2-7 Graphing Inequalities

Main Ideas

- Graph linear inequalities.
- Graph absolute value inequalities.

New Vocabulary

boundary

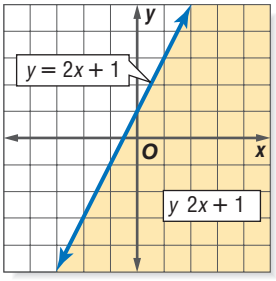
GET READY for the Lesson

Dana has Arizona Cardinals quarterback Kurt Warner as a player on his online fantasy football team. Dana gets 5 points for every yard on a completed pass and 100 points per touchdown pass that Warner makes. He considers 1000 points or more to be a good game. Dana can use a linear inequality to check whether certain combinations of yardage and touchdowns, such as those in the table, result in 1000 points or more.

	Yards	TDs
Game 1	168	3
Game 2	144	2
Game 3	136	1

Graph Linear Inequalities A linear inequality resembles a linear equation, but with an inequality symbol instead of an equals symbol. For example, $y \leq 2x + 1$ is a linear inequality and $y = 2x + 1$ is the related linear equation.

The graph of the inequality $y \leq 2x + 1$ is the shaded region. Every point in the shaded region satisfies the inequality. The graph of $y = 2x + 1$ is the **boundary** of the region. It is drawn as a solid line to show that points on the line satisfy the inequality. If the inequality symbol were $<$ or $>$, then points on the boundary would not satisfy the inequality, so the boundary would be drawn as a dashed line.



EXAMPLE 1 Dashed Boundary

Graph $2x + 3y > 6$.

The boundary is the graph of $2x + 3y = 6$. Since the inequality symbol is $>$, the boundary will be dashed.

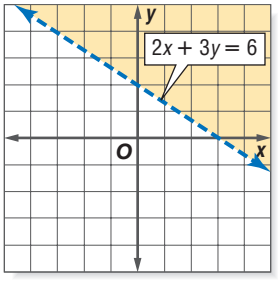
Now test the point (0, 0).

$2x + 3y > 6$ Original inequality

$2(0) + 3(0) > 6$ $(x, y) = (0, 0)$

$0 > 6$ false

Shade the region that does *not* contain (0, 0).



Study Tip

Mental Math

The point (0, 0) is usually a good point to test because it results in easy calculations that you can often perform mentally.

CHECK Your Progress

1A. Graph $3x + \frac{1}{2}y < 2$.

1B. Graph $-x + 2y > 4$.

Real-World EXAMPLE Solid Boundary

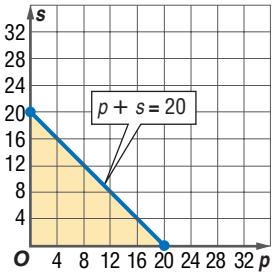
2 **BUSINESS** **A mail-order company is hiring temporary employees to help in its packing and shipping departments during their peak season.**

a. Write and graph an inequality to describe the number of employees that can be assigned to each department if the company has 20 temporary employees available.

Let p be the number of employees assigned to packing and let s be the number assigned to shipping. Since the company can assign *at most* 20 employees total to the two departments, use a $\leq$ symbol.

The employees for packing		the employees for shipping	are at most	twenty.
p	$+$	s	$\leq$	20

Since the inequality symbol is $\leq$, the graph of the related linear equation $p + s = 20$ is solid.



Test (0, 0).

$p + s \leq 20$ Original inequality

$0 + 0 \leq 20$ $(p, s) = (0, 0)$

$0 \leq 20$ true

Shade the region that contains (0, 0). *Since the variables cannot be negative, shade only the part in the first quadrant.*

b. Can the company assign 8 employees to packing and 10 to shipping?

The point (8, 10) is in the shaded region, so it satisfies the inequality. The company can assign 8 employees to packing and 10 to shipping.

Study Tip

Look Back

To review **translating verbal expressions to inequalities**, see Lesson 1-5.

CHECK Your Progress

2. Manuel has \$15 to spend at the fair. It costs \$5 for admission, \$0.75 for each ride ticket, and \$0.25 for each game ticket. Write and graph an inequality for the number of ride and game tickets that he can buy.

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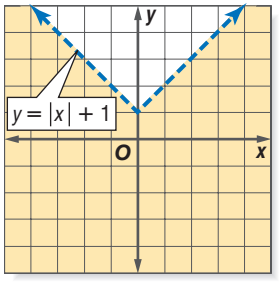
Graph Absolute Value Inequalities Graphing absolute value inequalities is similar to graphing linear inequalities.

EXAMPLE Absolute Value Inequality

3 **Graph $y < |x| + 1$.**

Since the inequality symbol is $<$, the boundary is dashed. Graph the equation. Then test (0, 0).



$y < |x| + 1$ Original inequality

$0 < |0| + 1$ $(x, y) = (0, 0)$

$0 < 0 + 1$ $|0| = 0$

$0 < 1$ true

Shade the region that includes (0, 0).

CHECK Your Progress

3. Graph $y > 2|x| - 3$.

CHECK Your Understanding

Examples 1–3 (pp. 102–103)

Graph each inequality.

1. $y < 2$
2. $y > 2x - 3$
3. $x - y \geq 0$
4. $x - 2y \leq 5$
5. $y > |2x|$
6. $y \leq 3|x| - 1$

Example 2 (p. 103)

SHOPPING For Exercises 7–9, use the following information.
Gwen wants to buy some used CDs that cost \$10 each and some used DVDs that cost \$13 each. She has \$40 to spend.

7. Write an inequality to represent the situation, where c is the number of CDs she buys and d is the number of DVDs.
8. Graph the inequality.
9. Can she buy 2 CDs and 3 DVDs? Explain.

Exercises

HOMEWORK HELP

For Exercises	See Examples
10–15	1
16–19, 22–26	2
20–21	3

Graph each inequality.

10. $x + y > -5$
11. $y > 6x - 2$
12. $y + 1 < 4$
13. $y - 2 < 3x$
14. $x - 6y + 3 > 0$
15. $y > \frac{1}{3}x + 5$
16. $y \geq 1$
17. $3 \geq x - 3y$
18. $x - 5 \leq y$
19. $y \geq -4x + 3$
20. $y \leq |x|$
21. $y > |4x|$

COLLEGE For Exercises 22 and 23, use the following information.
Rosa's professor says that the midterm exam will count for 40% of each student's grade and the final exam will count for 60%. A score of at least 90 is required for an A.

22. The inequality $0.4x + 0.6y \geq 90$ represents this situation, where x is the midterm score and y is the final exam score. Graph this inequality.
23. Refer to the graph. If she scores 85 on the midterm and 95 on the final, will Rosa get an A?

Ken Reid/Cobalt Pictures

FINANCE For Exercises 24–26, use the following information.
Carl Talbert estimates that he will need to earn at least \$9000 per year combined in dividend income from the two stocks he owns to supplement his retirement plan.

Company	Dividend per Share
Able Records	\$1.20
Best Bakes	\$1.30

24. Write an inequality to represent this situation.
25. Graph the inequality.
26. Will he make enough from 3000 shares of each company?

27. Graph all the points on the coordinate plane to the left of the graph of $x = -2$. Write an inequality to describe these points.
28. Graph all the points on the coordinate plane below the graph of $y = 3x - 5$. Write an inequality to describe these points.

Real-World Link
A dividend is a payment from a company to an investor. It is a way to make money on a stock without selling it.

Graph each inequality.

29. $4x - 5y - 10 \leq 0$
30. $y \geq \frac{1}{2}x - 5$
31. $y + |x| < 3$
32. $y \geq |x - 1| - 2$
33. $|x + y| > 1$
34. $|x| \leq |y|$

Graphing Calculator

SHADE(COMMAND You can graph inequalities by using the SHADE(command located in the DRAW menu. Enter two functions.

- The first function defines the lower boundary of the shaded region. If the inequality is "$y \leq$," use the Ymin window value as the lower boundary.
- The second function defines the upper boundary of the region. If the inequality is "$y \geq$," use the Ymax window value as the upper boundary.

Graph each inequality.

35. $y \geq 3$ **36.** $y \leq x + 2$ **37.** $y \leq -2x - 4$ **38.** $x - 7 \leq y$

H.O.T. Problems

39. REASONING Explain how to determine which region to shade when graphing an inequality.

40. CHALLENGE Graph $|y| < x$.

41. *Writing in Math* Use the information on page 102 to write an inequality that defines a good game for Kurt Warner in Dana's fantasy football league, and explain how you obtained it.

EXTRA PRACTICE
See pages 895, 927.

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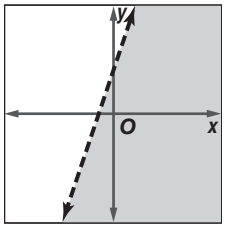
STANDARDIZED TEST PRACTICE

42. ACT/SAT Which could be the inequality for the graph?



A $y < 3x + 2$

B $y \leq 3x + 2$

C $y > 3x + 2$

D $y \geq 3x + 2$

43. REVIEW What is the solution set of the inequality?

$$6 - |x + 7| \leq -2$$

F $-15 \leq x + \leq 1$

G $-1 \leq x \leq 3$

H $x \leq -1$ or $x \geq 3$

J $x \leq -15$ or $x \geq 1$

Spiral Review

Graph each function. Identify the domain and range. (Lesson 2-6)

44. $f(x) = [\![x]\!] - 4$ **45.** $g(x) = |x| - 1$ **46.** $h(x) = |x - 3|$

SALARY For Exercises 47–49, use the table which shows the years of experience for eight computer programmers and their yearly salary. (Lesson 2-5)

Years	6	5	3	1	4	3	6	2
Salary ($)	55,000	53,000	45,000	42,000	48,500	46,500	53,000	43,000

47. Draw a scatter plot and describe the correlation.

48. Find a prediction equation.

49. Predict the salary for a representative with 9 years of experience.

Solve each equation. Check your solution. (Lesson 1-3)

50. $4x - 9 = 23$ **51.** $11 - 2y = 5$ **52.** $2z - 3 = -6z + 1$