**Anticipation Guide**

**Analyzing Linear Equations**

**Step 1** Before you begin Chapter 4

- Read each statement.
- Decide whether you Agree (A) or Disagree (D) with the statement.
- Write A or D in the first column OR if you are not sure whether you agree or disagree, write NS (Not Sure).

<table>
<thead>
<tr>
<th>STEP 1</th>
<th>Statement</th>
<th>STEP 2</th>
<th>A, D, or NS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The slope of a line given by an equation in the form ( y = mx + b ) can be determined by looking at the equation.</td>
<td>A</td>
<td>A, D, or NS</td>
</tr>
<tr>
<td>2.</td>
<td>The ( y )-intercept of ( y = 12x - 8 ) is 8.</td>
<td>D</td>
<td>A, D, or NS</td>
</tr>
<tr>
<td>3.</td>
<td>If two points on a line are known, then an equation can be written for that line.</td>
<td>A</td>
<td>A, D, or NS</td>
</tr>
<tr>
<td>4.</td>
<td>An equation in the form ( y = mx + b ) is in point-slope form.</td>
<td>D</td>
<td>A, D, or NS</td>
</tr>
<tr>
<td>5.</td>
<td>If a pair of lines are parallel, then they have the same slope.</td>
<td>A</td>
<td>A, D, or NS</td>
</tr>
<tr>
<td>6.</td>
<td>Lines that intersect at right angles are called perpendicular lines.</td>
<td>A</td>
<td>A, D, or NS</td>
</tr>
<tr>
<td>7.</td>
<td>A scatter plot is said to have a negative correlation when the points are random and show no relation between ( x ) and ( y ).</td>
<td>D</td>
<td>A, D, or NS</td>
</tr>
<tr>
<td>8.</td>
<td>The closer the correlation coefficient is to zero, the more closely a best-fit line models a set of data.</td>
<td>D</td>
<td>A, D, or NS</td>
</tr>
<tr>
<td>9.</td>
<td>The equations of a regression line and a median-fit line are very similar.</td>
<td>A</td>
<td>A, D, or NS</td>
</tr>
<tr>
<td>10.</td>
<td>Step functions and absolute value functions are types of piecewise-linear functions.</td>
<td>A</td>
<td>A, D, or NS</td>
</tr>
</tbody>
</table>

**Step 2** After you complete Chapter 4

- Reread each statement and complete the last column by entering an A or a D.
- Did any of your opinions about the statements change from the first column?
- For those statements that you mark with a D, use a piece of paper to write an example of why you disagree.

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**Example 1**

Write an equation in slope-intercept form for the line with a slope of \( -4 \) and a \( y \)-intercept of 3.

\[
y = mx + b, \text{ where } m \text{ is the given slope and } b \text{ is the } y \text{-intercept}
\]

\[
y = -4x + 3
\]

Replace \( m \) with \(-4\) and \( b \) with 3.

**Example 2**

Graph \( 3x - 4y = 8 \).

Original equation

\[
-4y = -3x + 8
\]

Subtract 3x from each side.

\[
-4y = -3x + 8
\]

Divide each side by \(-4\).

\[
y = \frac{3}{4}x - 2
\]

Simplify.

The \( y \)-intercept of \( y = \frac{3}{4}x - 2 \) is \(-2\) and the slope is \( \frac{3}{4} \). So graph the point \((0, -2)\). From this point, move up 3 units and right 4 units. Draw a line passing through both points.

**Exercises**

Write an equation of a line in slope-intercept form with the given slope and \( y \)-intercept.

1. slope: 8, \( y \)-intercept: \(-3\)  
   \( y = 8x - 3 \)

2. slope: \(-2\), \( y \)-intercept: \(-1\)  
   \( y = -2x - 1 \)

3. slope: \(-1\), \( y \)-intercept: \(-7\) 
   \( y = -x - 7 \)

Write an equation in slope-intercept form for each graph shown.

4. \( y = 2x - 2 \)
5. \( y = -x + 3 \)
6. \( y = \frac{3}{4}x - 5 \)

Graph each equation.

7. \( y = 2x + 1 \) 

8. \( y = -3x + 2 \) 

9. \( y = -x - 1 \)
**Example**

Since 1999, the number of music cassettes sold has decreased by an average rate of 27 million per year. There were 124 million music cassettes sold in 1999.

a. Write a linear equation to find the average number of music cassettes sold in any year after 1999.

The rate of change is $-27$ million per year. In the first year, the number of music cassettes sold was 124 million. Let $N$ be the number of millions of music cassettes sold. Let $x$ be the number of years after 1999. An equation is $N = -27x + 124$.

b. Graph the equation.

The graph of $N = -27x + 124$ is a line that passes through the point $(0, 124)$ and has a slope of $-27$.

c. Find the approximate number of music cassettes sold in 2003.

There were about 16 million music cassettes sold in 2003.

**Exercises**

1. **MUSIC** In 2001, full-length cassettes represented 3.4% of total music sales. Between 2001 and 2006, the percent decreased by about 0.5% per year.

   a. Write an equation to find the percent $P$ of recorded music sold as full-length cassettes for any year $x$ between 2001 and 2006. $P = -0.5x + 3.4$.

   b. Graph the equation on the grid at the right.

   c. Find the percent of recorded music sold as full-length cassettes in 2004.

2. **POPULATION** The population of the United States is projected to be 300 million by the year 2010. Between 2010 and 2050, the population is expected to increase by about 2.5 million per year.

   a. Write an equation to find the population $P$ in any year $x$ between 2010 and 2050. $P = 2,500,000x + 300,000,000$.

   b. Graph the equation on the grid at the right.

   c. Find the population in 2050. About 400,000,000

15. **VIDEO RENTALS** A video store charges $10 for a rental card plus $2 per rental.

   a. Write an equation in slope-intercept form for the total cost $c$ of buying a rental card and renting $m$ movies. $c = 10 + 2m$.

   b. Graph the equation.

   c. Find the cost of buying a rental card and 6 movies. $22$
4-1 Practice

Graphing Equations in Slope-Intercept Form

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

1. Slope: \( \frac{1}{4} \), y-intercept: 3
   \[ y = \frac{1}{4}x + 3 \]

2. Slope: \(-\frac{3}{2}\), y-intercept: -4
   \[ y = -\frac{3}{2}x - 4 \]

3. Slope: 1.5, y-intercept: -1
   \[ y = 1.5x - 1 \]

4. Slope: -2.5, y-intercept: 3.5
   \[ y = -2.5x + 3.5 \]

Write an equation in slope-intercept form for each graph shown.

5. \[ y = \frac{2}{3}x + 2 \]
6. \[ y = \frac{2}{3}x + 3 \]
7. \[ y = -\frac{2}{3}x - 2 \]

Graph each equation.

8. \[ y = -\frac{1}{2}x + 2 \]
9. \[ 3y = 2x - 6 \]
10. \[ 6x + 3y = 6 \]

11. Writing Carla has already written 10 pages of a novel. She plans to write 15 additional pages per month until she is finished.
   a. Write an equation to find the total number of pages \( P \) written after any number of months \( m \).
   \[ P = 10 + 15m \]
   b. Graph the equation on the grid at the right.
   c. Find the total number of pages written after 5 months.

4-1 Word Problem Practice

Graphing Equations in Slope-Intercept Form

1. Savings Wade’s grandmother gave him $100 for his birthday. Wade wants to save his money to buy a new MP3 player that costs $275. Each month, he adds $25 to his MP3 savings. Write an equation in slope-intercept form for the number of months that it will take Wade to save $275.
   \[ 275 = 25x + 100 \]

2. Car Care Suppose regular gasoline costs $2.76 per gallon. You can purchase a car wash at the gas station for $3. The graph of the equation for the cost of gasoline and a car wash is shown below. Write the equation in slope-intercept form for the line shown on the graph.

3. Adult Education Angie’s mother wants to take some adult education classes at the local high school. She has to pay a one-time enrollment fee of $25 to join the adult education community, and then $45 for each class she wants to take. The equation \( y = 45x + 25 \) expresses the cost of taking classes. What are the slope and y-intercept of the equation?
   \[ m = 45; \ y-intercept = 25 \]

4. Business A construction crew needs to rent a trench digger for up to a week. An equipment rental company charges $40 per day plus a $20 non-refundable insurance cost to rent a trench digger. Write and graph an equation to find the total cost to rent the trench digger for \( d \) days.
   \[ y = 40d + 20 \]

5. Energy From 2002 to 2005, U.S. consumption of renewable energy increased an average of 0.17 quadrillion BTUs per year. About 6.07 quadrillion BTUs of renewable power were produced in the year 2002.
   a. Write an equation in slope-intercept form to find the amount of renewable power \( P \) (quadrillion BTUs) produced in year \( y \) between 2002 and 2005.
   \[ P = 0.17y + 6.07 \]
   b. Approximately how much renewable power was produced in 2007?
   6.58 quadrillion BTUs
   c. If the same trend continues from 2006 to 2010, how much renewable power will be produced in the year 2010?
   7.43 quadrillion BTUs
4-1 Enrichment

Using Equations: Ideal Weight
You can find your ideal weight as follows.
A woman should weigh 100 pounds for the first 5 feet of height and 5 additional pounds for each inch over 5 feet (5 feet = 60 inches).
A man should weigh 106 pounds for the first 5 feet of height and 6 additional pounds for each inch over 5 feet. These formulas apply to people with normal bone structures.
To determine your bone structure, wrap your thumb and index finger around the wrist of your other hand. If the thumb and finger just touch, you have normal bone structure. If they overlap, you are large-boned. Small-boned people should decrease their calculated ideal weight by 10%. Large-boned people should increase the value by 10%.

Calculate the ideal weight of these people.

1. woman, 5 ft 4 in., normal-boned
   120 lb

2. man, 5 ft 11 in., large-boned
   189.2 lb

3. man, 6 ft 5 in., small-boned
   187.2 lb

For Exercises 5–9, use the following information.
Suppose a normal-boned man is x inches tall. If he is at least 5 feet tall, then x – 60 represents the number of inches this man is over 5 feet tall. For each of these inches, his ideal weight is increased by 6 pounds. Thus, her proper weight (y) is given by the formula

\[ y = 6x - 60 + 108 \] or \[ y = 6x - 254. \]

If the man is large-boned, the formula becomes \( y = 6x - 254 + 0.10(6x - 254) \).

5. Write the formula for the weight of a large-boned man in slope-intercept form. \( y = 6.6x - 279.4 \)

6. Derive the formula for the ideal weight (y) of a normal-boned female with height x inches. Write the formula in slope-intercept form. \( y = 5x - 200 \)

7. Derive the formula in slope-intercept form for the ideal weight (y) of a large-boned female with height x inches. \( y = 5.5x - 220 \)

8. Derive the formula in slope-intercept form for the ideal weight (y) of a small-boned male with height x inches. \( y = 5.4x - 228.6 \)

9. Find the heights at which normal-boned males and large-boned females would weigh the same. 68 in., or 5 ft 8 in.

4-2 Study Guide and Intervention

Writing Equations in Slope-Intercept Form

Write an Equation Given the Slope and a Point

Example 1 Write an equation of the line that passes through \((-4, 2)\) with a slope of 3.

The line has slope 3. To find the y-intercept, replace m with 3 and \((x, y)\) with \((-4, 2)\) in the slope-intercept form.

\[ y = mx + b \]

\[ 2 = 3(-4) + b \]

\[ 2 = -12 + b \]

\[ b = 14 \]

Therefore, the equation is \( y = 3x + 14 \).

Example 2 Write an equation of the line that passes through \((-2, -1)\) with a slope of \( \frac{1}{4} \).

The line has slope \( \frac{1}{4} \). Replace \( m \) with \( \frac{1}{4} \) and \((x, y)\) with \((-2, -1)\) in the slope-intercept form.

\[ y = mx + b \]

\[ -1 = \frac{1}{4}(-2) + b \]

\[ -1 = -\frac{1}{2} + b \]

\[ b = -\frac{1}{2} \]

Therefore, the equation is \( y = \frac{1}{4}x - \frac{1}{2} \).

Exercises

Write an equation of the line that passes through the given point and has the given slope.

1. \( y = 2x - 1 \)

2. \( y = -2x \)

3. \( y = \frac{1}{4}x + 3 \)

4. \( (8, 2); \) slope \( -\frac{3}{4} \)

5. \((-1, -3); \) slope 5

6. \((-4, -5); \) slope \( -\frac{1}{2} \)

7. \((-5, 4); \) slope 0

8. \((2, 2); \) slope \( \frac{1}{2} \)

9. \((1, -4); \) slope -6

10. \((3, 0), m = 2 \)

11. \((0, 4), m = -3 \)

12. \((0, 350), m = \frac{1}{5} \)
### Writing Equations in Slope-Intercept Form

#### Example
Write an equation of the line that passes through $(1, 2)$ and $3, -2$. Find the slope $m$. To find the $y$-intercept, replace $m$ with its computed value and $(x, y)$ with $(1, 2)$ in the slope-intercept form. Then solve for $b$.

$m = \frac{y_2 - y_1}{x_2 - x_1}$

$m = -2$  

$y = mx + b$

To find the $y$-intercept, replace $m$ with its computed value and $(x, y)$ with $(1, 2)$. Then solve for $b$.

$y = -2 \times 1 + b$

Therefore, the equation is $y = -2x + 4$.

#### Exercises
Write an equation of the line that passes through each pair of points.

1. $(0, 4), (2, 8)$
   - $y = 4x - 3$
2. $(1, -3), (3, -1)$
   - $y = -x + 4$
3. $(2, 1), (4, 3)$
   - $y = \frac{1}{3}x + 1$
4. $(-1, 6), (7, -10)$
   - $y = -2x + 4$
5. $(0, 2), (1, 7)$
   - $y = 5x + 2$
6. $(2, -5), (-1, 3)$
   - $y = -4x - 1$
7. $(-2, -1), (2, 11)$
   - $y = 3x + 5$
8. $(0, -1), (4, 2)$
   - $y = -\frac{1}{2}x + 4$
9. $(14, -2), (7, 7)$
   - $y = \frac{3}{7}x + 4$

10. $(4, 0), (0, 2)$
    - $y = \frac{1}{2}x + 2$
11. $(-3, 0), (0, 5)$
    - $y = \frac{5}{3}x + 5$
12. $(0, 16), (-10, 0)$
    - $y = \frac{8}{5}x + 16$

#### INVESTING
The price of a share of stock in XYZ Corporation was $74 two weeks ago. Seven weeks ago, the price was $59 a share.

a. Write a linear equation to find the price $p$ of a share of XYZ Corporation stock $w$ weeks from now.

$$p = 3w + 80$$

b. Estimate the price of a share of stock five weeks ago.

$56$
4-2 Practice

Writing Equations in Slope-Intercept Form

Write an equation of the line that passes through the given point and has the given slope.

1. \( y = 3x - 1 \)
2. \( y = -2x - 2 \)
3. \( y = -x - 4 \)
4. \( (-5, 4); \text{ slope} = -3 \)
5. \( (4, 3); \text{ slope} = \frac{3}{2} \)
6. \( (-1, -5); \text{ slope} = \frac{3}{2} \)
7. \( (3, 7); \text{ slope} = \frac{2}{3} \)
8. \( (-2, \frac{3}{2}); \text{ slope} = -\frac{1}{2} \)
9. \( (5, 0); \text{ slope} = 0 \)

Write an equation of the line that passes through each pair of points.

10. \( y = x - 6 \)
11. \( y = -x + 5 \)
12. \( y = -2x - 5 \)
13. \( (0, -4), (5, -4) \)
14. \( (-4, -2), (4, 0) \)
15. \( (-2, -3), (4, 5) \)
16. \( (0, 1), (5, 3) \)
17. \( (-3, 0), (1, -6) \)
18. \( (1, 0), (5, -1) \)
19. \( y = \frac{2}{3}x + 1 \)
20. \( y = \frac{2}{3}x - \frac{9}{2} \)

19. DANCE LESSONS The cost for 7 dance lessons is $82. The cost for 11 lessons is $122. Write a linear equation to find the total cost \( C \) for \( t \) lessons. Then use the equation to find the cost of 4 lessons. \( C = 10t + 12; \$52 \)

20. WEATHER It is 76°F at the 6000-foot level of a mountain, and 49°F at the 12,000-foot level of the mountain. Write a linear equation to find the temperature \( T \) at an elevation \( x \) on the mountain, where \( x \) is in thousands of feet. \( T = -4.5x + 103 \)

4-2 Word Problem Practice

Writing Equations in Slope-Intercept Form

1. FUNDRAISING Yvonne and her friends held a bake sale to benefit a shelter for homeless people. The friends sold 22 cakes on the first day and 15 cakes on the second day of the bake sale. They collected $88 on the first day and $60 on the second day. Let \( x \) represent the number of cakes sold and \( y \) represent the amount of money made. Find the slope of the line that would pass through the points given.

2. JOBS Mr. Kimball receives a $3000 annual salary increase on the anniversary of his hiring if he receives a satisfactory performance review. His starting salary was $41,250. Write an equation to show Mr. Kimball’s salary after \( y \) years at this company if his performance reviews are always satisfactory.

\[ k = 3000y + 41,250 \]

3. CENSUS The population of Laredo, Texas, was about 215,500 in 2007. It was about 123,000 in 1990. If we assume that the population growth is constant and \( y \) represents the number of years after 1990, write a linear equation to find \( p \), Laredo’s population for any year after 1990.

\[ p = 5441y + 123,000 \]

4. WATER Mr. Williams pays $40 a month for city water, no matter how many gallons of water he uses in a given month. Let \( x \) represent the number of gallons of water used per month. Let \( y \) represent the monthly cost of the city water in dollars. What is the equation of the line that represents this information? What is the slope of the line?

\[ y = 40; \text{ slope is 0. The line is horizontal.} \]

5. SHOE SIZES The table shows how women’s shoe sizes in the United Kingdom compare to women’s shoe sizes in the United States.

<table>
<thead>
<tr>
<th>Women’s Shoe Sizes</th>
<th>U.K.</th>
<th>U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3.5</td>
<td>4</td>
</tr>
<tr>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
</tr>
<tr>
<td>4</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>4.5</td>
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<td>5.5</td>
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<td>6</td>
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<td>7</td>
</tr>
<tr>
<td>6.5</td>
<td>7</td>
<td>7.5</td>
</tr>
<tr>
<td>7</td>
<td>7.5</td>
<td>8</td>
</tr>
<tr>
<td>7.5</td>
<td>8</td>
<td>8.5</td>
</tr>
</tbody>
</table>

Source: Deichampfoot UK

a. Write a linear equation to determine any U.S. size if you are given the U.K. size.

\[ y = x + 2.5 \]

b. What is the slope and \( y \)-intercept of the line?

Slope = 1; \( y \)-intercept = 2.5

c. Is the \( y \)-intercept a valid data point for the given information?

No. It is not likely a valid data point because the U.K. sizing probably does not include zero. However, the point is the \( y \)-intercept of the line represented by the data if the data were to continue indefinitely in both directions.
Tangent to a Curve
A tangent line is a line that intersects a curve at a point with the same rate of change, or slope, as the rate of change of the curve at that point.

For quadratic functions (functions of the form \(ax^2 + bx + c\)), the equation of the tangent line can be found. This is based on the fact that the slope through any two points on the curve is equal to the slope of the line tangent to the curve at the point whose \(x\)-value is halfway between the \(x\)-values of the other two points.

Example
To find the equation of a tangent line to the curve \(y = x^2 + 3x + 2\) through the point \((2, 12)\), first find two points on the curve whose \(x\)-values are equidistant from the \(x\)-value of the point the tangent needs to go through.

Step 1: Find two more points. Use \(x = 1\) and \(x = 3\).
When \(x = 1\), \(y = 1^2 + 3(1) + 2 = 6\).
When \(x = 3\), \(y = 3^2 + 3(3) + 2 = 20\).
So, the two ordered pairs are \((1, 6)\) and \((3, 20)\).

Step 2: Find the slope of the line that goes through these two points.
\[m = \frac{20 - 6}{3 - 1} = 7\]

Step 3: Now use this slope and the point \((2, 12)\) to find the equation of the tangent line.
\[y = mx + b\]
Replace \(x\) with 2, \(y\) with 12, and \(m\) with 7.
\[12 = 7(2) + b\]
Solve for \(b\).
\[b = 2\]
So, the equation of the tangent line to \(y = x^2 + 3x + 2\) through the point \((2, 12)\) is \(y = 7x - 2\).

Exercises
For 1–3, find the equations of the lines tangent to each curve through the given point.
1. \(y = x^2 - 3x + 7\), \((2, 5)\)
2. \(y = 3x^2 + 4x - 5\), \((-4, 27)\)
3. \(y = 5 - x^2\), \((1, 4)\)

4. Find the slope of the line tangent to the curve at \(x = 0\) for the general equation \(y = ax^2 + bx + c\). \(m = b\)

5. Find the slope of the line tangent to the curve \(y = ax^2 + bx + c\) at \(x = 0\) by finding the slope of the line through the points \((0, c)\) and \((2x, 4ax^2 + 2bx + c)\). Does this answer work for \(x = 0\) in the answer you found to problem 4? \(m = 2ax + b\), yes

Example 1
Write an equation in point-slope form for the line that passes through \((6, 1)\) with a slope of \(-\frac{5}{2}\).

Point-Slope Form
\[y - y_1 = m(x - x_1)\]
\[y - 1 = -\frac{5}{2}(x - 6)\]
\[y + \frac{5}{2}x - 15 = 0\]
Simplify.
\[\frac{5}{2}x - y - 13 = 0\]

Example 2
Write an equation in point-slope form for a horizontal line that passes through \((4, -1)\).

Point-Slope Form
\[y - y_1 = m(x - x_1)\]
\[y - (-1) = 0(x - 4)\]
\[y + 1 = 0\]
Therefore, the equation is \(y + 1 = 0\).

Exercises
Write an equation in point-slope form for the line that passes through the given point with the slope provided.

1. \(y - 1 = x - 4\)
2. \(y - 2 = 0\)
3. \(y + 3 = -2(x - 2)\)

4. \((2, 1), m = 4\)
5. \((-7, 2), m = 6\)
6. \((8, 3), m = 1\)

7. \((-6, 7), m = 0\)
8. \((4, 9), m = \frac{3}{2}\)
9. \((-4, -5), m = -\frac{1}{2}\)

10. Write an equation in point-slope form for a horizontal line that passes through \((-4, -2)\).
11. Write an equation in point-slope form for a horizontal line that passes through \((-2, 6)\).
12. Write an equation in point-slope form for a horizontal line that passes through \((5, 0)\).

Answers
**4-3 Study Guide and Intervention (continued)**

**Point-Slope Form**

Forms of Linear Equations

<table>
<thead>
<tr>
<th>Form</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope-Intercept Form</td>
<td>( y = mx + b )</td>
</tr>
<tr>
<td>m = slope, ( b ) = y-intercept</td>
<td></td>
</tr>
<tr>
<td>Point-Slope Form</td>
<td>( y - y_1 = m(x - x_1) )</td>
</tr>
<tr>
<td>m = slope, ( x ), ( y_1 ) = a given point</td>
<td></td>
</tr>
<tr>
<td>Standard Form</td>
<td>( Ax + By = C )</td>
</tr>
</tbody>
</table>

A and \( B \) are not both zero. Usually \( A \) is nonnegative and \( A, B, \) and \( C \) are integers whose greatest common factor is 1.

**Example 1**

Write \( y + 5 = \frac{2}{3}(x - 6) \) in standard form.

\[
3y + 15 = \frac{2}{3}(3x - 6)
\]

Multiply each side by 3.

\[
9y + 45 = 2x - 12
\]

Subtract 15 from each side.

\[
9y = 2x - 57
\]

Add 2 to each side.

\[
9y + 9 = 2x - 27
\]

Multiply each side by \(-1\).

\[
-9y - 9 = -2x + 27
\]

Therefore, the standard form of the equation is \(-2x - 3y = 27\).

**Example 2**

Write \( y = 2 - \frac{1}{4}(x - 8) \) in slope-intercept form.

\[
y = 2 - \frac{1}{4}x + 2
\]

Distributive Property

\[
y = -\frac{1}{4}x + 4
\]

Add \(2\) to each side.

\[
y + 2 = -\frac{1}{4}x + 6
\]

Therefore, the slope-intercept form of the equation is \(y = -\frac{1}{4}x + 6\).

**Exercises**

Write each equation in standard form.

1. \( y + 2x - 3x - 1 \)
2. \( y - 1 = -\frac{1}{2}x - 6 \)
3. \( y + 2 = \frac{2}{3}x - 9 \)
4. \( 3x + y = 1 \)
5. \( x + 3y = 9 \)
6. \( 4x + 3 = (x + 5) \)
7. \( 5y - 4 = \frac{2}{3}(x + 3) \)
8. \( x + y = 2 \)
9. \( 5x - 3y = -27 \)
10. \( 2x + y = 16 \)

Write each equation in slope-intercept form.

7. \( y = 4x - 12 \)
8. \( y = \frac{1}{3}x + 3 \)
9. \( y - 8 = -\frac{1}{4}(x + 8) \)
10. \( y = 6x + \frac{2}{3} \)
11. \( y = 4x + 5 \)
12. \( y = -2x - 14 \)
13. \( y = 3x + 5 \)
14. \( y = \frac{1}{2}x - 8 \)
15. \( y = \frac{3}{2}x + 5 \)

Write an equation in point-slope form for the line that passes through the given point with the slope provided.

1. \( (3,1), m = 0 \)
2. \( (1, -3), m = -4 \)
3. \( (4, -6), m = 1 \)
4. \( (3, 3), m = \frac{4}{3} \)
5. \( (0, 4), m = -1 \)
6. \( (2, -5), m = \frac{5}{4} \)

Write each equation in standard form.

10. \( y + 1 + x = 2 \)
11. \( y + 9 = -3x - 2 \)
12. \( y - 7 = 4x + 4 \)
13. \( x - y = -1 \)
14. \( y - 6 = 4x + 3 \)
15. \( x + 5 = -5x - 3 \)
16. \( x + y = 5 \)
17. \( 4x - y = -18 \)
18. \( 5x + y = 10 \)
19. \( y - 10 = -2x - 3 \)
20. \( 17y - 2 = -\frac{1}{2}x - 4 \)
21. \( 2x + y = 16 \)
22. \( 2x + y = 8 \)
23. \( x - 3y = 30 \)

Write each equation in slope-intercept form.

19. \( y - 4 = 3x - 2 \)
20. \( y + 2 = -x + 4 \)
21. \( y - 6 = -2x + 2 \)
22. \( y = 3x - 2 \)
23. \( y - 3 = 6x - 1 \)
24. \( y = -3x + 5 \)
25. \( y = -5x + 14 \)
26. \( y = 6x - 3 \)
27. \( y = 2x + 23 \)
28. \( y = \frac{1}{2}x + 5 \)
29. \( y = -\frac{3}{4}x - 4 \)
30. \( y = x + 1 \)
4-3 Practice

Point-Slope Form
Write an equation in point-slope form for the line that passes through the given point with the slope provided.

1. \((2, 2), m = -3\)  
   \(y - 2 = -3(x - 2)\)

2. \((1, -6), m = -1\)  
   \(y + 6 = -(x - 1)\)

3. \((-3, 4), m = 0\)  
   \(y + 4 = 0\)

4. \((3, 4), m = \frac{3}{4}\)  
   \(y - 3 = \frac{3}{4}(x + 1)\)

5. \((-8, 5), m = -1\)  
   \(y - 5 = -1(x + 8)\)

6. \((3, -3), m = \frac{1}{3}\)  
   \(y + 3 = \frac{1}{3}(x - 3)\)

Write each equation in standard form.

7. \(y - 11 = 3x - 2\)  
   \(3x - y = -5\)

8. \(y - 10 = -x - 2\)  
   \(x + y = 12\)

9. \(y + 7 = 2x + 5\)  
   \(2x - y = -3\)

10. \(y - 5 = \frac{3}{4}x + 4\)  
    \(11y + 2 = -\frac{3}{4}x + 1\)

11. \(y - 6 = \frac{3}{4}x - 3\)  
    \(12x - 3y = -6\)

12. \(3x - 2y = -22\)  
    \(3x + 4y = -11\)

13. \(15x + 2y = 2\)  
    \(14y - 3 = -24(x - 5)\)

14. \(y - 4 = 2.5x + 30\)  
    \(5x - 2y = -23\)

Write each equation in slope-intercept form.

15. \(y = 4x + 2\)  
    \(y = 4x + 2\)

16. \(y = 4x + 6\)  
    \(y = -7x + 8\)

17. \(y = -5x - 57\)  
    \(y = 15x + 60\)

18. \(y = -3x + 12\)  
    \(y = 15x + 15(x - 9)\)

19. \(y = \frac{3}{2}x + 11\)  
    \(y = -3x - 2\)

20. \(y = -2x + \frac{7}{6}\)

21. \(y = 3.5(x - 5)\)

22. CONSTRUCTION  A construction company charges $15 per hour for debris removal, plus a one-time fee for the use of a trash dumpster. The total fee for 9 hours of service is $195.

   a. Write the point-slope form of an equation to find the total fee \(y\) for any number of hours \(x\). \(y = 15x + 15(x - 9)\)

   b. Write the equation in slope-intercept form. \(y = 15x + 60\)

   c. What is the fee for the use of a trash dumpster? $60

23. MOVING  There is a set daily fee for renting a moving truck, plus a charge of $0.50 per mile driven. It costs $64 to rent the truck on a day when it is driven 48 miles.

   a. Write the point-slope form of an equation to find the total charge \(y\) for any number of miles \(x\) for a one-day rental. \(y = 64 = 0.5(x - 48)\)

   b. Write the equation in slope-intercept form. \(y = 0.5x + 40\)

   c. What is the daily fee? $40

4-3 Word Problem Practice

Point-Slope Form

1. BICYCLING  Harvey rides his bike at an average speed of 12 miles per hour. In other words, he rides 12 miles in 1 hour, 24 miles in 2 hours, and so on. Let \(h\) be the number of hours he rides and \(d\) be distance traveled. Write the equation for the relationship between distance and time in point-slope form.
   
   \(d - 12 = 12(h - 1)\)

2. GEOMETRY  The perimeter of a square varies directly with the side length. The point-slope form of the equation for this function is \(y = 4 = 4(x - 1)\). Write the equation in standard form.
   
   \(4x - y = 0\)

3. NATURE  In a near perfect linear relationship, the frequency of a male cricket’s chirp matches the outdoor temperature. The relationship is expressed by the equation \(T = n + 40\), where \(T\) is the temperature in degrees Fahrenheit and \(n\) is the number of chirps the cricket makes in 14 seconds. Use the information on the graph below to write a point-slope form of the equation for the line.

\[\text{Sample answer: } y - 0 = 0.5(x - 0)\]

4. CANOEING  Geoff paddles his canoe at an average speed of 3.5 miles per hour. After 5 hours of canoeing, Geoff has traveled 18 miles. Write an equation in the point-slope form to find the total distance \(y\) for any number of hours \(x\).
   
   \(y - 18 = 3.5(x - 5)\)

5. AVIATION  A jet plane takes off and climbs consistently 20 feet for every 40 feet it moves horizontally. The graph shows the trajectory of the jet.

   a. Write an equation in point-slope form for the line representing the jet’s horizontal trajectory.
      \(y - 0 = 0.5(x - 0)\)

   b. Write the equation from part a in slope-intercept form.
      \(y = 0.5x\)

   c. Write the equation in standard form.
      \(x - 2y = 0\)
### Graphing Calculator Activity

**Writing Linear Equations**

Lists can be used with the linear regression function to write and verify linear equations given two points on a line, or the slope of a line and a point through which it passes. The linear regression function, \textit{LinReg (ax + b)}, is found under the \textit{STAT CALC} menu.

**Example 1**

Write the slope-intercept form of an equation of the line that passes through (3, 2) and (6, 4).

Enter the \(x\)-coordinates of the points into \(L_1\) and the \(y\)-coordinates into \(L_2\). Use the linear regression function to write the equation of the line.

<table>
<thead>
<tr>
<th>(x)-coordinate</th>
<th>(y)-coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

**Example 2**

Verify the equation of a line passing through (2, 3) with slope \(-\frac{3}{2}\) can be written as \(3x + 4y = -6\).

Use the given point and slope to determine a second point through which the line passes. Enter the \(x\)-coordinates of the points into \(L_1\) and the \(y\)-coordinates into \(L_2\). Use \textit{LinReg (ax + b)} to determine the slope-intercept form of an equation.

**Exercises**

Write the slope-intercept form and the standard form of an equation of the line that satisfies each condition.

1. passes through (0, 7) and \((\frac{1}{7}, -5)\)
2. passes through \((-5, 1), (10, 10), \) and \((-10, -2)\)
3. passes through (6, -4), \(m = \frac{3}{2}\)
4. passes through (3, 5), \(m = -4\)
5. \(x\)-intercept: 1, \(y\)-intercept: \(-\frac{1}{2}\)
6. passes through \((-18, 11)\), \(y\)-intercept: 3

<table>
<thead>
<tr>
<th>(x)-coordinate</th>
<th>(y)-coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>(\frac{1}{7})</td>
<td>-5</td>
</tr>
</tbody>
</table>

The points are not collinear. This is not a straight line.
Parallel and Perpendicular Lines

Two nonvertical lines are parallel if they have the same slope. All vertical lines are parallel.

Example
Write an equation in slope-intercept form for the line that passes through (–1, 6) and is parallel to the graph of \( y = 2x + 12 \).

A line parallel to \( y = 2x + 12 \) has the same slope, 2. Replace \( m \) with 2 and \((x_1, y_1)\) with \((-1, 6)\) in the point-slope form.

\[
y - y_1 = m(x - x_1) \quad \text{Point-slope form}
\]

\[
y - 6 = 2(x - (-1)) \quad m = 2, (x, y) = (-1, 6)
\]

\[
y - 6 = 2x + 2 \quad \text{Simplify}
\]

\[
y = 2x + 8 \quad \text{Slope-intercept form}
\]

Therefore, the equation is \( y = 2x + 8 \).

Exercises
Write an equation in slope-intercept form for the line that passes through the given point and is parallel to the graph of each equation.

1. \((2, 3), y = -x + 4\)
2. \((-4, 2), y = -
\frac{1}{2}x + 3\)
3. \((3, 4), y = 4x + 7\)

4. \((-2, 2), y = 4x - 2\)
5. \((6, 4), y = \frac{3}{2}x + 1\)

6. \((-2, -2), y = 3x + 2\)
7. \((-2, -4), y = 3x + 10\)

8. \((1, 6), y = 3x + y = 12\)
9. \((-4, 6), y = 3x + 2y = 5\)

Find an equation of the line that has a \( y \)-intercept of 2 that is parallel to the graph of \( 4x + 2y = 8 \). \( y = -2x + 2 \)

11. Find an equation of the line that has a \( y \)-intercept of -1 that is parallel to the graph of \( x - 3y = 6 \). \( y = \frac{1}{3}x - 1 \)

12. Find an equation of the line that has a \( y \)-intercept of -4 that is parallel to the graph of \( y = 6 \). \( y = -4 \)

Parallel and Perpendicular Lines

Two nonvertical lines are perpendicular if their slopes are negative reciprocals of each other. Vertical and horizontal lines are perpendicular.

Example
Write an equation in slope-intercept form for the line that passes through \((-4, 2)\) and is perpendicular to the graph of \( 2x - 3y = 9 \).

Find the slope of \(-4, 3\) and \( y = \frac{2}{3}x - \frac{3}{5} \). So, the slope of the line passing through \((-4, 2)\) that is perpendicular to this line is the negative reciprocal of \( -\frac{2}{3} \) or \( \frac{3}{2} \).

Slope of line: \( y = \frac{2}{3}x - \frac{3}{5} \)

Slope of line through \((-4, 2)\) is \( y = \frac{3}{2}x - 4 \).

Exercises

1. ARCHITECTURE On the architect's plans for a new high school, a wall represented by \( \overrightarrow{MN} \) has endpoints \((-3, -1)\) and \((2, 1)\). A wall represented by \( \overrightarrow{PQ} \) has endpoints \((4, -1)\) and \((2, 1)\). Are the walls perpendicular? Explain.

Yes, because the slope of \( \overrightarrow{MN} \) is the negative reciprocal of the slope of \( \overrightarrow{PQ} \).

2. Write an equation in slope-intercept form for the line that passes through the given point and is perpendicular to the graph of each equation.

\[
4. \ (4, 2), y = \frac{3}{2}x + 1
\]

\[
5. \ (0, -3), y = -\frac{1}{2}x + 1
\]

\[
6. \ (6, 4), y = 7x + 1
\]

\[
y = -x + 10
\]

\[
y = \frac{3}{2}x - 6
\]

\[
y = \frac{1}{2}x + \frac{34}{7}x
\]

\[
y = -x - 8
\]

\[
y = 3x - 6
\]

\[
y = \frac{5}{2}x - 3
\]

\[
y = \frac{1}{2}x - 4
\]

\[
y = -\frac{2}{5}x - 3
\]
4-4 Skills Practice

Parallel and Perpendicular Lines

Write an equation in slope-intercept form for the line that passes through the given point and is parallel to the graph of each equation.

1. \((3, 2), y = x + 5\)
2. \((2, 5), y = -4x + 2\)
3. \((-2, -5), y = -\frac{3}{4}x + 1\)

4. \((5, 4), y = \frac{2}{3}x - 2\)
5. \((12, 3), y = \frac{4}{5}x + 5\)
6. \((3, 1), 2x + y = 5\)

7. \((1, -3), y = -4x - 1\)
8. \((-4, 2), y = x + 3\)
9. \((-4, 3), y = \frac{1}{2}x - 6\)

10. \((1, -2), y = -3x - 5\)
11. \((-1, 1), y = x - 4\)
12. \((-4x + 1\)
13. \(y = x + 2\)

14. \((2, 5), y = -4x + 2\)

15. \((3, 2), y = x + 5\)

16. \((2, 4), y = \frac{7}{4}x + 8\)
17. \((-1, 2), 3x - 7 = 0\)
18. \((-4, -5), 5x + 1 = 0\)

19. \((4, -1), 4x + 3y = 4\)
20. \((10, 5), 5x + 4y = 8\)
21. \((4, -5), 2x + 3y = 10\)

22. \((1, 3), 3x + 2y = -7\)
23. \((-6, -5), 4x + 3y = -6\)
24. \((-3, 5), 5x - 6y = 9\)

25. \(y = \frac{2}{3}x + 1\)
26. \(y = -\frac{1}{2}x + 1\)
27. \(y = 3x - 3\)

28. \(y = -2x\)
29. \(y = \frac{3}{4}x + 6\)
30. \(y = -4x - 5\)

10. RADAR On a radar screen, a plane located at \(A(-2, 4)\) is flying toward \(B(4, 3)\). Another plane, located at \(C(-3, 1)\), is flying toward \(D(3, 0)\). Are the planes' paths parallel? Explain.

No; the slopes are equal, meaning the paths are parallel.

Determine whether the graphs of the following equations are parallel or perpendicular. Explain.

11. \(y = \frac{2}{3}x + 3, y = \frac{2}{3}x, 2x - 3y = 8\)
   - first and third are parallel; slopes are equal
   - first and second are perpendicular; slopes are negative reciprocals

Write an equation in slope-intercept form for the line that passes through the given point and is parallel to the graph of each equation.

13. \((3, 2), y = x + 5\)
14. \((-2, -2), y = -\frac{3}{4}x + 9\)
15. \((-5, 1), y = x - 5\)

16. \((0, 1), x + 5y = 15\)
17. \((2, 4), x - 6y = 2\)
18. \((-1, -7), 3x + 12y = -6\)

19. \((-4, 1), 4x + 3y = 6\)
20. \((10, 5), 5x + 4y = 8\)
21. \((-4, -5), 2x + 3y = 10\)

22. \((1, 3), 3x + 2y = -7\)
23. \((-6, -5), 4x + 3y = -6\)
24. \((-3, 5), 5x - 6y = 9\)

25. GEOMETRY Quadrilateral \(ABCD\) has diagonals \(AC\) and \(BD\). Determine whether \(AC\) is perpendicular to \(BD\). Explain.
   - Yes; they are perpendicular because their slopes are \(-\frac{1}{2}\) and \(-\frac{3}{4}\), which are negative reciprocals.

26. GEOMETRY Triangle \(ABC\) has vertices \(A(0, 4), B(1, 2),\) and \(C(4, 6)\). Determine whether triangle \(ABC\) is a right triangle. Explain.
   - Yes; sides \(AB\) and \(AC\) are perpendicular because their slopes are \(-2\) and \(-\frac{1}{2}\), which are negative reciprocals.
4-4 Word Problem Practice

Parallel and Perpendicular Lines

1. BUSINESS Brady's Books is a retail store that also sells books online. The store's profits \( y \) are given by the equation \( y = 2x + 3 \) where \( x \) is the number of available hours for customer purchases. Brady's discontinues the online shopping option. Write a new equation in slope-intercept form to show a new profit line with the same profit rate containing the point (0, 0).

2. ARCHITECTURE The front view of a house is drawn on graph paper. The left side of the roof of the house is represented by the equation \( y = x \). The rooflines intersect at a right angle and the peak of the roof is represented by the point (5, 5). Write the equation in slope-intercept form for the line that creates the right side of the roof.

3. ARCHAEOLOGY An archaeologist is comparing the location of a jeweled box she just found to the location of a brick wall. The wall can be represented by the equation \( y = -\frac{3}{2}x + 13 \). The box is located at the point (10, 9). Write an equation representing a line that is perpendicular to the wall and that passes through the location of the box.

4. GEOMETRY A parallelogram is created by the intersections of the lines \( x = 2 \), \( x = 6 \), \( y = \frac{1}{2}x + 2 \), and another line. Find the equation of the fourth line needed to complete the parallelogram. The line should pass through (2, 0). (Hint: Sketch a graph to help you see the lines.)

5. INTERIOR DESIGN Pamela is planning to install an island in her kitchen. She draws the shape she likes by connecting vertices of the square tiles on her kitchen floor. She records the location of each corner in the table.

<table>
<thead>
<tr>
<th>Corner</th>
<th>Distance from West Wall (tiles)</th>
<th>Distance from South Wall (tiles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>D</td>
<td>11</td>
<td>7</td>
</tr>
</tbody>
</table>

a. How many pairs of parallel sides are there in the shape she designed? Explain.

b. How many pairs of perpendicular sides are there in the shape she designed? Explain.

c. What is the shape of her new island?

4-4 Enrichment

Pencils of Lines

All of the lines that pass through a single point in the same plane are called a pencil of lines. All lines with the same slope, but different intercepts, are also called a “pencil,” a pencil of parallel lines.

Graph some of the lines in each pencil.

1. A pencil of lines through the point (1, 3)

2. A pencil of lines described by \( y - 4 = mx - 2 \), where \( m \) is any real number

3. A pencil of lines parallel to the line \( x - 2y = 7 \)

4. A pencil of lines described by \( y = mx + 3m - 2 \)
Scatter Plots and Lines of Fit

Investigate Relationships Using Scatter Plots

A scatter plot is a graph in which two sets of data are plotted as ordered pairs in a coordinate plane. If $y$ increases as $x$ increases, there is a positive correlation between $x$ and $y$. If $y$ decreases as $x$ increases, there is a negative correlation between $x$ and $y$. If $x$ and $y$ are not related, there is no correlation.

Exercises

Determine whether each graph shows a positive correlation, a negative correlation, or no correlation. If there is a positive or negative correlation, describe its meaning in the situation.

1. Average Weekly Work Hours in U.S.

2. Average Jogging Speed

3. Average U.S. Hourly Earnings

4. U.S. Imports from Mexico

Example

EARNINGS

The graph at the right shows the amount of money Carmen earned each week and the amount she deposited in her savings account that same week. Determine whether the graph shows a positive correlation, a negative correlation, or no correlation. If there is a positive or negative correlation, describe its meaning in the situation.

The graph shows a positive correlation. The more Carmen earns, the more she saves.

Exercises

Refer to the table for Exercises 1–3.

1. Draw a scatter plot.

2. Draw a line of fit for the data.

3. Write the slope-intercept form of an equation for the line of fit.

Example

Movie Admission Prices

The points (0, 5.08) and (3, 5.81) give $y = 0.243x + 5.08$ as a line of fit.
Determine whether each graph shows a positive correlation, a negative correlation, or no correlation. If there is a positive or negative correlation, describe its meaning in the situation.

1. Positive; the longer the exercise, the more Calories burned.
2. No correlation
3. Negative; as weight increases, the number of repetitions decreases.
4. Positive; as the year increases, the dealership's revenue increases.

5. BASEBALL The scatter plot shows the average price of a major league baseball ticket from 1997 to 2006.
   a. Determine what relationship, if any, exists in the data. Explain.
   b. Use the points (1998, 13.60) and (2003, 19.00) to write the slope-intercept form of an equation for the line of fit shown in the scatter plot.
   c. Predict the price of a ticket in 2009. About $25.48

DISEASE The table shows the number of cases of Foodborne Botulism in the United States for the years 2001 to 2005.

a. Draw a scatter plot and determine what relationship, if any, exists in the data. Explain.
   b. Draw a line of fit for the scatter plot.
   c. Write the slope-intercept form of an equation for the line of fit. Sample answer: \( y = -129.75x + 906 \)
   d. Predict the maximum longevity for an animal with an average longevity of 33 years. About 67 yr
1. **MUSIC** The scatter plot shows the number of CDs (in millions) that were sold from 1999 to 2005. If the trend continued, about how many CDs were sold in 2006?

Sample answer: around 700 million

2. **FAMILY** The table shows the predicted annual cost for a middle income family to raise a child from birth until adulthood. Draw a scatter plot and describe what relationship exists within the data.

There is a positive correlation between the child’s age and annual cost.

3. **HOUSING** The median price of an existing home was $160,000 in 2000 and $240,000 in 2007. If 2000 represents year 0, use these data points to determine a possible line of best fit for the trends in the price of existing homes. Write the equation in slope-intercept form.

\[ y = 4285.7x + 110,000 \]

4. **BASEBALL** The table shows the average length (in minutes) of professional baseball games in selected years.

Source: Elias Sports Bureau

a. Draw a scatter plot and determine what relationship, if any, exists in the data.

no correlation

b. Explain what the scatter plot shows.

There is no consistent trend regarding the length of games.

c. Draw a line of fit for the scatter plot.

See line of fit on scatter plot above.

---

**Latitude and Temperature**

The latitude of a place on Earth is the measure of its distance from the equator. What do you think is the relationship between a city’s latitude and its January temperature? At the right is a table containing the latitudes and January mean temperatures for fifteen U.S. cities.

Sample answers are given.

1. Use the information in the table to create a scatter plot and draw a line of best fit for the data.

2. Write an equation for the line of fit. Make a conjecture about the relationship between a city’s latitude and its mean January temperature.

Sample answer: \[ y = -2.39x + 121.86; \] The higher the latitude, the lower the temperature.

3. Use your equation to predict the January mean temperature of Juneau, Alaska, which has latitude 58.23 N. -17.7°F

4. What would you expect to be the latitude of a city with a January mean temperature of 15°F? 44.42 N

5. Was your conjecture about the relationship between latitude and temperature correct? Yes; as the latitude increases, the temperature decreases.

6. Research the latitudes and temperatures of cities in the southern hemisphere instead. Does your conjecture hold for these cities as well? Yes.
ERROR: undefined
OFFENDING COMMAND:

STACK: