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5.5 Solving Equations by Graphing

For use with Exploration 5.5

Essential Question How can you use a system of linear equations to solve an equation with variables on both sides?

1 EXPLORATION: Solving an Equation by Graphing

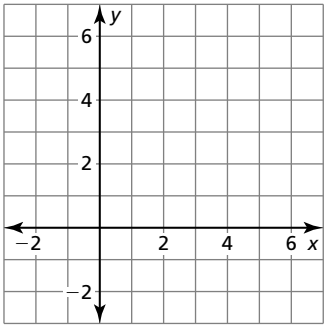
Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Solve $2x - 1 = -\frac{1}{2}x + 4$ by graphing.

a. Use the left side to write a linear equation. Then use the right side to write another linear equation.

b. Graph the two linear equations from part (a). Find the x-value of the point of intersection. Check that the x-value is the solution of

$$2x - 1 = -\frac{1}{2}x + 4.$$



c. Explain why this "graphical method" works.

2 EXPLORATION: Solving Equations Algebraically and Graphically

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

Work with a partner. Solve each equation using two methods.

Method 1 Use an algebraic method.

Method 2 Use a graphical method.

Is the solution the same using both methods?

a. $\frac{1}{2}x + 4 = -\frac{1}{4}x + 1$

b. $\frac{2}{3}x + 4 = \frac{1}{3}x + 3$

5.5 Solving Equations by Graphing (continued)

2 EXPLORATION: Solving Equations Algebraically and Graphically (continued)

c. $-\frac{2}{3}x - 1 = \frac{1}{3}x - 4$

d. $\frac{4}{5}x + \frac{7}{5} = 3x - 3$

e. $-x + 2.5 = 2x - 0.5$

f. $-3x + 1.5 = x + 1.5$

Communicate Your Answer

3. How can you use a system of linear equations to solve an equation with variables on both sides?

4. Compare the algebraic method and the graphical method for solving a linear equation with variables on both sides. Describe the advantages and disadvantages of each method.

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5.5 Practice
For use after Lesson 5.5

Core Concepts

Solving Linear Equations by Graphing

Step 1 To solve the equation $ax + b = cx + d$, write two linear equations.

$ax + b = cx + d$

$y = ax + b$ and $y = cx + d$

Step 2 Graph the system of linear equations. The x-value of the solution of the system of linear equations is the solution of the equation $ax + b = cx + d$.

Notes:

Worked-Out Examples

Example #1

Solve the equation by graphing. Determine whether the equation has one solution, no solution, or infinitely many solutions.

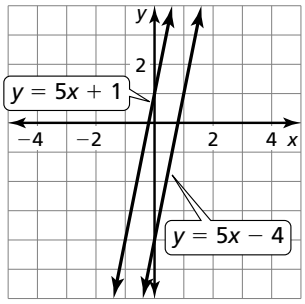
$5x - 4 = 5x + 1$

Graph the system.

$y = 5x - 4$

$y = 5x + 1$

The lines have the same slope but different y-intercepts. So, they are parallel. Because parallel lines never intersect, there is no point that is a solution of both linear equations. So, the original equation has no solution.



Example #2

Solve the equation by graphing. Check your solutions.

$|2x + 5| = |-2x + 1|$

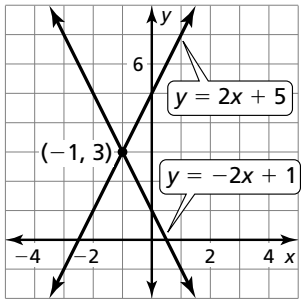
Equation 1

$2x + 5 = -2x + 1$

System 1

$y = 2x + 5$

$y = -2x + 1$



The graphs intersect at $(-1, 3)$.

Equation 2

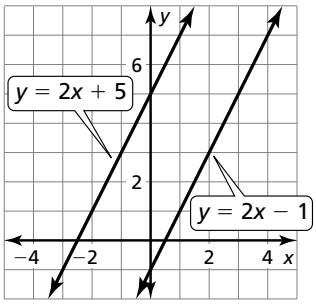
$2x + 5 = -(-2x + 1)$

$2x + 5 = 2x - 1$

System 2

$y = 2x + 5$

$y = 2x - 1$



The graphs do not intersect. So, this system has no solution.

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5.5 Practice (continued)

Check $|2x + 5| = |-2x + 1|$

$|2(-1) + 5| \stackrel{?}{=} |-2(-1) + 1|$

$|-2 + 5| \stackrel{?}{=} |2 + 1|$

$|3| \stackrel{?}{=} |3|$

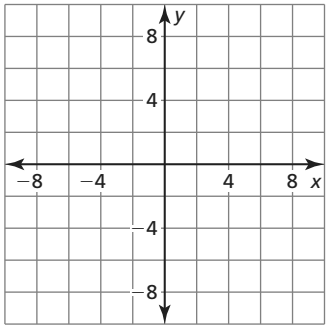
$3 = 3$ ✓

So, the solution is $x = -1$.

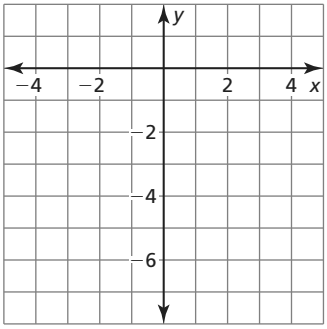
Practice A

In Exercises 1–9, solve the equation by graphing. Check your solution(s).

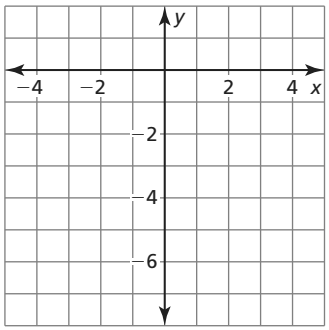
1. $2x - 7 = -2x + 9$



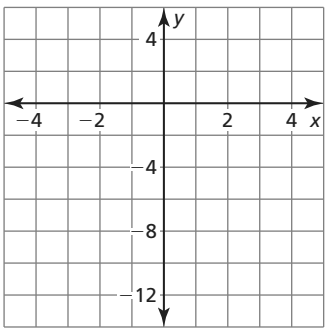
2. $3x = x - 4$



3. $4x + 1 = -2x - 5$



4. $-x - 4 = 3(x - 4)$



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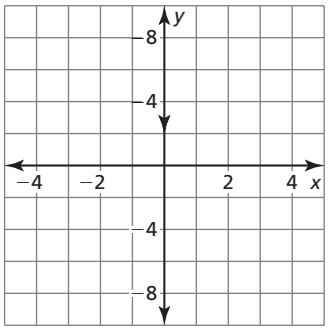
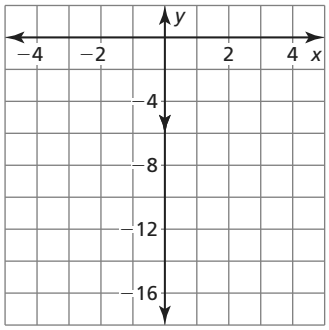
5.5 Practice (continued)

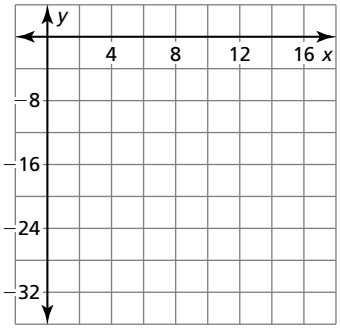
5. $-3x - 5 = 6 - 3x$

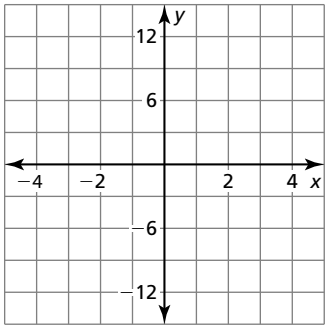


6. $7x - 14 = -7(2 - x)$

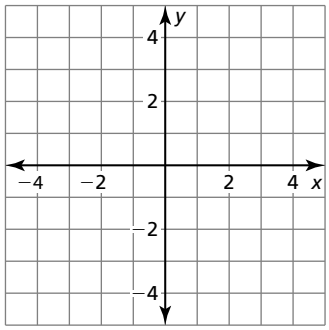


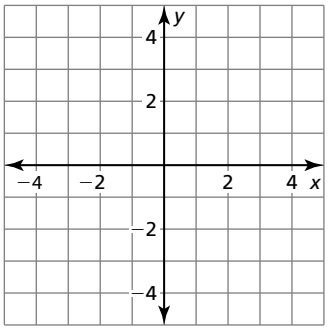
7. $|3x| = |2x + 10|$



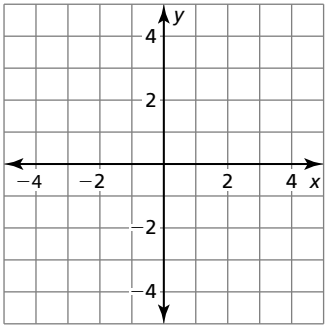


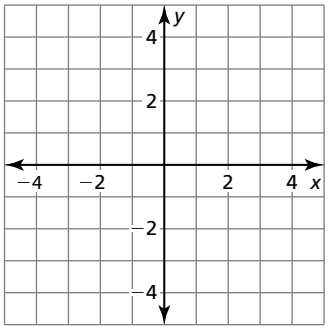
8. $|x - 1| = |x + 3|$





9. $|x + 4| = |2 - x|$





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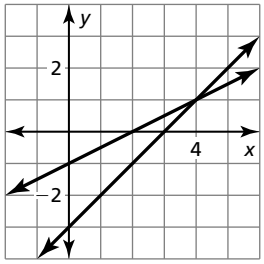
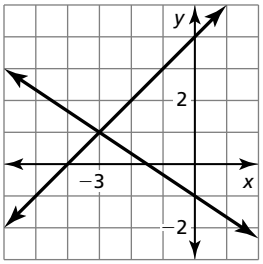
Practice B

In Exercises 1 and 2, use the graph to solve the equation. Check your solution.

1. $x - 3 = \frac{1}{2}x - 1$



2. $-\frac{2}{3}x - 1 = x + 4$



In Exercises 3–6, solve the equation by graphing. Check your solution.

3. $-3x + 5 = x + 1$

4. $\frac{1}{4}x - 6 = -2x + 3$

5. $3x + 6 = 3(x + 2)$

6. $-5(x + 2) = 4x - 1$

In Exercises 7 and 8, solve the equation by graphing. Determine whether the equation has *one solution*, *no solution,* or *infinitely many solutions.*

7. $-2(-x - 1) = 2x + 2$

8. $\frac{1}{4}(12x - 10) = 3x + 2$

In Exercises 9 and 10, solve the equation by graphing. Check your solutions.

9. $|x + 2| = |5 - x|$

10. $3|x - 1| = |2x + 8|$

In Exercises 11 and 12, use a graphing calculator to solve the equation.

11. $0.6x - 1.1 = 0.5x - 0.4$

12. $1.3x + 0.8 = 2.5x - 0.4$

13. Determine one set of values of a and b of the equation $2x - 3 = ax + b$ in each situation.

a. The equation has no solution.

b. The equation has infinitely many solutions.

c. $x = 4$ is a solution.

14. You need to hire a taxi. Taxi A charges \$9.25 plus \$1.50 per mile. Taxi B charges \$10.50 plus \$1.25 per mile. Use a graphing calculator to find the number of miles for which the total costs are the same for each taxi.