

13.1 Graphing Linear Equations

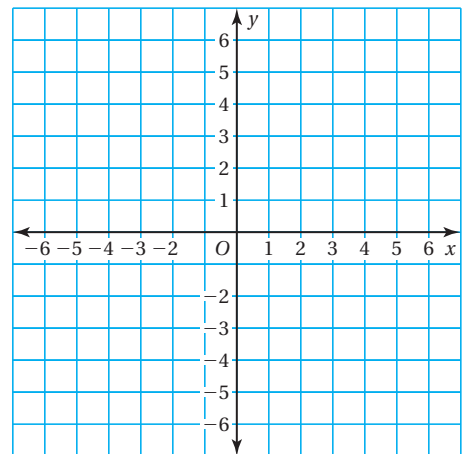
Essential Question How can you recognize a linear equation?
How can you draw its graph?

1 ACTIVITY: Graphing a Linear Equation

Work with a partner.

- Use the equation $y = \frac{1}{2}x + 1$ to complete the table. (Choose any two x -values and find the y -values.)
- Write the two ordered pairs given by the table. These are called *solution points* of the equation.
- PRECISION** Plot the two solution points. Draw a line *exactly* through the two points.
- Find a different point on the line. Check that this point is a solution point of the equation $y = \frac{1}{2}x + 1$.
- LOGIC** 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.

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



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

- LOGIC** 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.
- Why do you think $y = ax + b$ is called a *linear equation*?

Graphing Equations

In this lesson, you will

- understand that lines represent solutions of linear equations.
- graph linear equations.

2

ACTIVITY: Using a Graphing Calculator

Use a graphing calculator to graph $y = 2x + 5$.

- a. Enter the equation $y = 2x + 5$ into your calculator.

```

Plot1 Plot2 Plot3
Y1=2X+5
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
  
```

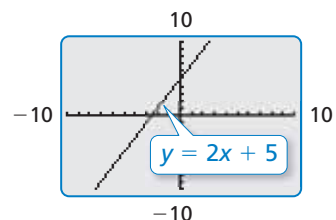
- b. Check the settings of the *viewing window*. The boundaries of the graph are set by the minimum and the maximum x - and y -values. The numbers of units between the tick marks are set by the x - and y -scales.

```

WINDOW
Xmin=-10
Xmax=10
Xscl=1
Ymin=-10
Ymax=10
Yscl=1
Xres=1
  
```

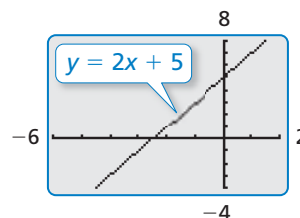
This is the standard viewing window.

- c. Graph $y = 2x + 5$ on your calculator.



- d. Change the settings of the viewing window to match those shown.

Compare the two graphs.

**Math Practice****Recognize Usefulness of Tools**

What are some advantages and disadvantages of using a graphing calculator to graph a linear equation?

What Is Your Answer?

- 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.
- Use a graphing calculator to graph $y = 5x - 12$ in the standard viewing window.
 - Can you tell where the line crosses the x -axis? Can you tell where the line crosses the y -axis?
 - How can you adjust the viewing window so that you can determine where the line crosses the x - and y -axes?
- CHOOSE TOOLS** You want to graph $y = 2.5x - 3.8$. Would you graph it by hand or by using a graphing calculator? Why?

Practice

Use what you learned about graphing linear equations to complete Exercises 3 and 4 on page 570.

Key Vocabulary

linear equation,
p. 568
solution of a linear
equation, p. 568

Remember

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

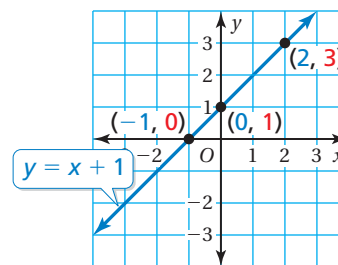
Key Idea

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 $y = -2x + 1$.

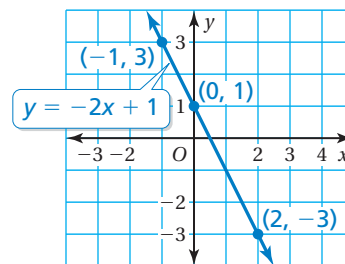
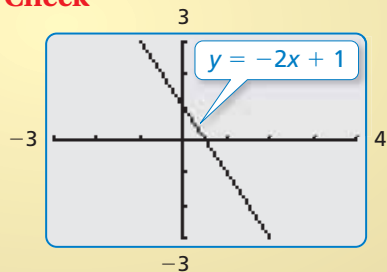
Step 1: Make a table of values.

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.

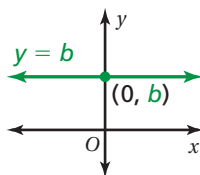
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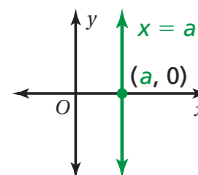
Key Idea

Graphing Horizontal and Vertical Lines

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



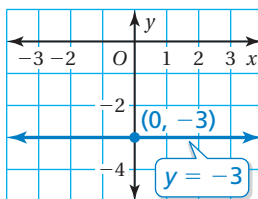
The graph of $x = a$ is a vertical line passing through $(a, 0)$.



EXAMPLE 2 Graphing a Horizontal Line and a Vertical Line

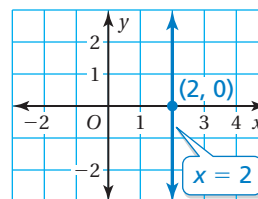
a. Graph $y = -3$.

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.



Now You're Ready
Exercises 5–16

On Your Own

Graph the linear equation. Use a graphing calculator to check your graph, if possible.

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

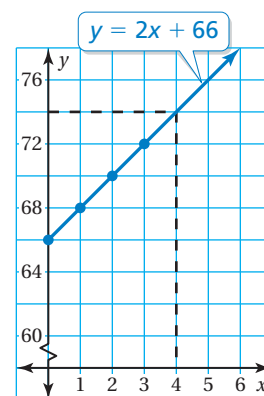


A tropical storm becomes a hurricane when wind speeds are at least 74 miles per hour.

- 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?** The wind speed of the storm is $y = 1.5x + 62$. When does the storm become a hurricane?

Vocabulary and Concept Check

- VOCABULARY** What type of graph represents the solutions of the equation $y = 2x + 4$?
- WHICH ONE DOESN'T BELONG?** Which equation does *not* belong with the other three? Explain your reasoning.

$$y = 0.5x - 0.2$$

$$4x + 3 = y$$

$$y = x^2 + 6$$

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

Practice and Problem Solving

PRECISION 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		
$y = 3x - 1$		

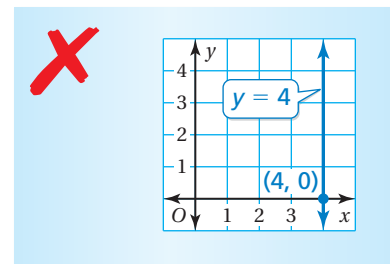
4.

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

Graph the linear equation. Use a graphing calculator to check your graph, if possible.

- | | | | | | |
|---|---|------------------------|-----------------------|----------------------------|--------------------------------------|
| 1 | 2 | 5. $y = -5x$ | 6. $y = \frac{1}{4}x$ | 7. $y = 5$ | 8. $x = -6$ |
| | | 9. $y = x - 3$ | 10. $y = -7x - 1$ | 11. $y = -\frac{x}{3} + 4$ | 12. $y = \frac{3}{4}x - \frac{1}{2}$ |
| | | 13. $y = -\frac{2}{3}$ | 14. $y = 6.75$ | 15. $x = -0.5$ | 16. $x = \frac{1}{4}$ |

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



18. **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. What does the graph tell you?



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

Solve for y . Then graph the equation. Use a graphing calculator to check your graph.

20. $y - 3x = 1$ 21. $5x + 2y = 4$
 22. $-\frac{1}{3}y + 4x = 3$ 23. $x + 0.5y = 1.5$

24. **SAVINGS** You have \$100 in your savings account and plan to deposit \$12.50 each month.
- Graph a linear equation that represents the balance in your account.
 - How many months will it take you to save enough money to buy 10 acres of land on Mars?

25. **GEOMETRY** The sum S of the interior angle measures of a polygon with n sides is $S = (n - 2) \cdot 180^\circ$.
- Plot four points (n, S) that satisfy the equation. Is the equation a linear equation? Explain your reasoning.
 - Does the value $n = 3.5$ make sense in the context of the problem? Explain your reasoning.

26. **SEA LEVEL** Along the U.S. Atlantic coast, the sea level is rising about 2 millimeters per year. How many millimeters has sea level risen since you were born? How do you know? Use a linear equation and a graph to justify your answer.



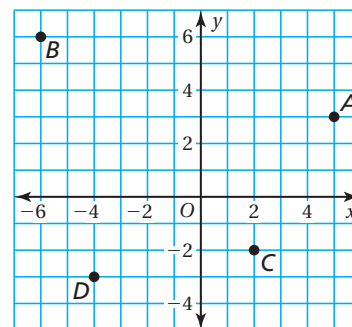
27. **Problem Solving** One second of video on your digital camera uses the same amount of memory as two pictures. Your camera can store 250 pictures.
- Write and graph a linear equation that represents the number y of pictures your camera can store when you take x seconds of video.
 - How many pictures can your camera store in addition to the video shown?



Fair Game Review what you learned in previous grades & lessons

Write the ordered pair corresponding to the point.
(Skills Review Handbook)

28. point A 29. point B
 30. point C 31. point D
32. **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