

4.6

Quick Graphs Using Slope-Intercept Form

What you should learn

GOAL 1 Graph a linear equation in slope-intercept form.

GOAL 2 Graph and interpret equations in slope-intercept form that model **real-life** situations, such as the snowstorm in Exs. 56–59.

Why you should learn it

▼ To model **real-life** situations, such as a flooding river in Example 4.



Mississippi and Ohio Rivers flooding

GOAL 1 GRAPHING USING SLOPE-INTERCEPT FORM

In Lesson 4.4 you learned to find the slope of a line given two points on the line. There is also a method for finding the slope given an equation of a line.

ACTIVITY

Developing Concepts

Investigating Slope-Intercept Form

Copy and complete the table. Then write a generalization about the meaning of m and b in $y = mx + b$.

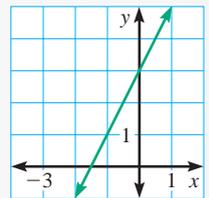
	Equation	Two solutions	Slope	y-Intercept
1.	$y = 2x + 1$	$(0, ?), (?, 0)$?	?
2.	$y = -2x - 3$	$(0, ?), (?, 0)$?	?
3.	$y = x + 4$	$(0, ?), (?, 0)$?	?
4.	$y = 0.5x - 2.5$	$(0, ?), (?, 0)$?	?

In this activity, you may have discovered the following idea, which applies only when an equation is in slope-intercept form.

SLOPE-INTERCEPT FORM OF THE EQUATION OF A LINE

The linear equation $y = mx + b$ is written in **slope-intercept form**. The slope of the line is m . The y-intercept is b .

$y = 2x + 3$
Slope is **2**.
y-intercept is **3**.



EXAMPLE 1 Writing Equations in Slope-Intercept Form

EQUATION	SLOPE-INTERCEPT FORM	SLOPE	y-INTERCEPT
a. $y = -x + 2$	$y = (-1)x + 2$	$m = -1$	$b = 2$
b. $y = \frac{x+3}{2}$	$y = \frac{1}{2}x + \frac{3}{2}$	$m = \frac{1}{2}$	$b = \frac{3}{2}$
c. $y = -4$	$y = 0x - 4$	$m = 0$	$b = -4$
d. $2x - 4y = 16$	$y = 0.5x - 4$	$m = 0.5$	$b = -4$

EXAMPLE 2 Graphing Using Slope and y-Intercept

Graph the equation $3x + y = 2$.

SOLUTION

Write the equation in slope-intercept form.

$$y = -3x + 2$$

Find the slope and the y-intercept.

$$m = -3 \quad b = 2$$

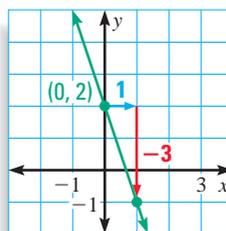
Plot the point $(0, b)$.

Draw a slope triangle to locate a second point on the line.

$$m = \frac{-3}{1} = \frac{\text{rise}}{\text{run}}$$

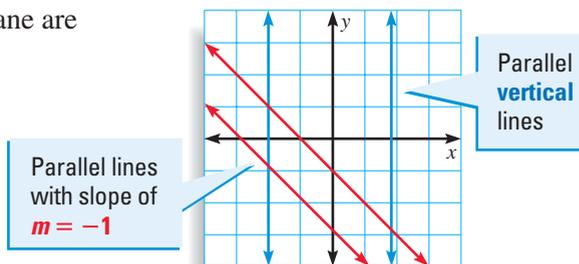
Draw a line through the two points.

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Two different lines in the same plane are **parallel** if they do not intersect.

In a coordinate plane, any two vertical lines are parallel. Any two nonvertical lines are parallel if and only if they have the same slope.



EXAMPLE 3 Identifying a Family of Parallel Lines

Which of the following lines are parallel?

line a: $-x + 2y = 6$

line b: $-x + 2y = -2$

line c: $x + 2y = 4$

SOLUTION Begin by writing each equation in slope-intercept form.

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

line b: $y = \frac{1}{2}x - 1$

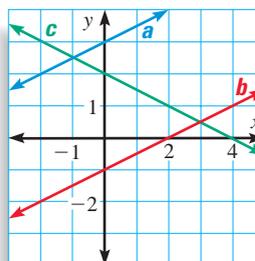
line c: $y = -\frac{1}{2}x + 2$

Lines **a** and **b** are parallel because each has a slope of $\frac{1}{2}$.

Line **c** is not parallel to either of the other two lines because it has a slope of $-\frac{1}{2}$.

✓ **CHECK** The graph gives you a visual check. It shows that line **c** intersects each of the two parallel lines.

▶ Line **a** and line **b** are parallel.



GOAL 2 SOLVING REAL-LIFE PROBLEMS

EXAMPLE 4 Graphing Using Slope-Intercept Form

CITY PLANNING You are an intern at a city planner's office and are asked to create a graph for a planning board meeting. The graph will represent different heights of a local river during a flood.

You are given the following equations to model the changing river heights. In each equation, h represents the height of the river (in feet) and t represents the time (in hours) since the flooding began.

$$\text{Stage 1 (first 60 hours): } h = \frac{1}{2}t + 24 \quad 0 \leq t \leq 60$$

$$\text{Stage 2 (next 12 hours): } h = 54 \quad 60 < t \leq 72$$

$$\text{Stage 3 (last 48 hours): } h = -\frac{5}{8}t + 99 \quad 72 < t \leq 120$$

SOLUTION

You decide to graph all three equations in the same coordinate plane and label the graph to describe the three stages of flooding. You notice that each equation is in slope-intercept form. The slope in each equation represents the rate at which the river's height is changing during a particular period of time.

Stage 1: During the first 60 hours, the slope is $\frac{1}{2}$. The river height increased $\frac{1}{2}$ foot per hour, from 24 feet to 54 feet.

Stage 2: During the next 12 hours, the river stayed at a constant peak height of 54 feet.

Stage 3: During the last 48 hours, the slope is $-\frac{5}{8}$. The river height decreased $-\frac{5}{8}$ foot per hour, from 54 feet to a normal 24 feet.

To graph each model, you plot each stage within each domain.

FOCUS ON CAREERS



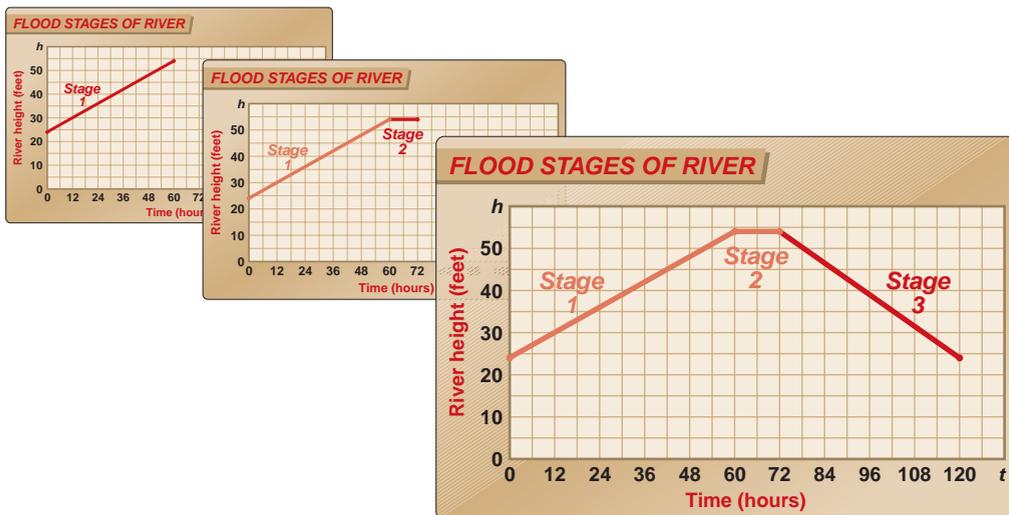
CITY PLANNERS

develop strategies for use of a community's land and resources. They also predict future needs of a community and suggest protection methods for ecologically sensitive areas.



CAREER LINK

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GUIDED PRACTICE

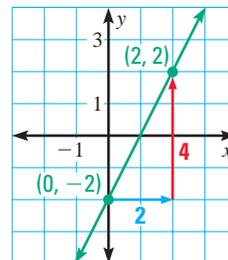
Vocabulary Check ✓

Concept Check ✓

Skill Check ✓

- Why is the equation $y = mx + b$ called the *slope-intercept form*?
- Explain how to graph $2x - 3y = 6$ using slope-intercept form.
- Decide whether the graphs of $y = x + 2$ and $y = x - 4$ are parallel lines.
- Choose the equation whose graph is shown at the right.

A. $y = \frac{1}{2}x - 2$ B. $y = 2x - 2$ C. $y = 2x$



Find the slope and the y -intercept of the graph of the equation.

- $y = 2x + 1$
- $y = 11x$
- $y = x + 3$
- $y = -1.5x$
- $y = 5x - 3$
- $y = -x - 2$

SAVINGS ACCOUNT In Exercises 11 and 12, you have \$50 in your savings account at the beginning of the year. Each month you save \$30. Assuming no interest is paid, the equation $s = 30m + 50$ models the amount of money s in your savings account after m months.

- What is the slope of the graph of the line? What is the y -intercept?
- Graph your total savings.

PRACTICE AND APPLICATIONS

STUDENT HELP

Extra Practice
to help you master skills is on p. 800.

SLOPE AND y -INTERCEPT Find the slope and the y -intercept of the graph of the equation.

- $y = 6x + 4$
- $y = 3x + 1$
- $y = 2x - 3$
- $y - 9x = 0$
- $y = -2$
- $3x + 4y = 16$
- $y = \frac{x+2}{4}$
- $y = \frac{6-x}{3}$
- $12x + 4y - 2 = 0$

GRAPHING LINES Graph the equation.

- $y = x + 3$
- $y = 2x - 1$
- $y = x + 5$
- $y = -x + 4$
- $y = 6 - x$
- $y = 3x + 7$
- $y = 4x + 4$
- $y = x + 9$
- $y = 4x + 9$
- $y = \frac{2}{3}x$
- $y = -\frac{1}{2}x - 3$
- $y = 2$

STUDENT HELP

HOMEWORK HELP

- Example 1:** Exs. 13–21
Example 2: Exs. 22–45, 52–55
Example 3: Exs. 46–51
Example 4: Exs. 56–59

GRAPHING LINES Write the equation in slope-intercept form. Then graph the equation.

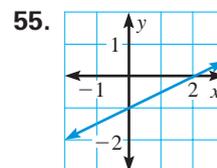
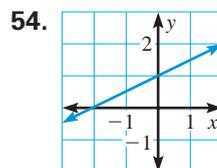
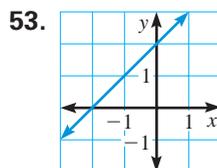
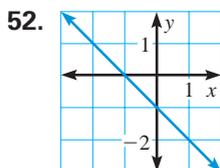
- $y = -2$
- $3x - 6y = 9$
- $4x + 5y = 15$
- $4x - y - 3 = 0$
- $x - y + 4 = 0$
- $x + y = 0$
- $x - y = 0$
- $x + 3y - 3 = 0$
- $2x - 3y - 6 = 0$
- $y - 0.5 = 0$
- $5(x + 3 + y) = 10x$
- $2x + 3y - 4 = x + 5$

PARALLEL LINES Decide whether the graphs of the two equations are parallel lines. Explain your answer.

46. $y = -3x + 2$, $y + 3x = -4$ 47. $2x - 12 = y$, $y = 10 + 2x$
 48. $y + 6x - 8 = 0$, $2y = 12x - 4$ 49. $3y - 4x = 3$, $3y = -4x + 9$
 50. $y + 3x = 6x + 1$, $9x - 3y = 7$ 51. $-x + 3 + y = 2x + 3$, $y + 4 = 3x$

MATCHING EQUATIONS AND GRAPHS Match the equation with its graph.

- A. $y = \frac{1}{2}x + 1$ B. $y = \frac{1}{2}x - 1$ C. $y = x + 2$ D. $y = -x - 1$



FOCUS ON APPLICATIONS



SNOWSTORMS

Each year an average of 105 snowstorms affect the continental United States.

SNOWSTORM In Exercises 56–59, snow fell for 9 hours at a rate of $\frac{1}{2}$ inch per hour. Before the snowstorm began, there were already 6 inches of snow on the ground. The equation $y = \frac{1}{2}x + 6$ models the depth y of snow on the ground after x hours.

56. What is the slope of $y = \frac{1}{2}x + 6$? What is the y -intercept?
 57. **CRITICAL THINKING** Explain what the slope and the y -intercept mean in the snowstorm model.
 58. Graph the amount of snow on the ground during the storm.
 59. **Writing** In the Apple County School District, school is canceled if there is a foot or more of snow on the ground. If this 9-hour storm occurred in Apple County, would school be canceled? Explain your reasoning.

PHONE CALL In Exercises 60 and 61, the cost of a long-distance telephone call is \$.87 for the first minute and \$.15 for each additional minute.

60. **PLOTTING POINTS** Let c represent the total cost of a call that lasts t minutes. Plot points for the costs of calls that last 1, 2, 3, 4, 5, and 6 minutes.
 61. **CRITICAL THINKING** Draw a line through the points you plotted in Exercise 60. Find the slope. What does the slope represent?

GEOMETRY CONNECTION In Exercises 62–63, use the following linear equations.

line a : $y = -x + 2$ line b : $y = -1$ line c : $y = x + 2$

62. Which of the lines are parallel? Explain.
 63. Graph each equation in the same coordinate plane. What type of polygon do they form? Find the area of the polygon. Justify your method.
MODELING REAL LIFE In Exercises 64 and 65, graph the situation.
 64. You start from home and drive 55 miles per hour for 3 hours, where d is your distance from home.
 65. You start 165 miles from home and drive toward home at 55 miles per hour for 3 hours, where d is your distance from home.

STUDENT HELP



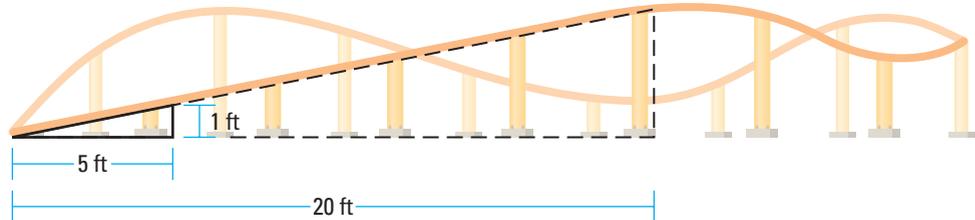
HOMEWORK HELP

Visit our Web site www.mcdougallittell.com for help with problem solving in Ex. 63.

STUDENT HELP

APPLICATION LINK
 Visit our Web site
www.mcdougallittell.com
 for more information
 about roller coasters.

ROLLER COASTER In Exercises 66–68, use the following information. You are supervising the construction of a roller coaster for young children. For the first 20 feet of horizontal distance, the track must rise off the ground at a constant rate. After your crew has constructed 5 feet of horizontal distance, the track is 1 foot off the ground.



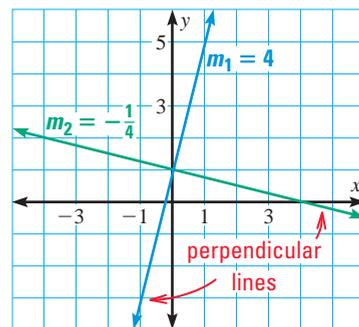
66. Plot points for the heights of the track at 5-foot intervals. Draw a line through the points. Find the slope of the line. What does the slope represent?
67. After 20 feet of horizontal distance is constructed, you are at the highest point of your roller coaster. How high off the ground is the track?
68. During construction, the park passes a regulation that the track for any roller coaster for young children must not be higher than 5 feet off the ground. Will your roller coaster pass inspection when it is completed?
69. **MULTIPLE CHOICE** What is the slope of a line parallel to the graph of the equation $1.6x - 3.2y = 16$?
- (A) -5 (B) 0.5 (C) -0.5 (D) 5
70. **MULTIPLE CHOICE** If $y + 8 = 0$, what is the slope of the graph?
- (A) Undefined (B) 1 (C) 0 (D) -1

Test Preparation

★ Challenge

GEOMETRY CONNECTION In Exercises 71–73, graph the two equations in the same coordinate plane. Use the following information to decide whether the lines are perpendicular.

It can be shown that two different nonvertical lines in the same plane with slopes m_1 and m_2 are perpendicular if and only if m_2 is the negative reciprocal of m_1 .



71. $y = 2x + 4$ 72. $y = -\frac{1}{3}x - 4$ 73. $y = 1 + \frac{2}{3}x$
 $y = -\frac{1}{2}x + 2$ $y = 3x + 2$ $y = \frac{3}{2}x - 2$

PERPENDICULAR LINES In Exercises 74–76, use Exercises 71–73 to help you write an equation of a line that is perpendicular to the given line.

74. $y = 3x - 4$ 75. $y = -2x + 1$ 76. $y = \frac{4}{3}x - 3$

77. **PARALLEL LINES** Is it possible to find another line that is parallel to $3x + 9y = 1$ and passes through the point $(0, \frac{1}{9})$? Explain your reasoning.

EXTRA CHALLENGE

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MIXED REVIEW

SOLVING EQUATIONS Solve the equation. (Review 3.3, 3.4 for 4.7)

78. $x + 6 = 14$

79. $9 - y = 4$

80. $7b = 21$

81. $\frac{a}{4} = 3$

82. $\frac{1}{3}g - 2 = 1$

83. $3p - 12 = 6$

84. $2(v + 1) = 4$

85. $3(r - 1) = 2(r - 2)$

86. $5(w - 5) = 25$

87.  **COIN COLLECTION** You have 32 coins in a jar. Each coin is either copper or silver. You have 8 more copper coins than silver coins. Let c be the number of copper coins. Which equation correctly models the situation? (Review 1.5)

A. $(c - 8) + c = 32$

B. $c + (c + 8) = 32$

-  **COST OF RAISING A CHILD** In Exercises 88 and 89, the table shows estimated costs of raising a child born in 1996 to a low income family for the child's first seven years. (Review 1.6)

Year	1996	1997	1998	1999	2000	2001	2002
Cost (in dollars)	5670	5960	6280	6730	7080	7450	8000



DATA UPDATE of USDA data at www.mcdougallittell.com

88. Make a line graph of the data.
89. During which year did the cost increase the most?

QUIZ 2

Self-Test for Lessons 4.4–4.6

Find the slope of the line passing through the points. (Lesson 4.4)

1. $(0, 0), (5, 2)$

2. $(1, -3), (-4, -5)$

3. $(3, 3), (-6, -4)$

4. $(-3, 2), (-5, -2)$

5. $(0, -4), (5, -4)$

6. $(1, -2), (-7, 6)$

The variables x and y vary directly. Given one pair of values for x and y , find an equation that relates the variables. (Lesson 4.5)

7. $x = 2, y = 10$

8. $x = 8, y = 64$

9. $x = 12, y = 72$

10. $x = 16, y = 12$

11. $x = 10, y = 7$

12. $x = 18, y = 8$

Write the equation in slope-intercept form. Then graph the equation. (Lesson 4.6)

13. $y = 2x - 4$

14. $6x + 12y + 4 = 0$

15. $x - 2y = 12$

16. $x - y + 2 = 0$

17. $x + 2y - 2 = 0$

18. $\frac{3}{2}x + \frac{3}{2}y = \frac{3}{4}$

19.  **BUSINESS** On January 1, a company had \$365,800 in its account. On June 1, the company had \$215,400 in its account. If the amount in the company's account changed by an equal amount each month, find the rate of change. Give your answer in dollars per month. (Lesson 4.4)