SECONDARY
JHS

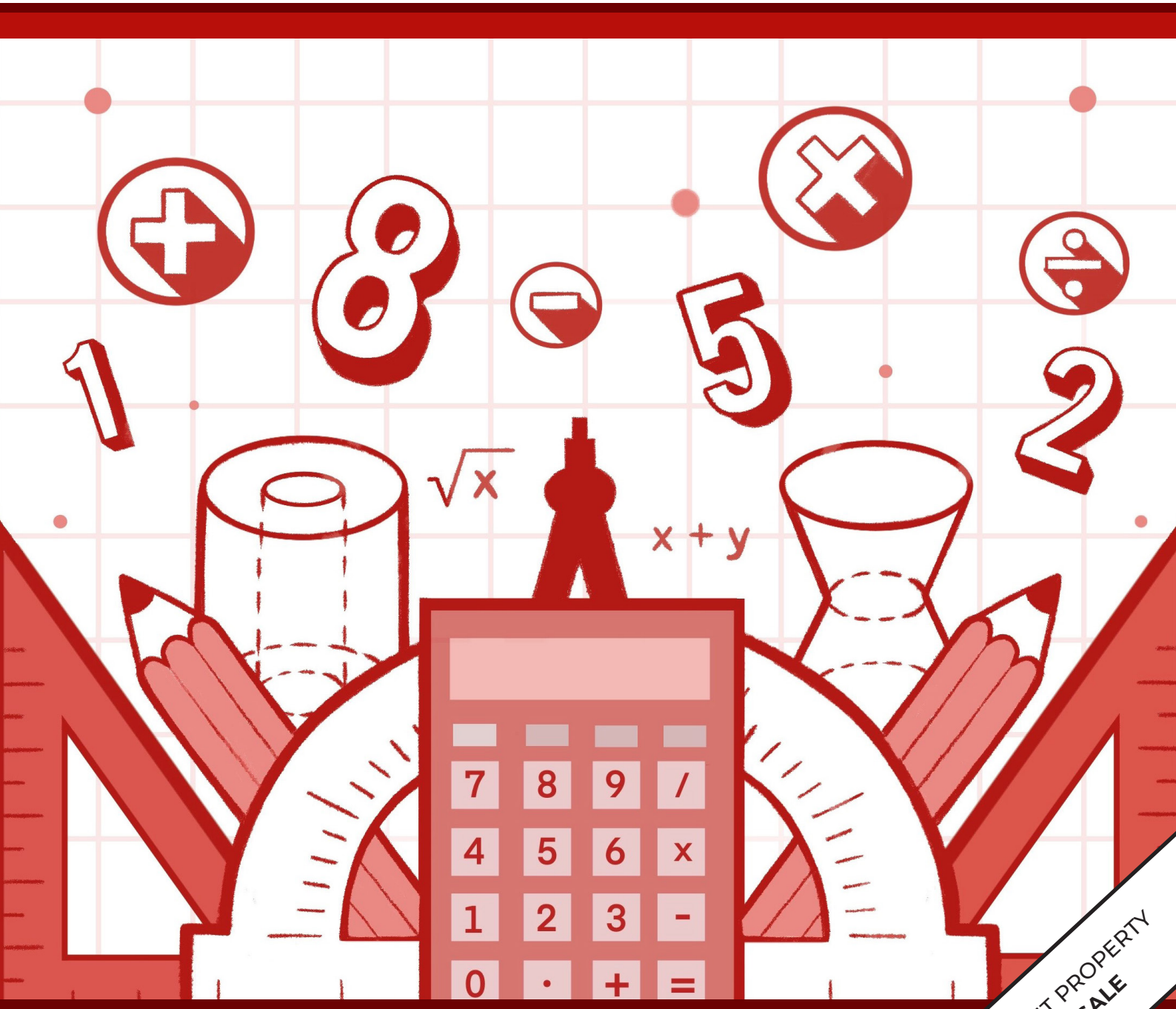
DepED DEPARTMENT OF EDUCATION

ALS Alternative Learning System LIFELONG LEARNING

LEARNING STRAND 3
MATHEMATICAL & PROBLEM-SOLVING SKILLS

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

THIS IS WHERE WE DRAW THE LINE!

MATHEMATICAL AND PROBLEM SOLVING SKILLS
MODULE 3

ALS Accreditation and Equivalency Program: Junior High School
Learning Strand 3: Mathematical and Problem-Solving Skills
Module 3: This Is Where We Draw the Line!

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User's Guide

For the ALS Learner:

Welcome to 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 (BEC).

This module was designed to provide you with fun and meaningful opportunities for guided and independent learning at your own pace and time. You will be enabled to process the contents of the learning resource while being an active learner.

This module has the following parts and corresponding icons:

 *Let's Get to Know*	This will give you an idea of the skills or competencies you are expected to learn in the module.
 *Pre-assessment*	This part includes an activity that aims to check what you already know about the lesson. If you get all the answers correct (100%), you may decide to skip this module.
 *Setting the Path*	This section provides a brief discussion of the lesson. This aims to help you discover and understand new concepts and skills.
 *Trying This Out*	This comprises activities for independent practice to solidify your understanding and skills of the topic. You may check the answers to the exercises using the Answer Key at the end of the module.
 *Understanding What You Did*	This includes questions that process what you learned from the lesson.
 *Sharpening Your Skills*	This section provides an activity that will help you transfer your new knowledge or skill in real-life situations or concerns.
 *Treading the Road to Mastery*	This is a task which aims to evaluate your level of mastery in achieving the given learning competency.
 *Don't Forget*	This part serves as a summary of the lesson in the module.
 *Explore More*	In this portion, another activity will be given to you to enrich your knowledge or skill of the lesson learned. This also tends retention of learned concepts.
 *Reach the Top*	This part will assess your level of mastery in achieving the learning competencies in each lesson in the module.
Answer Key	This contains answers to all activities in the module.
Glossary	This portion gives information about the meanings of the specialized words used in the module.

At the end of this module you will also find:

References This is a list of all sources used in developing this module.

The following are some reminders in using this module:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer the Pre-assessment before moving on to the other activities included in the module.
3. Read the instruction carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and checking your answers.
5. Finish the task at hand before proceeding to the next.
6. Return this module to your ALS Teacher/Instructional Manager/Learning Facilitator once you are through with it.

If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your ALS Teacher/Instructional Manager/Learning Facilitator. Always bear in mind that you are not alone.

We hope that through this material, you will experience meaningful learning and gain deep understanding of the relevant competencies. You can do it!

CONTENTS

CONTENTS

MODULE 3

LET'S GET TO KNOW

Mang Neho, a taxi driver, was curious about how Global Positioning System (GPS) works because of the road apps he uses such as Google Maps and Waze. He asked you to explain it to him as his young children also asked him the same. Let us help Mang Neho understand the concepts behind GPS.

MODULE 3
PRE-ASSESSMENT

Instructions: Choose the letter of the correct answer. Write your answers on a separate sheet of paper.

1. It is a type of relation in which for every member of the first group, there corresponds one and only one member of the second group.

   a. consistent **b.** inconsistent **c.** true **d.** function

2. If x=5, what is the value of y= $-3x + 10$?

   a. −5 **b.** −4 **c.** −3 **d.** −2

3. What do you call the intersection of the x- and y- axes?

   a. slope **b.** axes **c.** origin **d.** relation

4. What point does the expression "from the origin, move 2 units left, then 3 units up" represent?

   a. (2, −3) **b.** (2, 3) **c.** (−2, 3) **d.** (−2, −3)

5. What kind of function is represented by a line in the Cartesian plane?

   a. relation **b.** linear **c.** number **d.** plane

6. Identify the movement of the point (−10, −3) in the Cartesian plane.

   a. 10 units left, then 3 units up
   b. 10 units left, then 3 units down
   c. 10 units right, then 3 units up
   d. 10 units right, then 3 units down

7. It is the measure of steepness of a line.

a. slope **b.** intercept **c.** steep **d.** linear

8. Find the slope of a line containing the point (0, 1) and (3, −2).

a. 0 **b.** −1 **c.** −2 **d.** −3

9. What is the sign of the slope if the line goes downward from left to right?

a. zero **b.** positive **c.** negative **d.** undefined

10. What is the orientation of the line if the slope is zero?

a. vertical **b.** diagonal **c.** curved **d.** horizontal

11. It refers to the point where the graph crosses the x- axis.

a. vertex **b.** y-intercept **c.** dot **d.** x-intercept

12. It refers to the point where the graph intersects the y- axis.

a. y-intercept **b.** dot **c.** x-*i*ntercept **d.** vertex

13. What is the x- intercept of $3x + 2y = 12$?

a. (0, 3) **b.** (4, 0) **c.** (0, −3) **d.** (−4, 0)

14. Find the y-intercept of $2x - 5y = 20$?

a. (0, −4) **b.** (0, 4) **c.** (4, 0) **d.** (−4, 0)

15. The growth rate of two grocery stores A and B are represented by $y = 5x - 1$ and $y = 1 - 5x$, respectively. Which grocery store is more likely to fail?

a. both **b.** store *A* **c.** store *B* **d.** none

LESSON 1

SETTING THE PATH

MAKE RELATIONS FUNCTION

At the end of this lesson, you will be able to:

- illustrate polynomial functions (LS3MP-PA-PSE-JHS-68);
- evaluate functions (LS3MP-PA-PSE-JHS-70); and
- express satisfaction in mastery of new ways of thinking through application of mathematics (LS3MP-PA-PSE-AE-23).

LESSON 1

TRYING THIS OUT

Let us get to know your families. Ask help from three of you friends. Write down the name of your family member based on the relationship indicated in each number. Connect the names from the left to the correct partner on the right by drawing an arrow between them. Be ready to introduce your families to the class.

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

Nanay, Tatay, Guardian, or You	→	Tatay, Nanay, you, or Guardian

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

Children	→	Tatay, Nanay, or Guardian

3. Grandparent (choose Lolo or Lola) to grandchildren

Lolo or Lola	→	Grandchildren

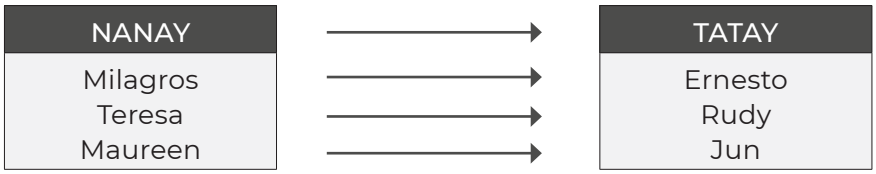
4. You and your siblings to your cousins

You and your siblings	→	Your cousins

LESSON 1

UNDERSTANDING WHAT YOU DID

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.



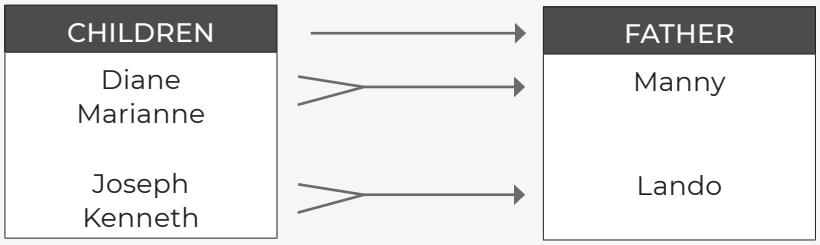
We can rewrite these connections as a set to summarize who are partners. To do so, we have to write the individuals connected with each other inside a parenthesis "( )" and separated by a comma " , ".

FUNCTIONS

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

Member of first group	Member of second group	Member of first group	Member of second group	Member of first group	Member of second group

Make sure to write the member of the first group before the member of the second group. Each pairing is called an **ordered pair**. A set of one or more ordered pairs is called a **relation**. Another example of a relation is shown below.



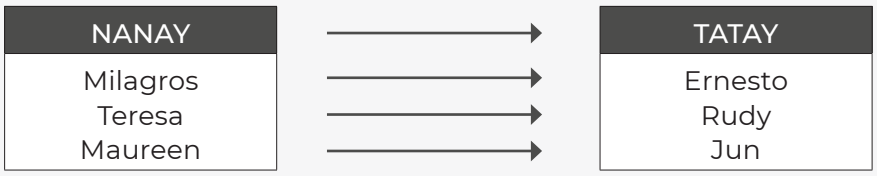
Children to Tatay : { (Diane, Manny), (Marianne, Manny), (Joseph, Lando), (Kenneth, Lando)}

FUNCTIONS

A special type of relation called a **function** follows a strict rule where each member in the first group has **exactly one partner** from the second group.

In the activity, the sets of spouses and children-to-parent are examples of functions as members of the first group has exactly one partner in the second group.

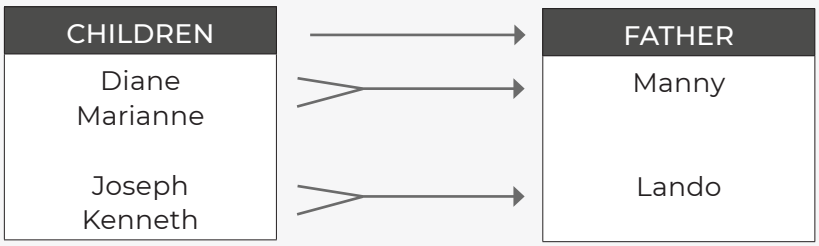
1. Spouse



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.

2. Children-to-parent

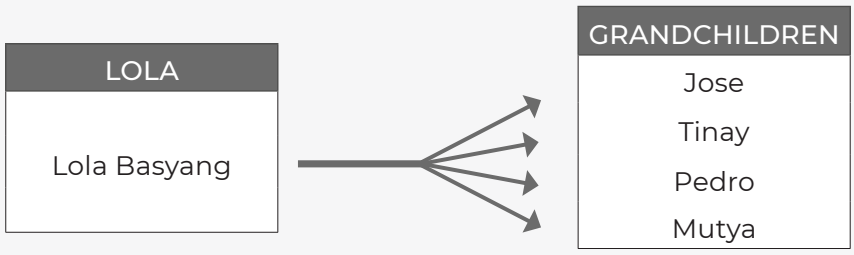


This is an example of a function because each child has exactly one father.

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.

On the other hand, the relation of grandparent to grandchildren is not a function because a lolo or lola can have many grandchildren.

3. 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).

EVALUATING FUNCTIONS

Mathematics also uses the concept of relations and functions to show numbers as a family.

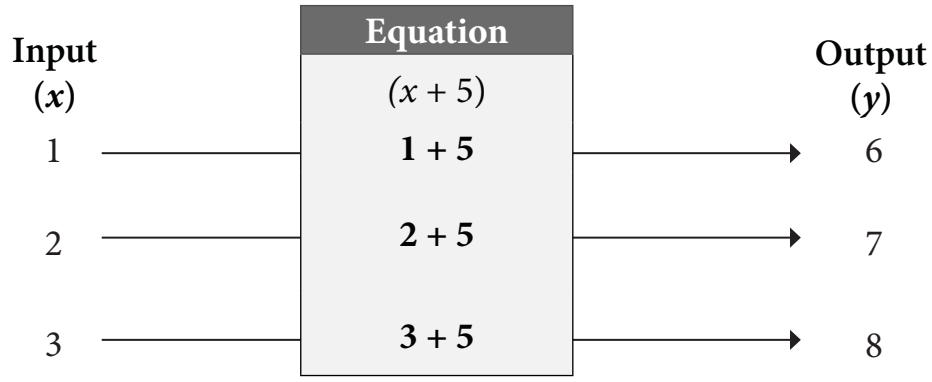
Example 1:

For the set of numbers $x = \{1, 2, 3\}$, find their partner numbers using "y" by adding 5 to each (in mathematical form, we define $y = x + 5$).

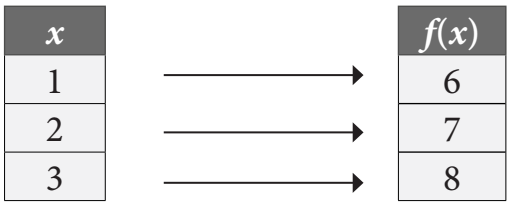
Imagine that we are processing the numbers, as shown below, by substituting each value in place of x:

Using $x = 1$,	Using $x = 2$,	Using $x = 3$,
$y = x + 5$	$y = x + 5$	$y = x + 5$
↓	↓	↓
$y = \mathbf{1} + 5$	$y = \mathbf{2} + 5$	$y = \mathbf{3} + 5$
Result	**Result**	**Result**
$\boldsymbol{y = 6}$	$\boldsymbol{y = 7}$	$\boldsymbol{y = 8}$

We can also imagine the mathematical process using this diagram



Instead of y, we can also represent the result using f(x) (read as "f of x").



This shows that these numbers can be made into ordered pairs (x, y) similar to a family, where they are all related using the equation $y = x + 5$. The ordered pairs produced by the function $y = x + 5$ for $x = 1, 2, 3$ are

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

This is read as "the set consisting of ordered pairs (1,6), (2,7), and (3,8).

Example 2:

Write the set of ordered pairs in the equation $f(x) = 2x - 1$ for $x = \{-1, 1, 3, 5\}$.

Using $x = -1$ $f(x) = 2x - 1$	Using $x = 1$ $f(x) = 2x - 1$	Using $x = 3$ $f(x) = 2x - 1$	Using $x = 5$ $f(x) = 2x - 1$
↓	↓	↓	↓
$f(x) = 2(-1) - 1$	$f(x) = 2(1) - 1$	$f(x) = 2(3) - 1$	$f(x) = 2(5) - 1$
$= -2 - 1$	$= 2 - 1$	$= 6 - 1$	$= 10 - 1$
$f(x) = -3$	$f(x) = 1$	$f(x) = 5$	$f(x) = 9$
(-1, -3)	**(1, 1)**	**(3, 5)**	**(5, 9)**

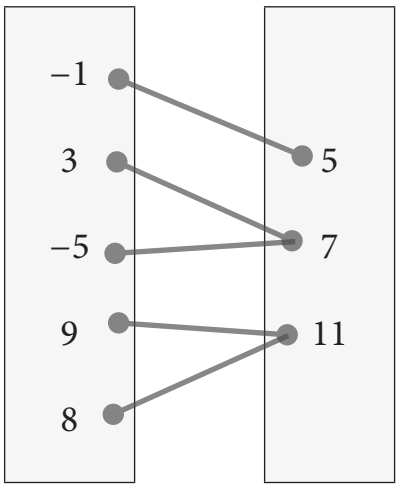
The ordered pairs in the function are {(-1, -3), (1, 1), (3, 5), (5, 9)}.

LESSON 1

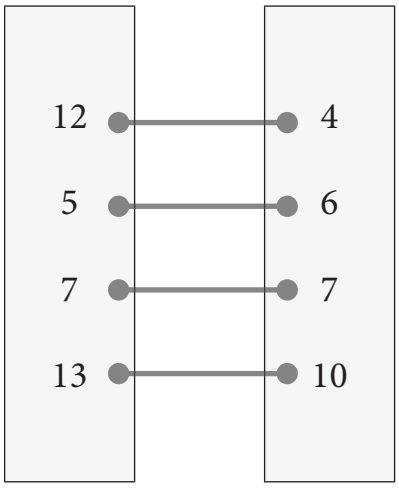
SHARPENING YOUR SKILLS

I. **Instructions:** On a separate sheet of paper, write the set of ordered pairs for each relation. Then, identify whether it is just a relation or function.

1.



2.



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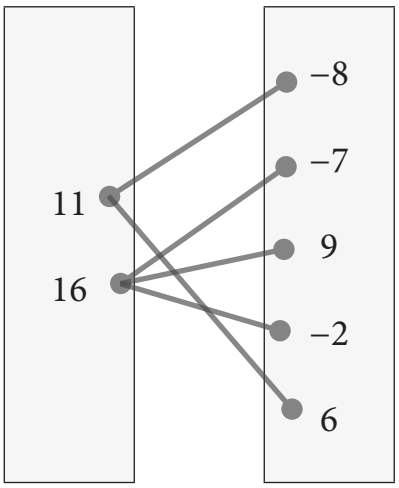
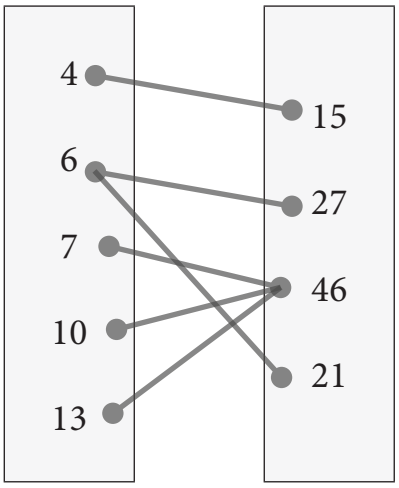


4.



II. Instructions: Determine the value of ***y*** by replacing ***x*** in each equation with the given value.

1. $y = 8x - 10$ $x = 6$

2. $y = -3x + 5$ $x = -1$

3. $y = 15 - 8x$ $x = 4$

4. $y = 2 + 7x$ $x = 1$

5. $y = -9x - 100$ $x = -10$

LESSON 1

TREADING THE ROAD TO MASTERY

Instructions: Solve the values of y for each given value of x. Then, write the set of ordered pairs for each equation.

1. $y = 2x + 7$

x	y	ORDERED PAIR
1		
2		
3		

2. $y = -3x + 1$

x	y	ORDERED PAIR
–1		
0		
1		

3. $y = -2x - 5$

x	y	ORDERED PAIR
–5		
–3		
–1		

4. $y = 4x - 7$

x	y	ORDERED PAIR
4		
6		
5		

LESSON 2

SETTING THE PATH

WHERE ARE YOU EXACTLY?

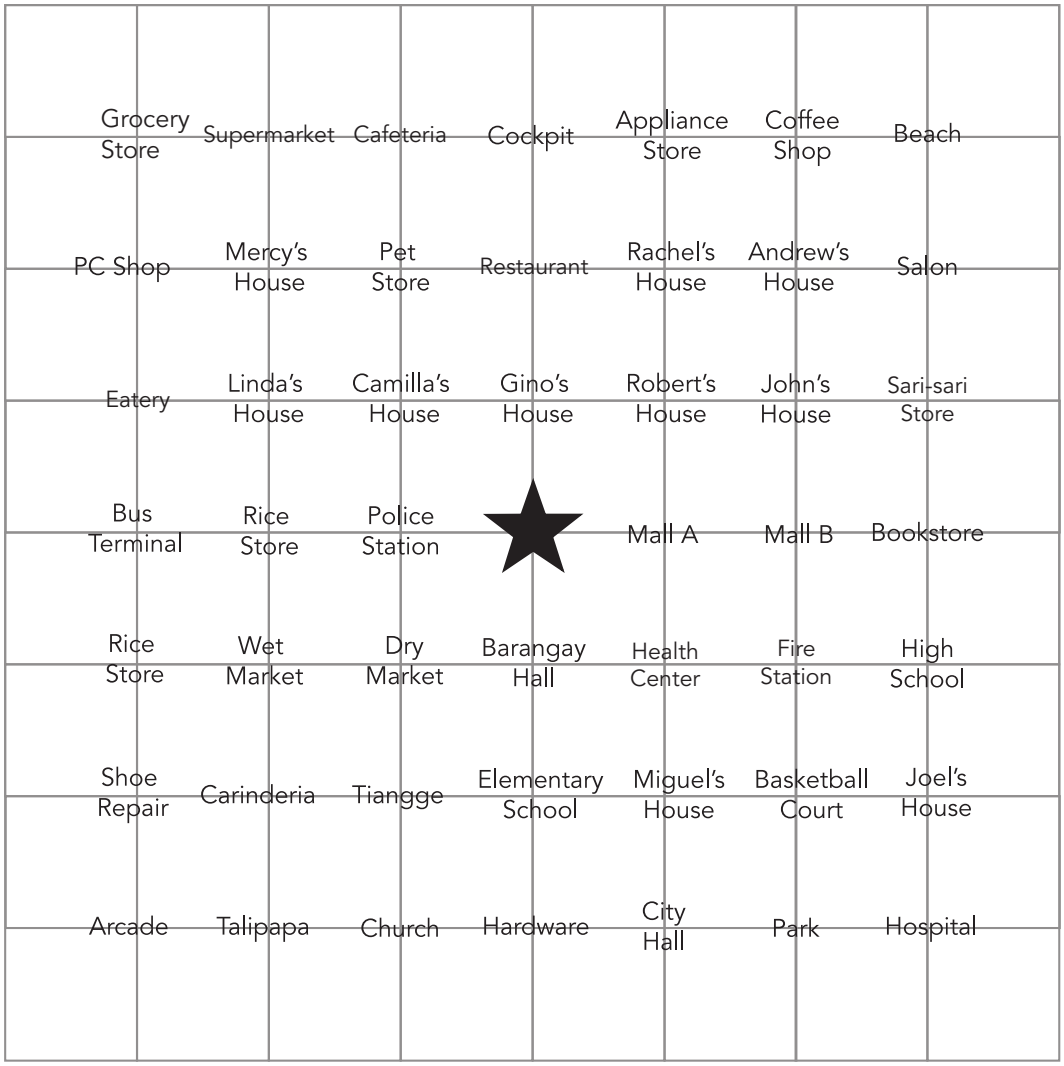
At the end of this lesson, you will be able to:

- illustrate the rectangular coordinate system and its use; (LS3MP-PA-PSE-JHS-38)
- define linear equations; and (LS3MP-PA-PSE-JHS-39)
- graph different types of linear equations (LS3MP-PA-PSE-JHS-44).

LESSON 2

TRYING THIS OUT

Instructions: Use the given map below to locate where Mang Neho is going. Follow the directions he inputs on his map application (app) 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, 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

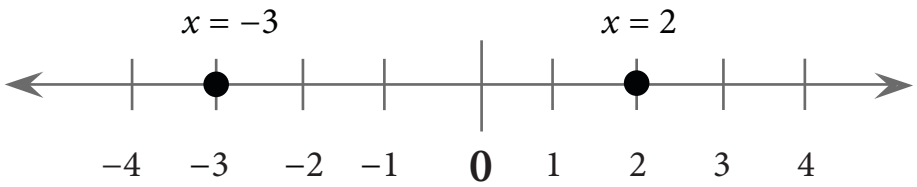
LESSON 2

UNDERSTANDING WHAT YOU DID

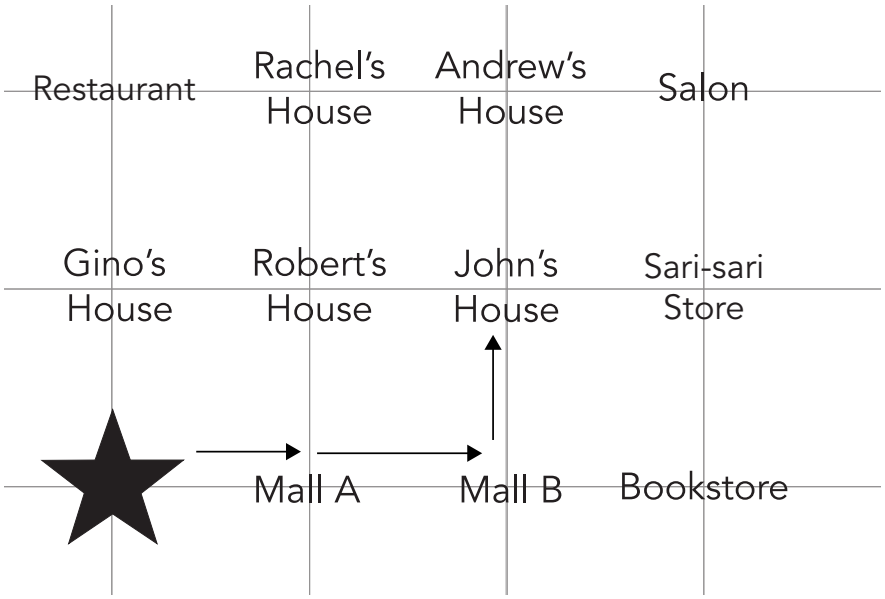
In the activity, we used numbers to describe exactly where a location is (2 left, 1 up) with respect to a fixed point (the star). In mathematics, we also use a similar system to demonstrate where points are in a given plane.

We use a number line to describe where a number is from fixed point (usually from zero). But locating a point in this number line only moves in the horizontal direction (left or right only).

Example: Shown here is the location of $x = -3$ and $x = 2$.

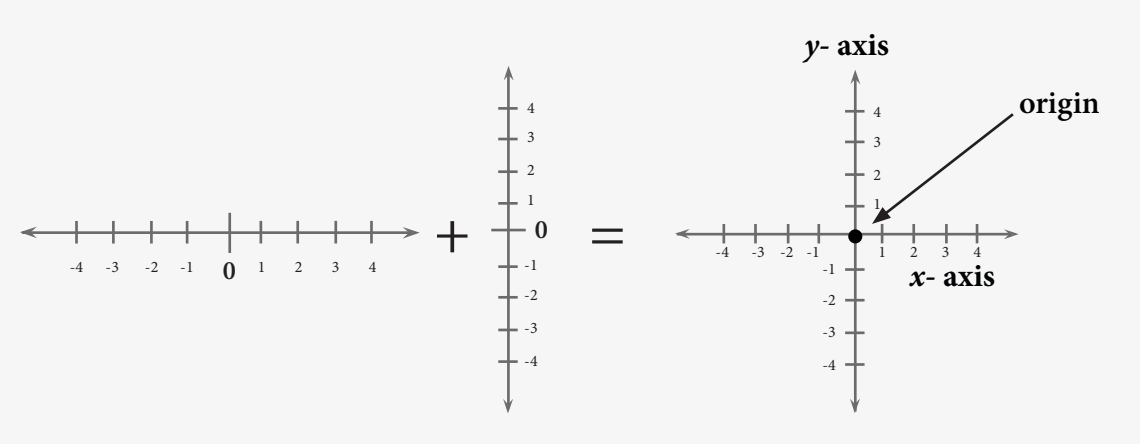


However, each location in a space, like in the map we used, is accessible by moving in **two directions,** horizontal (left or right) and vertical (upward or downward). For example, when moving 2 to the right and 1 upwards, these two movements end up in John's house.



RECTANGULAR COORDINATE SYSTEM

To locate points in a plane, we use the **rectangular coordinate system**. This is made up of two perpendicular number lines, where one is horizontal and the other is vertical. The rectangular coordinate system is also called the **Cartesian plane.**



The two lines intersect at their zeroes called **the origin**. Each number line in the rectangular coordinate system is referred to as an **axis.** The **x-axis** is the horizontal line, while the **y-axis** is the vertical line.

Points on the rectangular coordinate system are represented by an **ordered pair** that we have learned in Lesson 1. Ordered pairs are also called **coordinates.** In an ordered pair, the first number is the x- coordinate and the second number is the y- coordinate.

The movement of the point is identified by the *x*- coordinate in the *x*- axis (left or right) first, followed by the *y*- coordinate in the *y*- axis (up or down).

Examples:

In the point (2, –5), 2 is the horizontal movement and –5 is the vertical movement.

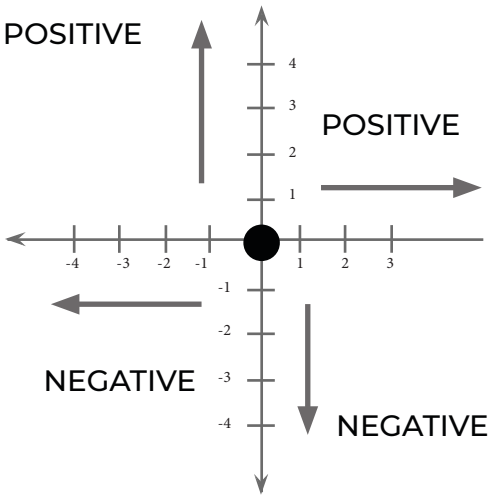
In the point (-3, 1), –3 is the horizontal movement and 1 is the vertical movement.

PLOTTING POINTS AND EQUATION IN THE RECTANGULAR COORDINATE SYSTEM

Locating points in the rectangular coordinate system is called **plotting of points.** We follow these rules to determine the signs of numbers in 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.



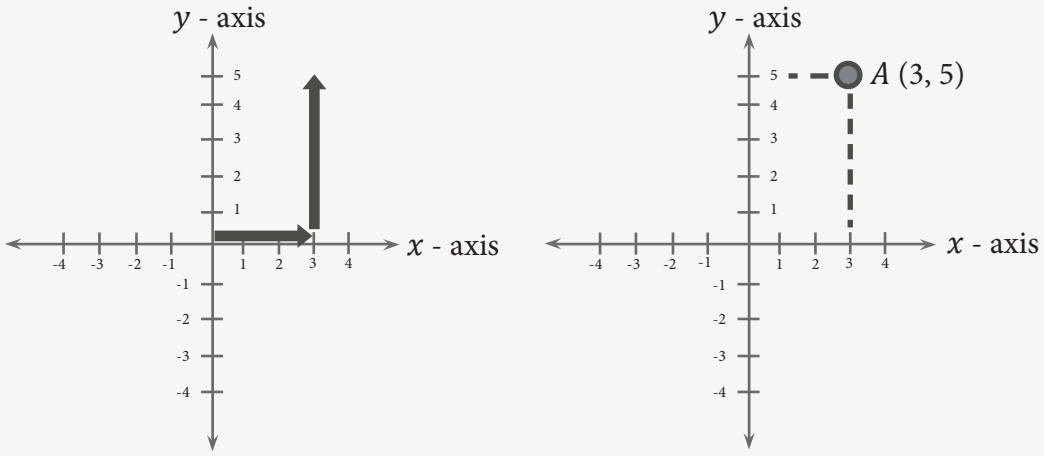
Example 1: Plot the following points on the rectangular coordinate system.

$A\ (3, 5)$ $B\ (-1, 2)$ $C\ (-4, -3)$ $D(2, -4)$

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

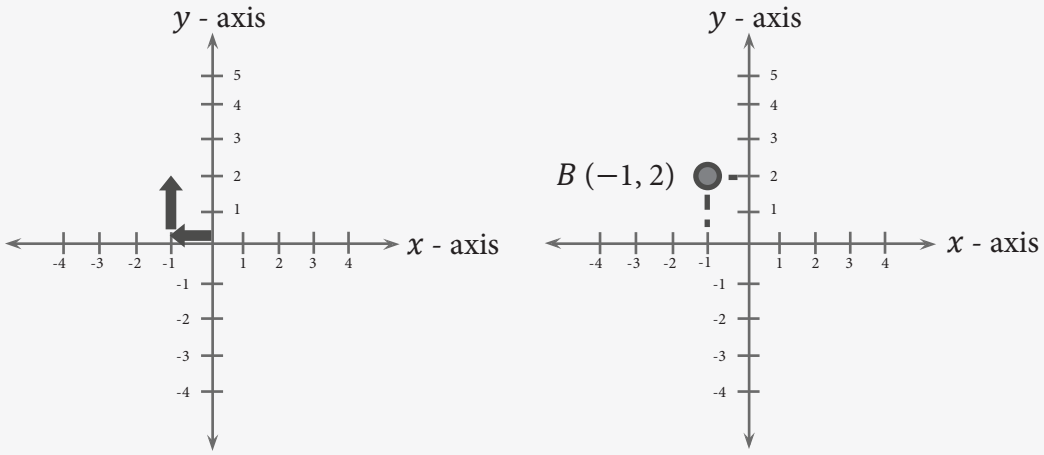
Continuation on the next page.

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



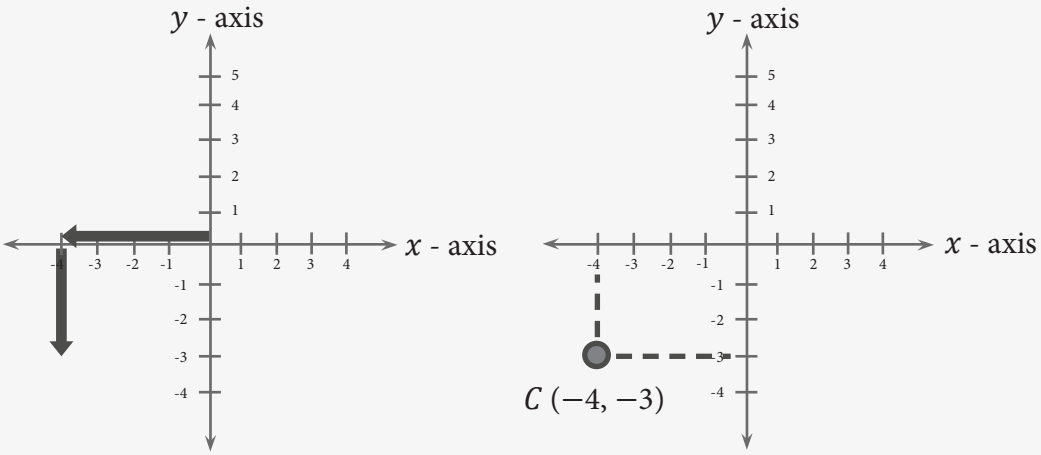
Plotting $B(-1,2)$ means -1 is the movement on the x-axis and 2 is the movement on the y-axis:

−1 (negative) means we move 1 unit to the left
2 (positive) means we move 2 units upwards



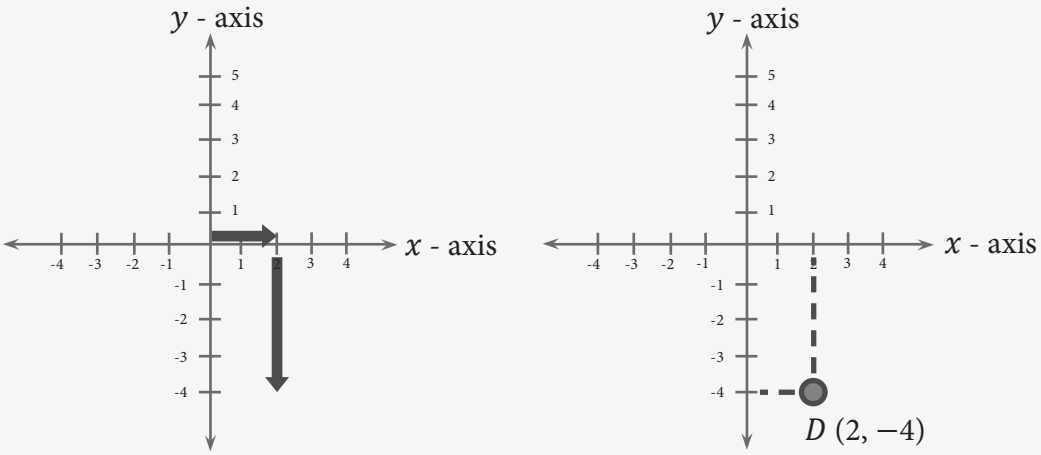
Plotting $C(-4, -3)$ means -4 is the movement on the x-axis and -3 is the movement on the y-axis:

−4 (negative) means we move 4 units to the left
−3 (negative) means we move 3 units downwards



Plotting $D(2, -4)$ means 2 is the movement on the x-axis and -4 is the movement on the y-axis:

2 (positive) means we move 2 units to the right
−4 (negative) means we move 4 units downwards



Example 2. Plot the equation $y = 2x + 1$.

Remember in Lesson 1, we found out that equations can give us ordered pairs. To do so, think of at least three numbers you like to substitute with the variable x.

Let us use small numbers such as 1, 2, and 3 to replace x. But you can try other numbers you want.

Using $x = -1$,

$$\begin{aligned} y &= 2x + 1 \\ &= 2(1) + 1 \\ &= 2 + 1 \\ &= 3 \end{aligned}$$

$(1, 3)$

Using $x = 2$,

$$\begin{aligned} y &= 2x + 1 \\ &= 2(2) + 1 \\ &= 4 + 1 \\ &= 5 \end{aligned}$$

$(2, 5)$

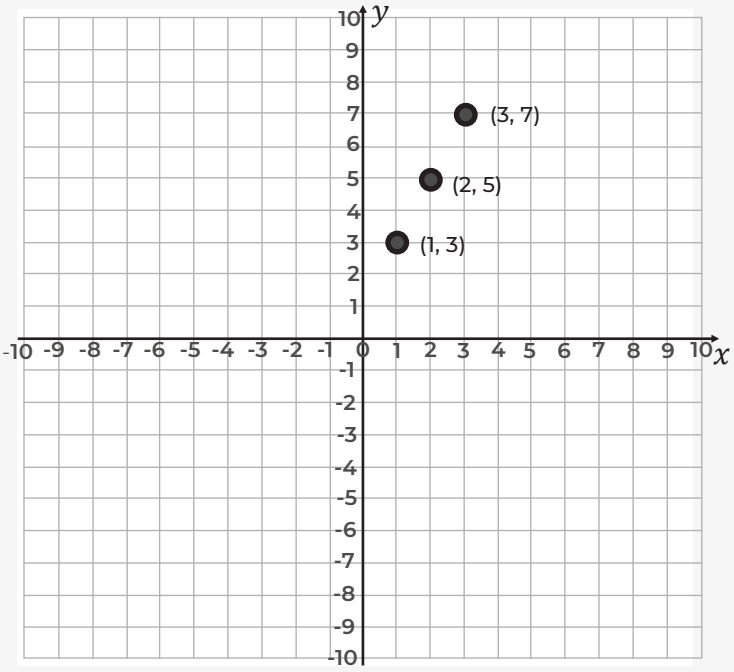
Using $x = 3$,

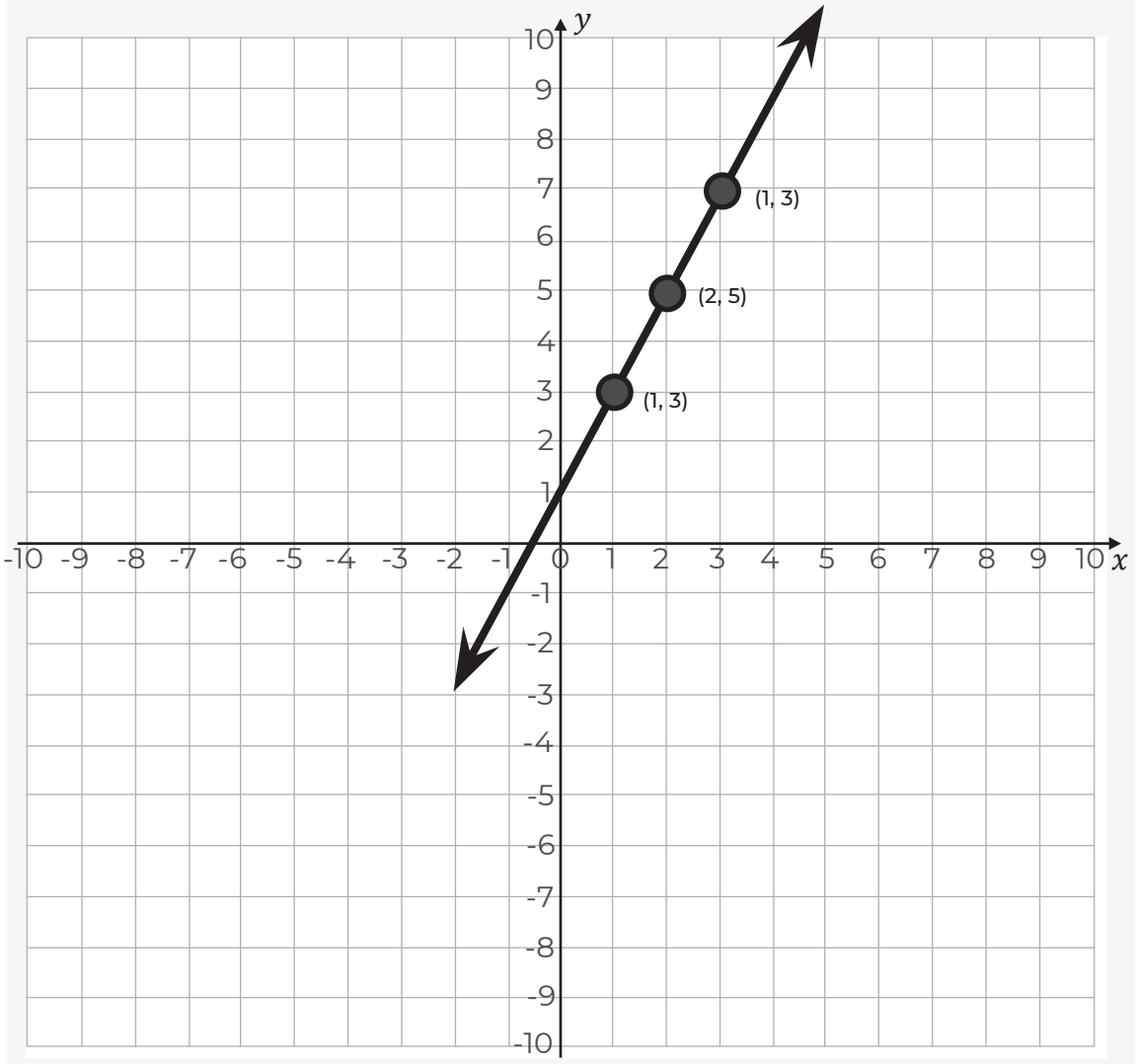
$$\begin{aligned} y &= 2x + 1 \\ &= 2(3) + 1 \\ &= 6 + 1 \\ &= 7 \end{aligned}$$

$(3, 7)$

Using these ordered pairs, we can now plot the equation in the rectangular coordinate system.

Since the ordered pairs come from the equation $y = 2x + 1$, we need to show that they belong to the same family by connecting them using a line.





This kind of function represented by a line in the rectangular coordinate system is called a **linear function.**

Example 3. Plot the equation $y = 4$.

First, we need to replace the variable x to get ordered pairs.

Let us use $x = \{1, 3, 5\}$. However, $y = 4$ does not have an x-variable. This only means that x is being multiplied by zero (0). The equation can be rewritten as:

$$y = 0x + 4$$

Using $x = 1$,

$$\begin{aligned} y &= 0x + 4 \\ &= 0(1) + 4 \\ &= 0 + 4 \\ &= 4 \end{aligned}$$

$(1, 4)$

Using $x = 3$,

$$\begin{aligned} y &= 0x + 4 \\ &= 0(3) + 4 \\ &= 0 + 4 \\ &= 4 \end{aligned}$$

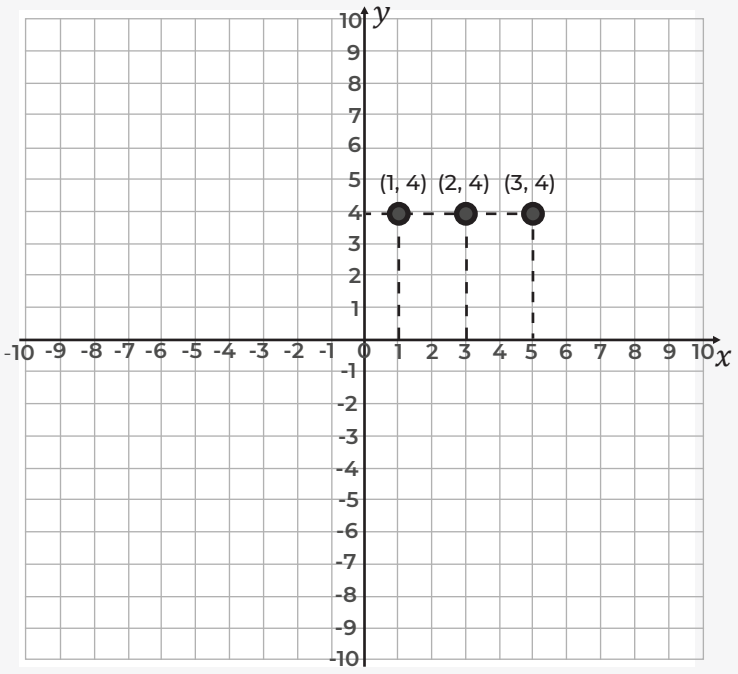
$(3, 4)$

Using $x = 5$,

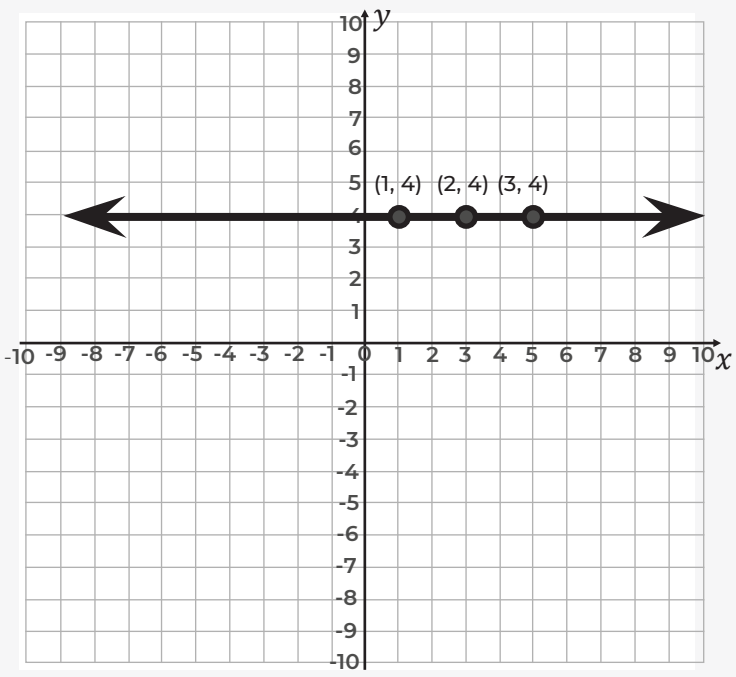
$$\begin{aligned} y &= 0x + 4 \\ &= 0(5) + 4 \\ &= 0 + 4 \\ &= 4 \end{aligned}$$

$(5, 4)$

Plot the points in the rectangular coordinate system.



Connecting the points, we now get the line representing $y = 4$.



LESSON 2

SHARPENING YOUR SKILLS

Place your answers on a separate sheet of paper.

I. Identify the movement and direction of the ordered pairs in each axis when plotted in the rectangular coordinate system. Then, plot the point.

	movement on *x*-axis	movement on *y*-axis
1. (2, 5)		
2. (−3, −2)		
3. (−4, 7)		
4. (6, −1)		
5. (−15, 12)		
6. (21, −10)		
7. (−7, −8)		
8. (9, 0)		
9. (0, −11)		
10. (−25, −45)		

II. Create a rectangular coordinate system with an interval of 1 for each item. Then, plot the point.

1. $(-3, -5)$
2. $(4, 7)$
3. $(6, -1)$
4. $(-3, 8)$
5. $(0, 5)$

LESSON 2

TREADING THE ROAD TO MASTERY

Instructions: Solve for the values of y for each given value of x. Write the set of ordered pairs for each equation on the space provided. Then, plot the points in the rectangular coordinate system. Do the graph in a separate sheet of paper.

1. $y = x + 5$

x	y	ORDERED PAIR
1		
2		
3		

2. $y = 2x - 3$

x	y	ORDERED PAIR
-1		
0		
1		

3. $y = 2 - 4x$

x	y	ORDERED PAIR
0		
1		
2		

4. $y = 4x - 7$

x	y	ORDERED PAIR
3		
4		
5		

5. $y = -4 - 6x$

x	y	ORDERED PAIR
−3		
−2		
−1		

LESSON 3

SETTING THE PATH

WATCH YOUR STEEP

At the end of this lesson, you will be able to:

- find the slope of linear equations (LS3MP-PA-PSE-JHS-43);
- find the intercepts of linear equations, both x- and y- intercepts (LS3MP-PA-PSE-JHS-34);
- describe the slope and intercepts of linear equation based on the graph(LS3MP-PA-PSE-JHS-45); and
- express satisfaction in mastery of new ways of thinking through application of mathematics (LS3MP-NS-PSA-BL/LE/AE/JHS-3).

LESSON 3
TRYING THIS OUT

Mang Neho now asks for your help in further answering some questions that involve the use of linear functions, so he can make a more informed decision in each scenario. Use graphing of linear equations in each scenario to make comparisons. Explain your answer. Write your answers on a separate sheet of paper.

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. Fill the regions of the pie chart with the correct name on the list using their values.

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

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 researched on the internet that the property values follow the given equations. Which is a better investment?

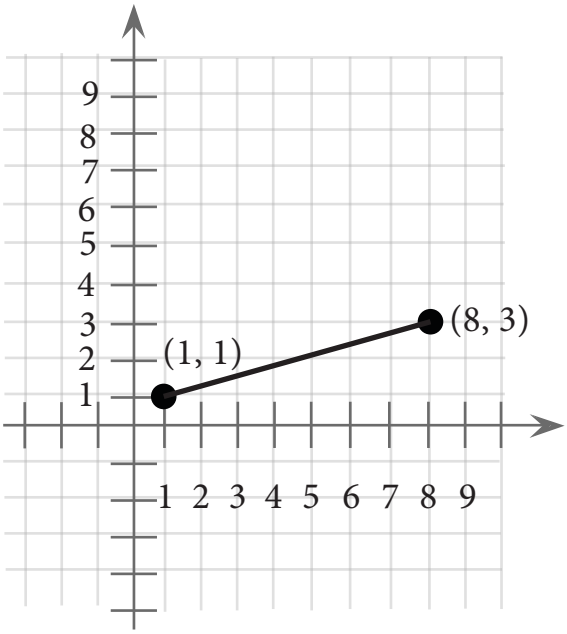
Farmland	$y = 1 + 2x$
Car	$y = 5 - 2x$

LESSON 3

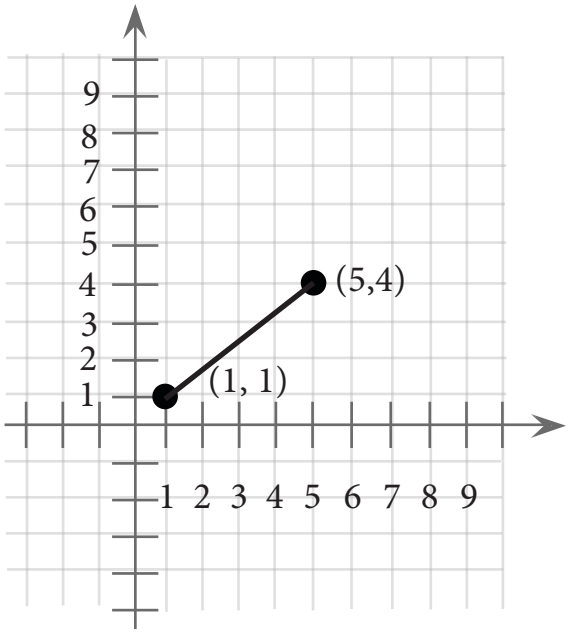
UNDERSTANDING WHAT YOU DID

Let us discuss the scenarios and the better options that Mang Neho can choose with your help.

In number 1, if Mang Neho wants to avoid the more dangerous road, we have to look at the elevation of the roads using the graph of the points in the rectangular coordinate system.



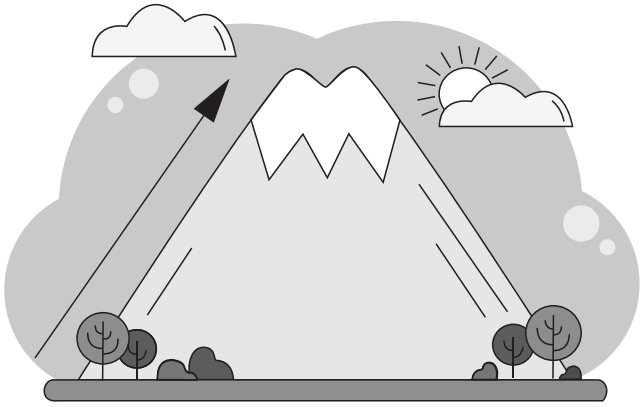
Road A



Road B

Based on the graph, it is easy 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.

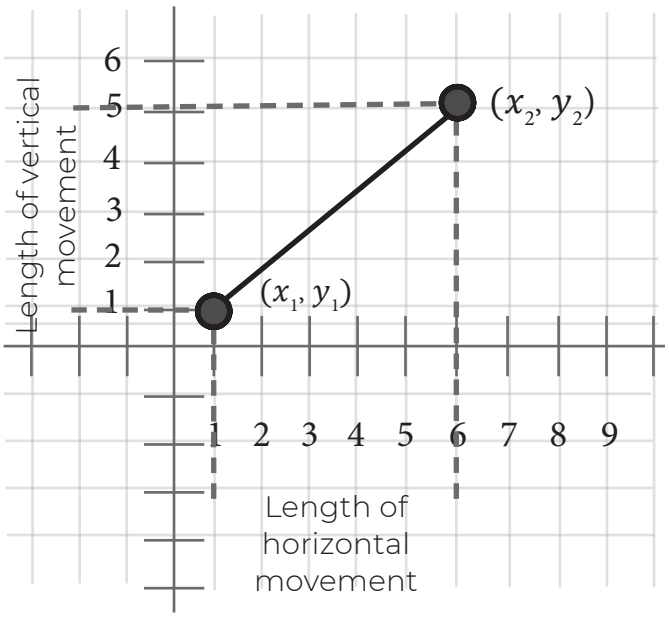
SLOPE OF A LINE



In mathematics, the measure of the steepness of a line is called the **slope.** The slope is denoted by the variable "m". When you say slope, the first thing that might come into your mind is the side of the mountain just like the image on the right.

The slope of a line in the rectangular coordinate system is the ratio between the difference of the vertical movement and the difference of the horizontal movement from one point to another.

Let us call the starting point P_1 with coordinates (x_1,y_1) and endpoint P_2 with coordinates (x_2, y_2), and connect these two points, as shown on the right.



Since slope is the ratio between the difference of the vertical movement and the difference of the horizontal movement, we have the following formula for the slope:

$$m = \frac{\text{difference in } y\text{-values}}{\text{difference in } x\text{-values}} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

In this formula, we subtract the y-values and the x-values, then divide the differences.

Example 1. Using number 1 in the activity, let us compute for the slope of the two roads using the given points for each.

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

Align the x- values and y- values before setting up to solve for the slope.

ROAD A

$$(8, 3)$$
$$(1, 1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 1}{8 - 1} = \frac{2}{7}$$

ROAD B

$$(5, 4)$$
$$(1, 1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 1}{5 - 1} = \frac{3}{4}$$

Comparing the values of the slopes (m), the slope of Road A is less than the slope of Road B. This confirms our observation that Road A is safer than road because it is less steep.

Example 2. Find the slope of the line containing the given points.

a. (2,3) and (1,1)
b. (0,-3) and (5,-5)
c. (-1,2) and (3,2)

In all these items, we will be using the formula for slope,

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

a. (2, 3) and (1, 1)
$\downarrow\downarrow \quad \downarrow\downarrow$
$x_1\, y_1 \quad x_2\, y_2$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 3}{1 - 2} = \frac{-2}{-1} = 2$$

b. (0, −3) and (5, −5)
$\downarrow \; \downarrow \quad \downarrow \; \downarrow$
$x_1 \; y_1 \quad x_2 \; y_2$

Continuation on the next page

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5 - (-3)}{5 - 0} = \frac{-5 + 3}{5} = \frac{-2}{5} = -\frac{2}{5}$$

a. $(-1, 2)$ and $(3, 2)$
$\downarrow\downarrow \quad \downarrow\downarrow$
$x_1\, y_1 \quad x_2\, y_2$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 2}{3 - (-1)} = \frac{0}{3 + 1} = \frac{0}{4} = 0$$

The slope of a line can also tell us the trend or movement of values and predicting success or failure of investments, budgeting and the likes.

Example 3. We can compare the performance of the two companies offering a car insurance to Mang Neho by plotting the equation on a rectangular coordinate system. Since we know that the equations will generate a line, we only need to get two points to connect.

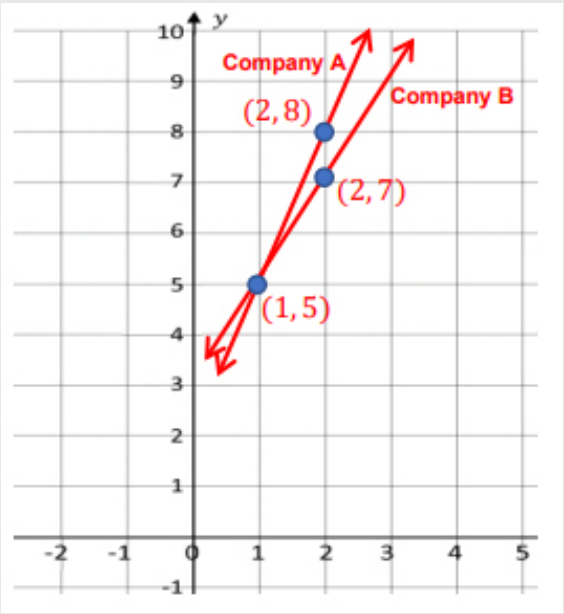
Continuation on the next page

Company A yearly growth: $y = 3x + 2$			
x	y	ordered pair	slope
1	5	(1, 5)	$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8 - 5}{2 - 1} = \frac{3}{1}$
2	8	(2, 8)	$m = 3$

Company B yearly growth: $y = 2x + 3$			
x	y	ordered pair	slope
1	5	(1, 5)	$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 5}{2 - 1} = \frac{2}{1}$
2	7	(2, 7)	$m = 2$

We plot the ordered pairs and connect them. The graphs of the lines are shown on the right.

Observe from the graphs that the slope of the line for Company A is steeper than the slope of the line for Company B.



Lines that are steeper or has a greater slope means that it increases faster than lines with lesser slope. This means that Company A has better performance than Company B due to its growth.

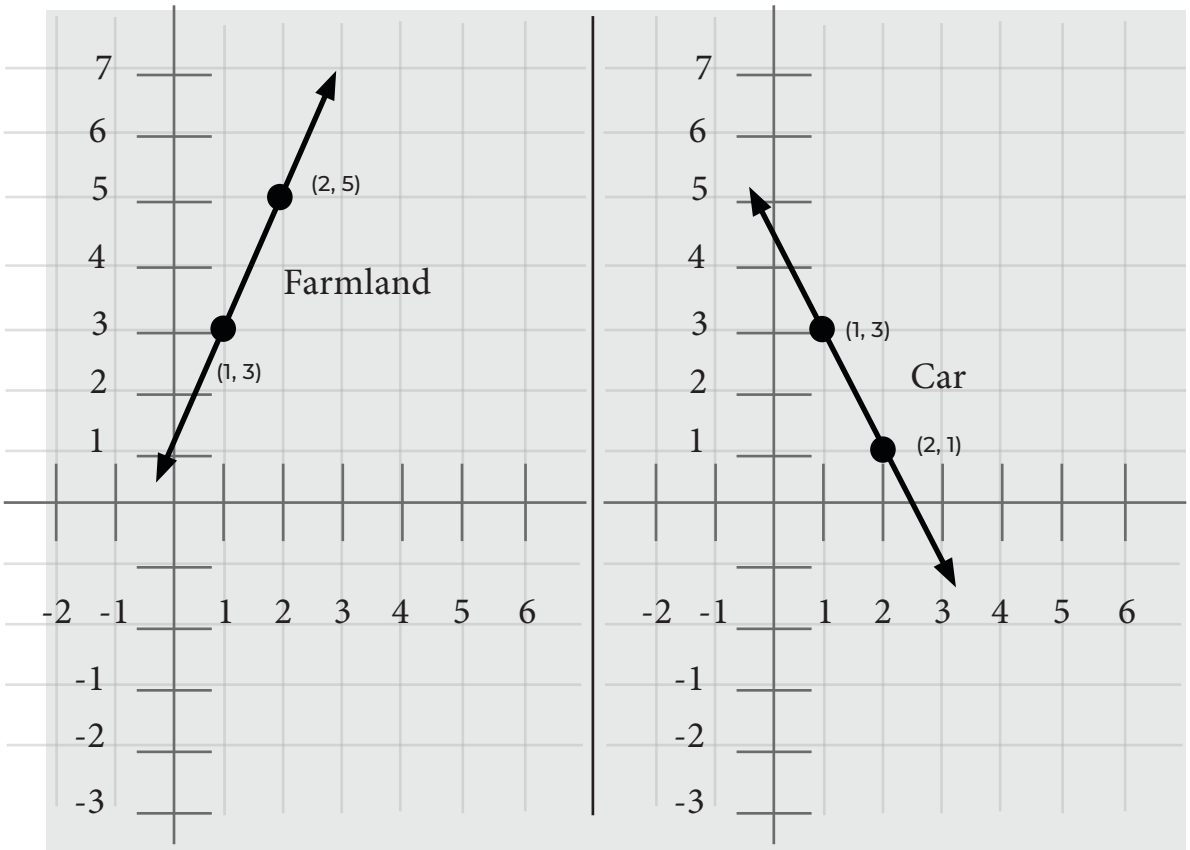
Example 4. If we need to compare car and farmland in terms of investments over time, we can graph the lines on the rectangular coordinate system and find their slopes.

Farmland: $y = 1 + 2x$			
x	y	ordered pair	Slope
1	3	(1, 3)	$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5-3}{2-1} = \frac{2}{1}$
2	5	(2, 5)	$m = 2$

Car: $y = 5 - 2x$			
x	y	ordered pair	Slope
1	3	(1, 3)	$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1-3}{2-1} = \frac{-2}{1}$
2	1	(2, 1)	$m = -2$

We plot the ordered pairs and connect them. The graphs of the lines are shown on the next page.

Continuation on the next page



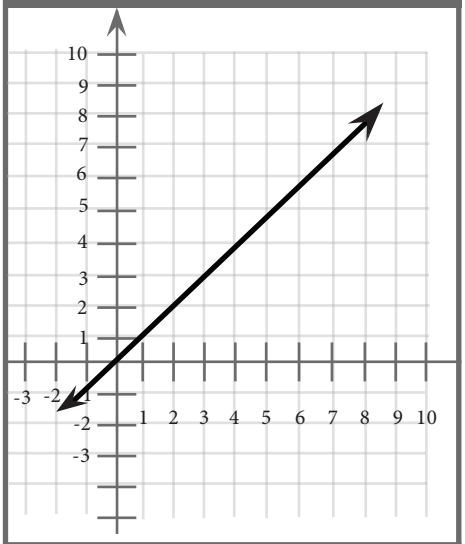
Observe that the lines representing the property values of the farmland and the car have different directions. The line representing the investment in farmland rises from left to right while the line representing the investment in car goes down from left to right.

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

In addition, we can see that the slope of the line for farmland is positive while the slope of the line for car is negative.

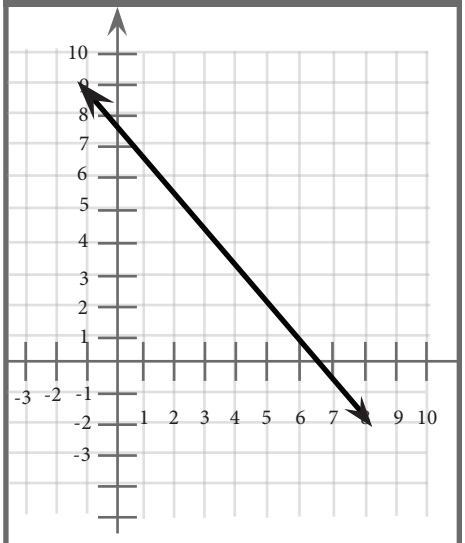
We can tell if the slope is positive, negative, zero, or undefined by looking at the graph of a line—without calculation. It can be summarized in the table below.

POSITIVE SLOPE



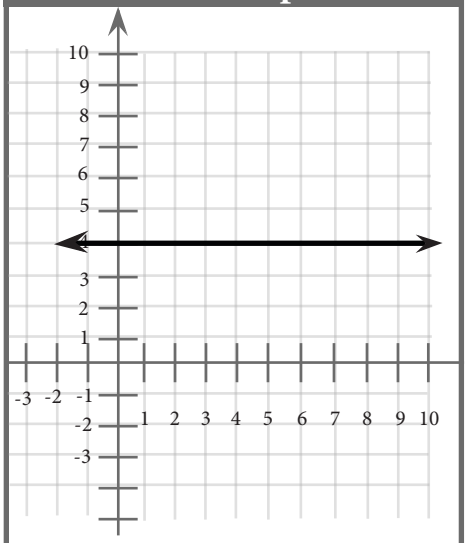
Line goes **upward** from left to right.

NEGATIVE SLOPE



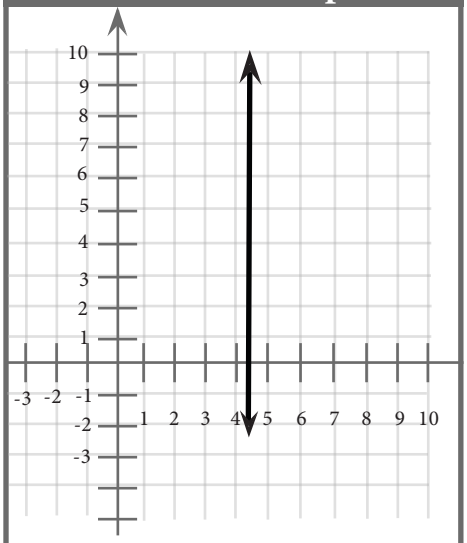
Line goes **downward** from left to right.

Zero slope



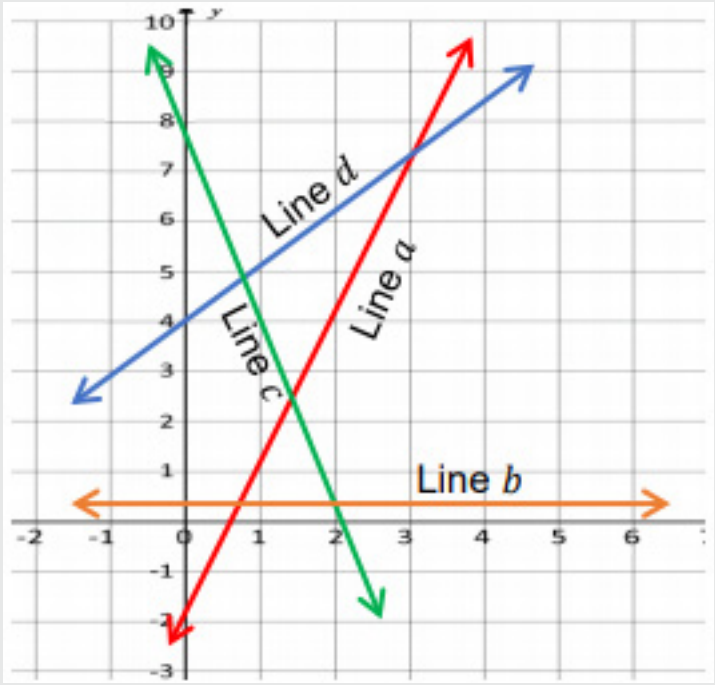
Line is horizontal.

Undefined slope



Line is vertical.

Example 5: Describe the slope based on the graph of the following linear equations:



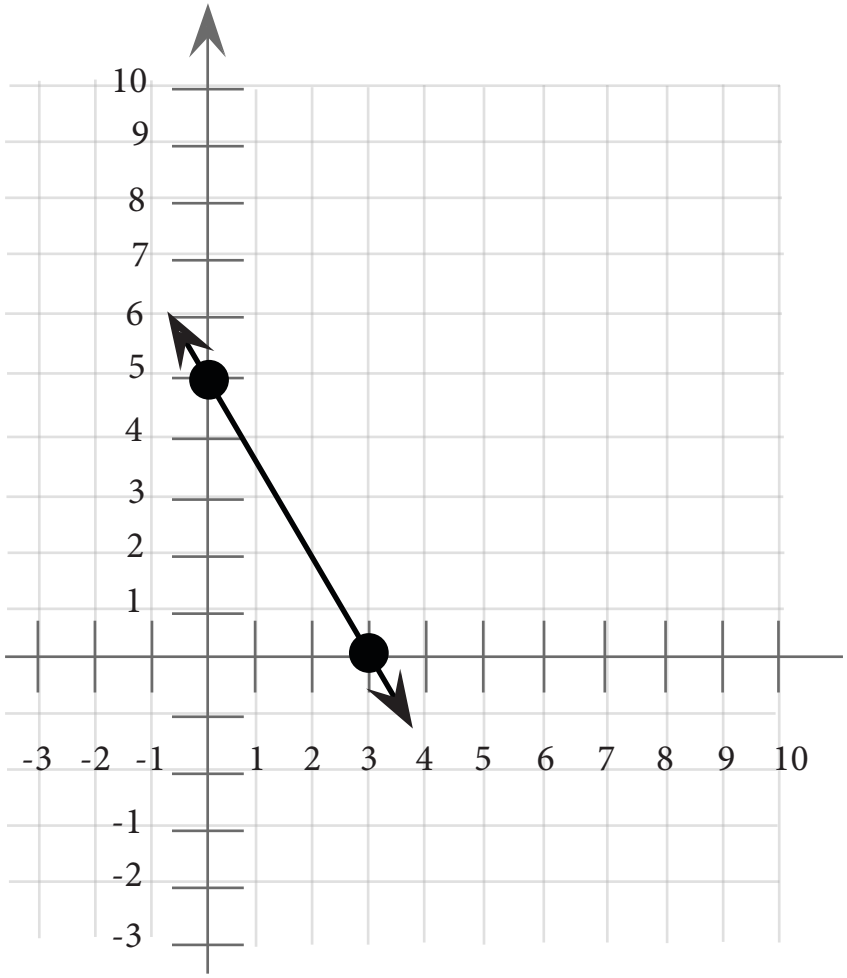
Lines a and d have positive slope because they rise from left to right. Line b has a slope of 0 because it is horizontal. Line c has a negative slope because it goes downward from left to right.

INTERCEPTS OF A LINEAR EQUATION

The intercepts of a linear equation are important when graphing lines. The intercepts are where the graph intersects or crosses the axes.

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

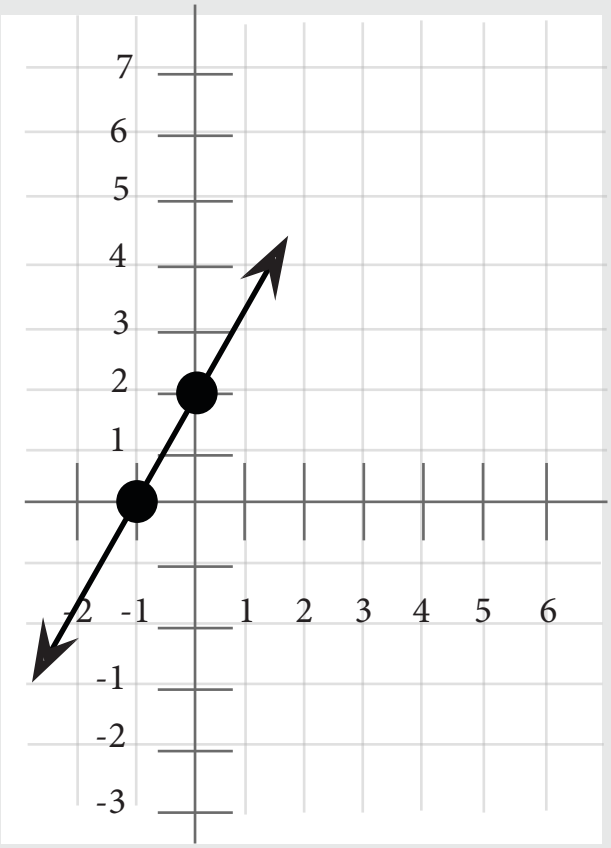
In the graph below, we can see that the line crosses the x-axis at the point (3, 0). This means that the x-intercept is (3, 0). On the other hand, the line intersects the y-axis at the point (0, 5). This implies that (0, 5) is the y-intercept.



Observe the intercepts of the line carefully. For the x-intercept (3, 0), we can see that the y-coordinate of the point is 0. For the y-intercept (0, 5), the x-coordinate of the point is 0. Applying this observation in terms of equations, we can also say that

- the ***x*-intercept** is a point in the equation where the y-value is 0; and
- the ***y*-intercept** is a point in the equation where the x-value is 0.

Example 1. Find the x- and y-interecpts in the graph below.



Look where the graph crosses the x-axis, which tells us the x-intercept. Thus, $(-1,0)$ is the x-intercept. Now, look where the graph intersects the y-axis. This gives us the y-intercept. Hence, the y-intercept is $(0,2)$.

Example 2. Find the intercepts of the given linear equation.

a. $3x + 2y = 12$
b. $-3x + 5y = -30$
c. $2x - 4y = -16$

To find the intercepts, we should replace one variable with 0 and solve for the other.

a. $3x + 2y = 12$

To find the x-intercept, replace y with 0 and solve for x.	**To find the y-intercept, replace x with 0 and solve for y.**
$3x + 2y = 12$ $3x + 2\,(0) = 12$ $3x + 0 = 12$ $3x = 12$ $x = 4$ The x- intercept is (4, 0).	$3x + 2y = 12$ $3\,(0) + 2y = 12$ $0 + 2y = 12$ $2y = 12$ $y = 6$ The y- intercept is (0, 6).

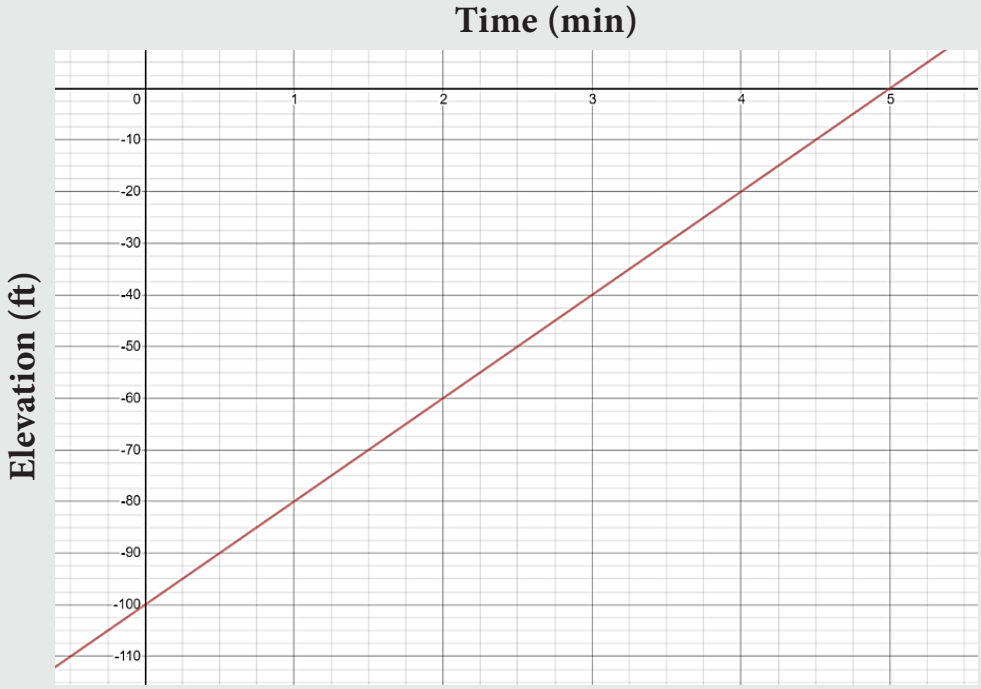
a. $-3x + 5y = -30$

To find the x-intercept, replace y with 0 and solve for x.	To find the y-intercept, replace x with 0 and solve for y.
$-3x + 5y = -30$ $-3x + 5\,(0) = -30$ $-3x + 0 = -30$ $-3x = -30$ $x = 10$ The x- intercept is $(10, 0)$.	$-3x + 5y = -30$ $-3(0) + 5y = -30$ $0 + 5y = -30$ $5y = -30$ $y = -6$ The y- intercept is $(0, -6)$.

b. $2x - 4y = -16$

To find the x-intercept, replace y with 0 and solve for x.	To find the y-intercept, replace x with 0 and solve for y.
$2x - 4y = -16$ $2x - 4\,(0) = -16$ $2x - 0 = -16$ $2x = -16$ $x = -8$ The x- intercept is $(-8, 0)$.	$2x - 4y = -16$ $2\,(0) - 4y = -16$ $0 - 4y = -16$ $-4y = -16$ $y = 4$ The y- intercept is $(0, 4)$.

Example 3. A fisherman dove into the ocean 100 ft below the surface and then rose at a rate of 20 feet per minute. The graph below shows the fisherman's elevation below sea level during the rise. Describe the x- and y- intercept based on the graph.



The x-intercept is (5, 0). This means that the fisherman will reach the surface after 5 minutes. The y-intercept is (0, −100). This means that the fisherman is 100 ft below the surface at the start of the elevation.

LESSON 3

SHARPENING YOUR SKILLS

Write your answers on a separate sheet of paper.

I. Graph the line containing the given points and find the slope using the formula.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

1. Line containing the points (3, 1) and (2, 4)
2. Line containing the points (-4, 3) and (-5, 2)
3. Line containing the points (-2, -1) and (1, 3)

II. Graph the line and describe the slope based on the graph.

1. Line with equation $y = 2x - 1$ using $x = 2$ and $x = 3$.
2. Line with equation $y = 3 - 5x$ using $x = -1$ and $x = 2$.

III. Find the x- and y-intercepts of the line represented by each equation. Verify the intercepts by graphing the line.

1. $3x + 4y = 24$
2. $3x - 4y = 12$
3. $x - 3y = 6$

LESSON 3

TREADING THE ROAD TO MASTERY

Solve the following word problems on a separate sheet of paper.

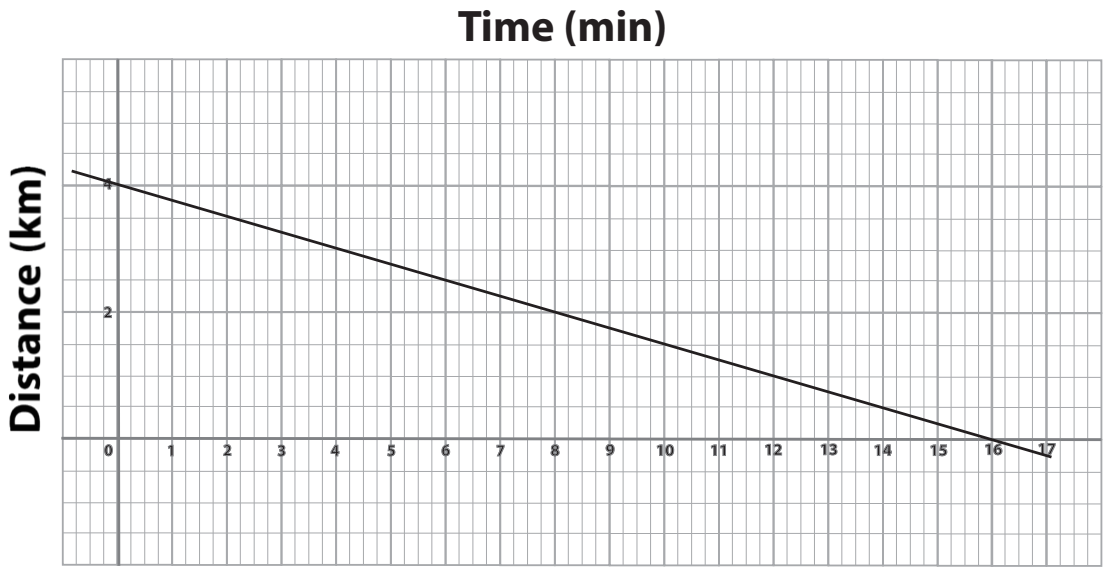
1. The lines describing the performances of James and Michael include the following points (describing shots made and shots attempted). Using the slope, who has a better increase in performance? Why?

Michael	James
(1, 2)	(1, 5)
(4, 8)	(3, 7)

2. Which bank will you choose to open an account at given their investment interest as represented by the following equations? Using the values $x = 1$ and $x = 2$, find the slopes to compare their investment interests.

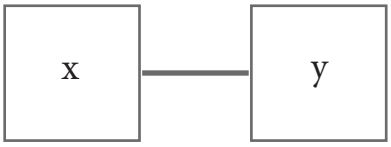
ABC Bank	LMN Bank
y = 6 + 3x	y = 4x + 1

3. Mark joined a 4-km race. Let x represent the time (in minutes) and y represent his distance from the finish line (in kilometers). His distance is represented by $y = 4 - \frac{1}{4}x$, shown on the next page. Find and describe the intercepts.


Time (min)
Distance (km)
4
2
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

DON'T FORGET

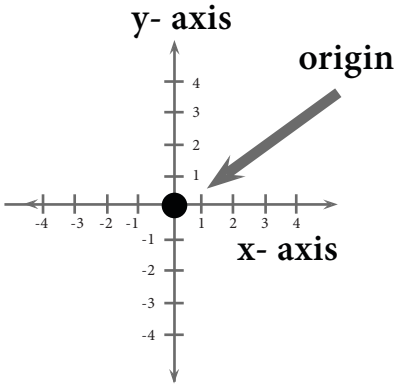
- A **relation** is a non-empty set of ordered pairs of objects enclosed in "( )". The first value in an ordered pair comes from the first set and the second value comes from the second set.



ordered pair: (x, y)

- A **function** is a special type of relation where each value from the first set has exactly one partner from the second set.

- The **rectangular coordinate system (Cartesian plane)** is an intersection of a vertical number line and a horizontal number line perpendicular to each other that meet at their zeros called the **origin (0, 0).**



- Each number line is called an **axis.** The horizontal number line is the **x- axis** and the vertical number line is the **y- axis.**

- An ordered pair represents a point on the rectangular coordinate system, where the first number is the horizontal movement parallel to the *x*- axis and the second number is the vertical movement parallel the *y*- axis.

- A mathematical equation with two variables (usually "*x*" and "*y*") is an example of a function as it maps out values of x to a partner value of y using substitution.

  If $x = 1$ in the equation $y = x + 1$, then

  $$y = x + 1$$
  $$y = 1 + 1$$
  $$y = 2$$

  Therefore, the ordered pair is (1, 2).

- Equations that form straight lines when the ordered pairs are plotted in the rectangular coordinate system are called **linear functions.**

- Given two points (x_1, y_1) and (x_2, y_2) on the line, the **slope** of a line can be computed using the formula

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

- The slope measures the steepness of a line. The higher the value of the slope, the steeper the line.

- Slopes can also be described based on the graph of a line. A line going in an upward direction from left to right has a positive slope. A line going in a downward direction from left to right has a negative slope. A horizontal line has zero slope. A vertical line has an undefined slope.

- The x- intercept is the point where the line crosses the x- axis. It is also the point whose y- value is 0. The y- intercept is the point where the line intersects the y- axis. It is also the point whose x- value is 0.

MODULE 3

EXPLORE MORE

If you wish to study further, here are some additional materials you can refer to:

"Plotting Points on the Cartesian Plane" through https://www.youtube.com/watch?v=VDONZfzIDJU

"**Central Tendency of Grouped Data**" through https://www.youtube.com/watch?v=pd1A_HWA24k

"Plotting Points on the Coordinate Plane" through https://www.youtube.com/watch?v=s7NKLWXkEEE

"Slope & direction of a line" through https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-slope/v/slope-intuition-example

MODULE 1
REACH THE TOP

Instructions: Choose the letter of the correct answer by writing it on a separate sheet of paper.

1. Which of the following is not a linear equation?

   a. $y = 4x^3 - 4$
   b. $y = 5 + \frac{2}{3}x$
   c. $y = 2x - 6$
   d. $y = \frac{1}{3}x + 5$

2. If $f(x) = \frac{5}{3}x - 4$, what is $f(-2)$?

   a. -10 **b.** -9 **c.** -8 **d.** -7

3. If $f(x) = 3x - 1$, which of the following is a member of the function?

   a. (2, 4) **b.** (0, 1) **c.** (−3, −9) **d.** (−5, −16)

4. What is the slope of the line $y = -\frac{3}{2}x - 4$?

   a. -4 **b.** $\frac{3}{2}$ **c.** $-\frac{3}{2}$ **d.** 4

5. The higher the slope, the _____ the line is.

   a. less steep **b.** steeper **c.** curver **d.** higher

6. If the slope is undefined, then the line is _____ .

   a. curve **b.** high **c.** vertical **d.** horizontal

7. A relation is a set of _____ .

   a. functions **b.** slopes **c.** ordered pairs **d.** points

8. If $f(x) = 2x - 9$, find $f(0)$.

a. −10 **b.** −9 **c.** −8 **d.** −7

9. What is the x- intercept of $\frac{1}{2}x - \frac{3}{4}y = 8$?

a. (0, −16) **b.** (8, 0) **c.** (16, 0) **d.** (2, 0)

10. What is the trend of the slope of a line containing the points (0, 4) and (0, −4)?

a. curved **b.** horizontal **c.** high **d.** vertical

11. Find the y– intercept of $10x + 17y = 34$.

a. (0, 10) **b.** (0, 2) **c.** (2, 0) **d.** (10, 0)

12. Find the intercept of $f(x) = 3+\frac{1}{3}x$

a. 3 **b.** $\frac{1}{3}$ **c.** $-\frac{1}{3}$ **d.** −3

13. Determine $f(5)$ if $f(x) = 2 - 3x$?

a. −16 **b.** −15 **c.** −14 **d.** −13

14. Which of the following equation has y- intercept (−1, 0)?

a. $x-y=1$ **b.** $x+y=1$ **c.** $x-y=2$ **d.** $x+y=2$

15. The growth rate of two grocery stores A and B are represented by $y=3x+1$ and $y=1-3x$ respectively. Which grocery store is more likely to fail?

a. store A **b.** store B **c.** both **d.** none

ANSWER KEY

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 1: MAKE RELATIONS FUNCTION

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)

ANSWER KEY

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

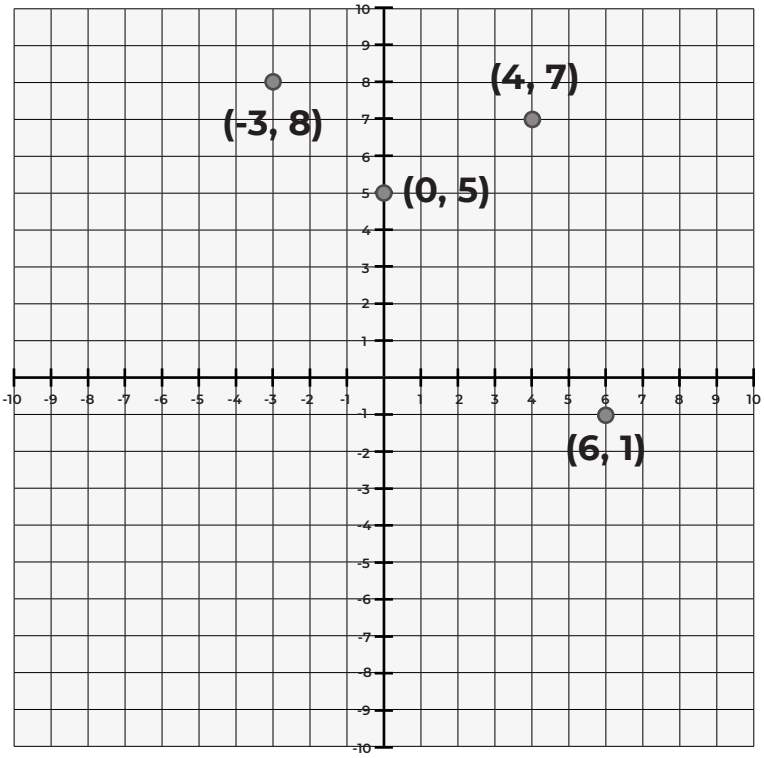
PAGE 26

ACTIVITY I

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

PAGE 27

ACTIVITY II

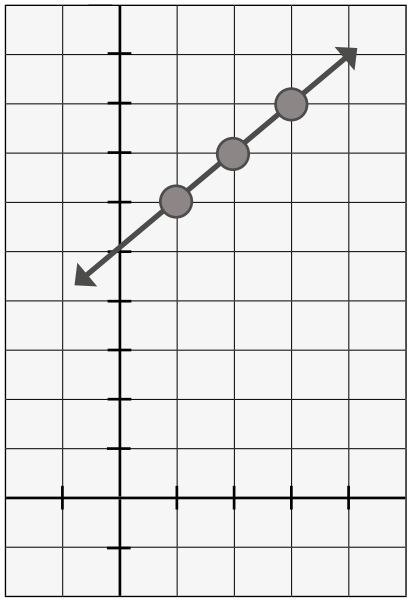


ANSWER KEY

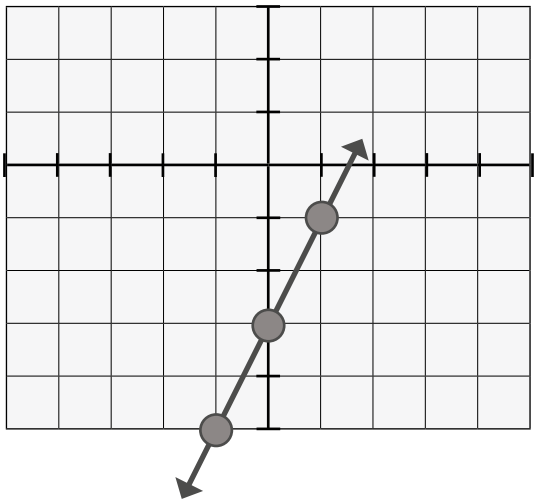
TREADING THE ROAD TO MASTERY

PAGE 28

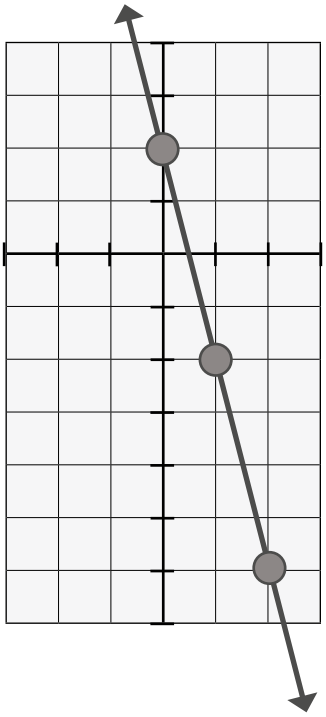
1. {(1, 6), (2, 7), (3, 8)}



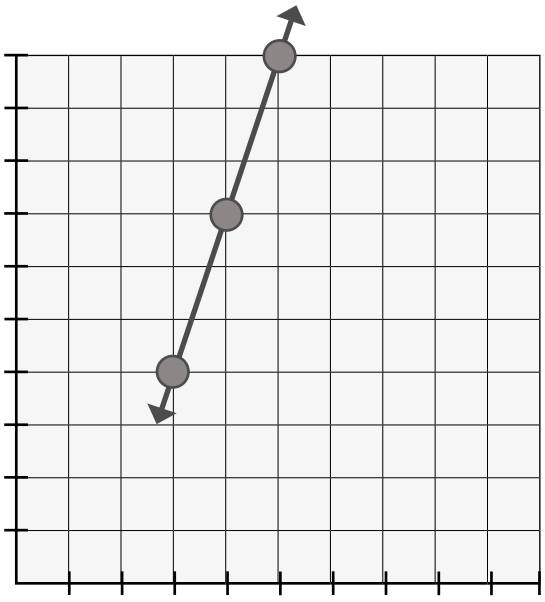
2. {(-1, -5), (0, -3), (1, -1)}



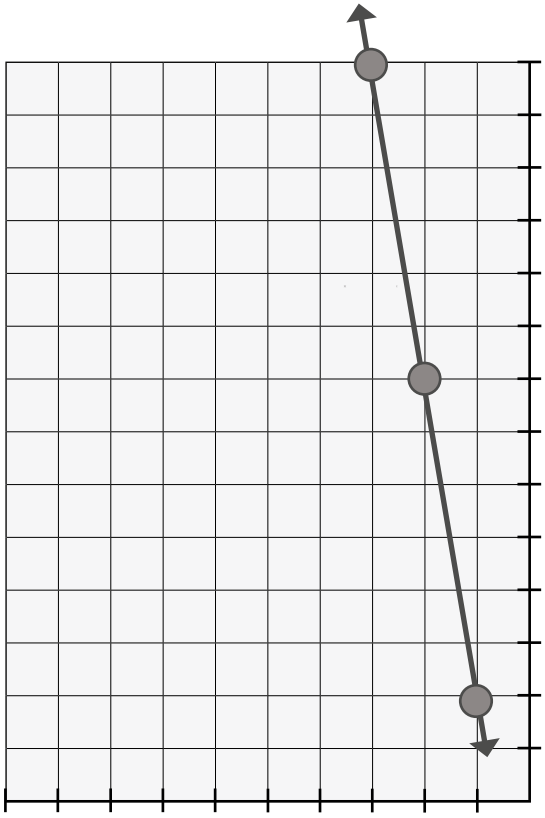
3. {(0, 2), (1, -2), (2, -6)}



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



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



ANSWER KEY

LESSON 3: WATCH YOUR STEEP

SHARPENING YOUR SKILLS

ACTIVITY I

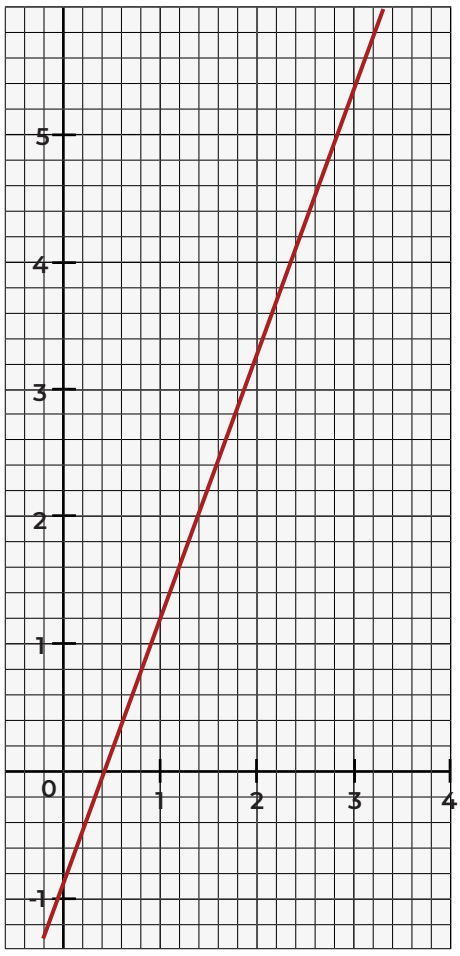
PAGE 48

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

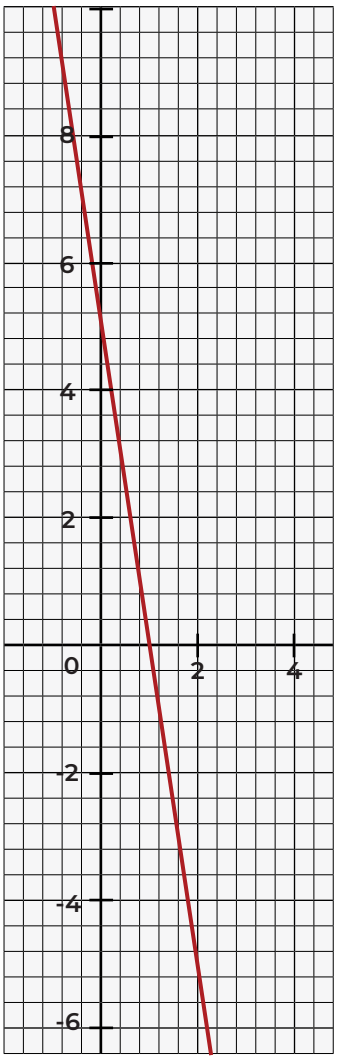
ACTIVITY II

PAGE 48

1. positive slope



2. negative slope

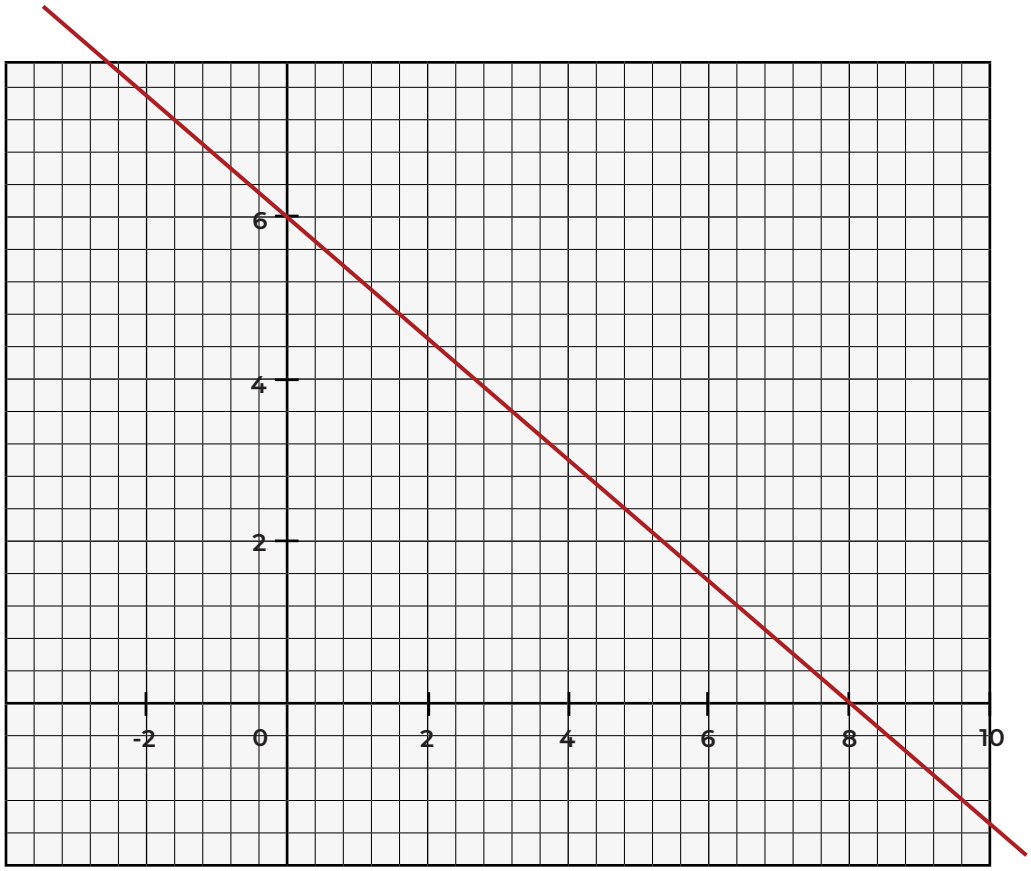


ANSWER KEY

ACTIVITY III

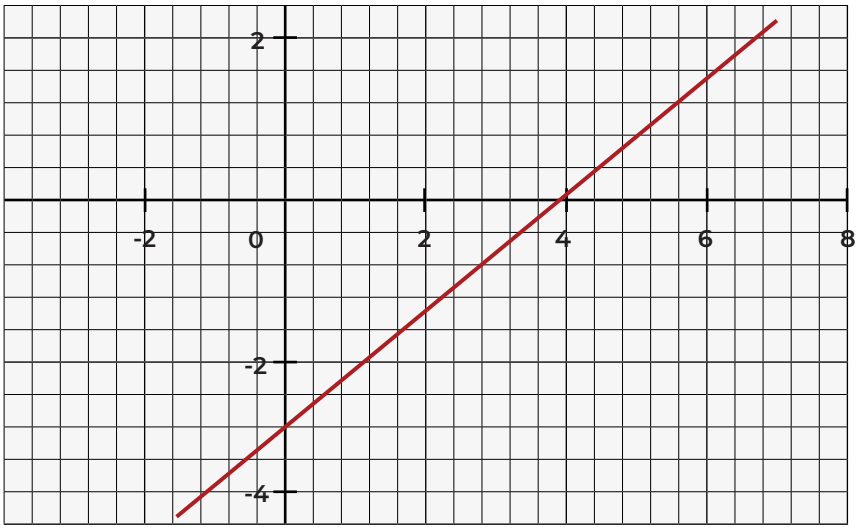
PAGE 48

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

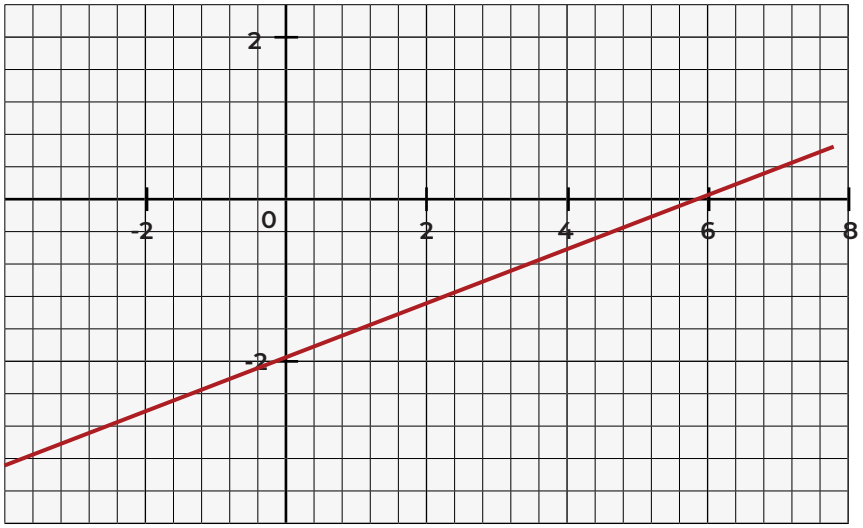


ANSWER KEY

2. x – intercept: (4, 0); y – intercept: (0, 3)



3. x – intercept: (6, 0); y – intercept: (0, –2)



ANSWER KEY

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.

ANSWER KEY

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

GLOSSARY

Axis (plural: axes)	the vertical number line and horizontal number line in the rectangular coordinate system
Function	a special type of relation where each value from the first set has exactly one partner from the second set
Linear function	an equation that forms a straight line when the ordered pairs are plotted in the rectangular coordinate system
Negative slope	slope of a line going in a downward direction
Ordered pair (coordinates)	a point on the rectangular coordinate system, where the first number is the horizontal movement parallel to the x- axis and the second number is the vertical movement parallel to the y- axis
Origin (0, 0)	point of intersection of the vertical and horizontal axes in the Cartesian plane
Positive slope	slope of a line going in an upward direction
Rectangular coordinate system (Cartesian plane)	an intersection of a vertical number line and a horizontal number line perpendicular to each other that meet at their zeroes.

GLOSSARY

Relation	a non-empty set of ordered pairs of objects enclosed in parenthesis "( )"
Slope	the measure of steepness of a line; formula is $m = \frac{y_2 - y_1}{x_2 - x_1}$, where (x_1, y_1) and (x_2, y_2) are two points on the line
Undefined slope	slope of a vertical line
x-axis	the horizontal number line in the rectangular coordinate system
x- intercept	point where the line crosses the *x*- axis; the point whose *y*- value is 0
y-axis	the vertical number line in the rectangular coordinate system
y- intercept	point where the line crosses the y- axis; the point whose x- value is 0
Zero slope	slope of a horizontal line

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