SECONDARY
JHS

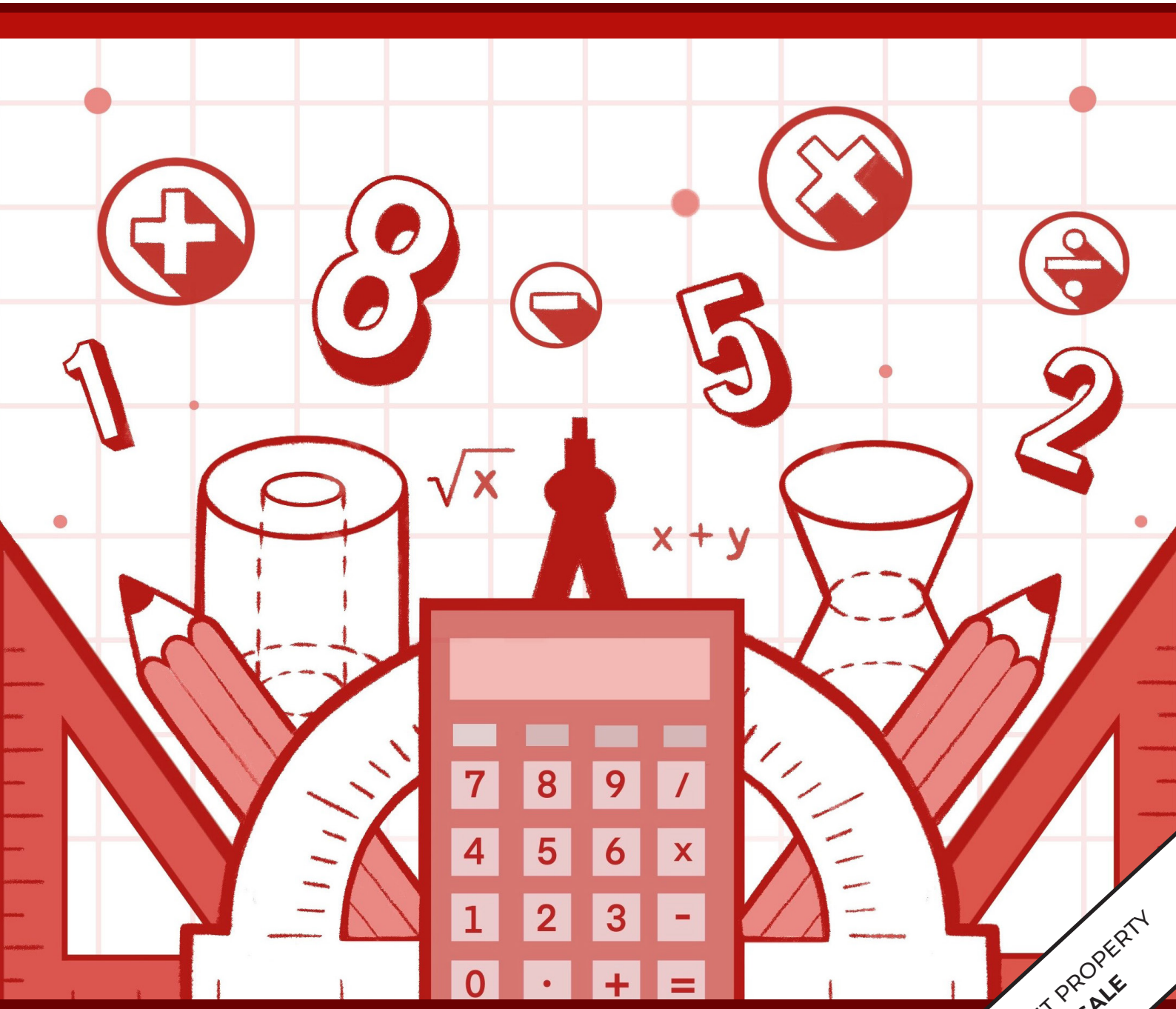
DepED DEPARTMENT OF EDUCATION

ALS Alternative Learning System LIFELONG LEARNING

LEARNING STRAND 3
MATHEMATICAL & PROBLEM-SOLVING SKILLS

SESSION GUIDES FOR MODULE 3:
THIS IS WHERE WE DRAW THE LINE!

ALS Accreditation and Equivalency Program: Junior High School



UNESCO United Nations Educational, Scientific and Cultural Organization
KOICA Korea International Cooperation Agency

LEARNING STRAND 3

SESSION GUIDES

Alternative Learning System - Accreditation and Equivalency (ALS-A&E)

JUNIOR HIGH SCHOOL: MATHEMATICAL AND PROBLEM-SOLVING SKILLS
SESSION GUIDES FOR MODULE 3 (THIS IS WHERE WE DRAW THE LINE!)

ALS Accreditation and Equivalency Program: Junior High School
Learning Strand 3: Mathematical and Problem-Solving Skill**s**
Session Guides for Module 3 (This is Where We Draw the Line!)

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User's Guide

For the ALS Teacher/Instructional Managers/Learning Facilitator:

Welcome to the Session Guides of this Module entitled This is Where We Draw the Line! under Learning Strand 3 Mathematical and Problem-Solving Skills of the ALS K to 12 Basic Education Curriculum (BEC).

This module was collaboratively designed, developed, and reviewed by select DepEd field officials and teachers from formal school and ALS, and private institutions to assist in helping the ALS learners meet the standards set by the ALS K to 12 Basic Education Curriculum (BEC) while overcoming their personal, social, and economic constraints in attending ALS learning interventions.

This learning resource hopes to engage the learners in guided and independent learning activities at their own pace and time. Furthermore, this also aims to help learners acquire the needed 21st century skills while taking into consideration their needs and circumstances.

As an ALS Teacher/Instructional Manager/Learning Facilitator, you are expected to orient the learners on how to use this module. You also need to keep track of the learners' progress while allowing them to manage their learning. Moreover, you are expected to encourage and assist the learners as they do the tasks included in the module.

MAKE RELATIONS FUNCTION
Session Guide No. 1

I. **Duration of Session:** 3 hours

II. **Key Understandings to Be Developed**
- Polynomial functions
- Evaluation of functions

III. **Learning Objectives**
1. Illustrates polynomial functions.
2. Evaluates functions.
3. Express satisfaction in mastery of new ways of thinking through application of mathematics.

IV. **Resources** (none)

V. **Activity**
1. Ask the learners to get to know each other by writing down family members with relationships such as person who helps mother and father, grandparents to grandchildren, siblings to cousins, etc.

   The activity is advised to be done in groups to ensure that there will be more than one object in a group in each relationship to better demonstrate the concept of relations and functions. Be sensitive of learners that might have issues within their own families. Allow them to list down people that they consider fit for the descriptions given in each item.

   Have the students ask three of their friends to write down the indicated people in their family based on the relationship indicated in each item below. Connect the names on the left to the correct partner on the right by drawing an arrow between them. Item (a) serves as an example.

a. Person who helps nanay, tatay, guardian, or you

b. All the children and parent (choose nanay, tatay, or guardian)
c. Grandparent (choose Lolo or Lola) to grandchildren
d. You and your siblings to your cousins

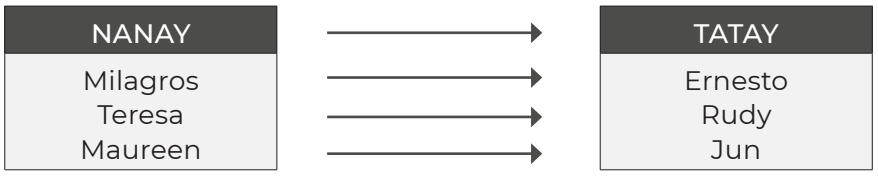
2. The basic relationships that students learn first are the relationships within their family. Most families have blood relations, but some families neither share family name nor blood. This same concept of family relationships will be used to show pairs of numbers with the same characteristics under relations and functions.

3. Ask the learners to explain how they came up with their final output.

VI. Analysis

1. Based on the activity, ask the following: *When do we say that people are related? What qualifies for two people to have a relation?*

In the activity, you have shown individuals who you have relations with. The most common relations exist in the family. The lines you

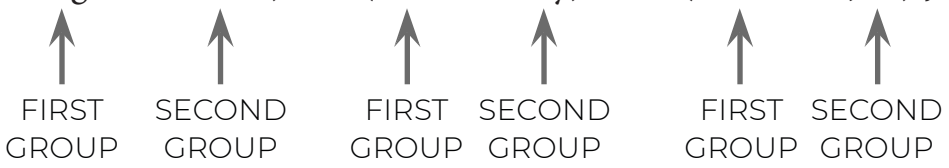


made show which people are related with each other.

Make sure to write the member of the first group before the member of the second group. Each pairing is called an **ordered pair.** The given example can be rewritten in ordered pairs as

Continuation on the next page.

Partners : { (Milagros, Ernesto), (Teresa, Rudy), (Maureen, Jun) }



- Explain that relationship means that two people or objects share a connection with each other either by biological affiliation or by emotional attachment (partners, such as husband-wife/ boyfriend-girlfriend, or adoptive families).

2. Use the answers gathered from the learners focusing on the fact that relations exist through connections between objects in a group (such as in families). Shift the discussion to mathematics by introducing the concept of relations and functions.

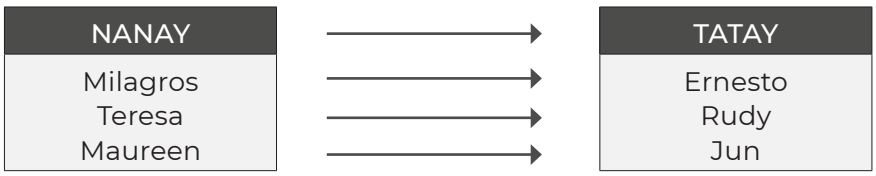
VII. Abstraction/Generalization

1. Present the definition and examples.

   A set of one or more ordered pairs is called a **relation.**

2. **Relations and functions:**
   - Relations are made up of two groups, both with at least one object in them that are connected by some characteristic or rule.
   - Use arrows to show connections between pairs of objects between groups.
   - Emphasize that in writing ordered pairs, the elements must be written in a strict order: (first group, second group).
   - All functions are relations, but not all relations are functions.
   - **Functions** have all elements in the first group paired with exactly one object in the second group (one-to-one relation). If an element in the second group is paired with two or more objects in the first group, it can still be a function provided that the first statement is still followed (many-to-one relation).

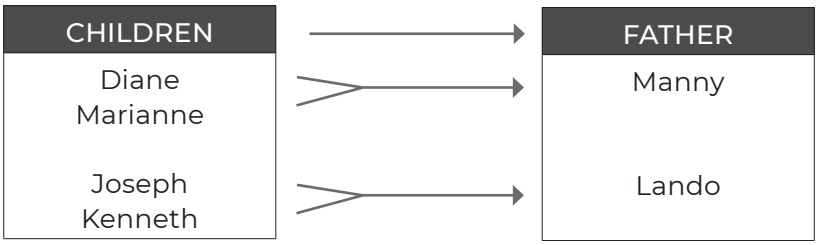
Partners



This is an example of a function because each person has exactly one partner. Moreover, this illustration shows a **one-to-one function** because for every one nanay, there corresponds only one tatay from the second group.

Children-to-parent

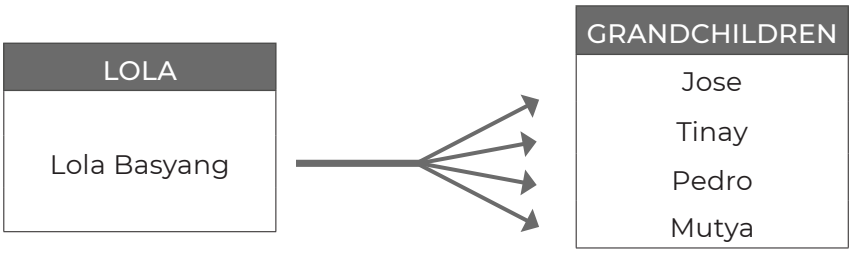
This is an example of a function because each child has exactly one father.



In addition, this illustration shows a many-to-one function because there are more than one child that has one tatay. For instance, Diane and Marianne connect to Manny as their tatay. Similarly, Joseph and Kenneth connect to Tatay Lando.

- *One-to-many* and *many-to-many* relations cannot be functions and are simply referred to as **relations.**

Grandparent to Grandchildren



This illustration shows a **one-to-many correspondence** because Lola Basyang connects to more than one grandchildren (Jose, Tinay, Pedro, and Mutya).

- Ask the learners to give examples of each type of relations using connections or relationships they see around them, or have some examples at the ready.

3. **Evaluating functions:**
   - Recall equations in two variables x and y. Give some simple examples of these equations such as:

$$y = x + 1 \qquad y = x + 3 \qquad y = x - 5$$

   - Recall substitution of a value in $\boldsymbol{x}$ to get the value of $\boldsymbol{y}$.

Using $x = 1$, $y = x + 5$	Using $x = 2$, $y = x + 5$	Using $x = 3$, $y = x + 5$
$y = 1 + 5$	$y = 2 + 5$	$y = 3 + 5$
RESULT $y = 6$	**RESULT** $y = 7$	**RESULT** $y = 8$

   - Explain that equations are also relations of numbers relating $\boldsymbol{x}$ and $\boldsymbol{y}$.

- Demonstrate or represent the equations in a function as a *processing machine* with the x–value as input and the y–value as the output (refer to the Learner's Module).
- Emphasize that when writing ordered pairs, the x-value should be written first followed by the y-value and enclosed in parenthesis (x, y).

  Using the same example above, the ordered pairs are in the set $\{(1, 6), (2, 7), (3, 8)\}$.

VIII. Application

1. Ask the learners to define relation and function.
2. Have them evaluate functions.
3. Present the *Sharpening Your Skills* and *Treading the Road to Mastery* assessments which aim to further develop their skills on:

   a. writing ordered pairs and distinguishing between functions and relations.
   b. evaluating a function given a value of x.
   c. listing the ordered pairs that belong to a function.
   d. identifying the correct elements in the union of sets.

4. Process the activity by allowing learners to explain their answers.

IX. Concluding Activity

End the session by reviewing the key understandings developed and relating the concepts of relations and functions to real life.

WHERE ARE YOU EXACTLY?
Session Guide No. 2

I. **Duration of Session:** 3 hours

II. **Key Understandings to be Developed**
- Rectangular Coordinate System
- Linear equations and its graphs

III. **Learning Objectives**
1. Illustrate the rectangular coordinate system and its use.
2. Define linear equations.
3. Graph different types of linear equations.

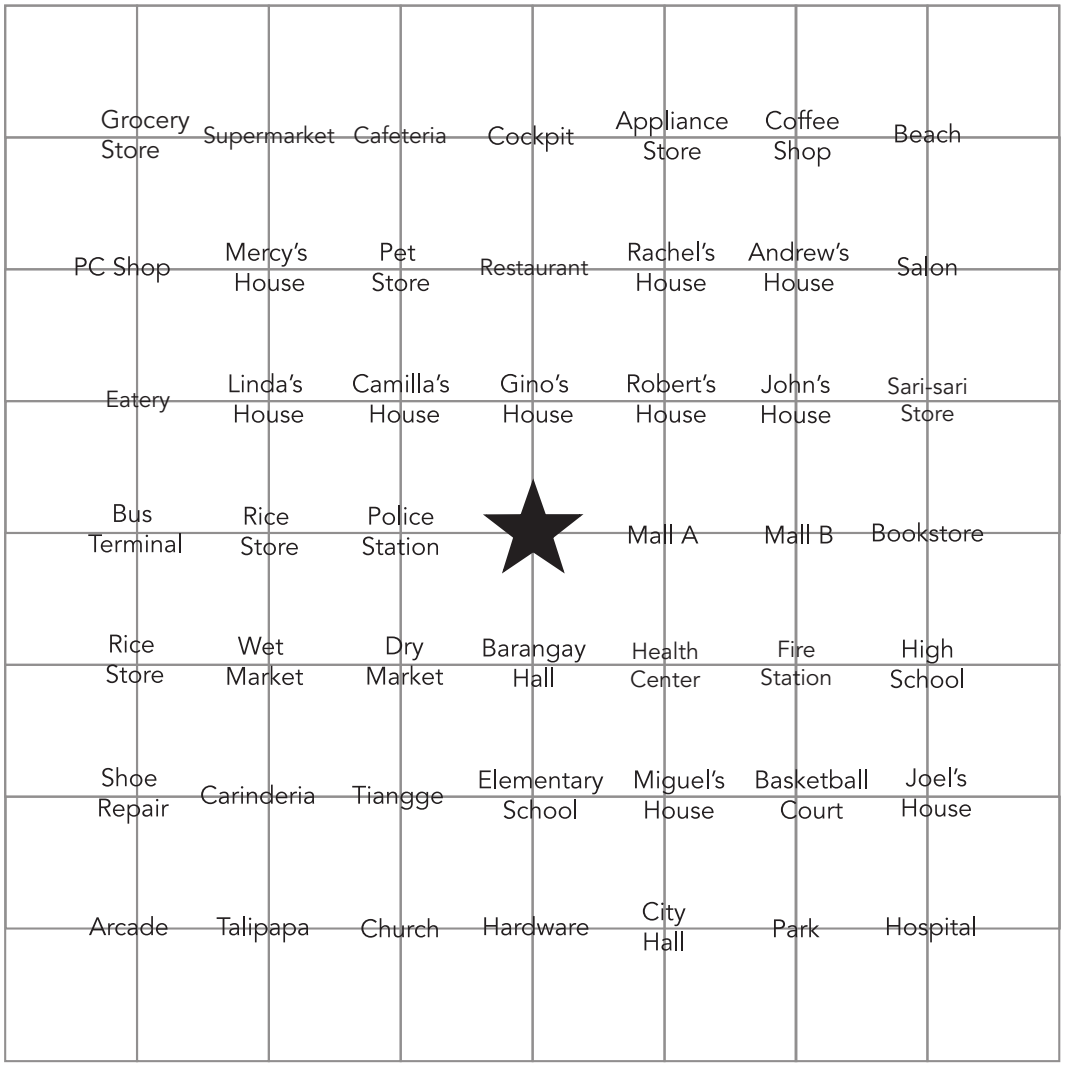
IV. **Resources** (none)

V. **Activity**
1. Ask the learners to help Mang Neho locate destinations on his map by following directions. *The activity is designed to highlight the use of directions and mathematics (using the number of steps) using gridlines similar with maps and globes. This allows learners to see the important role of mathematics in the development of technology, related to locating places using Global Positioning System (GPS).*

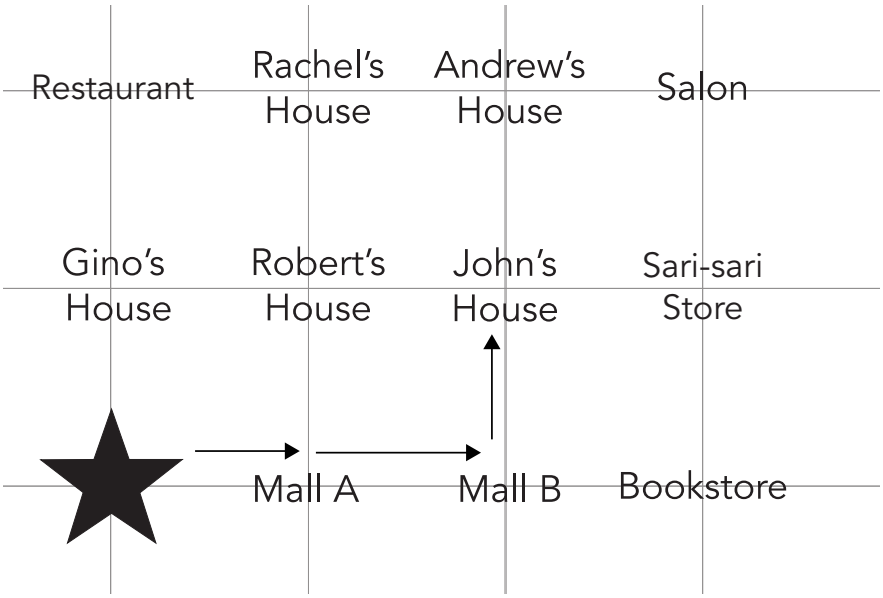
   Use the given map on the next page to locate where Mang Neho is going. Follow the directions he inputs on his map application to identify his destination. Your starting point is the **star** in the middle of the map.

   DIRECTIONS:

   1. 2 to the right, 1 upwards
   2. 3 to the left, 2 upwards
   3. 3 to the right, 2 downwards
   4. 2 to the left
   5. 1 to the right, 3 downwards
   6. 3 to the right, 3 upwards
   7. 2 downwards
   8. 2 to the left, 3 downwards
   9. 1 to the left, 2 upwards
   10. 3 upwards


Grocery Store
Supermarket
Cafeteria
Cockpit
Appliance Store
Coffee Shop
Beach
PC Shop
Mercy's House
Pet Store
Restaurant
Rachel's House
Andrew's House
Salon
Eatery
Linda's House
Camilla's House
Gino's House
Robert's House
John's House
Sari-sari Store
Bus Terminal
Rice Store
Police Station
Mall A
Mall B
Bookstore
Rice Store
Wet Market
Dry Market
Barangay Hall
Health Center
Fire Station
High School
Shoe Repair
Carinderia
Tiangge
Elementary School
Miguel's House
Basketball Court
Joel's House
Arcade
Talipapa
Church
Hardware
City Hall
Park
Hospital

Number 1 serves as an example below.



2. Ask learners to explain how they identified the destinations. Provide help and guidance while learners are presenting.

VI. Analysis

1. Based on the activity, ask the following questions: *Who among you have used a map before? Who among you have already used map applications on your mobile phone? Which apps have you used? How do you give out directions when somebody asks you to help them?*

   Each location in a space, like in the map we used, is accessible by moving in **two directions,** horizontal (left or right) and vertical (upward or downward). For example, when moving 2 to the right and 1 upwards, these two movements end up in John's house (*see the above figure*).

   - Explain that when giving out directions, we use a reference point to direct where to turn left or right. We also use a reference point in maps using gridlines, as in the activity.

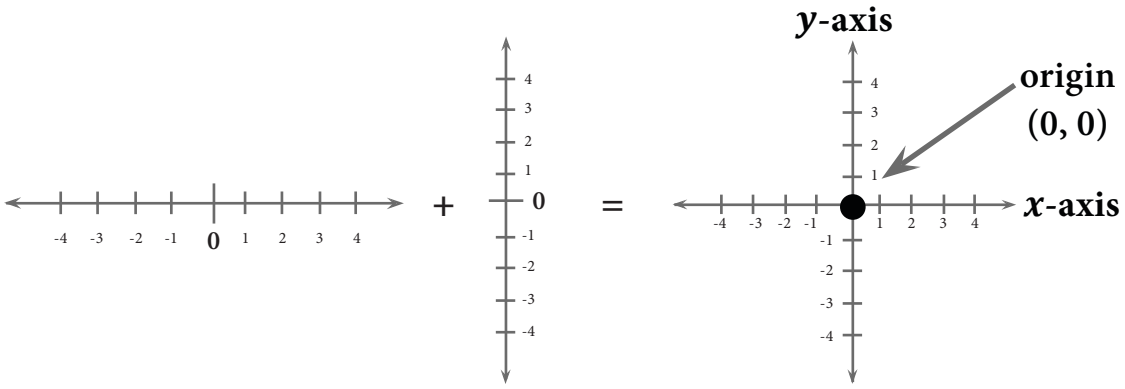
2. Shift discussion to mathematics by using the gridlines in maps and explain that locating points in space also uses the help of lines.
3. Recall how to locate a point in the number line (refer to the Learner's Module). In a plane, we use a combination of two number lines (horizontal and vertical) that intersect each other.

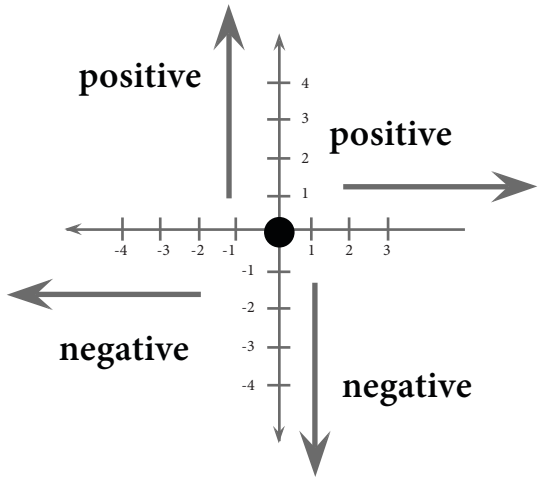
VII. Abstraction/Generalization

1. Present the definition of terms and examples.

   A rectangular coordinate system is made up of two perpendicular number lines, where one is horizontal and the other one is vertical. It is also called Cartesian plane.

2. **Rectangular coordinate system:**
   - Point out the different parts of the rectangular coordinate system: origin, $x-$axis, and $y-$axis.





- Emphasize the need for equal intervals or spaces between numbers when making the rectangular coordinate system.

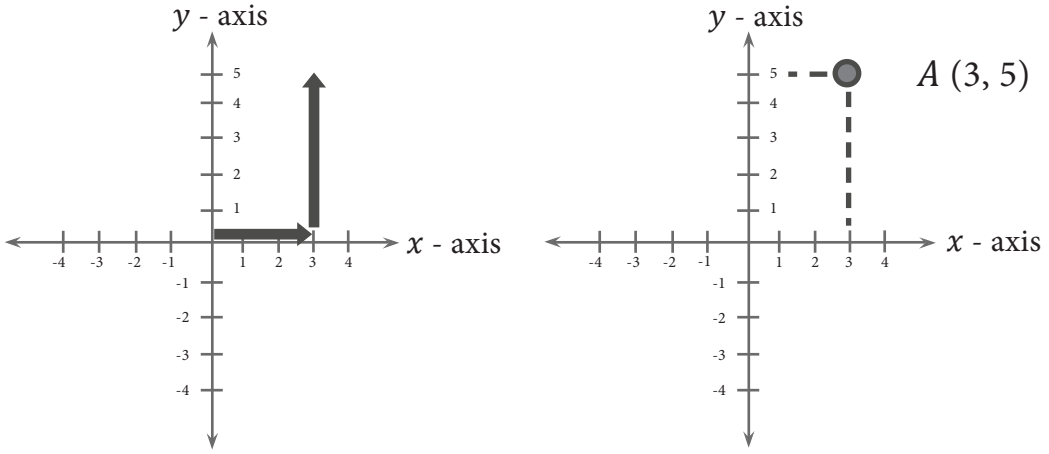
  Numbers on the **right and upwards** of the origin are **positive.**
  Numbers on the **left and downwards** of the origin are **negative.**

- When plotting ordered pairs in a rectangular coordinate system, carefully show the movements in the x–axis and y–axis. You can do this in two ways:
    - Locate the numbers in their respective number lines, then use broken lines parallel to the other axis until they meet. The point of intersection represents the ordered pair in the rectangular coordinate system; or
    - Show the horizontal movement in the x–axis first, then continue with the vertical movement parallel to the y–axis.
- Label the point correctly by putting the ordered pair beside it.

Example: Plot (3, 5) in the Cartesian plane.

Plotting $A(3, 5)$ means 3 is the movement on the x-axis and 5 is the movement on the y–axis.

3 (positive) means we move 3 units to the right
5 (positive) means we move 5 units upwards



3. **Graphing linear equations:**
   - Explain that a given equation contains an infinite number of ordered pairs that satisfy it since we can replace the x–value with any number and be able to get a unique y–value pair for it. Equations can, therefore, be considered as a "family" of infinitely many points (represented by the ordered pairs).
   - Explain that since the equation contains an infinite number of points related to one another, they can be all connected to form a line. This is the reason why we call equations linear functions.
   - Recall and demonstrate the process of substitution by showing how to replace the x–value in the equation.

     Example: Given the equation $\boldsymbol{y = x + 1}$. Use $x = 1$.
     Write $y = x + 1$, then replace it with the value **1.**
     Then, perform the operation to find $\boldsymbol{y}$.

     $\boldsymbol{y = 1 + 1 = 2}$

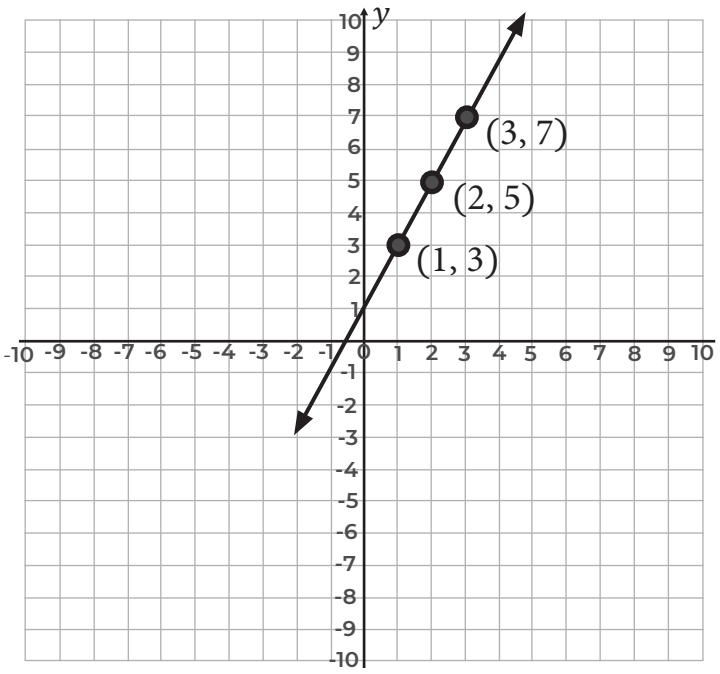
   - Show how to plot this point on the rectangular coordinate system.
   - Call on learners who will try to solve for the value of y by substituting and graphing in front of the class. Supervise and provide corrections in the process being done if necessary.

     Example: Graph the equation $y = 2x + 1$.

     Use small numbers such as 1, 2, and 3 to replace x.

Using $x = 1$,	Using $x = 2$,	Using $x = 3$,
$y = 2x + 1$	$y = 2x + 1$	$y = 2x + 1$
$= 2(1) + 1$	$= 2(2) + 1$	$= 2(3) + 1$
$= 2 + 1$	$= 4 + 1$	$= 6 + 1$
$= 3$	$= 5$	$= 7$

Plot the points then connect them to form a line.



VIII. Application

1. Ask the learners to illustrate and discuss the parts of a rectangular coordinate system.
2. Ask them how to graph linear equations.
3. Present the *Sharpening Your Skills* and *Treading the Road to Mastery* which aim to further develop their skills on

    a. identifying the movement and the direction in the x–axis and y–axis given an ordered pair.
    b. creating a Cartesian plane with proper labels and plotting points accurately.
    c. plotting lines representing functions by plotting points on the Cartesian plane.

4. Process the activity by allowing the learners to explain their answers.

IX. Concluding Activity

End the session by reviewing the key understandings developed and relating the concepts of rectangular coordinate system and linear equations to real life.

WATCH YOUR STEEP
Session Guide No. 3

I. **Duration of Session:** 3 hours

II. **Key Understandings to Be Developed**
- Slope of a line
- Intercepts of a line

III. **Learning Objectives**
1. Find the slope of linear equations.
2. Find both the x- and y- intercepts of linear equations.
3. Describe the slope and intercepts of linear equation based on the graph.
4. Express satisfaction in mastery of new ways of thinking through application of mathematics

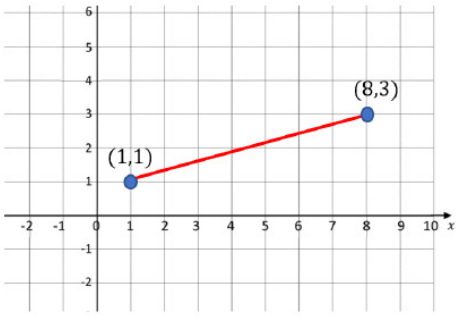
IV. **Resources** (none)

V. **Activity**
1. Ask the learners to help Mang Neho to come up with the best decision in the given scenarios by making comparisons. *The activity is designed to practice and show the applications of graphing linear equations learned in the previous lesson. Problem number 1 specifically highlights the slope of a line which is the main idea tackled in this lesson.*

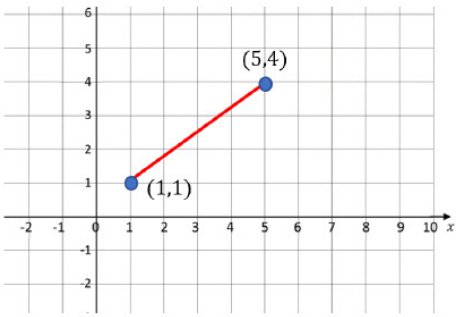
   Use graphing of linear equations in each scenario to make comparisons. Item (1) serves as an example.

   1. Mang Neho has to choose between two uphill roads. Which road is more dangerous to drive on and that he must avoid? Compare by graphing.

	Start	End
Road A	(1, 1)	(8, 3)
Road B	(1, 1)	(5, 4)



Road A



Road B

Based on the graph, it is easier to see that Road A is safer than Road B. This is because Road B is **steeper,** or with a higher angle of elevation, than Road A.

2. Choosing between two car insurance offers, Mang Neho looked for the equation of the yearly growth of each company. Which one has a faster growth? Compare by graphing and use the same values for x in both equations.

Company A	$y = 3x + 2$
Company B	$y = 2x + 3$

3. Mang Neho is also considering investments. He is choosing to buy either a car or a farmland in his province. He found out on the internet that the property values follow the given equations. Which is a better investment?

Farmland	$y = 1 + 2x$
Car	$y = 5 - 2x$

2. Emphasize that the skills of graphing and plotting points in a rectangular coordinate system should be used in this activity. Supervise and remind the learners to create a rectangular coordinate system with equal intervals.

VI. Analysis

1. Based on the activity, ask this question: *What kind of lines were you able to graph in each item?*
   - Point out that the lines in the equations are diagonals which are sloped. These slopes can be mathematically described and can be used to interpret what set of points in an equation represent or mean.

     What comes into mind when you say slope? Where can you see slopes in nature or around you?

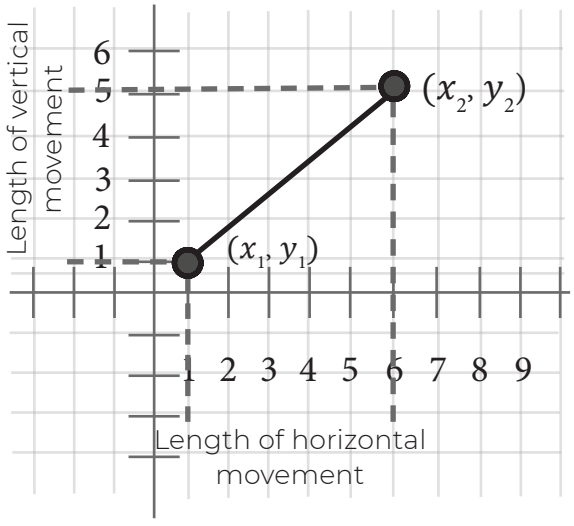
   - Explain, as introduction, that slopes are naturally observed in mountains. This can be used as introduction to the notation of the slope of the line (***m***).

VII. Abstraction/Generalization (*The discussion is advised to be done simultaneously with analysis.*)

1. **Slope of a line:**

   The measure of steepness of a line is called the **slope.**

   - Emphasize that there is a change in the position in *x* and *y* whenever we move from one point to another point in a line.



- Using items 1, 2, and 3 in the activity, ask this question: *What does it mean when a line is steeper?*

  The lines in items 1, 2, and 3 are all rising from the left. They have positive slopes.

- Explain that the steeper the line is, the faster or the bigger the change in the values of x and y from one point to another.
- Emphasize that when assigning the points as (x_1, y_1) and (x_2, y_2), they may choose any for as long as they will be consistent in putting the correct values as x_1 and its partner y_1.

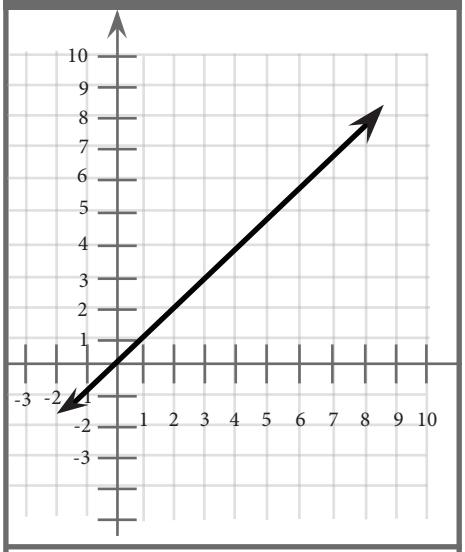
  Remind learners to be careful with the positive or negative signs when substituting the values in the formula and performing the operations.

- Using item 4 in the activity, ask this question: *What can you say about the directions of the lines?*

  One line is rising from the left and the other one is falling from the left.

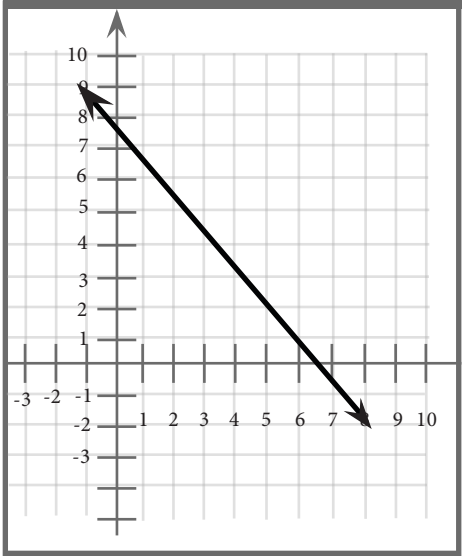
- Set the standard in describing the direction of the line that should be from left to right (same with how we read). This means that a line going up (or increasing) is going up from left to the right, a line going down (or decreasing) is going down from the left to the right.
- Emphasize that slopes can be described just by looking at the graph of a line – without calculation. Slopes can be positive, negative, zero, or undefined.

POSITIVE SLOPE



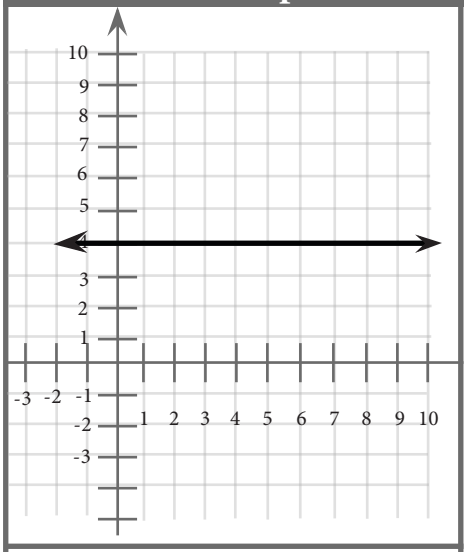
Line goes **upward** from left to right.

NEGATIVE SLOPE



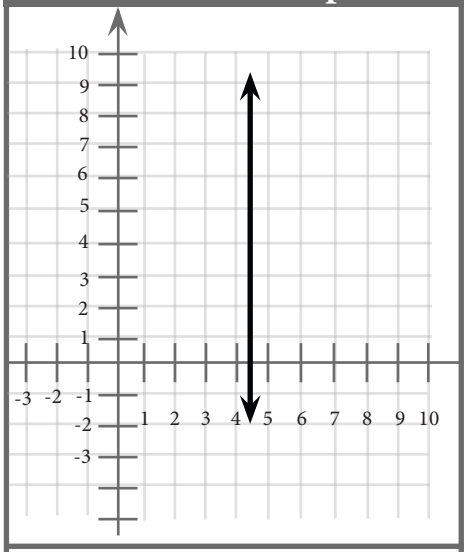
Line goes **downward** from left to right.

Zero slope



Line is horizontal.

Undefined slope



Line is vertical.

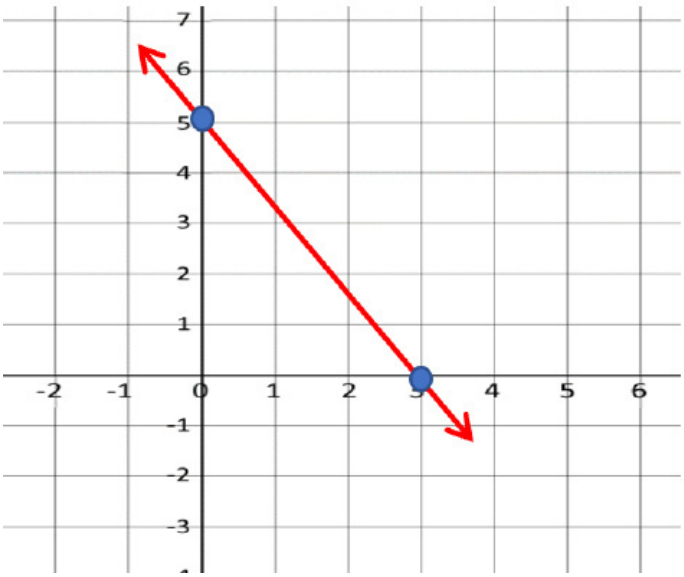
- Explain that the slope of the line is used to predict the movement and possible values of data in a set especially in finance and economics. In graphs, commonly, the x–axis is used as the value for time and the y–axis is the amount of investment and the like.

2. **Intercepts of a linear equation:**
   - Show the definition of x– and y–intercepts. Emphasize that these intercepts can be obtained based on the equation and graph of the line.

     The x–intercept is the point where the graph intersects the x–axis. The y–intercept is the point where the graph crosses the y–axis.

   - Explain that the x–intercept is the value of x when $y = 0$ and the y–intercept is the value of y when $x = 0$.
   - Emphasize that intercepts can also be used to graph a linear equation.

     Example: The line shown has an x–intercept of (3, 0) and y–intercept of (0, 5).



VIII. Application

1. Ask the learners to define the slope and intercept of a line.
2. Ask them how to solve for the slope and intercepts of a line.
3. Ask the learners how they can use the slope and intercepts to graph linear equations.
4. Present the *Sharpening Your Skills* and *Treading the Road to Mastery* assessments which aim to further develop their skills on

    a. substituting correct values in the formula of a slope by distinguishing x and y and using the ordered pairs to graph the line.
    b. graphing the line and describing the slope based on the graph
    c. determining the x– and y–intercepts of a linear equation and using these intercepts to graph a line

IX. Concluding Activity

End the session by reviewing the key understandings developed and relating the concepts of slopes and intercepts in real-life scenario.

PRE-ASSESSMENT

PAGE 2

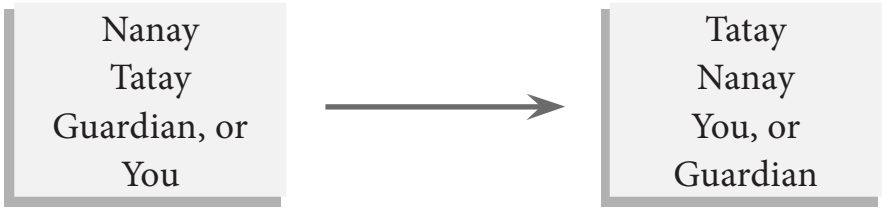
1. d
2. a
3. c
4. c
5. b
6. b
7. a
8. b
9. c
10. d
11. d
12. a
13. b
14. a
15. c

LESSON I: MAKE RELATIONS FUNCTION

TRYING THIS OUT

PAGE 8

1. Person who helps nanay, tatay, guardian, or you



2. All the children and parent (choose nanay, tatay, or guardian)

1. Grandparent (choose Lolo or Lola) to grandchildren

2. You and your siblings to your cousins

SHARPENING YOUR SKILLS

ACTIVITY I

PAGE 12

1. {(–1, 5), (3, 7), (–5, 7), (9, 2), (8, 2)} **Function**
2. {(11, –8), (11, 6), (16, –7), (16, 9), (16, -2)} **Relation**
3. {(12, 4), (5, 6), (7, 7), (13, 10)} **Function**
4. {(4, 15), (6, 27), (6, 21), (7, 46), (10, 46), (13, 46)} **Relation**

ACTIVITY II

PAGE 13

1. 38
2. 8
3. –17
4. 9
5. –10

TREADING THE ROAD TO MASTERY

PAGE 14

1. (1, 9), (2, 11), (3, 13)
2. (–1, 4), (0, 1), (1, –2)
3. (–5, 5), (-3, 1), (–1, -3)
4. (4, 9), (6, 17), (7, 21)

LESSON 2: WHERE ARE YOU EXACTLY?

TRYING THIS OUT

PAGE 16

1. John's House
2. PC Shop
3. Joel's House
4. Rice Store
5. City Hall
6. Beach
7. Elementary school
8. Talipapa
9. Pet Store
10. Cockpit

SHARPENING YOUR SKILLS

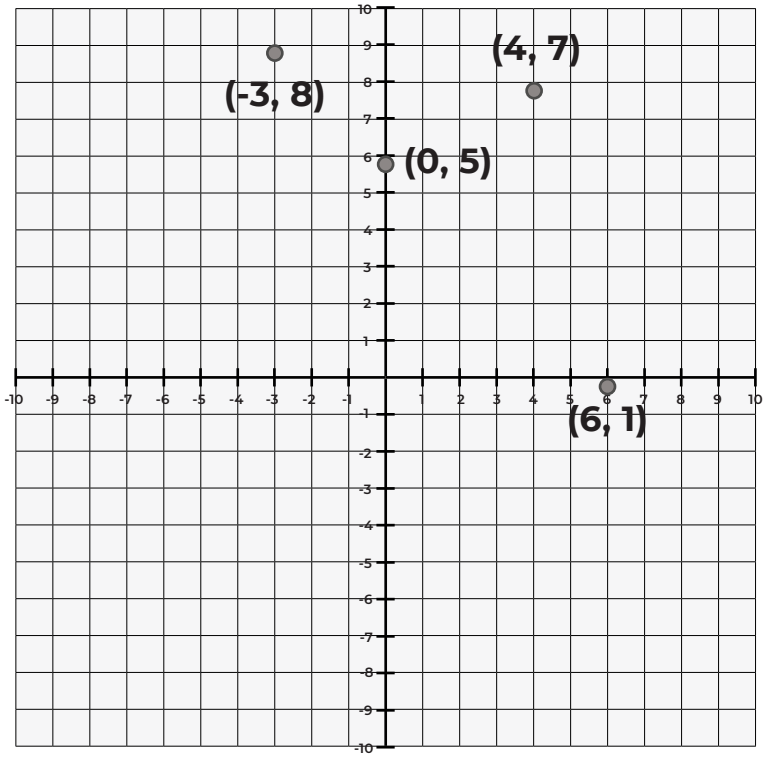
ACTIVITY I

PAGE 26

1. 2 right, 5 up
2. 3 left, 2 down
3. 4 left, 7 up
4. 6 right, 1 down
5. 15 left, 12 up
6. 21 right, 10 down
7. 7 left, 8 down
8. 9 right
9. 11 down
10. 25 left, 45 down

ACTIVITY II

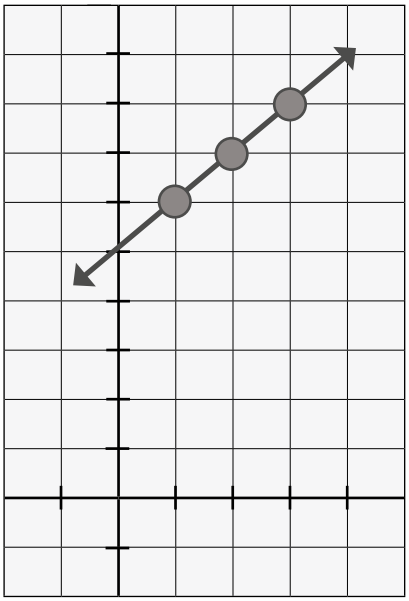
PAGE 27



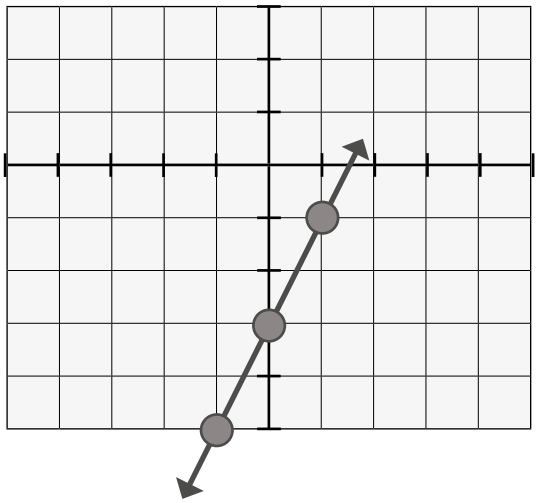
TREADING THE ROAD TO MASTERY

PAGE 28

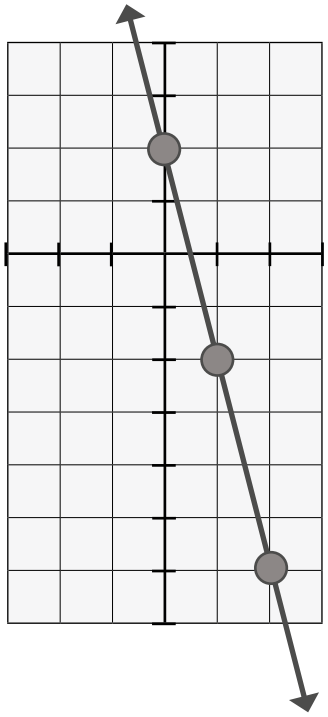
1. {(1, 6), (2, 7), (3, 8)}



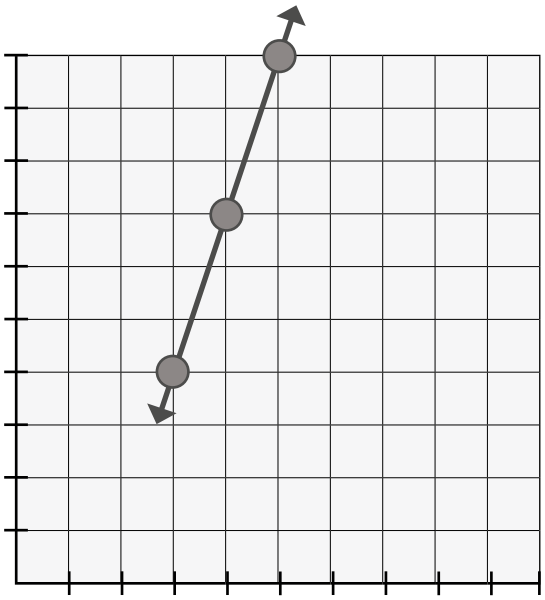
2. {(-1, -5), (0, -3), (1, -1)}



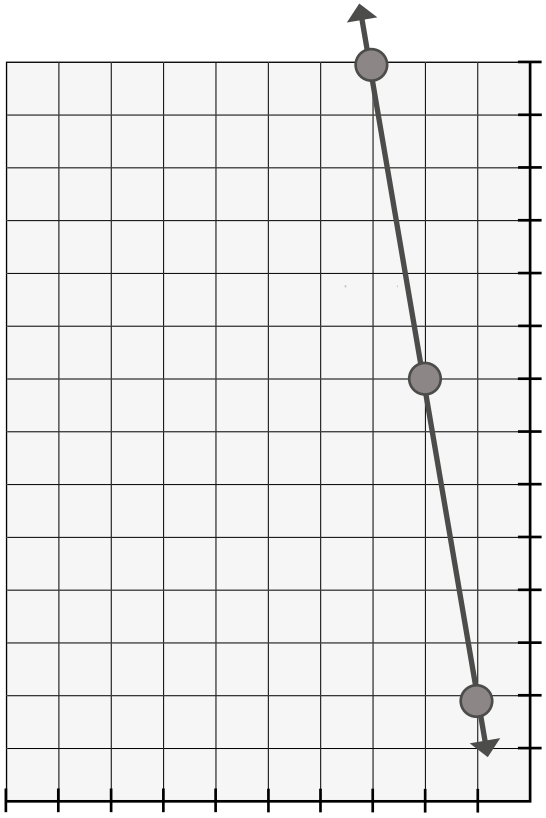
3. {(0, 2), (1, -2), (2, -6)}



4. {(3, 4), (4, 7), (5, 10)}



5. {(-1, 2), (-2, 8), (-3, 14)}

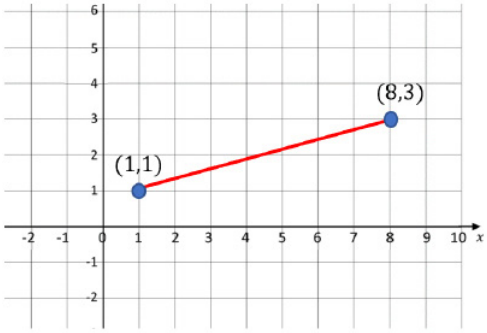


LESSON 3: WATCH YOUR STEEP

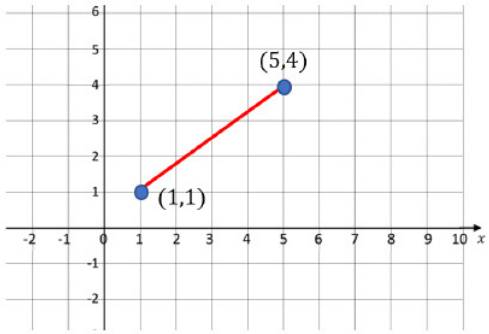
TRYING THIS OUT

PAGE 31

1. Road A is safer than Road B. Road B must be avoided.

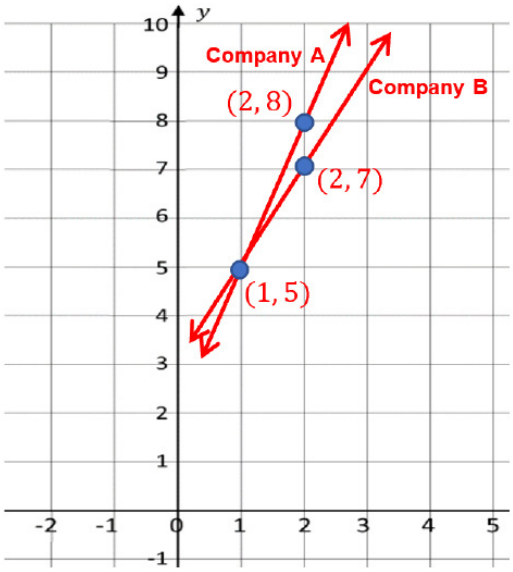


Road A

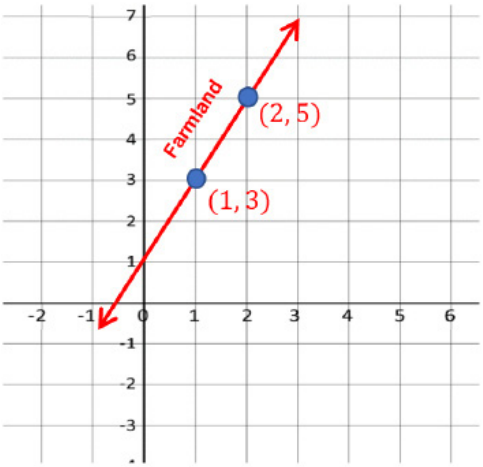


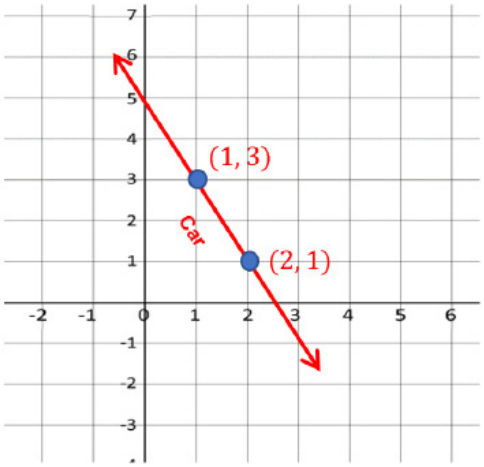
Road B

2. The line representing Company A's yearly growth is steeper than Company B's yearly growth. This means that Company A has better performance than Company B due to its growth.



3. It is better for Mang Neho to invest in farmland because it increases in value over time, while the car decreases in value.





SHARPENING YOUR SKILLS

ACTIVITY I

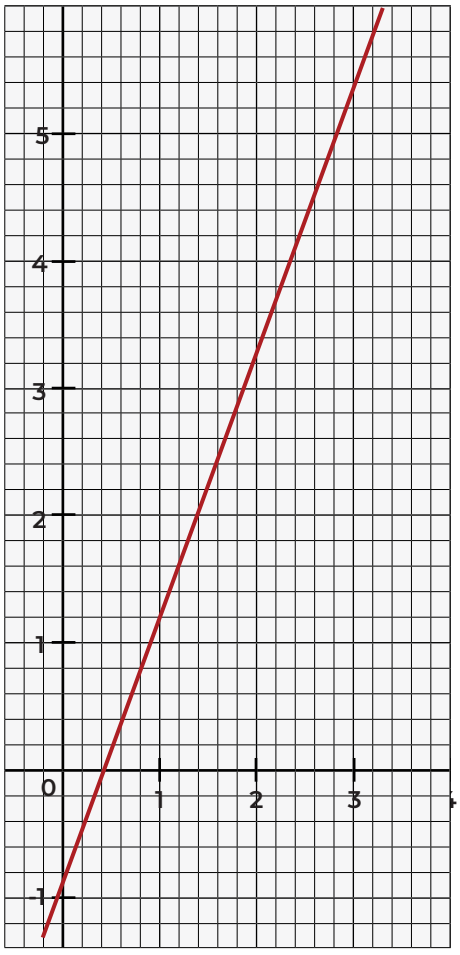
PAGE 48

1. $m = -3$
2. $m = 1$
3. $m = \frac{4}{3}$

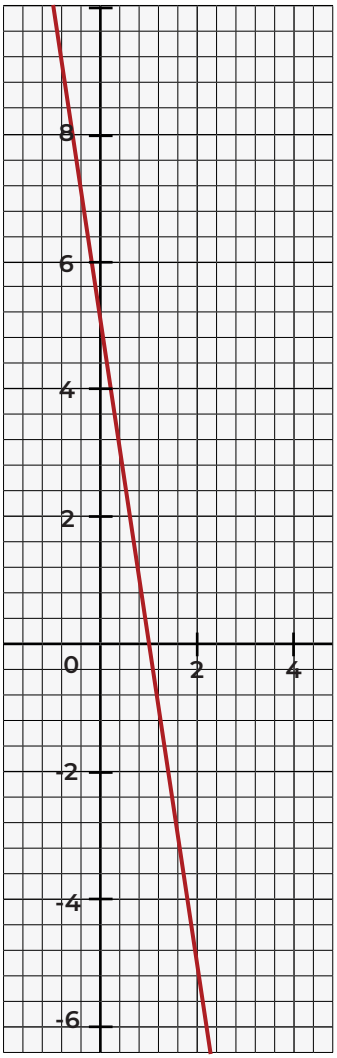
ACTIVITY II

PAGE 48

1. positive slope



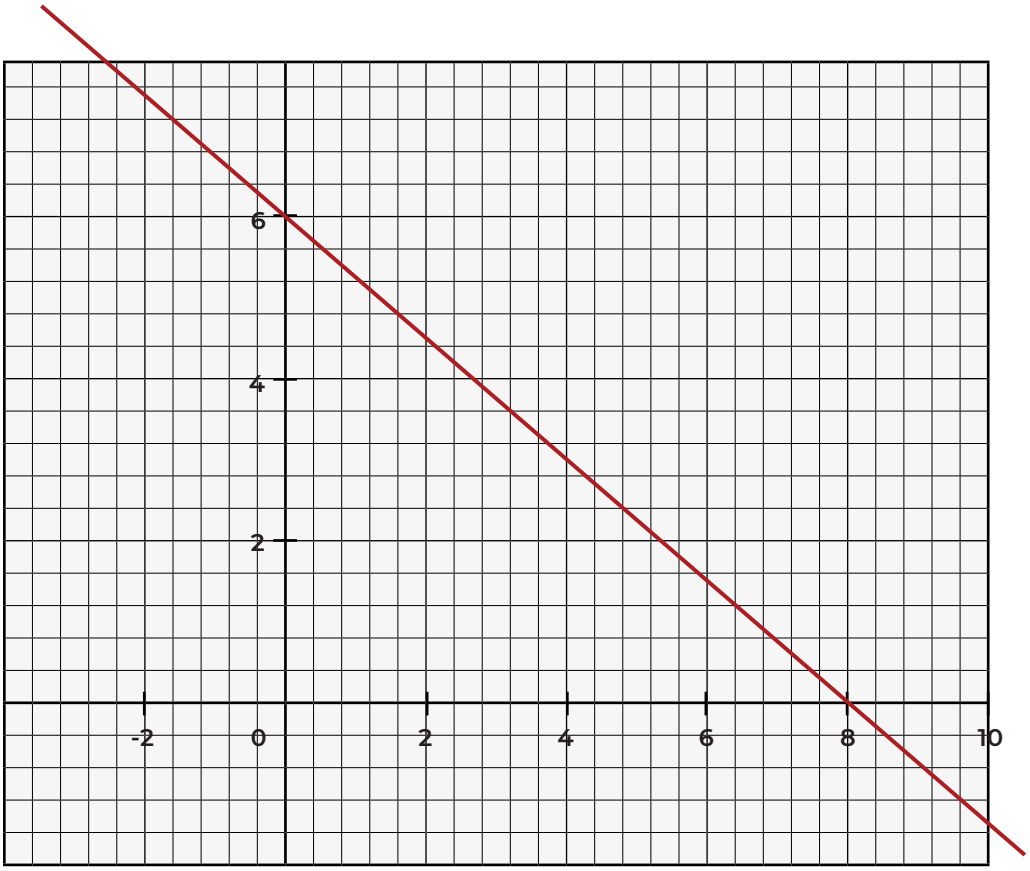
2. negative slope



ACTIVITY III

PAGE 48

1. x – intercept: (8, 0); y – intercept: (0, 6)



TREADING THE ROAD TO MASTERY

PAGE 49

1. Michael: $m = 2$; James: $m = 1$
   Michael performed better than James.

2. AMC Bank: $m = 3$; LMN Bank: $m = 4$
   Choose LMN Bank because it has greater investment interests.

3. y – intercept is (16, 0). This means Mark will reach the finish line after 16 minutes.
   x – intercept is (0, 4). This means that Mark's distance from the finish line at the start of the race is 4 km.

REACH THE TOP

PAGE 54

1. a
2. b
3. d
4. c
5. b
6. c
7. c
8. b
9. c
10. d
11. b
12. a
13. d
14. a
15. a

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