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5.6 Graphing Linear Inequalities in Two Variables

For use with Exploration 5.6

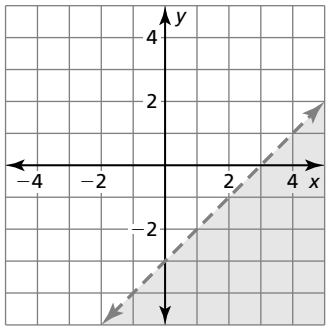
Essential Question How can you graph a linear inequality in two variables?

A **solution of a linear inequality in two variables** is an ordered pair (x, y) that makes the inequality true. The **graph of a linear inequality** in two variables shows all the solutions of the inequality in a coordinate plane.

1 EXPLORATION: Writing a Linear Inequality in Two Variables

Work with a partner.

a. Write an equation represented by the dashed line.



b. The solutions of an inequality are represented by the shaded region. In words, describe the solutions of the inequality.

c. Write an inequality represented by the graph. Which inequality symbol did you use? Explain your reasoning.

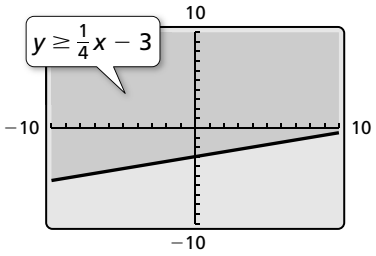
2 EXPLORATION: Using a Graphing Calculator

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Use a graphing calculator to graph $y \geq \frac{1}{4}x - 3$.

a. Enter the equation $y = \frac{1}{4}x - 3$ into your calculator.

b. The inequality has the symbol ≥. So, the region to be shaded is above the graph of $y = \frac{1}{4}x - 3$, as shown. Verify this by testing a point in this region, such as (0, 0), to make sure it is a solution of the inequality.



Because the inequality symbol is *greater than or equal to*, the line is solid and not dashed. Some graphing calculators always use a solid line when graphing inequalities. In this case, you have to determine whether the line should be solid or dashed, based on the inequality symbol used in the original inequality.

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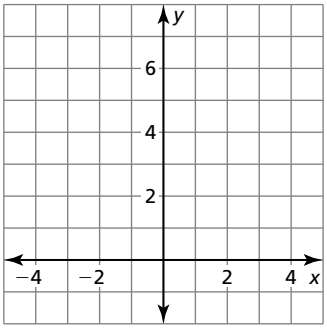
5.6 Graphing Linear Inequalities in Two Variables (continued)

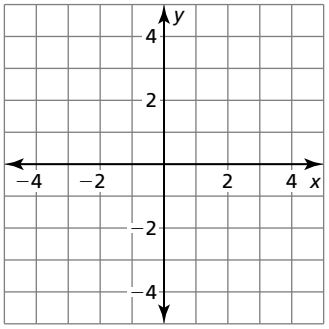
3 EXPLORATION: Graphing Linear Inequalities in Two Variables

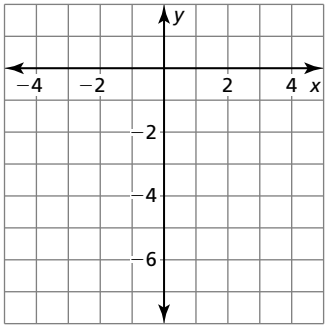
Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Graph each linear inequality in two variables. Explain your steps. Use a graphing calculator to check your graphs.

a. $y > x + 5$ **b.** $y \leq -\frac{1}{2}x + 1$ **c.** $y \geq -x - 5$







Communicate Your Answer

4. How can you graph a linear inequality in two variables?

5. Give an example of a real-life situation that can be modeled using a linear inequality in two variables.

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5.6 Practice
For use after Lesson 5.6

Core Concepts

Graphing a Linear Inequality in Two Variables

Step 1 Graph the boundary line for the inequality. Use a dashed line for $<$ or $>$. Use a solid line for $\leq$ or $\geq$.

Step 2 Test a point that is not on the boundary line to determine whether it is a solution of the inequality.

Step 3 When a test point is a solution, shade the half-plane that contains the point. When the test point is *not* a solution, shade the half-plane that does *not* contain the point.

Notes:

Worked-Out Examples

Example #1

Tell whether the ordered pair is a solution of the inequality.

$-4x - 8y < 15;\ (-6, 3)$

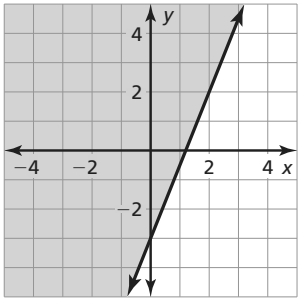
$$\begin{aligned} -4x - 8y &< 15 \\ -4(-6) - 8(3) &\stackrel{?}{<} 15 \\ 24 - 24 &\stackrel{?}{<} 15 \\ 0 &< 15 \ \checkmark \end{aligned}$$

So, $(-6, 3)$ is a solution of the inequality.

Example #2

Graph the inequality in a coordinate plane.

$$\begin{aligned} 5x - 2y &\leq 6 \\ 5x - 5x - 2y &\leq 6 - 5x \\ -2y &\leq -5x + 6 \\ \frac{-2y}{-2} &\geq \frac{-5x + 6}{-2} \\ y &\geq \frac{5}{2}x - 3 \end{aligned}$$



Test $(0, 0)$.

$$\begin{aligned} 5x - 2y &\leq 6 \\ 5(0) - 2(0) &\stackrel{?}{\leq} 6 \\ 0 &\leq 6 \ \checkmark \end{aligned}$$

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5.6 Practice (continued)

Practice A

In Exercises 1–6, tell whether the ordered pair is a solution of the inequality.

1. $x + y > 5; (3, 2)$

2. $x - y \geq 2; (5, 3)$

3. $x + 2y \leq 4; (-1, 2)$

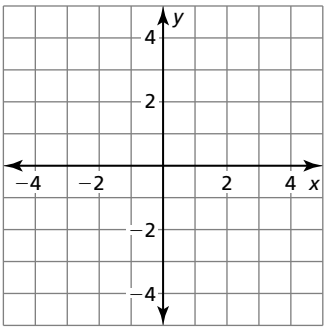
4. $5x + y < 7; (2, -2)$

5. $3x - 4y > 6; (-1, -1)$

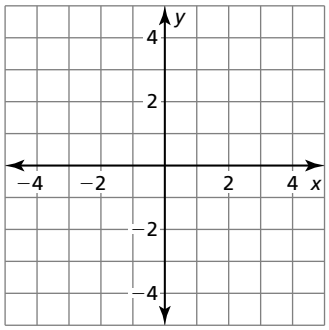
6. $-x - 2y \geq 5; (-2, -3)$

In Exercises 7–18, graph the inequality in a coordinate plane.

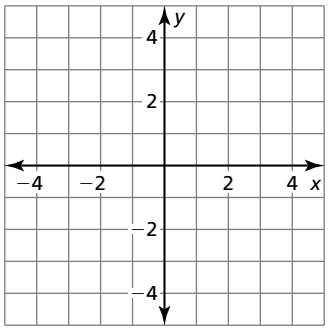
7. $y < 4$



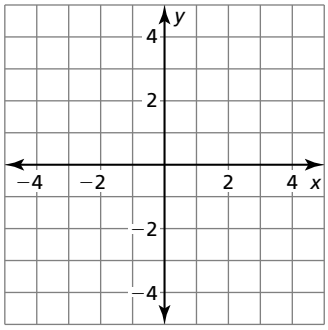
8. $y > -1$



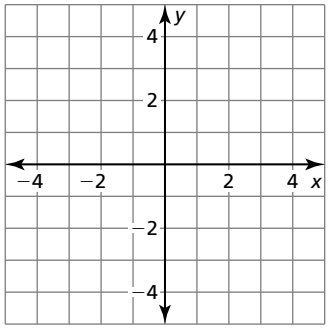
9. $x > 3$



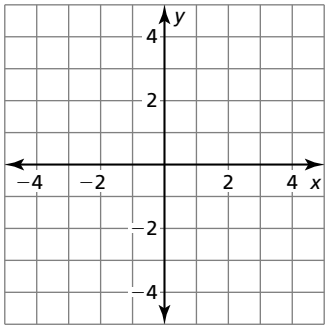
10. $x \leq -1$



11. $y < -2$



12. $x > -2$



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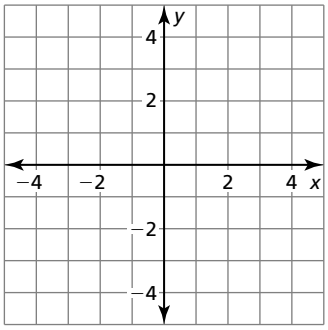
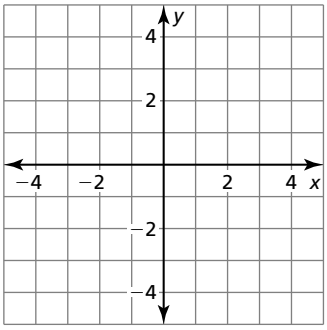
5.6 Practice (continued)

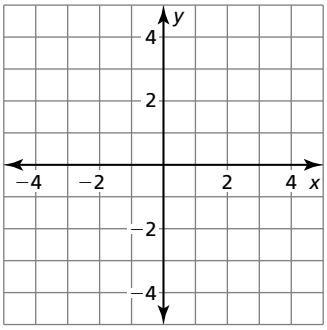
13. $y < 3x + 1$



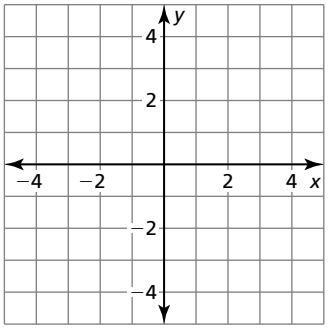
14. $y \geq -x + 1$



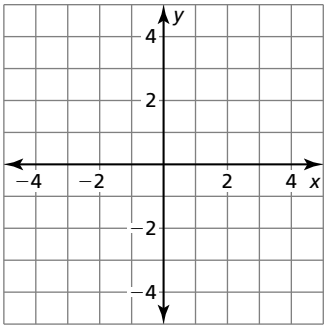
15. $x - y < 2$



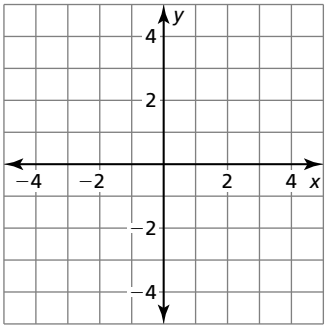
16. $x + y \geq -3$



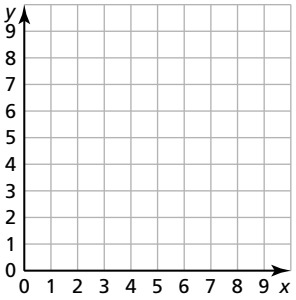
17. $x + 2y < 4$



18. $-2x + 3y > 6$



19. An online store sells digital cameras and cell phones. The store makes a \$100 profit on the sale of each digital camera x and a \$50 profit on the sale of each cell phone y. The store wants to make a profit of at least \$300 from its sales of digital cameras and cell phones. Write and graph an inequality that represents how many digital cameras and cell phones they must sell. Identify and interpret two solutions of the inequality.



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Practice B

In Exercises 1–4, tell whether the ordered pair is a solution of the inequality.

1. $5x + 7y \leq 10; (-1, 2)$

2. $4x - y > 2; (-2, -2)$

3. $-3x - 2y \geq 0; (3, -3)$

4. $-8x - y < 4; (0, 2)$

5. The inequality $9x + 5y \geq 60$ represents the number x of newspapers and the number y of magazines you must sell to earn enough points to earn a special school lunch. You sell four newspapers and six magazines. Do you receive a special school lunch? Explain.

In Exercises 6–11, graph the inequality in a coordinate plane.

6. $x \geq 4$

7. $y < -6$

8. $x < 0$

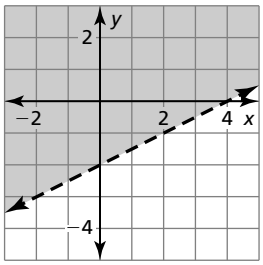
9. $y < 2x + 2$

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

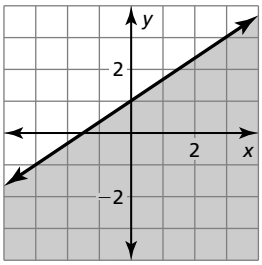
11. $x - 2y \geq 6$

In Exercises 12 and 13, write an inequality that represents the graph.

12.



13.



14. Write a linear inequality in two variables that has the following two properties.

- $(2, -1)$, $(2, 3)$, and $(3, 1)$ are not solutions.
- $(0, -3)$, $(-2, 1)$, and $(1, -5)$ are solutions.

In Exercises 15 and 16, write and graph an inequality whose graph is described by the given information.

15. The points $(4, 10)$ and $(-2, -8)$ lie on the boundary line. The points $(1, -3)$ and $(-1, -7)$ are *not* solutions of the inequality.

16. The points $(-3, 7)$ and $(9, -5)$ lie on the boundary line. The points $(-4, 2)$ and $(6, -5)$ are solutions of the inequality.