# 6-2 Slope-Intercept Form

**What You'll Learn**

- To write linear equations in slope-intercept form
- To graph linear equations

**...And Why**

To use a graph to relate total earnings to sales, as in Example 5

## Check Skills You'll Need

GO for Help Lessons 1-2 and 2-3

**Evaluate each expression.**

1. $6a + 3$ for $a = 2$
2. $-2x - 5$ for $x = 3$
3. $\frac{1}{4}x + 2$ for $x = 16$
4. $0.2x + 2$ for $x = 15$
5. $8 - 5n$ for $n = 3$
6. $-4p + 9$ for $p = 2$

## New Vocabulary

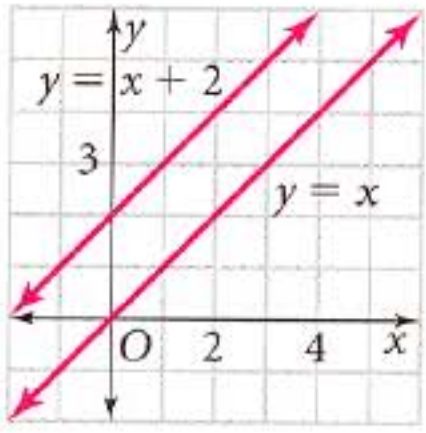
- linear equation
- parent function
- linear parent function
- *y*-intercept
- slope-intercept form

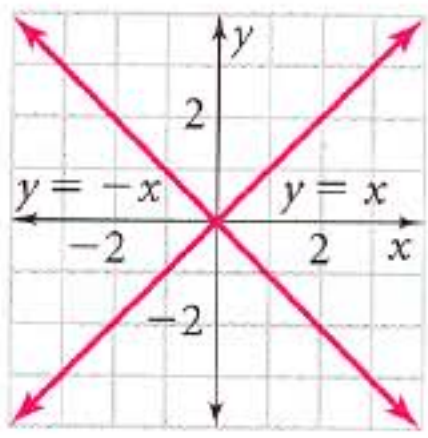
## 1 Writing Linear Equations

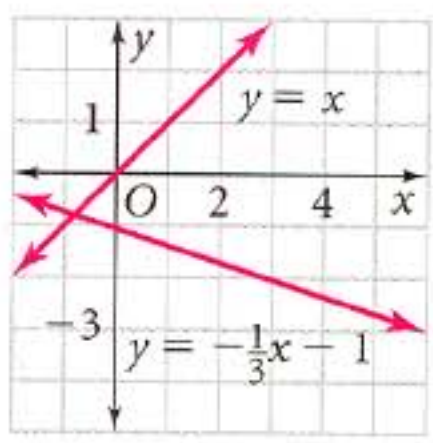
**Vocabulary Tip**

The word linear contains the word "line".

An equation whose graph is a line is a **linear equation.** A variable in a linear equation cannot be raised to a power other than 1. So $y = 2x$ is a linear equation but $y = x^2$ or $y = 2^x$ are not. All linear equations are related.



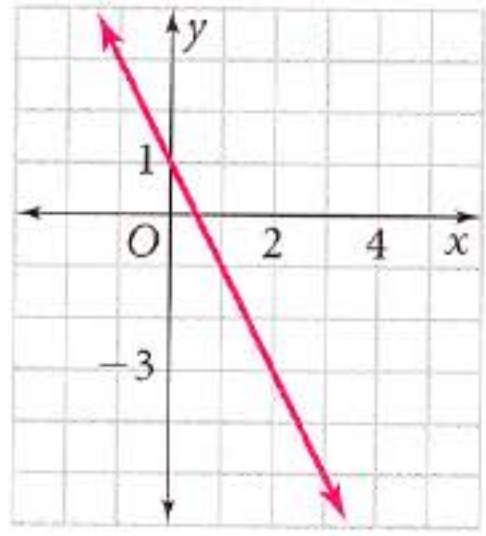




The functions shown above all graph as lines. A **parent function** is the simplest equation of a function. The equation $y = x$ or $f(x) = x$ is the **linear parent function** for all equations that graph as lines.

The equation of a line gives important information about its graph. Consider the table and graph of the equation $y = -2x + 1$.

| $x$ | $-2x + 1$ | $y$ |
|---|---|---|
| 0 | $-2(0) + 1$ | 1 |
| 1 | $-2(1) + 1$ | −1 |
| 2 | $-2(2) + 1$ | −3 |




Two points on the line are $(0, 1)$ and $(2, -3)$. The slope is $\frac{1 - (-3)}{0 - 2} = -\frac{4}{2}$ or $-2$. The **y-intercept** is the $y$-coordinate of the point where a line crosses the $y$-axis. Since $y = -2x + 1$ crosses the $y$-axis at $(0, 1)$, the $y$-intercept is 1.

If you know the slope of a line and its $y$-intercept, you can write the equation of the line. The letter $m$ refers to the *slope*.

## Key Concepts

**Definition** **Slope-Intercept Form of a Linear Equation**

The **slope-intercept form** of a linear equation is $y = mx + b$.

slope: $m$ ↑ $y$-intercept: $b$ ↑

### Test-Taking Tip

As you do homework, make a list of formulas you can use later to study for quizzes and tests.

## 1 EXAMPLE Identifying Slope and y-Intercept

What are the slope and $y$-intercept of $y = 3x - 5$?

$y = mx + b$ **Use the slope-intercept form.**

$y = 3x + (-5)$ **Think of $y = 3x - 5$ as $y = 3x + (-5)$.**

- The slope is 3; the $y$-intercept is $-5$.

**Quick Check**

1. **a.** Find the slope and $y$-intercept of $y = \frac{7}{6}x - \frac{3}{4}$.
   **b. Critical Thinking** For the equation in Example 1, what happens to the graph of the line and to the equation if the $y$-intercept is moved down 3 units?

## 2 EXAMPLE Writing an Equation

Write an equation of the line with slope $\frac{3}{8}$ and $y$-intercept 6.

$y = mx + b$ **Use the slope-intercept form.**

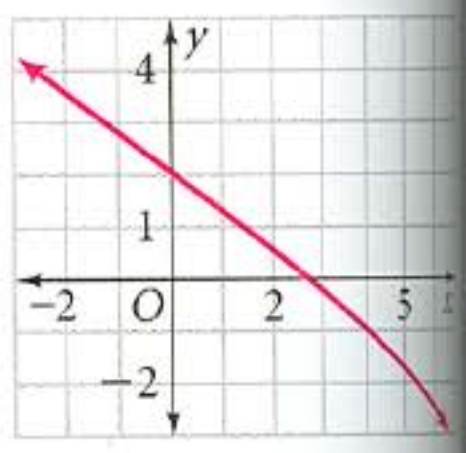
$y = \frac{3}{8}x + 6$ **Substitute $\frac{3}{8}$ for $m$ and 6 for $b$.**

**Quick Check**

2. Write an equation of a line with slope $m = \frac{2}{5}$ and $y$-intercept $b = -1$. $\frac{2}{5}$

## 3 EXAMPLE Writing an Equation From a Graph

**Multiple Choice** Which equation models the linear function shown in the graph?




(A) $y = -\frac{3}{4}x + 2$ (B) $y = -\frac{4}{3}x + 2$

(C) $y = 2x - \frac{4}{3}x$ (D) $y = 2x - \frac{3}{4}$

Find the slope. Two points on the line are $(0, 2)$ and $(4, -1)$.

$$\text{slope} = \frac{-1 - 2}{4 - 0} = -\frac{3}{4}$$

The $y$-intercept is 2. Write an equation in slope-intercept form.

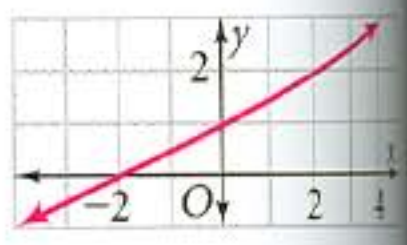
$y = mx + b$

$y = -\frac{3}{4}x + 2$ **Substitute $-\frac{3}{4}$ for $m$ and 2 for $b$.**

- The equation is $y = -\frac{3}{4}x + 2$. So the answer is A.

**Quick Check**

3. **a.** Write the equation of the line using the points $(0, 1)$ and $(2, 2)$.
   **b. Critical Thinking** Does the equation of the line change if you use $(-2, 0)$ instead of $(2, 2)$? Explain.

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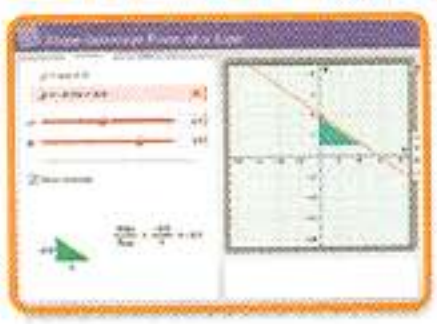


**For:** Slope-Intercept Activity
**Use:** Interactive Textbook, 6-2

## 2 Graphing Linear Equations

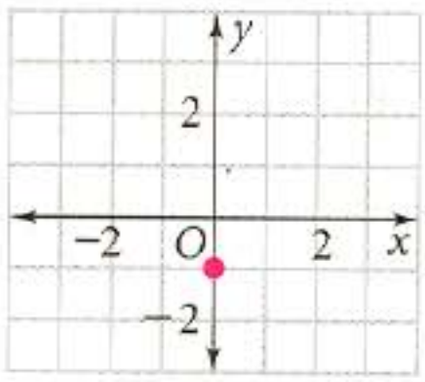
Each point on the graph of an equation is an ordered pair that makes the equation true. The graph of a linear equation is a line that indicates all the solutions of the equation. You can use the slope and $y$-intercept to graph a line.

### 4 EXAMPLE Graphing Equations

Graph $y = 3x - 1$.

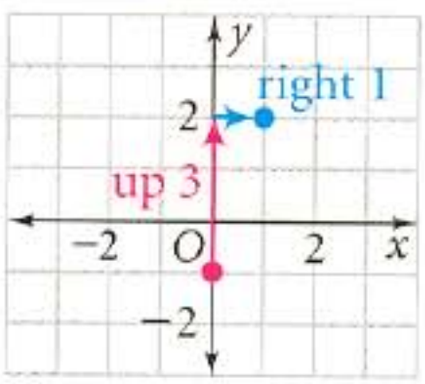
**Step 1**

The $y$-intercept is $-1$. So plot a point at $(0, -1)$.



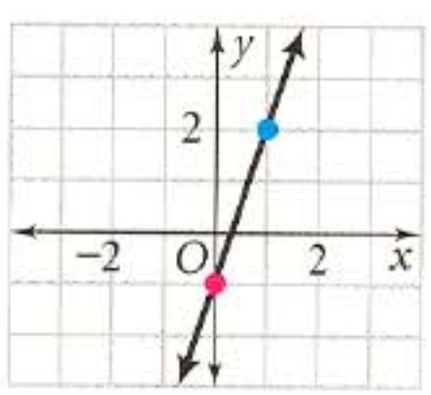

**Step 2**

The slope is 3, or $\frac{3}{1}$. Use the slope to plot a second point.




**Step 3**

Draw a line through the two points.




**Quick Check** 4 Graph $y = \frac{3}{2}x - 2$.

When you graph equations for real-world situations, use scales on the $x$- and $y$-axes that are reasonable for the situation. Recall that you can avoid having a large blank space in a graph by using a zigzag line to show a break in a scale.

### 5 EXAMPLE Real-World Problem Solving

**Commission** The base pay of a water-delivery person is \$210 per week. He also earns 20% commission on any sale he makes. The equation $t = 210 + 0.2s$ relates total earnings $t$ to sales $s$. Graph the equation.

**Step 1** Identify the slope and $y$-intercept.

$$t = 210 + 0.2s$$

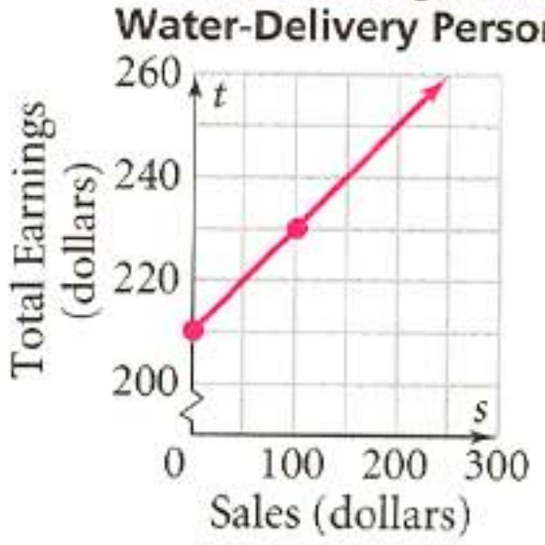
$$t = 0.2s + 210$$ Rewrite the equation in slope-intercept form.

$0.2$: slope; $210$: $y$-intercept

**Step 2** Plot two points. First plot $(0, 210)$, the $y$-intercept. Then use the slope to plot a second point.

The slope is 0.2, which equals $\frac{2}{10}$, or $\frac{20}{100}$. Plot a second point 20 units above and 100 units to the right of the $y$-intercept.

**Step 3** Draw a line through the points.




**Real-World Connection**

Between 1990 and 1999, the sales of bottled water in the United States increased 107.6%, which means that sales more than doubled.

**Quick Check** 5 Suppose the base pay of the delivery person is \$150, and his commission on each sale is 30%. The equation relating his total earnings $t$ to sales $s$ is $t = 150 + 0.3s$. Graph the equation.

# EXERCISES

For more exercises, see *Extra Skill and Word Problem Practice.*

## Practice and Problem Solving

### A Practice by Example

**Example 1 (page 318)**

**Find the slope and *y*-intercept of each equation.**

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

**4.** $y = 5x + 8$ **5.** $y = \frac{2}{3}x + 1$ **6.** $y = -4x$

**7.** $y = -x - 7$ **8.** $y = -0.7x - 9$ **9.** $y = -\frac{3}{4}x - 5$

**Example 2 (page 318)**

**Write an equation of a line with the given slope and *y*-intercept.**

**10.** $m = \frac{2}{9}, b = 3$ **11.** $m = 3, b = \frac{2}{9}$ **12.** $m = \frac{9}{2}, b = 3$

**13.** $m = 0, b = 1$ **14.** $m = -1, b = -6$ **15.** $m = -\frac{2}{3}, b = 5$

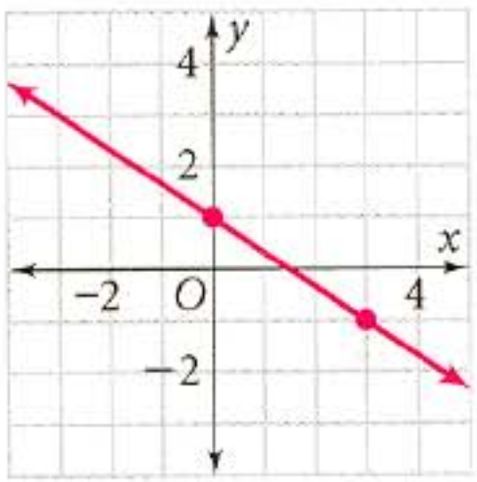
**16.** $m = 0.3, b = 4$ **17.** $m = 0.4, b = 0.6$ **18.** $m = -7, b = \frac{1}{3}$

**19.** $m = -\frac{1}{5}, b = -\frac{2}{5}$ **20.** $m = -\frac{1}{4}, b = \frac{5}{4}$ **21.** $m = \frac{8}{3}, b = \frac{2}{3}$

**Example 3 (page 318)**

**Write the slope-intercept form of the equation for each line.**

**22.**

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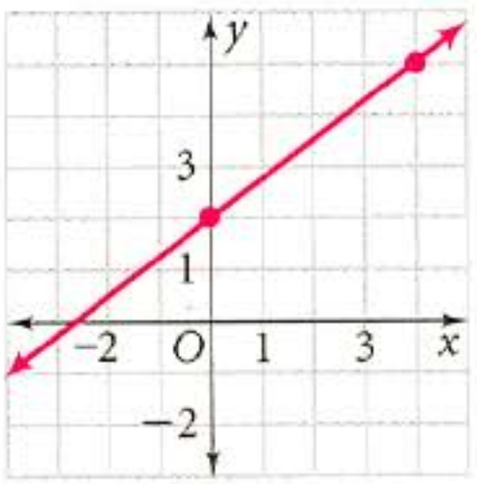


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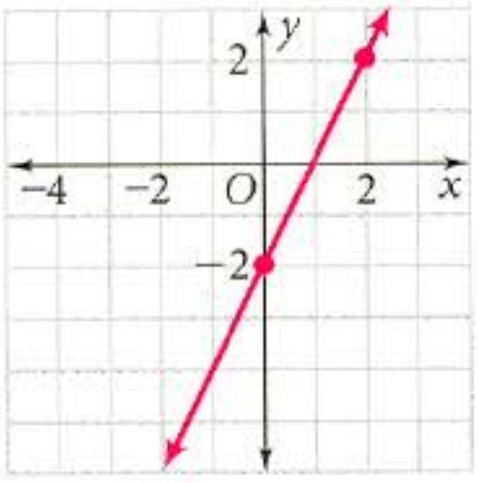


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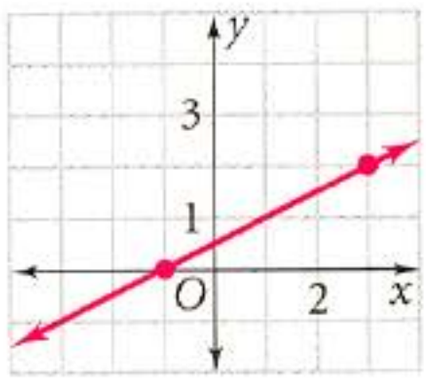


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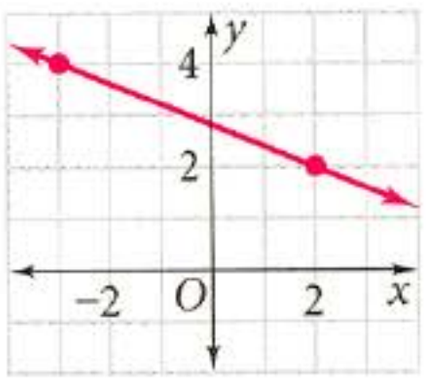


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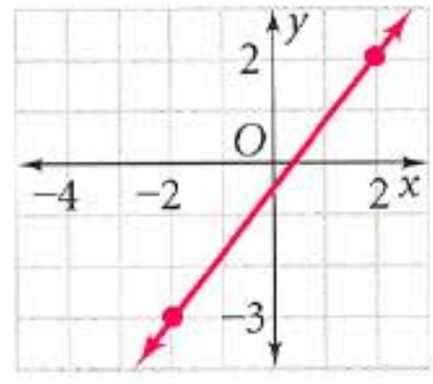



**Example 4 (page 319)**

**Use the slope and *y*-intercept to graph each equation.**

**28.** $y = \frac{1}{2}x + 4$ **29.** $y = \frac{2}{3}x - 1$ **30.** $y = -5x + 2$ **31.** $y = 2x + 5$

**32.** $y = x + 4$ **33.** $y = -x + 2$ **34.** $y = 4x - 3$ **35.** $y = -\frac{3}{2}x$

**36.** $y = \frac{2}{5}x - 3$ **37.** $y = -\frac{2}{3}x + 2$ **38.** $y = -\frac{4}{5}x + 4$ **39.** $y = -0.5x + 2$

**Example 5 (page 319)**

**40. Retail Sales** A music store is offering a coupon promotion on its CDs. The regular price for CDs is \$14. With the coupon, customers are given \$4 off the total purchase. The equation $t = 14c - 4$, where $c$ is the number of CDs and $t$ is the total cost of the purchase, models this situation.

**a.** Graph the equation.

**b.** Find the total cost for a sale of 6 CDs.

### B Apply Your Skills

**Find the slope and *y*-intercept of each equation.**

**41.** $y - 2 = -3x$ **42.** $y + \frac{1}{2}x = 0$ **43.** $y - 9x = \frac{1}{2}$

**44.** $y = 3x - 9$ **45.** $2y - 6 = 3x$ **46.** $-2y = 6(5 - 3x)$

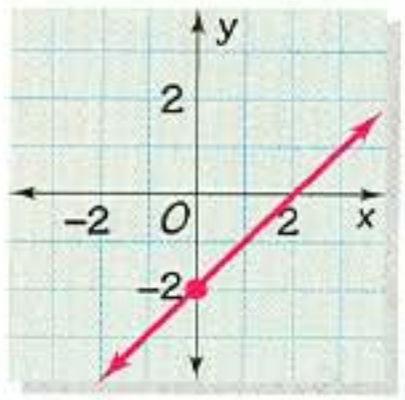
**47.** $y - d = cx$ **48.** $y = (2 - a)x + a$ **49.** $2y + 4n = -6x$

**Use the slope and *y*-intercept to graph each equation.**

**50.** $y = 7 - 3x$ **51.** $2y + 4x = 0$ **52.** $3y + 6 = -2x$

**53.** $y + 2 = 5x - 4$ **54.** $4x + 3y = 2x - 1$ **55.** $-2(3x - 4) + y = 0$

**56. Error Analysis** Fred drew the graph at the right for the equation $y = -2x + 1$. What error did he make?




**57. a.** A candle begins burning at time $t = 0$. Its original height is 12 in. After 30 min the height of the candle is 8 in. Draw a graph showing the change in the height of the candle.

**b.** Write an equation that relates the height of the candle to the time it has been burning.

**c.** How many minutes after the candle is lit will it burn out?

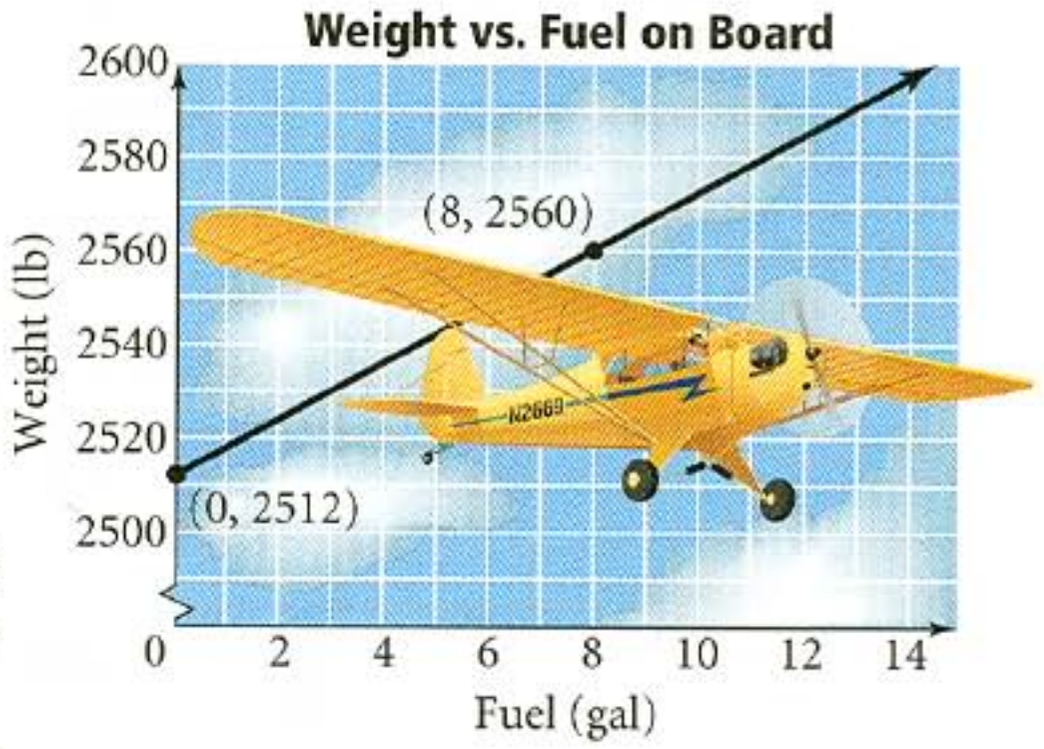
Real-World Connection

Careers Airport ground crews direct airplanes to and from their gates.

**58. Airplane Fuel** The graph shows the relationship between the number of gallons of fuel in the tank of an airplane and the weight of the airplane. The equation $y = 6x + 2512$, where $x$ is the number of gallons of fuel and $y$ is the weight of the airplane, models this situation.

**a.** What does the slope represent?

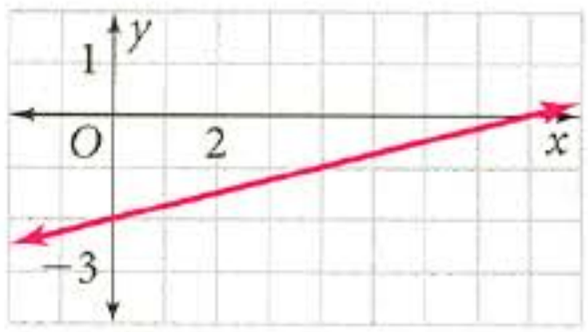
**b.** Use the equation to predict the weight of the plane when the tank contains 25 gallons of fuel.



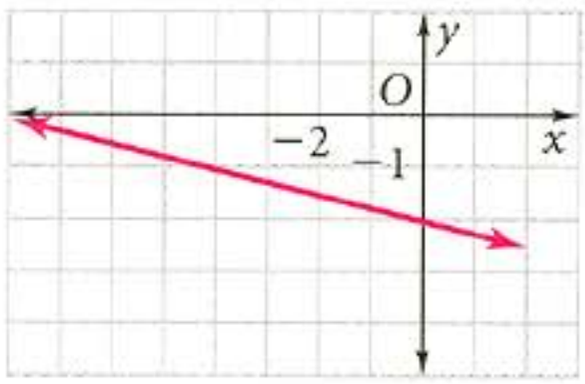

**Is the ordered pair on the graph of the given equation?**

**59.** $(-3, 4); y = -2x + 1$ **60.** $(-6, 5); y = -\frac{1}{2}x + 2$ **61.** $(0, -1); y = x - \frac{5}{4}$

**62. Multiple Choice** At the right is the graph of $y = \frac{1}{4}x - 2$. Which of the graphs below represents the linear function if the slope is doubled and the *y*-intercept stays the same?




A

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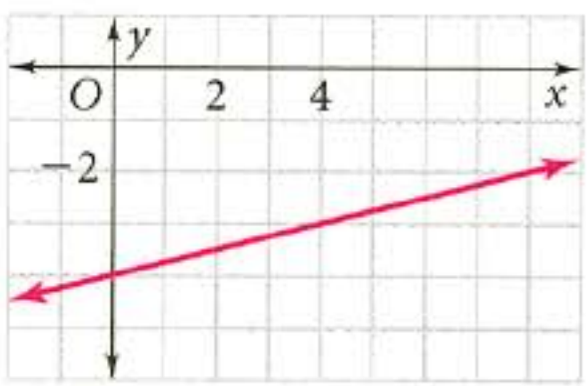


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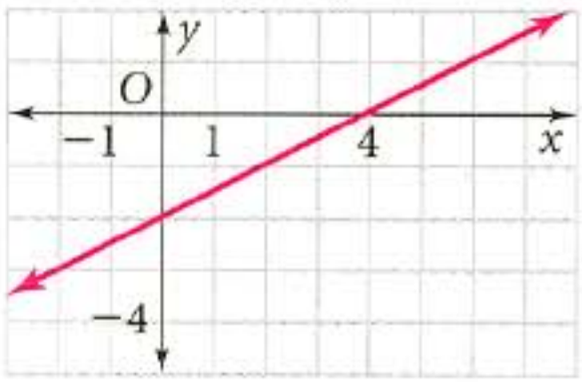


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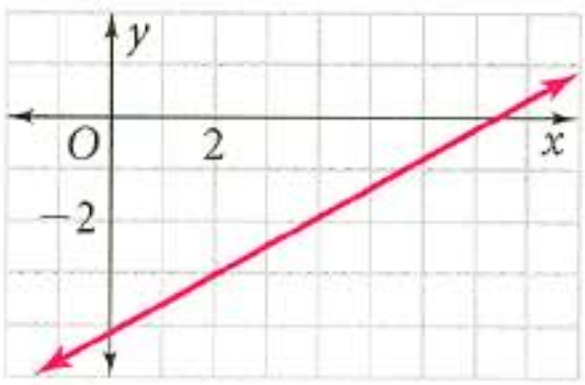


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**Real-World Connection**

In the United States, although 35% of households have pet cats and 37% have pet dogs, there are about 25% more pet cats than pet dogs.

**63. Pet Care** When the Bryants leave town for a vacation, they put their dog Tyco in a kennel. The kennel charges $15 for a first-day flea bath and $5 per day. The equation $t = 15 + 5d$ relates the total charge $t$ to the number of days $d$.

**a.** Rewrite the equation in slope-intercept form.

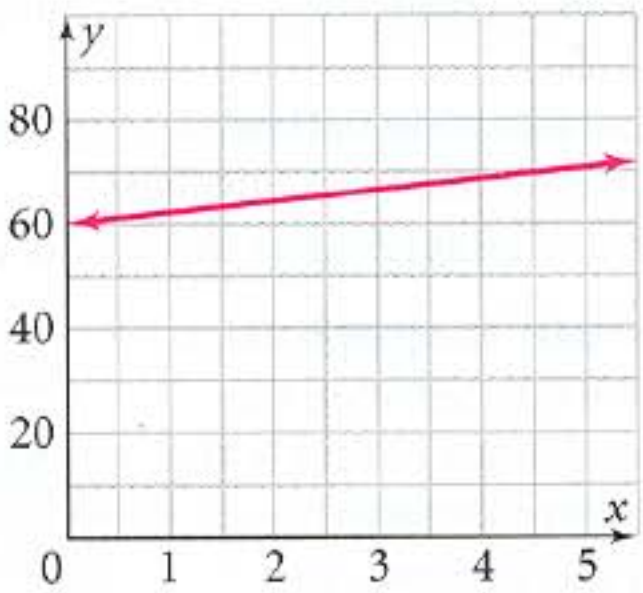
**b.** Graph the equation.

**c.** Explain why the line you graph should lie only in Quadrant I.

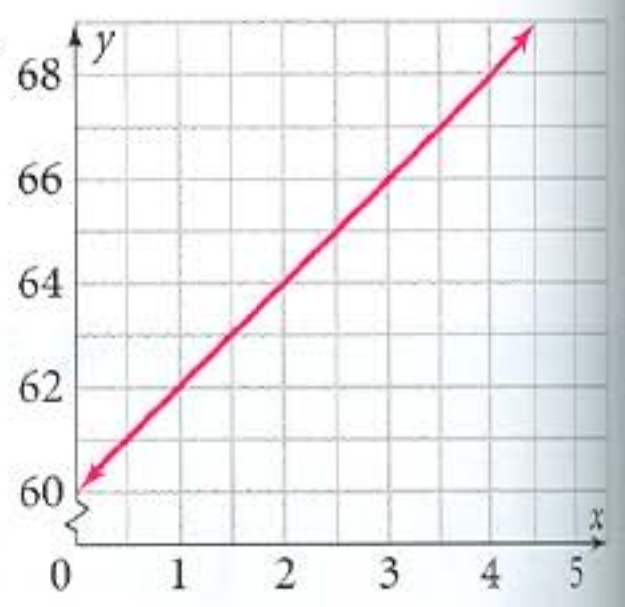
**64. Writing** Explain the steps you would use to graph $y = \frac{3}{4}x + 5$.

**65. Critical Thinking** Which graphed line has the greater slope? Explain.

**A.**




**B.**




**Given two points on a line, write the equation of the line in slope-intercept form.**

**66.** (3, 5), (5, 9)

**67.** (5, –13), (2, –1)

**68.** (–4, 10), (6, 5)

**69.** (8, 7), (–12, 2)

**70.** (–7, 4), (11, –14)

**71.** (–1, –9), (2, 0)

**72. Graphing Calculator** Suppose you want to graph the equation $y = \frac{5}{4}x - 3$. Enter each key sequence and display the graph.

**a.** Y= 5 ÷ 4 X,T,θ,n − 3

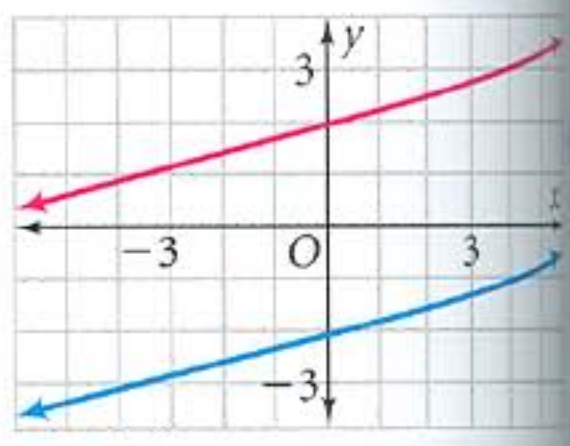
**b.** Y= ( 5 ÷ 4 ) X,T,θ,n −

**c.** Which equation gives you the graph of $y = \frac{5}{4}x - 3$? Explain.

**73. a.** What is the slope of each line?

**b.** What is the $y$-intercept of each line?

**c. Geometry** The lines in the graph are parallel. What appears to be true about the slopes of parallel lines?




**74. Open-Ended** Write a linear equation. Identify the slope and $y$-intercept. Then graph your equation.

**Challenge**

**Find the value of $a$ such that the graph of the equation has the given slope.**

**75.** $y = 2ax + 4; m = -1$ **76.** $y = -\frac{1}{2}ax - 5; m = \frac{5}{2}$ **77.** $y = \frac{3}{4}ax + 3; m = \frac{9}{16}$

**78. a. Geometry** Graph these equations on the same grid.

$y = 3$ $y = -3$ $x = 2$ $x = -2$

**b.** What geometric figure did you draw? Justify your answer.

**c.** Draw a diagonal of the figure. What is the equation of this line? Explain.

**79. Recreation** A group of mountain climbers begin an expedition with 265 lb of food. They plan to eat a total of 15 lb of food per day.

**a.** Write an equation in slope-intercept form relating the remaining food supply $r$ to the number of days $d$.

**b.** Graph your equation.

**c.** The group plans to eat the last of their food the day their expedition ends. Use your graph to find how many days they expect the expedition to last.

## Test Prep

**Multiple Choice**

**80.** Which equation has the same *y*-intercept as $y = 4x - 3$?

**A.** $y - 3 = x$ **B.** $y = 8x + 3$ **C.** $3 - y = 4x$ **D.** $y = -3 + 8x$

**81.** Which of the following is the equation of the line that has the same slope as $y = -\frac{3}{2}x + 2$ and the same *y*-intercept as $y = 3x - 2$?

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

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

**82.** A software company started with 2 employees. In 6 months, the company had 7 employees. The number of employees increased at a steady rate. Which equation models the relationship between the number of employees *n* and the number of months *m* since the company started?

**A.** $n = \frac{5}{6}m + 2$ **B.** $m = 2n + \frac{5}{6}$

**C.** $n = \frac{6}{5}m + 2$ **D.** $m = \frac{5}{6}n + 2$

**Short Response**

**83.** A line passes through the points (0, 3) and (1, 5). Graph this line and find an equation for the line in slope-intercept form. Show your work.

## Mixed Review

**Lesson 6-1**

GO for Help

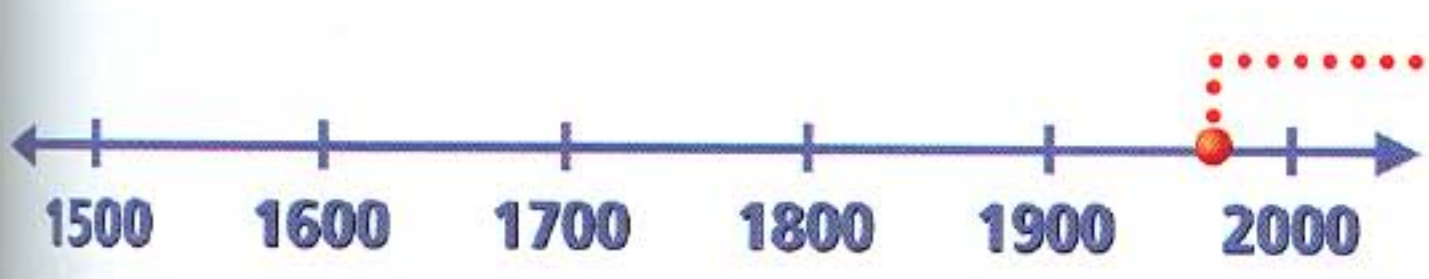
**Find the slope of the line that passes through each pair of points.**

**84.** $(-2, 8), (5, -1)$ **85.** $(0, 0), (-6, 5)$ **86.** $(4, 6), (2, -3)$ **87.** $(1, 2), (2, 1)$

**Review page 166**

**88.** The greeting card industry sells over 6 billion cards annually. Women purchase 80% of all greeting cards sold. How many cards do women purchase annually?

## A Point in Time




**On** August 30, 1984, Astronaut Judith A. Resnik became the second American woman in space, on the shuttle *Discovery*'s first voyage. Resnik was an electrical engineer with a Ph.D. from the University of Maryland. Prior to her mission, she helped to design and develop a remote manipulator system. This required skill in writing linear equations. Her job during *Discovery*'s six-day voyage was to manipulate a robotic arm and to extend and retract the shuttle's solar power array. Resnik died tragically in the *Challenger* disaster in 1986.

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