TEACHING GUIDE

Module 5: Systems of Linear Equations and Inequalities in Two Variables

A. Learning Outcomes

Content Standard:

The learner demonstrates understanding of key concepts of systems of linear equations and inequalities in two variables.

Performance Standard:

The learner is able to formulate real-life problems involving systems of linear equations and inequalities in two variables and solve these with utmost accuracy using a variety of strategies.

UNPACKING THE STANDARDS FOR UNDERSTANDING

<table>
<tr><td rowspan="2">SUBJECT:
Grade 8 Mathematics
QUARTER:
First Quarter
STRAND:
Algebra
TOPIC:
Systems of Linear Equations and Inequalities in Two Variables
LESSONS:
1. Systems of Linear Equations in Two Variables and Their Graphs
2. Solving Systems of Linear Equations in Two Variables
3. Graphical Solutions of Systems of Linear Inequalities in Two Variables</td><td colspan="2">LEARNING COMPETENCIES
1. Describe systems of linear equations and inequalities using practical situations and mathematical expressions.
2. Identify which systems of linear equations have graphs that are parallel, intersect and coincide.
3. Graph systems of linear equations in two variables.
4. Solve systems of linear equations by (a) graphing; (b) elimination; (c) substitution.
5. Graph system of linear inequalities in two variables.
6. Solve a system of linear inequalities in two variables by graphing.
7. Solve problems involving systems of linear equations and inequalities in two variables.</td></tr>
<tr><td>ESSENTIAL UNDERSTANDING:
Students will understand that systems of linear equations and inequalities in two variables are useful tools in solving real-life problems and in making decisions</td><td>ESSENTIAL QUESTION:
How do systems of linear equations and inequalities in two variables facilitate finding solutions to real-life problems and making decisions?</td></tr>
<tr><td></td><td colspan="2">TRANSFER GOAL:
Students will be able to apply the key concepts of systems of linear equations and inequalities in two variables in formulating and solving real-life problems and in making decisions.</td></tr>
</table>

B. Planning for Assessment

Product/Performance

The following are products and performances that students are expected to come up with in this module.

a. Systems of linear equations drawn from real-life situation and the graph of each system
b. Role-playing of real-life situations where systems of linear equations in two variables are applied
c. Real-life problems involving systems of linear equations in two variables formulated and solved
d. Design or sketch plan of an expanded school vegetable garden that demonstrates students' understanding of systems of linear equations and inequalities in two variables.

Assessment Map

TYPE	KNOWLEDGE	PROCESS/SKILLS	UNDERSTANDING	PERFORMANCE
Pre-Assessment/ Diagnostic	**Pre-Test: Part I** Identifying systems of linear equations and inequalities in two variables and their graphs	**Pre-Test: Part I** Graphing systems of linear equations and inequalities in two variables Solving systems of linear equations and inequalities in two variables	**Pre-Test: Part I** Solving problems involving systems of linear equations and inequalities in two variables	**Pre-Test: Part I** Products and performances related to or involving systems of linear equations and inequalities in two variables
	Pre-Test: Part II Identifying mathematics concepts previously learned through the illustrations made	**Pre-Test: Part II** Illustrating mathematics concepts previously learned	**Pre-Test: Part II** Expressing understanding of mathematics concepts previously learned	

Pre-Test: Part III Situational Analysis				
	Identifying the information given in a problem	Calculating unknown values Representing situations using mathematical expressions and statements	Explaining how a mathematical statement is derived from a given situation	Citing situations involving linear equations in two variables Formulating and solving problems involving linear equations in two variables
Formative	**Quiz: Lesson 1** Identifying systems of linear equations in two variables	**Quiz: Lesson 1** Graphing systems of linear equations in two variables Describing the solution sets of a systems of linear equations in two variables using graphs	**Quiz: Lesson 1** Representing situations using systems of linear equations in two variables Explaining how to graph systems of linear equations in two variables	
	Quiz: Lesson 2 Giving examples of systems of linear equations in two variables Identifying the information given in a problem involving systems of linear equations in two variables	**Quiz: Lesson 2** Finding the solutions of systems of linear equations in two variables graphically and algebraically Using the different methods of solving systems of linear equations in two variables in finding solutions to real-life problems	**Quiz: Lesson 2** Explaining how to obtain the solutions of systems of linear equations in two variables Explaining why some systems of linear equations in two variables have one solution, no solution, or infinite number of solutions Explaining how to check or verify results obtained Describing the advantages and disadvantages of using	

			the different methods of solving systems of linear equations in two variables Solving problems involving systems of linear equations in two variables Choosing and justifying the best option based on the solved problems involving systems of linear equations in two variables	
	Quiz: Lesson 3 Giving examples of systems of linear inequalities in two variables Identifying the information given in a problem involving systems of linear inequalities in two variables	**Quiz: Lesson 3** Determining whether an ordered pair is a solution of a given system of linear inequalities in two variables Solving systems of linear inequalities in two variables graphically	**Quiz: Lesson 3** Explaining why some systems of linear inequalities in two variables have no solution or infinite number of solutions Explaining how the graphical solution of a system of linear inequalities in two variables is determined Describing the solution set of a system of linear inequalities in two variables Describing the advantages and disadvantages of finding the solution set of a system of linear inequalities in two variables graphically	

			Solving problems involving systems of linear inequalities in two variables Making and justifying the best decision based on the solved problems involving systems of linear inequalities in two variables	
Summative	**Post-Test: Part I** Identifying systems of linear equations and inequalities in two variables and their graphs	**Post-Test: Part I** • Graphing systems of linear equations and inequalities in two variables • Solving systems of linear equations and inequalities in two variables	**Post-Test: Part I** Solving problems involving systems of linear equations and inequalities in two variables	**Post-Test: Part I** Products and performances related to or involving systems of linear equations and inequalities in two variables
	Part II Identifying systems of linear equations and inequalities in two variables	**Part II** Solving systems of linear equations and inequalities in two variables graphically and algebraically	**Part II** Describing the solution set of systems of linear equations and inequalities in two variables	
			Part III Solving problems involving systems of linear equations and inequalities	**Part IV:** **GRASPS Assessment**
Self-Assessment	**Journal Writing:** Expressing understanding of systems of linear equations in two variables Expressing understanding of finding solutions of systems of linear equations in two variables graphically and algebraically Expressing understanding of systems of linear inequalities in two variables			

Assessment Matrix (Summative Test)

Levels of Assessment	What will I assess?	How will I assess?	How Will I Score?
Knowledge 15%	The learner demonstrates understanding of key concepts of systems of linear equations and inequalities in two variables. Describes systems of linear equations and inequalities using practical situations and mathematical expressions. Identifies which given systems of linear equations have graphs that are parallel, intersect and coincide. Graphs systems of linear equations in two variables. Solves systems of linear equations by (a) graphing; (b) elimination; and (c) substitution. Graph system of linear inequalities in two variables. Solve a system of linear inequalities in two variables by graphing. Solve problems involving systems of linear equations and inequalities in two variables.	**Paper and Pencil Test** **Part I** items 1, 2, and 8 **Part II** item 1 **Part IV** item 1	1 point for every correct response
Process/Skills 25%		**Part I** items 3, 5, 10, 11, and 12 **Part II** item 3	1 point for every correct response Rubric on Problem Solving Rubric for drawing Criteria: Neat and Clear Accurate Justified Appropriate Relevant
Understanding 30%		**Part I** items 4, 7, 9, 13, 15, and 17 **Part II** items 2 and 4 **Part III** Items 1 and 2 **Part IV** items 2, 3, and 5	1 point for every correct response Rubric for explanation Criteria: Clear Coherent Justified Rubric for drawing Criteria: Neat and Clear Accurate Appropriate Justified Relevant Rubric on Problem Solving Rubric for explanation Criteria: Clear Justified Coherent

Product/ Performance 30%	The learner is able to formulate real-life problems involving systems of linear equations and inequalities in two variables and solve these with utmost accuracy using a variety of strategies.	**Part I** Items 6, 14, 16, 18, 19, and 20 **Part IV** item 4 **GRASPS Assessment** Make a design or a sketch plan of a vegetable school garden with an area of at least one hectare. Apply your understanding of the key concepts of systems of linear equations and inequalities in two variables. Then, use the design or sketch plan of the garden in formulating and solving problems involving systems of linear equations and inequalities in two variables.	1 point for every correct response Rubric on Problem Posing/ Formulation and Problem Solving Criteria: Relevant Authentic Creative Clear Insightful Rubric on Design/Sketch Plan Criteria: 1. Content 2. Clarity of Presentation 3. Accuracy of Measurements 4. Diversity of Plants

C. Planning for Teaching-Learning

Introduction:

This module covers key concepts of systems of linear equations and inequalities in two variables. It is divided into three lessons namely: Systems of Linear Equations and their Graphs, Solving Systems of Linear Equations, and Graphical Solutions of Systems of Linear Inequalities in Two Variables. In Lesson 1, students will describe systems of linear equations and their graphs and solution sets. The students will also draw the graphs of systems of linear equations using any graphing materials, tools, or computer software such as GeoGebra. In Lesson 2, the students will find the solution set of systems of linear equations graphically and algebraically. The two algebraic methods of solving systems of linear equations that students will use are *substitution method* and *elimination method*. In Lesson 3, the students will determine the graphical solutions of systems of linear inequalities in two variables. Again, students will use any graphing materials, tools, or computer software. It would be more convenient for students to find the solution sets of system of linear inequalities if the use of GeoGebra is encouraged.

In all lessons, students are given the opportunity to use their prior knowledge and skills in learning systems of linear equations and inequalities. They are also given varied activities to process the knowledge and skills learned and deepen and transfer their understanding of the different lessons.

As an introduction to the main lesson, ask them the following questions:

Have you ever asked yourself how businessmen make profits? How can farmers increase their yield or harvest? How parents budget their income on food, education, clothing and other needs? How cellular phone users choose the best payment plan? How students spend their daily allowances or travel from home to school?

Entice the students to find out the answers to these questions and to determine the vast applications of systems of linear equations and inequalities in two variables through this module.

Objectives:

After the learners have gone through the lessons contained in this module, they are expected to:

a. describe systems of linear equations using practical situations and mathematical expressions;
b. identify which given systems of linear equations have graphs that are parallel, intersect, and coincide;
c. draw the graph of systems of linear equations in two variables;
d. find the solution set of systems of linear equations by (a) graphing; (b) elimination; (c) substitution;
e. draw the graph of system of linear inequalities in two variables;
f. determine the graphical solutions of a system of linear inequalities in two variables; and
   formulate and solve problems involving systems of linear equations and inequalities in two variables.

Pre-Assessment:

Check students' prior knowledge, skills, and understanding of mathematics concepts related to Systems of Linear Equations and Inequalities in Two Variables. Assessing these will facilitate teaching and students' understanding of the lessons in this module.

Answer Key

Part I

1.	B	11.	C
2.	B	12.	A
3.	D	13.	C
4.	D	14.	C
5.	B	15.	D
6.	C	16.	A
7.	B	17.	A
8.	C	18.	A
9.	B	19.	C
10.	D	20.	A

Part III:

1. Php 20; Php 12
2.

Number of Adults	Admission Fee	Number of Children	Admission Fee
2	40	2	24
3	60	3	36
4	80	4	48
5	100	5	60
6	120	6	72

III. PRE - ASSESSMENT

Part I: Find out how much you already know about this module. Choose the letter that you think best answers the question. Please answer all items. Take note of the items that you were not able to answer correctly and look for the right answer as you go through this module.

1. Which of the following is a system of linear equations in two variables?

   a. $2x - 7y = 8$

   b. $3x + 5y = -2$
      $x - 4y = 9$

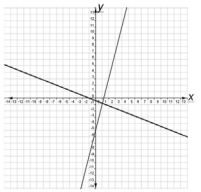
   c. $x + 9y = 2$
      $2x - 3y > 12$

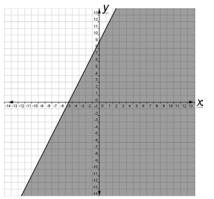
   d. $4x + 1 = 8$
      $3y - 7 = 11$

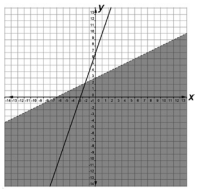
2. What point is the intersection of the graphs of the lines $x + y = 8$ and $2x - y = 1$?

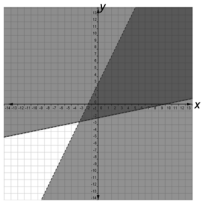
   a. (1, 8) b. (3, 5) c. (5, 3) d. (2, 6)

3. Which of the following is a graph of a system of linear inequalities in two variables?

   a. 

   c. 

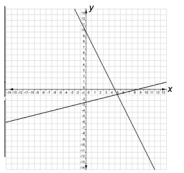
   b. 

   d. 

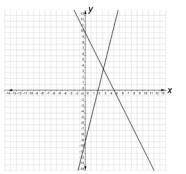
Teacher's Note and Reminders

4. Which of the following shows the graph of the system $\begin{matrix} 2x + y < 2 \\ x - 4y > 9 \end{matrix}$?

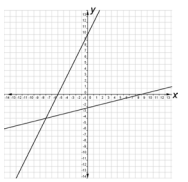
a.



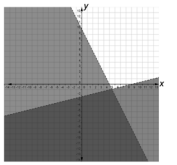
c.



b.



d.



5. If $2x + y = 9$ and $2x - y = 11$, what is the value of x?

a. 4 b. 5 c. 10 d. 20

6. A car park charges Php 45 for the first three hours and Php 5 for every succeeding hour or a fraction thereof. Another car park charges Php 20 for the first three hours and Php 10 for every succeeding hour or a fraction thereof. In how many hours would a car owner pay the same parking fee in any of the two car parks?

a. 2 hr b. 3 hr c. 5 hr d. 8 hr

7. How many solutions does a consistent and independent system of linear equations have?

a. 0 b. 1 c. 2 d. Infinite

8. Which of the following ordered pairs satisfy both $2x + 7y > 5$ and $3x - y \leq 2$?

a. (0, 0) b. (10, -1) c. (-4, 6) d. (-2, -8)

Teacher's Note and Reminders

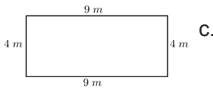
9. Mr. Agpalo paid Php 260 for four adult's tickets and six children's tickets. Suppose the total cost of an adult's ticket and a children's ticket is Php 55. How much does an adult's ticket cost?

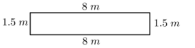
   a. Php 20 b. Php 35 c. Php 80
   d. Php 120

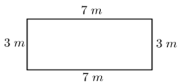
10. Which system of equations has a graph that shows intersecting lines?

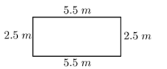
   a. $2x + 4y = 14$, $x + 2y = 7$
   b. $-3x + y = 5$, $6x - 2y = 1$
   c. $4x + 8y = 7$, $x + 2y = 3$
   d. $3x + y = 10$, $3x - y = 5$

11. Mr. Bonifacio asked each of his agriculture students to prepare a rectangular garden such that its perimeter is at most 19 m and the difference between its length and its width is at least 5 m. Which of the following could be the sketch of a garden that a student may prepare?

   a. 

   c. 

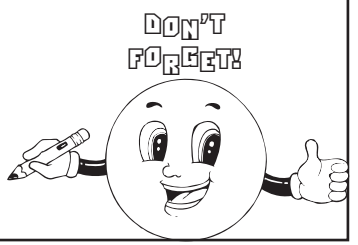
   b. 

   d. 

12. Luisa says that the system $3x + y = 2$, $2y = 15 - 6x$ has no solution. Which of the following reasons would support her statement?
   I. The graph of the system of equations shows parallel lines.
   II. The graph of the system of equations shows intersecting lines.
   III. The two lines as described by the equations in the system have the same slope.

   a. I and II b. I and III c. II and III d. I, II, and III

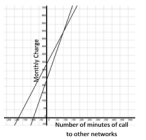
Teacher's Note and Reminders



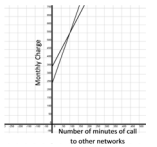
13. Jose paid at most Php 250 for the four markers and three pencils that he bought. Suppose the marker is more expensive than the pencil and their price's difference is greater than Php 30. Which of the following could be the amount paid by Jose for each item?

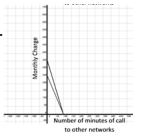
    a. Marker: Php 56 Pencil: Php 12
    b. Marker: Php 35 Pencil: Php 15
    c. Marker: Php 46 Pencil: Php 7
    d. Marker: Php 50 Pencil: Php 19

14. Bea wanted to compare the mobile network plans being offered by two telecommunication companies. Suppose Bea's father would like to see the graph showing the comparison of the two mobile network plans. Which of the following graphs should Bea present to his father?

    a. 

    b. 

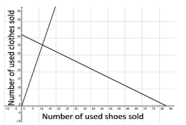
    c. 

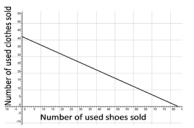
    d. 

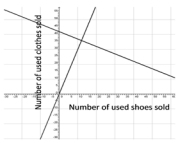
15. Edna and Grace had their meal at a pizza house. They ordered the same kind of pizza and drinks. Edna paid Php 140 for 2 slices of pizza and a drink. Grace paid for Php 225 for 3 slices of pizza and 2 drinks. How much did they pay for the total number of slices of pizza?

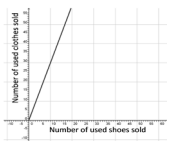
    a. Php 55
    b. Php 110
    c. Php 165
    d. Php 275

16. The Senior Citizens Club of a certain municipality is raising funds by selling used clothes and shoes. Mrs. Labrador, a member of the club, was assigned to determine how many used clothes and shoes were sold after knowing the important information needed. She was asked further to present to the club how she came up with the result using graph. Which of the following graphs could Mrs. Labrador present?

    a. 

    c. 

    b. 

    d. 

Teacher's Note and Reminders

17. The Math Club rented a sound system for their annual Mathematics Camp. They also rented a generator in case of power interruption. After the 3-day camp, the club paid a total amount of Php3,000, three days for the sound system and two days for the generator. If each is rented for one day, the club should have paid a total amount of Php1,100. What was the daily rental cost of the generator?

    a. Php 300
    b. Php 600
    c. Php 800
    d. Php 2,400

18. Mrs. Soriano would like to keep track of her family's expenses to have an idea of the maximum or minimum amount of money that she will allot for electric and water consumption, food, clothing, and other needs. Which of the following should Mrs. Soriano prepare?

    a. Budget Plan
    b. Compilation of Receipts
    c. Pricelist of Commodities
    d. Bar Graph of Family's Expenses

19. A restaurant owner would like to make a model which he can use as a guide in writing a system of equations. He will use the system of equations in determining the number of kilograms of pork and beef that he needs to purchase daily given a certain amount of money (C), the cost (A) of a kilo of pork, the cost (B) of a kilo of beef, and the total weight of meat (D). Which of the following models should he make and follow?

    a. $Ax - By = C$
       $x + y = D$
    b. $Ax + By = C$
       $x - y = D$
    c. $Ax + By = C$
       $x + y = D$
    d. $Ax - By = C$
       $x - y = D$

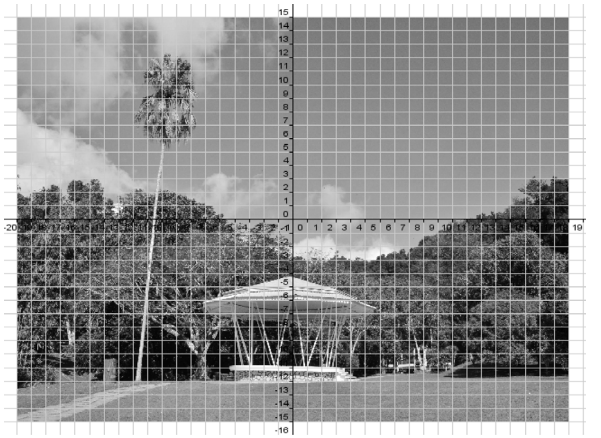
20. Mrs. Jacinto would like to instill the value of saving and to develop decision-making among her children. Which of the following situations should Mrs. Jacinto present to her children?

    a. Buying and selling different items.
    b. A person putting coins in his piggy bank.
    c. Buying assorted goods in a department store.
    d. Making bank deposits in two banks that give different interests.

Teacher's Note and Reminders

Part II. Illustrate each mathematics concept in the given figure then describe it by completing the statement at the bottom.

Lines	**Slope of a Line**	**y - intercept of a Line**
Points on a Line	**Points**	**Coordinates of Points**
Parallel Lines	**Intersecting Lines**	**Linear Equations**
	Linear Inequality	



My idea of (mathematics concept given) is _____
_____
_____
_____

Teacher's Note and Reminders

Part III. Use the situation below to answer the questions that follow.

One Sunday, a Butterfly Exhibit was held at the Quezon Memorial Circle in Quezon City. A number of people, children and adults, went to see the exhibit. Admission was Php 20 each for adults and Php 12 each for children.

Questions:

1. How much did an adult pay for the exhibit? How about a child?

2. Complete the table below for the amount that must be paid by a certain number of adults and children who will watch the exhibit.

Number of Adults	Admission Fee	Number of Children	Admission Fee
2		2	
3		3	
4		4	
5		5	
6		6	

3. How much would 10 adults pay if they watch the exhibit? How about 10 children? Show your solution.

4. If a certain number of adults watched the exhibit, what expression would represent the total admission fee?

   What mathematical statement would represent the total amount that will be collected from a number of children? Explain your answer.

5. Suppose six adults and 15 children watch the exhibit. What is the total amount they will pay for the admission? Show your solution.

6. If a number of adults and another number of children watch the exhibit, how will you represent the total amount they will pay as admission? Explain your answer.

7. Suppose the total amount collected was Php 3,000. How many adults and how many children could have watched the exhibit?

8. The given situation illustrates the use of linear equations in two variables. In what other real-life situations are linear equations in two variables applied? Formulate problems out of these situations then solve.

LEARNING GOALS AND TARGETS:

Students are expected to demonstrate understanding of key concepts of systems of linear equations and inequalities in two variables, formulate real-life problems involving these concepts, and solve these with utmost accuracy using a variety of strategies.

Lesson 1: SYSTEMS OF LINEAR EQUATIONS IN TWO VARIABLES AND THEIR GRAPHS

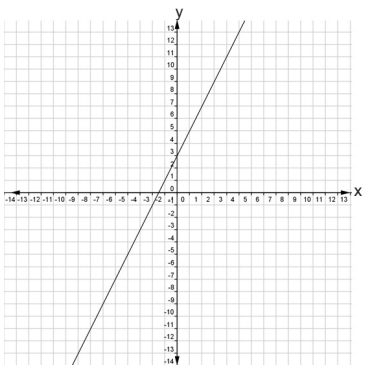
What to Know

Let the students draw and describe the graphs of some linear equations in two variables by doing Activity 1. This activity provides the students the opportunity to recall graphing linear equations and to determine the characteristics of lines.

Answer Key

Activity 1

1.



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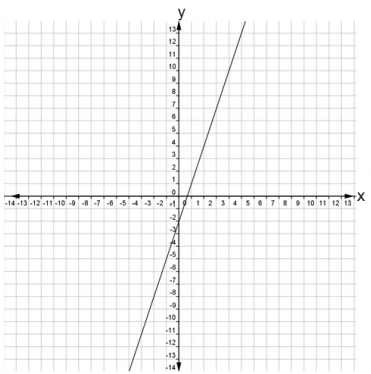


Lesson 1 Systems of Linear Equations in Two Variables and their Graphs

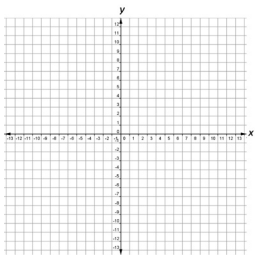
What to Know

Start Lesson 1 of this module by assessing your knowledge of the different mathematics concepts previously studied and your skills in performing mathematical operations. These knowledge and skills may help you in understanding Systems of Linear Equations in Two Variables and their Graphs. As you go through this lesson, think of the following important question: *"How is the system of linear equations in two variables used in solving real-life problems and in making decisions?"* To find the answer, perform each activity. If you find any difficulty in answering the exercises, seek the assistance of your teacher or peers or refer to the modules you have gone over earlier. To check your work, refer to the answer key provided at the end of this module.

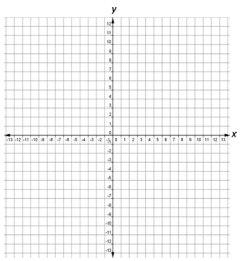
Activity 1 DESCRIBE ME!

Directions: Show the graph of each of the following linear equations in a Cartesian coordinate plane. Answer the questions that follow.

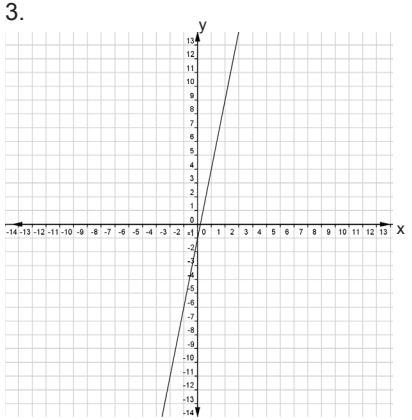
1. $y = 2x + 3$



2. $3x - y = 2$



3.



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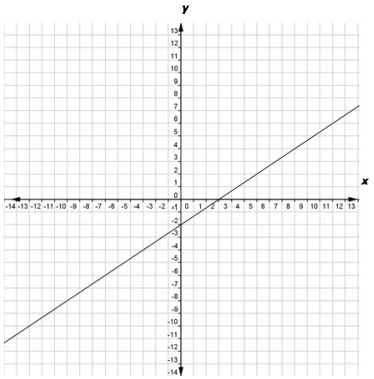
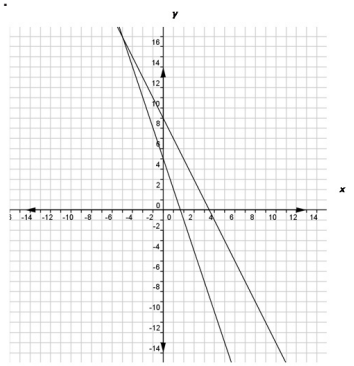


Let the students find the slopes and the y-intercepts of the graphs of some pairs of linear equations. Then ask them to describe the solution set of each pair of linear equations using their slopes and y-intercepts. Tell them to perform Activity 2. In this activity, the students will be able to see how the slopes and y-intercepts of two lines are related to the solution set of the system of equations describing these lines.

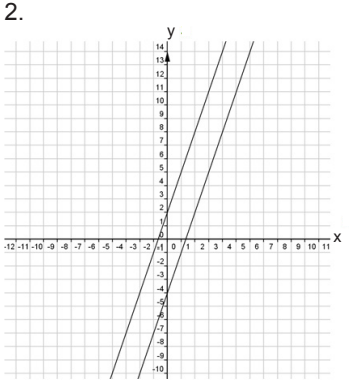
Answer Key

Activity 2

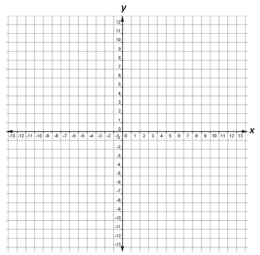
1.



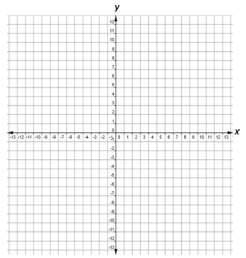
2.



3. y = 5x – 1



4. 2x – 3y = 6



QUESTIONS ?

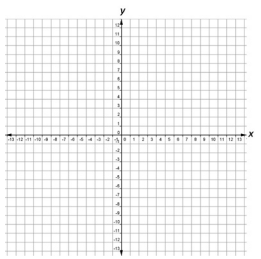
a. How did you graph each linear equation in two variables?
b. How do you describe the graphs of linear equations in two variables?

Were you able to draw and describe the graphs of linear equations in two variables? Suppose you draw the graphs of two linear equations in the same coordinate plane. How would the graphs of these equations look like? You'll find that out when you do the next activity.

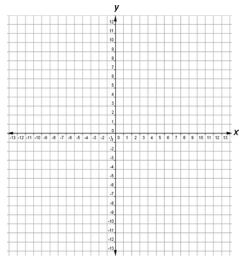
Activity 2 MEET ME AT THIS POINT IF POSSIBLE...

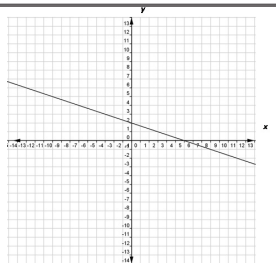
Directions: Show the graph of each pair of linear equations below using the same Cartesian plane then answer the questions that follow.

1. $3x + y = 5$ and $2x + y = 9$



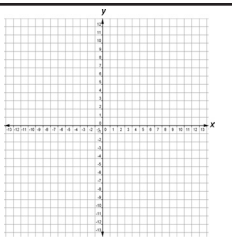
2. $3x - y = 4$ and $y = 3x + 2$



3. 

Activity 2(Graphs)

a. Methods in graphing linear equations
b. Intersecting lines; parallel lines; coinciding lines
c. $3x + y = 5$ and $2x + y = 9$; one point of intersection; (-4, 17)
d. $3x - y = 4$ and $y = 3x + 2$; Its graph is parallel
   $x + 3y = 6$ and $2x + 6y = 12$; Its graph is coinciding
e. e.1) one e.2) none e.3) many
f. f.1) $3x + y = 5$ slope = -3 y-intercept = 5
   $2x + y = 9$ slope = -2 y-intercept = 9
   f.2) $3x - y = 4$ slope = 3 y-intercept = -4
   $y = 3x + 2$ slope = 3 y-intercept = 2
   f.3) $x + 3y = 6$ slope = y-intercept = 2
   $2x + 6y = 12$ slope = y-intercept = 2
g. $3x + y = 5$ slope = not equal y-intercept = not equal
   $2x + y = 9$
   $3x - y = 4$ slope = equal y-intercept = equal
   $y = 3x + 2$
   $x + 3y = 6$ slope = equal y-intercept = equal
   $2x + 6y = 12$
h. $3x + y = 5$ There is one solution if the slopes and y-intercepts are not
   $2x + y = 9$ equal.
   $3x - y = 4$ There is no solution if the slopes are equal $y = 3x + 2$ and
   the y-intercepts are not equal.
   $x + 3y = 6$ There are many solutions if the slopes and y-intercepts are equal.
   $2x + 6y = 12$
i. Many possible answers

3. $x + 3y = 6$ and $2x + 6y = 12$ 

QUESTIONS ?

a. How did you graph each pair of linear equations?
b. How would you describe the graphs of $3x + y = 5$ and $2x + y = 9$?
   How about $3x - y = 4$ and $y = 3x + 2$? $x + 3y = 6$ and $2x + 6y = 12$?
c. Which pair of equations has graphs that are intersecting?
   How many points of intersection do the graphs have?
   What are the coordinates of their point(s) of intersection?
d. Which pair of equations has graphs that are not intersecting? Why?
   How do you describe these equations?
e. Each pair of linear equations forms a system of equations. The point of intersection of the graphs of two linear equations is the solution of the system. How many solutions does each pair of equations have?
   e.1) $3x + y = 5$ and $2x + y = 9$
   e.2) $3x - y = 4$ and $y = 3x + 2$
   e.3) $x + 3y = 6$ and $2x + 6y = 12$
f. What is the slope and the y-intercept of each line in the given pair of equations?
   f.1) $3x + y = 5$; slope = y-intercept =
   $2x + y = 9$; slope = y-intercept =
   f.2) $3x - y = 4$; slope = y-intercept =
   $y = 3x + 2$; slope = y-intercept =
   f.3) $x + 3y = 6$; slope = y-intercept =
   $2x + 6y = 12$; slope = y-intercept =
g. How would you compare the slopes of the lines defined by the linear equations in each system?
   How about their y-intercepts?
h. What statements can you make about the solution of the system in relation to the slopes of the lines?
   How about the y-intercepts of the lines?
i. How is the system of linear equations in two variables used in solving real-life problems and in making decisions?

Let the students read and understand some important notes on systems of linear equations and their graphs before they perform the succeeding activities. Tell them to study carefully the examples given.

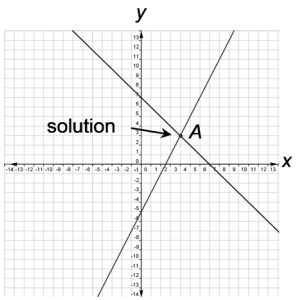
Teacher's Note and Reminders

Equations like $x - y = 7$ and $2x + y = 8$ are called **simultaneous linear equations or a system of linear equations** if we want them to be true for the same pair of numbers. The solution of such equations is an ordered pair of numbers that satisfies both equations. The solution set of a system of linear equations in two variables is the set of all ordered pairs of real numbers that makes every equation in the system true.

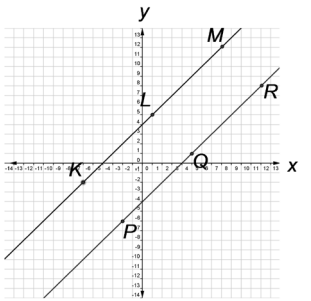
The solution of a system of linear equations can be determined algebraically or graphically. To find the solution graphically, graph both equations on a Cartesian plane then find the point of intersection of the graphs, if it exists. The solution to a system of linear equations corresponds to the coordinates of the points of intersection of the graphs of the equations.

A system of linear equations has:

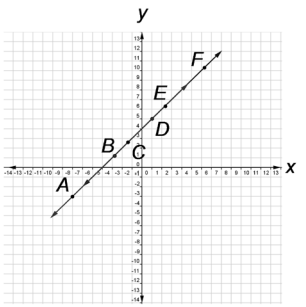
a. only one solution if their graphs intersect.
b. no solution if their graphs do not intersect.
c. infinitely many solutions if their graphs coincide.



Exactly one solution



No solution



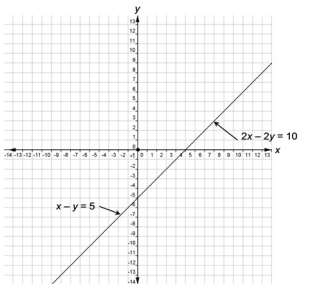
Infinitely Many Solutions

Teacher's Note and Reminders

There are three kinds of systems of linear equations in two variables according to the number of solutions. These are:

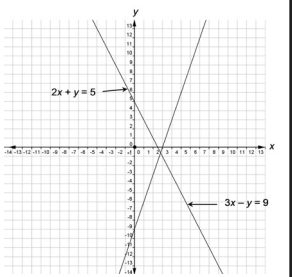
1. **System of consistent and dependent equations**
   This is a system of linear equations having infinitely many solutions. The slopes of the lines defined by the equations are equal; their y-intercepts are also equal; and their graphs coincide.

   Example: The system of equations $\begin{matrix} x - y = 5 \\ 2x - 2y = 10 \end{matrix}$ is consistent and dependent. The slopes of their lines are equal, their y-intercepts are also equal, and their graphs coincide.



2. **System of consistent and independent equations**
   This is a system of linear equations having exactly one solution. The slopes of the lines defined by the equations are not equal; their y-intercepts could be equal or unequal; and their graphs intersect.

   Example: The system of equations $\begin{matrix} 2x + y = 5 \\ 3x - y = 9 \end{matrix}$ is consistent and independent. The slopes of their lines are not equal, their y-intercepts could be equal or unequal, and their graphs intersect.



3. **System of inconsistent equations**
   This is a system of linear equations having no solution. The slopes of the lines defined by the equations are equal or have no slopes; their y-intercepts are not equal; and their graphs are parallel.

   Example: The system of equations $\begin{matrix} 2x + y = -6 \\ 2x + y = 10 \end{matrix}$ is inconsistent. The slopes of their lines are equal; their y-intercepts are not equal; and their graphs are parallel.

Pose the question:

"How are the solutions to problems involving systems of linear equations used in making decisions?"

What to Process

Let students identify, describe, and give examples of systems of linear equations that are consistent and dependent, consistent and independent, or inconsistent. Ask them to perform Activity 3.

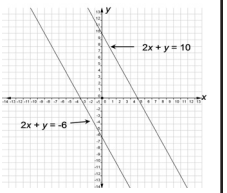
Answer Key

Activity 3

1. Consistent and independent
2. Inconsistent
3. Consistent and dependent
4. Inconsistent
5. Consistent and independent
6. Consistent and independent
7. Consistent and dependent
8. Consistent and independent
9. Inconsistent
10. Consistent and independent

Teacher's Note and Reminders

Systems of linear equations in two variables are illustrated in many real-life situations. A system of linear equations in two variables can be used to represent problems that involve finding values of two quantities such as the number of objects, costs of goods or services, or amount of investments, solutions of which can also be described using graphs. But how are the solutions to problems involving systems of linear equations used in making decisions?



What to Process

Your goal in this section is to apply the key concepts of systems of linear equations in two variables and their graphs. Use the mathematical ideas and the examples presented in the preceding section to answer the activities provided.

Activity 3 CONSISTENT OR INCONSISTENT?

Directions: Determine whether each system of linear equations is consistent and dependent, consistent and independent, or inconsistent. Answer the questions that follow.

1. $2x - y = 7$
   $3x - y = 5$
2. $2x + y = -3$
   $2x + y = 6$
3. $x - 2y = 9$
   $2x - 4y = 18$
4. $8x + 2y = 7$
   $y = -4y + 1$
5. $-3x + y = 10$
   $4x + y = 7$
6. $x - 2y = 9$
   $x + 3y = 14$
7. $6x - 2y = 8$
   $y = 3x - 4$
8. $x + 3y = 8$
   $x - 3y = 8$
9. $2y = 6x - 5$
   $3y = 9x + 1$
10. $3x + 5y = 15$
    $4x - 7y = 10$

Teacher's Note and Reminders

In Activity 4, let the students describe the graphs of some systems of linear equations in two variables. Strengthen their understanding of consistent and dependent, consistent and independent, or inconsistent systems of linear equations by asking them to give examples. Let them draw and describe the graphs of these systems of linear equations.

Answer Key

Activity 4

1. one solution
2. many solutions
3. no solution
4. one solution

QUESTIONS ?

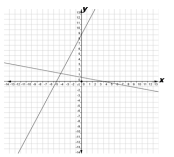
a. How were you able to identify system of equations that are consistent- dependent, consistent-independent and inconsistent?
b. When do you say that a system of linear equations is consistent and dependent? consistent and independent? inconsistent?
c. Give examples of systems of linear equations that are consistent and dependent, consistent and independent, and inconsistent.

Were you able to determine which system of linear equations in two variables is consistent and dependent, consistent and independent, or inconsistent? In the next activity, you will describe the solution set of system of linear equations in two variables through its graph.

Activity 4 HOW DO I LOOK?

Directions: Describe the solution set of the system of linear equations as shown by the following graphs. Answer the questions that follow.

1.



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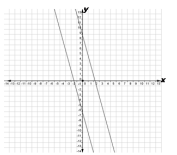

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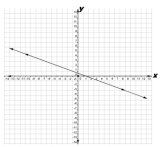

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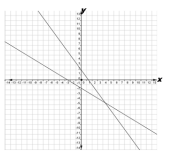


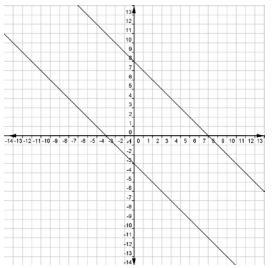
QUESTIONS ?

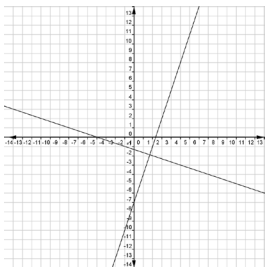
a. How many solution/s does each graph of system of linear equations have?
b. Which graph shows that the system of linear equations is consistent and dependent? consistent and independent? inconsistent? Explain your answer.
c. When do you say that the system of linear equations as described by the graph is consistent and dependent? consistent and independent? inconsistent?
d. Draw graphs of systems of linear equations that are consistent and dependent, consistent and independent, and inconsistent. Describe each graph.

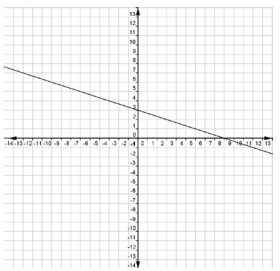
Ask the students to draw the graphs of some systems of linear equations then describe the solution set of each. Let them perform Activity 5. If math software like GeoGebra is available, ask the students to make use of this. GeoGebra is a dynamic mathematics software that can be used to visualize and understand concepts in algebra, geometry, calculus, and statistics.

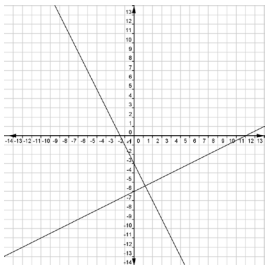
Answer Key

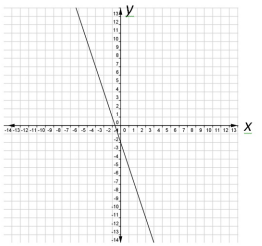
Activity 5

1. 

2. 

3. 

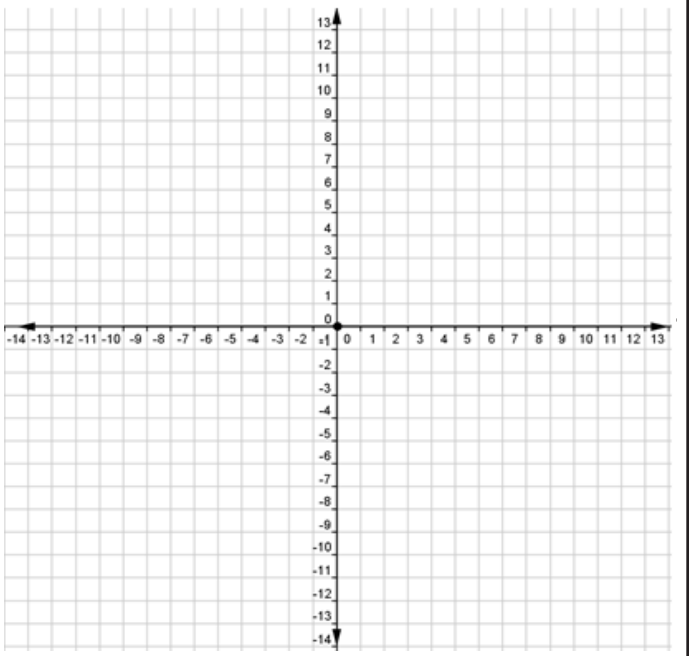
4. 

5. 

Activity 5 DESCRIBE MY SOLUTIONS!

Directions: Graph each of the following systems of linear equations in two variables on the Cartesian coordinate plane. Describe the solution set of each system based on the graph drawn. Answer the questions that follow.

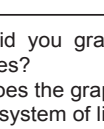
1. $x + y = 8$
   $x + y = -3$
2. $3x - y = 7$
   $x + 3y = -4$
3. $x + 6y = 9$
   $2x + 6y = 18$
4. $x - 2y = 12$
   $6x + 3y = -9$
5. $3x + y = -2$
   $x + 2y = -4$



In some cases where students draw the graphs of some linear equations, the lines drawn may not appear to intersect because of the limited space on the Cartesian coordinate plane used. In such cases, emphasize to the students that lines can be extended indefinitely and that the lines will meet at a certain point.

Ask students to have a closer look at some aspects of the systems of linear equations and their graphs. Provide them opportunities to think deeper and test further their understanding of the lesson by doing Activity 6.

Teacher's Note and Reminders



a. How did you graph each system of linear equations in two variables?
b. How does the graph of each system look like?
c. Which system of linear equations has only one solution? Why? How about the system of linear equations with no solution? infinite number of solutions? Explain your answer.

In this section, the discussion was about system of linear equations in two variables and their graphs.

Go back to the previous section and compare your initial ideas with the discussion. How much of your initial ideas are found in the discussion? Which ideas are different and need revision?

Now that you know the important ideas about this topic, let's go deeper by moving on to the next section.

What to Understand

Your goal in this section is to take a closer look at some aspects of the topic. You are going to think deeper and test further your understanding of systems of linear equations in two variables and their graphs. After doing the following activities, you should be able to answer the following question: **How is the system of linear equations in two variables used in solving real-life problems and in making decisions?**

Activity 6 HOW WELL I UNDERSTOOD...

Directions: Answer the following.

1. How do you describe a system of linear equations in two variables?
2. Give at least two examples of systems of linear equations in two variables.
3. When is a system of linear equations in two variables used?
4. How do you graph systems of linear equations in two variables?
5. How do you describe the graphs of systems of linear equations in two variables?
6. How do you describe systems of linear equations that are consistent and dependent? consistent and independent? inconsistent?

Teacher's Note and Reminders

Before the students move to the next section of this lesson, give a short test (formative test) to find out how well they understood the lesson.

What to Transfer

Give the students opportunities to demonstrate their understanding of systems of linear equations by doing a practical task. Let them perform Activity 7. You can ask the students to work individually or in group. Emphasize to them that they must come up with some linear equations in two variables and that a pair of these equations must form a system.

7. Study the situation below:

Jose wanted to construct a rectangular garden such that its perimeter is 28 m and its length is 6 times its width.

a. What system of linear equations represents the given situation?
b. Suppose the system of linear equations is graphed. How would the graph look like?
c. Is the system consistent and dependent, consistent and independent, or inconsistent? Why?

In this section, the discussion was about your understanding of systems of linear equations in two variables and their graph.

What new realizations do you have about the systems of linear equations in two variables and their graphs? What new connections have you made for yourself?

Now that you have a deeper understanding of the topic, you are ready to do the tasks in the next section.

What to Transfer

Your goal in this section is to apply your learning to real-life situations. You will be given a practical task which will demonstrate your understanding.

Activity 7 HOW MUCH AND WHAT'S THE COST?

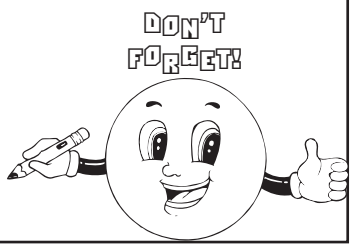
Directions: Complete the table below by writing all the school supplies that you use. Indicate the quantity and the cost of each.

School Supply	Quantity	Cost

SUMMARY/SYNTHESIS/GENERALIZATION:

This lesson was about systems of linear equations in two variables and their graphs. The lesson provided students opportunities to describe systems of linear equations and their solution sets using practical situations, mathematical expressions, and their graphs. They identified and described systems of linear equations whose graphs are parallel, intersecting, or coinciding. Moreover, the students were given the chance to draw and describe the graphs of systems of linear equations in two variables and to demonstrate their understanding of the lesson by doing a practical task. Students' understanding of this lesson and other previously learned mathematics concepts and principles will facilitate their learning of the next lesson, Solving Systems of Linear Equations Graphically and Algebraically.

Teacher's Note and Reminders



Formulate linear equations in two variables based on the table. Then use some pairs of these equations to form different systems of equations. Draw the graph of each system of linear equations. Use the rubric provided to rate your work.

Rubric for Real-Life Situations Involving Systems of Linear Equations in Two Variables and their Graphs

4	3	2	1
Systematically listed in the table the data, properly formulated linear equations in two variables that form a system of equations, and accurately drawn the graph of each system of linear equations.	Systematically listed in the table the school supplies, the quantity, and cost of each item, properly formulated linear equations in two variables that form a system of equations but unable to draw the graph accurately.	Systematically listed in the table the school supplies, the quantity, and cost of each item and formulated linear equations in two variables but unable to form systems of equations.	Systematically listed in the table the school supplies, the quantity, and cost of each item.

In this section, your task was to cite three real-life situations where systems of linear equations in two variables are illustrated.

How did you find the performance task? How did the task help you see the real world use of the topic?

Lesson 2: SOLVING SYSTEMS OF LINEAR EQUATIONS IN TWO VARIABLES

What to Know

Provide the students opportunities to represent a given situation using linear equations in two variables, show the graphs of these equations, then find possible solutions. Ask them to perform Activity 1. This activity will lead to students' understanding of solving systems of linear equations.

Answer Key

Activity 1

Number of Passengers	Amount Collected by the Tricycle Driver in Peso	Amount Collected by the Jeepney Driver in Peso
1	10	12
2	20	24
3	30	36
4	40	48
5	50	60
10	100	120
15	150	180
20	200	240
25	250	300
30	300	360

Lesson 2 Solving Systems of Linear Equations in Two Variables

What to Know

Start the lesson by assessing your knowledge of the different mathematics concepts previously studied and your skills in performing mathematical operations. These knowledge and skills may help you in understanding Solving Systems of Linear Equations in Two Variables. As you go through this lesson, think of the following important question: H**ow is the system of linear equations in two variables used in solving real-life problems and in making decisions?** To find out the answer, perform each activity. If you find any difficulty in answering the exercises, seek the assistance of your teacher or peers or refer to the modules you have gone over earlier.

Activity 1 HOW MUCH IS THE FARE?

Directions: Use the situation below to answer the questions that follow.

Suppose for a given distance, a tricycle driver charges Php 10.00 every passenger while a jeepney driver charges Php 12.00.

1. Complete the table below for the fare collected by the tricycle and jeepney drivers from a certain number of passengers.

Number of Passengers	**Amount Collected by the Tricycle Driver**	**Amount Collected by the Jeepney Driver**
1		
2		
3		
4		
5		
10		

Teacher's Note and Reminders

15		
20		
25		
30		

2. How did you determine the amount collected by the tricycle and jeepney drivers from their passengers?

3. Suppose in three round trips the tricycle and jeepney drivers had carried a total of 68 passengers.
   a. How would you find the number of passengers each had?
   b. What mathematical statement will you use to find the number of passengers each carried?

   What is the total amount of fare collected from the passengers by the two drivers? Explain how you arrived at your answer.

   c. How would you draw the graph of the mathematical statement obtained in 3b? Draw and describe the graph.

4. Suppose the total fare collected by the tricycle and jeepney drivers is Php 780.
   a. How would you find the number of passengers each had?
   b. What mathematical statement will you use to find the number of passengers each had?
   c. How would you draw the graph of the mathematical statement obtained in 4b? Draw the graph in the Cartesian coordinate plane where the graph of the mathematical statement in 3b was drawn. Describe the graph.

5. How do you describe the two graphs drawn?

6. What do the graphs tell you?

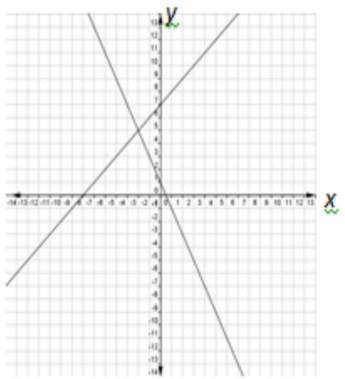
7. How did you determine the number of passengers each driver had?

Strengthen students' skills in graphing systems of linear equations. At the same time, provide them opportunities to examine different graphs drawn in a Cartesian coordinate plane. Tell them to perform Activity 2. Let them find out which graphs are intersecting, parallel, or coinciding. If intersecting, ask them to determine their point of intersection and the meaning of this.

Answer Key

Activity 2

1.



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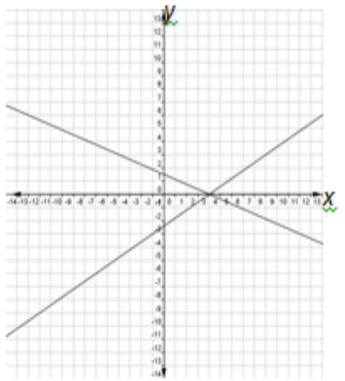

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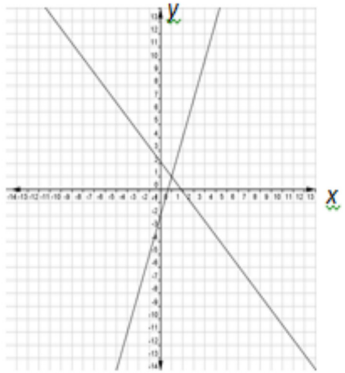
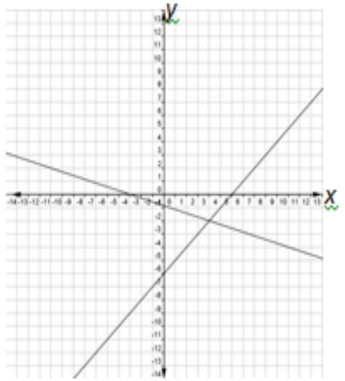


4.

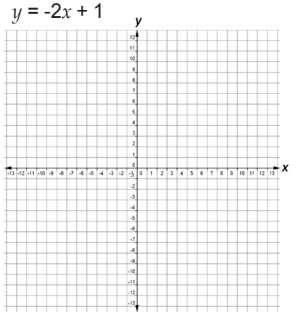


How did you find the activity? Were you able to use linear equations in two variables to represent a real-life situation? Were you able to find some possible solutions of a linear equation in two variables and draw its graph? In the next activity, you will show the graphs of systems of linear equations in two variables. You need this skill to learn about the graphical solutions of systems of linear equations in two variables.

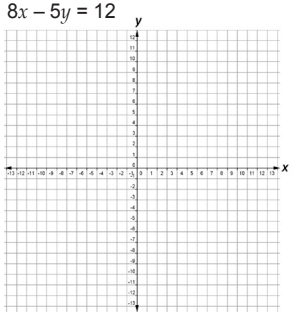
Activity 2 LINES, LINES, LINES...

Directions: Use the situation below to answer the questions that follow.

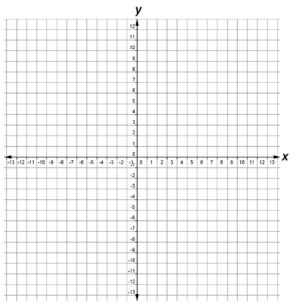
1. $y = x + 7$
   $y = -2x + 1$



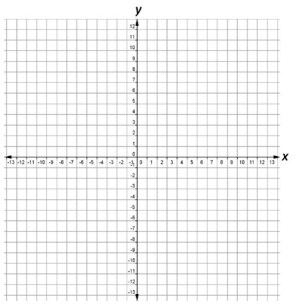
3. $3x + 8y = 12$
   $8x - 5y = 12$



2. $y = 3x - 2$
   $8x + 7y = 15$



4. $x - y = 6$
   $2x + 7y = -6$



Let students know that there are different ways of solving systems of linear equations in two variables. Tell them that in this module, the graphical and the algebraic methods are highlighted. Furthermore, provide the students opportunities to recall the different properties of equality by doing Activities 3 and 4. Let them realize that to solve systems of linear equations in two variables algebraically, they have to demonstrate greater understanding of solving linear equations in one variable.

Answer Key

Activity 3

1. $y = -4x + 11$
2. $y = 5x - 9$
3. $x = -\frac{y}{4} + 3$
4. $y = \frac{5x}{4} - 4$
5. $y = -\frac{2x}{3} + 2$
6. $x = \frac{7y}{2} - 9$
7. $x = -\frac{8y}{3} - 5$
8. $x = -12y + 8$
9. $y = 12x - 21$
10. $x = -\frac{3y}{4} - 12$

a. How did you show the graph of each system of equations?
b. How do you describe the graph of each system of equations?
c. Are the graphs intersecting lines? If yes, what are the coordinates of the point of intersection of these lines?
d. What do you think do the coordinates of the point of intersection of the lines mean?

Were you able to draw the graph of each system of linear equations in two variables? Were you able to determine and give the meaning of the coordinates of the point of intersection of intersecting lines? As you go through this module, you will learn about this point of intersection of two lines and how the coordinates of this point are determined algebraically. In the next activity, you will solve for the indicated variable in terms of the other variable. You need this skill to learn about solving systems of linear equations in two variables using the substitution method.

Activity 3 IF I WERE YOU...

Directions: Solve for the indicated variable in terms of the other variable. Explain how you arrived at your answer.

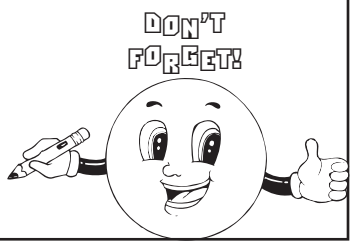
1. $4x + y = 11$; $y =$
2. $5x - y = 9$; $y =$
3. $4x + y = 12$; $x =$
4. $-5x - 4y = 16$; $y =$
5. $2x + 3y = 6$; $y =$
6. $-2x + 7y = 18$; $x =$
7. $-3x - 8y = 15$; $x =$
8. $\frac{1}{4}x + 3y = 2$; $x =$
9. $\frac{4}{9}x - \frac{1}{3}y = 7$; $y =$
10. $-\frac{2}{3}x - \frac{1}{2}$;$y = 8$ $x =$

Answer Key

Activity 4

1. $x = 3$
2. $x = -7$
3. $x = -3$
4. $x = \frac{12}{7}$
5. $x = 12$
6. $x = 3$
7. $y = 3$
8. $y = -4$
9. $y = 3$
10. $x = -5$

Teacher's Note and Reminders



Before the students proceed to the next set of activities, let the students read and understand some important notes on solving systems of linear equations. Tell them to study carefully the examples given.

Activity 4 WHAT MAKES IT TRUE?

Directions: Find the value of the variable that would make the equation true. Answer the questions that follow.

1. $5x = 15$
2. $-3x = 21$
3. $9x = -27$
4. $-7x = -12$
5. $\frac{2}{3}x = 8$
6. $x + 7 = 10$
7. $3y - 5 = 4$
8. $2y + 5y = -28$
9. $-3y + 7y = 12$
10. $5x - 2x = -15$

QUESTIONS ?

a. How did you solve each equation?
b. What mathematics concepts or principles did you apply to solve each equation? Explain how you applied these mathematics concepts and principles.
c. Do you think there are other ways of solving each equation? Explain your answer.

The solution of a system of linear equations can be determined algebraically or graphically. To find the solution graphically, graph both equations on a Cartesian coordinate plane then find the point of intersection of the graphs, if it exists. You may also use graphing calculator or computer software such as GeoGebra in determining the graphical solutions of systems of linear equations. GeoGebra is a dynamic mathematics software which helps you visualize and understand concepts in algebra, geometry, calculus, and statistics.

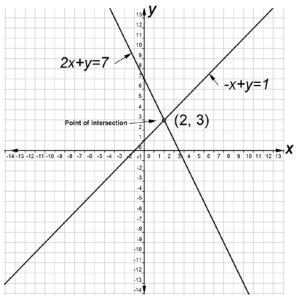
The solution to a system of linear equations corresponds to the coordinates of the points of intersection of the graphs of the equations.

Teacher's Note and Reminders

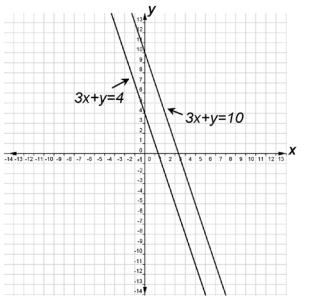
Examples: Find the solutions of the following systems of linear equations graphically.

a. $2x + y = 7$, $-x + y = 1$ b. $3x + y = 4$, $3x - y = -5$ c. $x - 2 = -5$, $2x - 4y = -10$

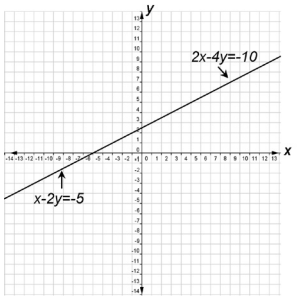
Answer (a): The graphs of $2x + y = 7$ and $-x + y = 1$ intersect at (2, 3). Hence, the solution of the system $\begin{matrix} 2x + y = 7 \\ -x + y = 1 \end{matrix}$ is $x = 2$ and y = 3.



Answer (b): The graphs of $3x + y = 4$ and $3x + y = 10$ are parallel. Hence, the system $\begin{matrix} 3x + y = 4 \\ 3x - y = -5 \end{matrix}$ has no solution.



Answer (c): The graphs of $x - 2y = -5$ and $2x - 4y = -10$ coincide. Hence, the system $\begin{matrix} x - 2 = -5 \\ 2x - 4y = -10 \end{matrix}$ has infinite number of solutions.



Teacher's Note and Reminders

A system of linear equations can be solved algebraically by **substitution** or **elimination methods.**

To solve a system of linear equations by substitution method, the following procedures could be followed:

a. Solve for one variable in terms of the other variable in one of the equations. If one of the equations already gives the value of one variable, you may proceed to the next step.
b. Substitute to the second equation the value of the variable found in the first step. Simplify then solve the resulting equation.
c. Substitute the value obtained in (b) to any of the original equations to find the value of the other variable.
d. Check the values of the variables obtained against the linear equations in the system.

Example: Solve the system $\begin{matrix} 2x + y = 5 \\ -x + 2y = 5 \end{matrix}$ by substitution method.

Solution: Use $2x + y = 5$ to solve for y in terms of x.

Subtract $-2x$ from both sides of the equation.

$2x + y - 2x = 5 - 2x \rightarrow y = 5 - 2x$

Substitute $5 - 2x$ in the equation $-x + 2y = 5$.

$-x + 2(5 - 2x) = 5$

Simplify.

$-x + 2(5) + 2(-2x) = 5 \rightarrow -x + 10 - 4x = 5$

$-5x = 5 - 10 \rightarrow -5x = -5$

Solve for x by dividing both sides of the equation by -5.

$\frac{-5x}{-5} = \frac{-5}{-5} \rightarrow x = 1$

Substitute 1, value of x, to any of the original equations to solve for y.

$-x + 2y = 5 \rightarrow -1 + 2y = 5$

Simplify.

$-1 + 2y = 5 \rightarrow 2y = 5 + 1 \rightarrow 2y = 6$

Solve for y by dividing both sides of the equation by 2.

$\frac{2y}{2} = \frac{6}{2} \rightarrow y = 3$

Teacher's Note and Reminders

Check the values of the variables obtained against the linear equations in the system.

1. $2x + y = 5$; $x = 1$ and $y = 3$
   $2(1) + 3 = 5 \rightarrow 2 + 3 = 5 \rightarrow 5 = 5$
   Hence, $x = 1$ and $y = 3$ are true to $2x + y = 5$.

2. $-x + 2y = 5$; $x = 1$ and $y = 3$
   $-1 + 2(3) = 5 \rightarrow -1 + 6 = 5 \rightarrow 5 = 5$
   Hence, $x = 1$ and $y = 3$ are true to -x + 2y = 5

Therefore, the solution to the system $\begin{matrix} 2x + y = 5 \\ -x + 2y = 5 \end{matrix}$ is the ordered pair (1, 3).

To solve a system of linear equations in two variables by the elimination method, the following procedures could be followed:

a. Whenever necessary, rewrite both equations in standard form Ax + By = C.
b. Whenever necessary, multiply either equation or both equations by a nonzero number so that the coefficients of x or y will have a sum of 0. (Note: The coefficients of x and y are additive inverses.)
c. Add the resulting equations. This leads to an equation in one variable. Simplify then solve the resulting equation.
d. Substitute the value obtained to any of the original equations to find the value of the other variable.
e. Check the values of the variables obtained against the linear equations in the system.

Example: Solve the system $\begin{matrix} 3x + y = 7 \\ 2x - 5y = 16 \end{matrix}$ by elimination method.

Solution: Think of eliminating y first.
Multiply 5 to both sides of the equation $3x + y = 7$.

$5(3x + y = 7) \rightarrow 15x + 5y = 35$

Add the resulting equations.

$$\begin{matrix} 15x + 5y = 35 \\ 2x - 5y = 16 \\ \underline{17x \quad = 51} \end{matrix}$$

Solve for x by dividing both sides of the equation by 17.

$17x = 51 \rightarrow \frac{17x}{17} = \frac{51}{17} \rightarrow x = 3$

Substitute 3, value of x, to any of the original equations to solve for y.

$2x - 5y = 16 \rightarrow 2(3) - 5y = 16$

Simplify.

$6 - 5y = 16 \rightarrow -5y = 16 - 6 \rightarrow -5y = 10$

Teacher's Note and Reminders

Solve for y by dividing both sides of the equation by -5.

$$-5y = 10 \rightarrow \frac{-5y}{-5} = \frac{10}{-5} \rightarrow y = -2$$

Check the values of the variables obtained against the linear equations in the system.

1. $3x + y = 7$; $x = 3$ and $y = -2$
   $3(3) + (-2) = 7 \rightarrow 9 - 2 = 7 \rightarrow 7 = 7$
   Hence, $x = 3$ and $y = -2$ are true to $3x + y = 7$.

2. $2x - 5y = 16$; $x = 3$ and $y = -2$
   $2(3) - 5(-2) = 16 \rightarrow 6 + 10 = 16 \rightarrow 16 = 16$
   Hence, $x = 3$ and y = -2 are true to $2x - 5y = 16$.

Therefore, the solution to the system $\begin{matrix} 3x + y = 7 \\ 2x - 5y = 16 \end{matrix}$ is the ordered pair (3, -2).

Systems of linear equations in two variables are applied in many real-life situations. They are used to represent situations and solve problems related to uniform motion, mixture, investment, work, and many others. Consider the situation below.

A computer shop hires 12 technicians and three supervisors for total daily wages of Php 7,020. If one of the technicians is promoted to a supervisor, the total daily wages become Php 7,110.

In the given situation, what do you think is the daily wage for each technician and supervisor? This problem can be solved using system of linear equations.

Let x = daily wage of a technician and y = daily wage of a supervisor. Represent the total daily wages before one of the technicians is promoted to a supervisor.

$$12x + 3y = 7{,}020$$

Represent the total daily wages after one of the technicians is promoted to a supervisor.

$$11x + 4y = 7{,}110$$

Use the two equations to find the daily wages for a technician and a supervisor.

$$12x + 3y = 7{,}020$$
$$11x + 4y = 7{,}110$$

Solve the system graphically or by using any algebraic method.

Teacher's Note and Reminders

Challenge the students to cite other real-life situations where systems of linear equations in two variables are illustrated or applied. Ask them also how they can use system of linear equations in two variables in solving real-life problems and in making decisions.

Let's solve the system using Elimination Method. Multiply both sides of the first equation by 4 and the second equation by 3 to eliminate y.

$12x + 3y = 7{,}020$ → $4(12x + 3y = 7{,}020)$ → $48x + 12y = 28{,}080$
$11x + 4y = 7{,}110$ $3(11x + 4y = 7{,}110)$ $33x + 12y = 21{,}330$

The resulting system of linear equations is $48x + 12y = 28{,}080$
$33x + 12y = 21{,}330$
.

Subtract the terms on both sides of the resulting equations.

$$\begin{array}{l} 48x + 12y = 28{,}080 \\ \underline{33x + 12y = 21{,}330} \\ 15x \quad\quad = 6{,}750 \end{array}$$

Using the equation $15x = 6{,}750$, solve for x by dividing both sides of the equation by 15.

$15x = 6{,}750$ → $\frac{15x}{15} = \frac{6{,}750}{15}$ → $x = 450$

The daily wage of a technician is **Php 450.**

Find the daily wage of a supervisor by substituting 450 to x in any of the original equations. Then, solve the resulting equation.

$12x + 3y = 7{,}020$; $x = 450$
$12(450) + 3y = 7{,}020$ → $5{,}400 + 3y = 7{,}020$
→ $3y = 7{,}020 - 5{,}400$
→ $3y = 1{,}620$ → $\frac{3y}{3} = \frac{1{,}620}{3}$
→ $y = 540$

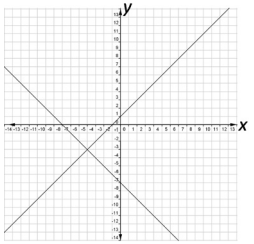
The daily wage of a supervisor is **Php 540.**

Answer: The daily wages for a technician and a supervisor are **Php 450 and Php 540**, respectively.

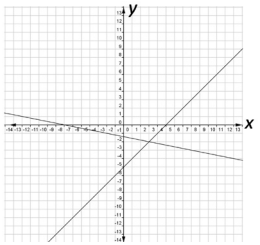
Answer Key

Activity 5

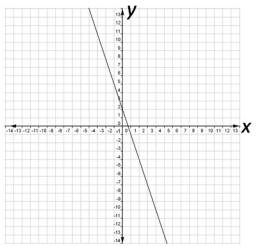
1. Solution: (-4, -3)



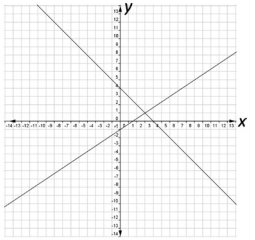
2. Solution: (3, -2)



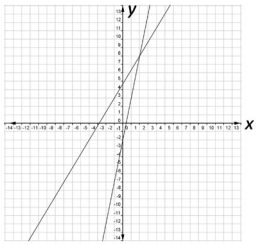
3. Possible Solutions: (0, 2), (1, -1), (-1, 5). The graph shows coinciding lines.



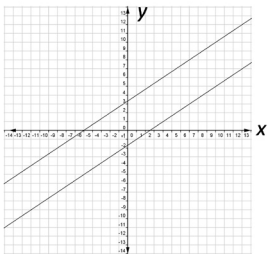
4. Solution: (3, 1)



5. Solution: (2, 8)



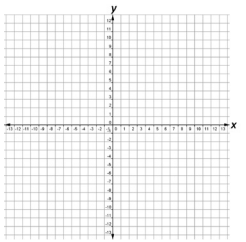
6. Solution: None. The graph shows parallel lines



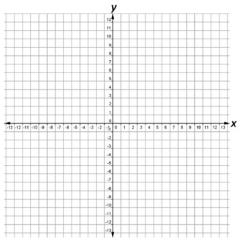
Activity 5 WHAT SATISFIES BOTH?

Directions: Solve each of the following systems of linear equations graphically then check. You may also use GeoGebra to verify your answer. If the system of linear equations has no solution, explain why.

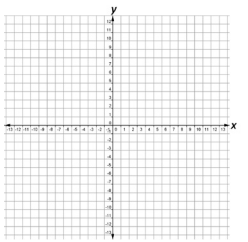
1. $x + y = -7$
   $y = x + 1$



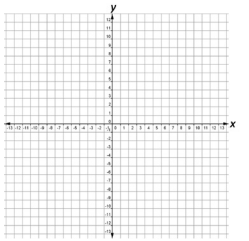
2. $x - y = 5$
   $x + 5y = -7$



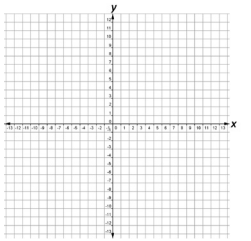
3. $3x + y = 2$
   $2y = 4 - 6x$



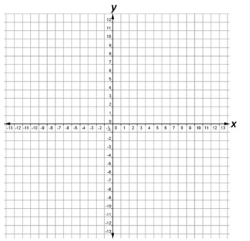
4. $x + y = 4$
   $2x - 3y = 3$



5. $y = 5x - 2$
   $5x - 3y = -14$



6. $2x - 3y = 5$
   $3y = 10 + 2x$



In solving systems of linear equations algebraically using the substitution method, one skill that students need to develop is to come up with the resulting equation when the value of one variable is substituted to the original equation. Activity 6 provides the students the opportunity to develop such skill.

Answer Key

Activity 6

Resulting Equation	Value of x	Value of y
1. 4x + x + 3 = 7	$\frac{4}{5}$	$\frac{19}{5}$
2. 4 – y + 3y = 12	0	4
3. 2x – 3(x – 2) = 9	-3	-5
4. 5(3y + 1) + 2y = 8	$\frac{26}{17}$	$\frac{3}{17}$
5. 4x – 7(x – 4) = -10	$\frac{38}{3}$	$\frac{26}{3}$
6. -5x = 3x + 5 - 4	$\frac{1}{8}$	$\frac{37}{8}$

Teacher's Note and Reminders

Activity 6 TAKE MY PLACE!

Directions: Determine the resulting equation by substituting the given value of one variable to each of the following equations. Then solve for the other variable using the resulting equation. Answer the questions that follow.

Equation	Value of Variable	Equation	Value of Variable
1. $4x + y = 7$;	y: $x + 3$	4. $5x + 2y = 8$;	x: $3y + 1$
2. $x + 3y = 12$;	x: $4 - y$	5. $4x - 7y = -10$;	y: $x - 4$
3. $2x - 3y = 9$;	y: $x - 2$	6. $-5x = y - 4$;	y: $3x + 5$

QUESTIONS ?

a. How did you determine each resulting equation?
b. What resulting equations did you arrive at?
c. How did you solve each resulting equation?
d. What mathematics concepts or principles did you apply to solve each resulting equation?
e. How will you check if the value you got is a solution of the equation?

Let the students check their understanding of solving systems of linear equations using the substitution method by doing Activity 7. In this activity, the students should realize that it would be more convenient to use this method if the expression equivalent to one of the variables is already given. One possible difficulty that students might experience when using the substitution method is solving for one variable in terms of the other variable. Errors in the use op. This happens when the expression equivalent to one of the variables is not given, e.g., $\begin{matrix} 3x + 7y = -10 \\ -2x + 5y = 8 \end{matrix}$.

Answer Key

Activity 7

1. (1, 7)
2. (-1, 8)
3. (2, 4)
4. (-5, -5)
5. $(-\frac{1}{7}, \frac{13}{7})$
6. (1, -1)
7. (4, 7)
8. (3, -6)
9. None
10. Possible Solutions: (2, 0), (5, 1), etc.

Teacher's Note and Reminders

Activity 7 SUBSTITUTE THEN SOLVE!

Directions: Determine the resulting equation by substituting the given value of one variable to each of the following equations. Then solve for the other variable using the resulting equation. Answer the questions that follow.

1. $x + y = 8$
   $y = x + 6$
2. $x = -y + 7$
   $x - y = -9$
3. $y = 2x$
   $4x + 3y = 20$
4. $y = 2x + 5$
   $3x - 2y = -5$
5. $2x + 5y = 9$
   $-x + y = 2$
6. $3x + y = 2$
   $9x + 2y = 7$
7. $x - y = -3$
   $3x + y = 19$
8. $4x + y = 6$
   $x - 2y = 15$
9. $2x + y = 10$
   $4x + 2y = 5$
10. $-x + 3y = -2$
    $-3x + 9y = -6$

QUESTIONS ?

a. How did you use substitution method in finding the solution set of each system of linear equations?
b. How did you check the solution set you got?
c. Which system of equations is difficult to solve? Why?
d. Which system of equations has no solution? Why?
e. Which system of equations has infinite number of solutions? Explain your answer.

When solving systems of linear equations in two variables using the elimination method, a term of one equation must be equal with or the additive inverse of a term in the other equation to eliminate the variable contained in both terms by performing the appropriate operation. There are instances, however, that students are not mindful of this condition. They try to eliminate at once one of the variables without noting whether there are equal terms in both equations in a system. At the end, students might not arrive at a solution to the system. Activity 8 provides the students the opportunity to determine the number(s) that must be multiplied to one or both equations in each system to eliminate one of the variables. In this activity, let the students realize the importance of this skill whenever they solve systems of linear equations using the elimination method.

Answer Key

Activity 8 (Possible Answers)

1. To eliminate x, multiply 2 (or -2) to both sides of the first equation and 5 (or -5) to the second equation.
   To eliminate y, multiply 2 (or -2) to both sides of the second equation.
2. To eliminate x, multiply 4 (or -4) to both sides of the first equation.
   To eliminate y, multiply 2 (or -2) to both sides of the first equation and 3 (or -3) to the second equation.
3. To eliminate x, multiply 5 (or -5) to both sides of the first equation.
   To eliminate y, multiply 4 (or -4) to both sides of the second equation.
4. To eliminate x, multiply 5 (or -5) to both sides of the first equation and -3 (or 3) to the second equation.
   To eliminate y, multiply 2 (or -2) to both sides of the first equation.
5. To eliminate x, multiply 3 (or -3) to both sides of the first equation and -2 or (2) to the second equation.
   To eliminate y, multiply 2 (or -2) to both sides of the first equation and 5 (or -5) to the second equation.
6. To eliminate x, multiply 3 (or -3) to both sides of the second equation.
   To eliminate y, multiply 7 (or -7) to both sides of the first equation and -5 (or 5) to the second equation.

Activity 8 ELIMINATE ME!

Directions: Determine the number(s) that must be multiplied to one or both equations in each system to eliminate one of the variables. Justify your answer.

1. $5x - 2y = 12$
   $2x + y = 7$
2. $x + 3y = 5$
   $4x + 2y = 7$
3. $x - 4y = 12$
   $5x + y = -5$
4. $-3x + 2y = 7$
   $5x - 4y = -2$
5. $-2x - 5y = 10$
   $3x - 2y = 6$
6. $9x - 5y = 8$
   $3x + 7y = 12$

To eliminate x	To eliminate y

Let the students check their understanding of solving systems of linear equations using the elimination method by doing Activity 9. In this activity, the students should realize the importance of using this method when the value of one variable in a system of equations cannot be determined at once. One possible error that students might commit is performing operations on algebraic expressions particularly on the signs (positive or negative) of the results. Likewise, the wrong use of the different properties of equality might also come up when solving the resulting equations.

Answer Key

Activity 9

1. (-4, 4)
2. (2, 5)
3. (2, -2)
4. (2, 1)
5. (1, -2)
6. (4, 0)
7. $(4\frac{4}{5}, -\frac{3}{5})$
8. (1.51, 1.22)
9. (-2.03, -0.14)
10. (5.14, 0.86)

Teacher's Note and Reminders

Activity 9 ELIMINATE THEN SOLVE!

Directions: Solve each system of linear equations by elimination method then check. Answer the questions that follow.

1. $3x + 2y = -4$
   $2x - y = -12$
2. $7x - 2y = 4$
   $5x + y = 15$
3. $5x + 2y = 6$
   $-2x + y = -6$
4. $2x + 3y = 7$
   $3x - 5y = 1$
5. $x - 4y = 9$
   $3x - 2y = 7$
6. $3x + 7y = 12$
   $5x - 4y = 20$
7. $2x + y = 9$
   $x - 2y = 6$
8. $5x + 2y = 10$
   $3x - 7y = -4$
9. $2x + 7y = -5$
   $3x - 8y = -5$
10. $-3x + 4y = -12$
    $2x - 5y = 6$

QUESTIONS ?

a. How did you use the elimination method in solving each system of linear equations?
b. How did you check the solution set you got?
c. Which system of equations is difficult to solve? Why?
d. When is the elimination method convenient to use?
e. Among the three methods of solving systems of linear equations in two variables, which do you think is the most convenient to use? Which do you think is not? Explain your answer.

What to Understand

Provide the students opportunities to think deeper and test further their understanding of solving systems of linear equations using graphical and algebraic methods by doing Activities 10, 11, and 12. Give emphasis on how the solution set is obtained from the graph of the system and how it is checked. Moreover, emphasize the advantages and disadvantages of using any of the methods in solving systems of linear equations and let them find out and explain which method of solving a system of equations is more convenient to use. It is possible that students might give different views on which method is more convenient to use. There is nothing wrong with this. Just give the students the freedom to use any method.

Teacher's Note and Reminders

What to Understand

Your goal in this section is to take a closer look at some aspects of the topic. You are going to think deeper and test further your understanding of the different methods of solving systems of linear equations in two variables. After doing the following activities, you should be able to answer the following question: **How is the system of linear equations in two variables used in solving real-life problems and in making decisions?**

Activity 10 LOOKING CAREFULLY AT THE GRAPHS...

Directions: Answer the following questions.

1. How do you determine the solution set of a system of linear equations from its graph?
2. Do you think it is easy to determine the solution set of a system of linear equations by graphing? Explain your answer.
3. When are the graphical solutions of systems of linear equations difficult to determine?
4. How would you check if the solution set you found from the graphs of linear equations in a system are the solutions?
5. What do you think are the advantages and the disadvantages of the graphical method of solving systems of linear equations? Explain your answer.

Activity 11 HOW SUBSTITUTION WORK...

Directions: Use the system of linear equations $\begin{matrix} 5x - 2y = 3 \\ 2x + y = 12 \end{matrix}$ to answer the following questions:

1. How do you describe each equation in the system?
2. How will you solve the given system of equations?
3. Do you think the substitution method is more convenient to use in finding the solution set of the system? Explain your answer.
4. What is the solution set of the given system of equations? Explain how you arrived at your answer.
5. When is the substitution method convenient to use in solving systems of linear equations?
6. Give two examples of systems of linear equations in two variables then solve using the substitution method.

Teacher's Note and Reminders

Answer Key

Activity 13

1. For short distance of travel, LG's Rent a Car is more economical.
   For long distance of travel, Rent and Drive is more economical.
2. a. Php26,000 – cost of PC tablet with 12% commission
      Php16,000 – cost of PC tablet with 8% commission
   b. Php3,120 for PC tablet with 12% commission
      Php 1,280 for PC tablet with 8% commission
3. World Celcom has a better offer if you seldom call to other networks.
   Smartlink has a better offer if you always call to other networks.
4. a. Php 300,000 – first investment
      Php 100,000 – second investment
5. a. 120 chicken sandwiches
      300 egg sandwiches

Activity 12 ELIMINATE ONE TO FIND THE OTHER ONE

Directions: Use the system of linear equations $\begin{matrix} 3x - 5y = 8 \\ 2x + 7y = 6 \end{matrix}$ to answer the following questions:

1. How do you describe each equation in the system?
2. How will you solve the given system of equations?
3. Which algebraic method of solving system of linear equations do you think is more convenient to use in finding its solution set? Why?
4. What is the solution set of the given system of equations? Explain how you arrived at your answer.
5. When is the elimination method convenient to use in solving systems of linear equations?
6. Give two examples of systems of linear equations in two variables then solve using the elimination method.

Activity 13 SOLVE THEN DECIDE!

Directions: Answer each of the following questions. Show your complete solutions and explanations/justifications.

1. Which of the following is more economical when renting a vehicle? Justify your answer.

   LG's Rent a Car: Php 1,500 per day plus Php 35 per kilometer traveled
   Rent and Drive: Php 2,000 per day plus Php 25 per kilometer traveled

2. Luisa sells two brands of Tablet PC. She receives a commission of 12% on one brand and 8% on the other brand. If she is able to sell two Tablet PC's, one for each brand, the total cost is Php 42,000 and the amount that she will receive as commission is Php 4,400.

   a. What is the cost of each brand of Tablet PCs?
   b. How much commission does she receive on one brand? How about on the other brand?
   c. Suppose you are Luisa and you wish to earn more. Which Tablet PC will you ask the customers or clients to buy? Why?

Teacher's Note and Reminders

3. Which of the following mobile networks has a better offer? Justify your answer.

   World Celcom: Php 500 monthly charge
   Free calls and texts to World Celcom subscribers
   Php 6.50 per minute of call to other networks

   Smartlink: Php 650 monthly charge
   Free calls and texts to Smartlink subscribers
   Php 5 per minute of call to other networks

4. Mr. Salonga has two investments. His total investment is Php 400,000. He receives 3% interest on one investment and 7% interest on the other. The total interest that Mr. Salonga receives in a year is Php 16,000.

   a. How much money does Mr. Salonga have in each investment?
   b. Suppose you were Mr. Salonga. In which investment will you place more money? Why?

5. The school canteen sells chicken and egg sandwiches. It generates an income of Php 2 for every chicken sandwich sold and Php 1.25 for every egg sandwich. Yesterday, they were able to sell all 420 sandwiches prepared and generated an income of Php 615. The teacher in charge of the canteen realized that the canteen could have earned more if additional sandwiches are prepared.

   a. How many chicken sandwiches was the canteen able to sell on that day? How about egg sandwiches?
   b. If you were the teacher in charge of the canteen, which kind of sandwich would you prepare more? Why?

What to Transfer

Give the students opportunities to demonstrate their understanding of systems of linear equations by doing some practical tasks. Let them perform Activities 14 and 15. You can ask the students to work individually or in group. Emphasize to them that they must come up with some real-life problems that involve systems of linear equations in two variables. Moreover, students must be given the opportunity to solve the problems they have formulated.

SUMMARY/SYNTHESIS/GENERALIZATION:

This lesson was about solving systems of linear equations in two variables using the graphical and algebraic methods namely: substitution and elimination methods. In this lesson, students are exposed to different ways of finding the solutions of systems of linear equations and given the opportunity to determine the advantages and disadvantages of using each method and which is more convenient to use. Using the different methods of solving systems of linear equations, students were able to find out which system has no solution, one solution, and infinite number of solutions. More importantly, the students were given the chance to formulate and solve real-life problems, make decisions based on the problems, and demonstrate your understanding of the lesson by doing some practical tasks. Students' understanding of this lesson is extended in the next lesson, Graphical Solutions of Systems of Linear Inequalities in Two Variables. The mathematical skills of students in finding the graphical solutions of systems of linear equations can also be applied in the next lesson.

What to Transfer

Your goal in this section is to apply your learning to real-life situations. You will be given a practical task which you will demonstrate your understanding of solving systems of linear equations in two variables.

Activity 14 PLAY THE ROLE OF ∞

Cite situations in real life where systems of linear equations in two variables are applied. Form a group of five members and role play each situation. With your groupmates, formulate problems out of these situations then solve in as many ways as you can.

Activity 15 SELECT THE BEST POSTPAID PLAN

1. Make a list of all postpaid plans being offered by different mobile network companies.
2. Use the postpaid plans to formulate problems involving systems of linear equations in two variables. Solve the problems formulated. Use the rubric provided to rate your work.
3. Determine the best postpaid plan that each company offers. Explain your answer.
4. Determine the mobile network company that you will recommend to your parents, older brothers or sisters, or relatives if ever they apply for a postpaid plan. Justify your choice.

Lesson 3: GRAPHICAL SOLUTIONS OF SYSTEMS OF LINEAR INEQUALITIES IN TWO VARIABLES

Provide the students opportunities to represent a given situation using linear inequalities in two variables, show the graphs of these inequalities, then find possible solutions. Ask them to perform Activity 1. This activity will lead to students' understanding of graphical solutions of systems of linear inequalities.

Answer Key

Activity 1

1.

Number of bracelets sold	Cost	Number of necklaces sold	Cost	Total Cost
1	85	1	115	200
2	170	2	230	400
3	255	3	345	600
4	340	4	460	800
5	425	5	575	1,000
10	850	10	1,150	2,000
15	1,275	15	1,725	3,000
20	1,700	20	2,300	4,000
25	2,125	25	2,875	5,000
30	2,550	30	3,450	6,000
40	3,400	40	4,600	8,000
50	4,250	50	5,750	10,000
60	5,100	60	6,900	12,000
80	6,800	80	9,200	16,000
100	8,500	100	11,500	20,000

Lesson 3 Graphical Solutions of Systems of Linear Inequalities in Two Variables

Activity 1 SUMMER JOB

Directions: Use the situation below to answer the questions that follow.

Nimfa lives near a beach resort. During summer vacation, she sells souvenir items such as bracelets and necklaces which are made of local shells. Each bracelet costs Php 85 while each piece of necklace is Php 110. She needs to sell at least Php 15,000 worth of bracelets and necklaces.

1. Complete the table below.

Number of bracelets sold	Cost	Number of necklaces sold	Cost	Total Cost
1		1		
2		2		
3		3		
4		4		
5		5		
10		10		
15		15		
20		20		
25		25		
30		30		
40		40		
50		50		
60		60		
80		80		
100		100		

2. How much would Nimfa's total sale if she sells five pieces of bracelets and five pieces of necklaces?

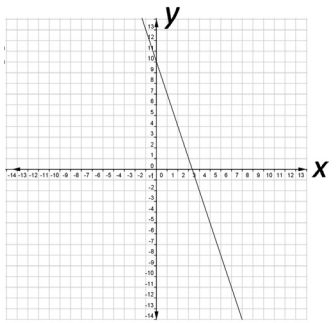
   How about if she sells 10 pieces of bracelets and 20 pieces of necklaces?

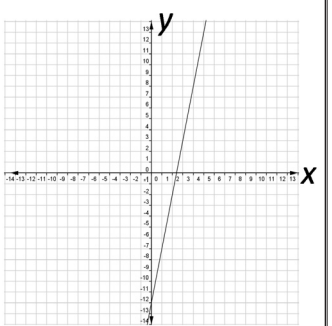
2. Php 1,000
   Php 4,850
3. Total Sale = $85x + 115y$, where x is the number of pieces of bracelets sold and y is the number of necklaces sold.
4. $85x + 115y \geq 15{,}000$
5. Many possible answers like 80 bracelets and 80 necklaces or 70 bracelets and 100 necklaces.

Let students draw and compare the graphs of linear equations and inequalities in two variables. Tell them to perform Activity 2. This activity will make students distinguish between lines and half-planes. Also, they will recall that one of the half-planes contain the solutions of the linear inequality. Furthermore, the students will be able to describe the graphs of two linear inequalities when drawn in the same coordinate plane. If the graphs of these inequalities intersect, the students will realize that the region where the shadings overlap contains all the coordinates of points satisfying both inequalities. From this point, students will be able to understand graphical solutions of systems of linear inequalities in two variables.

Answer Key

Activity 2

1. 

2. 

3. What mathematical statement would represent the total sale of bracelets and necklaces? Describe the mathematical statement then graph.

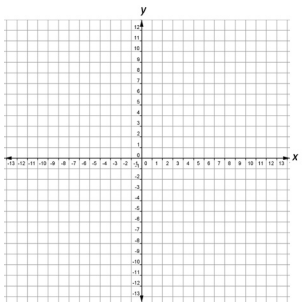
4. Nimfa wants to have a total sale of at least Php 15,000. What mathematical statement would represent this? Describe the mathematical statement then graph.

5. How many bracelets and necklaces should Nimfa sell to have a total sale of at least Php 15,000? Give as many answers as possible then justify.

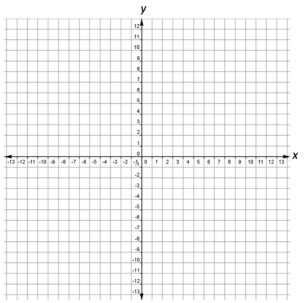
Activity 2
A LINE OR HALF OF A PLANE?

Directions: Draw the graphs of the following linear equations and inequalities in two variables. Answer the questions that follow.

1. $3x + y = 10$
2. $5x - y = 12$
3. $2x + 3y = 15$
4. $3x - 4y = 8$
5. $4x + 7y = -8$



6. $3x + y < 10$
7. $5x - y > 12$
8. $2x + 3y \leq 15$
9. $3x - 4y \geq 8$
10. $4x + 7y < -8$



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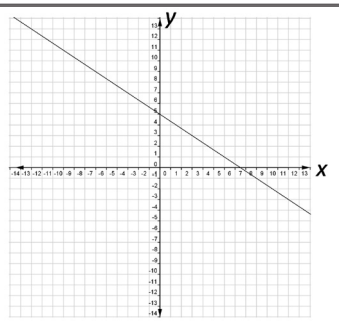

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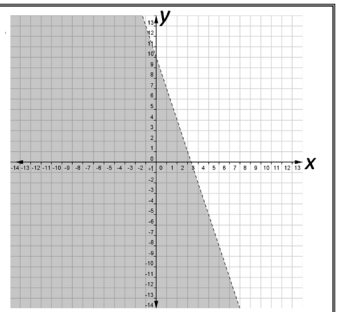

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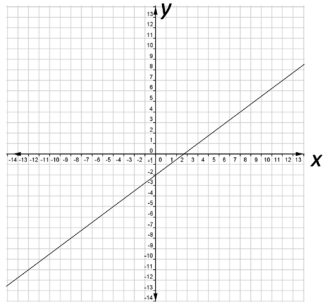

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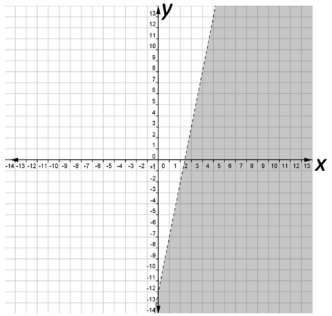

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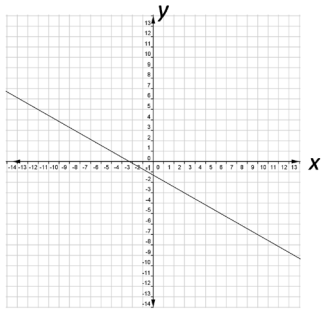

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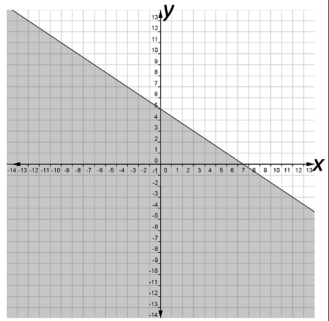
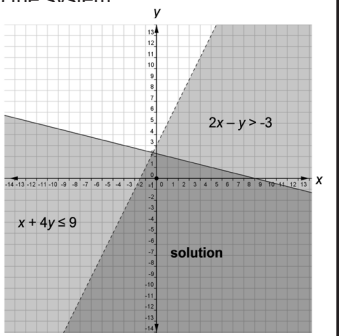


QUESTIONS ?

a. How did you graph each mathematical statement?
b. Compare the graphs of $3x + y = 10$ and $3x + y < 10$. What statements can you make?
How about $5x - y = 12$ *and* $5x - y > 12$*?* $2x + 3y = 15$ *and* $2x + 3y \leq 15$*?*
c. How do you differentiate the graphs of linear equations and inequalities in two variables?
d. How many solutions does a linear equation in two variables have? How about linear inequalities in two variables?
e. Suppose you draw the graphs of $3x + y < 10$ and $5x - y > 12$ on another Cartesian coordinate plane. How would you describe their graphs? What ordered pairs satisfy both inequalities?

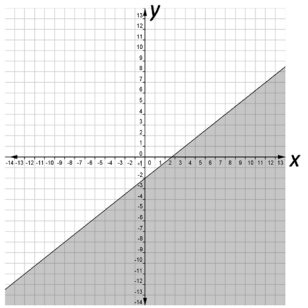
To solve a system of inequalities in two variables by graphing, draw the graph of each inequality on the same rectangular coordinate plane. Each time, shade the solution set of each inequality. The solution set of the system is the region where the shadings overlap.

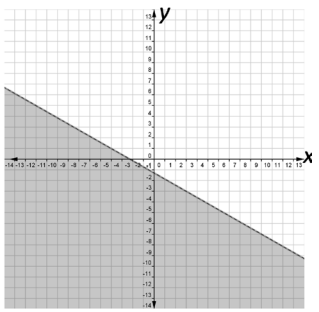
Example: To solve the system $\begin{matrix} 2x - y > -3 \\ x + 4y \leq 9 \end{matrix}$ graphically, graph $2x - y > -3$ and $x + 4y \leq 9$ on the same Cartesian coordinate plane. The region where the shadings overlap is the graph of the solution to the system.



Like systems of linear equations in two variables, systems of linear inequalities are also applied in many real-life situations. They are used to represent situations and solve problems related to uniform motion, mixture, investment, work, and many others.

Example: There are at most 56 people composed of children and adults who are in a bus. Each child and adult paid Php 80 and Php 100, respectively. If the total amount collected was not more than Php 4,800, how many children and adults are in the bus?

9. 

10. 

The succeeding activities are all about graphical solutions of systems of linear inequalities in two variables. Before the students perform these activities, let them read and understand some important notes on the graphical solutions of systems of linear inequalities in two variables. Tell them to study carefully the examples given.

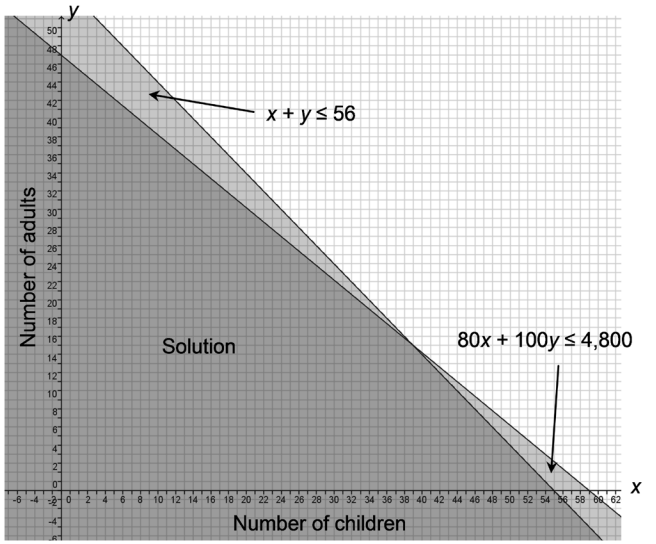
Teacher's Note and Reminders

Solution: Let x = number of children in the bus
y = number of adults in the bus

Represent the number of people in the bus as $x + y \leq 56$.

Represent the amount collected as $80x + 100y \leq 4{,}800$.

Use the two inequalities to find the number of children and adults who are in the bus. Write these as a system of linear inequalities then solve



The region where the shadings overlap is the graph of the solution to the system. Consider any point in this shaded region then substitute its coordinates in the system to check.

Consider the point whose coordinates are (20, 30). Check this against the inequalities $x + y \leq 56$ and $80x + 100y \leq 4{,}800$.

If x = 20 and y = 30, then 20 + 30 ≤ 56. The first inequality is satisfied.

Emphasize to the students that not all points in the region where the shadings overlap are solutions to the given situation. Only those values of x greater than or equal to zero ($x \geq 0$) and those values of y greater than or equal to zero ($x \geq 0$) can only be considered. For the given situation, the number of children and adults can never be negative.

Challenge the students to cite other real-life situations where systems of linear inequalities in two variables are illustrated or applied. Ask them further how they can use system of linear inequalities in two variables in solving real-life problems and in making decisions.

What to Process

A system of linear inequalities may have infinite number of solutions. Let students realize this by doing Activity 3. Let them determine whether the coordinates of a point satisfy both inequalities in a system. Ask them to justify their answers and verify the same using math software, GeoGebra, or any graphing calculators. In cases where the coordinates of a point satisfy both inequalities, let them come up with the idea that the ordered pair describing this point is a solution to the system.

Answer Key

Activity 3

1. Not a solution
2. Solution
3. Solution
4. Solution
5. Solution
6. Not a solution
7. Not a solution
8. Not a solution
9. Not a solution
10. Not a solution

Let students check their understanding of the graphical solutions of systems of linear inequalities in two variables by doing Activity 4. In this activity, the students should realize that systems of linear inequalities may have no solution or infinite number of solutions. Finding the solutions of linear inequalities graphically may be done manually. However, it is more convenient if students make use of any graphing calculators or math software like GeoGebra.

If $x = 20$ and $y = 30$, then $80(20) + 100(30) \leq 4{,}800$ or $1{,}600 + 3{,}000 \leq 4{,}800$ or $4{,}600 \leq 4{,}800$.

The second inequality is also satisfied. This means that one possible number of children in the bus is 20 and the number of children is 30.

However, not all points in the region where the shadings overlap are solutions to the given situation. Only those values of x greater than or equal to zero ($x \geq 0$) and those values of y greater than or equal to zero ($x \geq 0$) can only be considered. Can you think of the reason? Definitely, the number of children and adults can never be negative.

Activity 3
DO I SATISFY YOU?

Directions: Determine if each ordered pair is a solution to the system of linear inequality

$$2x + 5y < 10$$
$$3x - 4y \geq -8$$

. Then, Answer the questions that follow.

1. (3, 5)
2. (-2, -10)
3. (5, -12)
4. (-6, -8)
5. (0, 0)
6. (2, 15)
7. (-6, 10)
8. (-12, 1)
9. (0, 2)
10. (5, 0)

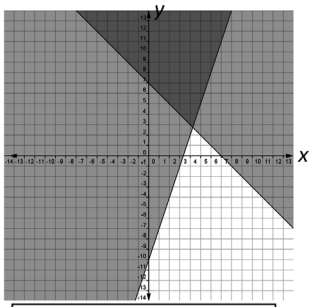
QUESTIONS ?

a. How did you determine if the given ordered pair is a solution of the system?
b. How did you know if the given ordered pair is not a solution of the system?
c. How many solutions do you think the system of inequalities has?

Answer Key

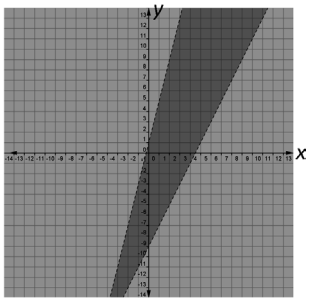
Activity 4

2.



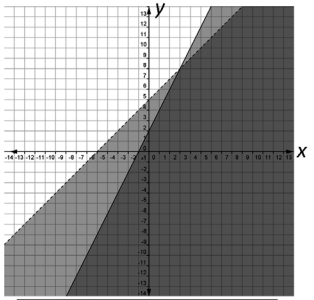
Possible Solutions: (0, 10), (3, 5), and (6, 13)

4.



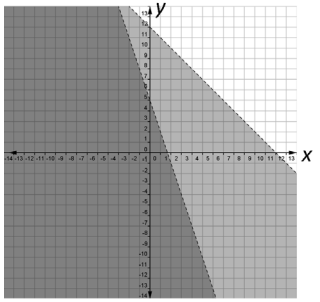
Possible Solutions: (1, 1), (2, -2), and (4, 7)

3.



Possible Solutions: (0, 0), (2, -6), and (7, 4)

5.

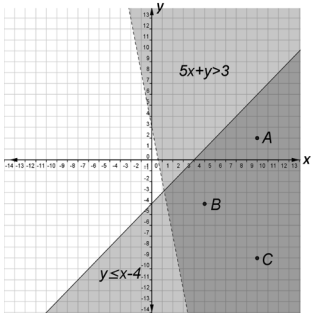


Possible Solutions: (-5, 3), (-4, -9), and (0, -10)

Activity 4
AM I IN THAT REGION?

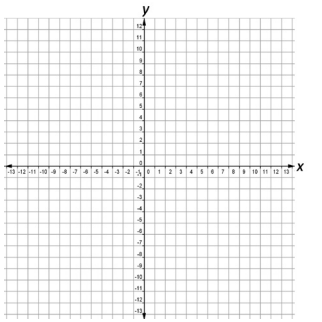
Directions: Solve the following systems of inequalities graphically then give three ordered pairs satisfying the inequalities. Show that the ordered pairs satisfy the inequalities. Answer the questions that follow. The first one is done for you.

1. $5x + y > 3$
   $y \leq x - 4$

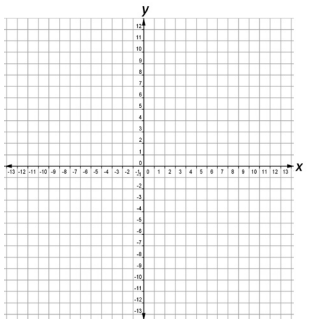


Some ordered pairs satisfying the system of inequalities are (10, 2), (5, -4), and (10, -9).

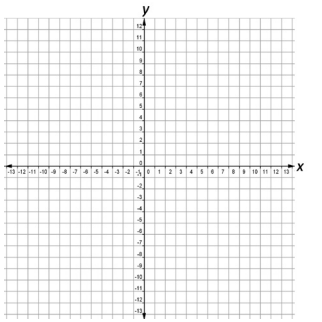
3. $2x - y \geq -2$
   $y < x + 4$



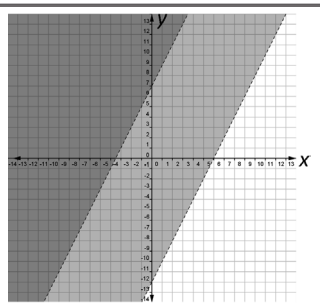
2. $x + y \geq 7$
   $3x - y \leq 10$



4. $y > 2x - 9$
   $y < 4x + 1$

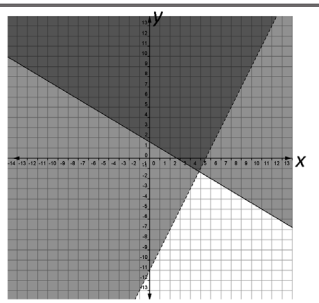


6.



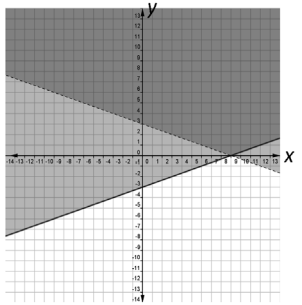
Possible Solutions: (-11, 1), (-12, -2), and (-7, 10)

9.



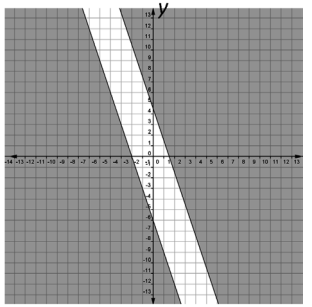
Possible Solutions: (-3, 9), (0, 15), and (4, 0)

7.



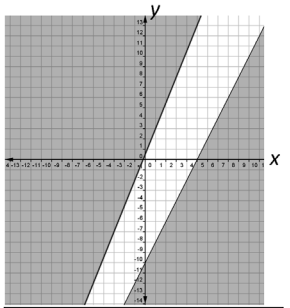
Possible Solutions: (0, 12), (-4, 10), and (10, 7)

10.



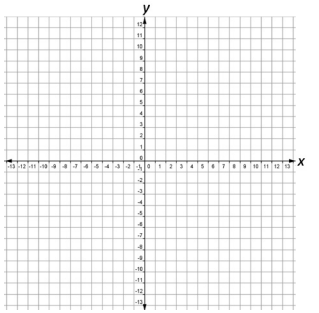
No solution

8.

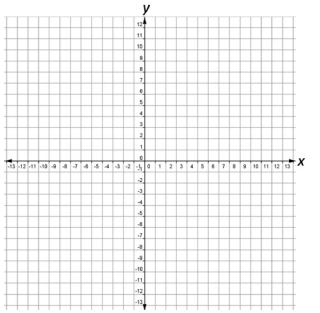


Possible Solutions: (-37, -88), (-41, -98), and (-32, -78)

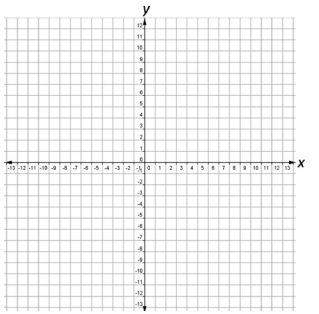
5. $x + y < 12$
$y < -3x + 5$



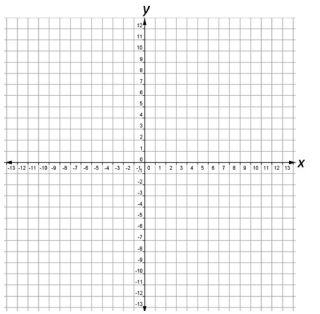
8. $2x - y \geq 10$
$2y \geq 5x + 1$



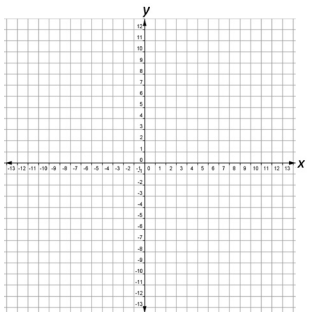
6. $y > 2x + 7$
$2x - y < 12$



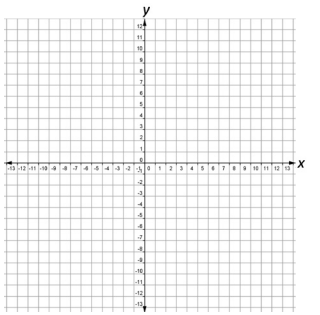
9. $2x - y < 11$
$3x + 5y \geq 8$



7. $x + 3y > 9$
$x - 3y \leq 9$



10. $6x + 2y \geq 9$
$3x + y \leq -6$

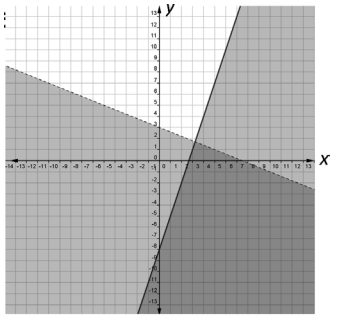


What to Understand

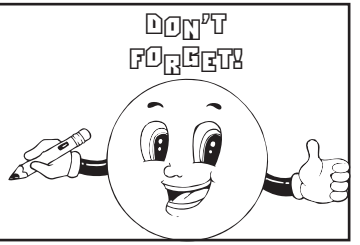
Provide the students opportunities to think deeper and test further their understanding of the graphical solutions of systems of linear inequalities in two variables by doing Activities 5 and 6. Give emphasis on how the solution set is obtained from the graph of the system and how it is checked. Also, let students describe and compare the graphical solutions of systems of linear equations and inequalities in two variables. Moreover, let students realize the advantages and disadvantages of finding the solutions of systems of linear inequalities graphically. Challenge them further if they can find the solutions algebraically.

Answer Key

Activity 5

1. 

Teacher's Note and Reminders



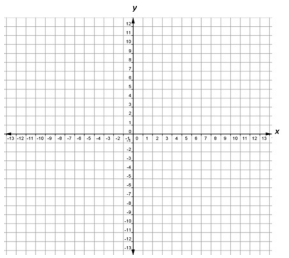
QUESTIONS ?

a. How did you determine the graphical solutions of each system of linear inequalities in two variables?
b. How did you know that the ordered pairs you listed are solutions of the system of inequalities?
c. Which system of linear inequalities has no solution? Why?
d. When do you say that a system of linear inequalities has solutions? has no solutions?
e. Give two examples of system of linear inequalities in two variables having no solutions. Justify your answer.

Activity 5 REGION IN A PLANE

Directions: Answer the following questions.

1. Show the graph of the solution of the system $\begin{matrix} 2x + 5y < 15 \\ 3x - y \geq 8 \end{matrix}$. Use the Cartesian coordinate plane on the next page.



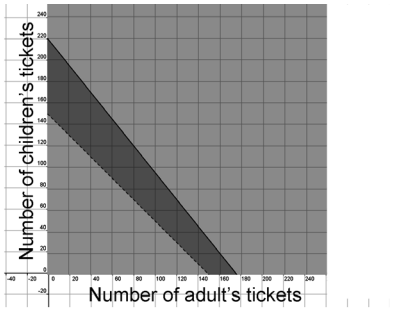
2. How would you describe the graphs of $2x + 5y < 15$ and $3x - y \geq 8$?
3. How would you describe the region where the graphs of $2x + 5y < 15$ and $3x - y \geq 8$ meet?
4. Select any three points in the region where the graphs of $2x + 5y < 15$ and $3x - y \geq 8$ meet. What statements can you make about the coordinates of these points?
5. How would you describe the graphical solutions of the system $2x + 5y < 15$?
   $3x - y \geq 8$
6. How is the graphical solution of a system of linear inequalities determined?
   How is it similar or different from the graphical solution of system of linear equations?

Let students extend their understanding of the graphical solutions of systems of linear inequalities in two variables as to how they are used in solving real-life problems. Ask them to perform Activity 7. In solving the problems, encourage them to use different ways of arriving at the solution. More importantly, provide them the opportunities to make decisions based on the problems presented. Students might have different perspectives whenever they make decisions. Just let them decide which decision is more practical.

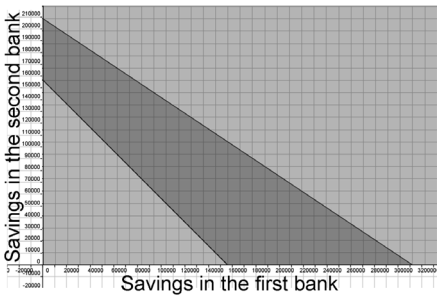
Answer Key

Activity 7

1. a. $x + y > 150$ and $250x + 200y \leq 44{,}000$
   b.



2. a. $x + y \geq 150{,}000$ and $0.04x + 0.06y \leq 12{,}000$
   b.



Activity 6 LOOKING CAREFULLY AT THE REGION...

Directions: Answer the following questions.

1. How do you determine the solution set of a system of linear inequalities in two variables from its graph?
2. Do you think it is easy to determine the solution set of a system of linear inequalities by graphing? Explain your answer.
3. In what instance will you find it difficult to determine the solution set of a system of linear inequalities from its graph?
4. How would you know if the solutions you found from the graphs of linear inequalities in a system are true?
5. What do you think are the advantages and the disadvantages of finding the solution set of a system of linear inequalities graphically? Explain your answer.
6. Is it possible to find the solution set of a system of linear inequalities in two variables algebraically? Give examples if there are any.

Activity 7 SOLVE THEN DECIDE!

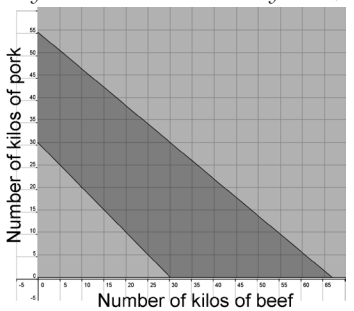
Directions: Answer each of the following. Show your complete solutions and explanations.

1. Tickets in a play cost Php 250 for adults and Php 200 for children. The sponsor of the show collected a total amount of not more than Php 44,000 from more than 150 adults and children who watched the play.

   a. What mathematical statements represent the given situation?
   b. Draw and describe the graphs of the mathematical statements.
   c. How will you find the number of children and adults who watched the play?
   d. Give four possible numbers of adults and children who watched the play. Justify your answer.
   e. The sponsor of the show realized that if the prices of the tickets were reduced, more people would have watched the play. If you were the sponsor of the play, would you reduce the prices of the tickets? Why?

3. a. $x + y \geq 30$ and $180x + 220y \leq 12{,}000$

b.

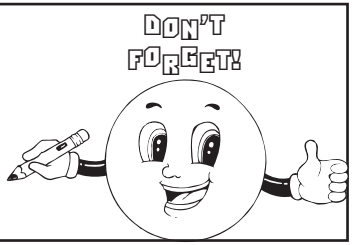


Before the students move to the next section of this lesson, give a short test (formative test) to find out how well they understood systems of linear inequalities in two variables, the graphical method of solving them, and their real-life applications.

What to Transfer

Give the students opportunities to demonstrate their understanding of systems of linear equations and inequalities in two variables by doing some practical tasks. Let them perform Activities 8, 9 and 10. You can ask the students to work individually or in group. Emphasize to them that they must come up with some real-life problems that involve systems of linear equations and inequalities in two variables. Moreover, students must be given the opportunity to solve the problems they have formulated.

Teacher's Note and Reminders



2. Mr. Agoncillo has savings account in two banks. The combined amount of these savings is at least Php 150,000. One bank gives an interest of 4% while the other bank gives 6%. In a year, Mr. Agoncillo receives at most Php12,000.

   a. What mathematical statements represent the given situation?
   b. Draw and describe the graphs of the mathematical statements.
   c. How will you determine the amount of savings in each bank account?
   d. Give four possible amounts of savings in both accounts. Justify your answer.
   e. If you were Mr. Agoncillo, in what bank account would you place greater amount of money? Why?

3. Mrs. Burgos wants to buy at least 30 kilos of pork and beef for her restaurant business but has to spend no more than Php 12,000. A kilo of pork costs Php 180 and a kilo of beef costs Php 220.

   a. What mathematical statements represent the given situation?
   b. Draw and describe the graphs of the mathematical statements.
   c. How will you determine the amount of pork and beef that Mrs. Burgos needs to buy?
   d. Give four possible amounts of pork and beef that Mrs. Burgos needs to buy. Justify your answer.
   e. Mrs. Burgos observed that every week, the number of people coming to her restaurant is increasing. She decided to buy more pork and beef to meet the demands of her customers. If you were Mrs. Burgos, will you do the same? Why?

Activity 8 PLAY THE ROLE OF ...

Cite situations in real life where systems of linear inequalities in two variables are applied. Form a group of five members and role play each situation. With your groupmates, formulate problems out of these situations then solve in as many ways as you can.

Teacher's Note and Reminders

SUMMARY/SYNTHESIS/GENERALIZATION:

This lesson was about the graphical solutions of systems of linear inequalities in two variables. In this lesson, students are exposed to the graphical method of finding the solutions of systems of linear inequalities and given the opportunity to determine the advantages and disadvantages of using such method. Using this method of solving systems of linear inequalities, students were able to find out which system has no solution and infinite number of solutions. More importantly, the students were given the chance to formulate and solve real-life problems, make decisions based on the problems, and demonstrate their understanding of the lesson by doing some practical tasks.

Activity 9 JOIN THE CAMP!

Directions: Perform the following activity. Refer to the situation below.

You are one of the members of the Boys Scouts of the Philippines in your school who will be joining the National Jamboree next month. Your scout master assigned you together with your troop members to take charge of all the camping materials needed such as tents, ropes, bamboos, cooking utensils, fire woods, and other necessary materials. He also asked you to prepare the food menu for the duration of the jamboree including the ingredients.

1. Make a list of all camping materials needed including the quantity of each.
2. Use the camping materials and their quantities to formulate problems involving systems of linear inequalities in two variables. Solve the problems formulated. Use the rubric provided to rate your work.
3. Determine if the camping materials needed are enough for the number of boys scouts who will join the jamboree. Explain your answer.

Rubric on Problems Formulated and Solved

Score	Descriptors
6	Poses a more complex problem with 2 or more correct possible solutions and communicates ideas unmistakably, shows in-depth comprehension of the pertinent concepts and/or processes and provides explanations wherever appropriate.
5	Poses a more complex problem and finishes all significant parts of the solution and communicates ideas unmistakably, shows in-depth comprehension of the pertinent concepts and/or processes.
4	Poses a complex problem and finishes all significant parts of the solution and communicates ideas unmistakably, shows in-depth comprehension of the pertinent concepts and/or processes.
3	Poses a complex problem and finishes most significant parts of the solution and communicates ideas unmistakably, shows comprehension of major concepts although neglects or misinterprets less significant ideas or details.
2	Poses a problem and finishes some significant parts of the solution and communicates ideas unmistakably but shows gaps on theoretical comprehension.
1	Poses a problem but demonstrates minor comprehension, not being able to develop an approach.

Source: D.O. #73 s. 2012

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Glossary of Terms:

1. **Elimination Method** – This is an algebraic method of solving systems of linear equations. In this method, the value of one variable is determined by eliminating the other variable. To eliminate the variable, some mathematical operations are followed.

2. **GeoGebra** – This is a dynamic mathematics software that can be used to visualize and understand concepts in algebra, geometry, calculus, and statistics.

3. **Graphical Method** – This is a method of finding the solution(s) of a system of linear equations by graphing.

4. **Simultaneous linear equations or system of linear equations** – a set or collection of equations that one solves all together at once.

5. **Simultaneous linear inequalities or system of linear inequalities** – a set or collection of inequalities that one solves all together at once.

6. **Solution to a system of linear equations** - This corresponds to the coordinates of the points of intersection of the graphs of the equations.

7. **Substitution Method** – This is an algebraic method of solving systems of linear equations. In this method, the expression equivalent to one variable in one equation is substituted to the other equation to solve for the other variable.

8. **System of consistent and dependent equations** – This is a system of linear equations having infinitely many solutions. The slopes of the lines defined by the equations are equal, their y-intercepts are also equal, and their graphs coincide

9. **System of consistent and independent equations** – This is a system of linear equations having exactly one solution. The slopes of the lines defined by the equations are not equal, their y-intercepts could be equal or unequal, and their graphs intersect at exactly one point.

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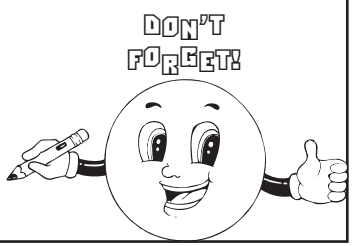
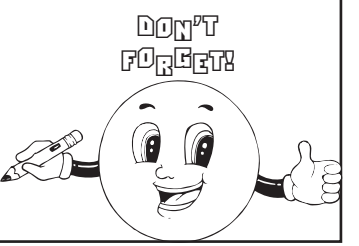
Teacher's Note and Reminders



10. System of inconsistent equations – This is a system of linear equations having no solution. The slopes of the lines defined by the equations are equal or have no slopes, their y-intercepts are not equal, and their graphs are parallel.

Teacher's Note and Reminders



Summative Test
Answer Key

Part I.

1. C	6. B	11. B	16. C
2. D	7. A	12. B	17. B
3. C	8. A	13. A	18. C
4. C	9. C	14. D	19. C
5. B	10. C	15. C	20. D

WEBSITE Links as References and for Learning Activities:

1. http://edhelper.com/LinearEquations.htm
2. http://illuminations.nctm.org/lessons/9-12/supply/Supply-AS-Sheet1.pdf
3. http://illuminations.nctm.org/lessons/9-12/supply/Supply-AS-sheet2.pdf
4. http://ltcconline.net/greenl/courses/152b/QuadraticsLineIneq/systems.htm
5. http://library.thinkquest.org/20991/alg /systems.html
6. http://math.about.com/od/algebra1help/a/System_of_Equations_Worksheets.htm
7. http://math.tutorvista.com/algebra/equations-and-inequalities.html#
8. https://new.edu/resources/solving-linear-systems-by-graphing
9. https://new.edu/resources/solving-systems-of-linear-inequalities-two-variables Solving Systems of Linear Inequalities
10. https://sites.google.com/site/savannaholive/mathed-308/algebra1
11. http://wveis.k12.wv.us/teach21/public/project/Guide.cfm?upid=3354&tsele1=2&tsele2=118
12. http://www.analyzemath.com/equations_inequalities.html

SUMMATIVE TEST

Part I. Select the letter that corresponds to your answer.

1. Which of the following is a system of linear equations in two variables?

   a. $2x + 5y = 7$, $x - 3y > 10$
   b. $3x + 9 = -4$, $x - 2 = 8$
   c. $x - 7y = 5$, $3x + 2y > 15$
   d. $6x + 7 = 12$, $2y - 4 = 9$

2. How many solutions does a consistent and dependent system of linear equations have?
   a. 0 b. 1 c. 2 d. Infinite

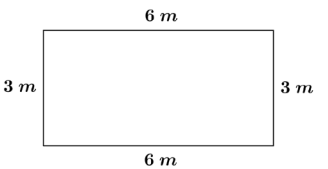
3. Which of the following ordered pairs satisfy both $3x - y < 10$ and $x + 6y \geq 15$?
   a. (-3, -3) b. (9, 1) c. (-6, 6) d. (7, -4)

4. Mrs. Dela Cruz has a total investment of Php 190,000, part at 8% and the rest at 6%. She receives an annual income of Php 13,800 from both investments. Suppose Mrs. Dela Cruz retains her investment at 6% and would like to earn an annual income of not more than Php 17,000. What should her investment be at 8% interest?
   a. Php 70,000 c. Php 160,000
   b. Php 120,000 d. Php 230,000

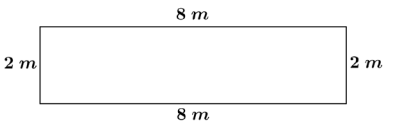
5. What point is the intersection of the graphs of the lines $x + y = 9$?
   a. (-5, 4) b. (4, 5) c. (5, 4) d. (-4, 5)

6. Mr. Agoncillo asked each of his Industrial Arts students to prepare a drawing of rectangular table such that its perimeter is at least 10 m and the difference between its length and its width is at most 5 m. Which of the following could be the sketch of the table's surface that a student may prepare?

   a.



   b.



13. http://www.coolmath.com/crunchers/algebra-problems-systems-equations-2x2.htm

14. http://www.classzone.com/books/algebra_1/page_build.cfm?id=none&ch=7

15. http://www.education.com/study-help/article/graphing-systems-linear-equations-inequalities1/

16. http://www.education.com/study-help/article/tackling-systems-equations-inequalities/

17. http://www.kgsepg.com/project-id/6653-systems-linear-equations-and-inequalities

18. http://www.kgsepg.com/project-id/6565-inequalities-two-variables

19. http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/v/addition-elimination-method-2

20. http://www.mathchamber.com/algebra7/unit_06/unit_6.htm

21. http://www.mathguide.com/lessons/Systems.html

22. http://www.mathwarehouse.com/algebra/linear_equation/linear-inequality.php

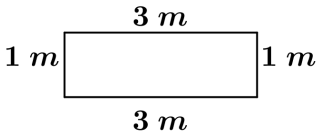
23. http://www.mathwarehouse.com/algebra/linear_equation/systems-of-equation/index.php

24. http://www.netplaces.com/algebra-guide/graphing-linear-relationships/graphing-linear-inequalities-in-two-variables.htm

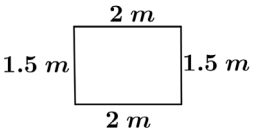
25. http://www.netplaces.com/algebra-guide/systems-of-linear-equations/solving-graphically.htm

26. http://www.netplaces.com/algebra-guide/systems-of-linear-equations/

c.



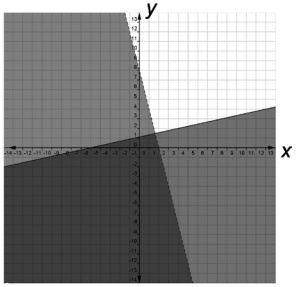
d.



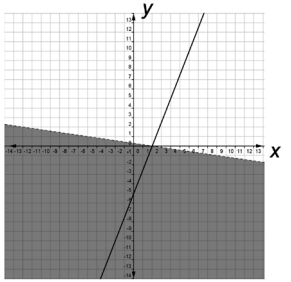
7. Michelle has two mobile network plans. In one plan, she pays a monthly charge of Php 350 plus Php 6 for every minute of call to other networks. In the other plan, she pays a monthly charge of Php 450 plus Php 4 for every minute of call to other networks. Last month, her monthly bills in both mobile networks are the same. What is the total call time to other networks did she make?
   a. 50 minutes
   b. 100 minutes
   c. 200 minutes
   d. 300 minutes

8. Which of the following is a graph of a system of linear inequalities in two variables?

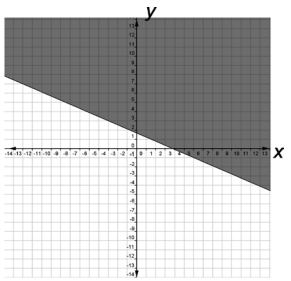
a.



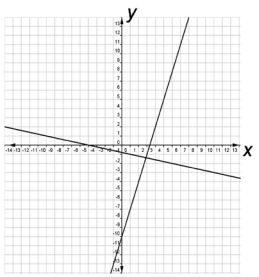
c.



b.



d.



27. http://www.netplaces.com/search.htm?terms=linear+inequalities+in+two+variables

28. http://www.personal.kent.edu/~rmuhamma/Algorithms/MyAlgorithms/MathAlgor/linear.html

29. http://www.purplemath.com/modules/syslneq.htm

30. http://www.purplemath.com/modules/systlin1.htm

31. http://www.saddleback.edu/faculty/lperez/algebra2go/begalgebra/index.html#systems

32. http://www.sophia.org/systems-of-linear-equations-and-inequalities--2-pathway

33. http://www.tutorcircle.com/solving-systems-of-linear-equations-and-inequalities-t71gp.html#close_iframe#close_iframe

WEBSITE Links for Videos:

1. http://johnsonsmath.weebly.com/chapter-3---systems-of-linear-equations--inequalities.html

2. http://video.search.yahoo.com/search/video?p=systems+of+linear+equations+and+inequalities

3. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-228s.html

4. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-229s.html

5. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-231s.html

6. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-232s.html

9. The school canteen sells two kinds of sandwiches. Chicken sandwich costs Php 18 each while egg sandwich costs Php 10 each. Yesterday, the canteen was able to sell 260 sandwiches that cost Php 3,320. How many egg sandwiches were sold?

   a. 80 b. 90 c. 170 d. 332

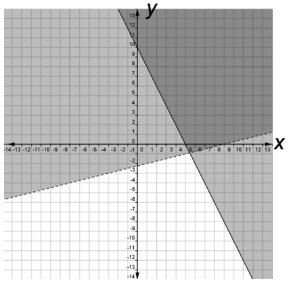
10. Which system of equations has graph that shows parallel lines?

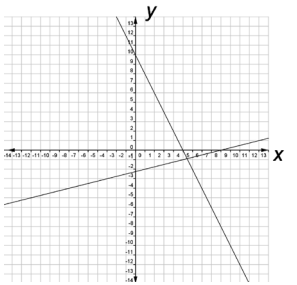
   a. $5x + 2y = 12$, $x - 7y = 8$
   b. $-3x + y = 5$, $6x - 2y = -10$
   c. $3x + 9y = 4$, $x + 3y = 5$
   d. $2x + y = 12$, $3x - y = 7$

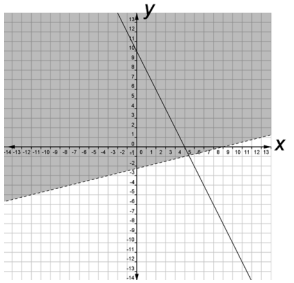
11. If $3x + 2y = 10$ and $3x - 2y = 8$, what is x equal to?

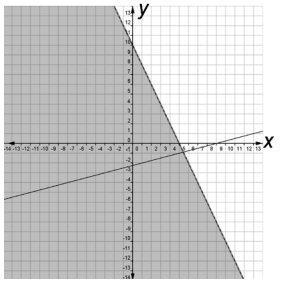
   a. $\frac{1}{2}$ b. 3 c. 6 d. 18

12. Which of the following shows the graph of the system $\begin{matrix} 2x + y = 10 \\ x - 4y < 7 \end{matrix}$?

   a. 

   c. 

   b. 

   d. 

7. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-233s.html

8. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-234s.html

9. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-235s.html

10. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-236s.html

11. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-238s.html

12. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-239s.html

13. http://www.phschool.com/atschool/academy123/english/academy123_content/wl-book-demo/ph-240s.html

14. http://www.youtube.com/watch?v=0X-bMeIN53I

15. http://www.youtube.com/watch?v=4XCPT1rFC5E

16. http://www.youtube.com/watch?v=6oehycq06vo

17. http://www.youtube.com/watch?v=lNeUozcbxnI

18. http://www.youtube.com/watch?v=rCB6cjDHY9k

19. http://www.youtube.com/watch?v=uLXV7XLw1B0

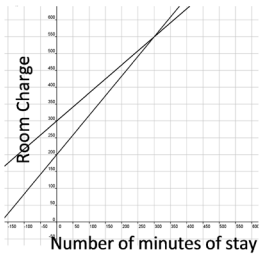
13. The Math Club rented a sound system for their annual Mathematics Festival. They also rented a generator in case of power interruption. After the 2-day event, the club paid a total amount of Php 1,850, two days for the sound system and one day for the generator. If each is rented for three days, the club should have paid a total amount of Php 3,300. What was the daily rental cost of the generator?
    a. Php 350 b. Php 750 c. Php 1,050 d. Php 2,250

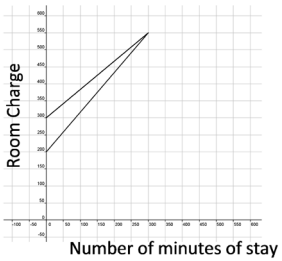
14. A businessman would like to make a model which he can use as a guide in writing a system of equations. He will use the system of equations in determining the number of computer units and printers that he needs to stock in his warehouse given the total cost (T), the cost (C) of each computer units, the cost (P) of each printer, and the total number of computer units and printers (N). Which of the following models should he make and follow?

    a. $\begin{aligned} Cx - Py &= T \\ x + y &= N \end{aligned}$
    b. $\begin{aligned} Cx - Py &= T \\ x - y &= N \end{aligned}$
    c. $\begin{aligned} Cx + Py &= T \\ x - y &= N \end{aligned}$
    d. $\begin{aligned} Cx + Py &= T \\ x + y &= N \end{aligned}$

15. Laila says that the system has infinite number of solutions. Which of the following reasons would support her statement?
    a. The two lines as described by the equations in the system have different slopes.
    b. The graph of the system of equations shows parallel lines.
    c. The two lines as described by the equations in the system coincide.
    d. The graph of the system of equations shows intersecting lines.

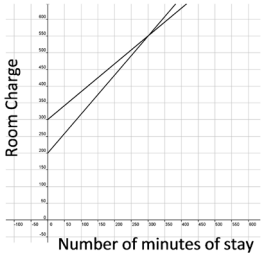
16. Kelly was asked by his supervisor to compare the room charges of two hotels. His supervisor would like to see the graph showing the comparison of the room charges. Which of the following graphs should Kelly present to his supervisor?

    a.
    

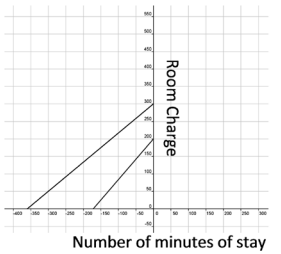
    b.
    

Teacher's Note and Reminders

c.



d.

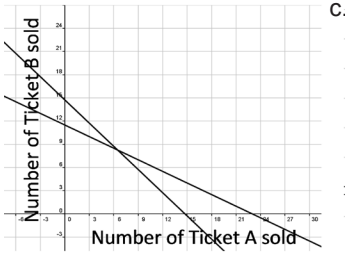


17. Mrs. Rosales bought two kg of mango and six kg of banana. She paid a total amount of Php 360. If she had bought a kilo of each kind of fruits, the total amount that Mrs. Rosales should have paid was Php 100. How much does a kilo of mango cost?

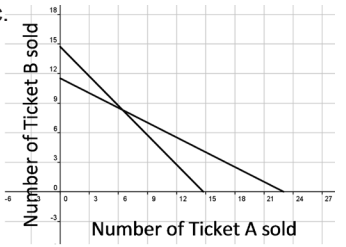
    a. Php 40 b. Php 60 c. Php 100 d. Php 120

18. A non-government organization is raising funds for the typhoon victims by selling two kinds of concert tickets. After the concert, the officers of the organization need to account all the money raised and present it graphically to their members. Which of the following graphs could be prepared and presented by the officers?

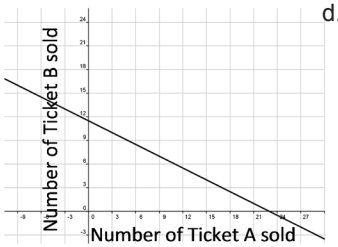
a.



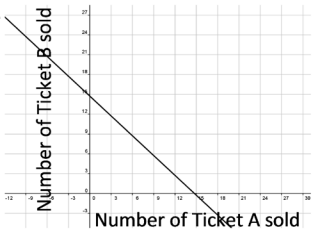
c.



b.



d.



Teacher's Note and Reminders

Summative Test
Answer Key

Part II.

1. Systems of Linear Equations in Two Variables:

   $2x + y = 15$, $3x - y = 5$ and $4x - 2y = 12$, $x + 3y = 3$

   Systems of Linear Inequalities in Two Variables:

   $x + 6y > 9$, $2x - 5y \leq 2$ and $3x - 2y \leq 6$, $4x + y > 11$

2. $5x - 2y = 10$, $2a + 7b = 6$ and $2xy \geq 14$, $7x - 2y < 8$

19. Mrs. Daza would like to prepare some foods for the birthday party of her daughter. She plans to serve the following according to her budget and the number of guests: noodles, fried chicken, sandwiches, drinks, and desserts. Which of the following should Mrs. Daza have before preparing the foods?
    I. Budget Plan
    II. Recipe book
    III. Pricelist of the food ingredients and drinks' mixtures

    a. I and II b. I and III c. II and III d. I, II, and III

20. The Mayor of a city would like to minimize the traffic jam in one of the major roads. He gathered all people concern to come up with some measures to follow. Which of the following measures may be followed to effectively ease the traffic flow in the city?
    I. Diverting private vehicles to some alternate routes.
    II. Assigning non-travel days for public utility vehicles.
    III. Reducing the number of travel permits being issued to public utility vehicles by the city government.

    a. I and II b. I and III c. II and III d. I, II, and III

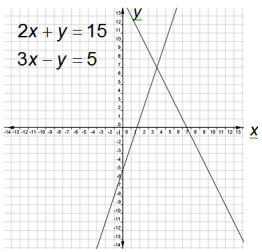
Part II. Use the following systems of equations and inequalities to answer the questions that follow.

$2x + y = 15$ $3x - y = 5$	$3x - 2y \leq 6$ $4x + y > 11$	$4x - 2y = 12$ $x + 3y = 3$
$x + 6y > 9$ $2x - 5y \leq 2$	$5x - 2y = 10$ $2a + 7b = 6$	$2xy \geq 14$ $7x - 2y < 8$

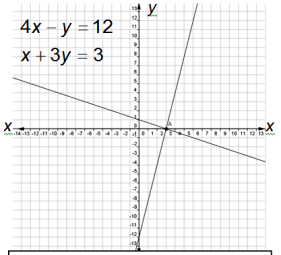
1. Which of the given systems of equations or inequalities are systems of linear equations in two variables? systems of linear inequalities in two variables?

2. Which of the given systems of equations or inequalities are not systems of linear equations in two variables? systems of linear inequalities in two variables? Explain your answer.

3.

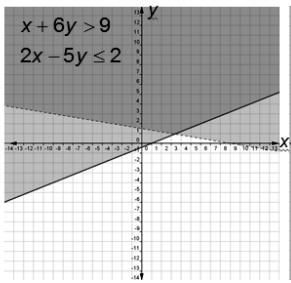


Solution: (4, 7)
Consistent and independent

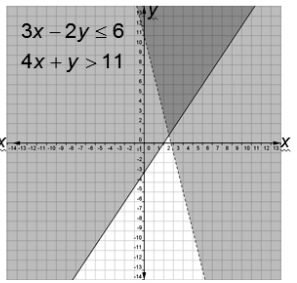


Solution: (3, 0)
Consistent and independent

4.

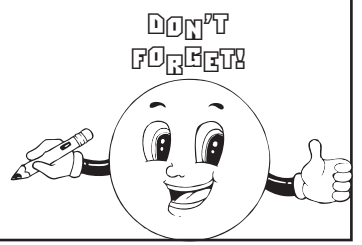


Possible solutions:
(-5, 7), (6, 7), (0, 10)

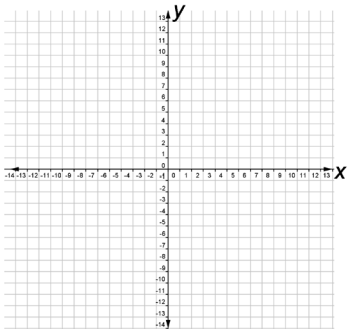


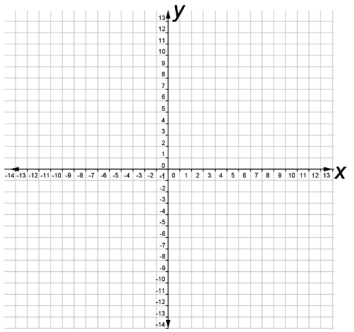
Possible solutions:
(-3, 24), (6, 21), (5, 4.5)

Teacher's Note and Reminders



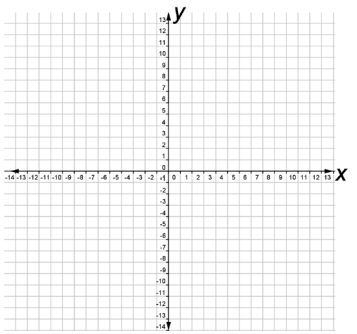
3. Find the solution of each system of linear equations in two variables graphically and algebraically. Check your answer against the equations in the system.

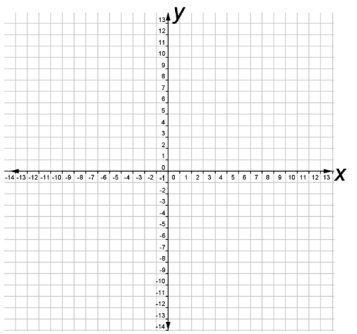




What kind of system of linear equations is each?

4. Find and describe the solution set of each system of linear inequalities in two variables graphically. Then give five ordered pairs that satisfy the system. Verify your answer.





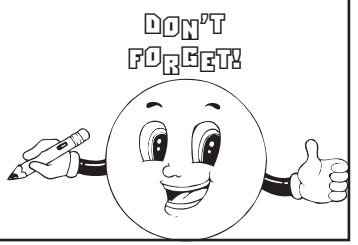
Summative Test
Answer Key

Part III.

1. Technician: Php 650
   Supervisor: Php 800

2. Possible answers: 5 children and 5 adults
   8 children and 7 adults
   9 children and 6 adults

Teacher's Note and Reminders



Part III. Solve the following problems.

1. A computer service center hires 15 technicians and two supervisors for total daily wages of Php 11,350. If two of the technicians are promoted as supervisors, the total daily wages become Php 11,650. What are the daily wages for a technician and a supervisor?

2. There are at most 15 people composed of children and adults who ride in an elevator that has a capacity of 600 kilograms. If children's weight averages 30 kilograms and adult's weight averages 55 kilograms, how many children and adults are in the elevator?

Part IV. Let's Go Gardening! (GRASPS Assessment)

Goal: Prepare and submit a design or sketch plan of an expanded school vegetable garden.

Role: Agriculture Teacher

Audience:

School Principal, Head of the TLE Department, other agriculture teachers, and the students taking agriculture subject

Situation:

Your school was nominated in the Regional Search for Best School Vegetable Garden. The school principal instructed one of the agriculture teachers to further improve the existing 500 sq. m. vegetable garden in your school and expand it to at least one hectare. He advised the teacher to come up with the design or sketch plan of the expanded garden and a list of vegetables to be grown including their quantities.

Product:

Design or sketch plan of an expanded school vegetable garden following the standards set

Standards:

The design or sketch plan must show the following:

1. Appropriate, flawless, and elegant illustration
2. Accurate measurements
3. Clear presentation of the sketch plan of the garden
4. Diversity of vegetables to be grown in the garden

Teacher's Note and Reminders

Use the rubric below to check students' work.

RUBRICS: DESIGN/SKETCH PLAN OF THE SCHOOL VEGETABLE GARDEN

CRITERIA	Excellent 4	Satisfactory 3	Developing 2	Beginning 1
Content	The design or the sketch plan of the school vegetable garden reveals student's exemplary understanding of the key concepts of systems of linear equations and inequalities in two variables. The main topic systems of linear equations and inequalities in two variables are illustrated appropriately, flawlessly, and elegantly.	The design or the sketch plan of the school vegetable garden reveals student's exemplary understanding of the key concepts of systems of linear equations and inequalities in two variables. The main topic systems of linear equations and inequalities in two variables are illustrated appropriately with minor errors.	The design or the sketch plan of the school vegetable garden reveals student's exemplary understanding of the key concepts of systems of linear equations and inequalities in two variables. The main topic systems of linear equations and inequalities in two variables are illustrated but with considerable errors.	The design or the sketch plan of the school vegetable garden reveals student's exemplary understanding of the key concepts of systems of linear equations and inequalities in two variables. The main topic systems of linear equations and inequalities in two variables are fairly illustrated and with major errors.

Teacher's Note and Reminders

Clarity of Presentation	Supporting statements pertinent to the design or sketch plan of the school garden are highly relevant, clearly presented, convincing, and accurate. Ideas are thoroughly developed and well-organized.	Supporting statements pertinent to the design or sketch plan of the school garden are relevant, clearly presented, convincing and fairly accurate. Ideas are well developed and organized.	Supporting statements pertinent to the design or sketch plan of the school garden are relevant, clearly presented, slightly convincing and fairly accurate. Ideas are developed but not well-organized.	Supporting statements pertinent to the design or sketch plan of the school garden are slightly relevant, and barely accurate. Ideas are slightly developed but not well-organized.
Accuracy of Measure-ments	Measurements of the different parts of the design or sketch plan of the school garden are of utmost accuracy.	Measurements of the parts of the design or sketch plan of the school garden are fairly accurate.	Measurements of the different parts of the design or sketch plan of the school garden are of minimal accuracy	Measurements of the different parts of the design or sketch plan of the school garden are barely accurate.
Diversity of Plants	The design shows different varieties of plants that are well-organized and properly situated.	The design shows different varieties of plants. However, the plants are not well-organized and not properly situated.	The design only shows a few varieties of plants that are well-organized and properly situated.	The design only shows a few varieties of plants and are not well-organized and not properly situated.

Teacher's Note and Reminders

Questions:

1. Were you able to make a design or sketch a plan of the vegetable garden?

2. How did you come up with the design or sketch plan?

3. Were you able to apply your understanding of systems of linear equations and inequalities in two variables? How?

4. Suppose you are asked to make a list of all materials needed for the improvement of the school vegetable garden.
   a. What are the materials that you would need?
   b. What is the quantity of each of these materials?
   c. Out of the materials listed and their respective quantities, formulate problems that illustrate the applications of systems of linear equations and inequalities in two variables. Solve these problems in different ways.

5. What important things have you learned from the task done?

Teacher's Note and Reminders