4.1 Graphing Linear Equations

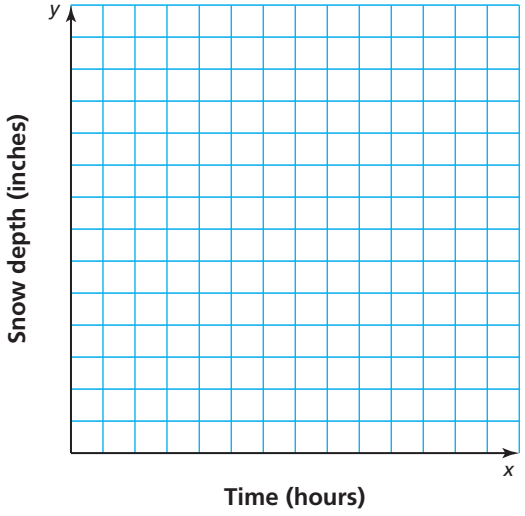
Learning Target: Graph linear equations.

Success Criteria:
- I can create a table of values and write ordered pairs given a linear equation.
- I can plot ordered pairs to create a graph of a linear equation.
- I can use a graph of a linear equation to solve a real-life problem.

EXPLORATION 1 Creating Graphs

Work with a partner. It starts snowing at midnight in Town A and Town B. The snow falls at a rate of 1.5 inches per hour.

a. In Town A, there is no snow on the ground at midnight. How deep is the snow at each hour between midnight and 6 A.M.? Make a graph that represents this situation.



b. Repeat part (a) for Town B, which has 4 inches of snow on the ground at midnight.

c. The equations below represent the depth y (in inches) of snow x hours after midnight in Town C and Town D. Graph each equation.

Town C	Town D
$y = 2x + 3$	$y = 8$

d. Use your graphs to compare the snowfall in each town.

Math Practice

Use a Graph

How can you use each graph to find the rate of snowfall? the depth of the snow when it begins to fall?

4.1 Lesson

Key Vocabulary
linear equation, *p. 142*
solution of a linear equation, *p. 142*

Remember
An ordered pair (x, y) is used to locate a point in a coordinate plane.

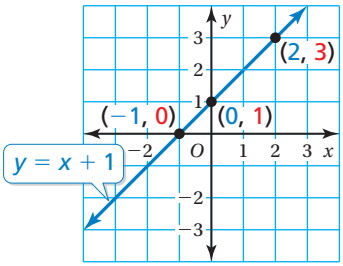
Key Idea

Linear Equations

A **linear equation** is an equation whose graph is a line. The points on the line are **solutions** of the equation.

You can use a graph to show the solutions of a linear equation. The graph below represents the equation $y = x + 1$.

x	y	(x, y)
-1	0	$(-1, 0)$
0	1	$(0, 1)$
2	3	$(2, 3)$



EXAMPLE 1 Graphing a Linear Equation

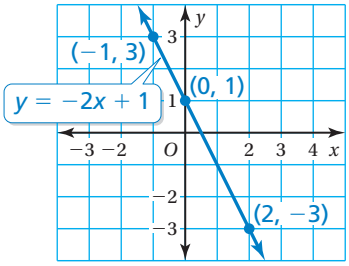
Graph $y = -2x + 1$.

Step 1: Make a table of values.

x	$y = -2x + 1$	y	(x, y)
-1	$y = -2(-1) + 1$	3	$(-1, 3)$
0	$y = -2(0) + 1$	1	$(0, 1)$
2	$y = -2(2) + 1$	-3	$(2, -3)$

Step 2: Plot the ordered pairs.

Step 3: Draw a line through the points.



Try It **Graph the linear equation.**

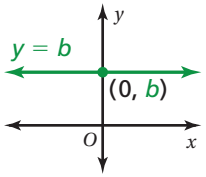
1. $y = 3x$ **2.** $y = -2x - 1$ **3.** $y = -\frac{1}{2}x + 2$

Every point that is a solution of $y = b$ has a y-coordinate of b. These points lie on a horizontal line through $(0, b)$. You can use similar reasoning to understand why the graph of $x = a$ is a vertical line through $(a, 0)$.

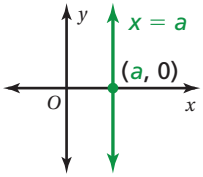
Key Idea

Graphing Horizontal and Vertical Lines

The graph of $y = b$ is a horizontal line passing through $(0, b)$.



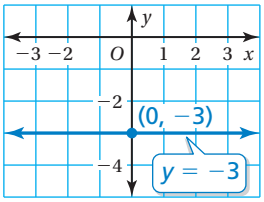
The graph of $x = a$ is a vertical line passing through $(a, 0)$.



EXAMPLE 2 Graphing a Horizontal Line and a Vertical Line

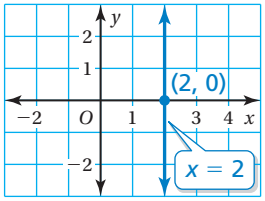
a. Graph $y = -3$.

The graph of $y = -3$ is a horizontal line passing through $(0, -3)$. Draw a horizontal line through this point.



b. Graph $x = 2$.

The graph of $x = 2$ is a vertical line passing through $(2, 0)$. Draw a vertical line through this point.



Try It **Graph the linear equation.**

4. $y = 3$ **5.** $y = -1.5$ **6.** $x = -4$ **7.** $x = \frac{1}{2}$

Self-Assessment for Concepts & Skills

Solve each exercise. Then rate your understanding of the success criteria in your journal.

GRAPHING A LINEAR EQUATION **Graph the linear equation.**

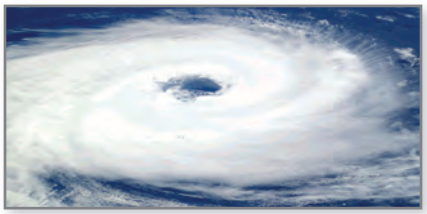
8. $y = -x + 1$ **9.** $y = 0.8x - 2$

10. $x = 2.5$ **11.** $y = \frac{2}{3}$

12. WHICH ONE DOESN'T BELONG? Which equation does *not* belong with the other three? Explain your reasoning.

$y = x - 2$ $4x + 3 = y$ $y = x^2 + 6$ $x + 5 = y$

EXAMPLE 3 Modeling Real Life

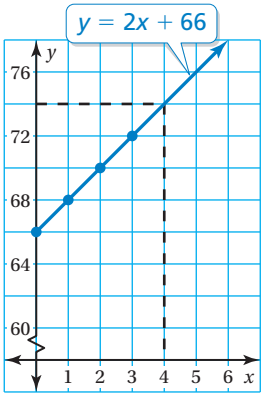


A tropical storm becomes a hurricane when wind speeds are at least 74 miles per hour.

The wind speed y (in miles per hour) of a tropical storm is $y = 2x + 66$, where x is the number of hours after the storm enters the Gulf of Mexico. When does the storm become a hurricane?

Use a graph to find the time it takes for the storm to become a hurricane. Make a table of values. Plot the ordered pairs and draw a line through the points.

x	$y = 2x + 66$	y	(x, y)
0	$y = 2(0) + 66$	66	(0, 66)
1	$y = 2(1) + 66$	68	(1, 68)
2	$y = 2(2) + 66$	70	(2, 70)
3	$y = 2(3) + 66$	72	(3, 72)



Another Method Use the equation $y = 2x + 66$ to find x when $y = 74$.

$$74 = 2x + 66$$
$$8 = 2x$$
$$4 = x \checkmark$$

From the graph, you can see that $y = 74$ when $x = 4$.

So, the storm becomes a hurricane 4 hours after it enters the Gulf of Mexico.

Self-Assessment for Problem Solving

Solve each exercise. Then rate your understanding of the success criteria in your journal.

13. A game show contestant earns y dollars for completing a puzzle in x minutes. This situation is represented by the equation $y = -250x + 5000$. How long did a contestant who earned \$500 take to complete the puzzle? Justify your answer.

14. The total cost y (in dollars) to join a cheerleading team and attend x competitions is represented by the equation $y = 10x + 50$.

a. Graph the linear equation.

b. You have \$75 to spend. How many competitions can you attend?

15. The seating capacity y for a banquet hall is represented by $y = 8x + 56$, where x is the number of extra tables you need. How many extra tables do you need to double the original seating capacity?

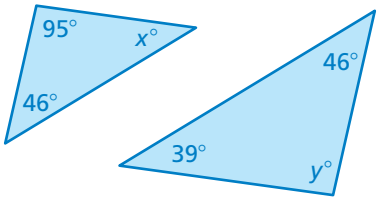
4.1 Practice

Go to **BigIdeasMath.com** to get HELP with solving the exercises.

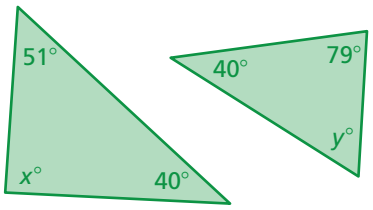
Review & Refresh

Tell whether the triangles are similar. Explain.

1.



2.



Describe the translation of the point to its image.

3. $(1, -4) \rightarrow (3, 0)$ **4.** $(6, 4) \rightarrow (-4, -6)$ **5.** $(4, -2) \rightarrow (-9, 3)$

Concepts, Skills, & Problem Solving

CREATING GRAPHS **Make a graph of the situation.** (See Exploration 1, p. 141.)

6. The equation $y = -2x + 8$ represents the amount y (in fluid ounces) of dish detergent in a bottle after x days of use.

7. The equation $y = 15x + 20$ represents the cost y (in dollars) of a gym membership after x months.

MP PRECISION **Copy and complete the table with two solutions. Plot the ordered pairs and draw the graph of the linear equation. Use the graph to find a third solution of the equation.**

8.

x		
$y = 3x - 1$		

9.

x		
$y = \frac{1}{3}x + 2$		

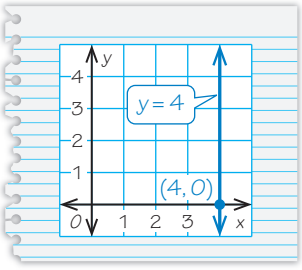
GRAPHING A LINEAR EQUATION **Graph the linear equation.**

10. $y = -5x$ **11.** $y = 9x$ **12.** $y = 5$ **13.** $x = -6$

14. $y = x - 3$ **15.** $y = -7x - 1$ **16.** $y = -\frac{x}{3} + 4$ **17.** $y = 0.75x - 0.5$

18. $y = -\frac{2}{3}$ **19.** $y = 6.75$ **20.** $x = -0.5$ **21.** $x = \frac{1}{4}$

22. **YOU BE THE TEACHER** Your friend graphs the equation $y = 4$. Is your friend correct? Explain your reasoning.



23. **MODELING REAL LIFE** The equation $y = 20$ represents the cost y (in dollars) for sending x text messages in a month. Graph the linear equation. What does the graph tell you about your texting plan?

24. **MODELING REAL LIFE** The equation $y = 2x + 3$ represents the cost y (in dollars) of mailing a package that weighs x pounds.

a. Use a graph to estimate how much it costs to mail the package.

b. Use the equation to find exactly how much it costs to mail the package.

SOLVING A LINEAR EQUATION **Solve for y. Then graph the linear equation.**

25. $y - 3x = 1$

26. $5x + 2y = 4$

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

28. $x + 0.5y = 1.5$

29. **MODELING REAL LIFE** The depth y (in inches) of a lake after x years is represented by the equation $y = 0.2x + 42$. How much does the depth of the lake increase in four years? Use a graph to justify your answer.

30. **MODELING REAL LIFE** The amount y (in dollars) of money in your savings account after x months is represented by the equation $y = 12.5x + 100$.

a. Graph the linear equation.

b. How many months will it take you to save a total of $237.50?

31. MP **PROBLEM SOLVING** The radius y (in millimeters) of a chemical spill after x days is represented by the equation $y = 6x + 50$.

a. Graph the linear equation.

b. The leak is noticed after two weeks. What is the area of the leak when it is noticed? Justify your answer.

32. **GEOMETRY** The sum S of the interior angle measures of a polygon with n sides is $S = (n - 2) \cdot 180°$.

a. Plot four points (n, S) that satisfy the equation. Is the equation a linear equation? Explain your reasoning.

b. Does the value $n = 3.5$ make sense in the context of the problem? Explain your reasoning.

33. DIG DEEPER! One second of video on your cell phone uses the same amount of memory as two pictures. Your cell phone can store 2500 pictures.

a. Create a graph that represents the number y of pictures your cell phone can store when you take x seconds of video.

b. How many pictures can your cell phone store in addition to a video that is one minute and thirty seconds long?