

UNIT 8

Introduction to Probability

Total Allotted period: 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

Introduction

It is quite common phenomena to relate success or failure in one thing with luck or chance. Trying to determine how likely something can occur is useful in applications. For such purpose, discussing probability is essential which will help represent such concepts as chance or luck mathematically. In this unit, students will discuss introductory concepts of probability starting from the definition of basic terms and real-life applications.

Suggested teaching aids

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, it is recommended that you might use models, fair dice, different coins and slip of paper for probability.

8.1. The concepts of probability

Period Allotted: 4 periods

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

Describe the concepts of probability.

This sub-unit begins with discussing the definition of basic terms of probability, which are experiment, sample space, event, certain event and impossible outcomes. Finally, dear teacher should make sure that students are using the activities, group work, and challenge problem of the textbook. To stabilize the lesson taught in each sub- unit

Teaching notes

Under each sub-topic, a hint given how to continue each sub-topic but your creativity is very crucial. 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.

Probability is a number that reflects the chance or likelihood that a particular event will occur. Probability can be expressed as proportions that range from 0 to 1, and they can also be expressed as percentages ranging from 0% to 100%. A probability 0 indicates that there is no chance that a particular event will occur; whereas probability of 1 indicates that an event is certain to occur

Established, more emphasis will be given to the different methods of finding the Probability of an event. While discussing an experiment, it is essential for the students to realize that the outcome of an experiment (if conducted randomly) is not known. Thus, the probability of an event under such a condition will be determined only after the experiment is conducted at full scale. As an implicit concern, however, after the students are made clear with the notions of experiment, sample space and event, the notion of probability of an event established under a random experiment

with equally likely outcomes can be known before conducting the experiment or even without conducting the experiment. In order to assist students, reach such an understanding, it is recommended to let them do Group Work 8.1 first.

Answer for Group work 8.1

In each of the first three experiments, the result or outcome is certain, and known in advance. That is, in experiment (a), the ball is certain to touch the earth and in (b) the sugar will certainly dissolve in milk and in (c) the petrol is sure to burn. But in the experiments d – e the results are uncertain. For example, when a coin is tossed everyone knows that there are two possible outcomes namely head and tail but no one could say with certainty which of the two possible outcomes will be obtained. In all, such experiments, that there is an element of chance, called probability which express the element of chance numerically. The occurrence or non-occurrence of things is studied in mathematics by the theory of probability. The theory of probability was introduced to give quantification to the possibility of certain outcome of the experiment in the face of uncertainty. Governments, scientists, insurance company, use probability

After Group work 8.1, you can formally write the definition of an experiment, a sample space and an event as stated in the student textbook. One important point in the discussion made so far is that the proportions or the probabilities could be identified only after the experiment is conducted. Once an experiment is performed, it will be thus possible to determine the probability. For this purpose, let each student do Exercise 8.1

Answer for Exercise 8.1

1.
 - a) An activity involving chance in which results are observed is called an experiment.
 - b) The set of all possible outcomes of an experiment are called possibility set.
 - c) Any sub set of outcomes of the experiment is called an event
2.
 - a) Select one card randomly from the cards

- b) The sample space $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
- c) The card numbered with $\{1, 3, 5, 7, 9\}$

Answer for Activity 8.1

- 1. a) It is always happen (Certain)
b) It is impossible
- 2. a) Certain
b) Certain
c) Impossible

Answer for Exercise 8.2

- 1. Choosing a yellow chocolate is impossible because there is no yellow chocolate in a glass jar
- 2. B
- 3. a) Impossible
b) Certain
c) Certain

Answer for Exercise 8.3

- 1. a) In rolling a dice, you will get 7 and When water boils it changes to milk
b) In tossing a coin, you will get H or T and You will be die.
c) Throwing a single die can produce six possible outcomes. All six outcomes are assumed equally likely. For any number of dice, the six faces are assumed equally likely to be produced and another example A cat is to chase a mouse.
d) Your hair would grow 3 inches longer by tomorrow and A cat is to chase a dog.
e) you will buy a new pair of shoes soon and A newly born baby will be a girl.

2. a) even chance

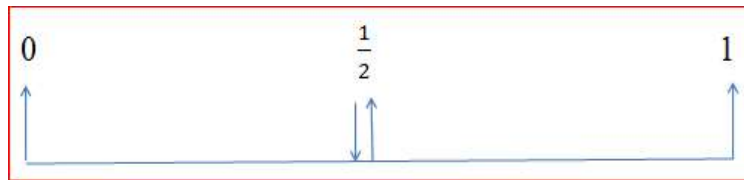


Figure 8.1

b) This will depend on the weather condition in July, it is reasonable to say it will rain at least one day on July in Addis Ababa is more likely.

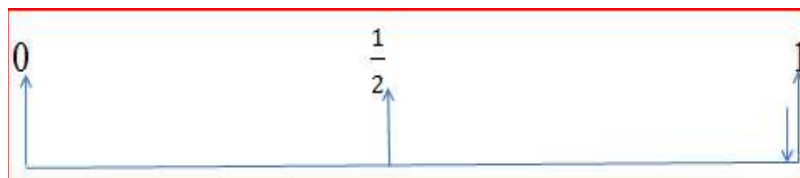


Figure 8.2

c) You will win a lottery is more unlikely the chance to win is closer to 0

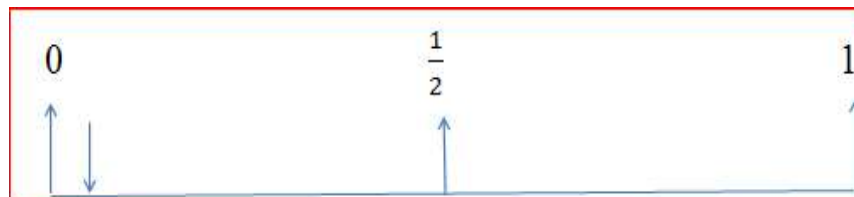


Figure 8.3

d) In a fair dice each face have equally likely to occur you expect from dice six equally likely

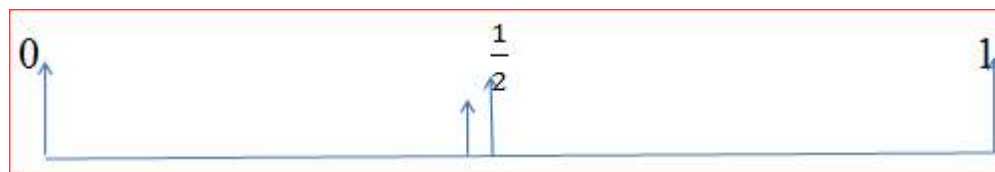
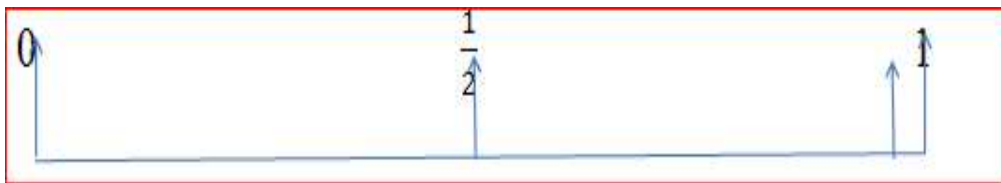


Figure 8.4

e) The probability of this is certain, as you can expect there to be birth day in this year.



Assessment

You can assess students while they conduct experiments by way of asking them different oral questions such as: If you keep on doing an experiment of tossing a coin one hundred times how many times do you expect head to show up? You can also give Exercise 8.4 as a group work so that students can present their work. Or as this is the end of the sub- unit, you can give test/quiz to assess students learning and understanding.

Additionally ask your students the following question

- ❖ Ask students to identify certain, uncertain and impossible out comes
- ❖ Ask students to identify experiment, trial, event and sample space
- ❖ Ask students to solve real-life applications of examples of certain and impossible out comes.
- ❖ Provide descriptive feedback for learners to improve their learning

For slow learner students

Choose the correct answer from the given alternatives

1. Which one of the following best replaces the blank? 'A and B are playing tennis. The event of A or B winning the match is _____
 A, a likely event C, an unlikely event
 B, an unlikely event D, none
2. Teacher assigns home work after $\frac{7}{10}$ of the lessons
 A, unlikely B, likely C, Certain D, equally likely
3. There is a 0% chance that the earth is the closest planet to the sun
 A, unlikely B, likely C, Certain D, impossible

4. You miss a tree throw $\frac{3}{10}$ of the time
A, likely B, unlikely C, Certain D, equally likely
5. A bag contains 5 red balls and 3 green balls. If a ball is chosen at random from the bag, then which of the following is an impossible event.
A, Choosing a red ball B, Choosing a yellow ball
C, Choosing a green ball D, none
6. The measure of chance is known as
A) Geometry
B) statistics
C) probability
D) none of above
7. An event in the probability that will never be happened is called as -
A) Unsure event
B) Sure event
C) Possible event
D) Impossible event

For fast learner students

Choose the correct answer from the given alternatives

1. A teacher choosing one boy from a class of 19 girls is _____ event
A, a possible B, a certain C, an impossible D, none
2. Your hair would grow 3 inches longer by tomorrow is _____ events
A, a likely B, an unlikely C, equally likely D, a certain
3. You will eat tomorrow is _____ event
A, Certain B, an impossible C, possible D, none
4. Which of the following probability cannot exist?
A) $\frac{2}{5}$ B) -1.5 C) 7 D) None of the above

5. What will be the probability of an impossible event?
A) 0 B) 1 C) Infinity D) None of the above
6. Which of the following can be the probability of an event?
A) -1.3 B) 004 C) $\frac{3}{8}$ D) $\frac{10}{7}$
7. The probability of winning the first prize in a lottery of a girl is $\frac{8}{100}$. If the 6000 tickets are sold, then how many tickets the girl purchased?
A) 480 B) 750 C) 280 D) None of the above
8. What will be the number of events if six coins are tossed simultaneously?
A) 32 B) 128 C) 100 D) 64

8.2. Probability of Simple events

Period Allotted: 7 periods

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

- ❖ Find the probability of simple events.

Introduction

In this sub-topic, we will learn how to find the probability of a simple event.

The probability of an event is the likelihood of it occurring. When we discuss the likelihood of an event happening in everyday life, we may use some common words to describe this likelihood, for example, “certain”, “likely”, “very unlikely”, or “impossible”. In mathematics, we can assign a numerical value to a probability. Impossible events have a probability of zero, and events that are certain to happen have a probability of one. Events that are equally likely can be written with a probability of 0.5, or $\frac{1}{2}$. The sum of the probabilities of all possible outcomes must equal 1. For example, when flipping a coin, the probability of getting “heads” plus the probability of getting “tails” is one. This is because the probability of getting either one of heads or tails is certain, that is, a probability of one. In probability

terms, a simple event refers to an event with a single outcome, for instance, getting “heads” with a single toss of a coin, or rolling a four on a die

Teaching notes

Events are equally likely to happen:

- ❖ When there is a 50% chance of rain, that means that there a chance that it might rain, but that there is also a chance that it might not rain. These chances are the same so the event is equally likely to happen.
- ❖ When one rolls a game die, he/she has exactly the same chance of landing on any of the six sides. Therefore, the probability of landing on any one specific side would be $\frac{1}{6}$. This is also true for any spinner. Say a spinner is divided into 10 sections. Then there is an equally likely chance that the spinner can land on any of the sections. Thus, the probability for the spinner to land in any designated section is $\frac{1}{10}$.
- ❖ The probability of selecting one of the three doors on the game show is also equally likely. There is no bias over the contestant’s decision so each door has a probability of $\frac{1}{3}$ being chosen. This is true if there are no arrows pointing towards one of the doors.

Answer for Exercise 8.4

1. a) $P(E) = \frac{n(E)}{n(S)} = \frac{2}{6} = \frac{1}{3}$

b) $P(E) = \frac{n(E)}{n(S)} = \frac{1}{6}$

c) $P(E) = \frac{n(E)}{n(S)} = \frac{1}{6}$

d) $P(E) = \frac{n(E)}{n(S)} = \frac{2}{6}$

e) $P(E) = \frac{n(E)}{n(S)} = \frac{6}{6}$

2. a) $n(\text{ letters I}) = 2$ and $n(S) = 8$ therefore, $P(E) = \frac{n(E)}{n(S)} = \frac{2}{8} = \frac{1}{4}$
 b) $N(\text{Vowels}) = 5$ and $n(S) = 8$ therefore, $P(E) = \frac{n(E)}{n(S)} = \frac{5}{8}$
 c) $N(\text{ letters B}) = 0$ and $n(S) = 8$ therefore, $P(E) = \frac{n(E)}{n(S)} = \frac{0}{8} = 0$
3. The probability of zero means there is no chance to occur an event (impossible outcomes) and the probability of one means sure to occur (certain out comes).
4. A

Assessments

You should asses each student's work continuously over the whole periods and ask the following question

- ❖ 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 feedback for learners to improve their learning

Finally give the following additional exercise problems for slow learner students and for fast learner students

For slow learner students

I, choose the correct answer from the given alternatives

1. A bag contains 5 quarters, 2 dims, and 4 pennies, what is the probability of picking a quarters?
 A, $\frac{5}{11}$ B, $\frac{1}{3}$ C, $\frac{5}{6}$ D, 5
2. Find the experimental probability: Roll dice: 1, 3, 3, 4, 4 then $P(1)=$ ____
 A, $\frac{3}{5}$ B, $\frac{2}{5}$ C, $\frac{5}{6}$ D, $\frac{1}{5}$
3. If you cut a shuffled deck, what is the probability you will get an 8 of diamonds?
 A, $\frac{1}{4}$ B, $\frac{1}{52}$ C, $\frac{1}{13}$ D, $\frac{4}{52}$
4. Probability of a simple event is.

- A, what should happen B, what will happen
C, what does happen D, what I want to happen
5. A card is drawn from a pack of 52 cards. What is the probability of getting a queen card?
- A) $\frac{1}{26}$ B) $\frac{1}{52}$ C) $\frac{3}{13}$ D) $\frac{1}{13}$
6. A dice is rolled. The probability of getting a number x where $1 < x < 6$ is-
- A) Greater than 0
B) Greater than 1
C) Between 1 and 0
D) Equal to 1
7. Which of the following statement is not true about probability?
- A) The probability of an impossible event is zero.
B) Probability can be greater than one or less than zero.
C) Probability cannot be greater than one.
D) None of the above

Answer the following questions

8. A coin is tossed twice. Lists all the possible outcomes?
9. Two dice are rolled together. Lists all possible outcomes?
10. What is the probability of getting six on a roll of a pair of a dice?
11. What is the probability of rolling an even number on a die?
II. Choose the correct answer

For fast learner students

12. If you rolled a 6 sided dice, what is the probability of a rolling a 3?
- A, $\frac{1}{6}$ B, $\frac{2}{3}$ C, $\frac{3}{6}$ D, $\frac{5}{6}$
13. If you flipped 2 coins, what is the probability that both will land on tails?

A, $\frac{2}{4}$ B, $\frac{3}{4}$ C, $\frac{1}{4}$ D, $\frac{0}{4}$

14. A card is selected from a deck of playing cards, what is the probability of selecting a red card?

A, $\frac{1}{4}$ B, $\frac{3}{4}$ C, $\frac{0}{2}$ D, $\frac{1}{2}$

15. In a class, there are 12 boys and 16 girls. One of them is called out by an enrol number, what is the probability that the one called is a girl?

A, $\frac{1}{4}$ B, $\frac{2}{5}$ C, $\frac{5}{12}$ D, $\frac{4}{7}$

16. If two dice are thrown simultaneously, what is the probability of getting a multiple of 2 on one dice and multiple of 3 on the other dice?

A) $\frac{5}{4}$ B) $\frac{5}{12}$ C) $\frac{11}{36}$ D) $\frac{1}{2}$

17. A school has five houses named as A, B, C, D, and E. There are 23 students in a class in which 4 students are from house A, 8 students are from house B, 5 from C, 2 from D, and the rest from house E. Class teacher randomly selects a student to be the class monitor. What is the probability that the selected student is not from house A, B, and C?

A) $\frac{1}{23}$ B) $\frac{2}{23}$ C) $\frac{5}{23}$ D) $\frac{6}{23}$

Work out (show necessary steps)

18. Two dice are tossed, state the probability of each event

a) The sum is 7 b) The sum is 13 c) The sum is not 7

19. When 4 coins are thrown what is the probability of

a) 4 heads b) 2 heads and 2 tails c) at least one head

20. A coin is tossed and a die is rolled. What is the probability of obtaining

a) a head and a 6 c) a tail and an odd number

b) a head and an even number d) an even number

21. A machine used for a lottery has 10 balls. Each ball is marked with a different single digit from 0 to 9. One ball is randomly selected and the digit is the winning number. Use this data for question 1 to 6
- What is the probability that the number is greater than 6?
 - What is the probability that the number is 3?
 - What is the probability that the number is less than or equal to 3?
 - What is the probability that the number is odd?
 - What is the probability that the number is not 8?
 - What is the probability that the number is 4 or 7?

8.3. Applications on Business, Climate, Road Transport,

Accidents and Drug Effects

Period Allotted: 3 periods

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

- ❖ Solve the probability of real-life problems.

Answer for Review Exercise unit 8

- False b) True c) True d) False
- A probability experiment is a situation where chance affects the result of an experiment. If the experiment can only have two outcomes, it is named Bernoulli trial. A coin flip is a probability experiment because chance affects whether a coin will land heads or tails when it is flipped.
 - A sample space is a collection or a set of possible outcomes of a random experiment. The sample space is represented using the symbol, "S". The sample space of an experiment is the set of all possible outcomes of that experiment
 - The difference between an outcome and an event is - an event is the total number of outcomes whereas an outcome is the result of an event. Consider an event of rolling a die ·

Sample space = {1, 2, 3, 4, 5, 6} · Each no in the sample space is an outcome. There are six outcomes in this experiment

- d) Getting an even number on the toss of a die and getting an odd number on the toss of a die are equally likely events, since the probabilities of each event are equal.
- e) If an event cannot happen the probability of such an event is considered zero.

3. A

4. Sample space = {Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday}, $n(S) = 7$

a) $n(E) = 3$

$$P(E) = \frac{n(E)}{n(S)} = \frac{3}{7}$$

b) $n(E) = 8$

$$P(E) = \frac{n(E)}{n(S)} = \frac{8}{7}$$

c) $n(E) = 0$

$$P(E) = \frac{n(E)}{n(S)} = \frac{0}{7} = 0$$

5. $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30\}$

$n(S) = 30$

a) $E = \{6, 12, 18, 24, 30\}$, $n(E) = 5$

$$P(\text{A multiple of 6}) = \frac{n(E)}{n(S)} = \frac{5}{30} = \frac{1}{6}$$

b) $E = \{1, 4, 9, 16, 25\}$, $n(E) = 5$

$$P(\text{A perfect square}) = \frac{n(E)}{n(S)} = \frac{5}{30} = \frac{1}{6}$$

6. a) $S = \{H, T\}$, $n(S) = 2$

$E = \{H\}$, $n(E) = 1$

$$P(\text{getting heads}) = \frac{n(E)}{n(S)} = \frac{1}{2} = 0.5$$

$$b) \quad P(E) = \frac{1}{4}$$

$$7. \quad S = \{1, 2, 3, 4, 5, 6\}, n(S) = 6$$

$$a) \quad E = \{4\}, n(E) = 1$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{1}{6}$$

$$b) \quad E = \{2, 4, 6\}, n(E) = 3$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{3}{6} = \frac{1}{2}$$

$$c) \quad E = \{5, 6\}, n(E) = 2$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{2}{6} = \frac{1}{3}$$

$$d) \quad E = \{1, 2, 3, 4, 5, 6\}, n(E) = 6$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{6}{6} = 1$$

$$8. \quad a) \quad S = \{(1,1), (1,2), (1,3), (1,4), (1,5), (1,6), (2,1), (2,2), (2,3), (2,4), (2,5), (2,6), (3,1), (3,2), (3,3), (3,4), (3,5), (3,6), (4,1), (4,2), (4,3), (4,4), (4,5), (4,6), (5,1), (5,2), (5,3), (5,4), (5,5), (5,6), (6,1), (6,2), (6,3), (6,4), (6,5), (6,6)\}, n(S) = 36$$

$$b) \quad i) \quad E = \{(1,6), (2,5), (3,4), (4,3), (5,2), (6,1)\}, n(E) = 6$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{6}{36} = \frac{1}{6}$$

$$ii) \quad E = \{(1,1), (2,2), (3,3), (4,4), (5,5), (6,6)\}, n(E) = 6$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{6}{36} = \frac{1}{6}$$

$$iii) \quad E = \{(1,2), (1,4), (1,6), (3,2), (3,4), (3,6), (5,2), (5,4), (5,6)\}, n(E) = 9$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{9}{36} = \frac{1}{4}$$

$$iv) \quad E = \{(4,6), (5,5), (5,6), (6,4), (6,5), (6,6)\}, n(E) = 6$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{6}{36} = \frac{1}{6}$$

$$9. \quad S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18\}, n(S) = 18$$

$$a) \quad E = \{2, 4, 6, 8, 10, 12, 14, 16, 18\}, n(E) = 9$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{9}{18} = \frac{1}{2}$$

b) $E = \{3, 6, 9, 12, 15, 18\}$, $n(E) = 6$

$$P(E) = \frac{n(E)}{n(S)} = \frac{6}{18} = \frac{1}{3}$$

c) $E = \{2, 3, 5, 7, 11, 13, 17\}$, $n(E) = 7$

$$P(E) = \frac{n(E)}{n(S)} = \frac{7}{18}$$

d) $E = \{4, 8, 12, 16\}$, $n(E) = 4$

$$P(E) = \frac{n(E)}{n(S)} = \frac{4}{18} = \frac{2}{9}$$

10. $n(S) = 20$

a) $n(E) = 13$

$$P(E) = \frac{n(E)}{n(S)} = \frac{13}{20}$$

b) $n(E) = 0$

$$P(E) = \frac{n(E)}{n(S)} = \frac{0}{20} = 0$$

c) $n(E) = 20$

$$P(E) = \frac{n(E)}{n(S)} = \frac{20}{20} = 1$$

11. a) $n(S) = 16$

b) i, $P(E) = \frac{n(E)}{n(S)} = \frac{1}{16}$

ii, $P(E) = \frac{n(E)}{n(S)} = \frac{7}{16}$

iii, $P(E) = \frac{n(E)}{n(S)} = \frac{1}{4}$

iv, $P(E) = \frac{n(E)}{n(S)} = \frac{9}{16}$

12. $P(E) = \frac{n(E)}{n(S)} = \frac{7}{13}$

13. $\frac{3}{7}$

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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 $\mathbb{W}$, $\mathbb{Z}$ and $\mathbb{Q}$.
- 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 (37 periods)

Learning Outcomes: At the end of this unit, learners 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.

Grade 8

Learning objectives for Grade 8

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

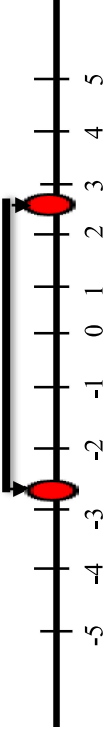
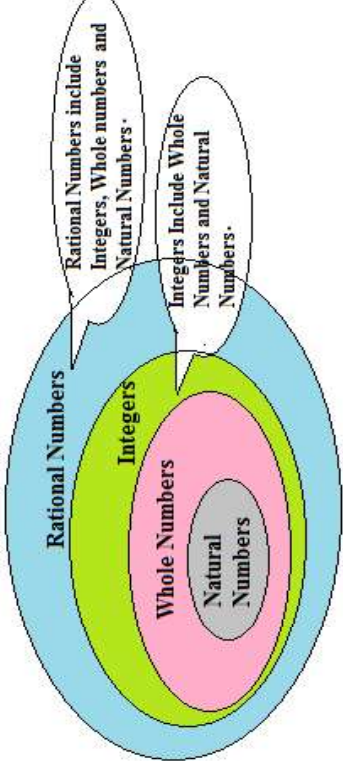
- Define and represent rational numbers as fractions
- Show the relationship among whole numbers, integers, and rational numbers.
- Apply operation of rational numbers
- Calculate the square and cube of rational numbers
- Determine square roots and cube roots of perfect squares and perfect cubes respectively.
- Extract approximate square roots of numbers by using the numerical table.
- Simplify algebraic expressions.
- Solve real life problems using variables.
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- 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 be able to:

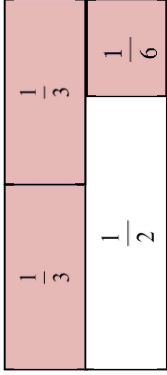
- Define and represent rational numbers as fractions
- Show the relationship among Natural numbers, whole numbers, integers, and rational numbers.
- Order rational numbers.
- Solve problems involving addition, subtraction, multiplication and division of rational numbers
- Apply rational numbers to solve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

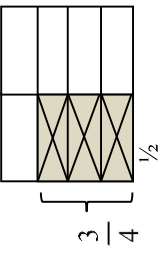
Competencies	Contents	Learning Strategies	Assessment
• Describe the concept of Rational Number practically • Express Rational numbers as fractions.	1.1 The Concept of Rational Numbers (6 periods)	• Encourage students to revise the order and representation of integers. • Divide students into small groups 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

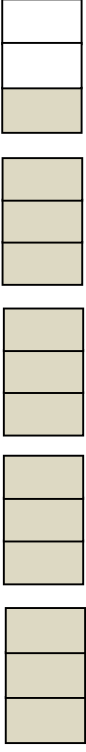
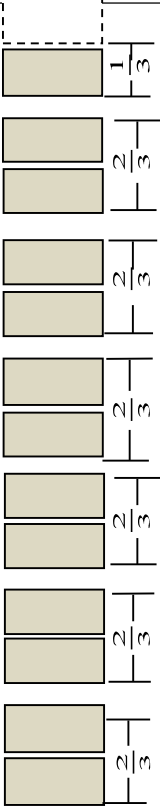
Competencies	Contents	Learning Strategies	Assessment
		 2. Analyze Relationships: If you plot the point -8.85 on a number line, would you place it to the left or right of -8.8? Explain.	feedback for learners to improve their learning.
Describe the relationship among the sets W, Z and Q	1.1.2 Relationship 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><td>Student</td><td>Rahel</td><td>Kassa</td><td>Tesfaye</td><td>Munih</td></tr></table>	Difference from Average Plant Growth					Student	Rahel	Kassa	Tesfaye	Munih	• 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	Munih									

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>$\frac{2}{8}$</td><td>$\frac{5}{8}$</td></tr></table>					$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{2}{8}$	$\frac{5}{8}$	• 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
$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$													
$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{2}{8}$	$\frac{5}{8}$													
	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 $-(-3 \times 4)$ 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 $\frac{1}{3}$ 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

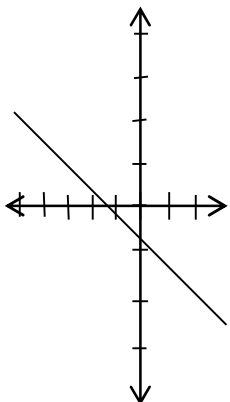
Competencies	Contents	Learning Strategies	Assessment
Calculate the square root of perfect squares.	2.1.3 Square Roots of a Rational Number 2.1.4 Use of table values and Scientific calculator to find square roots of rational numbers	- Assist students to use internet and explain the relation between squaring and extracting square root from the square with examples like $2 \text{ squared} = 2 \times 2 = 4$. 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, $\sqrt{100}$ $100 = 2 \times 2 \times 5 \times 5 = (2 \times 5) \times (2 \times 5) = 10 \times 10 = 10^2$ $\therefore \sqrt{100} = \sqrt{10^2} = 10$ - 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.

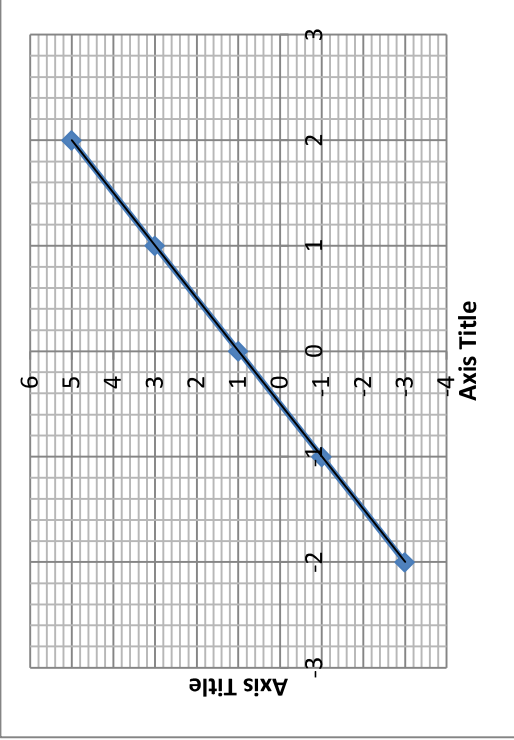
Competencies	Contents	Learning Strategies	Assessment
			Provide descriptive feedback for learners to improve their learning
		generalize, Observe the following pattern of sums of odd numbers. $1 = 1 = 1^3$ $3 + 5 = 8 = 2^3$ $7 + 9 + 11 = 27 = 3^3$ $13 + 15 + 17 + 19 = 64 = 4^3$ $21 + 23 + 25 + 27 + 29 = 125 = 5^3$ 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, $\sqrt[3]{-8} = \sqrt[3]{-2 \times -2 \times -2} = -2$.	
	2.2.2 Cube Root of a Rational Number	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
• Solve real-life problems	2.3 Applications on squares, square roots, cubes and cube roots (<i>3 periods</i>)		

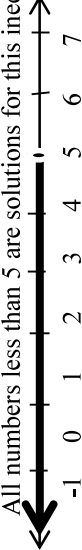
Unit 3: Linear equation and inequalities (21 periods)

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 Mathlab or Mathematica, etc and compare your result with manual drawing. Below is the graph of $y = 2x$ using computer Excel													

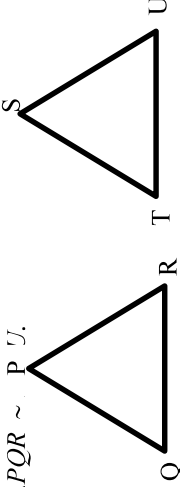
Competencies	Contents	Learning Strategies	Assessment
		 Assist students to discuss in groups and communicate to graph $y = 2x + 3$, $y = 3x + 5$. Observe that the natures of the graphs are similar.	
Solve linear inequalities	3.3 Solving Linear Inequalities <i>(8 periods)</i>	- Guide students to discuss 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

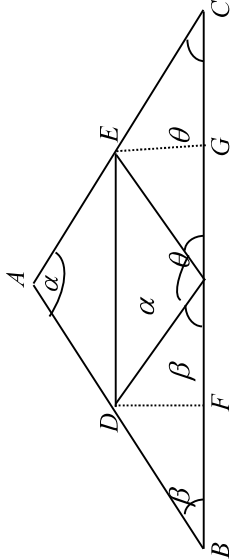
Competencies	Contents	Learning Strategies	Assessment
• Identify figures that are similar to each other • Apply the definition of similarity of two triangles to solve related problems.	4.1 Similar Plane Figures (8 periods) 4.1.1 Definition and Illustration of Similar Figures 4.1.2 Similar Triangles	• 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 $\angle P \cong \angle S$, $\angle Q \cong \angle T$, and $\angle R \cong \angle U$, 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

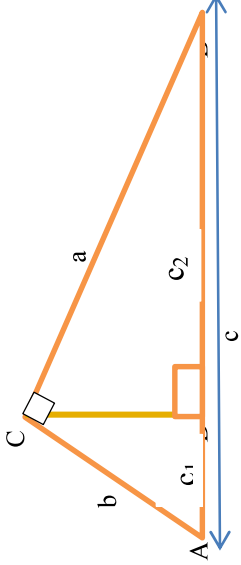
Competencies	Contents	Learning Strategies	Assessment
Determine the similarity of two triangles	4.1.3 Tests for similarity of triangles (AA, SSS, and SAS)	- Guide the students to answer the following: In the triangles $\triangle PQR$ and $\triangle STU$, if $\angle P \cong \angle S$, and $\angle Q \cong \angle T$. 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

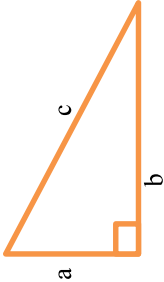
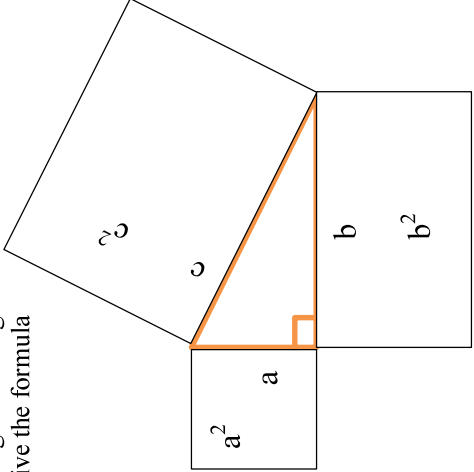
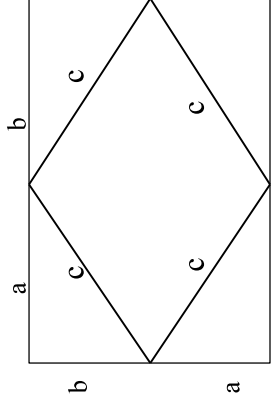
Unit 5: Theorems on Triangles (15 periods)

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 $\triangle ECG$ 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

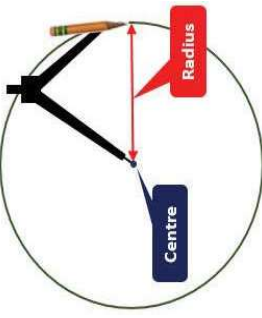
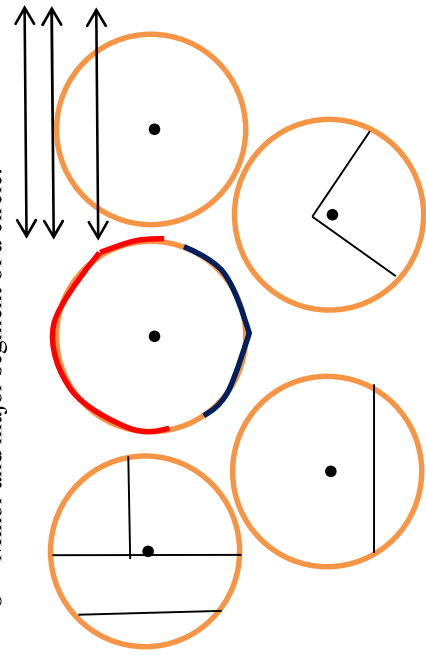
Competencies	Contents	Learning Strategies	Assessment
- Describe the right angle triangle, the altitude and hypotenuse - Apply Euclid's theorem and its converse for solving related problems	5.3 Theorems on the right angled triangle (10 periods) 5.3.1 Euclid' Theorem and its Converse	- Start the lesson 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. $\triangle ABC$ is a right angled triangle with hypotenuse AB, and altitude CD to AB. If $AD = 4$ cm, $DB = 5$ cm, 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

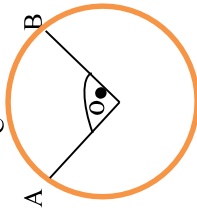
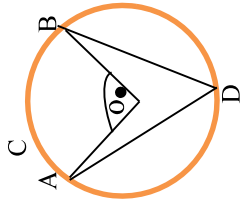
Competencies	Contents	Learning Strategies	Assessment
		 Arrange the triangle in the form of A and B and derive the formula A)  B) 	its converse Provide descriptive feedback for learners to improve their learning
		Encourage students to apply the "Pythagoras" Theorem to solve a real world problem.	

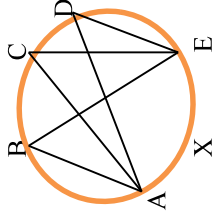
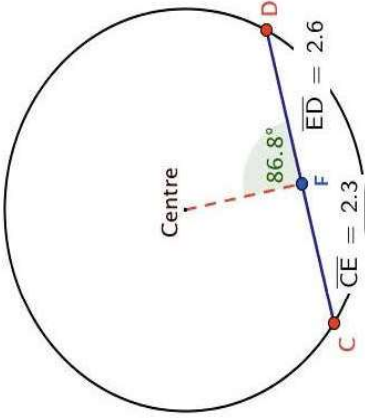
Unit 6: Lines and Angles in a Circle (17 periods)

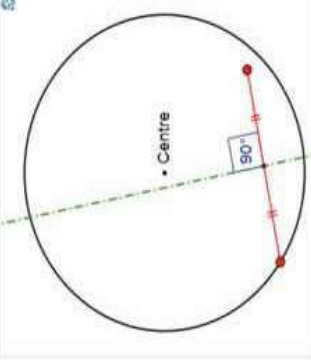
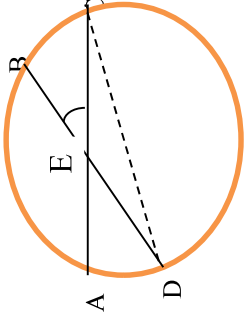
Learning Outcomes: At the end of this unit, learners will be able to:

- 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 <i>E</i> 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  1. To connect D & C using ruler	

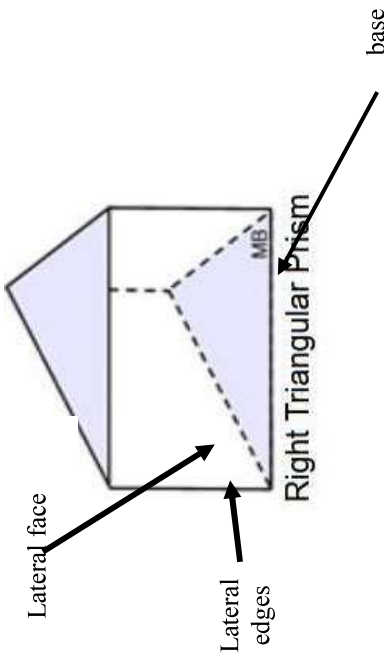
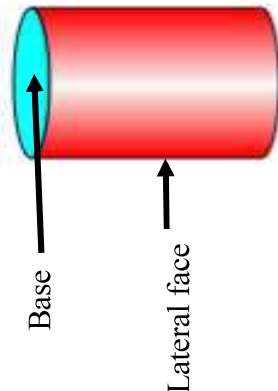
Competencies	Contents	Learning Strategies	Assessment
		2. To measure $\angle ACD$ and $\angle BDC$ using protractor 3. Based on step 2 ask them to write the measures of $\widehat{AD}$ & $\widehat{BC}$ 4. To measure $\angle BEC$ 5. To relate $m(\angle BEC)$ with the sum of $m(\widehat{AD})$ & $m(\widehat{BC})$ 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

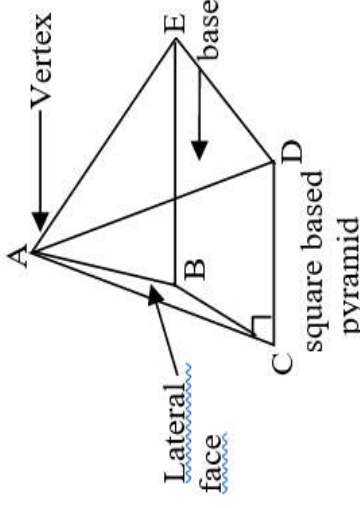
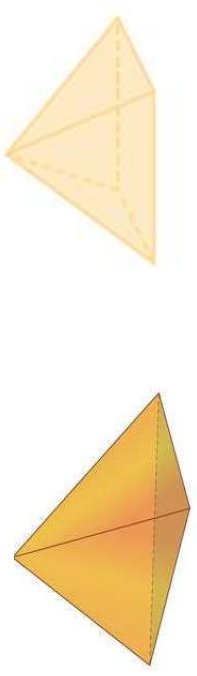
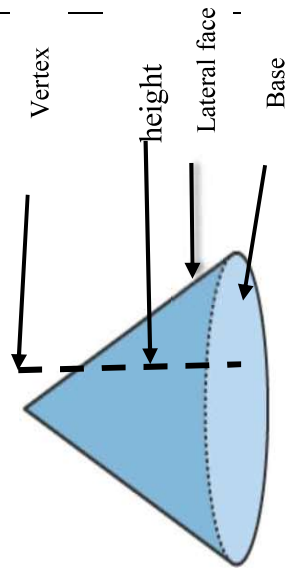
Unit 7: Solid Figures and Measurement (20 periods)

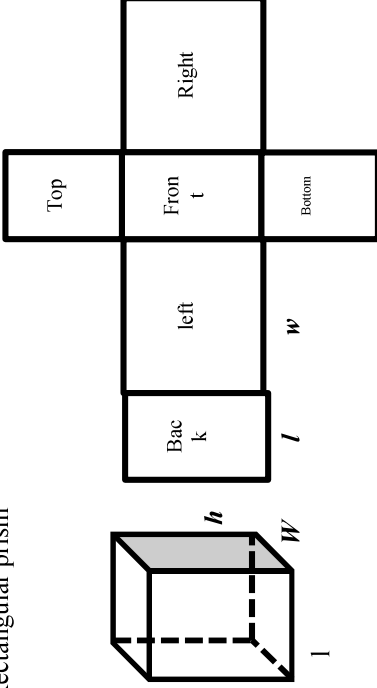
Learning Outcomes: At the end of this unit, learners will be able to:

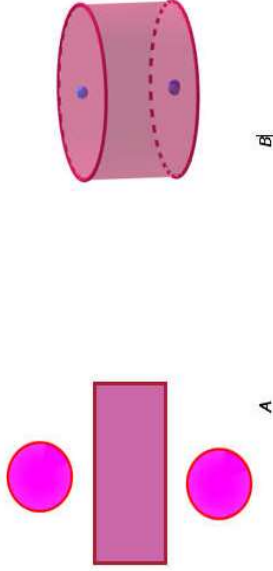
- Identify parts of solid figures
- Find the surface area of solid figures
- Find the volume of solid figures
- Solve applications of solid figures and measurements

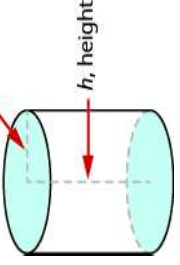
Competencies	Contents	Learning Strategies	Assessment
- Identify parts of a prisms, cylinders, pyramid and cones - Name different types of prisms, cylinders, pyramid and cones based on their bases.	7.1 Solid Figures (4 periods) 7.1.1 Prisms and Cylinders	- Divide students into small groups and let them 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.
		 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
	7.1.2 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 	
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 = $A_L + 2A_B$	- Ask questions and let some students how to derive the surface area formula of cylinder by net of cylinder. a) using Geogebra Software b) 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.

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.  $A_l = 2\pi r \times h = 2\pi r h$ $A_T = A_l + 2A_B$ $A_T = (\text{Circumference of bases}) \times \text{height} + 2(\text{Area of bases})$ $A_T = 2\pi r h + 2\pi r^2$ $A_T = 2\pi r(h + r)$ - 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 <i>(3 periods)</i>	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

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

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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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