English Spanish

2.1 Graphing Linear Equations

Essential Question How can you recognize a linear equation? How can you draw its graph?

1 ACTIVITY: Graphing a Linear Equation

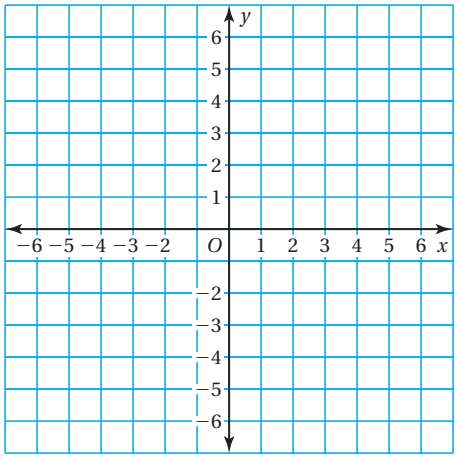
Work with a partner.

a. Use the equation $y = \frac{1}{2}x + 1$ to complete the table. (Choose any two x-values and find the y-values.)

	Solution Points	
x		
$y = \frac{1}{2}x + 1$		

b. Write the two ordered pairs given by the table. These are called **solution points** of the equation.

c. Plot the two solution points. Draw a line *exactly* through the two points.



d. Find a different point on the line. Check that this point is a solution point of the equation $y = \frac{1}{2}x + 1$.

e. **GENERALIZE** Do you think it is true that *any* point on the line is a solution point of the equation $y = \frac{1}{2}x + 1$? Explain.

f. Choose five additional x-values for the table. (Choose positive and negative x-values.) Plot the five corresponding solution points. Does each point lie on the line?

	Solution Points				
x					
$y = \frac{1}{2}x + 1$					

g. **GENERALIZE** Do you think it is true that *any* solution point of the equation $y = \frac{1}{2}x + 1$ is a point on the line? Explain.

h. **THE MEANING OF A WORD** Why is $y = ax + b$ called a *linear equation*?

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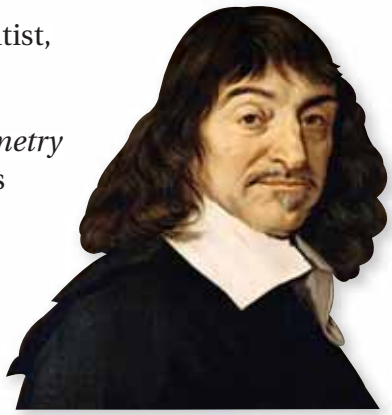
2 HISTORY: Analytic Geometry


René Descartes (1596–1650)

René Descartes was a French philosopher, scientist, and mathematician.

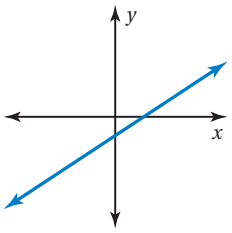
Up until the time of Descartes, *algebra* and *geometry* were separate fields of mathematics. Descartes's invention of the coordinate plane was of huge importance to mathematics. For the first time, people could "see" solutions of equations. No longer did people have to work with algebra from a purely symbolic point of view.

Descartes's combination of geometry and algebra is called *analytic* (or algebraic) *geometry*. One of the main discoveries in analytic geometry is that all of the important types of graphs (lines, parabolas, circles, ellipses, and so on) can be represented by simple algebraic equations.

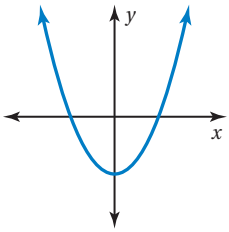
Within a few dozen years, other mathematicians were able to discover all of *calculus*, a field of mathematics that is of great value in business, science, and engineering.

In this book, you will study lines. In Algebra 1 and Algebra 2, you will study many other types of equations.

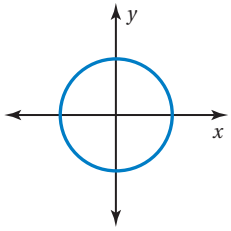
Line: $y = ax + b$



Parabola: $y = ax^2 + b$



Circle: $x^2 + y^2 = r^2$



What Is Your Answer?

3. **IN YOUR OWN WORDS** How can you recognize a linear equation? How can you draw its graph? Write an equation that is linear. Write an equation that is *not* linear.

4. Are you a visual learner? Most people can learn mathematics more easily when they see "pictures" of the mathematics. Why do you think Descartes's invention was important to mathematics?

Practice Use what you learned about graphing linear equations to complete Exercises 3 and 4 on page 52.

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2.1 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
linear equation, *p. 50*
solution of a linear equation, *p. 50*

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

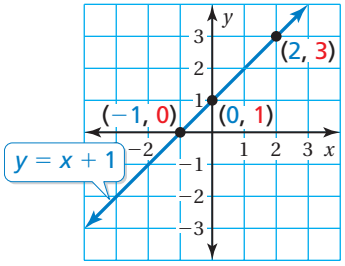
Key Idea

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 is for the equation $y = x + 1$.

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

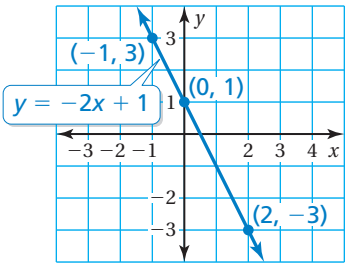


EXAMPLE 1 Graphing a Linear Equation

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	$(2, -3)$



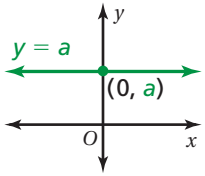
Step 2: Plot the ordered pairs.

Step 3: Draw a line through the points.

Key Idea

Graphing a Horizontal Line

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



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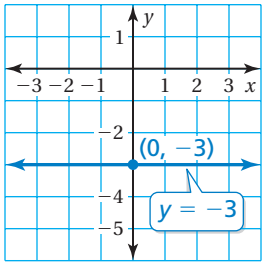
EXAMPLE 2 Graphing a Horizontal Line

Graph $y = -3$.

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

Plot $(0, -3)$. Draw a horizontal line through the point.



On Your Own

Now You're Ready
Exercises 5–13

Graph the linear equation.

1. $y = 3x$
2. $y = -\frac{1}{2}x + 2$
3. $y = \pi$
4. $y = -1.5$

EXAMPLE 3 Real-Life Application

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.

a. Graph the equation.

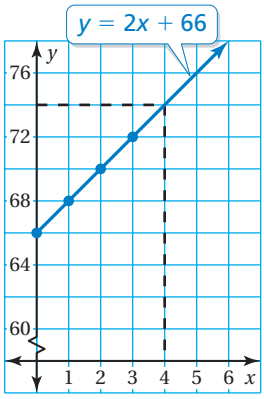
b. When does the storm become a hurricane?

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

a. Make a table of values.

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)

Plot the ordered pairs and draw a line through the points.



b. 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.

On Your Own

5. **WHAT IF?** In Example 3, the wind speed of the storm is $y = 1.5x + 62$. When does the storm become a hurricane?

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2.1 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. **VOCABULARY** What type of graph represents the solutions of the equation $y = 2x + 3$?

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

$y = 0.5x - 0.2$ $\quad 4x + 3 = y$ $\quad y = x^2 + 6$ $\quad \frac{3}{4}x + \frac{1}{3} = y$

Practice and Problem Solving

Copy and complete the table. Plot the two solution points and draw a line *exactly* through the two points. Find a different solution point on the line.

3.

x		
$y = 3x - 1$		

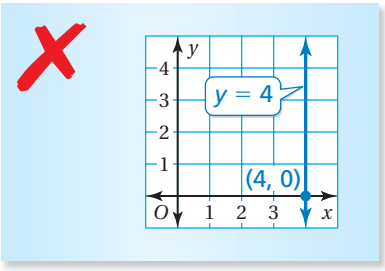
4.

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

Graph the linear equation.

5. $y = -5x$
6. $y = \frac{1}{4}x$
7. $y = 5$
8. $y = x - 3$
9. $y = -7x - 1$
10. $y = -\frac{x}{3} + 4$
11. $y = \frac{3}{4}x - \frac{1}{2}$
12. $y = -\frac{2}{3}$
13. $y = 6.75$

14. **ERROR ANALYSIS** Describe and correct the error in graphing the equation.



15. **MESSAGING** You sign up for an unlimited text messaging plan for your cell phone. The equation $y = 20$ represents the cost y (in dollars) for sending x text messages. Graph the equation.

16. **MAIL** The equation $y = 2x + 3$ represents the cost y (in dollars) of mailing a package that weighs x pounds.
   a. Graph the equation.
   b. Use the graph to estimate how much it costs to mail the package.
   c. Use the equation to find exactly how much it costs to mail the package.

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Solve for y. Then graph the equation.

17. $y - 3x = 1$

18. $5x + 2y = 4$

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

20. $x + 0.5y = 1.5$

21. **SAVINGS** You have \$100 in your savings account and plan to deposit \$12.50 each month.

a. Write and graph a linear equation that represents the balance in your account.

b. How many months will it take you to save enough money to buy 10 acres of land on Mars?

22. **CAMERA** One second of video on your digital camera uses the same amount of memory as two pictures. Your camera can store 250 pictures.

a. Write and graph a linear equation that represents the number y of pictures your camera can store if you take x seconds of video.

b. How many pictures can your camera store after you take the video shown?

23. **SEA LEVEL** Along the U.S. Atlantic Coast, the sea level is rising about 2 millimeters per year.

a. Write and graph a linear equation that represents how much sea level rises over a period of time.

b. How many millimeters has sea level risen since you were born?

24. Geometry The sum S of the measures of the angles of a polygon is $S = (n - 2) \cdot 180°$, where n is the number of sides of the polygon. Plot four points (n, S) that satisfy the equation. Do the points lie on a line? Explain your reasoning.

Fair Game Review What you learned in previous grades & lessons

Write the ordered pair corresponding to the point.

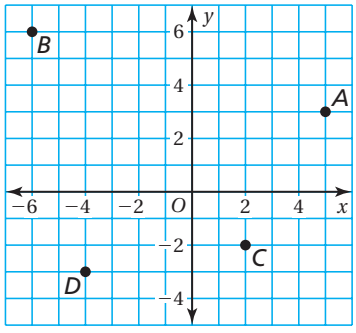
SKILLS REVIEW HANDBOOK

25. Point A

26. Point B

27. Point C

28. Point D



29. **MULTIPLE CHOICE** A debate team has 15 female members. The ratio of females to males is 3 : 2. How many males are on the debate team? SKILLS REVIEW HANDBOOK

(A) 6 (B) 10 (C) 22 (D) 25