LESSON 23

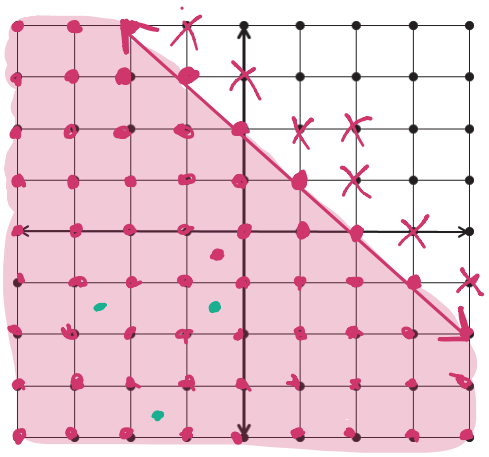
Graphing Linear Inequalities

LEARNING OBJECTIVES

- Today I am: exploring graphs of inequalities with two variables.
- So that I can: write the steps for graphing inequalities.
- I'll know I have it when I can: match inequalities to their graphs.

Exploratory Activity

You will need: a highlighter for this activity.



1. In the coordinate grid at the right, 81 points are marked.

   A. Highlight all the points that make the inequality $x + y \leq 2$ true.

   0 to 0 ≤ 2

   B. Graph the line $x + y = 2$. What do you notice about this line?

   $y = -x + 2$

   C. What does the less than or equal to ($\leq$) symbol do to the graph?

   D. The point $(-3.5, -1.5)$ is also in the solution set of this inequality. Name 3 other points that are in the solution set and mark them on the grid.

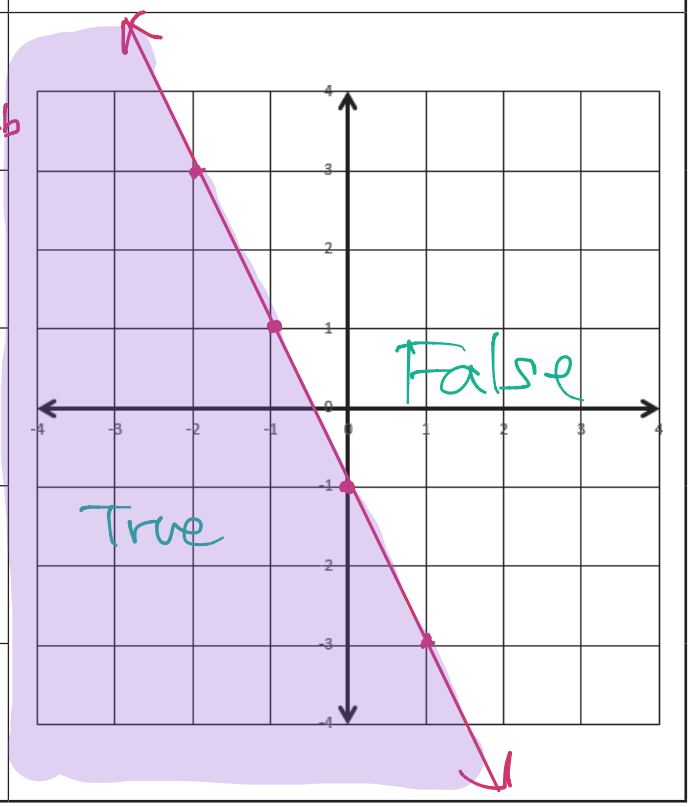
   (1.9, 0.1) (−4, −2.5)

   E. How many other points are in the solution set of this inequality? How can we show these points on the grid?

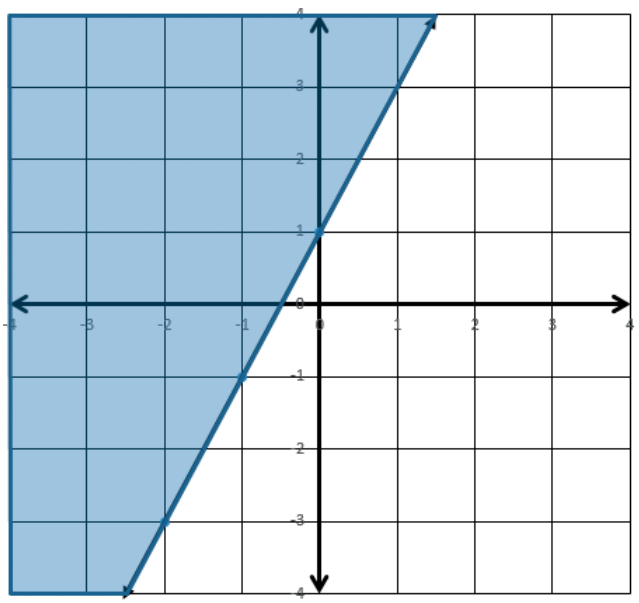
   Infinitely many

2. With your partner, write up the steps to graphing an inequality. Then use your steps to graph the inequality $2x + y \leq -1$.

$-2x \quad -2x \rightarrow y \leq -2x - 1$

Our Steps	Graphing $2x + y \leq -1$
(1) Rearrange the inequality to slope-intercept $y=mx+b$ (2) Graph $y=-2x-1$ $m=\frac{-2}{1}$ $b=-1$ * (3) Decide solid or dashed $\leq$ $\geq$ $<$, $>$ (4) Test (0,0) $y \leq -2x-1$ $0 \leq -1$ False	

3. Crystal graphed the inequality $y \geq 2x + 1$ and described the solution as the points to the ***left*** of the line $y = 2x + 1$.

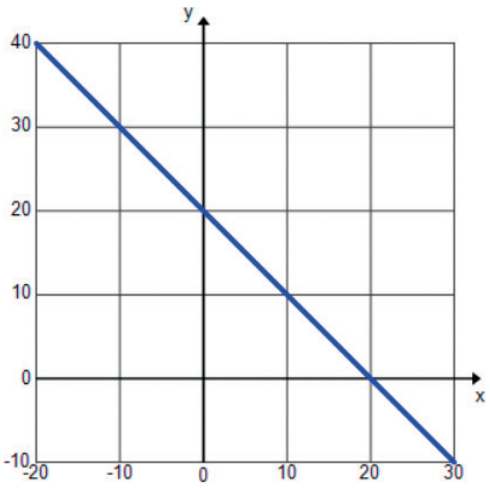


Ryan saw her graph and argued that the points are ***above*** the line.

A. Which do you think is the best way to describe the solution points? Why?

B. What other method could you use to determine where to shade?

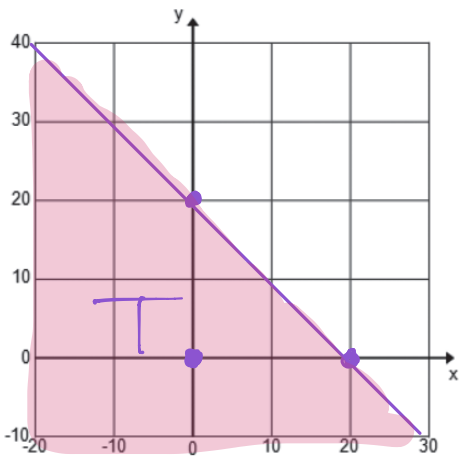
4. The solution to $x + y = 20$ is shown on the graph below.



Solid
≤, ≥
Dashed
<, >

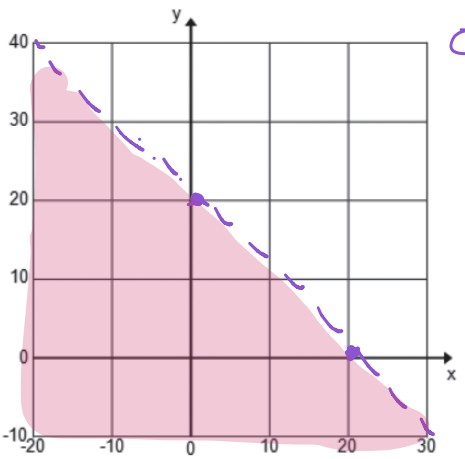
A. Graph the solution to $x + y \leq 20$.

Test (0,0)
0 + 0 ≤ 20
0 ≤ 20
T



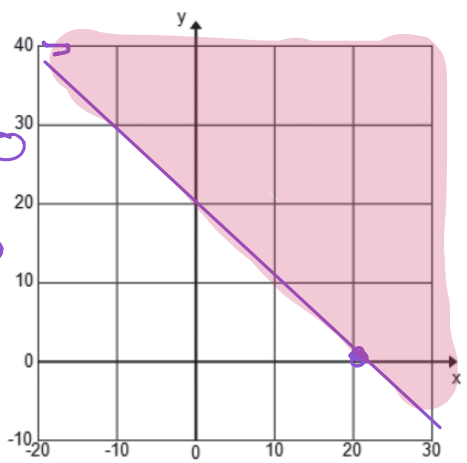
B. Graph the solution to $x + y < 20$.

Test
0 + 0 < 20
0 < 20
T



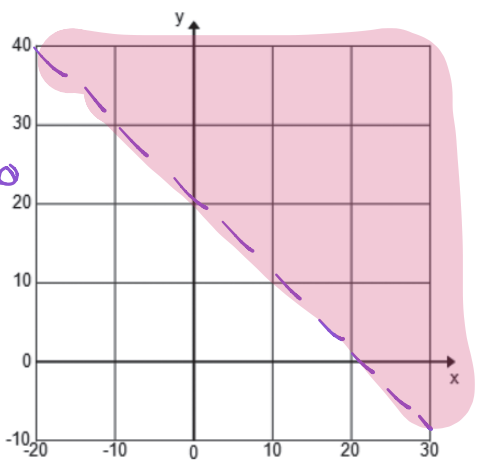
C. Graph the solution to $x + y \geq 20$.

0 + 0 ≥ 20
0 ≥ 20
F



D. Graph the solution to $x + y > 20$.

0 + 0 > 20
0 > 20
F

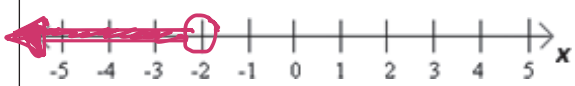
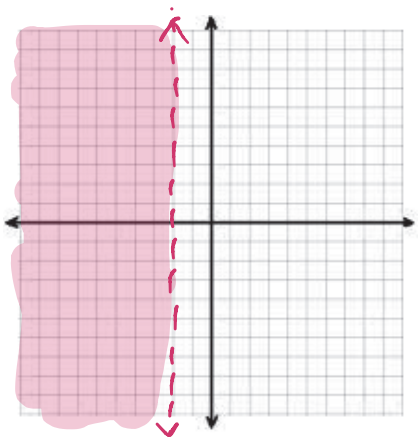


E. Look back at your steps from Exercise 2. Is there anything you need to change or add to your steps based on your work above?

Inequalities with One Variable

5. In Unit 3, you solved and graphed inequalities in one variable on a number line. In this lesson, you are using two variables and graphing on a coordinate plane.

   Graph the solution set to $x < -2$, reading it as an inequality in *one* variable, and describe the solution set in words. Then graph the solution set to $x < -2$ again, this time reading it as an inequality in *two* variables, and describe the solution set in words.

	$x < -2$ as a One Variable Inequality	**$x < -2$ as a Two Variable Inequality**
Graph		
Characteristics of the Graph		

shaded part

6. Describe in words the ***half-plane*** that is the solution to each inequality.

   A. $y \geq 0$

   B. $x > -5$

y=0 x-axis

above x-axis

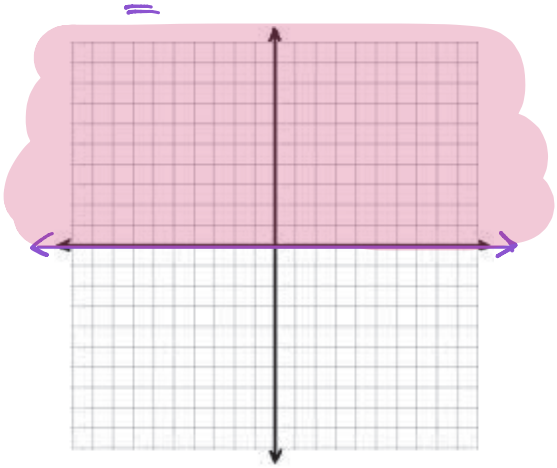
including the x-axis

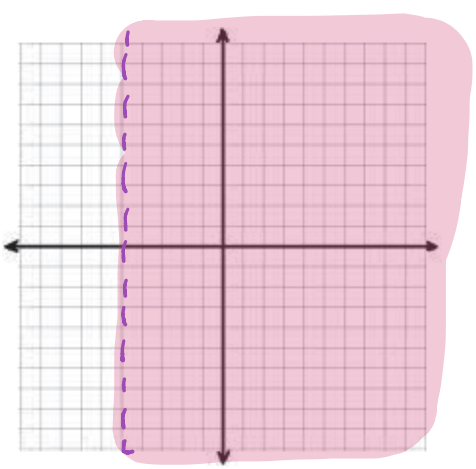
Right half of the line x=-5 not including the line x=-5

7. Graph the solution to each inequality. Was your description from Exercise 6 accurate?

   A. $y \geq 0$

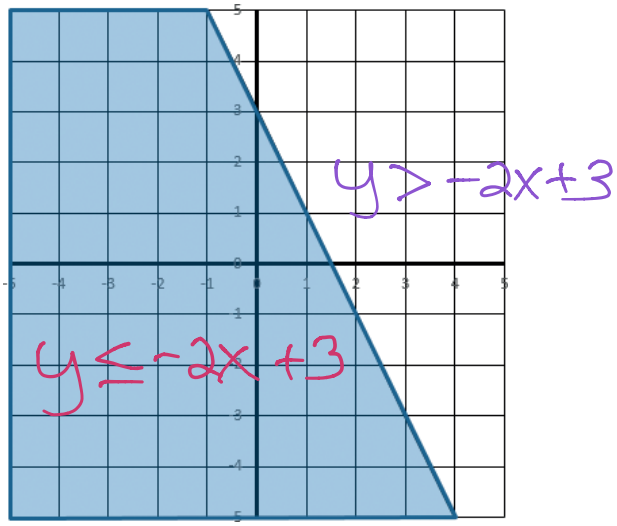
   B. $x > -5$





Challenge Problem

8. Lori graphed the inequality $y \leq -2x + 3$ as shown on the right. Which inequality when graphed with Lori's inequality will shade the entire coordinate plane? Choose all that apply.



A. $y \leq -2x + 5$

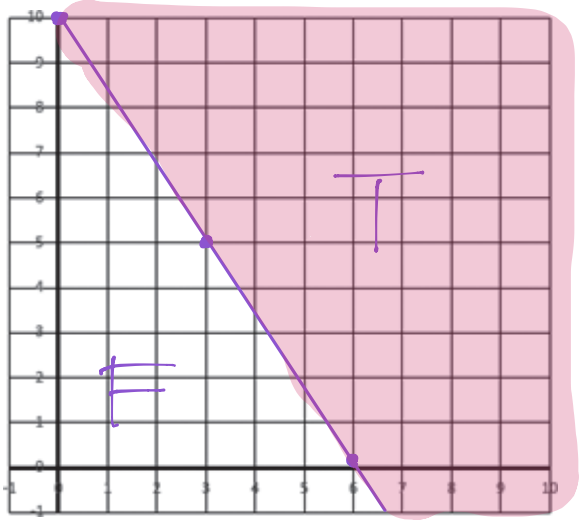
B. $y > -2x + 3$

C. $y \leq 2x + 3$

D. $y > -2x + 4$

Practice Graphing Inequalities

9. $5x + 3y \geq 30$



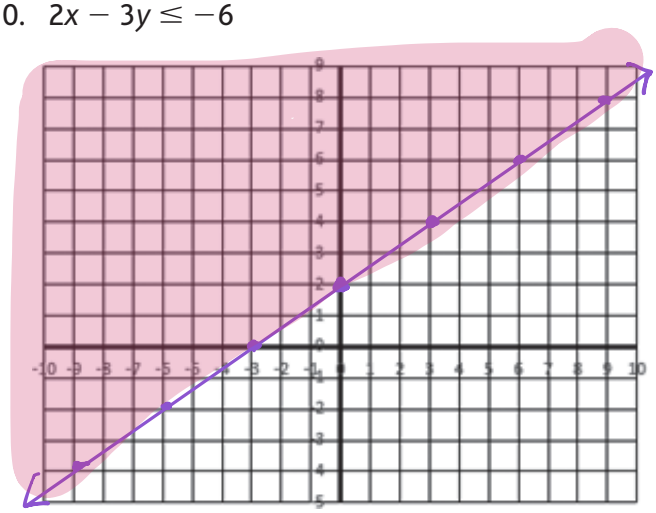
$3y \geq -5x + 30$

$y \geq \frac{-5x}{3} + 10$

Test (0,0)

$0 \geq 10$ F

10. $2x - 3y \leq -6$



$2x - 3y \leq -6$

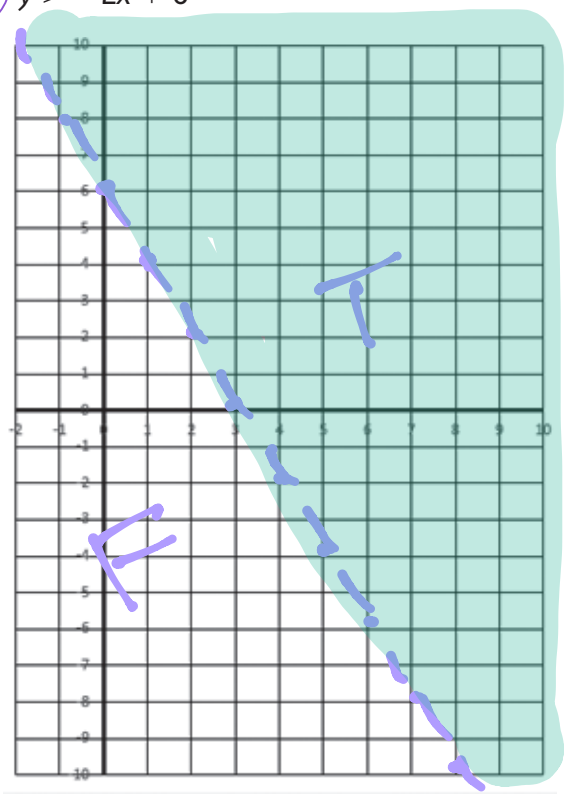
$\frac{-3y}{-3} \leq \frac{-2x}{-3} \frac{-6}{-3}$

$y \geq \frac{2}{3}x + 2$

Test (0,0)

$0 \geq 2$ F

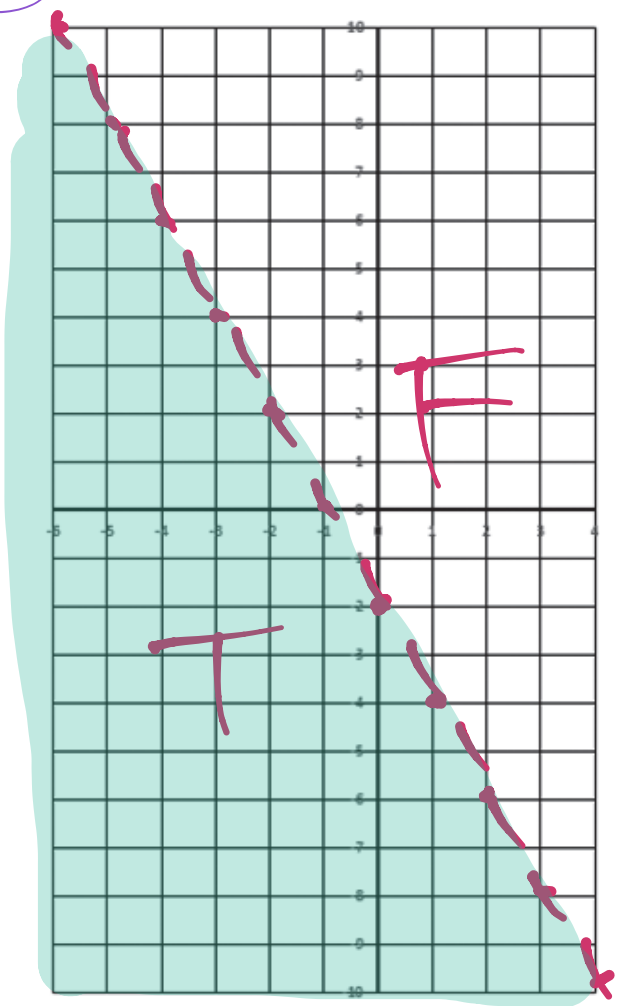
11. $y > -2x + 6$



Test (0,0)

$0 > 6$ False

12. $y < -2(x + 1)$ → $y < -2x - 2$



Test (0,0)

$0 < -2$

False

Lesson Summary

When graphing inequalities in two variables on a coordinate plane, you need to do the following:

1. Isolate y in the inequality.
2. Graph the boundary line with either a solid or dashed line.

   Solid line if _____ or _____.

   Dashed line if _____ or _____.
3. Choose a test point to determine which side of the boundary line to shade. Then shade the appropriate side.

NAME: _____ PERIOD: _____ DATE: _____

Homework Problem Set

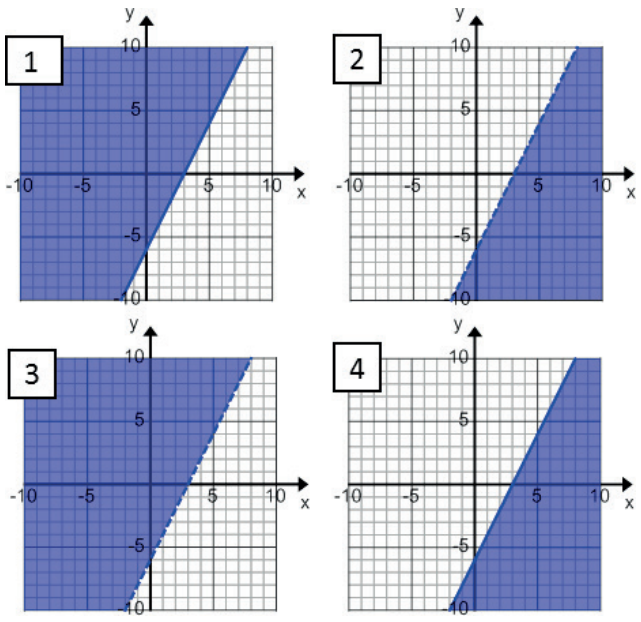
1. Match each inequality with its graph. Explain your reasoning.

   A. $2x - y > 6$

   B. $y \leq 2x - 6$

   C. $2x < y + 6$

   D. $2x - 6 \leq y$



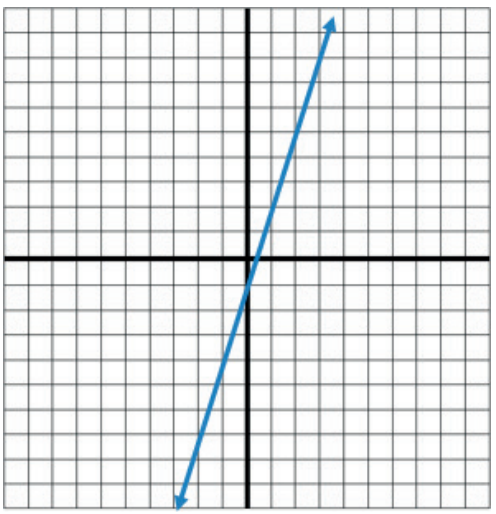
2. Ulli correctly graphed the line of the inequality $y \geq 3x - 1$, but she did not shade any region.

   A. Circle the coordinates below that are in the solution of this inequality.

   (2, 4) (−1, 5) (0, −7)

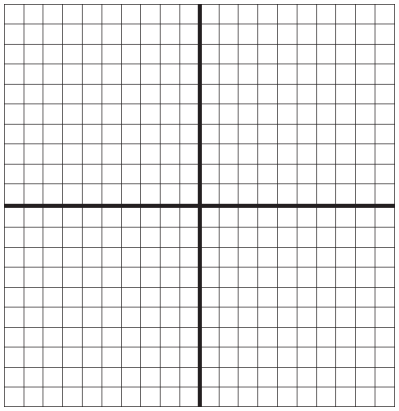
   (−8, 2) (7, 0) (0, 0)

   B. Shade the correct region for Ulli.

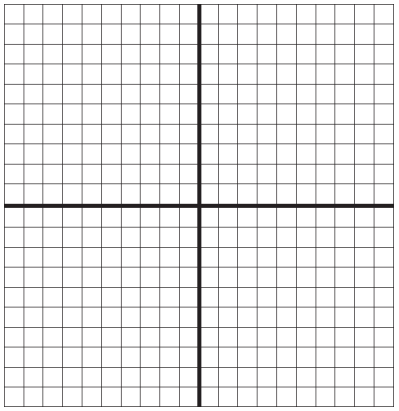


Graph the solution set in the coordinate plane. Support your answer by selecting two ordered pairs in the solution set and verifying that they make the inequality true.

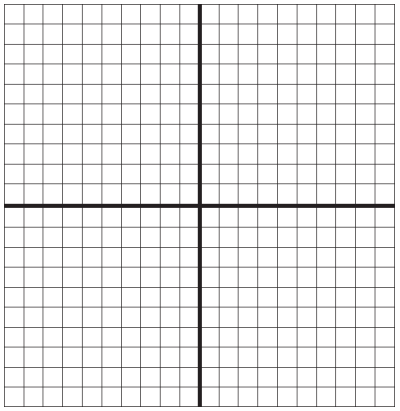
3. $-x + y > 5$



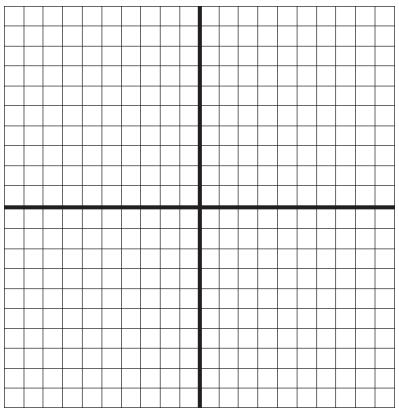
4. $-6 \leq y$



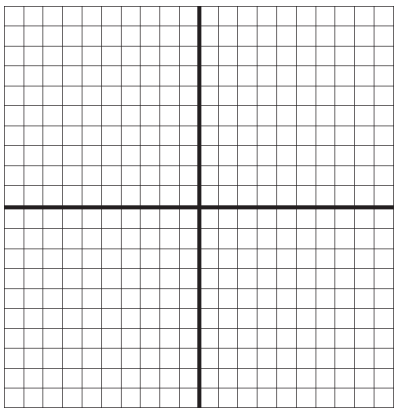
5. $y \leq -3x + 1$



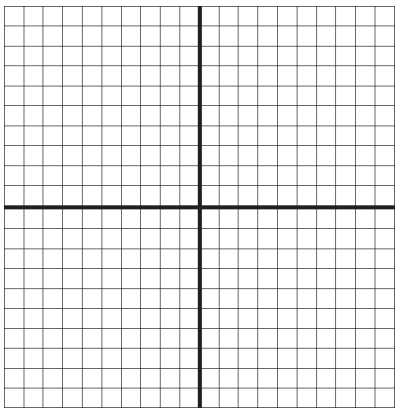
6. $2x - 24 \leq 8y$



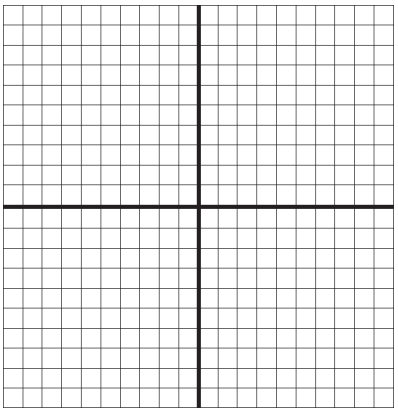
7. $3x < y$



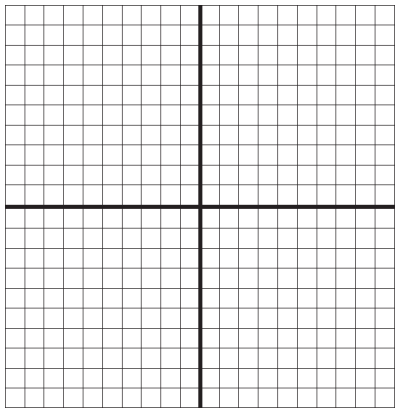
8. $2x > 0$



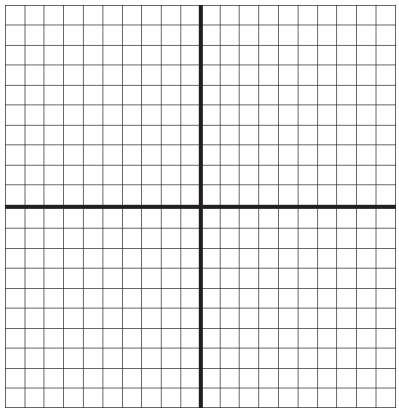
9. $3x \leq 6$



10. $3 < y + 4$



11. $x + 3 > 0$

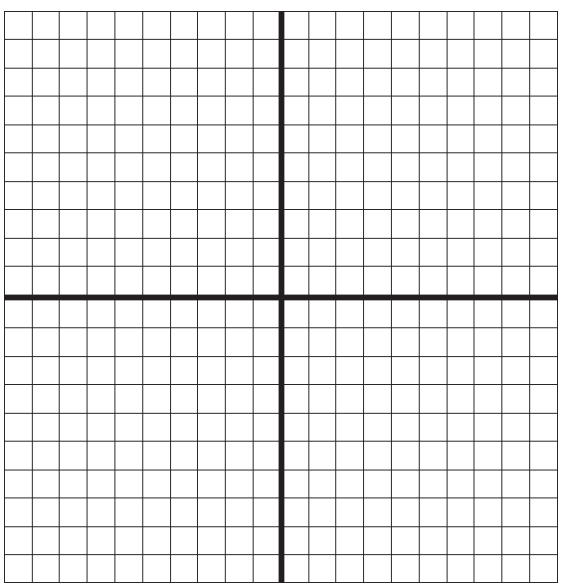


12. **Open Ended** Create 5 ordered pairs using the whole digits 0—9 exactly one time each. Then create a linear inequality such that:

- Two of the ordered pairs are solutions to the linear inequality.
- Two of the ordered pairs are NOT solutions to the linear inequality.
- One of the ordered pairs is on the boundary line but NOT a solution to the linear inequality.

Source: Open Middle

Note: A grid is included, but does not have to be used.



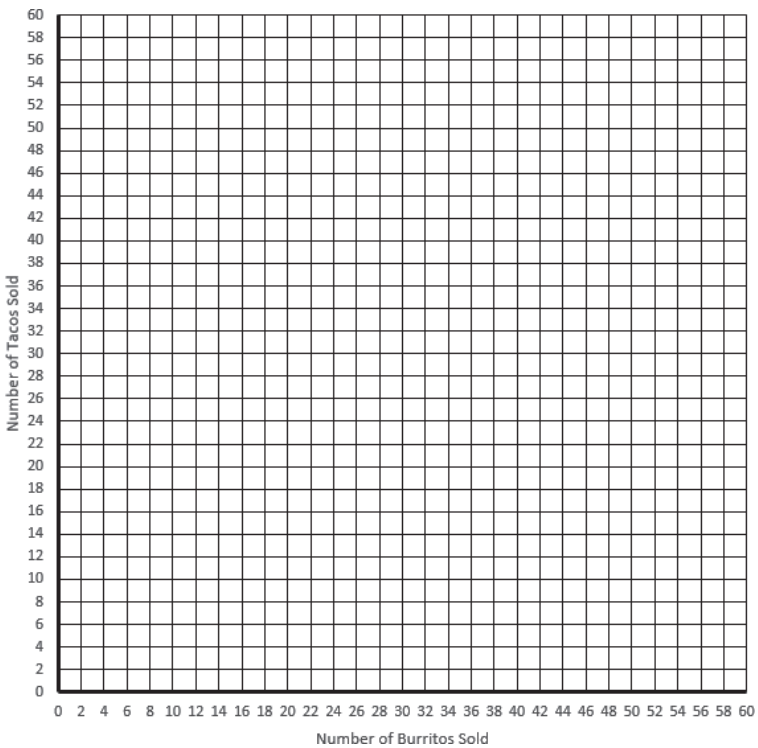
Marti sells tacos and burritos from a food truck at the farmers market. She sells burritos for $3.50 each and tacos for $2.00 each. She hopes to earn at least $120 at the farmers market this Saturday.

13. Identify three combinations of tacos and burritos that will earn Marti more than $120.

14. Identify three combinations of tacos and burritos that will earn Marti exactly $120.

15. Identify three combinations of tacos and burritos that will *not* earn Marti at least $120.

16. Graph your answers to Problems 13 and 14 in the coordinate plane, and then shade a half-plane that contains all possible solutions to this problem.



17. Create a linear inequality that represents the solution to this problem. Let x equal the number of burritos that Marti sells, and let y equal the number of tacos that Marti sells.

18. Is the point (10, 49.5) a solution to the inequality you created in Problem 17? Explain your reasoning.