

# MATHEMATICS

## Quarter 2 - Module 2: Solving Problems Involving System of Linear Inequalities in Two Variables



**AIRs - LM**

**Mathematics 8**  
**Quarter 2- Module 2: Solving Problems Involving System of Linear Inequalities in Two Variables**  
**Second Edition, 2021**

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Region I

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# 8

# MATHEMATICS

## **Quarter 2-Module 2: Solving Problems Involving System of Linear Inequalities in Two Variables**

# Introductory Message

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

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

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

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

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

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

Thank you.



## **Target**

This module was designed and written with you in mind. It is here to help you master on how to solve problems involving system of linear inequalities in two variables. The scope of this module permits it to be used in many different learning situations. The language and numeric used recognizes the diverse vocabulary and numeracy level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

After going through this module, you are expected to:

### **Learning Competency**

- solve problems involving system of linear inequalities in two variables.  
**(M8AL-IIb-2)**

### **Subtasks:**

1. Translate word problems into linear inequalities.
2. Solve problems involving system of linear inequalities in two variables.
3. Apply the concepts of solving system of linear inequalities in real-life problems.



## Pretest

### Pre-Assessment

**Directions:** Read each item very carefully. Choose the letter of the correct answer and write your answers on a separate sheet of paper.

- Which of the following ordered pairs is a solution of the inequality  $x + 3y \leq 5$ ?  
A. (1, 0)      B. (1, 2)      C. (2, 2)      D. (-3, 3)
- The difference between the weight of Joy (**d**) and Lisa (**p**) is at least 15. Write the statement as linear inequality in two variables.  
A.  $d - p = 15$       B.  $d - p \leq 15$       C.  $d - p \geq 15$       D.  $d - p > 15$
- To get a passing mark in school, a student must have a grade (**g**) of at least 75. What inequality model would represent the statement?  
A.  $g = 75$       B.  $g \leq 75$       C.  $g > 75$       D.  $g \geq 75$
- Which of the following is **NOT** a representation of linear inequality in two variables?  
A.  $Ax + By \leq C$       B.  $Ax + By = C$   
C.  $Ax + By < C$       D.  $Ax + By \geq C$
- Which ordered pair is a solution of the given system of linear inequalities below?  
$$\begin{cases} x + 2y > 11 \\ y \leq 2x - 7 \end{cases}$$
  
A. (6, 4)      B. (1, 2)      C. (5, 3)      D. (2, 3)
- Which of the following real-life situations is an inequality?  
A. The population of the Philippines is about 103 000 000  
B. The expenses for food is greater than the expenses for clothing  
C. Seven times the number of male teachers is the number of female teachers  
D. According to research, an average adult generates about 4 kg of waste daily
- Lyn bought three guavas and two oranges. The total amount she paid was at most Php 123. If **x** represent the number of guavas and **y** the number of oranges, which of the following mathematical statements represents the given situation?  
A.  $3x + 2y \geq 123$       B.  $3x + 2y \leq 123$   
C.  $3x + 2y > 123$       D.  $3x + 2y < 123$

For items **8 & 9** refer to the problem below.

Leo bought two shirt and a pair of shoes. The total amount he paid for the items is not more than Php 920.

- What linear inequality model best represent the situation above?  
A.  $2x + y \geq 920$       B.  $2x + y > 920$   
C.  $2x + y \leq 920$       D.  $2x + y < 920$

9. From the model above, what does **y** variable stand for?
- A. the cost of the two shirts                      B. the cost of each shirt  
C. the cost of a pair of shoes                      D. the cost of the pair of shoes and the shirt
10. Which system of linear inequalities satisfy the ordered pair (3,4)?
- A.  $\begin{cases} x + y > 5 \\ 2x - y < 4 \end{cases}$                       B.  $\begin{cases} x + y < 5 \\ 2x - y > 4 \end{cases}$   
C.  $\begin{cases} x + 2y > 11 \\ y \leq 2x - 7 \end{cases}$                       D.  $\begin{cases} x - y > -3 \\ x + 2y < 10 \end{cases}$
11. The total amount Cora paid for two kilos of beef and three kilos of fish is less than Php 700. Suppose a kilo of beef costs Php 250. What could be the maximum cost of a kilo of fish to the nearest pesos?
- A. Php 60                      B. Php 65                      C. Php 66                      D. Php 67
12. Typically, elevators have a load capacity of 1000 kg. Suppose that children, each weighing 35 kg and adults, each weighing 80 kg are in an elevator. Which of the following linear inequality model indicates that an elevator is overloaded?
- A.  $35x + 80y > 1000$                       B.  $35x + 80y \leq 1000$   
C.  $35x + 80y < 1000$                       D.  $35x + 80y = 1000$
13. Miss Casuga, a working student have two tutees: one paying Php250.00 per session and another paying Php300.00 per session. She must earn at least Php 6,000.00 a month to pay expenses while attending college. Write an inequality that shows the various ways she can schedule her time to achieve her goal.
- A.  $250x + 300y < 6,000$                       C.  $250x + 300y = 6,000$   
B.  $250x + 300y \leq 6,000$                       D.  $250x + 300y \geq 6,000$
14. Below are the steps in solving problems involving system of linear inequalities in two variables. Which of the following is the correct order?
- I. Read and understand the problem  
II. Translate the problem into an inequalities in two variables  
III. Draw the graph of both inequalities on an x-y plane. Make sure you use appropriate boundary lines and shade the correct half plane for each inequality.  
IV. Identify the intersection which is the solution of the two inequalities and answer the questions that pertain to the problem.
- A. I, II, III, IV                      B. I, III, IV, II  
C. I, III, II, IV                      D. II, I, III, IV
15. Paul earns Php 7 per hour at the bagel shop and Php 12 per hour mowing lawns. He needs to earn at least Php 120 per week but he must work less than 30 hours per week. What system of linear inequalities describes this situation?
- A.  $\begin{cases} 7x + 12y \geq 120 \\ x + y < 30 \end{cases}$                       B.  $\begin{cases} 7x + 12y > 120 \\ x + y < 30 \end{cases}$   
C.  $\begin{cases} 7x + 12y \leq 120 \\ x + y < 30 \end{cases}$                       D.  $\begin{cases} 7x + 12y < 120 \\ x + y < 30 \end{cases}$



## ***Jumpstart***

### **Activity: Summer Job**

**Directions:** Read the statement carefully and answer the questions that follow.

Bella lives near a beach resort. During summer vacation, she sells souvenir items such as bracelets and necklaces made of local shells. Each bracelet costs Php 85.00 while each piece of necklace costs Php 115.00. She needs to sell at least Php 15,000.00 worth of bracelets and necklaces.

#### **Guide Questions:**

1. Were you able to use linear inequalities in two variables to represent a real-life situation?
2. Bella needs to have a total sale of at least Php 15,000.00. What mathematical statement is being represented? Describe.
3. How many bracelets and necklaces should Bella sell to have a total sale of at least Php 15,000.00? Give at least five possible answers then justify.



## ***Discover***

### **Solving Problems Involving System of Linear Inequalities in Two Variables**

In the previous module, we graphed linear inequalities in two variables. To review, we graph the boundary line using a solid line if the boundary is part of the solution set and a broken line if the boundary is not part of the solution set. Then we test any point that is not on the boundary line in the original inequality. A true statement tells us that the point lies in the solution set; a false statement tells us the solution set is the other region.



Figure 1 shows the graph of the inequality  $x + y < 4$ . Note that the boundary is not included in the solution set and is therefore drawn with a broken line.

Figure 2 shows the graph of  $-x + y \leq 3$ . Note that the boundary is drawn with a solid line because it is part of the solution set.

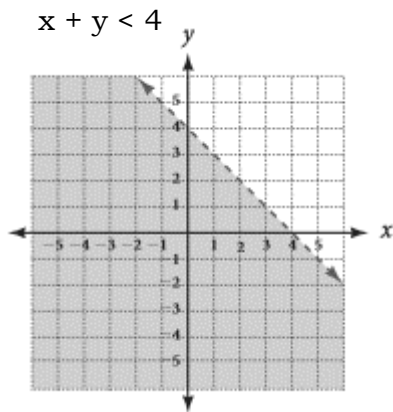


Figure 1

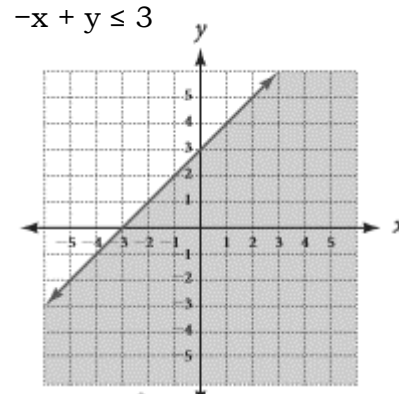


Figure 2

If we form a system of inequalities with the two inequalities, the solution set will be all the points common to both solution sets shown in the two figures above; it is the intersection of the two solution sets. Therefore, the solution set for the system of inequalities

$$\begin{cases} x + y < 4 \\ -x + y \leq 3 \end{cases}$$

is all the ordered pairs that satisfy both inequalities. It is the set of points that are below the line  $x + y = 4$  and also below (and including) the line  $-x + y = 3$ . The graph of the solution set to this system is shown in Figure 3. We have written the system in Figure 3 with the word and just to remind you that the solution set to a system of equations or inequalities is all the points that satisfy both equations or inequalities.

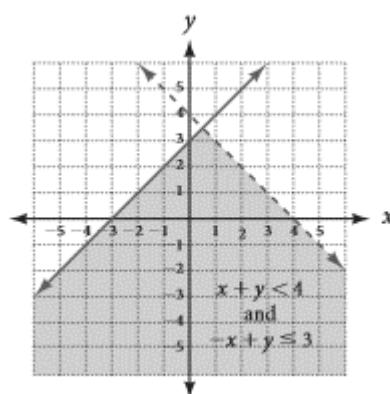
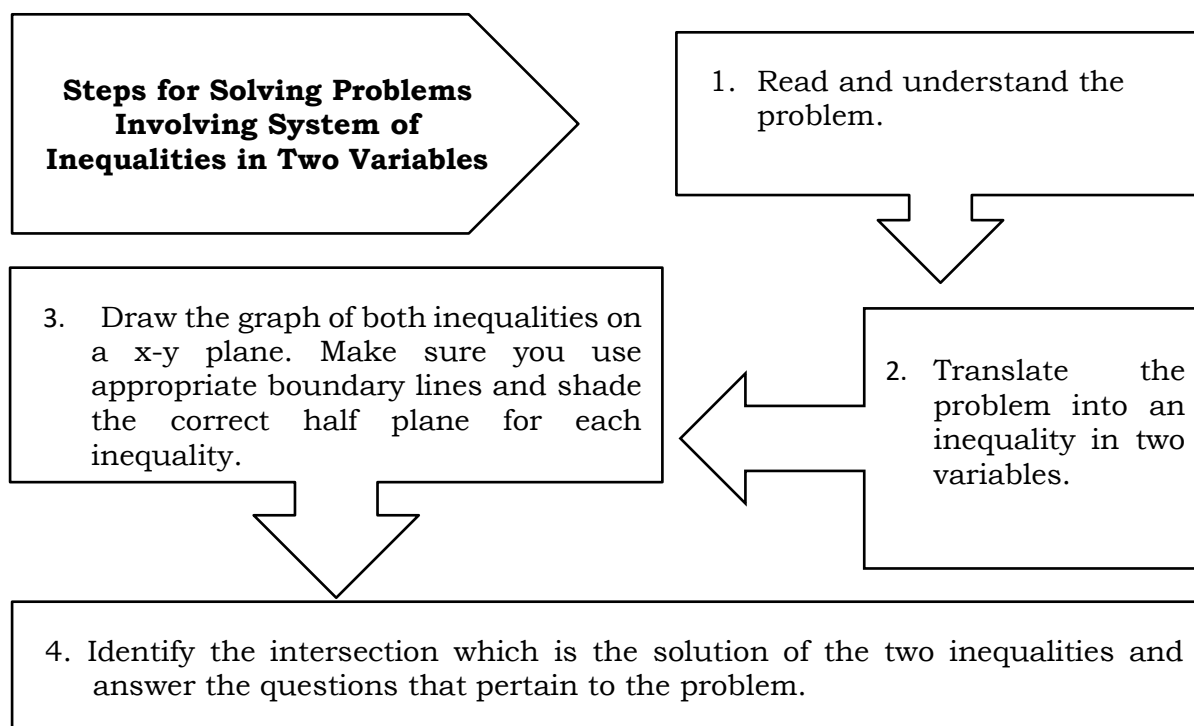


Figure 3

Many real-life situations require us to solve inequalities. In fact, inequality applications are so common that we often do not even realize we are doing algebra. Below are the steps to solve problems involving systems of linear inequalities in two variables:



Illustrative examples on solving systems of linear inequalities in two variables are provided for you to better understand the concepts.

### Illustrative Example 1.

The eighth graders are hosting the next school dance event. They would like to make at least a Php 500 profit from selling tickets. The ninth graders estimate that at most 300 students will attend the event. They will earn Php 3 for each ticket purchased in advance and Php 4 for each ticket purchased at the entrance.

- Write a system of inequalities to represent this situation.
- Graph each inequality on the grid.
- Suppose only 30 people buy advance tickets. How many people would need to buy tickets at the entrance? (Identify one realistic solution) Justify your answer.

### Solution:

#### Step 1. Read and Understand the Problem.

Given: Make at least Php 500 profit from selling tickets

At most 300 students will attend

Php3 for advance & Php4 for tickets at entrance

- We must write two inequalities. We know information about the cost of tickets and the number of expected attendees.

Let  $x$  = the number of people who purchase tickets in advance

Let  $y$  = the number of people who purchase tickets at the entrance

**Step 2.** Translate the problem into an inequality in two variables.

Verbal model for cost of tickets:

Advance purchase + Door purchase is at least Php 500

$$3x + 4y \geq 500$$

Verbal model for number of expected attendees (at most 300 students will attend)

$x + y \leq 300$  (The number of students total is the number of advance purchasers + the number of entrance purchasers  $(x + y)$ )

$$x + y \leq 300$$

• Our system of inequalities for this situation is:

$$3x + 4y \geq 500 \quad \& \quad x + y \leq 300$$

**Step 3.** Draw the graph of both inequalities on a x-y plane. Make sure you use appropriate boundary lines and shade the correct half plane for each inequality.

b. The first line represents:

$$3x + 4y \geq 500$$

The x-intercept (let  $y = 0$ )

$$3x + 4(0) = 500$$

$$3x = 500$$

$$x = 166.67 \quad (166.67, 0)$$

The y-intercept (let  $x = 0$ )

$$3(0) + 4y = 500$$

$$4y = 500$$

$$y = 125 \quad (0, 125)$$

The second inequality/line represents:

$$x + y \leq 300$$

The x-intercept (let  $y = 0$ )

$$x + 0 = 300$$

$$x = 300$$

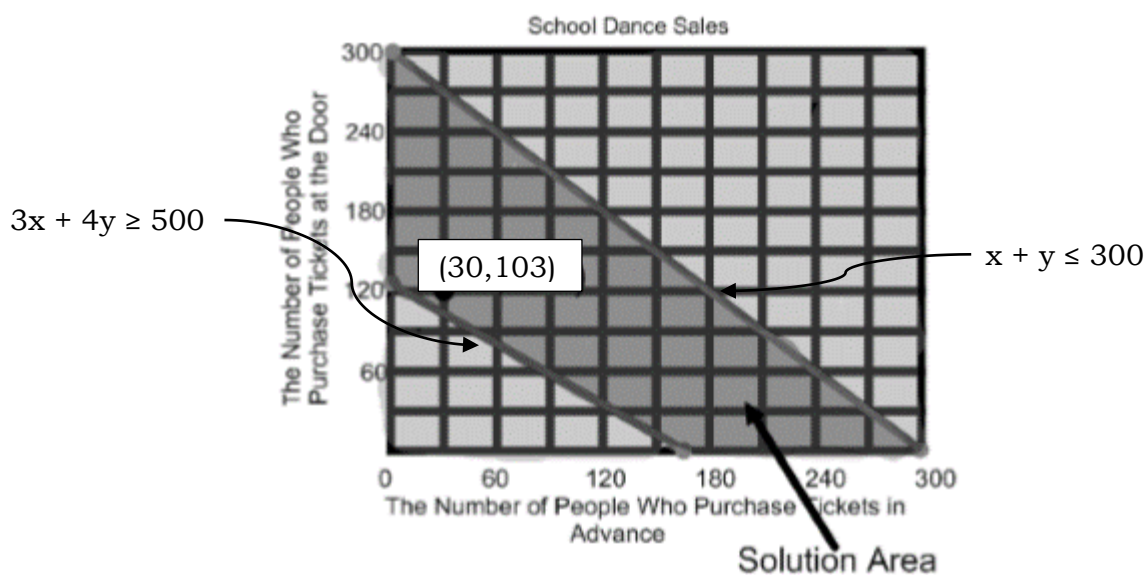
$$(300, 0)$$

The y-intercept (let  $x = 0$ )

$$0 + y = 300$$

$$y = 300$$

$$(0, 300)$$



Graph of the inequalities:  $3x + 4y \geq 500$  and  $x + y \leq 300$

**Step 4.** Identify the intersection which is the solution of the two inequalities and answer the questions that pertain to the problem.

c. According to the graph, if 30 people buy advance tickets, then about 103 would need to buy tickets at the door in order for the 9th graders to make their goal of at least Php500.

Justify:	Substitute:	
$3x+4y \geq 500$	$3x+4y \geq 500$	$x+y \leq 300$
$3(30) + 4y \geq 500$	$3(30) + 4(103) \geq 500$	$30 + 103 \leq 300$
$4y \geq 500 - 90$	$90 + 412 \geq 500$	$133 \leq 300$
$4y \geq 410$	$502 \geq 500$	
$y \geq 102.5 \sim 103$ (since we are talking with individuals)		

### Illustrative Example 2.

As a product output for your performance task in Arts subject, you went to a school supply store to buy heart and circle designs. Heart design cost Php 2 per piece and circle design costs Php 3 per piece. You have no more than Php 30 to spend. You expect to purchase at least 3 pieces of heart design.

- Write a system of inequalities to represent this situation.
- Graph the system of inequalities on the grid.
- Give three possible combinations for buying heart and circle design for your summer balloon party. Justify your answers.

#### Solution:

##### Step 1. Read and Understand the Problem.

Given: Heart design -Php 2

Circle design - Php 3

No more than Php 30 to spend

Purchase at least 3 pieces of balloon with heart design

- We must write two inequalities. We know information about the cost of heart and circle design and about how much heart design you will purchase.

Let  $x$  = the number of pieces of heart design

Let  $y$  = the number of pieces of circle design

##### Step 2. Translate the problem into an inequality in two variables.

Verbal Model:

Cost of heart design + Cost of circle design is no more than Php30

$$\begin{array}{ccccccc} 2x & + & 3y & & \leq & & 30 \\ & & & 2x + 3y \leq 30 & & & \end{array}$$

Purchase at least 3 pieces of heart design

$$x \geq 3 \quad (\text{heart design are greater than or equal to 3 pieces})$$

- Our system of inequalities for this situation is:

$$2x + 3y \leq 30 \quad \& \quad x \geq 3$$

**Step 3.** Draw the graph of both inequalities on a x-y plane. Make sure you use appropriate boundary lines and shade the correct half plane for each inequality.

**b.** Let the first line/inequality represent:

$$2x + 3y \leq 30$$

x intercept: (let  $y = 0$ )

$$2x + 3(0) = 30$$

$$2x = 30$$

$$x = 15 \quad (15, 0)$$

y intercept (let  $x = 0$ )  $2(0) + 3y = 30$

$$3y = 30$$

$$y = 10 \quad (0, 10)$$

Let the second line represent:

$$x \geq 3$$

$x = 3$  – this is a vertical line through the x intercept

$$x = 3.$$

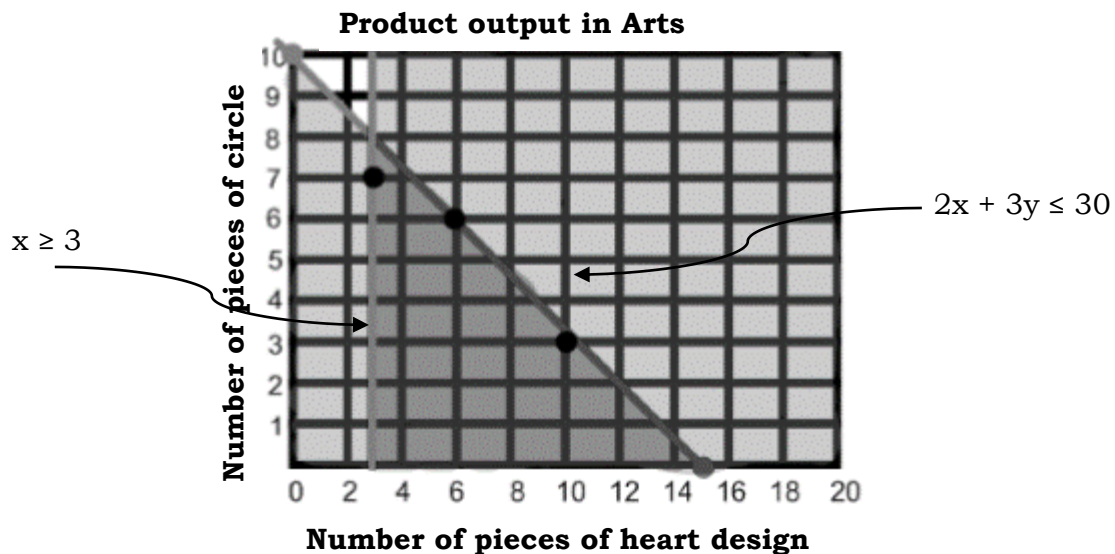


Figure 2. Graph of the inequalities:  $2x + 3y \leq 30$  and  $x \geq 3$

**Step 4.** Identify the intersection which is the solution of the two inequalities and answer the questions that pertain to the problem.

**c.** Three possible combinations for buying heart and circle designs are:

- (3, 7) 3 pieces of heart design and 7 pieces of circle design.

Justify:  $2(3) + 3(7) \leq 30$       &       $x \geq 3$   
 $27 \leq 30$        $3 \geq 3$

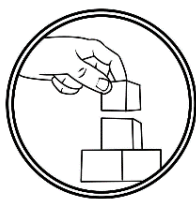
- (6, 6) 6 pieces of heart design and 6 pieces of circle design.

Justify:  $2(6) + 3(6) \leq 30$       &       $x \geq 3$   
 $30 \leq 30$        $6 \geq 3$

- (10, 3) 10 pieces of heart design and 3 pieces of balloon with circle design.

Justify:  $2(10) + 3(3) \leq 30$       &       $x \geq 3$   
 $29 \leq 30$        $10 \geq 3$

Answers will vary. Any ordered pair within the double shaded region is correct.



## Explore

### Activity 1: Watch Your Steps

**Directions:** Complete the solution in solving word problems involving system of linear inequalities in two variables by supplying the required information. Write your answer on a separate sheet of paper.

Jenny is making jewelry for an Arts and Crafts show. She would like to make at least Php100 in sales. She estimates that she will sell at most 50 pieces of jewelry. The bracelets that she is selling cost Php2 and the necklaces cost Php3.

- Write a system of inequalities to represent this situation.
- Graph each inequality on the grid below.
- Give two possible combinations of bracelets and necklaces that can be sold in order for Jenny to meet her goal. Justify your answer.

**Solution:**

**Step 1.** Read and Understand the Problem.

Given:

Let  $x$  represents the \_\_\_\_\_

Let  $y$  represents the \_\_\_\_\_

**Step 2.** Translate the problem into an inequality in two variables.

First inequality: \_\_\_\_\_

Second inequality: \_\_\_\_\_

**Step 3.** Draw the graph of both inequalities on a  $x$ - $y$  plane. Make sure you use appropriate boundary lines and shade the correct half plane for each inequality.

First line/inequality

\_\_\_\_\_

x- intercept

\_\_\_\_\_

\_\_\_\_\_

y-intercept

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Second line/inequality

\_\_\_\_\_

x-intercept

\_\_\_\_\_

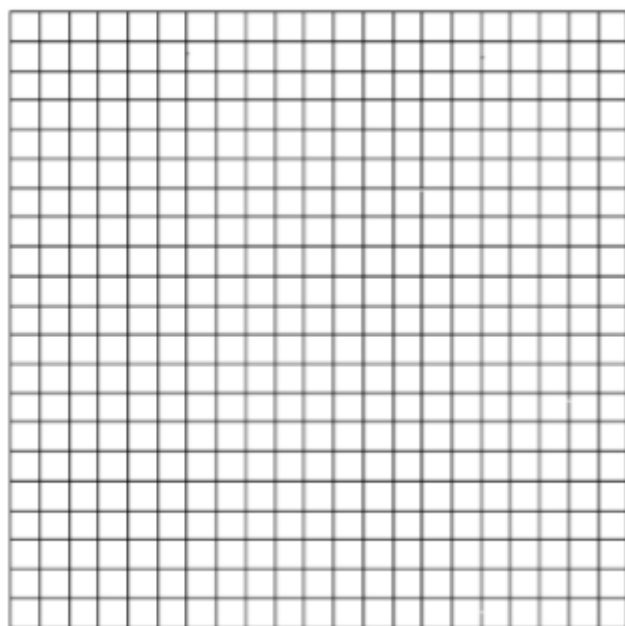
\_\_\_\_\_

y- intercept

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



**Step 4.** Identify the intersection which is the solution of the two inequalities and answer the questions that pertain to the problem.

Two possible combinations/solutions of bracelet and necklace sales

1. (\_\_\_\_, \_\_\_\_ ) Justify: \_\_\_\_\_  
 \_\_\_\_\_
2. (\_\_\_\_, \_\_\_\_ ) Justify: \_\_\_\_\_  
 \_\_\_\_\_

## Activity 2: You Symbolize Me

Below are two different situations, identify and represent the variables and translate the problems into an inequality.

- A.** George wants to rent a hall for an event. There is a maximum of 550 seats. Each adult entrée will cost Php 125 and each child entrée will cost Php75. The hall must make at least Php52,500 for the event.

**Step 1.** Read and Understand the Problem.

Given: \_\_\_\_\_

Let  $x$  represents the \_\_\_\_\_

Let  $y$ ) represents the \_\_\_\_\_

**Step 2.** Translate the problem into an inequality in two variables.

First inequality: \_\_\_\_\_

Second inequality: \_\_\_\_\_

- B.** A clothing manufacture has 1000 yards of cotton to make shirts and pajamas. A shirt requires 1 yard of fabric and a pair of pajamas requires 2 yards of fabric. It takes two hours to make a shirt and 3 hours to make the pajamas, and there are 1600 hours available to make the clothing.

**Step 1.** Read and Understand the Problem.

Given: \_\_\_\_\_

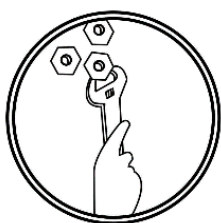
Let  $x$  represents the \_\_\_\_\_

Let  $y$  represents the \_\_\_\_\_

**Step 2.** Translate the problem into an inequality in two variables.

First inequality: \_\_\_\_\_

Second inequality: \_\_\_\_\_



## Deepen

With the illustrative examples you've encountered in this module that depict real-life applications of solving problems involving system of linear inequalities in two variables, let's turn the table around this time.

## Activity: It's Your Turn

Do the following. Use a separate sheet of paper (graphing paper) for your output.

1. Formulate two real-life problems involving system of linear inequalities in two variables.
2. Solve the problems you formulated accurately. Show complete solution then graph.

Be guided with the following rubric:

Points	Indicators
<b>10</b>	The problem is clear, detailed and organized. No grammatical issues. Chose an efficient strategy that made sense and all of the steps in the solution are correct.
<b>8</b>	The problem is clear and detailed with few grammatical issues. Chose a strategy that made sense and a few of the steps in the solution are incorrect.
<b>6</b>	The problem is not clear, not detailed and not organized. Have lots of grammatical issues. The strategy doesn't make sense and most of the solutions are incorrect.





## Gauge

**Directions:** Read each item very carefully. Choose the letter of the correct answer.  
Write your answers on a separate sheet of paper.

For Items 1- 4, refer to the given problem below.

Zoe plans to knit a scarf. She wants the scarf to be more than 1 but less than 1.5 feet wide (**x**), and more than 6 but less than 8 feet long (**y**).

1. Write the statement as linear inequality in two variables the width of the scarf.  
A.  $1 > x > 1.5$   
B.  $1 < x > 1.5$   
C.  $1 > x < 1.5$   
D.  $1 < x < 1.5$
2. Write the statement as linear inequality in two variables the length of the scarf.  
A.  $6 < y < 8$   
B.  $6 < y > 8$   
C.  $6 > y < 8$   
D.  $6 > y > 8$
3. If you are going to graph Zoe's scarf, where can you find the graph?  
A. Quadrant I  
B. Quadrant II  
C. Quadrant III  
D. Quadrant IV
4. Which of the following ordered pair is a solution for Zoe's scarf?  
A. (1, 6)  
B. (1.2, 7)  
C. (1.5, 8)  
D. (1.3, 8)
5. You can work at most 20 hours next week. You need to earn at least Php 920 to cover your weekly expenses. Your dog-walking job (**d**) pays Php 75 per hour and your job as a car wash attendant (**c**) pays Php 60 per hour. What system of linear inequalities models this situation?  
A.  $\begin{cases} d + c \geq 20 \\ 75d + 60c \geq 920 \end{cases}$   
B.  $\begin{cases} d + c \leq 20 \\ 75d + 60c \geq 920 \end{cases}$   
C.  $\begin{cases} d + c \geq 20 \\ 75d + 60c \leq 920 \end{cases}$   
D.  $\begin{cases} d + c \leq 20 \\ 75d + 60c \leq 920 \end{cases}$
6. Which of the following real-life situations is an inequality?  
A. The population of the Philippines is about 103 000 000  
B. The expenses for food is greater than the expenses for clothing  
C. Seven times the number of male teachers is the number of female teachers  
D. According to research, an average adult generates about 4 kg of waste daily
7. Lyn bought three guavas and two oranges. The total amount she paid was at most Php 123. If **x** represent the number of guavas and **y** the number of oranges, which of the following mathematical statements represents the given situation?  
A.  $3x + 2y \geq 123$   
B.  $3x + 2y > 123$   
C.  $3x + 2y \leq 123$   
D.  $3x + 2y < 123$

Lea bought two shirts and a pair of shoes. The total amount she paid for the items is not more than Php 920.

- LU Q2 Mathematics 8 Module 2

14. Below are the steps in solving problems involving system of linear inequalities in two variables. Which of the following is in correct order?

- I. Read and understand the problem
- II. Translate the problem into an inequalities in two variables
- III. Draw the graph of both inequalities on a x-y plane. Make sure you use appropriate boundary lines and shade the correct half plane for each inequality.
- IV. Identify the intersection which is the solution of the two inequalities and answer the questions that pertain to the problem.

A. I, II, III, IV

B. I, III, IV, II

C. I, III, II, IV

D. II, I, III, IV

15. Paul earns Php 7 per hour at the bagel shop and Php 12 per hour mowing lawns. Paul needs to earn at least Php 120 per week, but he must work less than 30 hours per week. What system of linear inequalities describes this situation?

A. 
$$\begin{cases} 7x + 12y \geq 120 \\ x + y < 30 \end{cases}$$

C. 
$$\begin{cases} 7x + 12y \leq 120 \\ x + y < 30 \end{cases}$$

B. 
$$\begin{cases} 7x + 12y > 120 \\ x + y < 30 \end{cases}$$

D. 
$$\begin{cases} 7x + 12y < 120 \\ x + y < 30 \end{cases}$$

*Congratulations for a job well done! Keep it up in your next endeavor.*

## ***References***

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### **LINKS**

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- "Systems of Inequalities Word Problems" Algebra-class.com, December 2020 [https://8theastviewmath.weebly.com/uploads/1/0/6/4/106446071/graphing\\_systems\\_of\\_inequalities\\_word\\_problems\\_ws.pdf](https://8theastviewmath.weebly.com/uploads/1/0/6/4/106446071/graphing_systems_of_inequalities_word_problems_ws.pdf)
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