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MATHEMATICS

Quarter 1 - Module 3:
Rectangular Coordinate System
Linear Equations in Two Variables
Slope of a Line

AIRs - LM

LU_Q1_Math8_Module 3

Mathematics 8
Quarter 1 - Module 3: Rectangular Coordinate System, Linear Equations in Two Variables and Slope of a Line

Second Edition, 2021

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MATHEMATICS

Quarter 1 - Module 3:
Rectangular Coordinate System
Linear Equations in Two Variables
Slope of a Line

Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check you are learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

This module has the following parts with their corresponding icons:

TARGET	This will give you an idea of the skills or competencies you are expected to learn in the module.
JUMPSTART	In this portion, the new lesson will be introduced to you in various ways such as a story, a song, a poem, a problem opener, an activity, or a situation.
DISCOVER	This section provides a brief discussion of the lesson. This aims to help you discover and understand new concepts and skills.
EXPLORE	This comprises activities for independent practice to strengthen your understanding and skills of the topic. You may check the answers in the exercises using the Answer Key at the end of the module.
DEEPEN	This section provides an activity which will help you transfer your new knowledge or skill into real life situations.
GAUGE	This is a task which aims to evaluate your level of mastery in achieving the learning competency.

At the end of this module, you will also find:

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

Target

Whether you are presenting data on a line graph or simply finding the location of the Philippines on the map, you will need to understand point coordinates.

This module was designed and written for you to answer the activity you've missed while you are away from school. It is here to help you master the rectangular coordinate system and its different parts. You will also learn how points are plotted on the Cartesian Plane and its uses in real life.

After going through this module, you are expected to:

Learning Competency:

1. illustrates the rectangular coordinate system and its uses. M8AL-Ie-1
2. illustrates linear equations in two variables. M8AL-Ie-3
3. Illustrates and finds the slope of a line given two points, equation, and graph

Learning Objectives:

1. Define coordinate plane and terms related to it.
2. Plot points using the rectangular coordinate system.
3. Determine the coordinates of a given point on a coordinate plane; and
4. Determine linear equation in two variables and identify the values of A, B, and C.
5. Define the slope of a line.
6. Find the slope of a line using the two-point formula.
7. Transform equation from standard form to slope-intercept form.

Before going on, check how much you know about this topic.

PRE-ASSESSMENT

Directions: Read each statement below carefully. Select the letter of the correct answer. Write your answer on a separate sheet of paper.

1. What is a Rectangular Coordinate System?

   A. It is a system used for graphing.

   B. It is a system used for naming points in a plane.

   C. It is a system used to determine the location of a point by using a single number.

   D. It is a system that is composed of two perpendicular number lines that meet at the point of origin (0,0) and divide the plane into four regions called quadrants.

2. What is the intersection of the x-axis and y-axis in the coordinate

   A. abscissa B. coordinate axes C. ordinate D. origin

3. On which quadrant does (5, 1) lie?

   A. I B. II C. III D. 1V

4. On which quadrant is the abscissa and the ordinate are both negative?

   A. I B. II C. III D. 1V

5. Which ordered pair locates a point on the x-axis?

   A. (7, 2) B. (5, 0) C. (3, -2) D. (0, 1)

6. What is C in the equation Ax + By = C?

   A. coefficient B. constant C. slope D. variable

7. What is the value of A in the equation $3x - 9y = 1$?

   A. -9 B. 1 C. 3 D. 9

8. What is the standard form of the equation $7x - y - 6 = 0$?

   A. $7x - y = -6$ B. $7x - y = 6$ C. $7x + y = -6$ D. $7x + y = 6$

9. On his notes on linear equations in two variables, Krishna found an equation $3x + 4y = 7$. If you were Krishna, how would you describe the equation according to its form?

   A. It has constant B. It has variables

   C. It is in standard form D. It is in slope-intercept form

10. Which of the following is true to xy = 8?

A. xy = 8 is linear equation in two variables because x and y are one term.

B. xy = 8 is linear equation in two variables because it has variables x and y.

C. xy = 8 is not a linear equation in two variables because x and y are one term.

D. xy = 8 is a linear equation in two variables but not written in standard form.

11. It is the ratio of the vertical rise of a line to its horizontal run.

A. equation B. function

C. inequality D. slope

12. What is the slope of the line that passes through points (-1, 5) and (2, 6)?

A. $\frac{1}{3}$ B. $\frac{1}{2}$ C. 2 D. 3

13. Find the slope of the equation y = -x + 3.

A. -1 B. 0 C. 1 D. 3

14. Find the slope of the equation 2x – y = 1.

A. -5 B. 0 C. 2 D. 5

15. When can a slope of a line be equal to zero?

A. When the values of x vary.

B. When the values of y vary.

C. When the values of x are constant.

D. When the values of y are constant.

Lesson 1 The Rectangular Coordinate System

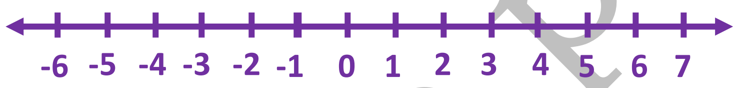
Jumpstart

You are familiar with the number line. On it, we determine the location of a point using a single number.

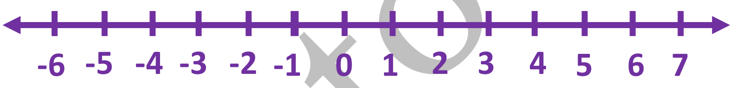
Activity 1: Plot Me

Plot the given point on the number line.

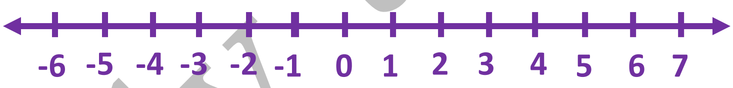
1. 0



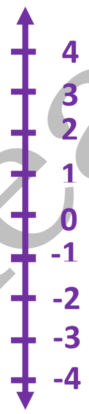
2. 6



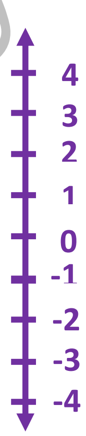
3. -4



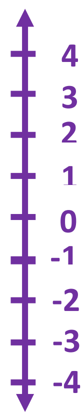
4. 0



5. 2



6. -4



Process Questions:

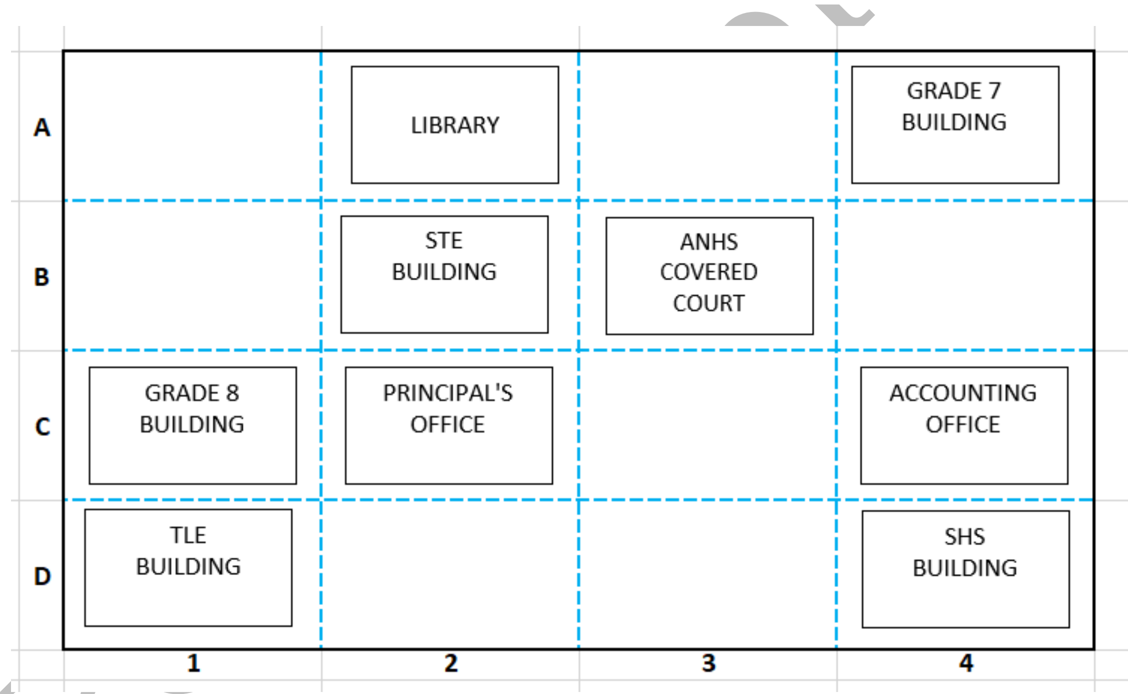
1. How were you able to locate a positive point and a negative point in the horizontal line?
2. How were you able to locate a positive point and a negative point in the vertical number line?

Activity 2: Identify the Location

Many maps, such as the School Map shown below use a grid system to identify locations. Do you see the numbers 1, 2, 3, and 4 across the bottom of the map and the letters A, B, C, and D along the sides? Every location on the map can be identified by a number and a letter.

This activity allows you to write the horizontal and vertical locations of the objects in ordered pairs. Similarly, the Rectangular Coordinate System is also written in ordered pairs.

For example, the Grade 8 Building is in Section 1C. It is in the grid section above the number 1 and next to the letter C. In which grid section is the Grade 7 Building? The Grade 7 Building is in section 4A.



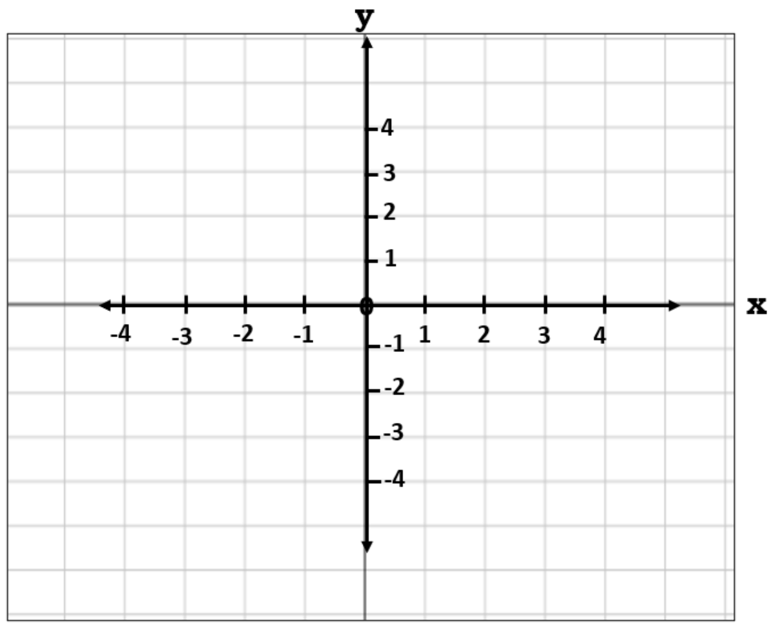
Use the map above to answer the following questions:

1. Find the grid section of the Principal's office.
2. Find the grid section of the SHS Building.
3. Find the grid section of the ANHS covered court?
4. What is located in section 2B?
5. What is located in section 1D?

Discover

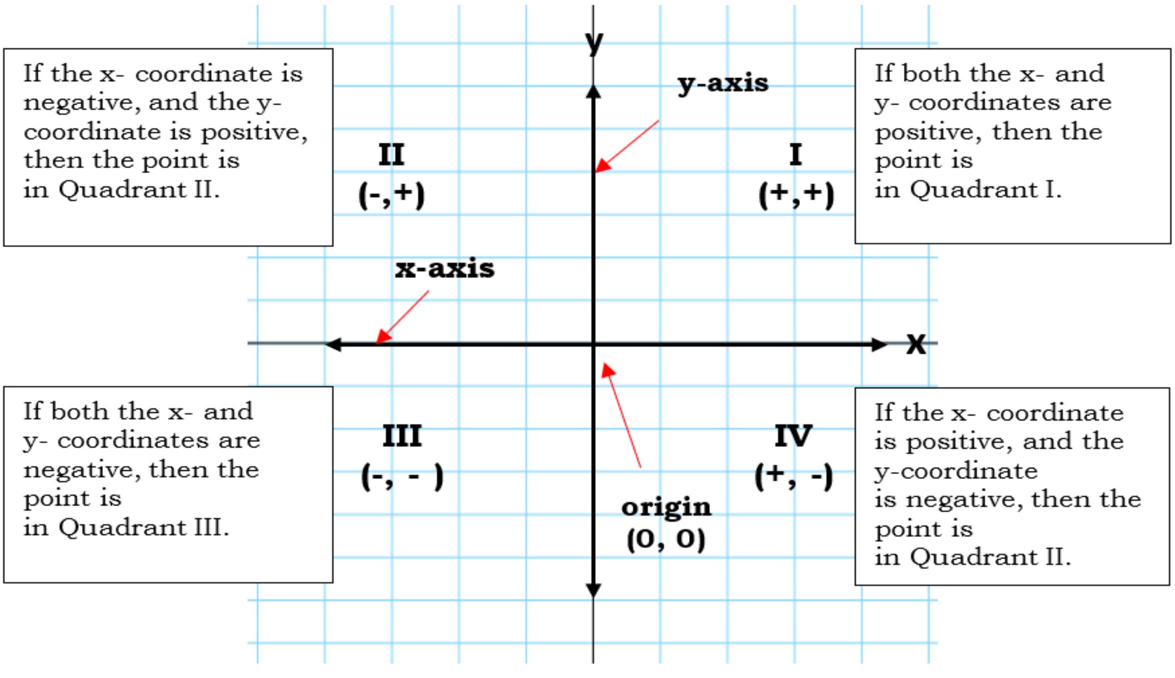
Just as maps use a grid system to identify locations, a grid system is used in algebra to show a relationship between two variables in a rectangular coordinate system. The **rectangular coordinate system** is also called the xy-plane, the coordinate plane, or the Cartesian coordinate system. It is named after the French mathematician and philosopher **Renè Descartes** (1596-1650), who introduced the coordinate system to show how algebra be used to solve geometric problems. This system is composed of two perpendicular lines that meet at the point of origin (0,0) and divide the plane into four regions called a **quadrant**.

To create this system, begin with a number line and then draw another number line perpendicular to the first so that their 0 points coincide.



The horizontal number line is the **x-axis** and the vertical number line is the **y-axis**. Together they are called the **coordinate axes**. The point of intersection of the coordinate axes is called the **origin**.

The axes divide the coordinate plane into **four quadrants**, identified by Roman Numerals I, II, III, and IV, beginning upper right and proceeding **counterclockwise**. The positive values on the y-axis are **above** the origin and the negative values are **below** the origin. The positive values on the x-axis are to the **right** of the origin and the **left** is the negative values.



This means that you can easily tell which quadrant an ordered pair is located in by just simply looking at the signs of the coordinates.

PLOTTING A POINT

The position of any point in the coordinate plane can be described by an ordered pair of numbers (x, y). The first number in an ordered pair is the x-coordinate or abscissa; it tells the distance of the point from the origin measured along the x-axis. The second number is the y-coordinate, or ordinate; it tells the distance of the point from the origin measured along the y-axis. The origin has the coordinates (0, 0). The ordered pair that represents a point is called the coordinates of the point.

(3, - 4)

x-coordinate or abscissa

y-coordinate or ordinate

Note on the use of parenthesis:

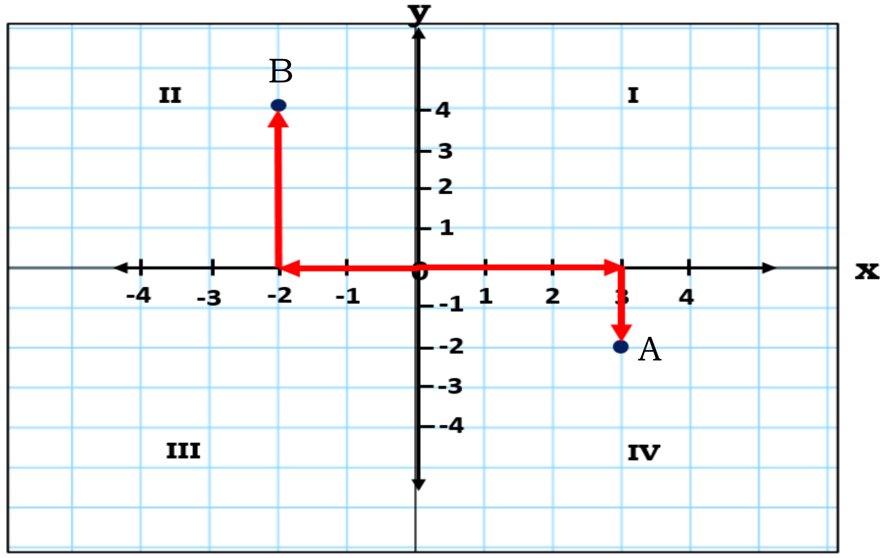
(3, -4) represents a point on the coordinate plane whereas

3 (-4) denotes multiplication

Example 1. Plot the following points: A (3, -2) and B (-2, 4) and determine the quadrant to which they lie.

Solution: To locate point A, move 3 units to the right of the origin and 2 units down. To locate point B, move 2 units to the left of the origin and 4 units up.

Point A is in Quadrant IV while point B lies in Quadrant II



Some points lie in *the x-and y−axes*. The points which lie in the *x-axis* have coordinates (x, 0) and the points which lie in the *y-axis* have coordinates (0, y) where *x* and *y* are real numbers. Let us explore the following examples below.

Example 2

The points A (0, 3), B (-3, 0), C (-2,0), D (4, 0), and E (0, 0) can be plotted in the Cartesian plane as shown in the illustration.

Solution:

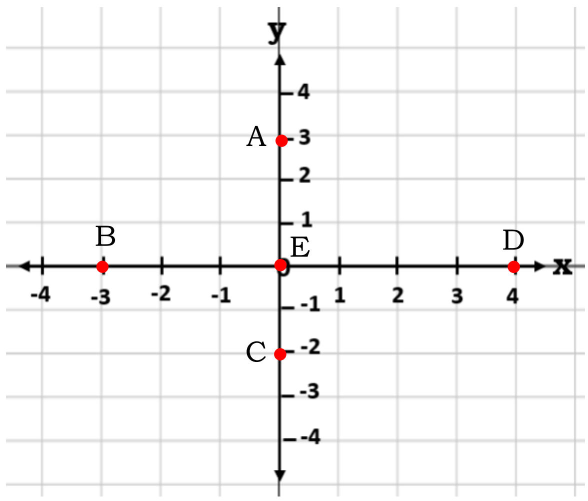
a.) point A is on the x-axis;

b.) point B is on the x-axis

c.) point C is on the y-axis

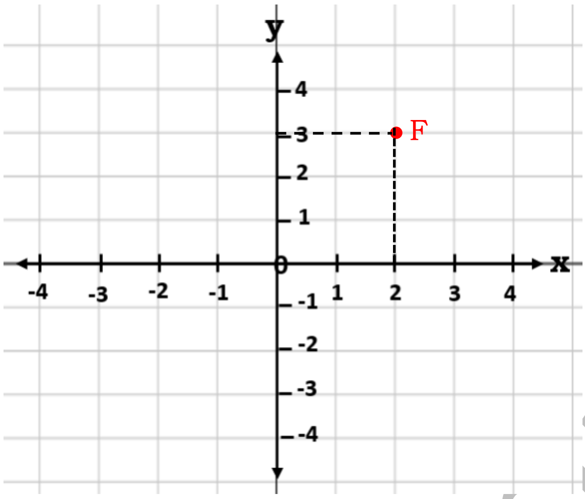
d.) point D is on the y-axis

e.) point E is the origin



DETERMINING THE COORDINATES

Example 3. Find the coordinates of point F.



Solution:

To determine the coordinates of point F:

a.) Measure how far it is along the x-axis from the origin, at a perpendicular distance from the y-axis. This provides the x-coordinate which has a value of 2.

b.) Next, measure how far the point is along the y-axis, in a perpendicular direction from the x—axis. This gives the y-coordinate, which has a value of 3.

The coordinates of Point F are (2, 3). Notice that the coordinates are both positive, so Point F lies in quadrant I.

Remember When reading or writing coordinates, it is very important that they are always in the order (x, y).

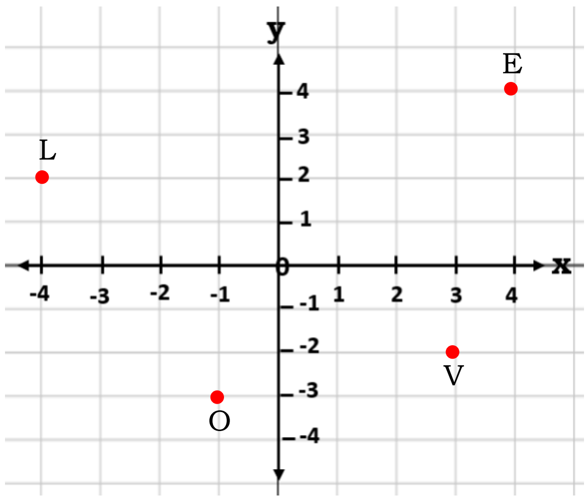
Example 4. Use the Cartesian plane to find the coordinates of the following points and determine the quadrant to which they lie.

a.) L

b.) O

c.) V

d.) E



SOLUTIONS:

a.) Point L is in Quadrant II. It is located 4 units to the left of the y-axis and 2 units above the x-axis. Hence, the coordinates of point L are (-4, 2).

b.) Point O is in Quadrant III. It is located 1 unit to the left of the y-axis and 3 units below the x-axis. Hence, the coordinates of point O are (-1, -3).

c.) Point V is in Quadrant IV. It is located 3 units to the right of the y-axis and 2 units below the x-axis. Hence, the coordinates of point V are (3, -2).

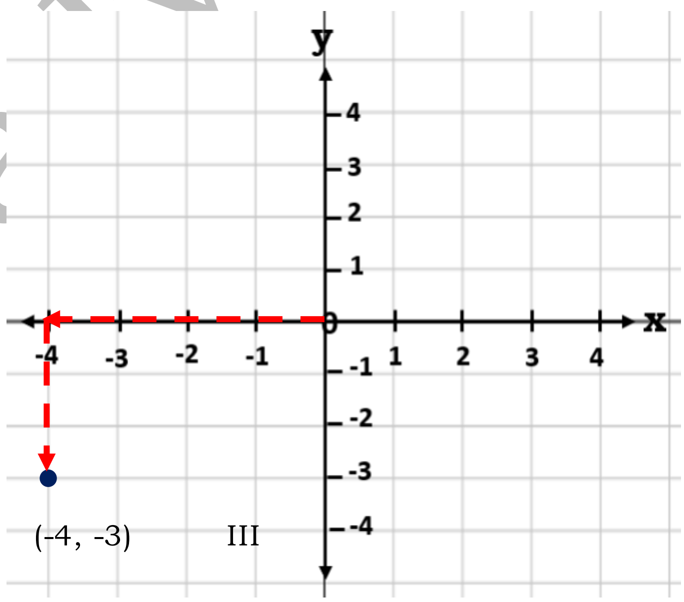
d.) Point E is in Quadrant I. It is located 4 units to the right of the y-axis and 4 units above the x-axis. Hence, the coordinates of point E are (4, 4).

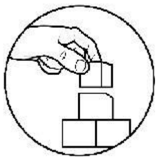
FINDING THE LOCATION OF A POINT FROM ITS COORDINATES

In some instances, you might be given only the coordinates and need to find the position of that point on the graph.

Example 5. Find the position on the graph of the points (-4, -3).

Solution: In this case, move 4 units to the left of the y-axis. Then, from that position, move in a perpendicular direction 3 units below the x-axis. Take note that the ordered pairs are both negative therefore, it is in quadrant III.

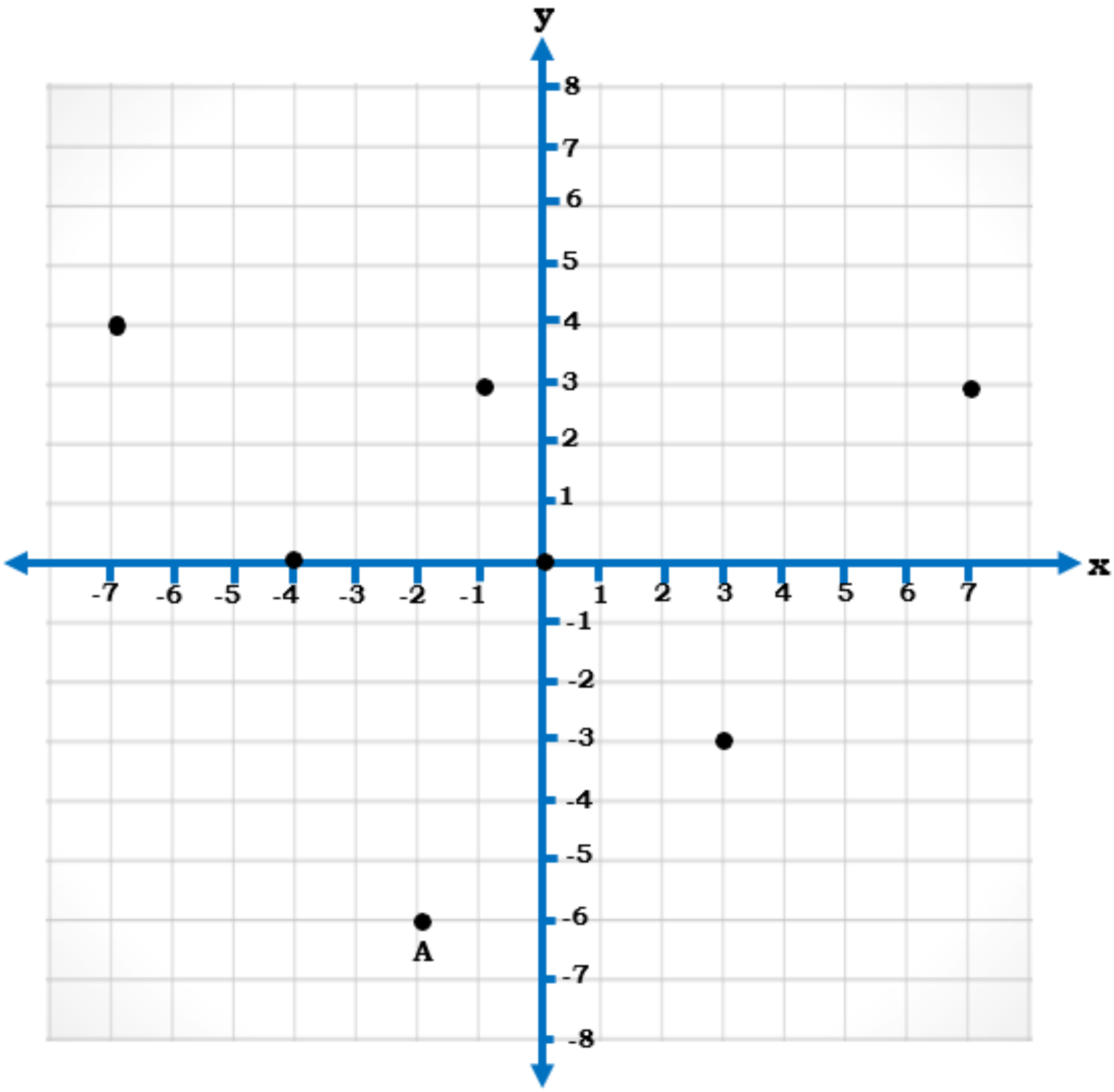




Explore

Activity 3:

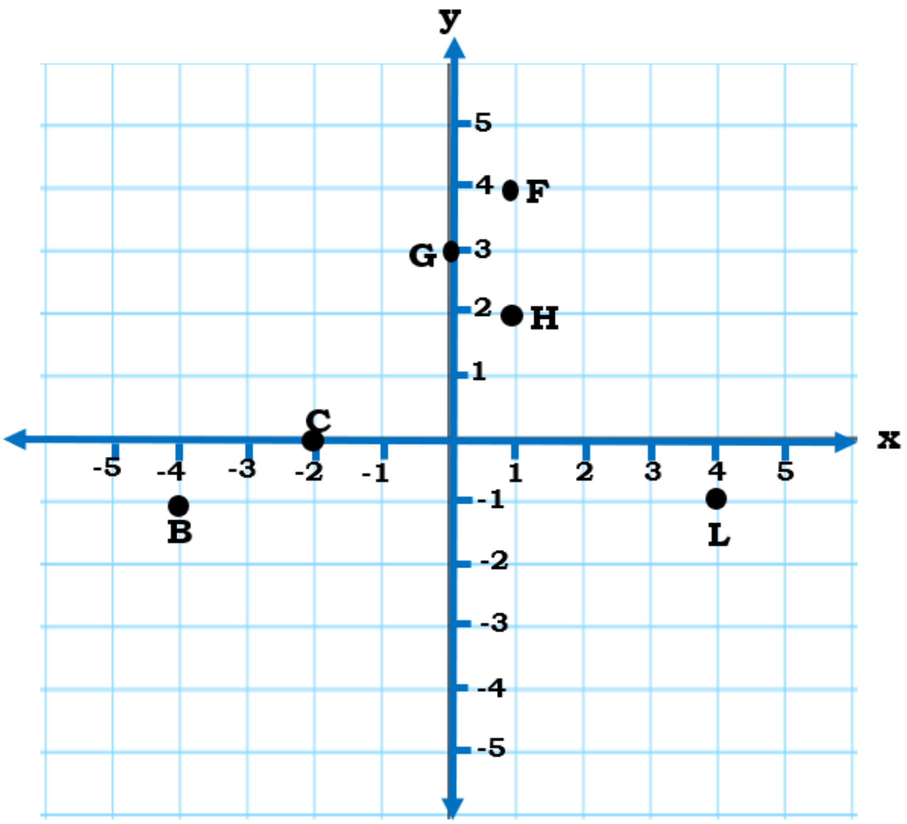
Directions: Indicate the name of each point in the Cartesian plane. Name each point by writing the letter beside it. The coordinates are provided in the box below. Point A is done for you.



1. A (-2, -6)	5. E (-7, 4)
2. B (3, -3)	6. F (-4, 0)
3. C (-1, 3)	7. G (7, 3)
4. D (0, 0)	

Activity 4: Write the coordinates of each point. Identify the quadrant/axis where each point lies. Complete the table below. Number 1 is done for you.

Coordinates	Quadrant/Axis
1. B **(__-4_, _-1__)**	**Quadrant III**
2. C (_____, _____)	
3. F (_____, _____)	
4. G (_____, _____)	
5. H (_____, _____)	
6. L (_____, _____)	



Deepen

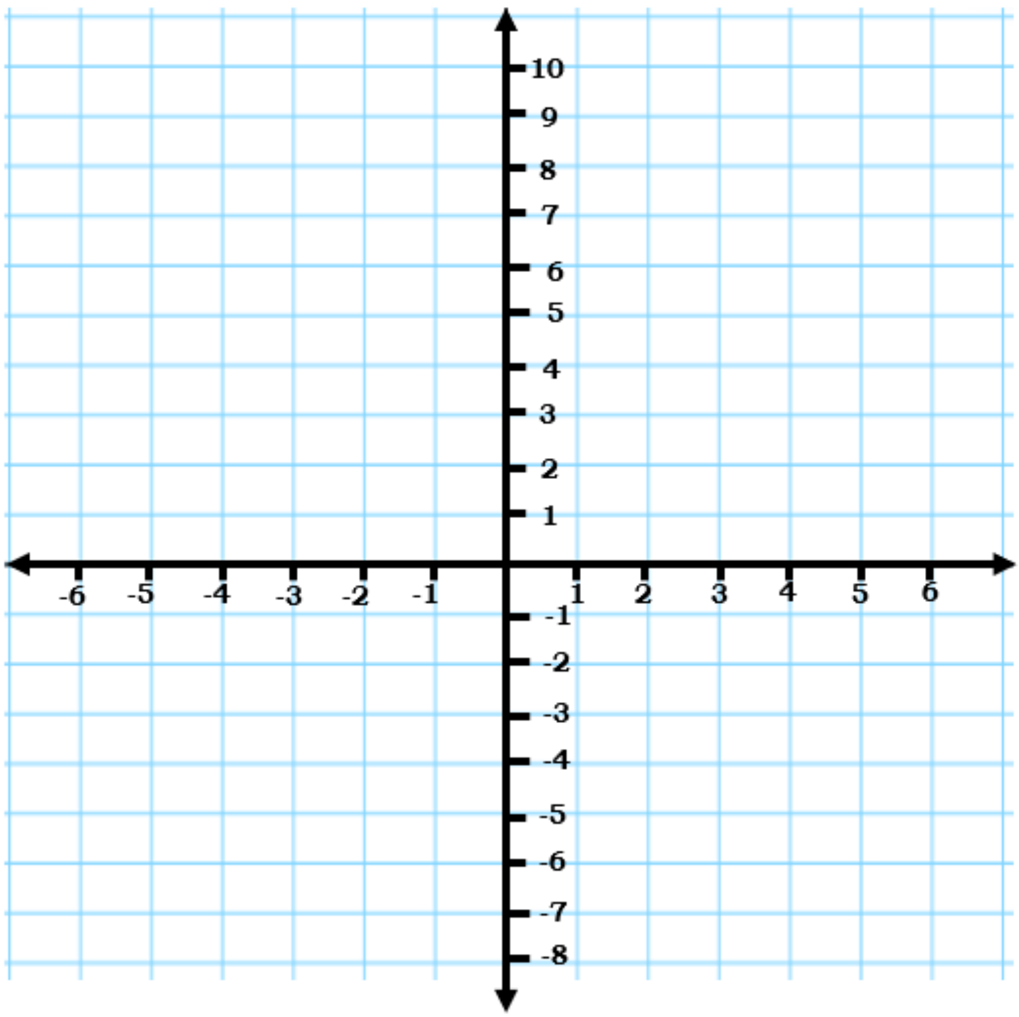
Activity 5: Someone is hiding in the picture. Plot these points on the Cartesian plane below. Connect the points alphabetically. (For example, connect A to B, to C, and so on.)

A (0, 3)	G (1, 3)	M (3, 3)	S (-2, -3)
B (-3, 4)	H (2, 6)	N (4, 1)	T (-4, 0)
C (-5, 7)	I (3, 8)	O (4, -1)	U (-4, 1)
D (-6, 10)	J (5, 10)	P (2, -3)	V (-3, 2)
E (-3, 8)	K (5, 7)	Q (-1, -4)	W (0, 3)
F (0, 5)	L (4, 4)	R (0, -2)	

Plot and separately connect the following:

X (3, -4)   Y (4, -6)   Z (1, -4) A^1 (1, -6) B^1 (3, -4)

Are you ready to meet him?



Rubric score	
Score	**Description**
10	Plotted all the points correctly and neatly
9	Plotted the points with minimal error but neat
8	Plotted the points with more than 5 errors but neat
7	Plotted the point with many errors and not neat

Lesson 2: Linear equations in two variables

Jumpstart

Activity 6. Consider the situation about Zoe and Zeke's combined score. Complete the table below by finding the score of one student given the score of the other student, then answer the questions that follow.

ZOE'S SCORE	ZEKE'S SCORE	ZOE + ZEKE'S SCORE
5		20
	12	20
9		20
	10	20
13		20

Process Questions:

1. How did you find the activity? Is it difficult to find the score of one student given the score of the other student?
2. What will be Zeke's score if Zoe's score is 13?
3. If Zoe's score is represented by a variable x and Zeke's score by a variable y, how would you write the problem algebraically?
4. The equation you formed in number 3 is an example of a linear equation in two variables.

Discover

In the previous activity, the combined scores of Zoe and Zeke can be written as **Zoe's Score + Zeke's score = 20.**

Replacing Zoe's score by a variable $\boldsymbol{x}$ and Zeke's score by a variable $\boldsymbol{y}$**,** respectively, the equation becomes $\boldsymbol{x + y = 20}$

This is an example of a linear equation in two variables.

> A **linear equation in two variables** is an equation that can be written in the form
>
> $$Ax + By = C$$
>
> where **A, B**, and **C** are **real numbers**, but A and B **cannot** both be zero.
>
> Note: The numbers A and B are the coefficients of the variables x and y, respectively, while the number c is the constant. A, B, and C must not share a common factor and **A** must **always** be positive.

The equation x + y = 20 is written in standard form where A=1, B=1, and C=20. Likewise, the exponent of the variables x and y are both equal to 1, which defines a linear equation in two variables.

Example 1. Consider the equation below and answer the questions that follow.

$$2y = 6 - 3x$$

Questions:

1. How many variables are used in the equation?
2. How many variable/s are in each term?
3. What is the exponent of each variable in each term?
4. Did you see any variable in the denominator?
5. Did you see any variable inside the radical sign?
6. Is the given equation linear in two variables? If so, what are the values of A, B, and C?
7. Is the equation written in standard form? If not, how can we rewrite this in standard form?

Solutions:

The equation $2y = 6 - 3x$ is a linear equation in two variables because:

1. it has two variables, x and y;
2. it has only 1 variable in each term;
3. the exponent of the variable in each term is 1 which means the degree of the equation is 1;
4. there is no variable in the denominator; and
5. there is no variable inside a radical sign.
6. Although the equation $2y = 6 - 3x$ is not in standard form because it is not written in the form $\boldsymbol{Ax} + \boldsymbol{By} = \boldsymbol{C}$, but this can be transformed into standard form as follows:

$2y = 6 - 3x$	Given
$2y + 3\boldsymbol{x} = 6 - 3x + \boldsymbol{3x}$	Additive Inverse Property
$2y + \boldsymbol{3x} = 6 - \boldsymbol{0}$	Simplified
$2y + 3x = 6$	Additive Identity Property
$\boldsymbol{3x} + 2y = 6$	Commutative Property of Addition/ Standard Form

Therefore, $3x + 2y = 6$ is now written in standard form where $A = 3$, $B = 2$, and $C= 6$.

Example 2. Determine whether each equation illustrates a linear equation in two variables. If so, identify the values of A, B, and C.

1. $2x = 10 + y$

Solution: Express the equation into standard form $Ax + By = C$

$$2x = 10 + y$$
$$2x – y = 10 + y – y$$
$$2x – y = 10$$

Since $2x = 10 + y$ can be expressed into the form $Ax + By = C$ as $2x – y = 10$, therefore it is a linear equation in two variables where, $A = 2$, $B = – 1$, and $C = 10$.

2. $x + 4 = 0$

Solution: Since $x + 4 = 0$ can be expressed into $Ax + By = C$, $x = -4$, therefore it is a linear equation in two variables where, $A = 1$, $B = 0$ and $C = -4$.
The coefficient of $y = 0$.

3. $y - 6 = 0$

Solution: Since $y - 6 = 0$ can be expressed into $Ax + By = C$, $y = 6$, therefore it is a linear equation in two variables where, $A = 0$, $B = 1$ and $C = 6$.
The coefficient of $x = 0$.

*Notice that although Numbers 2 & 3 equations contain numerical coefficients equal to zero, the equations are still considered as linear equations in two variables since **not** both a and b are zeros.*

4. $\frac{5x^2}{4} - y = 8$

Solution: This is not a linear equation because the exponent of x is 2 and a variable appears in the denominator of a fraction.

5. $xy = 7$

Solution: This is not a linear equation because the two variables are part of the same term.

A linear equation in two variables has many sets of ordered pairs **(solution)** that satisfy the equation.

Sometimes we are given an equation and one of the two coordinates in an ordered pair, and we are asked to find the other coordinate that makes the point satisfy the equation.

Example 3. Complete the following ordered pairs so that they satisfy the equation $4x + y = -1$.

a. (_____, 0) b. (2, _____)

Solutions:

a. To complete (_____, 0), substitute the value y = 0 into the equation and solve for x.

$$4x + y = -1$$
$$4x + 0 = -1$$
$$4x = -1$$
$$x = -\frac{1}{4}$$

Thus, the ordered pair is $\left(\frac{-1}{4}, 0\right)$.

b. Substitute the value x = 2 and solve for y.

$$4x + y = -1$$
$$4(2) + y = -1$$
$$8 + y = -1$$
$$y = -9$$

Thus, the ordered pair is $(2, -9)$.

Example 4. Find at least 2 ordered pairs that satisfy the equation 3x - 2y = -6

Solution:

To do this, we **assign** any value of x, **substitute** it to the equation to solve for the value of y.

If **x = 0**, then

$$3x - 2y = -6$$
$$3(0) - 2y = -6$$
$$0 - 2y = -6$$
$$-2y = -6$$
$$\left(\frac{1}{-2}\right)(-2y) = -6\left(\frac{1}{-2}\right)$$
$$y = 3$$

The ordered pair (0, 3) satisfies the equation 3x – 2y = –6.

If **x = –1**, then

$$3x - 2y = -6$$
$$3(-1) - 2y = -6$$
$$-3 - 2y = -6$$
$$-3 + 3 - 2y = -6 + 3$$
$$\left(\frac{1}{-2}\right) -2y = -3\left(\frac{1}{-2}\right)$$
$$y = \left(\frac{3}{2}\right)$$

The ordered pair $\left(-1, \frac{3}{2}\right)$ satisfies the equation 3x – 2y = -6.

Example 5. Determine whether (3, -2) is a solution of the equation 5y = -2x – 4.

Solution: Substitute 3 for x and -2 for y into the equation 5y = -2x – 4. Then, simplify.

$$5x = -2x - 4$$
$$5(-2) = -2(3) - 4$$
$$-10 = -6 - 4$$
$$-10 = -10$$

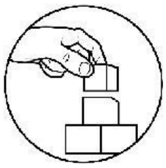
Since the ordered pair (3, -2) makes the equation a true statement, (3, -2) is a solution of the equation.

Example 6. Is (-1, 4) a solution of $6x + 2y = 3$?

Solution:

$$6x + 2y = 3$$
$$6(-1) + 2(4) = 3$$
$$-6 + 8 = 3$$
$$2 \neq 3$$

(-1, 4) is not a solution of $6x + 2y = 3$ because it does not make $6x + 2y = 3$ a true statement.



Explore

Activity 7. Illustrate that the following are linear equations in two variables by completing the solutions with the correct term.

A. Determine whether (2, 0) is a solution of the equation $2x - y = 4$.

$$2x - y = 4$$
$$2x = \underbrace{\_\_\_\_\_}_{(1)} + 4$$
$$2(\underbrace{\_\_\_\_\_}_{(2)}) = 0 + 4$$
$$4 = 4$$

Since the ordered pair (2, 0) makes the equation a true statement, (2, 0) is a $\underbrace{\_\_\_\_\_\_\_\_\_\_\_\_\_\_}_{(3)}$ of the equation.

B. The ordered pairs $(-\frac{1}{3}, 0)$ satisfy the equation 3x + y = -1.

Complete (_____, 2) to find another ordered pairs that satisfy the equation. Fill in the blanks with the correct term.

$$3x + y = -1$$

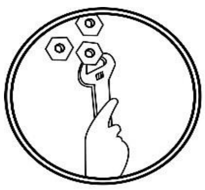
$$3x = -y - \underset{(4)}{\underline{\quad\quad}}$$

$$3x = -\underset{(5)}{\underline{\quad\quad}} - 1$$

$$(3x) = -2\ (-1)$$

$$\left(\frac{1}{3}\right)(3x) = -3\ \left(\frac{1}{3}\right)$$

$$x = \underset{(6)}{\underline{\quad\quad}}$$



Deepen

Activity 8. Put me into your standard!

Write each of the following linear equations in two variables in standard form.

1. 4y = 12 + 3x
2. 13 = x + 2y
3. y + 4 = 0
4. 7x - 5 = -y
5. x – 7 = 0

Lesson 3: Slope of a Line

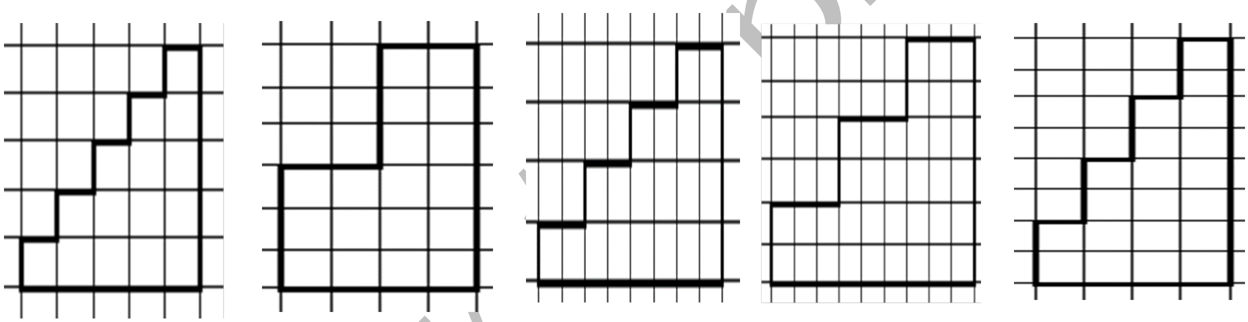
Jumpstart

Since the world is constantly changing, we need to be able to describe change to allow us to predict the future.

In this lesson, you will explore the rate of change, which is often seen as the slope of the line of an equation.

Activity 9. Staircase

Directions: Without measuring the staircases, arrange the letters of the stairs from the order of "steepness," starting with the shape with the least "steepness."



A B C D E

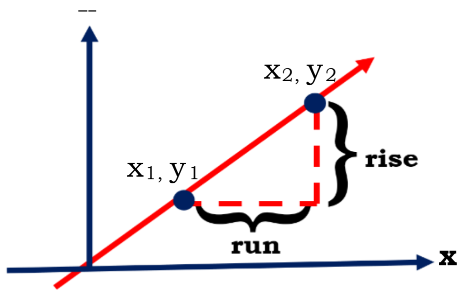
Answer: ______________________

Discover

From the activity above, the steepness of the stairs is called the slope. The **slope** is represented by **m** and is defined as the ratio of the vertical change and the horizontal change. The vertical change is referred to as the **rise** and the horizontal change as the **run**.

In symbol:

$$\textbf{slope (m)} = \frac{\textit{rise}}{\textit{run}} = \frac{\textit{vertical change in y}}{\textit{horizontal change in x}}$$



FINDING THE SLOPE OF A LINE

A. Slope of a Line Given an Equation

To find the slope of a line given the equation of the line, first write it in slope-intercept form. Use inverse operations to solve for y so that it is written as **y = mx + b** where m is the slope, b is the y-intercept and x and y are a point on the Remember to include the right sign of the slope.

Example 1. $y = 3x + 1$

Solution: Since the equation is already in the slope-intercept form $y = mx + b$, the slope of the equation(m) is equal to 3.

Example 2. $2x + 3y = 6$

Solutions: Since the equation is in the standard form $Ax + By + C$, we can put the equation in slope-intercept form ($y = mx + b$) or we can use the formula $m = \frac{-A}{B}$

Using the slope-intercept form

$$2x + 3y = 6$$

$$\frac{\cancel{3}y}{\cancel{3}} = -\frac{2x}{3} + \frac{6}{3}$$

$$y = -\frac{2}{3}x + 2$$

$$\mathbf{m = -\frac{2}{3}}$$

Using the formula $m = \frac{-A}{B}$

$$2x + 3y = 6$$

$A = 2$

$B = 3$

$$m = \frac{-A}{B}$$

$$\mathbf{m = \frac{-2}{3}}$$

> **Slope of a Line Given an Equation**
>
> To find the slope of a line given the equation of the line, first write it in slope-intercept form. Use inverse operations to solve for y so that it is written as **y = mx + b** where m is the slope, b is the y-intercept and x and y are a point on the
>
> Remember to include the right sign of the slope.

B. Slope of a Line Given two points

To find the slope between two points, (x_1, y_1) and (x_2, y_2), we use the slope-point formula: $m = \frac{y_2 - y_1}{x_2 - x_1}$ where $x_2 \neq x_1$. The slope(m) can be a fraction or a whole number, it can be positive or negative.

Example 3. Find the slope of the line that passes through (-1, -7) and (-3, 2)

Solutions:

1. **Step One: Identify two points on the line.**

   In this example, we are given two points, (-1, -7) and (-3, 2), on a straight line.

2. **Select one to be (x_1,y_1) and the other to be (x_2,y_2).**

   It doesn't matter which we choose, so let's take (-3, 2) to be (x_2, y_2). Let's take the point (-1, -7) to be the point (x_1, y_1).

3. **Step Three: Use the equation to calculate slope.**

$$\boldsymbol{m} = \frac{y_2-y_1}{x_2-x_1} = \frac{2-(-7)}{-3-(-1)} = \frac{2+7}{-3+1} = -\frac{\mathbf{9}}{\mathbf{2}}$$

What happens if we let (-3, 2) be (x_1, y_1) and (-1, -7) be (x_2, y_2)?

$$\boldsymbol{m} = \frac{y_2-y_1}{x_2-x_1} = \frac{-7-2}{-1-(-3)} = \frac{-9}{-1+3} = \frac{\mathbf{-9}}{\mathbf{2}} \ \mathbf{or} \ -\frac{\mathbf{9}}{\mathbf{2}}$$

Clearly, it does not matter which point is called (x_1, y_1) or (x_2, y_2).

Reminder: Make sure to subtract the y-coordinates and x-coordinates in the same order.

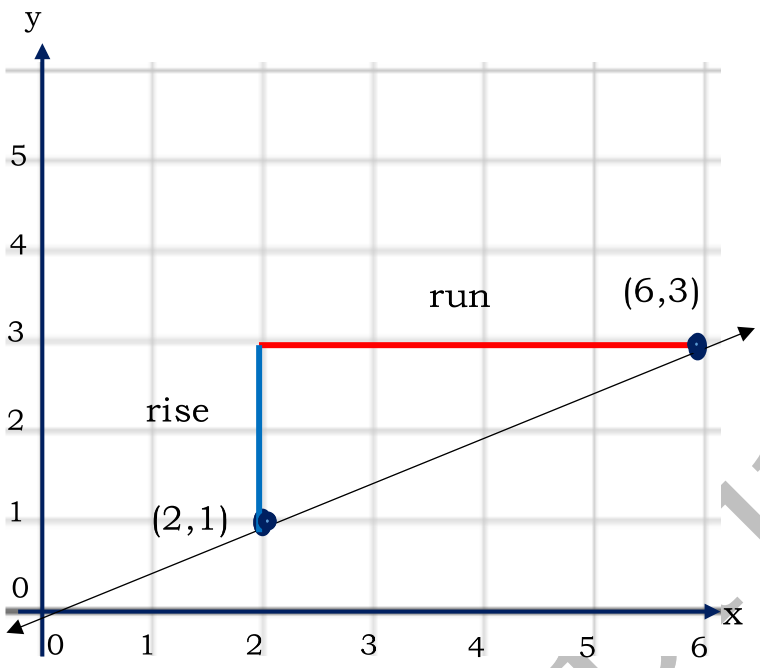
Slope of a Line Given two points

To find the slope between two points, (x_1, y_1) and (x_2, y_2), we use the slope-point formula: $m = \frac{y_2-y_1}{x_2-x_1}$ where $x_2 \neq x_1$. The slope(m) can be a fraction or a whole number, it can be positive or negative.

C. Slope of a Line Given a Graph

You can determine the slope of a line from its graph by looking at the **rise** and **run**. One characteristic of a line is that its slope is constant along with it. So, you can choose any 2 points along the graph of the line to figure out the slope

Example 4. Use the graph to find the slope of the line.



Solutions:

a. Locate two points on the graph, choosing points whose coordinates are integers.

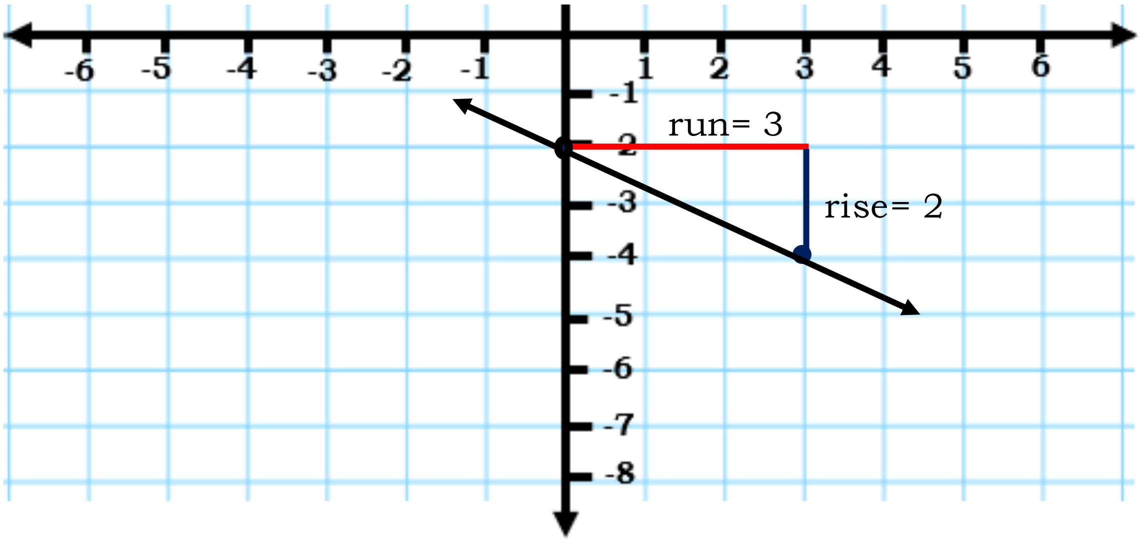
b. **rise = 2** Start from a point on the line, such as (2, 1) and move vertically until in line with another point on the line, such as (6, 3). The rise is 2 units. It is positive as you moved up.

c. **run = 4** Next, move horizontally to the point (6, 3). Count the number of units. The run is 4 units. It is positive as you moved to the right.

$$slope(\boldsymbol{m}) = \frac{rise}{run} = \frac{2}{4} = \frac{\mathbf{1}}{\mathbf{2}}$$

Note: Since the line on the graph rises from left to right, the slope is positive.

Example 5. Use the graph to find the slope of the line.



Solutions:

Count the rise = 2

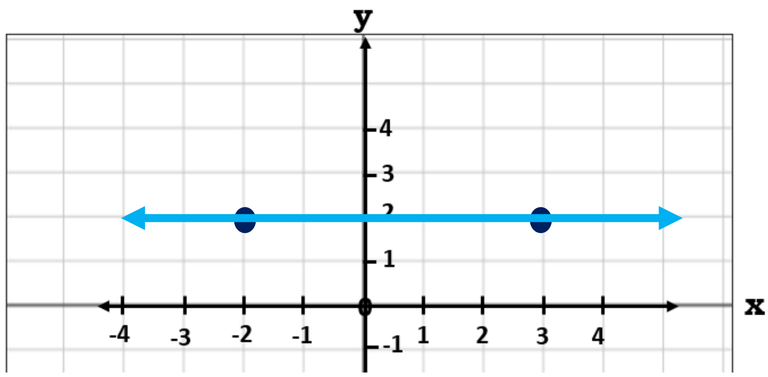
Count the run = 3

Note: Since the line on the graph falls from left to right, the slope is negative, thus

$$slope(\boldsymbol{m}) = \frac{rise}{run} = -\frac{2}{3}$$

It does not matter which points you use negative (—) the slope of the line is always the same. The slope of a line is constant!

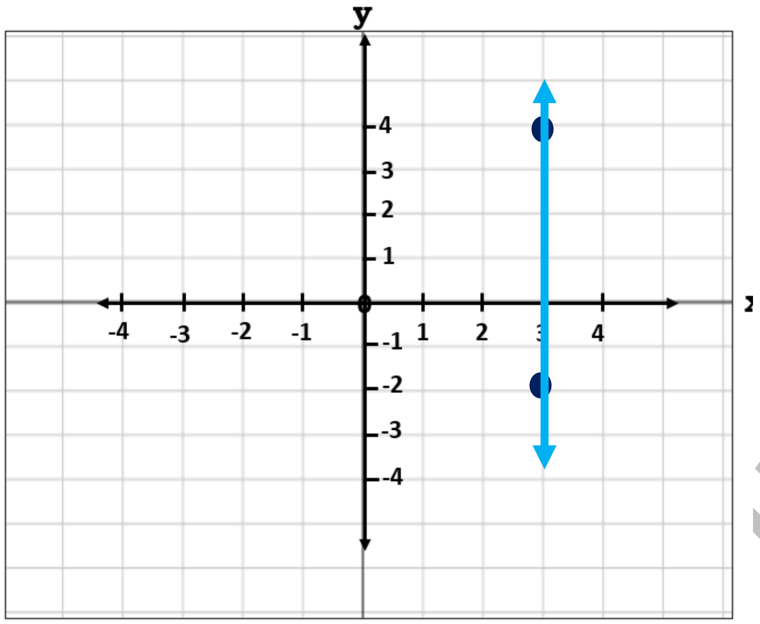
Example 6. Find the slope of a line that contains (-2, 2) and (3, 2).



Applying the slope-point formula: $\boldsymbol{m} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0}{5} = 0$

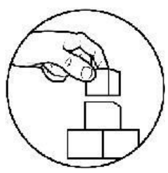
Note: Since the line on the graph is a horizontal line, the slope is zero.

Example 7. Find the slope of a line that contains (3, - 2) and (3, 4).



Applying the slope-point formula: $\boldsymbol{m} = \frac{y_2-y_1}{x_2-x_1} = \frac{4-(-2)}{3-3} = \frac{6}{0}$ = **undefined**

Note: The slope of a vertical line is undefined since division by 0 is undefined.

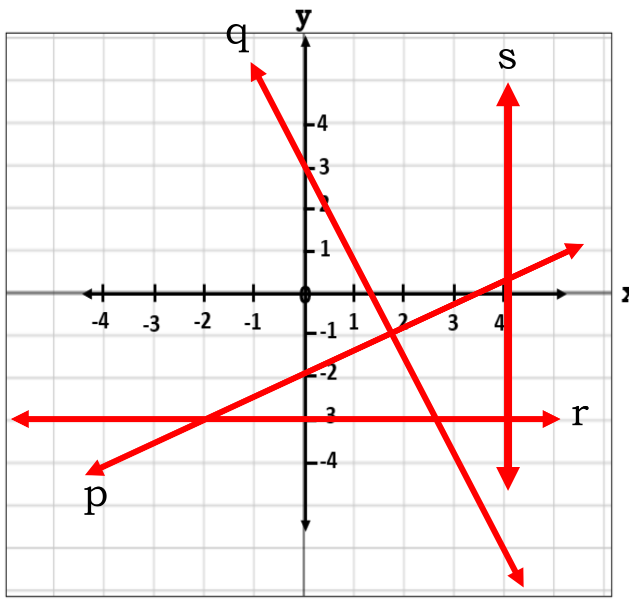


Explore

Activity 10.

Directions: Determine which line is being described in the statement.

1. Line that has a positive slope
2. Line that has a negative slope
3. Line that has an undefined slope
4. Line that has a zero slope
5. Line that is the steepest



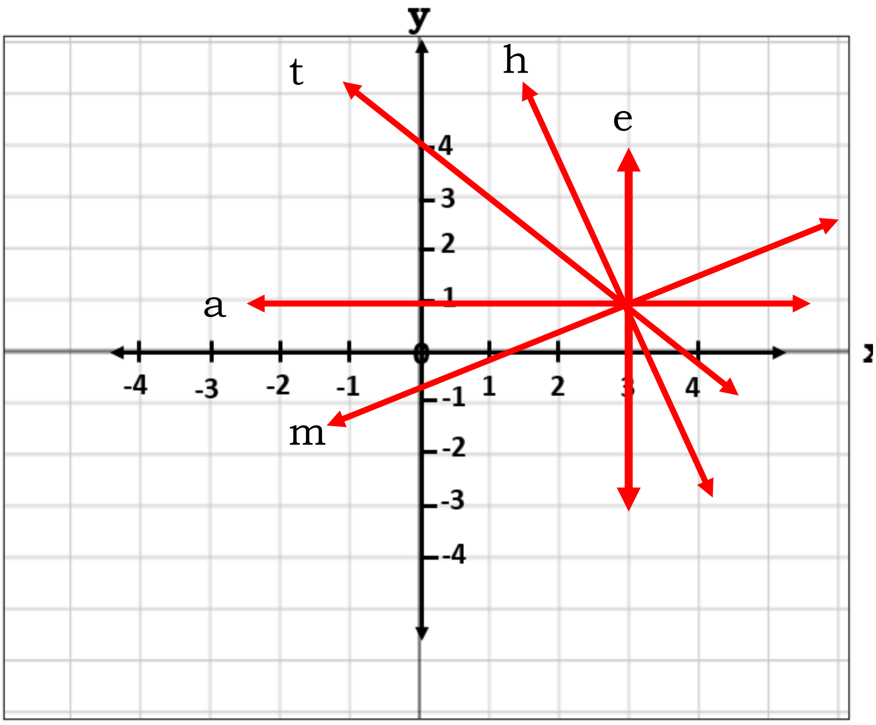
Activity 11. Find the slope(**m**) and y-intercept(**b**) of each line.

1. y = x – 1 m = ______________ b =______________
2. y = 4x m = ______________ b =______________
3. y = $\frac{2}{3}x + 2$ m = ______________ b =______________
4. y = -2x + 5 m = ______________ b =______________
5. y = -9 m = ______________ b =______________

Deepen

Activity 12. Find my Slope

Direction: The figure below shows lines with various slopes through (3, 1). Determine the slope of the given line.



1. Line m = _______
2. Line a = _______
3. Line t = _______
4. Line h = _______
5. Line e = _______

Gauge

***Directions*:** Read each statement below carefully. Select the letter of the correct answer. Write your answer on a separate sheet of paper.

1. Who among these mathematicians was the Cartesian Plane named after?

   A. Rene Descartes B. Pythagoras
   C. Euclid D. Blaise Pascual

2. Which best describes the point (2, -5)?

   A. It is 5 units above the x-axis and 2 units to the right of the y-axis.

   B. It is 5 units below the x-axis and 2 units to the right of the y-axis.

   C. It is 5 units above the x-axis and 2 units to the left of the y-axis.

   D. It is 5 units below the x-axis and 2 units to the left of the y-axis.

3. Which best describes the point (-4, -7)?

   A. It is 7 units above the x-axis and 4 units to the right of the y-axis.

   B. It is 7 units below the x-axis and 4 units to the right of the y-axis.

   C. It is 7 units above the x-axis and 4 units to the left of the y-axis.

   D. It is 7 units below the x-axis and 4 units to the left of the y-axis.

4. Which ordered pair locates a point on the y-axis?

   A. (7, 2) B. (5, 5) C. (3, 0) D. (0, 1)

5. On which quadrant is the abscissa and the ordinate are both positive?

   A. I B. II C. III D. 1V

6. Is the equation $x^2 – y = 11$ a linear equation in two variables? Why?

   A. Yes, because $x^2 – y = 11$ is just the same with $Ax + By = C$.

   B. No, because $x^2 – y = 11$ is just the same with $Ax + By = C$.

   C. Yes, because the equation is in degree 2.

   D. No, because the equation is in degree 2.

7. Which of the following statements does ***<u>NOT</u>*** describe the linear equation in two variables?

   A. The equation can be written in the standard form $Ax + By = C$

   B. A, B, and C are real numbers

   C. x and y are constant terms

   D. A and B are both not equal to zero

8. What is the standard form of the equation $3x + 4y – 6 = 0$?

   A. $3x + 4y = 6$ B. $3x - 4y = 6$ C. $3x + 4y = - 6$ D. $3x - 4y = 6$

9. What value of x would make $y = 1$ in the equation $3x + y = 4$?

A. −1 B. 0 C. 1 D. 2

10. Which ordered pair satisfies the linear equation $2x - 3y = 4$?

A. (−5, -2) B. (-5, 2) C. (5, -2) D. (5, 2)

11. Which of the following lines is the steepest?

A. $y = -5x + 3$ B. $y = \frac{2}{3}x - 1$

C. $y = 4x - 1$ D. $y = -2x + 6$

12. What is the slope of the line that passes through points (2, -1) and (2, 3)?

A. 0 B. -4 C. 4 D. undefined

13. Find the slope of a line through (-3, 4) and (5, -2)

A. 0 B. $-\frac{3}{4}$ C. $\frac{3}{4}$ D. 3

14. Find the slope of the equation $y = -8$

A. 0 B. -8 C. 8 D. undefined

15. Which equation has an undefined slope?

A. $x - 4 = 0$ B. $y + 5 = 0$ C. $x + y = 0$ D. $2x - y = 0$

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