280} \\
 &= \frac{247}{280}
 \end{aligned}$$

$$3) 23.72^{\circ}\text{C} + 3.23^{\circ}\text{C} = 26.95^{\circ}\text{C}$$

Assessment

Continuous assessment addresses various strategies that teachers can use in order to ensure that all students in their class can fully participate in meaningful discussion.

Dear teacher you can also give class activities, group discussion, assignments, exercise problem and quiz or test for assessing students learning. Finally divide the students into two groups such as slow learners and fast learners. And give simple problems and difficult problems respectively for slow learners and fast learners.

Slow learners

1) Perform the following operation

a) $\frac{7}{9} + \frac{13}{9}$

b) $\frac{11}{4} + \frac{8}{12}$

c) $2\frac{1}{3} + \frac{5}{7}$

2) What number should be added to $-\frac{7}{9}$ so as to get $-\frac{4}{3}$?

Fast learners

- From a rope 17 m long, two pieces of lengths $\frac{13}{5}$ m and $\frac{34}{7}$ m are cut off. What is the length of the remaining rope?
- The sum of two rational numbers is $\frac{67}{12}$. If one of the number is $\frac{16}{3}$, then what is the other number?

1.3.2. Subtraction Rational Numbers

Period Allotted: 4 periods

First give chance for the students to recall subtraction of integers. It is as a motivation to start subtraction of rational numbers. Please teacher encourage the students to express subtraction of rational numbers as addition of the opposite of the rational number to be subtracted.

Example: $7 - 5 = 7 + (-5)$

Advise the students to apply the rules learnt for addition of rational numbers to find the difference of rational numbers.

Answer to Activity 1.4

- 1) Yes
- 2) No

Answer to Exercise 1.7

- 1) a) $4\frac{5}{6} - 2\frac{3}{4} = \frac{29}{6} - \frac{11}{4} = \frac{58}{12} - \frac{33}{12} = \frac{58-33}{12} = \frac{25}{12}$
 b) $-5.3 - 3.45 = -8.75$
 c) $\frac{6}{13} - \left| -\frac{7}{13} \right| = \frac{6}{13} - \frac{7}{13} = -\frac{1}{13}$
 d) $\left| -\frac{5}{7} \right| - \left| \frac{3}{4} \right| = \frac{5}{7} - \frac{3}{4} = \frac{20}{28} - \frac{21}{28} = -\frac{1}{28}$
 e) $-32.24 - \left| -32.24 \right| = -32.24 - 32.24 = -64.48$
 f) $-3\frac{2}{5} - 2\frac{3}{7} = -\frac{17}{5} - \frac{17}{7} = -\frac{119}{35} - \frac{85}{35} = \frac{-119-85}{35} = \frac{-204}{35} = -5\frac{29}{35}$
- 2) a) $\frac{9}{4} - (\frac{2}{7} + 5) = \frac{9}{4} - (\frac{2}{7} + \frac{35}{7}) = \frac{9}{4} - (\frac{37}{7}) = \frac{63}{28} - \frac{148}{28} = \frac{63-148}{28} = -\frac{85}{28}$
 b) $15 - (-7 - \frac{4}{9}) = 15 - (-\frac{63}{9} - \frac{4}{9}) = 15 - (-\frac{67}{9}) = 15 + \frac{67}{9} = \frac{202}{9}$
- 3) $23 - (\frac{12}{7} + \frac{7}{4}) = 23 - \frac{97}{28} = \frac{644-97}{28} = \frac{547}{28} = 19\frac{15}{28}$

Therefore, the length of the remaining rope is 18.25 meter.

$$4) \quad \frac{58}{3} - (\frac{18}{7} + \frac{11}{9}) = \frac{58}{3} - \frac{162+77}{63} = \frac{58}{3} - \frac{239}{63} = \frac{1218-239}{63} = \frac{979}{63} = 15\frac{34}{63}$$

Therefore, bananas weighing is $15\frac{34}{63}$

Assessment

Always remember to consider the minimum learning competencies that is expected of the students. As part of your assessment technique, it mainly indicates that your students should determine the difference of rational numbers.

Dear teacher, please give the following questions for slow and fast learners.

For slow learners

Perform the following operations

a) $13.56 - 10.4$

b) $\frac{16}{13} - \frac{5}{13}$

c) $\frac{7}{9} - \frac{3}{5}$

d) $23.63 - \frac{9}{7}$

e) $\left(\frac{3}{4} + \frac{-2}{5}\right) + -\frac{7}{10}$

f) $-3 + \left(-\frac{3}{4} + -\frac{5}{3}\right)$

Fast learners

1) Perform the following operation

a) $-\frac{4}{10} + 2\frac{7}{8}$

b) $-\frac{13}{9} - 3\frac{5}{6}$

c) $3\frac{4}{7} - 2\frac{3}{5}$

d) $-4\frac{2}{5} - 2\frac{7}{9}$

2) A drum full of rice weighs $\frac{234}{5}$ kg. If the empty drum weighs $\frac{64}{6}$ kg, find the weight of rice in the drum.

3) A basket contains tree types of fruits weighing $\frac{71}{3}$ kg in all. If $\frac{43}{7}$ kg of these be apples, $\frac{13}{4}$ kg be oranges and the rest pears. What is the weight of the pears in the basket?

4) Is the difference of two rational numbers a rational number?

1.3.3 Multiplication of Rational Numbers

You can start this sub- topic by giving a chance for the students to revise multiplication of rational numbers and rules of multiplication of integers.

- i. The product of two integers with different signs
 - a. Decide the sign of the product, it is ‘ – ‘
 - b. Take the product of the absolute value of the numbers
 - c. Put the sign (-) in front of the product.
- ii. The product of two negative integers
 - a. Decide the sign of the product, it is ‘+’
 - b. Take the product of the absolute value of the numbers.

After revise these rules Come to multiplication of rational numbers and the rules learnt for multiplication of integers can be applied to find the product of rational numbers.

Encourage the students to discuss activity 1.5 with in groups. You should allow enough time to share their ideas.

Answer to Activity 1.5

- a. $\frac{5}{7} \times \frac{8}{11} = \frac{5 \times 8}{7 \times 11} = \frac{40}{77}$
- b. $-\frac{9}{7} \times \frac{4}{5} = \frac{-9 \times 4}{7 \times 5} = -\frac{36}{35}$
- c. $\frac{2}{3} \times \left(\frac{5}{9} \times \left(-\frac{3}{5}\right)\right) = \frac{2}{3} \times \left(\frac{5 \times -3}{9 \times 5}\right) = \frac{2}{3} \times \left(-\frac{15}{45}\right) = \frac{2 \times (-15)}{3 \times 45} = -\frac{30}{135} = -\frac{2}{9}$
- d. $3\frac{2}{5} \times 2\frac{4}{7} = \frac{17}{5} \times \frac{18}{7} = \frac{17 \times 18}{5 \times 7} = \frac{306}{35}$
- e. $-\frac{3}{8} \times \left(-\frac{2}{3}\right) = \frac{-3 \times (-2)}{8 \times 3} = \frac{1}{4}$

Answer to Exercise 1.8

- 1) a. $\frac{15}{32}$ b. $-\frac{9}{28}$ c. $\frac{24}{35}$ d. $\frac{182}{15}$ e. $-\frac{5}{4}$ f. $\frac{-105}{4}$
- 2) $1250 \times \frac{23}{6} = 625 \times \frac{23}{3} = \frac{14375}{3} = 4791\frac{2}{3}$
- 3) Therefore, An airplane covers $4791\frac{2}{3}$ km in $\frac{23}{6}$ hours.

1.3.4 Division of Rational Numbers

Before discussing division of rational numbers revise that the reciprocal of a rational number. For any rational number $\frac{a}{b}$, $\frac{a}{b} \times \frac{b}{a} = 1$, then $\frac{b}{a}$ is the reciprocal of $\frac{a}{b}$.

Now come to division of rational numbers and encourage students to discuss division as the product of the dividend and reciprocal of the divisor.

Example: $\frac{3}{4} \div \frac{2}{5} = \frac{3}{4} \times \frac{5}{2}$

Encourage students to find the quotient of rational numbers using grids to model.

To determine the sign of the quotient of rational numbers you can apply the rules that you have learnt for multiplication of rational numbers.

Answer to Activity 1.6

1) $12 \div \frac{3}{4} = 12 \times \frac{4}{3} = 16$

2) $3\frac{3}{5} \div \frac{2}{5} = \frac{18}{5} \times \frac{5}{2} = 9$

- 3) Divide each 4 grids in to three equal parts. Shade 3 grids and $\frac{1}{3}$ of a fourth grid to represent $3\frac{1}{3}$ and divide the shaded grids in to equal groups of 2.

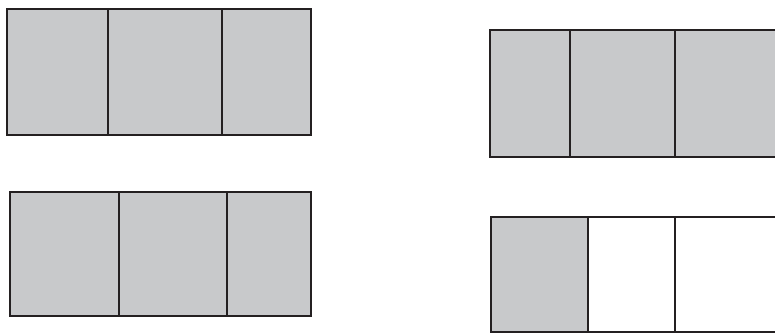


Figure 1.12

Thus, There are 5 groups of $\frac{2}{3}$.

Therefore, $3\frac{1}{3} \div \frac{2}{3} = 5$

Answer to Exercise 1.9

1) a) $\frac{5}{8} \div \frac{3}{4} = \frac{5}{8} \times \frac{4}{3} = \frac{5}{6}$

b) $-\frac{3}{5} \div \frac{6}{7} = -\frac{3}{5} \times \frac{7}{6} = -\frac{7}{10}$

$$c) -\frac{8}{9} \div \left(-\frac{5}{3}\right) = -\frac{8}{9} \times \left(-\frac{3}{5}\right) = \frac{8}{15}$$

$$d) 2\frac{3}{5} \div \left(-\frac{4}{3}\right) = \frac{13}{5} \times \left(-\frac{3}{4}\right) = -\frac{39}{20}$$

- 2) To find the number of bags, we have to divide $\frac{3}{4}$ by $\frac{3}{8}$.

$$\frac{3}{4} \div \frac{3}{8} = \frac{24}{12} = 2$$

Assessment

You should assess each student's work continuously over the whole period and discuss how to divide a rational numbers and some rules to determine the sign of the quotient.

Finally give different exercise problem for slow learners and fast learners.

For slow learners

- 1) Determine the quotient.

$$a) \frac{6}{7} \div \frac{5}{14}$$

$$b) -\frac{2}{9} \div \frac{6}{12}$$

$$c) 2\frac{3}{4} \div \frac{5}{9}$$

- 2) The cost of 8 meters of cloth is Birr $\frac{567}{5}$. What is the cost of one meter of cloth?

For fast learners

- 1) Determine the quotient

$$a) -\frac{13}{7} \div \frac{32}{15}$$

$$b) -3\frac{6}{11} \div -4\frac{5}{7}$$

$$c) 4.56 \div \frac{3}{8}$$

- 2) A cord of length $\frac{143}{2}$ m has been cut into 26 pieces of equal length. What is the length of each piece?

- 3) The product of two rational numbers is $\frac{48}{5}$. If one of the rational number is $\frac{66}{7}$, find the other rational number.

1.4 Real-life Applications of Rational Numbers

Period Allotted: 4 periods

Competencies:

After completing this sub-topic, students should:

- ❖ Solve application of Rational Number.

1.4.1. Application in Sharing something among friends

Period Allotted: 2 periods

You can start this sub-topic by divide the students with in groups and discuss about application of rational numbers in your day to day activities. After the student's discussion you conclude their ideas.

Note: The application of rational numbers is prevalent in our daily lives. They are a part of our daily calculations like following the recipes, determine shopping discounts, calculating prices, assessing the most cost-effective size of products, preparing budgets, savings, reading financial statements, etc.

Example: Dividing a birthday cake among five friend; each friend will receive one-fifth part of the cake, which can be represented using a rational number?

1.4.2 Application in calculating Interest and loans

Period Allotted: 2 periods

Before start this sub-topic encourage students to revise about simple interest and how to calculate simple interest from grade 7 mathematics lessons.

Answer to Exercise 1.10

$$\begin{aligned} 1. \quad I &= p \times R \times T = 1200 \times 10\% \times 5 \\ &= 1200 \times \frac{10}{100} \times 5 = 600 \end{aligned}$$

Therefore, the simple interest is Birr 600

2. $I = p \times R \times T$ from this you can calculate the principal as:

$$P = \frac{I}{RT} = \frac{637}{\frac{7}{100} \times 2} = 637 \times \frac{50}{7} = 4550$$

Therefore, the principal is Birr 4550.

3. $P = \text{Birr } 6000$

$A = \text{Birr } 7500$

$T = 5 \text{ month} = \frac{5}{12} \text{ year}$

To calculate the interest rate of a loan,

$I = PRT$ but

$I = A - P$

$7500 - 6000$

$= 1500$

Since $R = \frac{I}{PT}$

$$= \frac{1500}{6000 \times \frac{5}{12}}$$

$$= \frac{15}{25} = \frac{3}{5}$$

Therefore, the interest rate is 60%.

Assessment

Dear teacher assess your students' based on the following concepts on rational numbers:

- ✓ Give different rational numbers to represent on a number line.
- ✓ Give different exercise to show the relationship among $\mathbb{N}$, $\mathbb{W}$, $\mathbb{Z}$, and $\mathbb{Q}$.
- ✓ Give different exercise to describe the absolute value of rational numbers and represent on a number line.
- ✓ Give different exercise to evaluating equations involving absolute values.
- ✓ Give different exercise to comparing and ordering rational numbers in order to face real-life problems.
- ✓ Give different exercise on addition of rational numbers.
- ✓ Give different exercise to apply properties of addition.
- ✓ Give different exercise on subtraction of rational numbers.
- ✓ Give different exercise on multiplication of rational numbers and its properties.
- ✓ Give different exercise on division of rational numbers.

- Give tests.

1. There are 36 students in a class and $\frac{2}{3}$ of them are female students. How many students are female? And male?
2. An industrial factory makes $4\frac{2}{3}$ yards of chain every minute. The cost of each yard of chain is Birr 6.25. what is the total cost for all chain produced in 10 minutes?
3. What is the term of loan where Birr 600 was borrowed at a simple interest of 8% and the interest paid on the loan was Birr 156?

- a. false
 - b. true
- c. true
- d. true

2.

- a) $x = 7$ or $x = -7$
- b) $x - 5 = 4$
 $x = 9$
- c) $2x + 3 = 5$
 $2x = 2$
 $X = 1$
- d) $3x - 4 = 3$
 $3x = 7$
 $X = \frac{7}{3}$

- a) $x = 7$ or $x = -7$
- b) $x - 5 = -4$
 $x = 1$
- c) $2x + 3 = -5$
 $2x = -8$
 $x = -4$
- d) $3x - 4 = -3$
 $3x = 1$
 $x = \frac{1}{3}$

e) $5 + 3|x - 3| = 2$

$$3|x - 3| = 2 - 5$$

$$|x - 3| = -1, \text{ the absolute value cannot be negative}$$

Therefore, the equation has no solution.

3) $x = -8, y = 4$

$$\begin{aligned} \frac{3|x-5| - |4y|}{|x+y|} &= \frac{3|-8-5| - |4 \times 4|}{|-8+4|} \\ &= \frac{3|-13| - |16|}{|-4|} \\ &= \frac{3(13) - 16}{4} \\ &= \frac{39 - 16}{4} \\ &= \frac{23}{4} \end{aligned}$$

4) a) $\frac{3}{4} + \frac{9}{7} + 2\frac{3}{5} = \frac{105}{140} + \frac{180}{140} + \frac{364}{140} = \frac{649}{140} = 4\frac{89}{140}$

b) $-2\frac{1}{3} + 1\frac{4}{7} = -\frac{7}{3} + \frac{11}{7} = -\frac{49}{21} + \frac{33}{21} = \frac{-49+33}{21} = -\frac{16}{21}$

c) $3.35 + 2\frac{3}{7} = \frac{67}{20} + \frac{17}{7} = \frac{469}{140} + \frac{340}{140} = \frac{809}{140}$

5) a) $\frac{2}{7} - \frac{3}{8} = \frac{16}{56} - \frac{21}{56} = -\frac{5}{56}$

b) $-2\frac{6}{7} - \frac{13}{9} = -\frac{20}{7} - \frac{13}{9} = -\frac{180}{63} - \frac{92}{63} = -\frac{272}{63}$

6) a) $2\frac{3}{7} \times \frac{1}{4} = \frac{17}{7} \times \frac{1}{4} = \frac{17}{28}$

b) $2.34 \times \frac{7}{6} = \frac{117}{50} \times \frac{7}{6} = \frac{819}{300} = \frac{273}{100}$

c) $-3\frac{3}{5} \times 1\frac{2}{3} \times (-\frac{3}{4}) = -\frac{18}{5} \times \frac{5}{3} \times (-\frac{3}{4}) = \frac{9}{2}$

7) a) $\frac{3}{4} \div (-\frac{2}{7}) = \frac{3}{4} \times (-\frac{7}{2}) = -\frac{21}{8}$

b) $-3\frac{5}{8} \div 2\frac{3}{10} = -\frac{29}{8} \div \frac{23}{10} = -\frac{29}{8} \times \frac{10}{23} = \frac{-145}{92}$

c) $2\frac{3}{7} \div 2.3 = \frac{17}{7} \div \frac{23}{10} = \frac{17}{7} \times \frac{10}{23} = \frac{170}{161}$

8) a) $\frac{3}{5} + \frac{2}{7}(\frac{4}{5} + \frac{3}{2}) = \frac{3}{5} + \frac{2}{7}(\frac{8}{10} + \frac{15}{10})$
 $= \frac{3}{5} + \frac{2}{7}(\frac{23}{10})$

$$= \frac{3}{5} + \frac{23}{35}$$

$$= \frac{21}{35} + \frac{23}{35}$$

$$= \frac{44}{35}$$

$$\text{b) } \frac{4}{3} \div \left(\frac{5}{2} - \frac{6}{7} \right) = \frac{4}{3} \div \left(\frac{35}{14} - \frac{12}{14} \right) = \frac{4}{3} \div \frac{23}{14} = \frac{4}{3} \times \frac{14}{23} = \frac{56}{69}$$

$$\begin{aligned} \text{c. } \frac{\frac{1}{6} \div \left(\frac{1}{3} + \frac{4}{5} \right)}{\frac{5}{2} + \frac{1}{3} \left(\frac{2}{5} \div \frac{3}{5} \right)} &= \frac{\frac{1}{6} \div \left(\frac{5}{15} + \frac{12}{15} \right)}{\frac{5}{2} + \frac{1}{3} \left(\frac{2}{5} \times \frac{5}{3} \right)} = \frac{\frac{1}{6} \div \left(\frac{17}{15} \right)}{\frac{5}{2} + \frac{1}{3} \left(\frac{2}{3} \right)} = \frac{\frac{1}{6} \times \frac{15}{17}}{\frac{5}{2} + \frac{2}{9}} = \frac{\frac{15}{102}}{\frac{49}{18}} \\ &= \frac{15}{102} \times \frac{18}{49} = \frac{90}{1966} \end{aligned}$$

$$9) \quad \frac{3}{4}$$

10) $I = p \times R \times T$ from this you can calculate the time as:

$$T = \frac{I}{PR} = \frac{80}{500 \times \frac{9.5}{100}} = \frac{10}{9.5} = \frac{20}{19}$$

Therefore, the time is $\frac{20}{19}$ years.

UNIT 2

Squares, square roots, cubes and cube roots

Total allotted period 25 periods

Introduction

You give opportunities for the students to recall about

- multiplication of two similar factors,
- multiplication of three similar factors,
- area of a square and
- Volume of cuboids. Then students have understood they are familiar with the concept of squares, square roots, cubes and cube roots.

Learning Outcomes: At the end of this unit, learners will be able to:

- Understand the notion square and square roots and cubes and cube roots
- Determine the square of numbers
- Determine the square roots of the perfect square numbers
- Extract the approximate square roots of numbers by using the numerical table and scientific calculator.
- Determine the cube of numbers
- Extract the cube roots of perfect cubes.
- Apply squares, square roots, cubes and cube roots in the real-life situation

2.1 Squares and Square roots

Period Allotted-11 periods

Competencies

At the end of this sub-topic, students should be able to:

- ❖ Calculate the square of a number

Introduction

The square of a number is that number raised to the power 2.

Thus, if 'a' is a number, then the square of a is written as a^2 and is given by $a^2 = a \times a$.

That is, the square of a number is obtained by multiplying it by itself.

If $a \times a = b$ i.e. $a^2 = b$, then we say that the square of number a is number b or the number b is the square of number a.

For example: 1) $3^2 = 3 \times 3 = 9$, so we say that the square of 3 is 9;

2) $(-4)^2 = -4 \times -4 = 16$, so we say that the square of -4 is 16;

3) $(\frac{3}{5})^2 = (\frac{3}{5}) \times (\frac{3}{5}) = \frac{9}{25}$ so we say that the square of $\frac{3}{5}$ is $\frac{9}{25}$;

2.1.1 Square of a Rational Number

Competency: At the end of this sub- topic students should:

- ❖ Calculate the square of a number

Introduction

Here students have background idea on multiplication of rational numbers. Then you can start this lesson by asking such questions

1. Compute the following
 - a) 5×2
 - b) $\frac{3}{4} \times \frac{5}{2}$
2. Compute the products for each of the following
 - a) 3×3
 - b) 0.5×0.5

You can use examples similar to the examples given in the text book. Remind the students that most of the values obtained from the table are approximate values. Guide students to use the table because it is time saving.

The purpose of Activity 2.1 is introducing the concept of squaring just by counting the number of unit squares contained in the square region. So you should give much emphasis on the ways or forms of expressing the results that

are supposed to be filled in a $n \times n$ square. Answer to activity 2.1 are as follow as.

Answer for Activity 2.1

1. a. 1 b. 9 c. 16 d. 25
2. a. 20 b. $\frac{175}{20} = 8\frac{15}{20}$ c. 15
3. a. 36 b. 100 c. 0.25

Answer for group work 2.1

- a. $1+3+5+7+9+11+13+15+17+19+21+23+25+27+29 = 225$
and it is written as $15 \times 15 = 15^2$
then, the sum of the first fifteen odd numbers is 15^2
- b. The sum of the first n odd numbers is n^2
- c. We conclude that, the sum of the first n odd numbers is n^2 .

Encourage your students to square fractions. Whether it is positive or negative by using the concepts of multiplication of fraction. You should also guide the students to square decimals after changing them to fraction and express the result in decimal form. The possible answer to Exercise 2.1 is as follows

Answer for exercise 2.1

1. a. true b. False c. False d. false e. true
2. a. 36 b. 400 c. $\frac{169}{16}$ d. $\frac{25}{16}$
e. 0.0009 f. 20.25 g. $\frac{144}{16} = 9$
3. 4, 9, 16, 36, 0.04, $\frac{1}{4}$, $\frac{1}{121}$, 0.01, 225
4. a. is a square number
b. not a square number
c. is a square number
5. 196, 400, 324
We conclude that the square of even number is even.
6. 121, 225, 529

We conclude that the square of odd number is odd.

7. i, 75 ii, 149 iii, 183 iv, 209 v, 281 vi, 435

As you have seen the pattern, the difference of the square of two consecutive rational number is the sum of the numbers.

$$8. 64 = 1 + 3 + 5 + 7 + 9 + 11 + 13 + 15$$

Assessment

Dear teacher you are strongly you are strongly advised to give tutorials to the students by dividing them into three groups such as slow learners, bright learners and fast learners.

Finally ask your students orally to read and give meanings to squares of numbers. In addition to this for slow learners and fast learners, you can also give the following additional Exercise problems.

For slow learner students

1. Can you define a squaring a number?
2. Find the product
 - a) $3^2 \times 5^2$ b) $3^2 \times 5^2 \times 3^2$ c) $2^2 \times 6^2 \times 4^2$

For fast learner students

3. If $x = 3^2 + 6^2$, then What is the value of x ?
4. What is the area of a square whose sides is:
 - a) 6cm b) 8cm c) 25cm d) 100cm

Answer for exercise 2.2

1. a. false b. true c. false
2. a. $x = 4.2 \approx 4$

$$x^2 \approx 4^2 = 16$$
- b. $x = 10.8 \approx 11$

$$x^2 \approx 11^2 = 121$$

c. $x = -8.7 \approx -9$
 $x^2 \approx (-9)^2 = 81$

d. $x = 1.06 \approx 1$
 $x^2 \approx 1^2 = 1$

2.1.2. Use of table values and scientific calculator to find squares of rational numbers

Competencies

At the end of this sub-topic, students should:

- Calculate the square of a number

In the previous lesson students had learnt about scientific notation, scientific notation is one ways to find square roots of rational numbers.

To find the square of rational number when it is written in the form of a decimal is very tedious and time consuming work so, to avoid this tedious and time consuming work you have to consult students how they can find the square root of a rational numbers from numerical a table value and student can use scientific calculators.

You can start the lesson recalling

1. Write the following numbers in scientific form.

a. 26.4 b. 226 c. 0.226

Then students remembered that how they can do the following activity 2.2 to find the square roots of rational numbers by using numerical table value.

Answer for activity 2.2

1. A number is said to be in scientific notation (or standard form), if it is written as a product of the form $a \times 10^k$ where $1 \leq a < 10$ and k is an integer.
2. a. 4.5×10^2 c. 8.43×10^1
 b. 4.5×10^{-3} d. 2.56×10^{-1} e. 5×10^{-2}

3. a. 2.280 b. 21.16 c. 10.56
 d. 27.98 e. 25.60 f. 58.37

This problem given in exercise 2.3 are calculated the square of rational numbers and the square roots of rational numbers. So encourage your students to do all of them

Answer for exercise 2.3

1. a. false b. false c. false
2. *if* $(3.67)^2 = 13.47$
 - a. $(36.7)^2 = (3.67 \times 10)^2 = (3.67)^2 \times (10)^2 = 13.47 \times 100 = 1347$
 - b. $(367)^2 = (3.67 \times 100)^2 = (3.67)^2 \times (100)^2 = 13.47 \times 10000 = 134700$
 - c. $(0.367)^2 = (3.67 \times \frac{1}{10})^2 = (3.67)^2 \times (\frac{1}{10})^2 = 13.47 \times \frac{1}{100} = 0.1347$
3. *If* $(8.435)^2 = x$, *then*
 - a. $(84.35)^2 = (8.435 \times 10)^2 = (8.435)^2 \times (10)^2 = x \times 100 = 100x$
 - b. $(0.8435)^2 = (8.435 \times \frac{1}{10})^2 = (8.435)^2 \times (\frac{1}{10})^2 = x \times \frac{1}{100} = \frac{x}{100}$
4. a. $8.95 \approx 9$, then $(8.95)^2 \approx 9^2 = 81$
 b. 80.01 c. 80.0125

For slow learner students

1. Find the product of the following
 - a. $(\frac{5}{4})^2$
 - b. $\frac{2}{3} \times \frac{2}{3}$
 - c. 0.02×0.02
2. Find the area of a square plot of land whose each side measures $\frac{13}{2}$ meters.

For fast learners

1. Show that the differences between any two consecutive square numbers are an odd number.
2. Show that the difference between the 7th square number and the 4th square number is a multiple of 3.

2.1.3 Square Roots of a rational number

Competencies

At the end of this sub-topic, students should:

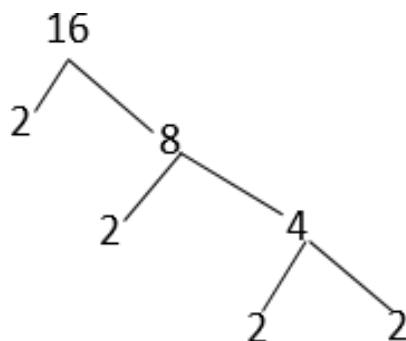
- ❖ Calculate the square root of perfect squares.

Introduction

In the previous sub-topics students are introduced to the concept of squaring and how to find the square of rational numbers. In this sub topics they will be introduce the reverse process of rational number which is square roots of rational numbers. The new concept is square roots of perfect square. Here you strongly begin the square roots of perfect squares, otherwise students confused to find the square roots of rational number which is not perfect. For instance $\sqrt{8}$ this is not possible in this grade level. You encourage the students to do the following activities.

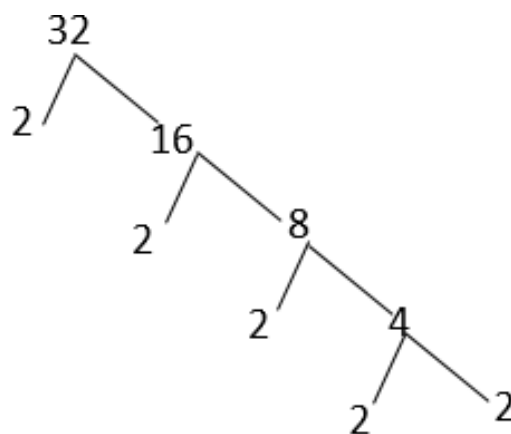
Answer for activity 2.3

1. a.



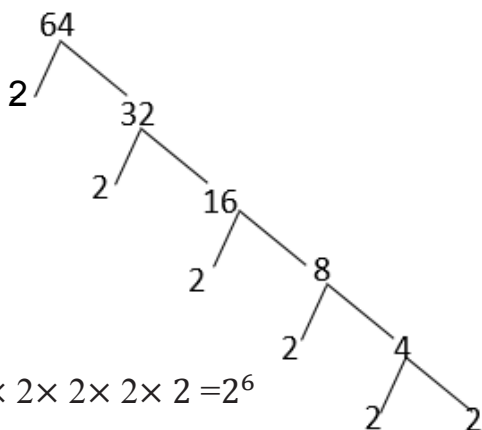
$$16 = 2 \times 2 \times 2 \times 2 = 2^4$$

b.

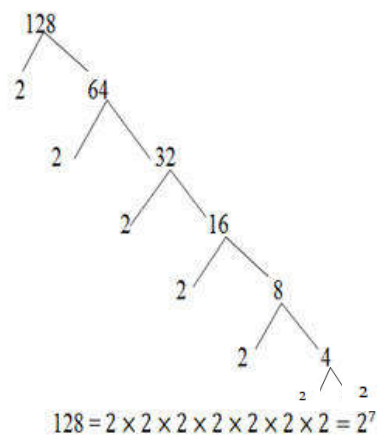


$$32 = 2 \times 2 \times 2 \times 2 \times 2 = 2^5$$

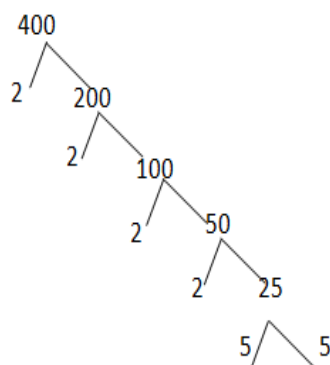
c.



d)



e.



$$400 = 2 \times 2 \times 2 \times 2 \times 5 \times 5 = 2^4 \times 5^2$$

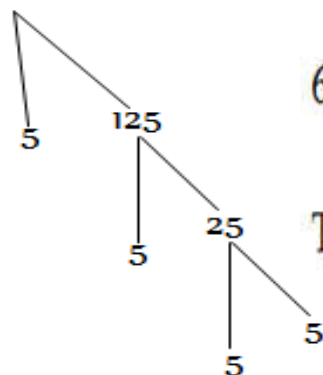
Additionally, in exercise 2.4 you can encourage your students how they can find the square roots of rational numbers by using prime factorization method.

Answer for exercise 2.4

1. a. 0 b. 13 c. 24 d. 0.5 e. 0.04

2. 12 length

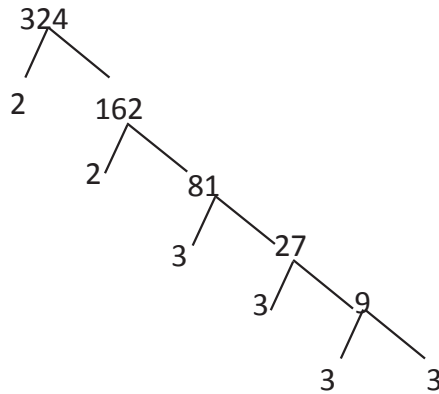
3. a. 625



$$625 = 5 \times 5 \times 5 \times 5 = (5 \times 5) \times (5 \times 5) = 25 \times 25$$

$$\text{Therefore, } \sqrt{625} = 25$$

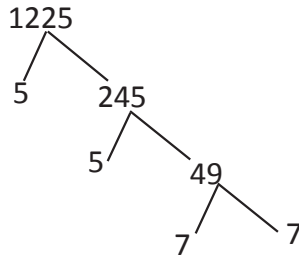
b.



$$324 = 2 \times 2 \times 3 \times 3 \times 3 \times 3 = (2 \times 3 \times 3) \times (2 \times 3 \times 3) = 18 \times 18$$

Therefore, $\sqrt{324} = 18$

c.



$$1225 = 5 \times 5 \times 7 \times 7 = (5 \times 7) \times (5 \times 7) = 35 \times 35$$

Therefore, $\sqrt{1225} = 35$

Assessment

Always remember to consider the minimum learning competencies that are expected of students. As part of your assessment technique, it mainly indicates that your students. So ask them to read the required root or number from the square table. Give questions and ask students to find square root of non-negative numbers and compare their result by computing, by using table of square and by using scientific calculator. Depending on their level of understanding you may also give additional exercise of the following type:

For slow learner students

Answer the following question

1. Can you define a square root?

2. Find the square root of 324.
3. Simplify the following square roots.

a. $\sqrt{8 + 17}$ b. $\sqrt{125 - 44}$ c. $\sqrt{49 \times 4}$

For fast learner students

4. Simplify each of the following.

a. $\sqrt{8}$ b. $\sqrt{12}$ c. $\sqrt{64 + 132}$ d. $\sqrt{\frac{32}{2}}$ e. $\sqrt{27}$

5. Find the length of sides of a square whose area is 196cm^2 .

2.1.4. Use of table values and scientific calculator to find square roots of rational numbers

Competencies

At the end of this sub-topic, students should:

- ❖ Calculate the square root of perfect squares.

Introduction

In previous, students discussed about the square root of perfect square. But, in this sub-topic the ways how we can find the square roots of decimal numbers is presented by use of table value and scientific calculator to find square roots of rational numbers. You will be motivate your students by explaining the importance of square table and make sure that they fully understand how to read and find the square roots of a numbers from the end of the text.

Answer for activity 2.4

1. a. 3.63 b. 9.90 c. 3.34 d. 7.54 e. 3.57

Dear teacher, if the radicand is not found in the body of the table, you can approximate to the nearest square roots of a numbers. Motivate your students to do exercise 2.5.

Answer for exercise 2.5

1. a. 1.62 b. 2.08 c. 3.96 d. 9.93 e. 9.75
2. if $(4.63)^2 = 21.44$
 - a. $\sqrt{21.44} = 4.63$
 - b. $\sqrt{2144} = \sqrt{21.44 \times 100} = \sqrt{21.44} \times \sqrt{100} = 4.63 \times 10 = 46.3$
 - c. $\sqrt{0.2144} = \sqrt{21.44 \times \frac{1}{100}} = \sqrt{21.44} \times \sqrt{\frac{1}{100}} = 4.63 \times \frac{1}{10} = 0.463$

Assessment

Dear teacher you have to motivate your students using square table to find the square roots of decimal numbers and initiate your students using calculator.

Finally based on the performances of your students.

- Asking oral questions.
- Giving your own assignment
- Giving quiz, Test and project work

Then give additional exercise of the following type:

For slow learner students

1. Find the square root of each of the following numbers using numerical table value.
 - a. 18.82 b. 3.112 c. 112.0

For fast learner students

Find the square root of each of the following numbers.

- a. 7.762 b. 77.62 c. 776.2 d. 7762 e. 0.7762

2.2 Cubes and cube roots

Allotted period: period -11

2.2.1.Cube of rational number

Competency: At the end of this sub-topic students should:

- ❖ Calculate the cube of a number

Introduction

In this sub-topics students should be calculate the cubes of a rational numbers and you can start the lesson by guide your students how to find the volume of cuboids and guide your students to realize that when a number is decomposed in to a product of three equal factors.

You may start the lesson by giving the following question

1. Find the cube of each of the following numbers

a. 3 b. $\frac{3}{4}$ c. -3

2. Find numbers whose cube

a. 8 b. 64

Answer for activity 2.5

1. a. 8 b. -64 c. $-\frac{1}{64}$ d. 0.125 e. 0
2. 8, 64, 729

Answer for Group work 2.2

Please guide the students to discuss the pattern that shown in group work 2.2 on students' text book and ask the students what you observe from the pattern?

The sum of the next eight odd numbers started from the last pattern is

$$57 + 59 + 61 + 63 + 65 + 67 + 69 + 71 = 8^3$$

The sum of the first ten consecutive odd numbers is 100.

Dear teacher please given proper feedback for each students and correct it exercise 2.6

1. a. false b. false c. true
d. false e. true f. true
2. a. 64 b. 0.125 c. $-\frac{1}{8}$ d. $\frac{27}{64}$
3. a. -27 b. 125 c. 0 d. 27
4. a. $\frac{27}{64}$, -125 and 216 are perfect cubes
5. 1, 8, 27 and 64 are the consecutive perfect cube numbers whose sum is 100.

1, 8, 27, 64, 125 and 216 are the consecutive perfect cube numbers whose sum is 441.

Dear teacher asses your students' based on the following sub-topics:

- Then give additional exercise of the following type:

1. Define perfect cube a number
2. Which one of the following number both perfect cube and perfect square.
a. 8 b. 64 c. 9 d. 40

For fast learner students

3. Identify whether each of the following numbers are perfect cubes

- a. 216 b. 729 c. 625 d. 3375

2.2.2. Cube Root of a rational number

Competency: At the end of this sub-topic students should:

- ❖ Calculate cube roots of a rational number

Introduction

In previous, students discussed about the cube of perfect square. But, in this sub-topic the ways how we can find the cube roots of decimal numbers is presented by use of table value and scientific calculator to find cube roots of rational numbers. You will motivate your students by explaining the importance of square table and make sure that they fully understand how to read and find the cube roots of a numbers from numerical table.

Answer for activity 2.6

1. students may be defining cube roots of a rational number in different ways, so you observe what students said that.
2. a. 8 b. 9 c. 7 d. 4 e. 11

Motivate your students by telling them the table of cube to simplify the numbers. Additional you should also tell them the given numbers in the numerical table to approximate value easily. The possible answer for exercise 2.7 as follows

Answer for exercise 2.7

1. cube root of 4
2. a. $10^{\frac{1}{3}}$ b. $(0.23)^{\frac{1}{3}}$
3. 8, 64, 216, 729 are perfect cubes.

4. a. 6 b. -7 c. 10 d. -12 e. 0

Assessment

- ❖ Give exercise 2.7 as a class work and home work which are given in the text and to take remedial measures based on their feedback.
- ❖ Assist your students to use internet and explain the relation between cubing and extracting cube root from the cube of a number.

For low learner students

1. Define cube Roots
2. Evaluate each of the following
 - a. $\sqrt[3]{8}$
 - b. $\sqrt[3]{27}$
 - c. $\sqrt[3]{64}$
3. Find the sides of a cube whose volume is 343cm^3 .

For fast learner students

4. Evaluate each of the following
 - a. $\sqrt[3]{216}$
 - b. $\sqrt[3]{3375}$
 - c. $\sqrt[3]{54}$
 - d. $\sqrt[3]{16}$

2.3 Applications on squares, square roots, and cubes and cube roots

Period Allotted – 3periods

Competency: At the end of this sub-topic students should:

- ❖ Solve real-life problems

Introduction

In this sub-unit will be solve real-life application on square, square roots, cubes and cube roots applying in carpentry, architecting, engineering, and etc. Guide your students how square and cubes related with real- life applications, motivate your students to lists some examples that related with their day to day activities.

Answer for activity 2.7

1. a. $As = 2 \times (l \times w + l \times h + w \times h)$

$$= 2 \times (6 \times 6 + 6 \times 6 + 6 \times 6) = 2 \times (36 + 36 + 36) = 2 \times (108) = 216$$

Therefore, the surface Area of a cube is 216cm^3 .

b. $v = l \times w \times h = (6 \times 6 \times 6) = 216$

therefore, the volume of a cube is 216cm^3

c. here the surface area and volume of a cube is the same which is 216cm^3 .

2. $A = l \times l = (5\text{cm})^2 = 25\text{cm}^2$.

Answer for exercise 2.8

Solution:

1. Let x be the number of rows and

y be the number of students in each row but the number of rows and number of students in each row is equal.

$$1225 = x^2$$

$$x = \sqrt{1225} = 35$$

2. $(s + 1)(s + 3) = s^2 + 19$

$$s^2 + 4s + 3 = s^2 + 19$$

$$s = 4$$

3. $A = s^2$

$$s = \sqrt{64} = 8$$

Assessment

Dear teacher you will list some applications that related with real-life of students to solve those problem by the easiest ways. Use cube root to solve for the dimensions of a three-dimensional object of a certain volume.

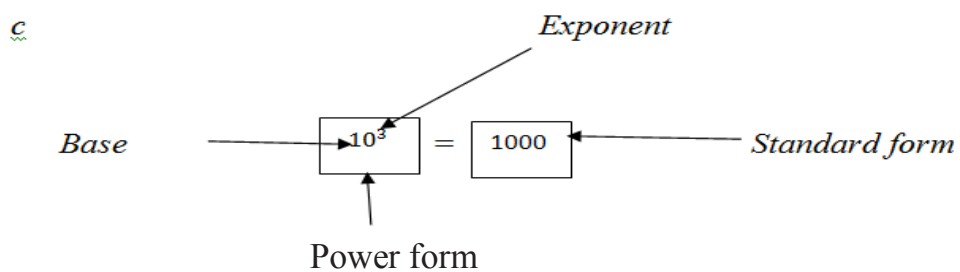
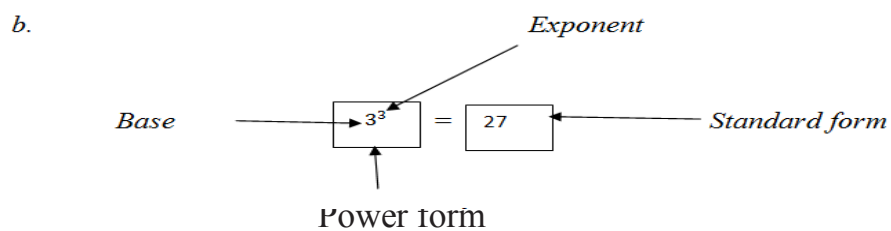
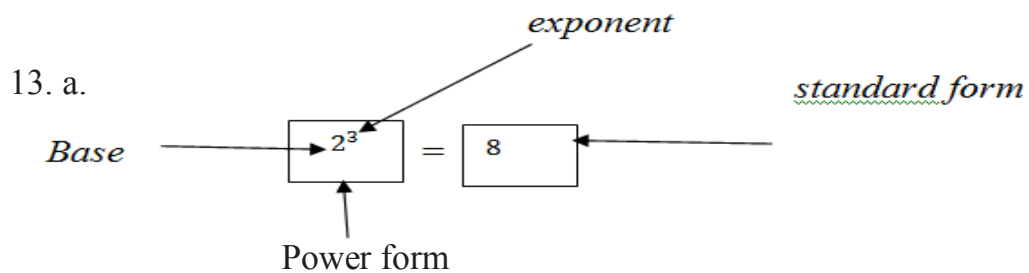
Dear teacher you may use group discussions, class work, homework, and quiz to make students to present it in the classroom.

Answer for Review Exercise 2

1. a. false b. true c. true d. false e. false f. true

2. a. $x = 0.09$

- b. $x = 4$
- c. $x = \frac{1}{16}$
- d. $x = \frac{225}{16}$
3. 625, 729, 900 and 2025 are perfect squares
4. 625
5. a. 64 b. 64.64 c. 64.6416
6. a. $x = 8$
b. $x = 9$
c. $x = 0.2$
7. You can use prime factorization method, then
a. $3^2 \times 5^2$
b. 5^4
c. $2^2 \times 5^4$
8. a. 4.43
b. 3.25
c. 5.48
d. 8.04
9. a. 5520 b. 552000 c. 0.552
10. a. 3.42 b. 34.2 c. 0.342
11. 27 and 64 are perfect cubes.
12. a. $x = 8$
b. $x = 0.000027$
c. $x = -8000$
d. $x = \frac{1}{64}$



14. a. 30^2

b. 18^2

c. 6^3

15. $31 + 33 + 35 + 37 + 39 + 41 = 216$

16. a. $As = AL + 2A_B$

$$As = Ph + 2(l \times w)$$

$$As = (4\text{cm} + 4\text{cm} + 4\text{cm} + 4\text{cm})4\text{cm} + 2(4\text{cm} \times 4\text{cm})$$

$$As = 64\text{cm}^2 + 32\text{cm}^2 = 96\text{cm}^2$$

b. $v = l \times w \times h = 4\text{cm} \times 4\text{cm} \times 4\text{cm} = 64\text{cm}^3$

c. Therefore, surface area of cube is greater than the volume of the cube.

17. $A = l^2$

$$l = \sqrt{A} = \sqrt{100} \text{ cm} = 10\text{cm}$$

UNIT 3

LINEAR EQUATIONS AND INEQUALITIES

Total Allotted Period: 21 Periods

LEARNING OUTCOMES: At the end of this unit, learners will be able to:

- ❖ Graph linear equations of the type $y = mx + c$.
- ❖ Solve linear inequalities.
- ❖ Solve applications of linear inequalities.

INTRODUCTION:

The main purpose of this unit is to extend the knowledge of the students about the Cartesian coordinate system and graphs of a linear equations. Furthermore, the students are required to be familiar with the x- axis and the y- axis which divide the coordinate plane into four quadrants namely I, II, III, and IV quadrant. The students should also be able to plot points on the coordinate plane representing given ordered pairs and conversely to read the coordinates of the given points on the coordinate plane and draw lines of the form

$$y = mx + c, m \in \mathbb{Q}, m \neq 0$$

In addition to this, the unit is formed on solving linear inequalities by means of a systematic discussion of rules for transforming inequalities. It is presented in such a way that students will develop skills in solving real life word problems systematically and independently.

Suggested Teaching Aids in Unit 3

- ✓ You can present different flow chart and graphs to demonstrate linear equations.
- ✓ You can also encourage students to prepare different representative graphs of linear equations by themselves.
- ✓ You can present chart showing the four quadrant of the coordinate plane.

Assessment

Generally, it is not necessary to assess all students every day. What is important is to keep track of their learning so that students who are lagging behind are identified and given extra help. And students who are succeeding and moving along quickly are given more challenges to keep them being simulated and learning.

3.1. Revision of Cartesian coordinate system

Period Allotted: 1 periods

Competency: At the end of this sub-topic, students should:

- ❖ Describe the Cartesian coordinate system.

Introduction:

This sub-topic mainly deals with Cartesian coordinate system. The concept we discussed in the sub-unit enables students to plot points on the xy-coordinate plane and read coordinates of the given points on the coordinate plane. Students are expected to have background on Cartesian coordinate plane. So, it is advisable to encourage students by giving time to discuss Activity 3.1. The main purpose of Activity 3.1 is to let you know and identify students who read and prepare themselves ahead. For this activity, especially question number one, you may use asking- answering methods. Don't give much emphasis on the correct answers but appreciate their bravery. The possible answers for activity 3.1

Answer for Activity 3.1

- Cartesian coordinate plane is a system in which the location of a point is given by coordinates that represent its distance from perpendicular lines.
 - Ordered pair is a pair of numbers that can be written in the form of (a, b) .
 - A quadrant is the region enclosed by the intersection of the x-axis and the y-axis.
- On the Cartesian plane when the two axes, x-axis and y-axis, intersect with each other at 90° , there are four regions formed around it. And their regions are called quadrants.

2

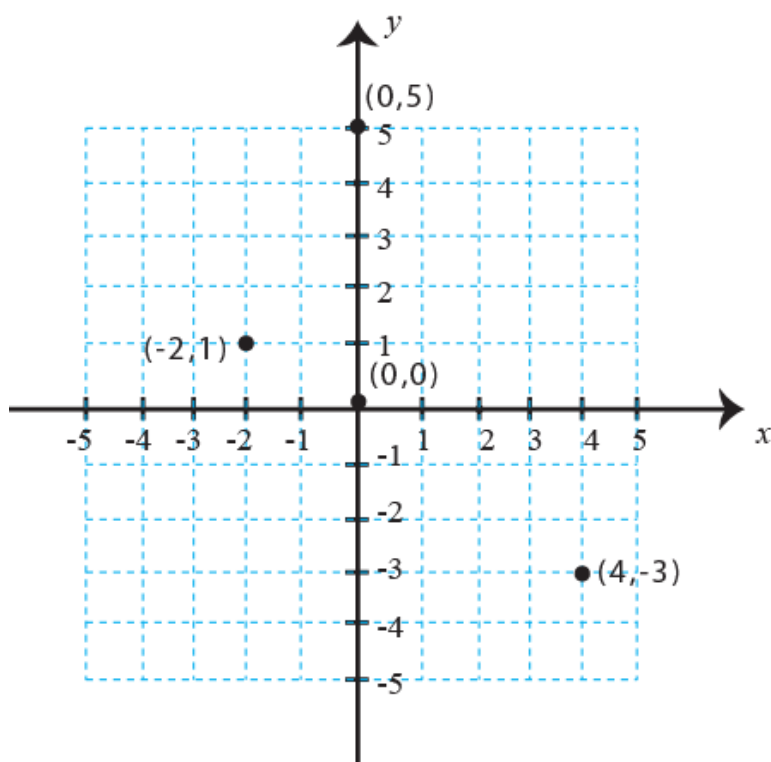


Figure 3.1

3. a) quadrant IV b) quadrant II c) quadrant III

4 a) quadrant IV b) quadrant III c) quadrant II d) quadrant I

5.a. If, $x = -1$, then $y = 3(-1) - 1 = -4$

If, $x = 0$, then $y = 3(0) - 1 = -1$

If, $x = 1$, then $y = 3(1) - 1 = 2$

b. The ordered pairs are $(-1, -4)$, $(0, -1)$ and $(1, 2)$.

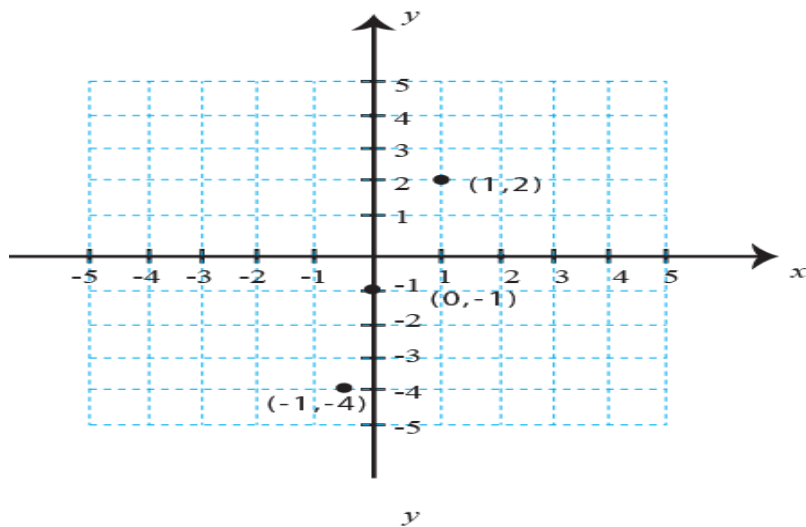


Figure 3.2

Answer for exercise 3.1

1. a. quadrant IV
c. quadrant III and IV
e. quadrant I
2. a. (-5,2)
b. (-10,0)

You can give additional exercise of your own other than the ones given in the student text book.

3.2. Graphs of linear Equations

Period allotted: 8 periods

Competency: At the end of this sub-topic, students should:

Draw the graph of linear equations like $y = mx + c$ in a Cartesian coordinate plane.

Introduction:

The students are already familiar with graphs of horizontal and vertical lines, and lines that pass through the origin. Start the lesson by drawing table of values for x and y in which y – is constant and following this let students plot these points and realize that the points lie on a horizontal line. You may take example like:

x	-3	-2	-1	0	1	2	3
y	4	4	4	4	4	4	4

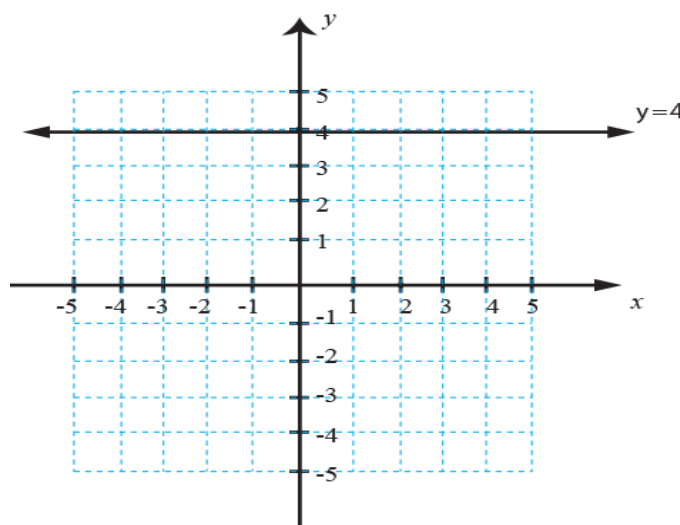


Figure 3.3

Assist students to come to the conclusion that $y = a$ where $a \in \mathbb{Q}$ is an equation of a horizontal line (or a line parallel to the x-axis). Do the same thing as suggested above, for vertical line, and assist students to come to the conclusion that $x = b$ where $b \in \mathbb{Q}$ is an equation of a vertical line (or a line parallel to the y-axis). After giving a brief summary of graphs of vertical and horizontal lines, give activity 3.2 as a group work.

Answer to activity 3.2

1.

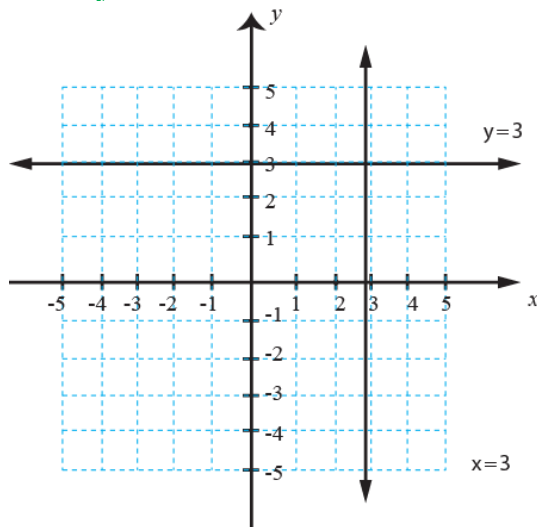


Figure 3.4

2. a. True

b. True

c. False

d. False

3. a. $y = 0$

b. $x = 0$

4.

x	-3	0	2
$5x - 2$	-17	-2	8

5. $3x + 5y = 4$

$$5y = -3x + 4$$

$$y = -\frac{3}{5}x + \frac{4}{5}$$

2)

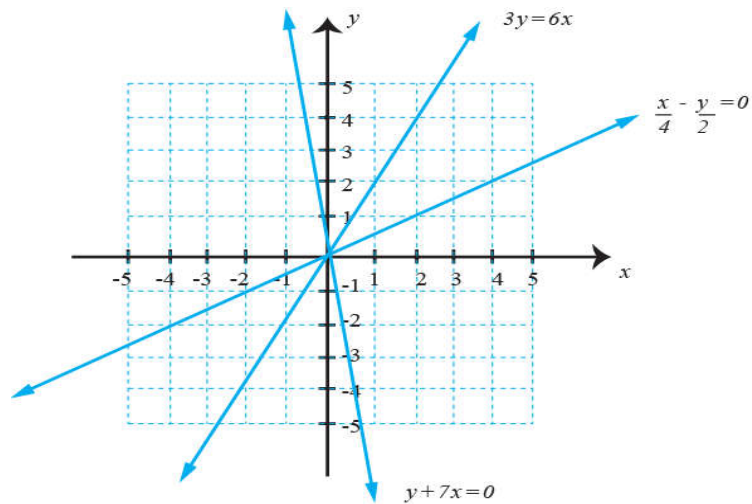


Figure 3.5

3) $(a, 3)$ is on the line $12x - 2y = 0$ means the point satisfies the equation.

Therefore, $12a - 2(3) = 0$

$$12a = 6$$

$$a = \frac{1}{2}$$

4a) $y = -3$

b) $x = 4$

c) yes

Answers to Exercise 3.3

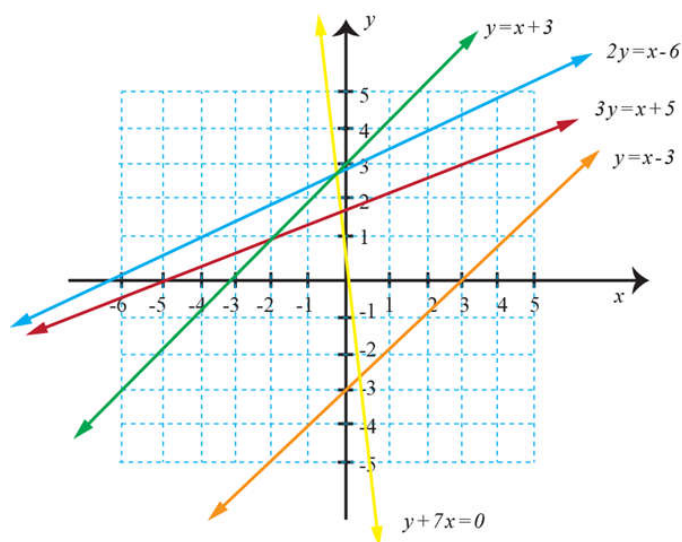


Figure 3.6

3.3. Solving Linear inequalities

Period Allotted: 8 periods

Competency: At the end of this sub-topic, students should:

- ❖ Solve linear inequalities.

Introduction:

This sub-unit mainly deals with solution of linear inequalities. The concept discussed in this sub- unit enables students to find solution of linear inequalities involving brackets, fractions and solve problems using linear inequalities.

You can start this lesson by reviewing solutions of equations given in activity 3.4 question number 1. This activity is mainly to remind the students how to solve linear equations in one variable. With active participation of students, you need to assist them to find the solution of a given linear equations. After you make sure that students have grasped the techniques of solving linear equations, extend it for solving linear inequalities by guiding students to solve linear inequalities given in activity 3.4 question number 3.

Answers to Activity 3.4

1a) $x = 18$ b) $x = 4$ c) $x = 5$

d) $(3x - 1) - 4(2x + 1) = 4(4x - 3)$

$$3x - 1 - 8x - 4 = 16x - 12$$

$$-5x - 5 = 16x - 12$$

$$7 = 21x$$

$$x = \frac{1}{3}$$

2) a and b.

3a) $10x < 23$

$$x < \frac{23}{10} = 2.3$$

In $\mathbb{W}$: $x = 0, 1, 2$

In $\mathbb{Z}$: $x = \dots -3, -2, -1, 0, 1, 2$

In $\mathbb{Q}$: $x < 2.3$

b) In $\mathbb{W}$: no solution

$$\text{In } \mathbb{Z}: x = \dots -5, -4, -3$$

$$\text{In } \mathbb{Q}: x < -2.5$$

c) In $\mathbb{W}: x = 8, 9, 10, \dots$

$$\text{In } \mathbb{Z}: x = 8, 9, 10, \dots$$

$$\text{In } \mathbb{Q}: x \geq 8$$

d) In $\mathbb{W}: x = 0, 1, 2, 3, 4$

$$\text{In } \mathbb{Z}: x = \dots, -2, -1, 0, 1, 2, 3, 4$$

$$\text{In } \mathbb{Q}: x \leq 4$$

Answers to Exercise 3.4

1a) $\leq$ b) $\geq$ c) $<$

2a) equivalent b) not equivalent

c) equivalent d) equivalent

Answers to exercise 3.5

1a) $2y - 3 < \frac{1}{2}(7 - y)$

$$2y - 3 + 3 < \frac{7}{2} - \frac{y}{2} + 3$$

$$2y < \frac{13}{2} - \frac{y}{2}$$

$$2y + \frac{y}{2} < \frac{13}{2} - \frac{y}{2} + \frac{y}{2}$$

$$\frac{5}{2}y < \frac{13}{2}$$

$$\frac{2}{5} \times \frac{5}{2}y < \frac{13}{2} \times \frac{2}{5}$$

$$y < \frac{13}{5}$$

In a similar way you must show the steps for the students of the remaining questions.

b) $x \geq -\frac{14}{5}$ c) $x \leq -\frac{4}{3}$

2a) no values of x satisfy the inequality.

b) all rational numbers satisfy the inequality.

3.4. Applications of Linear Equations and Inequalities

Period Allotted: 4 periods

Competencies: At the end of this sub-topic, students should:

- ❖ Apply linear equations and inequalities in real life situation.
- ❖ Solve linear equations and inequalities real- life problems.

Introduction:

The modern way of teaching mathematics is to relate or apply it to the real world situation. When you do this it helps you to motivate your students so that they appreciate and like the subject. So, you can present simple and more interesting problems from day- to –day activities that the students are familiar. Your examples and problems should be solved by using directly what you teach in the class. Here are possible answers to exercise 3.6 and 3.7 which are the applications of linear equations and linear inequalities in real life situation.

Answers to exercise 3.6

$$1a) 7x - 5 = 0 \qquad b) \frac{x}{9} = x - 2 \qquad c) 2x + 4 = 3x - 7$$

$$2) F = G \frac{mM}{r^2}$$

$$Fr^2 = GmM$$

$$M = \frac{Fr^2}{Gm}$$

$$3) B + G = 42 \text{ and } G = 1.1 B$$

$$\text{So, } B + 1.1B = 42$$

$$2.1 B = 42$$

$$B = \frac{42}{2.1} = 20 \text{ and } G = 42 - B = 42 - 20 = 22$$

Therefore, there are 20 boys and 22 girls are there in the class.

$$4) \text{ let } x \text{ be the age of the mother and } y \text{ be the age of her daughter.}$$

$$\text{Then, } x + y = 68 \text{ and } x = y + 22$$

$$y + 22 + y = 68$$

$$2y = 46$$

$$y = 23 \text{ and } x = y + 22 = 45$$

Therefore, the mother is 45 years old.

Answers to exercise 3.7

1 a) $3x - 4 \leq 20$

b) $\frac{x}{7} < 10$

c) $h \leq 6\text{m}$

d) $x + (x + 1) < 3x$

2. Let x be the number. Then,

$$5x - 2x < 12$$

$$3x < 12$$

$$x < 4$$

Therefore, the possible values of x are 1, 2, and 3.

3. Let x be the total km covered by the trip. Then,

$$50 + 10x \leq 1350$$

$$10x \leq 1300$$

$$x \leq 130 \text{ km}$$

Therefore, $x = 130 \text{ km}$

Assessment

After completing this topic, you can use any of the following techniques for assessing students learning class activities, group discussion, assignments and quiz or test.

Dear teacher, please assess your students' based on the following concepts.

- ✓ Give different exercise problems to describe Cartesian coordinate system
- ✓ Give different exercises to solve linear equations
- ✓ Give different exercise problems to draw graphs of linear equations
- ✓ Give different exercise problems to solve linear inequalities
- ✓ Give different exercise problems to solve real life problem in application of linear equations and inequalities.

For slow learners

1) Draw the graphs of the following linear equations on the same coordinate plane.

a) $y = \frac{2}{3}x + 6$

b) $y = \frac{3}{4}x + \frac{7}{6}x + 2$

2) Take the following numbers: -2, -1, 0, 2, and 3 and determine which numbers satisfy the inequality.

a) $3 - 2x \leq \frac{1}{2}$

b) $\frac{x}{2} \leq \frac{1}{2}$

c) $2x - 1 \geq x$

For fast learners

1) Draw the graph of the following linear equations on the same coordinate system

a) $y = \frac{7}{3}x - \frac{4}{10}x + 8$

b) $3x + \frac{12}{5}x + 2y = 0$

2) Solve the inequality and sketch the solution set $4 \leq 3x - 2 < 13$.

Solution:

The solution set consists of all values of x that satisfy both the inequalities

$$4 \leq 3x - 2 \text{ and } 3x - 2 < 13.$$

$$4 \leq 3x - 2 < 13$$

$$4 + 2 \leq 3x - 2 + 2 < 13 + 2$$

$$6 \leq 3x < 15$$

$$\frac{6}{3} \leq \frac{3x}{3} < \frac{15}{3}$$

$$2 \leq x < 5$$



- 3) Take the following numbers: $-2, -1, 0, \frac{1}{2}, 2, 3$ and determine which numbers satisfy the following inequalities
- $1 < 2x - 4 \leq 7$
 - $-2 \leq 3 - x < 2$
 - $-\frac{1}{2} \leq \frac{4-3x}{5} \leq \frac{1}{4}$
 - $\frac{1}{3}x + 2 < \frac{1}{6}x - 1$
- 4) The instructions on a bottle of medicine indicate that the bottle should be stored at a temperature between 5°C and 30°C . what range of temperature this correspond to on the Fahrenheit scale?

Solution:

The relationship between degrees Celsius (C) and degrees Fahrenheit (F) is given by the equation: $C = \frac{5}{9}(F - 32)$

Since $5 < C < 30$

$$5 < \frac{5}{9}(F - 32) < 30$$

$$\frac{9}{5} \times 5 < (F - 32) < \frac{9}{5} \times 30$$

$$9 < F - 32 < 54$$

$$9 + 32 < F < 54 + 32$$

$$41 < F < 86$$

Therefore, the medicine should be stored at a temperature between 41°F and 86°F .

Answers to Review Exercise

- 1a) False b) True c) False d) True e) True

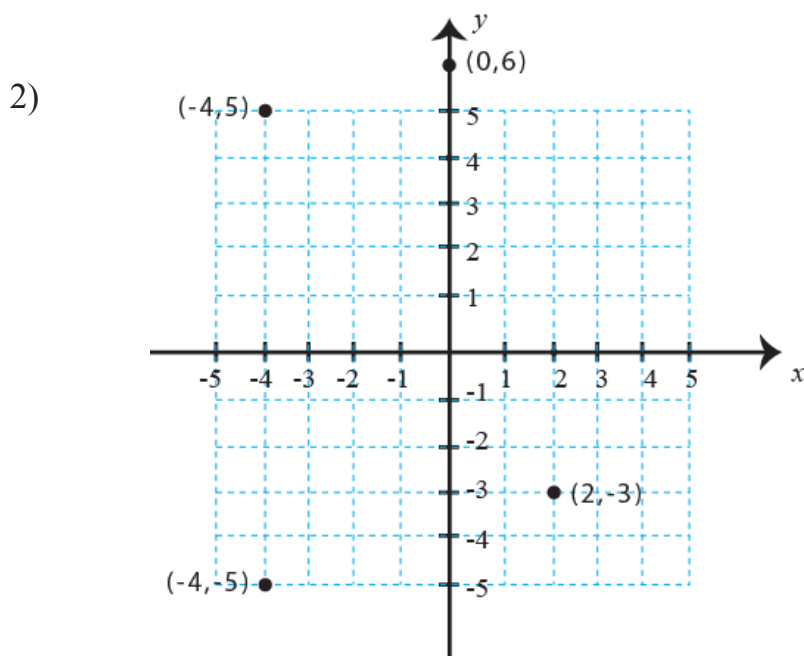


Figure 3.7

(0,6) does not lie in any quadrant.

- 3) a) D(0,4) x-coordinate = 0, y-coordinate = 4
 E(3,-1) x-coordinate = 3, y-coordinate = -1
 F(2,0) x-coordinate = 2, y-coordinate = 0

b) point A

c) y coordinate d) point C III quadrant and point E IV quadrant

- 4) a) $\leq$ b) $>$ c) $>$

5) a) (0, 0) – not on the line

b) (1, 0) – on the line

c) (-1, -1) – on the line

d) (2, 1) – not on the line

6)

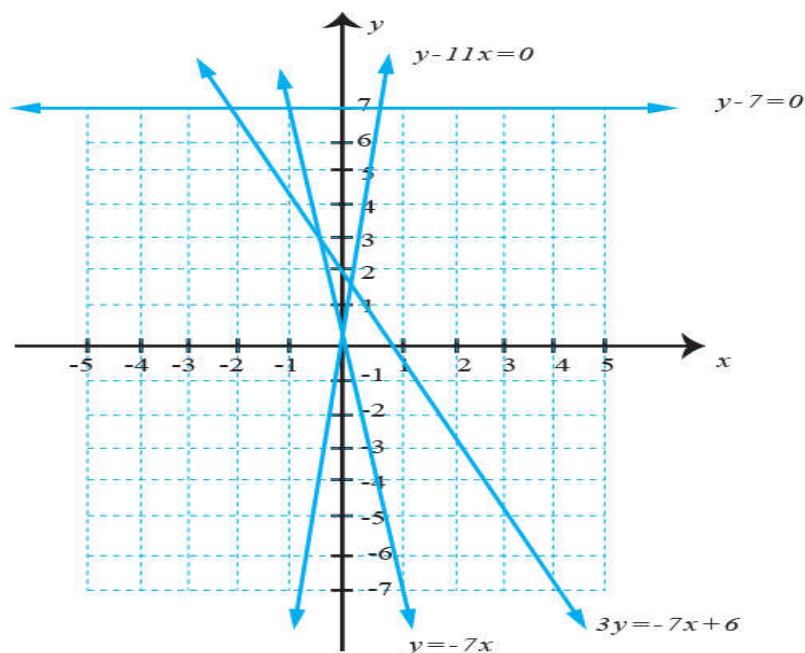


Figure 3.8

7) Given the equation $ax - by = 6$, substitute the values of x and y to get two equations in terms of a and b

where $x = 3$, and $y = 1$, $3a - b = 6$ and

where $x = 0$, and $y = 2$, $-2b = 6$ from this we get $b = -3$.

Now substitute the values of $b = -3$ in the equation

$$3a - b = 6$$

$$3a - 3 = 6$$

$$a = \frac{6-3}{3}$$

$$a = 1$$

Therefore, the values of a and b , are $a = 1$, $b = -3$

8)

x	-1	0	1
$y = x + 1$	0	1	2
$y = 1 - x$	2	1	0

b) –

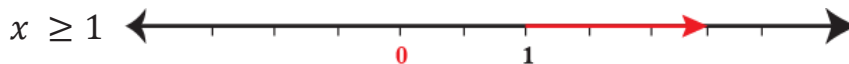
c) (0, 1) is an intersection point

9) a) $3x + 11 \leq 6x + 8$

$$3x - 6x \leq 8 - 11 \text{ -----collect like terms}$$

$$-3x \leq -3$$

$$\frac{-3x}{-3} \geq \frac{-3}{-3} \text{ -----divide both sides by } -3$$

$$x \geq 1$$


0

1

Figure 3.9

b) $6 - 2x > x + 9$

$$-2x - x > 9 - 6$$

$$-3x > 3$$

$$x < -1$$



-1

0

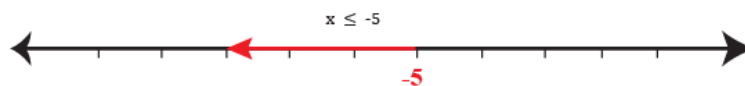
Figure 3.10

c) $4 - 3x \leq -\frac{1}{2}(2 + 8x)$

$$4 - 3x \leq -1 - 4x$$

$$-3x + 4x \leq -1 - 4$$

$$x \leq -5$$



$x \leq -5$

-5

Figure 3.11

10) a) $\frac{x}{7} \geq \frac{3}{14}x - \frac{1}{7}$

$$2x \geq 3x - 2$$

$$2x - 3x \geq -2$$

$$x \leq 2$$

b) $2\left(\frac{1}{2} - x\right) < 3\left(1 + \frac{1}{2}x\right) + 5$

$$1 - 2x < 3 + \frac{3}{2}x + 5$$

$$-2x - \frac{3}{2}x < 3 + 5 - 1$$

$$-\frac{7}{2}x < 7$$

$$x > -2$$

c) $x \leq -6$

d) $y < \frac{7}{4}$

e) no solution

f) All rational numbers

11. a) 1, 2, 3

b) No whole numbers satisfy the inequality.

c) All rational numbers satisfy the inequality.

12) a) $F - 1 > 3(S - 1)$

b) $\frac{3}{4}x > 12$

c) $x \geq 89$

13) $x = 1.1m, \quad y = 1.4m$

14) 5 years

15) $x = 13$

16) $G = 0, 1$ and $S = 3, 4$

Grade 8

Learning objectives for Grade 8

After completing grade 8, students should be able to:-

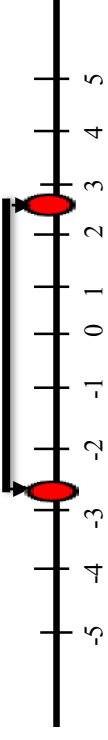
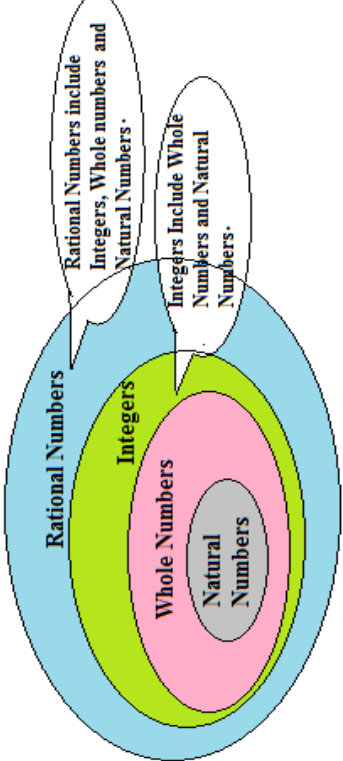
- Define and represent rational numbers as fractions
- Show the relationship among whole numbers, integers, and rational numbers.
- Apply operation of rational numbers
- Calculate the square and cube of rational numbers
- Determine square roots and cube roots of perfect squares and perfect cubes respectively.
- Extract approximate square roots of numbers by using the numerical table.
- Simplify algebraic expressions.
- Solve real life problems using variables.
- Draw equation of a line on a Cartesian coordinate plane.
- Solve linear inequalities by using rules of transformation.
- Give the conditions for triangles to be similar.
- Apply the tests for similarity to check whether two given triangles are similar or not.
- Give the relationships that exist between lines and circles.
- Apply basic facts about central and inscribed angles and angles formed by intersecting chords to solve related problems.
- Identify certain, uncertain and impossible outcomes.
- Describe event, sample space and probability of simple events.
- Calculate probabilities of simple events.
- Understand basic concepts about right angled triangles
- Apply important theorems on right angled triangles to solve related problems.

Unit 1: Rational numbers (30 periods)

Learning Outcomes: At the end of this unit, learners will able to:

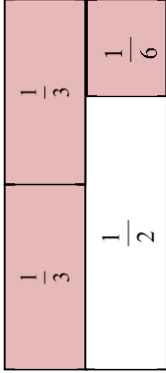
- Define and represent rational numbers as fractions
- Show the relationship among Natural numbers, whole numbers, integers, and rational numbers.
- Order rational numbers.
- Solve problems involving addition, subtraction, multiplication and division of rational numbers
- Apply rational numbers to solve practical problems.
- Aware the four operations as they relate to rational numbers.

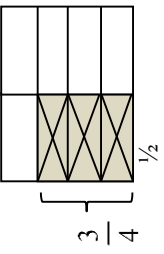
Competencies	Contents	Learning Strategies	Assessment
• Describe the concept of Rational Number practically • Express Rational numbers as fractions.	1.1 The Concept of Rational Numbers (6 periods)	• Encourage students to revise the order and representation of integers. • Divide students into small groups and let leaders present their ideas to the class for discussion. What is rational numbers? Discuss real life application of rational numbers? Eg. Solomon has 3 cats and 2 dogs. He wants to buy a toy for each of his pets. Solomon has 22 birr to spend on pet toys. How much can he spend on each pet? Write your answer as a fraction and as an amount in birr and cents. • Guide the students to solve the above problem using problem-solving methods as: Solution: Understand the problem. The data: Total number of toys is 5 Total amount in birr is 22. The unknown: To find the amount spent for each pet. Devise a plan 1) Use a variable strategy i.e., let x be the amount spent for each pet. 2) Set up an equation. $5x = 22$ Carry out the plan Solve the equation $5x = 22 \Rightarrow 1/5 \times 5x = 22 \times 1/5 \Rightarrow x = 22/5$ or 4 birr and 40 cents. Verifying the result Check the result: $22/5 \times 5 = 22$ is correct.	• Observe learners while they are performing group work and present outcomes of their discussions • Record their performance • Provide constructive feedback based on their performance.
• Represent rational numbers as a set of fractions on a number line.	1.1.1 Representation of Rational Numbers on a Number Line	▪ Let students to represent some rational numbers on a number line. Eg. 1. Two rational numbers are opposites if they are the same distance from 0 but on different sides of 0. $2\frac{3}{4}$ and $-2\frac{3}{4}$ are opposites	• Ask and let some students to represent a given rational number on the number line. • Provide descriptive

Competencies	Contents	Learning Strategies	Assessment
		 2. Analyze Relationships: If you plot the point -8.85 on a number line, would you place it to the left or right of -8.8? Explain.	feedback for learners to improve their learning.
• Describe the relationship among the sets W, Z and Q	1.1.2 Relationship Among W, Z and Q	- Let students to show the Relationship among N, W, Z and Q using Venn diagram.  - Give examples of set of numbers to show the relationship between rational numbers, integers, and whole numbers. - Encourage the students to answers the questions like: Critique Reasoning: Solomon says the number belongs only to the set of rational numbers. Explain his error. Critical Thinking: Is it possible for a number to be a rational number that is not an integer but is a whole number? Explain	- Ask and let some students to use venn diagram to show the relationship among N, W, Z and Q. - Provide descriptive feedback for learners to improve their learning.
• Determine the absolute value of a rational number	1.1.3 Absolute Value of Rational Numbers	- Ask students to tell the definition of the concept of absolute value of rational numbers “x” $x = \begin{cases} x & \text{if } x \geq 0 \\ x & \text{if } x < 0 \end{cases}$ - Engage students to interpret the concept of absolute value of a rational number geometrically. e.g $3 = 3$ and $-3 = 3$ means that on a number line the	- Ask and let some students to define and represent a given absolute value of a rational number on the number line. - Provide constrictive

Competencies	Contents	Learning Strategies	Assessment															
		distance of 3 from 0 is 3 units and the distance of -3 from 0 is also 3 units  Encourage students to solve equation of absolute value like $x = 5$	feedback for learners to improve their learning. - Ask and let some students to solve simple equation of absolute value - Provide descriptive feedback for learners to improve their learning. - Give homework exercise problems on evaluating absolute values of rational numbers															
Compare and order Rational numbers	1.2 Comparing and Ordering Rational Numbers (6 periods) 1.2.1 Comparing Rational Numbers 1.2.2 Ordering Rational Numbers	- Let students to compare rational numbers on a number line by changing the fractions to equivalent fractions with common denominator Eg. Use number line to compare decimals and fractions as: 1) Compare Decimals: Replace $\square$ with $<$, $>$, or $=$ to make a true statement. - $1.2 \square 0.8$ 2) Compare Fractions: Replace $\square$ with $<$, $>$, or $=$ to make a true statement $\frac{-7}{8} \square \frac{6}{8}$ - Let students to order rational numbers on a number line by changing the fractions to equivalent fractions with common denominator - Eg. Use number line to compare decimals and fractions as: - Order 0.2, 0.8, and 0.4 from least to greatest. - Ask students individually or in groups a real-life application to order rational numbers like Samuel's science class is growing plants under different conditions. The average plant growth during a week was 5.5 cm. The table shows the difference from the average for some students' plants. Order the differences from lowest to highest. <table><tr><th colspan="5">Difference from Average Plant Growth</th></tr><tr><th>Student</th><th>Rahel</th><th>Kassa</th><th>Tesfaye</th><th>Munir</th></tr><tr><td></td><td></td><td></td><td></td><td></td></tr></table>	Difference from Average Plant Growth					Student	Rahel	Kassa	Tesfaye	Munir						- Ask and let some students to compare and order rational numbers on the number line by changing the fractions to equivalent fractions with common denominator and by giving practical problems. - Provide constrictive feedback for learners to improve their learning. - Give students various exercise problems to compare rational using the inequality signs "$<$" and "$>$" between given rational numbers and check their work.
Difference from Average Plant Growth																		
Student	Rahel	Kassa	Tesfaye	Munir														

Competencies	Contents	Learning Strategies					Assessment										
			Difference (in.)	$3\frac{1}{4}$	-2.2	1.7	$-1\frac{7}{10}$										
• Add rational numbers • Subtract rational numbers	1.3 Operation and Properties of Rational Numbers (14 periods) 1.3.1 Addition of Rational Numbers	Let students revise addition of integers using a number line. • Divide students into groups and let them discuss by stating and showing the rule for addition of two rational numbers using examples • If the signs of the addends are different (i) take the sign of the addend with the greater absolute value. (ii) take the absolute values of both numbers and subtract the addend with smaller absolute value from the addend with greater absolute value. Eg. $-6 + 2 = -4$ • If both rational numbers are negative (i) decide (put) the sign first (ii) take the sum of the absolute values of the addend eg. $-3 + (-5) = -8$ • Let students show the validity of the commutative property and associative property. • Let students generalize that, for any rational number X, Y, Z (i) $X + Y = Y + Z$ (ii) $(X + Y) + Z = X + (Y + Z)$ • Encourage students to find addition of rational numbers using fraction bars. Eg. Find the sum of $\frac{3}{8}$ and $\frac{2}{8}$ using fraction bars. <table><tr><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td></tr><tr><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td></tr></table> $\frac{3}{8} + \frac{2}{8} = \frac{5}{8}$					$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	• Ask students orally to answer addition of integers using number line. • Ask your students to find the addition of rational numbers a) using properties of addition b) by using fractional bars c) by using Scientific calculator • Ask students to solve real-life applications of addition. • Provide descriptive feedback for learners to improve their learning • Give different exercise problems on addition of rational numbers and check their work. • Give different exercise problems on the use of the commutative and associative properties and follow up the performance of students
$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$													
$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$													
	1.3.2 Subtraction of Rational Numbers	• Let students to express subtraction of rational numbers as addition of the opposite of the rational number to be subtracted. Example 1. $5 - 4 = 5 + (-4)$ • The rule studied for addition of rational numbers can be applied to find the sum $5 + (-4)$.					• Ask your students to find the subtraction of rational numbers a) using properties of subtraction										

Competencies	Contents	Learning Strategies	Assessment
		Example 2. $5 - (-3) = 5 + 3$ Encourage students to find subtraction of rational numbers using fraction bars. Eg. Find the differences $\frac{2}{3} - \frac{1}{2}$ using fraction bars? Place a $\frac{1}{2}$ bar beneath bars that show $\frac{2}{3}$, and find which fraction fills in the remaining space.  $\frac{2}{3} - \frac{1}{2} = \frac{1}{6}$	b) by using fractional bars c) by using Scientific calculator - Ask students to solve real-life applications of subtraction. - Provide descriptive feedback for learners to improve their learning - Give different exercise problems on subtraction of rational numbers and check their work. - Give different exercise problems on the use of the commutative and associative properties and follow up the performance of students
- Multiply rational numbers - Divide rational numbers	1.3.3 Multiplication of Rational Numbers	- Divide students into ten groups and let them discuss on the rules for multiplication of rational numbers (i) Product of two rational numbers with different signs (a) decide the sign of the product, it is " - " (b) take the product of (-3×4) the absolute value the numbers Example $-3 \times 4 = -(-3 \times 4)$ $= -(3 \times 4) = -12$ (ii) Product of two negative rational numbers (a) decide the sign of the product, it is " + " (b) take the absolute values of the numbers and multiply them. Example $(-3) \times (-4) = \frac{1}{2} - 3\frac{1}{2} \times \frac{1}{2} - 4\frac{1}{2} = 3 \times 4 = 12$ - Engage students to come to the conclusion about the validity of the commutative, associative and distributive property of multiplication of	- Ask your students to find the multiplication of Rational Numbers a) using properties of multiplication and division b) by using grids to models c) by using Scientific calculator - Ask students to solve real-life applications of multiplication and division - Provide descriptive

Competencies	Contents	Learning Strategies	Assessment
		rational numbers. Encourage students to find multiplication of rational numbers using grids to model. Eg. Use a grid to model to find $\frac{3}{4} \times \frac{1}{2}$. Think of $\frac{3}{4}$ of $\frac{1}{2}$. a) Model $\frac{1}{2}$ by shading half of a grid b) Use a different colour to shade $\frac{3}{4}$ of the same grid  Divide the grid into 2 columns. Divide the grid into 4 rows. Shade 1 column to show $\frac{1}{2}$. Shade 3 rows to show $\frac{3}{4}$. c) Determine what fraction of the grid is shaded with both colours. There are 8 equal parts, and 3 of the parts are shaded with both colours. The fraction shaded with both colours is $\frac{3}{8}$.  $\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$ The section of the grid shaded with both colours shows 3 parts of $\frac{1}{2}$ when $\frac{1}{2}$ is divided into 4 equal parts. In other words, the grid shows $\frac{3}{4}$ of $\frac{1}{2}$, or $\frac{3}{4} \times \frac{1}{2}$.	feedback for learners to improve their learning - Give different exercise problems on multiplication and division of rational numbers and check their work. - Give different exercise problems on the use of the commutative and associative properties and follow up the performance of students
1.3.4 Division of Rational Numbers		Let students to discuss the rules for division of two rational numbers using examples and let the students come to the following conclusion. 1) To determine the sign of the quotient: - (a) If the signs of the dividend and the divisor are the same,	- Ask your students to find the division of Rational Numbers a) using properties of

Competencies	Contents	Learning Strategies	Assessment
		the sign of the quotient is " + " you may take examples like: $\frac{-10}{-5} = \frac{10}{5} = 2$ Encourage students to find division of rational numbers using grids to model. Eg. Use grids to model $4\frac{1}{3} \div \frac{2}{3}$. Divide 5 grids into thirds. Shade 4 grids and $\frac{1}{3}$ of a fifth grid to represent $4\frac{1}{3}$ Think: How many groups of $\frac{2}{3}$ are in $4\frac{1}{3}$? Divide the shaded grids into equal groups of 2.	division b) by using grids to models c) by using Scientific calculator - Ask students to solve real-life applications of division - Provide descriptive feedback for learners to improve their learning - Give different exercise problems on division of rational numbers and check their work. - Give different exercise problems on the use of the commutative and associative properties and follow up the performance of students
Solve application of Rational Number	1.4 Real-life Applications of Rational Numbers (4 periods) 1.4.1 Application in sharing something among friends 1.4.2 Application in calculating Interest and loans	There are 6 groups of $\frac{2}{3}$, with $\frac{1}{3}$ left over. This piece is $\frac{1}{2}$ of a group of $\frac{2}{3}$. Thus, there are $6 + \frac{1}{2}$ groups of $\frac{2}{3}$ in $4\frac{1}{3}$. $4\frac{1}{3} \div \frac{2}{3} = 6 + \frac{1}{2}$ - Guide students to solve real-life applications of rational numbers in sharing something among friends by discussing in groups and present in class. - Guide students to solve real-life applications of rational numbers in calculating interest and loan	- Ask group of students to work the real-life application problems. - Observe students while they are working together - Ask your students to communicate their result - Provide descriptive feedback for learners to improve their learning

Unit 2: Squares, square roots, cubes, and cube roots (25 periods)

Learning Outcomes: At the end of this unit, learners will be able to:

- Explain the notion square and square roots and cubes and cube roots
- Determine the square of numbers
- Determine the square roots of the perfect square numbers
- Extract the approximate square roots of numbers by using the numerical table and scientific calculator.
- Determine the cube of numbers
- Extract the cube roots of perfect cubes.
- Apply squares, square roots, cubes and cube roots in the real-life situation

Competencies	Contents	Learning Strategies	Assessment
• Calculate the square of a number	2.1 Squares and Square Roots (11 periods) 2.1.1 Square of a Rational Number 2.1.2 Use of table values and Scientific calculator to find squares of rational numbers	• Start the lesson by giving the application of the unit. • Engage the learners with warm-up activities by using rectangles to visualize the square of a number and then give examples of a square of a number like $9 \times 9 = 9^2 = 81$, and $\frac{1}{2} \times \frac{1}{2} = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$, which means squaring a number is multiplying the number by itself. • Guide group of students to discuss and communicate to approximate the square of numbers obtained from numerical table, i.e. $(2.25)^2 \approx 5.0625 \approx 5.06$ in the table. • Guide group of students to discuss and communicate with each other to apply Scientific calculator to find the squares of a number, • Motivate students by show interesting patterns of square of numbers and apply critical thinking to generalize, 1 [one odd number] $= 1 = 1^2$ $1 + 3$ [sum of first two odd numbers] $= 4 = 2^2$ $1 + 3 + 5$ [sum of first three odd numbers] $= 9 = 3^2$ $1 + 3 + 5 + 7$ [...] $= 16 = 4^2$ $1 + 3 + 5 + 7 + 9$ [...] $= 25 = 5^2$ $1 + 3 + 5 + 7 + 9 + 11$ [...] $= 36 = 6^2$ What is the <i>sum of first n odd natural numbers?</i>	• Ask students orally to answer simple squares of numbers. • Ask your students to find the square of a number and compare their result a) by computing b) by using table of square c) by using Scientific calculator • Ask students to solve real-life applications of square of numbers. • Provide descriptive feedback for learners to improve their learning

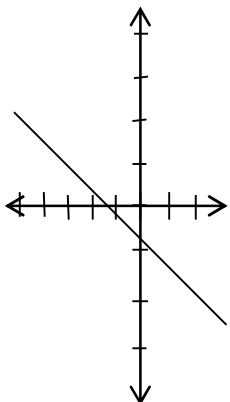
Competencies	Contents	Learning Strategies	Assessment
Calculate the square root of perfect squares.	2.1.3 Square Roots of a Rational Number 2.1.4 Use of table values and Scientific calculator to find square roots of rational numbers	- Assist students to use internet and explain the relation between squaring and extracting square root from the square with examples like 2 squared = $2 \times 2 = 4$. Therefore, the square root of 4 is 2 - Assist also to identify the symbol $\sqrt{\quad}$, called a <i>root sign</i>, represents a nonnegative square root. For example, $\sqrt{4} = 2$ is the positive square root of 4, and $-\sqrt{4} = -2$ is the negative square root of 4; but not $\sqrt{-4} = -2$ or 2. - Guide the student to use prime factorization to find the square root of perfect squares; for example, $\sqrt{100}$ $100 = 2 \times 2 \times 5 \times 5 = (2 \times 2) \times (5 \times 5) = 10 \times 10 = 10^2$ $\therefore \sqrt{100} = \sqrt{10^2} = 10$ - Guide students to solve real-life applications representing square of numbers discussing in groups and present in class Remark: Table of squares and square roots and using scientific calculator should be included in the text books.	- Give questions and ask students to find square root of non-negative numbers and compare their result - by computing - by using table of square - by using Scientific calculator - Provide descriptive feedback for learners to improve their learning
Calculate the cube of a number	2.2 Cubes and Cube Roots (11 periods) 2.2.1 Cube of a Rational Number	- Engage the learners with warm-up activities by using cubes to visualize the cube of a number and then give examples of a cube of a number like $3 \times 3 \times 3 = 3^3 = 27$, and $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$, which means cubing of a number is the product of three occurrences of itself. - Guide students to find some cubes of whole numbers using a table and scientific calculator. - Motivate students by show interesting patterns of cubes of numbers and apply critical thinking to	- Ask students orally to answer simple cubes of numbers. - Ask your students to find the cube of a number and compare their result - by computing - by using table of cube - by using Scientific calculator - Ask students to solve real-life applications of cube of numbers.

Competencies	Contents	Learning Strategies	Assessment
			• Provide descriptive feedback for learners to improve their learning
		generalize, Observe the following pattern of sums of odd numbers. $1 = 1 = 1^3$ $3 + 5 = 8 = 2^3$ $7 + 9 + 11 = 27 = 3^3$ $13 + 15 + 17 + 19 = 64 = 4^3$ $21 + 23 + 25 + 27 + 29 = 125 = 5^3$ How many consecutive odd numbers will be needed to obtain the sum as 10^3? • Project as a critical thinking: Give students as a project to think, discuss and write whether the following are perfect cubes. (i) 2700 (ii) 16000 (iii) 64000 (iv) 900 (v) 125000 (vi) 36000 (vii) 21600 (viii) 10,000 (ix) 27000000 (x) 1000. What pattern do you observe in these perfect cubes? • Assist students to use internet and explain the relation between cubing and extracting cube root from the cube of a number with examples like $2 \text{ cubed} = 2 \times 2 \times 2 = 8$. Therefore, the cube root of 8 is 2. • Assist also to identify the symbol $\sqrt[3]{}$, called a <i>cube root</i>. For example, $\sqrt[3]{8} = 2$; similarly, $\sqrt[3]{-8} = \sqrt[3]{-2 \times -2 \times -2} = -2$.	
• Solve real-life problems	2.2.2 Cube Root of a Rational Number 2.3 Applications on squares, square roots, cubes and cube roots (<i>3 periods</i>)	• Guide students to solve real-life applications on Application in carpentry, Application in architecting, and Application in engineering, representing cubes of numbers discussing in groups and present in class.	• Ask group of students to work the real-life application problems. • Observe students while they are working together • Ask your students to communicate their result • Provide descriptive feedback for learners to improve their learning

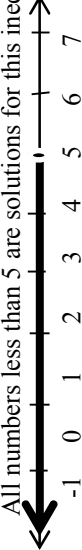
Unit 3: Linear equation and inequalities (21 periods)

Learning Outcomes: At the end of this unit, learners will be able to:

- Graph linear equations of type $y = mx + n$
- Solve linear inequalities
- Solve applications of linear inequalities

Competencies	Contents	Learning Strategies	Assessment												
Describe the Cartesian coordinate system	3.1 Revision of Cartesian Coordinate System (1 periods)	- Assist students to revise the x - axis and y-axis divide the coordinate plane into four quadrants and to read and plot points in the coordinate's plane. - Guide students to describe the sign of coordinates (x, y) in each quadrant.	- Ask students to identify the quadrants of the Cartesian plane. - Ask students to locate the coordinates in each quadrant.												
Draw linear equations like $y = mx + n$ in a Cartesian coordinate plane	3.2 Graph of linear equations (8 periods)	- Revise to the students to draw a vertical line and come to the conclusion that $x = b$ where $b \in \mathbb{Q}$ is an equation for a vertical line. - Assist students to draw a line whose equation is of the form $y = mx + n$, where $m, n \in \mathbb{Q}$ by the following steps: - Make table of values for easy x coordinates - Use the equation $y = mx + n$ to calculate the y value - Plot the points - Draw the lines through these points Example: Draw the line $y = 2x + 1$ <table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td></tr><tr><td>y</td><td>-3</td><td>-1</td><td>1</td><td>3</td><td>5</td></tr></table> 	x	-2	-1	0	1	2	y	-3	-1	1	3	5	- Ask your students to draw linear equations like $y = mx + n$; in a Cartesian coordinate plane and compare their result - by using table values manually - by using computer applications - Provide descriptive feedback for learners to improve their learning
x	-2	-1	0	1	2										
y	-3	-1	1	3	5										
		Guide students to draw the graph of $y = 2x + 1$ by using software such as computer Excel or Geogebra or Matlab or Mathematica, etc and compare your result with manual drawing. Below is the graph of $y = 2x$ using computer Excel													

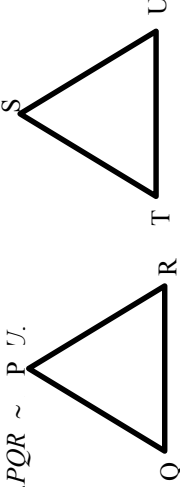
Competencies	Contents	Learning Strategies	Assessment
		Assist students to discuss in groups and communicate to graph $y = 2x + 3$, $y = 3x + 5$. Observe that the natures of the graphs are similar.	
Solve linear inequalities	3.3 Solving Linear Inequalities <i>(8 periods)</i>	- Guide students to discuss in groups and communicate the difference between $x > 5$ and $x \geq 5$; $x > 5$ and $x < 5$; and $x \geq 5$ and $x \leq 5$, etc. - Assist students to solve and graph the solution of One-Step Inequalities, such as Example: Solve each inequality. Graph and check the solution. $x + 5 < -12$ Solve the inequality. $x < -17$ Graph the solution. Check the solution. Substitute a solution from the shaded part of your number line into the original inequality. $-18 + 5 ? < -12$ $-13 < -12$	- Ask your students to solve linear inequalities. - Ask students to solve real-life applications of linear inequalities. - Provide descriptive feedback for learners to improve their learning

Competencies	Contents	Learning Strategies	Assessment
		inequalities, such as. Example: Solve and graph the solution of $-3x + 7 > -8$. $-3x + 7 > -8$ $-3x > -7 - 8$ $-3x > -15$ $x < 5$, because dividing or multiplying by negative makes the sign changed. All numbers less than 5 are solutions for this inequality.  • Assist students to discuss in groups and communicate the following Critical Thinking. Selam scored 95, 86, and 89 on three science tests. She wants her average score for 6 tests to be at least 90. What inequality can you write to find the average scores that she can get on her next three tests to meet this goal? Use x to represent the lowest average score. • Assist students to discuss in groups and communicate the following Critical Thinking. Is there any value of x with the property that $x < x - 1$? Explain your reasoning. • Assist students to solve real-life problems to solve linear inequalities.	
- Apply linear equations and inequalities in the real-life situation - Solve linear equations and inequalities real-life problems	3.4 Applications in Linear Equations and Inequalities <i>(4 periods)</i>	- Assist students to work in groups and communicate the solutions of the word problems in agriculture, engineering, business, education, day to day activities, etc. - Guide students to discuss and in groups and communicate the solution of the problems like road transport, business, etc. - Assist students to discuss in groups on causes and effects of climate change, and protection of the environment - Guide students to solve a real-life application problems like the Rise of Atmospheric Carbon Dioxide; Rising of Temperature; Rise of Sea Level, etc.	- Ask group of students to solve real-life application problems in terms of linear equations and inequalities. - Observe students while they are working together - Ask your students to communicate their result - Provide descriptive feedback for learners to improve their learning

Unit 4: Similarity of Figures (14 periods)

Learning Outcomes: At the end of this unit, learners will be able to:

- Explain the concept of similar figures and related terminologies
- Identify the condition for triangles being similar.
- Apply tests to check whether two given triangles are similar or not.
- Apply real-life situations in solving geometric problems

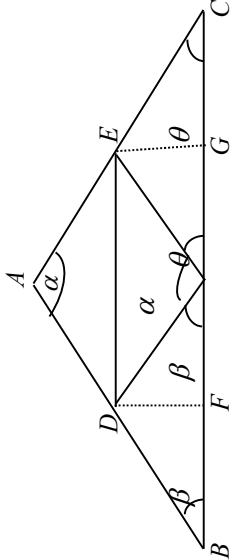
Competencies	Contents	Learning Strategies	Assessment
• Identify figures that are similar to each other • Apply the definition of similarity of two triangles to solve related problems.	4.1 Similar Plane Figures (8 periods) 4.1.1 Definition and Illustration of Similar Figures 4.1.2 Similar Triangles	• Aware the students about the concept of similar figures by using models of figures or objects like: photographs, polygons having the same shape but not necessarily the same size. • Assist students in groups to draw different pairs of similar figures and to give examples of similar figures from their everyday life. • Help the students to discuss in groups and communicate the following as Critical Thinking: In two similar triangles: ◦ the measures of their corresponding angles are equal, and ◦ the lengths of their corresponding sides are proportional. • Critical Thinking: Assist students to realize that it is not necessary to compare the two conditions; the two conditions are equivalent. • Students should aware that the symbol $\sim$ means “is similar to.” Two similar triangles $\triangle PQR \sim \triangle STU$ can be written as: $\triangle PQR \sim \triangle STU$.  If $\triangle PQR \sim \triangle STU$ then $\angle P \cong \angle S, \angle Q \cong \angle T, \text{ and } \angle R \cong \angle U, \text{ and}$ $\frac{PQ}{ST} = \frac{QR}{TU} = \frac{PR}{SU}$ • Assist students to solve problems like, Given $\triangle PQR \sim \triangle STU$, and $PQ = 6$ cm, $TU = 3$ cm, $PR = 12$ cm, and $SU = 4$ cm then find all sides of $\triangle PQR$ and $\triangle STU$? $\frac{PQ}{ST} = \frac{QR}{TU} = \frac{PR}{SU} \Rightarrow \frac{6}{ST} = \frac{QR}{3} = \frac{12}{4} = 3$ $\Rightarrow ST = 2$ cm and $QR = 9$ cm	• Ask students to identify the similarity of two given figures • Ask students to explain the concept of similar figures • Ask students to solve problems using two similar triangles • Provide descriptive feedback for learners to improve their learning

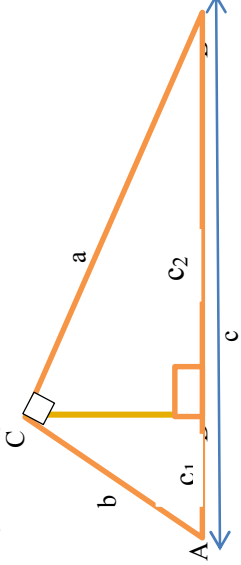
Competencies	Contents	Learning Strategies	Assessment
Determine the similarity of two triangles	4.1.3 Tests for similarity of triangles (AA, SSS, and SAS)	- Guide the students to answer the following: In the triangles $\triangle PQR$ and $\triangle STU$, if $\angle P \cong \angle S$, and $\angle Q \cong \angle T$. What must be true about $\angle R$ and $\angle U$? Why? Critical Thinking: Help students in groups to draw a triangle $\triangle PQR$. Use a compass and straightedge to construct a second triangle, $\triangle STU$, with $\angle P \cong \angle S$, and $\angle Q \cong \angle T$. Are your triangles similar? Explain. This answer the AA similarity. Critical Thinking: Help students in groups to construct another pair of triangles so that the side lengths of one triangle are a multiple of the side lengths of the other. Compare the corresponding angles of your triangles. Your work in this investigation should support SSS similarity conjecture. Note: If AA is a similarity shortcut, then so are ASA, SAA, and AAA, because each of those shortcuts contains two angles. That leaves SAS and SSA as possible shortcuts. In the next investigation, you will look at SAS. Critical Thinking: Help students in groups to construct two different triangles that have two pairs of sides proportional and the pair of included angles equal in measure. Can you do it? Your findings should support SAS similarity conjecture.	- Ask students to describe each of the similarity tests of triangles AA, SSS, and SAS - Ask students to determine the similarity of two triangles by using the SSS, SAS and AA similarity tests for triangles - Provide descriptive feedback for learners to improve their learning
- Explain the relation between the perimeters of two similar triangles - Explain the relation between the areas of two similar triangles	4.2 Perimeter and Area of Similar Triangles (6 periods)	- Help the students to revise the formula for perimeters and areas of triangles; and find perimeters and areas of two similar triangles and their ratios of the perimeters and areas. Critical Thinking: Help students in groups to conclude "the ratio of the perimeters of two similar triangles is equal to the ratio of their corresponding sides" and "The ratio of the areas of two similar triangles is equal to the square of the ratio of their corresponding sides."	- Ask students to relate the perimeters of two similar triangles - Ask students to relate the areas of two similar triangles - Provide descriptive feedback for learners to improve their learning

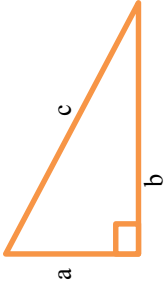
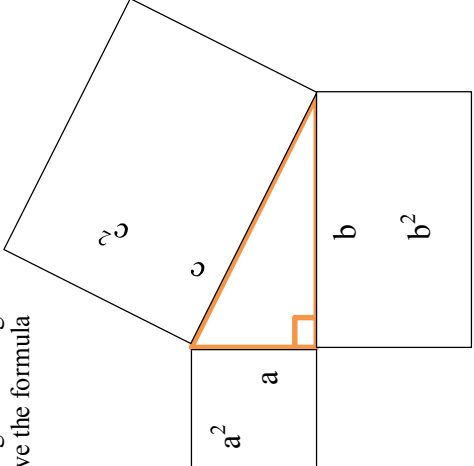
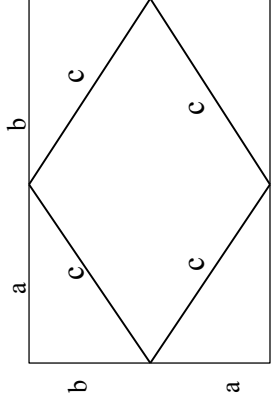
Unit 5: Theorems on Triangles (15 periods)

Learning Outcomes:- At the end of this unit, learners will be able to:

- Explain basic concepts about right angled triangles
- Apply some important theorems on right angled triangles.
- Apply real-life situations in solving geometric problems.

Competencies	Contents	Learning Strategies	Assessment
• Describe the angle sum theorem of a triangle • Apply the angle sum theorem of a triangle in solving related problems.	5.1 The three angles of a triangle add up to 180° (2 periods)	• Guide the students in group work to draw any triangle, cut it out carefully, tear the vertices off and fit them together. Based on the result lead them to communicate their result that the sum of the measures of interior angles of a triangle is 180°. • Another activity for group of students was, fold AB to get the mid-point at D and fold AC to get the mid-point at E. From D and E draw perpendicular line to line segment BC. Fold inwards $\triangle ADE$ at line segment DE, $\triangle DBF$ at line segment DF and $\triangle CEG$ at line segment EG. The three angles α, β and θ added together are seen to form a straight line on the base, that is, they are equal to 180°. 	• Ask students to describe the angle sum theorem of a triangle • Ask students to prove the sum of the measures of interior angles of a triangle is 180° using paper folding • Ask students to solve problems using the angle sum theorem of a triangle • Provide descriptive feedback for learners to improve their learning
• Describe the relation between the exterior angle and the two remote interior angles of a triangle. • Prove the exterior angle of a triangle equals the sum of the two remote interior angles	5.2 The exterior angle of a triangle equals the sum of the two remote interior angles. (3 periods)	• Assist students to prove that the sum of degree measure of interior angles of a triangle is 180° based on the knowledge of alternate interior angles and the measure of straight angle which is 180°. • Finally, guide the students to find the unknown angle of a triangle by applying the angle sum theorem of a triangle. • Encourage the students to prove the exterior angles theorem of a triangle by using the knowledge of angle sum theorem of a triangle and the measure of straight angle. • Finally, guide the students to determine unknown interior or exterior angle of a triangle by applying the exterior angle theorem of triangle.	• Ask students to describe the exterior angle and the two remote interior angles of a triangle • Ask students to prove the exterior angle of a triangle equals the sum of the two remote interior angles • Ask students to solve problems using the exterior angle theorem of triangle

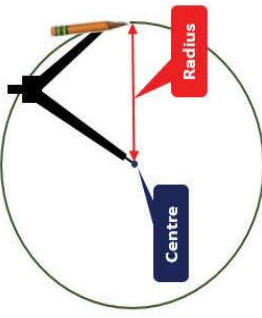
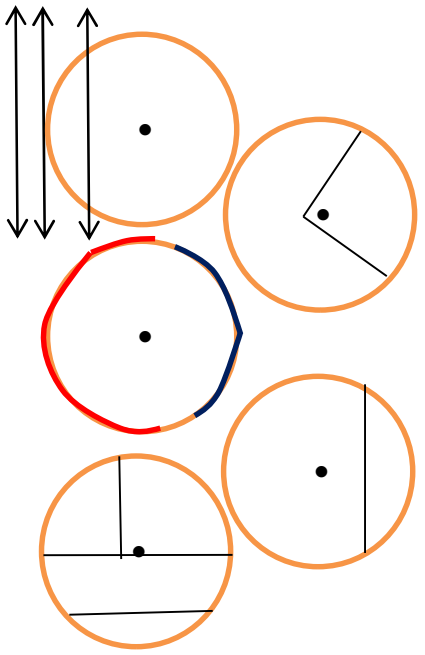
Competencies	Contents	Learning Strategies	Assessment
- Describe the right angle triangle, the altitude and hypotenuse - Apply Euclid's theorem and its converse for solving related problems	5.3 Theorems on the right angled triangle (10 periods) 5.3.1 Euclid' Theorem and its Converse	- Start the lesson by considering a right angled triangle $\triangle ABC$ and CD is its altitude, and the altitude divides $\triangle ABC$ in to two right angled triangle  - Guide students to find similar triangles from $\triangle ABC$ with the other two triangles formed and have the following similarities i) $\triangle CBD \sim \triangle ABC$... (by AA similarity test) $\frac{CB}{AB} = \frac{BD}{BC} \Rightarrow \frac{a}{c} = \frac{c_2}{a} \Rightarrow a^2 = cc_2$ ii) $\triangle ACD \sim \triangle ABC$ - (by AA similarity test) $\frac{AC}{AB} = \frac{AD}{AC} \Rightarrow \frac{b}{c} = \frac{c_1}{b} \Rightarrow b^2 = cc_1$ - Following this you can state the Euclid's Theorem and its converse - Encourage students to apply the theorem in exercises like: Example. DABC is a right angled triangle with hypotenuse AB, and altitude CD to AB. If AD = 4 cm, DB = 5cm, find the lengths of AC and BC Critical Thinking: Similarly you can give examples to illustrate the converse of the theorem.	- Provide descriptive feedback for learners to improve their learning - Ask students to describe the right angle triangle, the altitude and hypotenuse - Ask students to solve problems using Euclid's theorem and its converse - Provide descriptive feedback for learners to improve their learning
- Derive the Pythagoras theorem by using Euclid's theorem and paper folding - Apply Pythagoras' Theorem and its converse for solving related problem.	5.3.2 The Pythagoras' theorem and its converse	- Help students to revise Euclid's Theorem - Assist students to use the Euclidean relation to derive the Pythagorean relation and then state the theorem. - Guide students to derive the Pythagoras formula by different approaches: Let consider the right angle triangle in paper folding seen below	- Ask students to derive the Pythagoras theorem by using Euclid's theorem and paper folding - Ask students to solve problems using Pythagoras' Theorem and

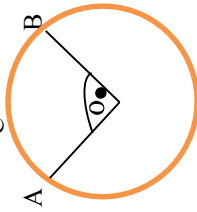
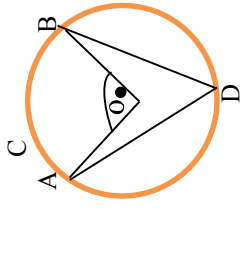
Competencies	Contents	Learning Strategies	Assessment
		 Arrange the triangle in the form of A and B and derive the formula A)  B) 	its converse Provide descriptive feedback for learners to improve their learning
		Encourage students to apply the "Pythagoras" Theorem to solve a real world problem.	

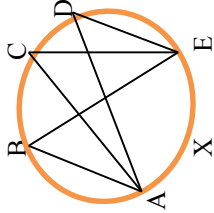
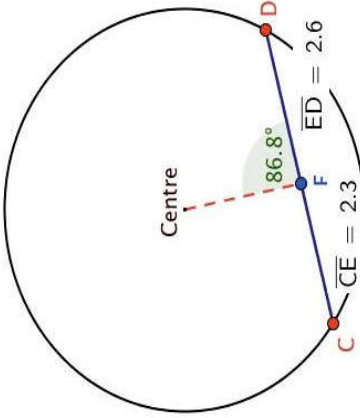
Unit 6: Lines and Angles in a Circle (17 periods)

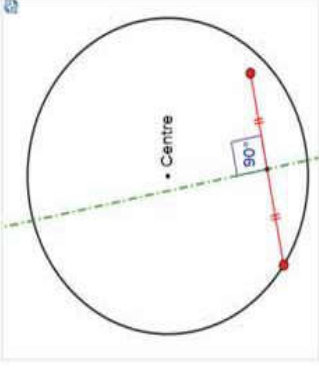
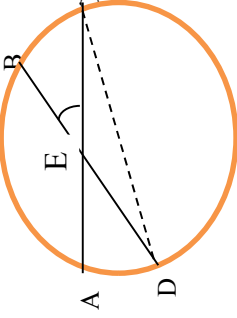
Learning Outcomes: At the end of this unit, learners will be able to:

- Have a better understanding of circles
- Realize the relationship between lines and circles
- Apply basic facts about central and inscribed angles and angles formed by intersecting chords to compute their measures.
- Apply real-life situations in solving geometric problems

Competencies	Contents	Learning Strategies	Assessment
• Identify the different types of arcs, sectors, segments • Describe the concepts "tangent" and "secant" of a circle.	6.1 Circles (15 periods) 6.1.1 Lines and Circles	• Use a compass to draw a circle.  • Guide students to differentiate by giving examples between ○ Radius, diameter, chord, secant and tangent of a circle. ○ Minor and major arc of a circle. ○ Minor and major sector. ○ Minor and major segment of a circle. 	• Ask students to describe the concepts in a circle. • Ask students to identify major arc and minor arc. • Ask students to identify major and minor sector of a circle. • Ask students to identify major and minor segment of a circle. • Ask students to describe the concepts "tangent" and "secant" of a circle. • Provide descriptive feedback for learners to improve their learning

Competencies	Contents	Learning Strategies	Assessment
- Describe the central angles and inscribed angles - Find the measure of central angle or inscribed angle or the intercepted arc based on the given information.	6.1.2 Central angle and inscribed angle	- Guide students to relate the central angle with the arc subtending it.  $m(\angle AOB) = m(\widehat{ACB})$ Critical Thinking: After introducing the meaning of inscribed angle, encourage the students to measure the central angle and the inscribed angle subtended by the same arc and conclude that - The measure of the inscribed angle is half of the measure of central angle - The measure of the inscribed angle is half of the measure of the arc subtends it.  $m(\angle ADB) = \frac{1}{2} m(\angle AOB)$ $m(\angle ADB) = \frac{1}{2} m(\widehat{AOB})$	- Ask students to describe the central angles and inscribed angles. - Ask students to identify central angles and inscribed angles. - Ask students to find the measure of central angle or inscribed angle or the intercepted arc based on the given information.. - Provide descriptive feedback for learners to improve their learning

Competencies	Contents	Learning Strategies	Assessment
		Critical Thinking: Let students relate inscribed angles subtended by the same arc. i.e. $m(\angle ABE) = m(\angle ACE) = m(\angle ADE)$ $= \frac{1}{2}m(\widehat{AXE})$ 	
		Project as a critical thinking: This investigation is about a line drawn from the centre to a chord. <i>Drag the point E.</i> What do you notice about the length of CE and DE when the angle is 90°? Change the chord by dragging C and D and repeat the process.  Complete the statement: If the angle is 90° then $CE = \dots$ Drag the point E in the previous sketch. What do you notice about the angle if $CE = DE$? Project as a critical thinking: What do you notice about the perpendicular bisector when both of the red points are on the circle (when the red line is a chord)?	

Competencies	Contents	Learning Strategies	Assessment
- Describe the angle formed by two intersecting chords - Solve problems related to angle formed by two intersecting chords inside a circle.	6.1.3 Angles formed by two intersecting chords	 We refer to a new discovery such as: <i>If the perpendicular bisector of a chord is drawn, then it passes through the centre of the circle.</i>	- Ask students to describe the angle formed by two intersecting chords. - Ask students to prove that an angle formed by two chords intersecting inside a circle is equal to half the sum of the intercepted arc by measurement. - Ask students to solve problems related to angle formed by two intersecting chords inside a circle. - Provide descriptive feedback for learners to improve their learning
		- Assist students to conclude the following as discovery: - The centre of a circle is on the perpendicular bisector of any chord, therefore their intersection point is the centre. - The perpendicular bisectors of the sides of a triangle meet at the centre of the circumscribed circle. - The angle subtended by an arc at the centre of a circle is double the size of the angle subtended by the same arc at the circle. - The angle subtended on the circle by the diameter is always 90°. Critical Thinking: Given the circle below and lead the students  - To connect D & C using ruler	

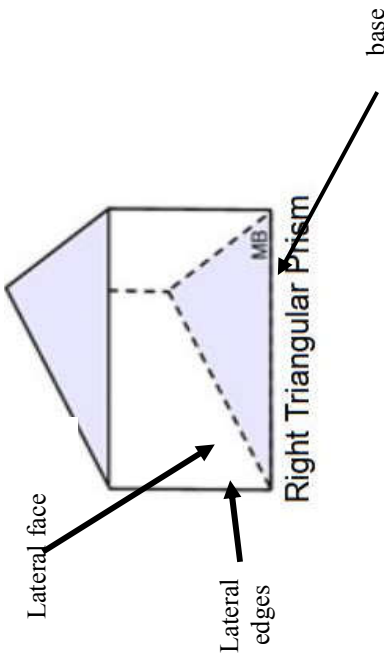
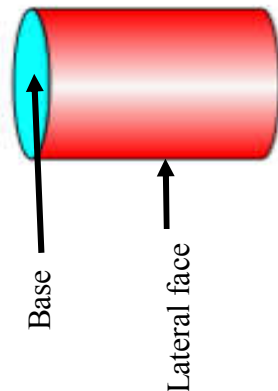
Competencies	Contents	Learning Strategies	Assessment
		2. To measure $\angle ACD$ and $\angle BDC$ using protractor 3. Based on step 2 ask them to write the measures of $\widehat{AD}$ & $\widehat{BC}$ 4. To measure $\angle BEC$ 5. To relate $m(\angle BEC)$ with the sum of $m(\widehat{AD})$ & $m(\widehat{BC})$ That is $m(\angle BEC) = \frac{1}{2}[m(\widehat{AD}) + m(\widehat{BC})]$	
Solve the application problems	6.2 Applications of Circle (2 periods)	Assist students to work in groups and communicate the results of the real-life applications in nature surrounding humans, technology, architecture, and mappings.	- Ask group of students to solve the real-life application problems in terms of geometry. - Observe students while they are working together - Ask your students to communicate their result - Provide descriptive feedback for learners to improve their learning

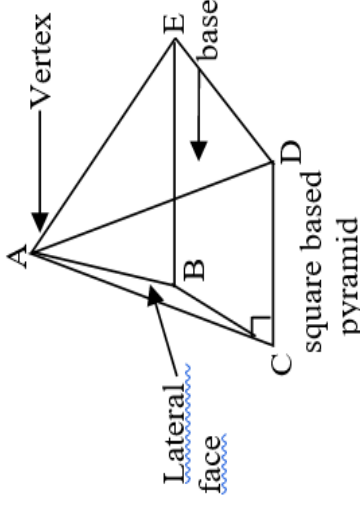
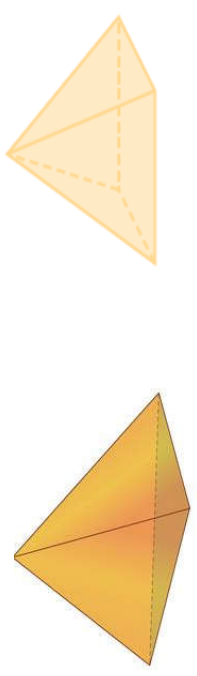
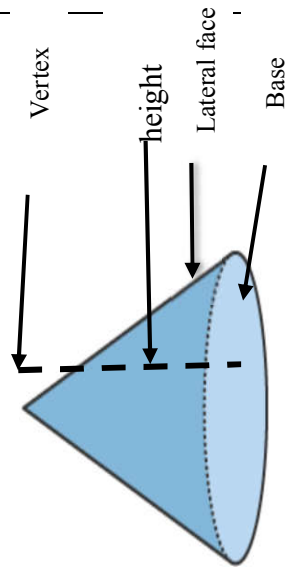
Unit 7: Solid Figures and Measurement (20 periods)

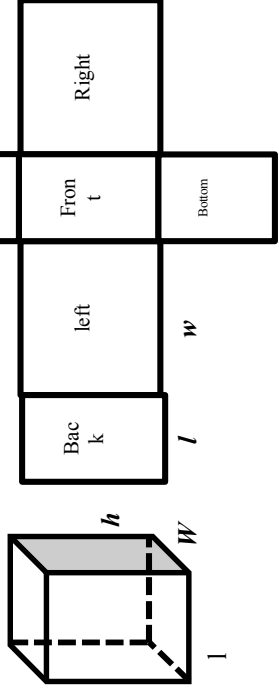
Learning Outcomes: At the end of this unit, learners will be able to:

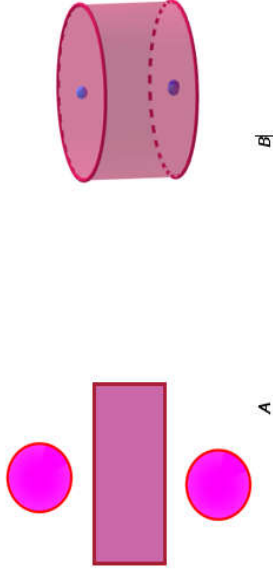
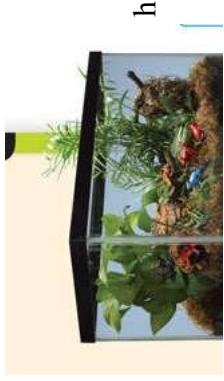
- Identify parts of solid figures
- Find the surface area of solid figures
- Find the volume of solid figures
- Solve applications of solid figures and measurements

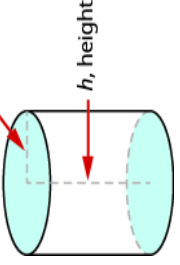
Competencies	Contents	Learning Strategies	Assessment
- Identify parts of a prisms, cylinders, pyramid and cones - Name different types of prisms, cylinders, pyramid and cones based on their bases.	7.1 Solid Figures (4 periods) 7.1.1 Prisms and Cylinders	- Divide students into small groups and let them to mention different objects having the shape of prisms by showing models of prisms and net of prisms. - Encourage students to identify bases, edge, vertices and faces of prisms from the model. - Encourage the students to define a prism as follows, A prism is a three-dimensional solid figure with two parallel faces, called bases, that are congruent triangle, square and rectangle, lateral edges and	Ask questions and let some students to identify parts prisms and cylinders by net of prisms and cylinders. a) using Geogebra Software

Competencies	Contents	Learning Strategies	Assessment
		lateral flat face which are rectangles in a right prism. The prism takes its name from the name of the base  Right Triangular Prism • Divide students into small groups and let them to introduce different types of prisms like rectangular prisms, square prisms and conclude that when the base is a circle the prism becomes cylinder.	b) using manually. • Provide constructive feedback for learners to improve their learning. ➤ Give project on the parts of prisms and cylinders and the teacher checks the performance of students.
	7.1.2 Pyramids and Cones	 We can see here that the net of a rectangular prism is made from six rectangles. • Divide students into small groups and let them to mention different objects having the shape of pyramid by showing models of pyramid. • Encourage students to identify vertex, edge and faces of pyramids from the model.	• Ask questions and let some students to identify parts Pyramids and Cones by net of Pyramids and Cones

Competencies	Contents	Learning Strategies	Assessment
		- Encourage the students to define a pyramid as follows, A pyramid is a solid defined by a base and a point, called an apex, not on the base. The pyramid takes its name from the name of the base.  square based pyramid - Divide students into small groups and let them to introduce different types of pyramids like triangular pyramid, rectangular pyramid and conclude that when the base is a circle the pyramid becomes a cone.  	a) using Geogebra Software b) using manually. - Provide constrictive feedback for learners to improve their learning. - Give project on the parts of Pyramids and Cones and the teacher checks the performance of students

Competencies	Contents	Learning Strategies	Assessment
		Divide students into small groups and let them to derive the surface area formula of right prism by using net of prisms. Eg. Rectangular prism 	- Ask questions and let some students how to derive the surface area formula of cylinder by net of cylinder. - using Geogebra Software - using manually. - Provide constructive feedback for learners to improve their learning. - Give project on the surface area of cylinder and the teacher checks the performance of students.
Find the surface area of prisms and cylinders	7.2 Surface Area and Volume of Solid Figures (13 periods) 7.2.1 Surface Area of Prisms, Pyramid and Cylinder	- Guide the students to see the net of a rectangular prism is made from six rectangles, and the front and the back are the same, the right side and the left side are the same, and the top and the bottom are the same - Area of front = Area of back = lh - Area of left = Area of Right = wh - Area of top = Area of bottom = lw - Lateral surface Area (A_L) = Sum of areas of lateral faces = Area of front + Area of back + Area of left + Area of right = $lh + lh + wh + wh$ = $2lh + 2wh$ = $2h(l + w)$ OR = $h \times 2(l + w)$ = ph (p = perimeter of the base) Total surface Area (A_T) = $A_L + 2A_B$ = lateral surface area + Area of two bases (upper & lower) = $2lh + 2wh + 2lw$ = $2(lh + wh + lw)$ $\therefore$ Total surface area = $A_L + 2A_B$	

Competencies	Contents	Learning Strategies	Assessment
		- Let students use the same formula for finding A_l of triangular prism. - Encourage students to apply the formula for computing the surface area of different prism. - Divide students into small groups and let them to derive the surface area formula of cylinder. - First let students to cut a cylinder vertically. Then its lateral surface gives rectangle with $2\pi r$ by h and 2 base area with πr^2.  $A_l = 2\pi r \times h = 2\pi rh$ $A_T = A_l + 2A_B$ $A_T = (\text{Circumference of bases}) \times \text{height} + 2(\text{Area of bases})$ $A_T = 2\pi rh + 2\pi r^2$ $A_T = 2\pi r(h + r)$ - Encourage students to apply the formula for computing the surface area of cylinder.	
Find the volume of prisms and cylinders	7.2.2 Volume of Prisms and Cylinders	Encourage students to elaborate a common volume formula for the right prisms  $V = \text{Base Area} \times \text{height}$ $V = A_B h$	- Ask questions and let some students how to derive the volume of prisms and cylinder by net of prisms and cylinder. a) using Geogebra Software b) using manually. - Provide constructive feedback for learners to improve their learning. - Give activity on the

Competencies	Contents	Learning Strategies	Assessment
		• Guide students to reach the conclusion that a cylinder is a circular prism. Thus, its volume can be found using same formula as all prisms  $V = A_B h$ But its base is a circle, $A_B = \pi r^2$ $V = \pi r^2 h$ • Guide students to apply the formula for computing the volumes of prisms and cylinder • Encourage the students to use the knowledge of geometry and measurements in fencing off an area to plot a crop, Planning the construction of a house, building a swimming pool, fill up your vehicle, the volume of gasoline your gas tank holds determines your purchase	volume of prisms and cylinder and the teacher checks the performance of students.
• Solve applications of solid figures and measurements	7.3 Applications on Solid Figures and Measurements (3 periods)	Give applicable problems in the area of Fencing off an area to plot a crop, Planning the construction of a house, building a swimming pool and Fuelling Up, when you fill up your vehicle, the volume of gasoline your gas tank holds determines your purchase.	• Ask group of students to work the application problems. • Observe students while they are working together • Ask your students to communicate their result • Provide descriptive feedback for learners to improve their learning

Unit 8: Introduction to Probability (14 periods)

Learning Outcomes: At the end of this unit, learners will be able to:

- Understand the concept of probability
- Find event, sample space and probability of simple events.
- Apply problems of real-life situations in solving the probabilities

Competencies	Contents	Learning Strategies	Assessment
• Describe the concepts of probability	8.1 The Concept of Probability (4 periods)	• Start the lesson by providing the application of the unit. • Assist students to use internet and describe the basic concepts of probability such as experiment, trial, outcomes, and event. An experiment is an activity involving chance in which results are observed. Each observation of an experiment is a trial, and each result is an outcome, the set of all possible outcomes of the experiment is the sample space of the experiment. A set of one or more outcomes is an event. If the event is not likely to occur, the probability of the event is close to 0. If an event is likely to occur, the event's probability is closer to 1. Impossible Unlikely As Likely as Not Likely Certain 0 $\frac{1}{2}$ 1 • Assist students to give real-life examples of certain and impossible outcomes. • Project as a critical thinking: Assist group of the students to experiment the tossing of coins repeatedly (say up to 20, 30, 50, ...) and register the outcomes. What do a group of students suggest the number of observing or getting head or tail?	• Ask students to identify certain, uncertain and impossible outcomes • Ask students to identify experiment, trial, event and sample space • Ask students to solve real-life applications of examples of certain and impossible outcomes. • Provide descriptive feedback for learners to improve their learning
• Find the probability of simple events	8.2 Probability of Simple Events (7 periods)	• From the above experiment, students discuss to derive the formula of the probability of a simple event as: $P(\text{Event}) = \frac{\text{Number of times the event occur}}{\text{Total number of equally likely possible outcomes}}$ $= \frac{n(E)}{n(S)}$ • Assist students to determine the probabilities of simple events, Example: Two coins are tossed. What is the probability that both land heads up?	• Ask group of students to derive the probability of simple Events • Ask students to find the probability of simple events • Ask students to solve real-life applications of probability of simple events. • Provide descriptive

Competencies	Contents	Learning Strategies	Assessment
			feedback for learners to improve their learning
		Because either coin can land heads up or tails up, the possible outcomes are as follows. HH = heads up on both coins HT = heads up on first coin and tails up on second coin TH = tails up on first coin and heads up on second coin TT = tails up on both coins So, the sample space is $S = \{HH, HT, TH, TT\}$. The event is $E = \{HH\}$. $P(E) = \frac{n(E)}{n(S)} = \frac{1}{4}$ Assist students to give real-life examples of finding the probability of an event.	
Solve the probability of real-life problems	8.2 Applications on Business, Climate, Road Transport accidents, and Drug Effects (3 periods)	Assist students to work in groups and communicate the results of the real-life applications in weather forecasting, insurance, car accident, drug usage by taking real data from the concerned offices.	- Ask group of students to solve the probability of real-life application problems. - Observe students while they are working together - Ask your students to communicate their result - Provide descriptive feedback for learners to improve their learning

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