8

MATHEMATICS

Quarter 2 - Module 1
Linear Inequalities in Two Variables

AIRs - LM

MATHEMATICS 8
Quarter 2 - Module 1: Linear Inequalities in Two Variables
Second Edition, 2021

Development Team of the Module

Author: John Michael L. Ordinario
Editor: SDO La Union, Learning Resource Quality Assurance Team
Illustrator: Ernesto F. Ramos, Jr.
Content Reviewers: Joel C. Garcia and Virginia G. Acas
Language Reviewers: John Michael L. Ordinario and Lorna M. Tampos
Design and Layout: Frances Mae E. Rimando

Management Team:

Atty. Donato D. Balderas, Jr.
Schools Division Superintendent
Vivian Luz S. Pagatpatan, PhD
Assistant Schools Division Superintendent
German E. Flora, PhD, *CID Chief*
Virgilio C. Boado, PhD, *EPS in Charge of LRMS*
Erlinda M. dela Peña, EdD, *EPS in Charge of Mathematics*
Michael Jason D. Morales, *PDO II*
Claire P. Toluyen, *Librarian II*

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Department of Education – SDO La Union
Office Address: Flores St. Catbangen, San Fernando City, La Union
Telefax: 072 – 205 – 0046
Email Address: launion@deped.gov.ph

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MATHEMATICS

Quarter 2-Week 1 Module 1: Linear Inequalities in Two Variables

DepED
DEPARTMENT OF EDUCATION

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 will help you understand the key concepts of Linear Inequalities in Two Variables. Moreove, you' ll find out how these mathematics concepts are used in solving real-life problems. In all lessons, you are given the opportunity to use your prior knowledge and skills in linear inequalities in one variable. Activities are also given to process your knowledge and skills acquired, deepen and transfer your understanding of the different lessons. The scope of this modules enables you to use it in many different learning situations. The lesson are arranged to follow the standard sequence of the course. But in order in which you read them can be changed to corresponds with the textbooks you are using.

This module contains the following lessons:

- Linear Inequalities and Equations in Two Variables
- Graphing Linear Inequalities in Two Variables
- Solving Problems involving Linear Inequalities in Two Variables

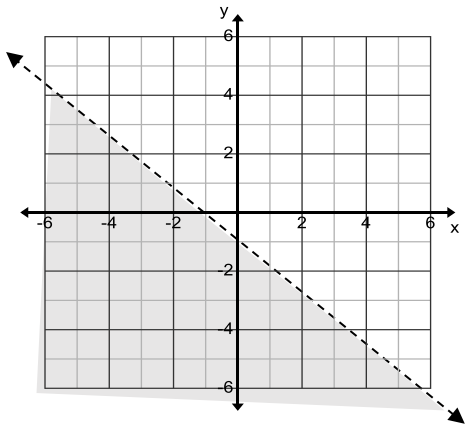
After going through this module, you are expected to

1. differentiate linear inequalities in two variables from linear equations in two variables **(M8AL-IIa-2)**;
2. illustrate and graph linear inequalities in two variables **(M8AL-IIa-3)**; and
3. solve problems involving linear inequalities in two variables **(M8AL-IIa-4)**.

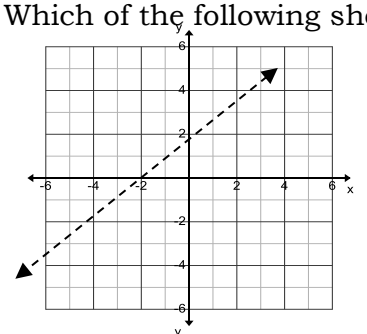
Pretest

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

1. Which of the following is a linear inequality in two variables?
   A. $2x - 4y = 6$ B. $6t + 3 < 15$ C. $3s \leq 14$ D. $15 + 2h \geq 3j$
2. How many solutions does a linear inequality in two variables have?
   A. 0 B. 1 C. 2 D. infinite
3. What is the graph of linear inequalities in two variables?
   A. Half-plane B. Half of a parabola C. Parabola D. Straight line
4. Which of the following ordered pairs is a solution of the inequality $3x + 4y \leq 12$?
   A. (0, 0) B. (2, 2) C. (4, 4) D. (6, 6)
5. In the inequality $x + 2y \leq 6$, what could be the values of d if $x = 5$?
   A. $y \leq -1/2$ B. $y \geq -1/2$ C. $y \leq 1/2$ D. $y \geq 1/2$
6. What linear inequality is represented by the graph?
   A. $-x - y > 1$ B. $-x - y < 1$ C. $-x + y > 1$ D. $-x + y < 1$



7. Which of the following shows the plane divider of the graph of $y + x \leq 4$?

A.


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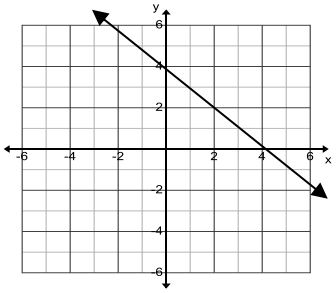

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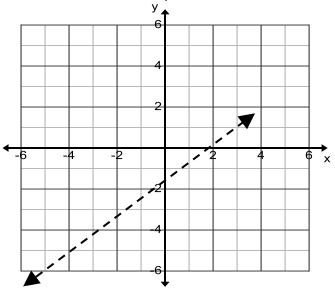

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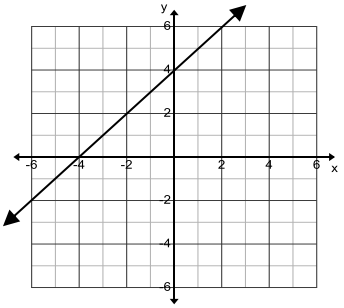
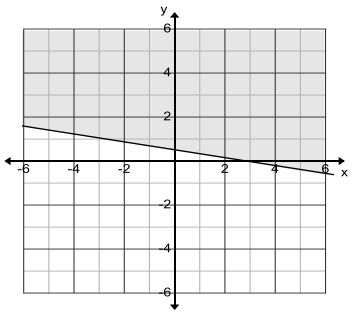


8. The Mathematics Club of Masagana National High School is raising at least Php 12,000 for their future activities. Its members are selling pad papers and pens to their school- mates. To determine the income that they generate, the treasurer of the club was asked to prepare an interactive graph which shows the costs of the pad papers and pens sold. Which of the following sketches of the interactive graph the treasurer may present?(note: 1 unit = Php 2,000)

A.



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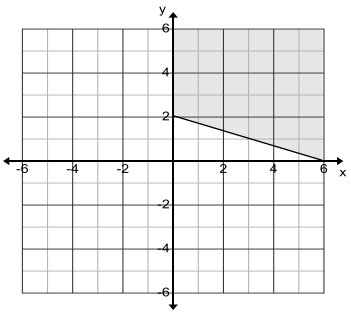

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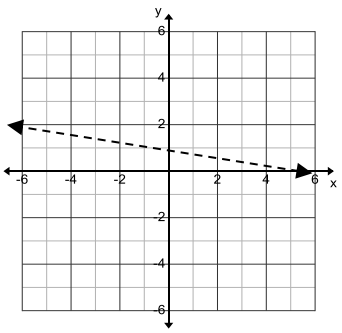
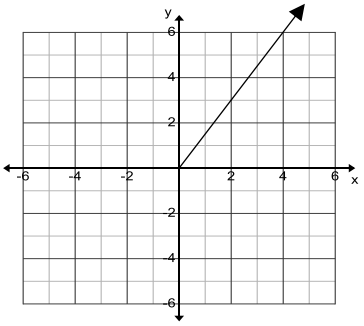
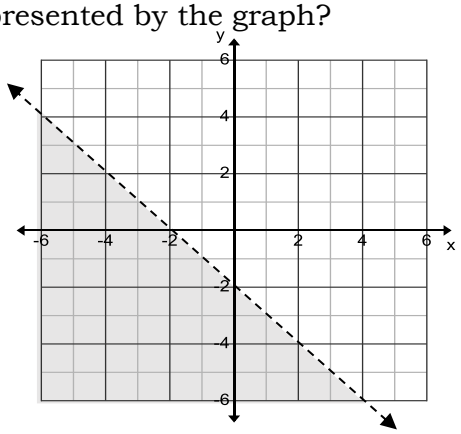


D.

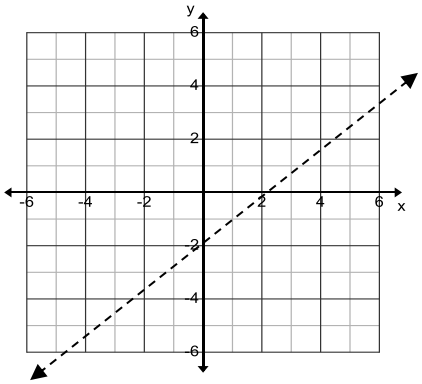


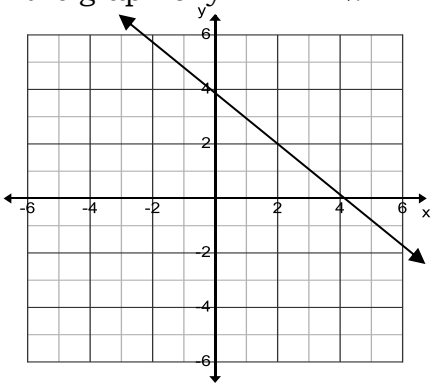
9. What linear inequality is represented by the graph?

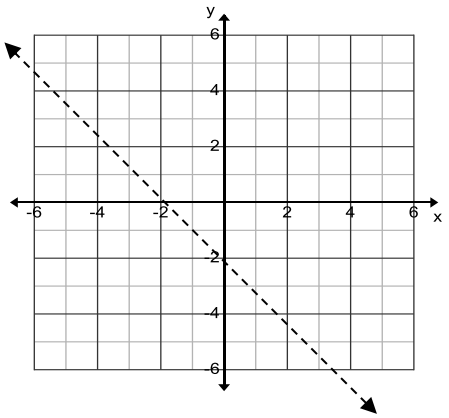
A. x – y > 2
B. x – y < 2
C. -x - y > 2
D. -x - y < 2

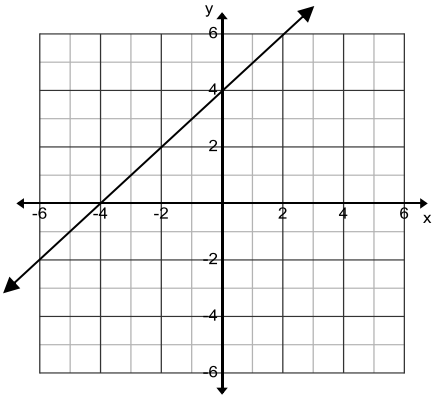


10. Which of the following shows the plane divider of the graph of y + x > -2?

A. 

B. 

C. 

D. 

11. A restaurant owner would like to make a model which he can use as guide in writing a linear inequality in two variables. He will use the inequality 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. Which of the following models should he make and follow?

I. $Ax + By \leq C$
II. $Ax + By = C$
III. $Ax + By \geq C$

A. I and II B. I and III C. II and III D. I, II, and III

12. Jonel bought three apples and two oranges. The total amount she paid was at most Php 123. If x represents the cost of each apple and y represents the cost of each orange, 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. $3x + 2y < 123$

13. The total amount Cora paid for 2 kilos of beef and 3 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

14. Adeth has some Php 10 and Php 5 coins. The total amount of these coins is at most Php 750. Suppose there are 50 Php 5-coins. Which of the following is true about the number of Php 10-coins?

I. The number of Php 10-coins is less than the number of Php 5-coins.

II. The number of Php 10-coins is more than the number of Php 5-coins.

III. The number of Php 10-coins is equal to the number of Php 5-coins.

A. I and II B. I and III C. II and III D. I, II, and III

15. The difference between the scores of Connie and Minnie in the test is not more than 6 points. Suppose Connie's score is 32 points, what could possibly be the score of Minnie?

A. 20 B. 30 C. 40 D. 50

Jumpstart

Activity 1: WHEN DOES LESS BECOMES MORE?

Directions: Supply each phrase with what you think the most appropriate word. Explain your answer briefly.

1. Less money, more _____
2. More profit, less _____
3. More smile, less _____
4. Less make-up, more _____
5. More peaceful, less _____
6. Less talk, more _____
7. More harvest, less _____
8. Less work, more _____
9. Less trees, more _____
10. More savings, less _____

Questions

a. How did you come up with your answer?

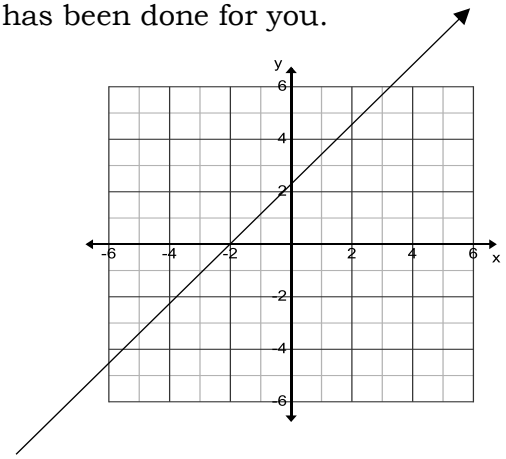
b. How did you know that the words are appropriate for the given phrases?

c. When do we use the word "less"? How about "more"?

d. When does less really become more? e. How do you differentiate the meaning of "less" and "less than"? How are these terms used in Mathematics?

Activity 2: ABOVE, BELOW AND ON THE LINE!

Directions: Graph the line y = x + 3. Plot the points and tell whether each point lies on the line, above the line, or below the line. Complete the table given by putting a check mark under the column where the given point lies. Number 1 has been done for you.



	Point	On the line	Above the line	Below the line
1	(-5, 1)			
2	(1, -2)			
3	(-2, 4)			
4	(0, 1)			
5	(0, 3)			
6	(2, 3)			
7	(-1, 4)			
8	(3, 5)			
9	(5, 5)			
10	(-3, 0)			

Discover

Linear Inequalities and Equations in Two Variables

An equation or inequality may contain one or more variables. In Grade 7 Mathematics, we studied linear (first degree) equation and inequalities in one variable. Let us now consider linear equations and linear inequalities in two variables.

A **linear equation** in two variables has the standard form:

$$Ax + By = C$$

where A, B, and C are real numbers and A and B are not both equal to zero.

Examples:

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

A **linear inequality** in two variables is an inequality that can be written in one of the following forms:

$$Ax + By < C$$
$$Ax + By \leq C$$
$$Ax + By > C$$
$$Ax + By \geq C$$

where A, B, and C are real numbers and A and B are not both equal to zero.

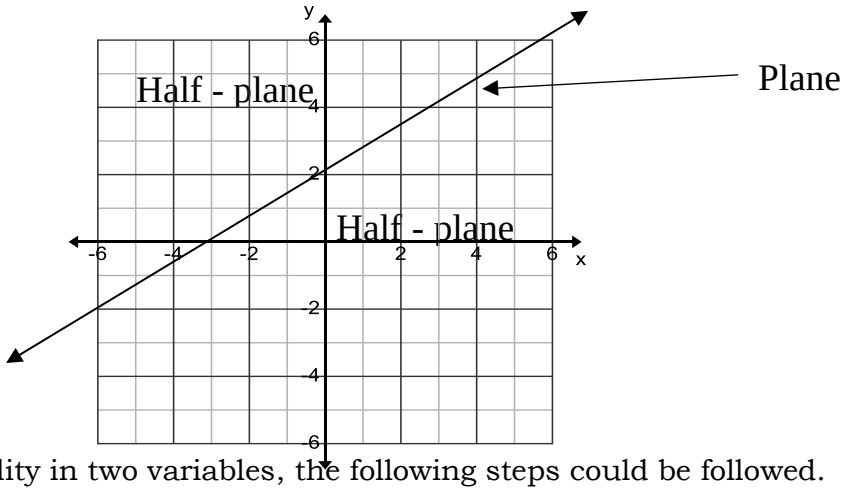
Examples:

1. $4x - y > 1$	2. $8x - 3y \geq 14$	3. $x + 5y \leq 9$
4. $2y > x - 5$	5. $3x + 7y < 2$	6. $y \leq 6x + 11$

In equations and inequalities in two variables, the exponent of each variable must be equal to 1. Also, we cannot have a term which contains the product or quotient of the two variables.

Graphing Linear Inequalities in Two Variables

The graph of a linear inequality in two variables is the set of all points in the rectangular coordinate system whose ordered pairs satisfy the inequality. When a line is graphed in the coordinate plane, it separates the plane into two regions called **half- planes**. The line that separates the plane is called the **plane divider**.



To graph an inequality in two variables, the following steps could be followed.

1. Replace the inequality symbol with an equal sign. The resulting equation becomes the plane divider.

   Examples:

   a. $y > x + 4$ → $y = x + 4$

b. $y < x - 2$ ⟹ $y = x - 2$

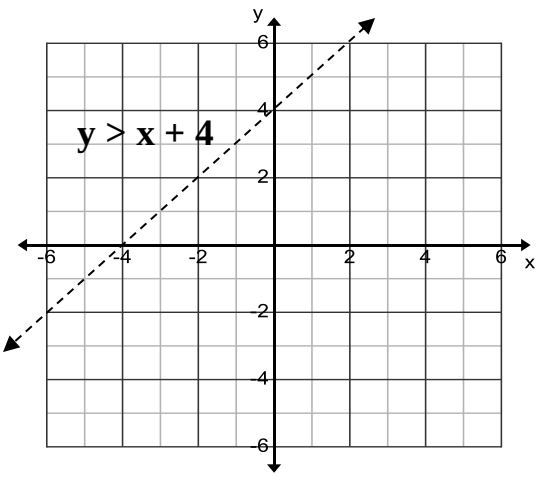
c. $y \geq -x + 3$ ⟹ $y = -x + 3$

d. $y \leq -x - 5$ ⟹ $y = -x - 5$

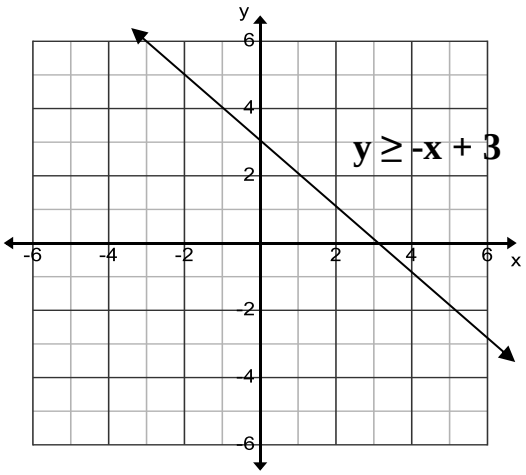
2. Graph the resulting equation with a solid line if the original inequality contains ≤ or ≥ symbol. The solid line indicates that all points on the line are part of the solution of the inequality.

   If the inequality contains < or > symbol, use a dash or a broken line. The dash or broken line indicates that the coordinates of all points on the line are not part of the solution set of the inequality.

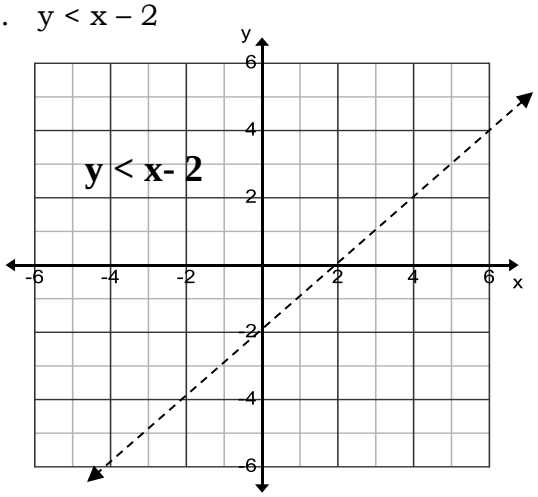
a. $y > x + 4$



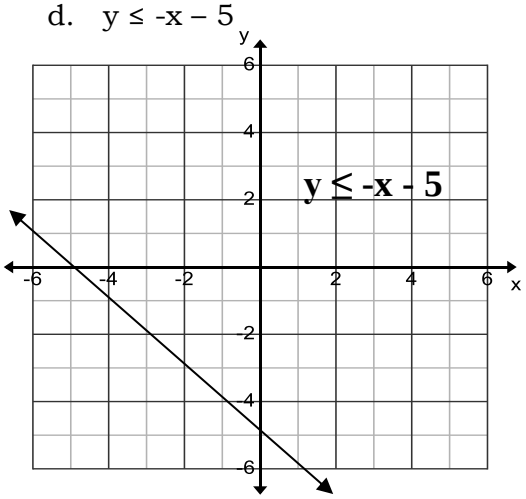
b. $y \geq -x + 3$



c. $y < x - 2$

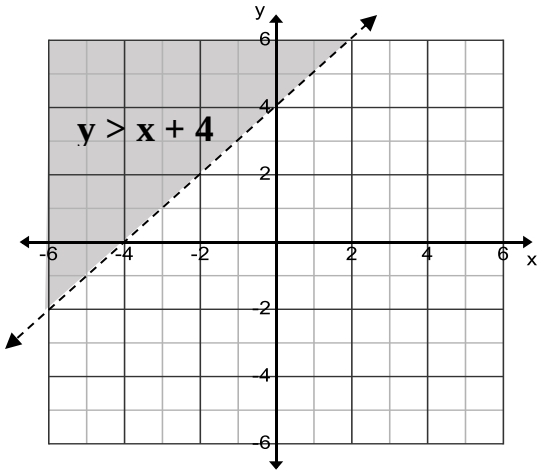


d. $y \leq -x - 5$



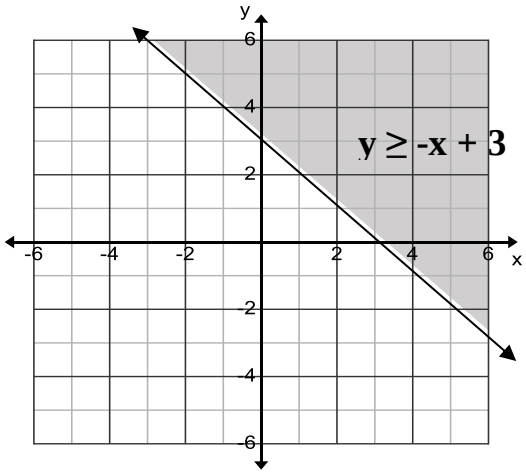
3. Choose three points in one of the half-planes that are not on the line. Substitute the coordinates of these points into the inequality. If the coordinates of these points satisfy the inequality or make the inequality true, shade the half-plane or the region on one side of the plane divider where these points lie. Otherwise, the other side of the plane divider will be shaded.

a. $y > x + 4$



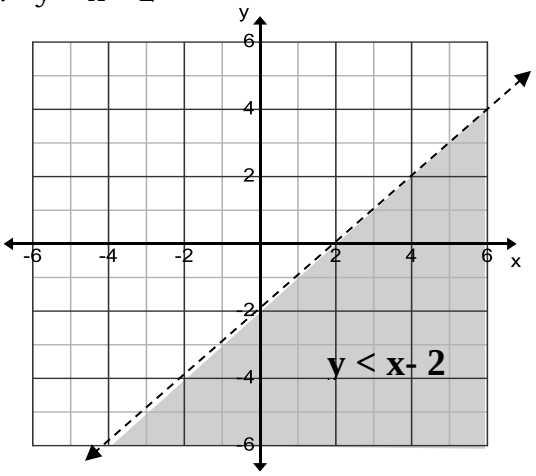
For example, points (0, 3), (2, 2), and (4, -5) do not satisfy the inequality $y > x + 4$. Therefore, the half-plane that does not contain these points will be shaded. The shaded portion constitutes the solution of the linear inequality.

b. $y \geq -x + 3$



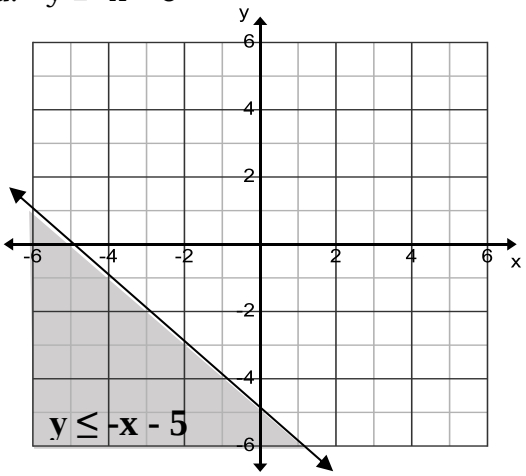
For example, points (-2, 8), (0, 7), and (8, -1) satisfy the inequality $y \geq -x + 3$. Therefore, the half-plane containing these points will be shaded. The shaded portion constitutes the solution of the linear inequality.

c. $y < x - 2$



For example, points (0, 5), (-3, 7), and (2, 10) do not satisfy the inequality $y < x - 2$. Therefore, the half-plane that does not contain these points will be shaded. The shaded portion constitutes the solution of the linear inequality.

d. $y \leq -x - 5$



For example, points (12, -3), (0, -9), and (3, -11) satisfy the inequality $y \leq -x - 5$. Therefore, the half-plane containing these points will be shaded. The shaded portion constitutes the solution of the linear inequality.

Solving Problems involving Linear Inequalities in Two Variables

Certain situations in real life can be modeled by linear inequalities.

Examples:

1. The total amount of 1-peso coins and 5-peso coins in the bag is more than Php 150.
   - The situation can be modeled by the linear inequality $x + 5y > 150$, where x is the number of 1-peso coins and y is the number of 5-peso coins.

2. Emily bought two blouses and a pair of pants. The total amount she paid for the items is not more than Php 980.
   - The situation can be modeled by the linear inequality $2x + y \leq 980$, where x is the cost of each blouse and y is the cost of a pair of pants.

The solutions of linear inequalities in x and y can be expressed in ordered pairs (x,y). An ordered pair (x, y) is a solution of am inequality in x and y if a true statement results when the variable in the equality is replaced by the coordinates of the ordered pair.

In the first example, if there are five 1-peso coins and fifty 5-peso coins, the ordered pair will be (5, 50). Substitute this ordered pair in the inequality.

$$x + 5y > 150; \quad (5, 50)$$
$$5 + 5(50) > 150$$
$$5 + 250 > 150$$
$$255 > 150.$$

Since 255 is more than 150, which is a true statement, then the ordered pair (5, 50) can be a solution to the linear inequality $x + 5y > 150$.

Explore

Activity 3: WHAT AM I?

Directions: Determine whether the following situations is an equation or an inequality and then write its equation or the inequality model in the appropriate column.

Real-Life Situations	Classification (Equation or Inequality)	Inequality Model
1. The value of one Philippine peso (p) is less than the value of one US dollar (d).		
2. According to the NSO, there are more female (f) Filipinos than male (m) Filipinos.		
3. The number of girls (g) in the band is one more than twice the number of boys (b).		
4. The school bus has a maximum seating capacity (c) of 80 persons.		
5. According to research, an average adult generates about 4 kg of waste daily (w).		
6. To get a passing mark in school, a student must have a grade (g) of at least 75.		
7. The daily school allowance of Jillean (j) is less than the daily school allowance of Gwyneth (g).		
8. Seven times the number of male teachers (m) is the number of female teachers (f).		
9. The expenses for food (f) is greater than the expenses for clothing (c).		
10. The population (p) of the Philippines is about 103 000 000.		

Questions:

1. How do you describe the situations in 3, 5, 8, and 10? How about the situations in 1, 2, 4, 6, 7, and 9?

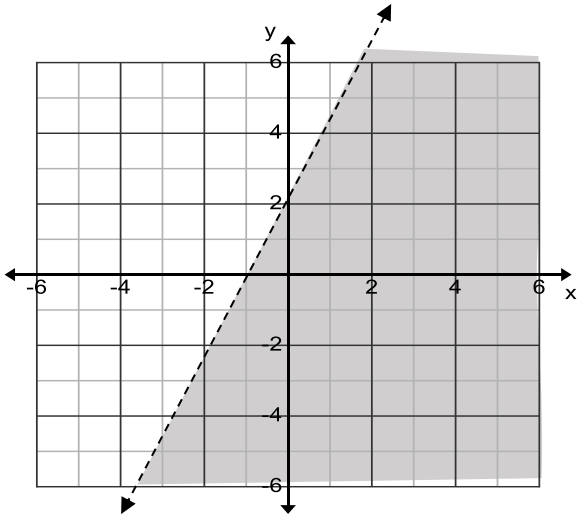
2. How do the situations in 3, 5, 8, and 10 differ from the situations in 1, 2, 4, 6, 7, and 9?

3. What makes linear inequality different from linear equations? 4. How can you use equations and inequalities in solving real-life problems?

Activity 4: COME AND TEST ME!

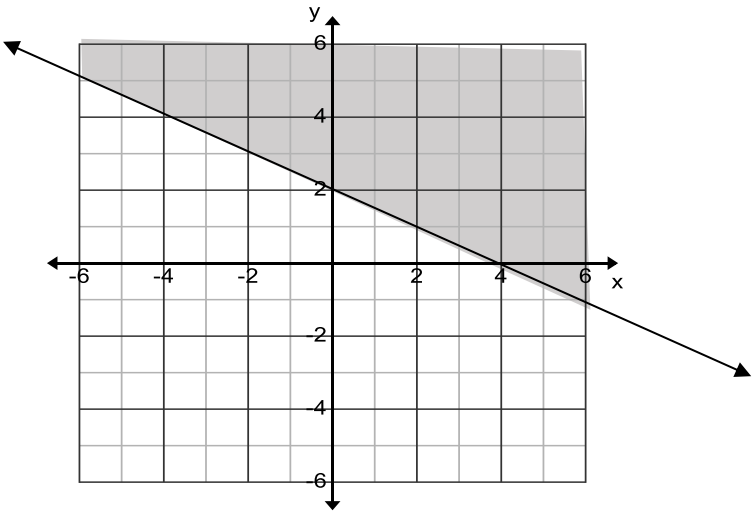
Directions: Tell which of the given coordinates of points satisfy the inequality. Justify your answer.

1. $y < 2x + 2$



____a. (0, 2)
____b. (5, 1)
____c. (-4, 6)
____d. (8, -9)
____e. (-3, -12)

2. $3x \geq 12 - 6y$



___a. (1, -1)
___b. (4, 0)
___c. (6, 3)
___d. (0, 5)
___e. (-2, 8)

Questions:

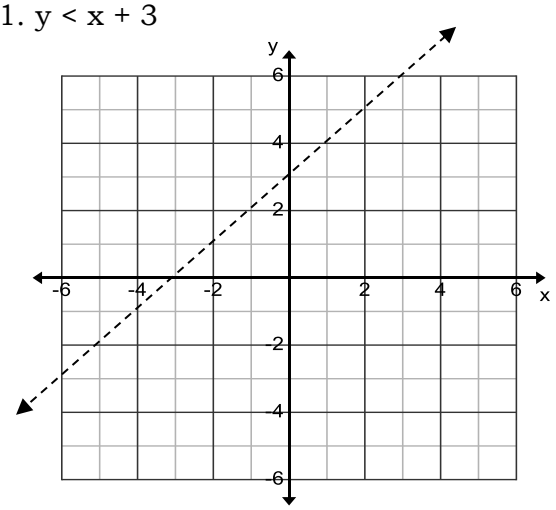
1. How did you determine if the given coordinates of points on the graph satisfy the inequality?

2. What did you do to justify your answer?

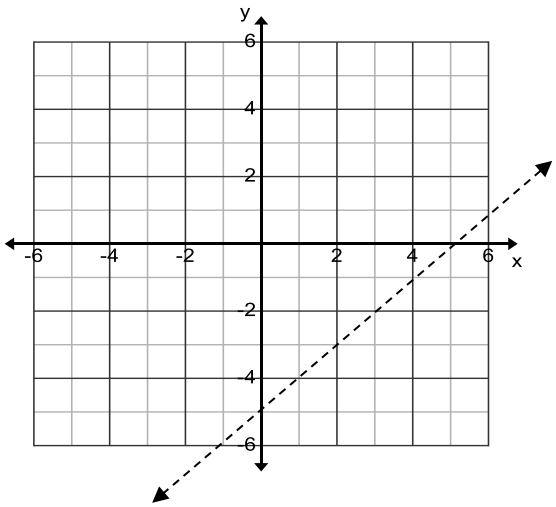
Activity 5: COLOR ME!

Directions: Illustrate the graph of the following inequalities by shading the appropriate side of the plane divider where the solutions of the inequality are found.

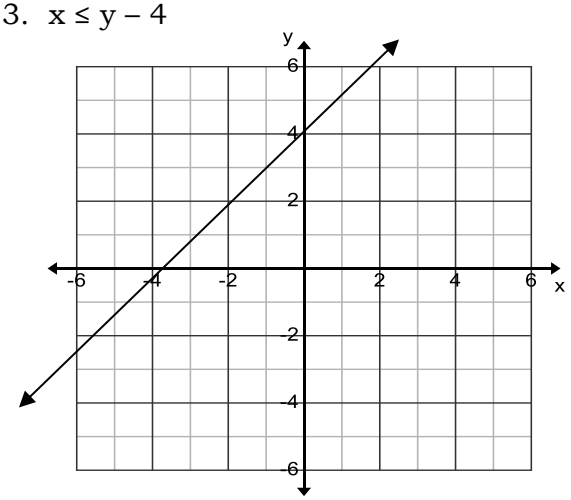
1. $y < x + 3$



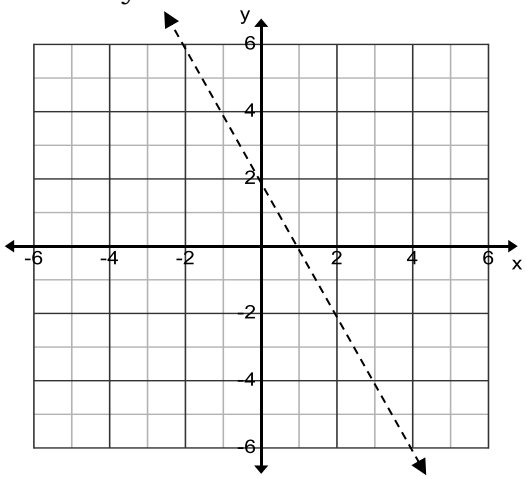
2. $y - x > -5$



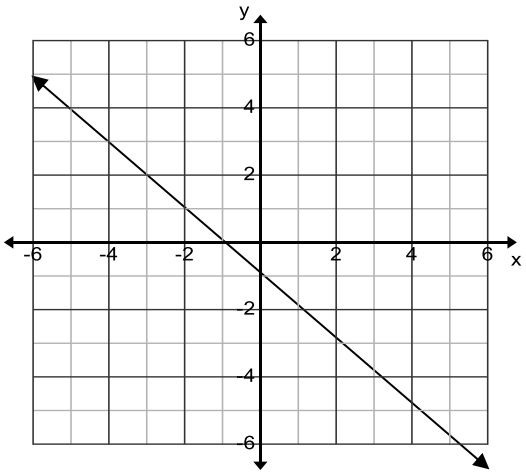
3. $x \leq y - 4$



4. $2x + y < 2$

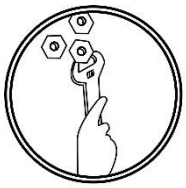


5. $x + y \geq 1$



Questions:

1. How did you determine the part of the plane to be shaded?
2. Suppose a point is located on the plane where the graph of a linear inequality is drawn. How do you know if the coordinates of this point is a solution of the inequality?
3. Give at least 5 solutions for each linear inequality.



Deepen

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Activity 6: GRAPH AND TELL!

Directions: Show and illustrate the graph on Cartesian plane and describe the solutions of each of the following inequalities.

1. $y > 4x$
2. $y > x + 2$
3. $3x + y \leq 5$
4. $y < 1\ 3\ x$
5. $x - y < -2$

Questions:

1. How did you graph each of the linear inequalities?
2. How do you describe the graphs of linear inequalities in two variables?
3. Give at least 3 solutions for each linear inequality.
4. How did you determine the solutions of the linear inequalities?

Activity 7: TRANSLATE ME!

Directions: Write each statement as a linear inequality in two variables.

Statement	Linear Inequality Model
1. The sum of 20-peso bills (t) and fifty-peso bills (f) is greater than Php 420.	
2. The difference between the weight of Diana (d) and Princess (p) is at least 26.	
3. Five times the length of a ruler (r) increased by 2 inches is less than the height of Daniel (h).	
4. In a month, the total amount the family spends for food (f) and educational expenses (e) is at most Php 8,000.	
5. The price of a motorcycle (m) less Php 36,000 is less than or equal to the price of a bicycle (b).	

6. A dozen of short pants (s) added to half a dozen of pajamas (p) has a total cost of not greater than Php 960.	
7. The difference of the number of 300-peso tickets (p) and 200-peso tickets (q) is not less than 30.	
8. Thrice the number of red balls (r) is less than the number of blue balls (b).	
9. The number of apples (a) more than twice the number of ponkans (p) is greater than 24.	
10. Nicole bought 2 blouses (b) and 3 shirts (s) and paid not more than Php 1,150.	

Questions:

1. How did you translate the given situations into linear inequalities?
2. When do we use the term "at most"? How about "at least"?
3. What other terms are similar to "at most"? How about "at least"?
4. Give at least two statements that make use of these terms.
5. In what real-life situations are the terms such as "at most" and "at least" used?

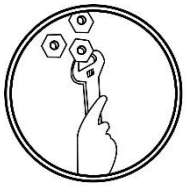
Activity 8: WHAT'S YOUR POINT?

Directions: State whether each given ordered pair is a solution of the inequality. Write **S** if the ordered pair is a solution, otherwise, write **NS**. Justify your answer.

1. $2x - y > 10$; (7, 2)
2. $x + 3y \leq 8$; (4, -1)
3. $y < 4x - 5$; (0, 0)
4. $7x - 2y \geq 6$; (-3, -8)
5. $16 - y > x$; (-1, 9)
6. $-3x + y < -12$; (0, -5)
7. $9 + x \geq y$; (-6, 3)
8. $2y - 2x \leq 14$; (-3, -3)
9. 1 2 x + y > 5; (4, 1 2)
10. 9x + 2 3 y < 2; (1 5 ,1)

Questions:

1. How did you determine if the given ordered pair is a solution of the inequality?
2. What did you do to justify your answer?



Deepen

Activity 9: MAKE IT REAL!

Directions: Answer the following questions. Give your complete solutions or explanations.

1. The difference between Connie's height and Janel's height is not more than 1.5 ft.
   a. What mathematical statement represents the difference in the heights of Connie and Janel? Define the variables used.
   b. Based on the mathematical statement you have given, who is taller? Why?
   c. Suppose Connie's height is 5 ft and 3 in, what could be the height of Janel? Explain your answer.

2. A motorcycle has a reserved fuel of 0.5 liter which can be used if its 3-liter fuel tank is about to be emptied. The motorcycle consumes at most 0.5 liter of fuel for every 20 km of travel.
   a. What mathematical statement represents the amount of fuel that would be left in the motorcycle's fuel tank after traveling a certain distance if its tank is full at the start of travel?
   b. Suppose the motorcycle's tank is full and it travels a distance of 55 km, about how much fuel would be left in its tank?
   c. If the motorcycle travels a distance of 130 km with its tank full, would the amount of fuel in its tank be enough to cover the given distance? Explain your answer.

3. The total amount Jurene paid for 5 kilos of rice and 2 kilos of fish is less than Php 600.
   a. What mathematical statement represents the total amount Jurene paid? Define the variables used.
   b. Suppose a kilo of rice costs Php 35. What could be the greatest cost of a kilo of fish to the nearest pesos?
   c. Suppose Jurene paid more than Php 600 and each kilo of rice costs Php 34. What could be the least amount she will pay for 2 kilos of fish to the nearest pesos?

Gauge

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

1. Which of the following is a linear inequality in two variables?
   A. $4a - 3b = 5$ B. $7c + 4 < 12$ C. $3x \leq 16$ D. $11 + 2t \geq 3s$

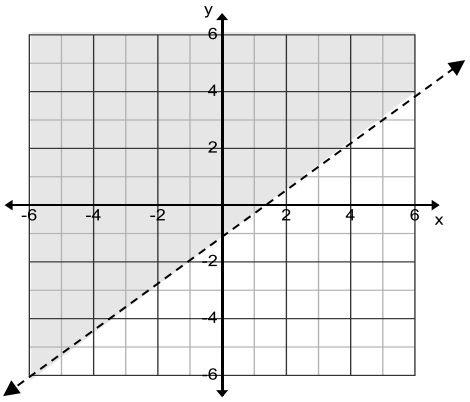
2. How many solutions does a linear inequality in two variables have?
   A. 0 B. 1 C. 2 D. infinite

3. What is the graph of linear inequalities in two variables?
   A. Half-plane B. Half of a parabola C. Parabola D. Straight line

4. Which of the following ordered pairs is a solution of the inequality $2x + 6y \leq 10$?
   A. (3, 1) B. (2, 2) C. (1, 2) D. (1, 0)

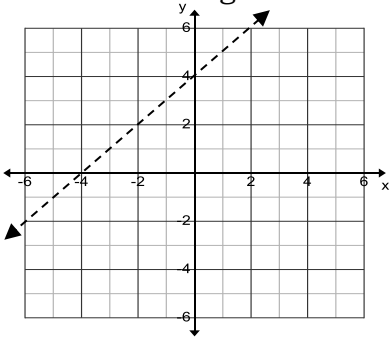
5. In the inequality $c - 4d \leq 10$, what could be the values of d if $c = 8$?
   A. $d \leq -1/2$ B. $d \geq -1/2$ C. $d \leq 1/2$ D. $d \geq 1/2$

6. What linear inequality is represented by the graph?
   A. $x - y > 1$
   B. $-x + y > 1$
   C. $x - y < 1$
   D. $-x + y < 1$



7. Which of the following shows the plane divider of the graph of $y \geq x + 4$?

A.



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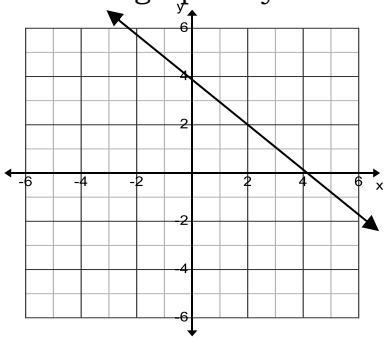

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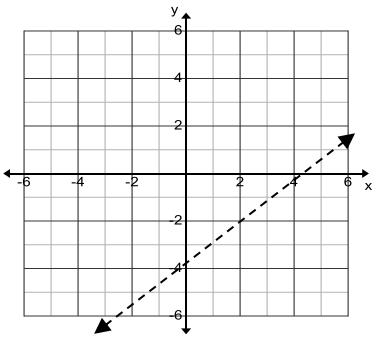
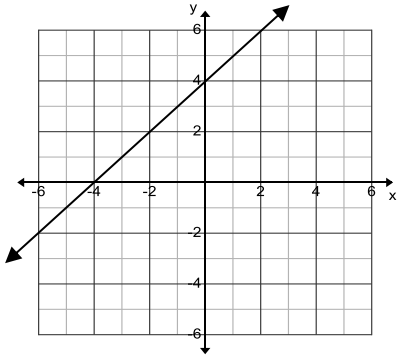
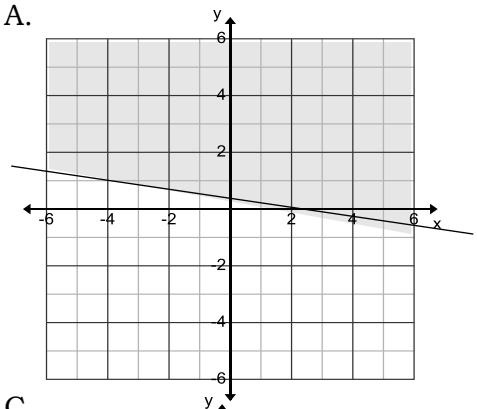


D.



8. The Mathematics Club of Masagana National High School is raising at least Php 12,000 for their future activities. Its members are selling pad papers and pens to their school- mates. To determine the income that they generate, the treasurer of the club was asked to prepare an interactive graph which shows the costs of the pad papers and pens sold. Which of the following sketches of the interactive graph the treasurer may present?(note: 1 unit = Php2,000)

A.



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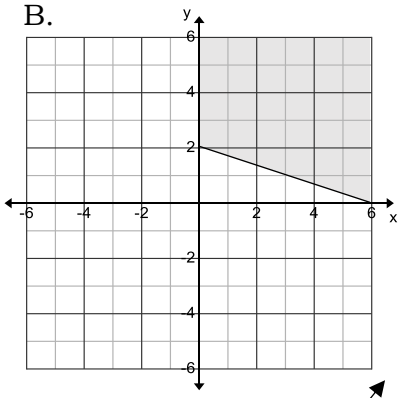
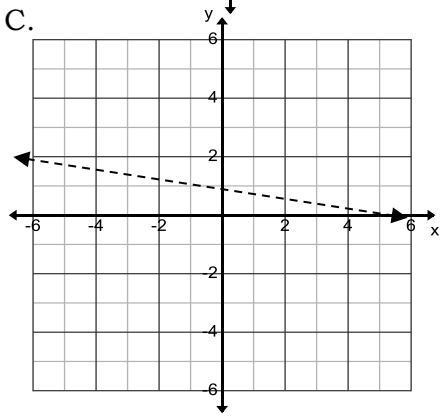
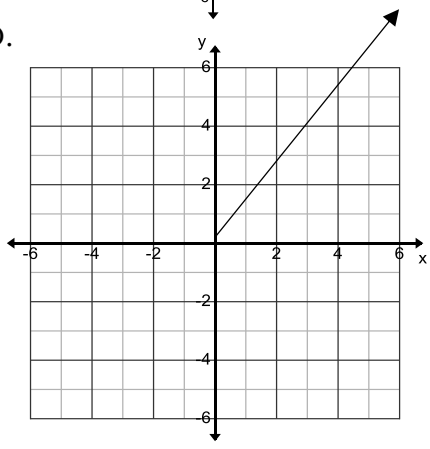


C.

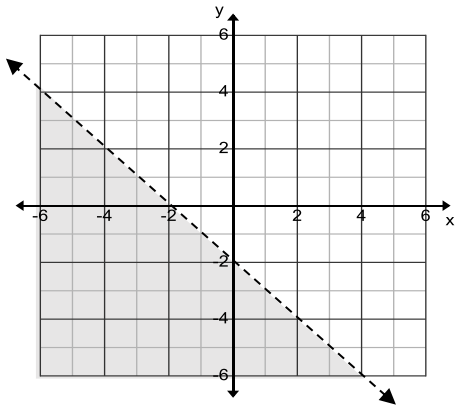


D.



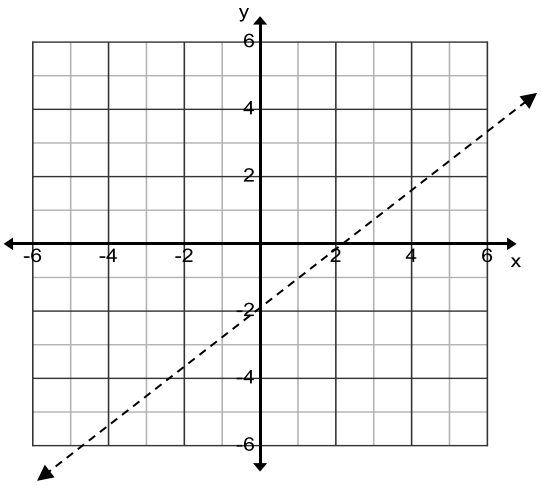
9. What linear inequality is represented by the graph?

A. x – y > 2
B. x – y < 2
C. -x - y > 2
D. -x - y < 2

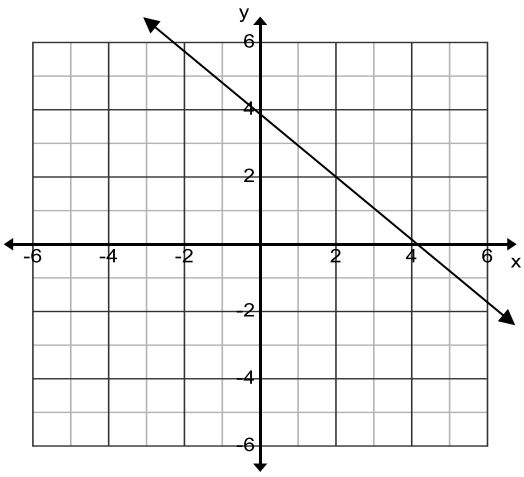


10. Which of the following shows the plane divider of the graph of y > x - 2?

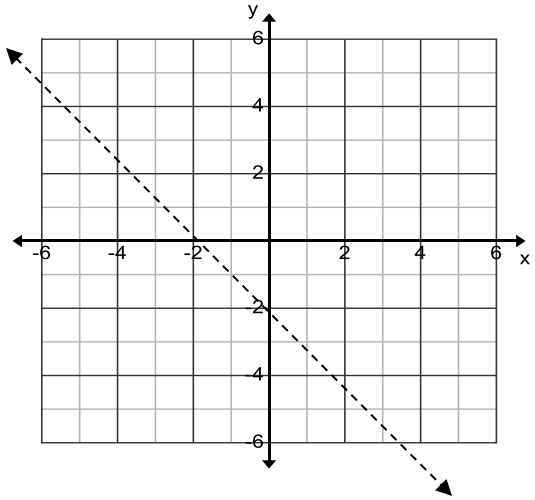
A.



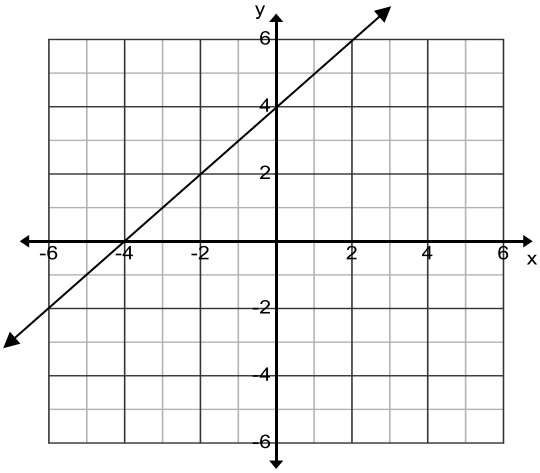
B.



C.



D.



11. Jonel bought three apples and two oranges. The total amount she paid was at most Php 123. If x represents the cost of each apple and y represents the cost of each orange, 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. $3x + 2y < 123$

12. Adeth has some Php 10 and Php 5 coins. The total amount of these coins is at most Php 750. Suppose there are 50 Php 5-coins. Which of the following is true about the number of Php 10-coins?

I. The number of Php 10-coins is less than the number of Php 5-coins.

II. The number of Php 10-coins is more than the number of Php 5-coins.

III. The number of Php 10-coins is equal to the number of Php 5-coins.

A. I and II B. I and III C. II and III D. I, II, and III

13. The difference between the scores of Connie and Minnie in the test is not more than 6 points. Suppose Connie's score is 32 points, what could possibly be the score of Minnie?

A. 20 B. 30 C. 40 D. 50

14. Mary and Rose ought to buy some chocolates and candies. Mary paid Php 198 for 6 bars of chocolates and 12 pieces of candies. Rose bought the same kinds of chocolates and candies but only paid less than Php 100. Suppose each piece of candy costs Php 4, how many bars of chocolates and pieces of candies could Rose have bought?

A. 3 bars of chocolates and 6 pieces of candies

B. 3 bars of chocolates and 8 pieces of candies

C. 4 bars of chocolates and 2 pieces of candies

D. 4 bars of chocolates and 4 pieces of candies

15. Mrs. Roxas gave the cashier Php 500-bill for 3 adult's tickets and 5 children's tickets that cost more than Php 400. Suppose an adult ticket costs Php 75. Which of the following could be the cost of a children's ticket?

A. Php 60 B. Php 45 C. Php 35 D. Php 30

Great job! You are done with this module.

References

A. Books

Emmanuel P. Abuzo, Merden L.Bryant, Jem Boy B.Cabrera, Belen P. Caldez, Melvin M. Callanta, Anastacia Proserfina I. Castro, Alicia R. Halabaso, Sonia P. Javier, Roger T. Nocom, and Concepcion S. Ternida, (2013), Mathematics Grade 8 Learner's Module, Quezon City, Book Media Press, Inc., and Printwell, Inc.

Orlando A. Oronce, Marilyn O. Mendoza. (2015). Exploring Math 8, Worktext in Mathematics. Sampaloc, Manila: Rex Book Store, Inc.

B. Other References

Hand-outs, DepEd Regional Mass Training on Critical Content on Mathematics 8, May 21-June 1, 2018.

For inquiries or feedback, please write or call:

Department of Education – SDO La Union
Curriculum Implementation Division
Learning Resource Management Section
Flores St. Catbangen, San Fernando City La Union 2500
Telephone: (072) 607 - 8127
Telefax: (072) 205 - 0046
Email Address:
launion@deped.gov.ph
lrm.launion@deped.gov.ph