CONSUMABLE WORKBOOKS  Many of the worksheets contained in the Chapter Resource Masters booklets are available as consumable workbooks in both English and Spanish.

<table>
<thead>
<tr>
<th>Study Guide and Intervention Workbook</th>
<th>MHID</th>
<th>ISBN</th>
</tr>
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<tbody>
<tr>
<td>Homework Practice Workbook</td>
<td>0-07-660292-3</td>
<td>978-0-07-660292-6</td>
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<tr>
<td>Homework Practice Workbook</td>
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<tr>
<th>Spanish Version</th>
<th>MHID</th>
<th>ISBN</th>
</tr>
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<tbody>
<tr>
<td>Homework Practice Workbook</td>
<td>0-07-660294-X</td>
<td>978-0-07-660294-0</td>
</tr>
</tbody>
</table>

Answers For Workbooks  The answers for Chapter 4 of these workbooks can be found in the back of this Chapter Resource Masters booklet.

ConnectED  All of the materials found in this booklet are included for viewing, printing, and editing at connected.mcgraw-hill.com.

Spanish Assessment Masters  (MHID: 0-07-660289-3, ISBN: 978-0-07-660289-6) These masters contain a Spanish version of Chapter 4 Test Form 2A and Form 2C.
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Chapter 4 Resource Masters

The Chapter 4 Resource Masters includes the core materials needed for Chapter 4. These materials include worksheets, extensions, and assessment options. The answers for these pages appear at the back of this booklet.

All of the materials found in this booklet are included for viewing, printing, and editing at connectED.mcgraw-hill.com.

Chapter Resources

**Student-Built Glossary** (pages 1–2) These masters are a student study tool that presents up to twenty of the key vocabulary terms from the chapter. Students are to record definitions and/or examples for each term. You may suggest that students highlight or star the terms with which they are not familiar. Give this to students before beginning Lesson 4-1. Encourage them to add these pages to their mathematics study notebooks. Remind them to complete the appropriate words as they study each lesson.

**Anticipation Guide** (pages 3–4) This master, presented in both English and Spanish, is a survey used before beginning the chapter to pinpoint what students may or may not know about the concepts in the chapter. Students will revisit this survey after they complete the chapter to see if their perceptions have changed.

Lesson Resources

**Study Guide and Intervention** These masters provide vocabulary, key concepts, additional worked-out examples and Check Your Progress exercises to use as a reteaching activity. It can also be used in conjunction with the Student Edition as an instructional tool for students who have been absent.

**Skills Practice** This master focuses more on the computational nature of the lesson. Use as an additional practice option or as homework for second-day teaching of the lesson.

**Practice** This master closely follows the types of problems found in the Exercises section of the Student Edition and includes word problems. Use as an additional practice option or as homework for second-day teaching of the lesson.

**Word Problem Practice** This master includes additional practice in solving word problems that apply the concepts of the lesson. Use as an additional practice or as homework for second-day teaching of the lesson.

**Enrichment** These activities may extend the concepts of the lesson, offer an historical or multicultural look at the concepts, or widen students’ perspectives on the mathematics they are learning. They are written for use with all levels of students.

**Graphing Calculator, TI-Nspire, or Spreadsheet Activities** These activities present ways in which technology can be used with the concepts in some lessons of this chapter. Use as an alternative approach to some concepts or as an integral part of your lesson presentation.
Assessment Options

The assessment masters in the Chapter 4 Resource Masters offer a wide range of assessment tools for formative (monitoring) assessment and summative (final) assessment.

Student Recording Sheet This master corresponds with the standardized test practice at the end of the chapter.

Extended Response Rubric This master provides information for teachers and students on how to assess performance on open-ended questions.

Quizzes Four free-response quizzes offer assessment at appropriate intervals in the chapter.

Mid-Chapter Test This 1-page test provides an option to assess the first half of the chapter. It parallels the timing of the Mid-Chapter Quiz in the Student Edition and includes both multiple-choice and free-response questions.

Vocabulary Test This test is suitable for all students. It includes a list of vocabulary words and 11 questions to assess students’ knowledge of those words. This can also be used in conjunction with one of the leveled chapter tests.

Leveled Chapter Tests

• **Form 1** contains multiple-choice questions and is intended for use with below grade level students.

• **Forms 2A and 2B** contain multiple-choice questions aimed at on grade level students. These tests are similar in format to offer comparable testing situations.

• **Forms 2C and 2D** contain free-response questions aimed at on grade level students. These tests are similar in format to offer comparable testing situations.

• **Form 3** is a free-response test for use with above grade level students.

All of the above mentioned tests include a free-response Bonus question.

Extended-Response Test Performance assessment tasks are suitable for all students. Sample answers and a scoring rubric are included for evaluation.

Standardized Test Practice These three pages are cumulative in nature. It includes three parts: multiple-choice questions with bubble-in answer format, griddable questions with answer grids, and short-answer free-response questions.

Answers

• The answers for the Anticipation Guide and Lesson Resources are provided as reduced pages.

• Full-size answer keys are provided for the assessment masters.
This is an alphabetical list of the key vocabulary terms you will learn in Chapter 4. As you study the chapter, complete each term’s definition or description. Remember to add the page number where you found the term. Add these pages to your Algebra Study Notebook to review vocabulary at the end of the chapter.

<table>
<thead>
<tr>
<th>Vocabulary Term</th>
<th>Found on Page</th>
<th>Definition/Description/Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>best-fit line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bivariate data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>correlation coefficient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>inverse function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>inverse relation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>line of fit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>linear extrapolation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>linear interpolation</td>
<td></td>
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</tr>
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</table>

(continued on the next page)
<table>
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<th>Vocabulary Term</th>
<th>Found on Page</th>
<th>Definition/Description/Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>linear regression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>median-fit line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>parallel lines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>perpendicular lines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>residual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>scatter plot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>slope-intercept form</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Anticipation Guide

## Equations of Linear Functions

### 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 A, D, or NS</th>
<th>Statement</th>
<th>STEP 2 A or D</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></td>
</tr>
<tr>
<td>2.</td>
<td>The ( y )-intercept of ( y = 12x - 8 ) is 8.</td>
<td></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></td>
</tr>
<tr>
<td>4.</td>
<td>An equation in the form ( y = mx + b ) is in point-slope form.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>If a pair of lines are parallel, then they have the same slope.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Lines that intersect at right angles are called perpendicular lines.</td>
<td></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 relationship between ( x ) and ( y ).</td>
<td></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></td>
</tr>
<tr>
<td>9.</td>
<td>The equations of a regression line and a median-fit line are very similar.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>An inverse relation is obtained by exchanging the ( x )-coordinates with the ( y )-coordinates of each ordered pair of the original relation.</td>
<td></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.
### Ejercicios preparatorios

**Ecuaciones de Funciones Lineales**

#### Paso 1

**Antes de comenzar el Capítulo 4**

- Lee cada enunciado.
- Decide si estás de acuerdo (A) o en desacuerdo (D) con el enunciado.
- Escribe A o D en la primera columna O si no estás seguro(a) de la respuesta, escribe NS (No estoy seguro(a)).

<table>
<thead>
<tr>
<th>PASO 1 A, D, o NS</th>
<th>Enunciado</th>
<th>PASO 2 A o D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>La pendiente de una recta dada por una ecuación de la forma ( y = mx + b ) se puede determinar mediante la observación de la ecuación.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>La intersección y de ( y = 12x - 8 ) es 8.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Si se conocen dos puntos sobre una recta, entonces se puede escribir una ecuación para esa recta.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Una ecuación de la forma ( y = mx + b ) está en forma punto-pendiente.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>A las rectas que se intersecan en ángulos rectos se les llama rectas perpendiculares.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Se dice que un diagrama de dispersión tiene correlación negativa cuando los puntos son aleatorios y no muestran relación entre ( x ) y ( y ).</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Entre más cercano se encuentre de cero el coeficiente de correlación, mejor modela un conjunto de datos la recta de mejor ajuste.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>La ecuación de una línea de regresión y una recta de mediano ajuste son muy parecidas.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Una relación inversa es obtenida cambiando las ( x )-coordenadas con las ( y )-coordenadas de cada par pedido de la relación original.</td>
<td></td>
</tr>
</tbody>
</table>

#### Paso 2

**Después de completar el Capítulo 4**

- Vuelve a leer cada enunciado y completa la última columna con una A o una D.
- ¿Cambió cualquiera de tus opiniones sobre los enunciados de la primera columna?
- En una hoja de papel aparte, escribe un ejemplo de por qué estás en desacuerdo con los enunciados que marcaste con una D.
### Study Guide and Intervention

#### Graphing Equations in Slope-Intercept Form

**Slope-Intercept Form**

<table>
<thead>
<tr>
<th>Slope-Intercept Form</th>
<th>( y = mx + b ), where ( m ) is the slope and ( b ) is the ( y )-intercept</th>
</tr>
</thead>
</table>

**Example 1**

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

\[ y = mx + b \quad \text{Slope-intercept form} \]

\[ y = -4x + 3 \quad \text{Replace } m \text{ with } -4 \text{ and } b \text{ with 3.} \]

**Example 2**

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

\[
\begin{align*}
3x - 4y &= 8 & \text{Original equation} \\
-4y &= -3x + 8 & \text{Subtract } 3x \text{ from each side.} \\
\frac{-4y}{-4} &= \frac{-3x + 8}{-4} & \text{Divide each side by } -4. \\
y &= \frac{3}{4}x - 2 & \text{Simplify.}
\end{align*}
\]

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 \(-3\)  
2. slope: \(-2\), \( y \)-intercept \(-1\)  
3. slope: \(-1\), \( y \)-intercept \(-7\)

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

4. \[
\begin{array}{c}
\text{Graph}
\end{array}
\]

5. \[
\begin{array}{c}
\text{Graph}
\end{array}
\]

6. \[
\begin{array}{c}
\text{Graph}
\end{array}
\]

Graph each equation.

7. \( y = 2x + 1 \)  
8. \( y = -3x + 2 \)  
9. \( y = -x - 1 \)
**4-1 Study Guide and Intervention (continued)**

**Graphing Equations in Slope-Intercept Form**

**Modeling Real-World Data**

**Example** MEDIA 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 \( N \) = the number of millions of music cassettes sold. Let \( x \) = the number of years since 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 at (0, 124) and has a slope of \(-27\).

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

\[
N = -27x + 124 \quad \text{Original equation}
\]
\[
N = -27(4) + 124 \quad \text{Replace } x \text{ with 4.}
\]
\[
N = 16 \quad \text{Simplify.}
\]

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.

   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.

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

   c. Find the population in 2050.
Lesson 4-1 Skills 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: 5, \( y \)-intercept: \(-3\)  
2. slope: \(-2\), \( y \)-intercept: 7
3. slope: \(-6\), \( y \)-intercept: \(-2\)  
4. slope: 7, \( y \)-intercept: 1
5. slope: 3, \( y \)-intercept: 2  
6. slope: \(-4\), \( y \)-intercept: \(-9\)
7. slope: 1, \( y \)-intercept: \(-12\)  
8. slope: 0, \( y \)-intercept: 8

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

9.  
10.  
11.  

Graph each equation.

12. \( y = x + 4 \)  
13. \( y = -2x - 1 \)  
14. \( x + y = -3 \)

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.
   b. Graph the equation.
   c. Find the cost of buying a rental card and renting 6 movies.
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
2. slope: \(\frac{3}{2}\), y-intercept: \(-4\)
3. slope: 1.5, y-intercept: \(-1\)
4. slope: \(-2.5\), y-intercept: 3.5

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

5.

6.

7.

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 \(m\).
   
b. Graph the equation on the grid at the right.
   
c. Find the total number of pages written after 5 months.
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 $x$, the number of months that it will take Wade to save $275.

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 $x$ gallons of gasoline and a car wash is shown below. Write the equation in slope-intercept form for the line.

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 $x$ classes. What are the slope and $y$-intercept of the equation?

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.

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.
   
   b. Approximately how much renewable power was produced in 2005?
   
   c. If the same trend continues from 2006 to 2010, how much renewable power will be produced in the year 2010?
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 small-boned. If they don’t 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 weights of these people.

1. woman, 5 ft 4 in., normal-boned
2. man, 5 ft 11 in., large-boned
3. man, 6 ft 5 in., small-boned
4. you, if you are at least 5 ft tall

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, his proper weight $y$ is given by the formula $y = 6(x - 60) + 106$ 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.
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.
7. Derive the formula in slope-intercept form for the ideal weight $y$ of a large-boned female with height $x$ inches.
8. Derive the formula in slope-intercept form for the ideal weight $y$ of a small-boned male with height $x$ inches.
9. Find the heights at which the ideal weights of normal-boned males and large-boned females would be the same.
Write an equation of the line that passes through the given point and has the given slope.

1. \((3, 5)\)  \(m = 2\)

2. \((0, 0)\)  \(m = -2\)

3. \((2, 4)\)  \(m = \frac{1}{2}\)

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. \((0, 350)\), \(m = \frac{1}{5}\)
4-2 Study Guide and Intervention (continued)

Writing Equations in Slope-Intercept Form

Write an Equation Given Two Points

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 \( b \).

\[
m = \frac{y_2 - y_1}{x_2 - x_1} \quad \text{Slope formula}
\]

\[
m = \frac{-2 - 2}{3 - 1} \quad y_2 = -2, y_1 = 2, x_2 = 3, x_1 = 1
\]

\[
m = -2 \quad \text{Simplify.}
\]

\[
y = mx + b \quad \text{Slope-intercept form}
\]

\[
2 = -2(1) + b \quad \text{Replace } m \text{ with } -2, y \text{ with } 2, \text{ and } x \text{ with } 1.
\]

\[
2 = -2 + b \quad \text{Multiply.}
\]

\[
4 = b \quad \text{Add 2 to each side.}
\]

Therefore, the equation is \( y = -2x + 4 \).

Exercises

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

1. 

2. 

3. 

4. \((-1, 6), (7, -10)\)

5. \((0, 2), (1, 7)\)

6. \((6, -25), (-1, 3)\)

7. \((-2, -1), (2, 11)\)

8. \((10, -1), (4, 2)\)

9. \((-14, -2), (7, 7)\)

10. \((4, 0), (0, 2)\)

11. \((-3, 0), (0, 5)\)

12. \((0, 16), (-10, 0)\)
4-2 Skills Practice

Writing Equations in Slope-Intercept Form

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

1. \((-1, 4); \text{ slope } -3\)

2. \((4, 1); \text{ slope } 2\)

3. \((-1, 2); \text{ slope } 1\)

4. \((1, 9); \text{ slope } 4\)

5. \((4, 2); \text{ slope } -2\)

6. \((2, -2); \text{ slope } 3\)

7. \((3, 0); \text{ slope } 5\)

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

9. \((-5, 4); \text{ slope } -4\)

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

10. \((-2, 3); (3, -2)\)

11. \((-1, -3); (1, 1)\)

12. \((0, 3); (2, -1)\)

13. \((1, 3), (-3, -5)\)

14. \((1, 4), (6, -1)\)

15. \((1, -1), (3, 5)\)

16. \((-2, 4), (0, 6)\)

17. \((3, 3), (1, -3)\)

18. \((-1, 6), (3, -2)\)

19. 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.

b. Estimate the price of a share of stock five weeks ago.
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. \((1, 2); m = 3\)

2. \((-2, 2); m = -2\)

3. \((-1, -3); m = \frac{1}{2}\)

4. \((-5, 4); \text{slope} -3\)

5. \((4, 3); \text{slope} \frac{1}{2}\)

6. \((1, -5); \text{slope} -\frac{3}{2}\)

7. \((3, 7); \text{slope} \frac{2}{7}\)

8. \((-2, \frac{5}{2}); \text{slope} -\frac{1}{2}\)

9. \((5, 0); \text{slope} 0\)

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

10. \((4, -2), (2, -4)\)

11. \((0, 5), (4, 1)\)

12. \((-3, 1), (-1, -3)\)

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. 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 \(\ell\) lessons. Then use the equation to find the cost of 4 lessons.

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.
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 $k$, Mr. Kimball’s salary after $t$ years at this company if his performance reviews are always satisfactory.

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 $t$ represents the number of years after 1990, write a linear equation to find $p$, Laredo’s population for any year after 1990.

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?

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></td>
<td>3</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>5.5</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>8.5</td>
</tr>
</tbody>
</table>

*Source: DanceSport UK*

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

b. What are the slope and $y$-intercept of the line?

c. Is the $y$-intercept a valid data point for the given information?
**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, equations of the form $y = ax^2 + bx + c$, equations of the tangent lines 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**

Find an equation of the line tangent 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 $(2, 12)$.

**Step 1:** Find two points on the curve. Use $x = 1$ and $x = 3$.
- When $x = 1$, $y = 1^2 + 3(1) + 2$ or 6.
- When $x = 3$, $y = 3^2 + 3(3) + 2$ or 20.
- So, the two ordered pairs are $(1, 6)$ and $(3, 20)$.

**Step 2:** Find the slope of the line that passes through these two points.

$m = \frac{20 - 6}{3 - 1}$ or 7

**Step 3:** Now use this slope and the point $(2, 12)$ to find an equation of the tangent line.

$y = mx + b$ Slope-intercept form

$12 = 7(2) + b$ Replace $x$ with 2, $y$ with 12, and $m$ with 7.

$-2 = b$ Solve for $b$.

So, an equation of the tangent line to $y = x^2 + 3x + 2$ through the point $(2, 12)$ is $y = 7x - 2$.

**Exercises**

Find an equation of the line 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 $y = ax^2 + bx + c$.

5. Find the slope of the line tangent to the curve $y = ax^2 + bx + c$ at $x$ by finding the slope of the line through the points $(0, c)$ and $(2x, 4ax^2 + 2bx + c)$. Does this equation find the same slope for $x = 0$ as you found in Exercise 4?
Study Guide and Intervention
Writing Equations in Point-Slope Form

Point-Slope Form

\[ y - y_1 = m(x - x_1), \text{ where } (x_1, y_1) \text{ is a given point on a nonvertical line} \]
and \( m \) is the slope of the line

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

\[
\begin{align*}
y - 1 &= -\frac{5}{2}(x - 6) \quad \text{Point-slope form} \\
m &= -\frac{5}{2}; (x_1, y_1) = (6, 1)
\end{align*}
\]

Therefore, the equation is \( y - 1 = -\frac{5}{2}(x - 6) \).

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

\[
\begin{align*}
y - (-1) &= 0(x - 4) \quad \text{Point-slope form} \\
m &= 0; (x_1, y_1) = (4, -1) \\
y + 1 &= 0 \quad \text{Simplify.}
\end{align*}
\]

Therefore, the equation is \( y + 1 = 0 \).

**Exercises**

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

1. \((4, 1), m = 1\)  
2. \((-3, 2), m = 0\)  
3. \((2, -3), m = -2\)

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

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

12. Write an equation in point-slope form for a horizontal line that passes through \((5, 0)\).
4-3 Study Guide and Intervention (continued)

Writing Equations in Point-Slope Form

Forms of Linear Equations

<table>
<thead>
<tr>
<th>Form</th>
<th>Equation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope-Intercept Form</td>
<td>$y = mx + b$</td>
<td>$m =$ slope; $b =$ y-intercept</td>
</tr>
<tr>
<td>Point-Slope Form</td>
<td>$y - y_1 = m(x - x_1)$</td>
<td>$m =$ slope; $(x_1, y_1)$ is a given point</td>
</tr>
<tr>
<td>Standard Form</td>
<td>$Ax + By = C$</td>
<td>$A$ and $B$ are not both zero. Usually $A$ is nonnegative and $A$, $B$, and $C$ are integers whose greatest common factor is 1.</td>
</tr>
</tbody>
</table>

Example 1

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

1. $y + 5 = \frac{2}{3}(x - 6)$ Original equation
2. $3(y + 5) = 3\left(\frac{2}{3}\right)(x - 6)$ Multiply each side by 3.
3. $3y + 15 = 2(x - 6)$ Distributive Property
4. $3y + 15 = 2x - 12$ Distributive Property
5. $3y = 2x - 27$ Subtract 15 from each side.
6. $-2x + 3y = -27$ Add $-2x$ to each side.
7. $2x - 3y = 27$ Multiply each side by $-1$.

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.

1. $y - 2 = -\frac{1}{4}(x - 8)$ Original equation
2. $y - 2 = -\frac{1}{4}x + 2$ Distributive Property
3. $y = -\frac{1}{4}x + 4$ Add 2 to each side.

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

Exercises

Write each equation in standard form.

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

Write each equation in slope-intercept form.

7. $y + 4 = 4(x - 2)$
8. $y - 5 = \frac{1}{3}(x - 6)$
9. $y - 8 = -\frac{1}{4}(x + 8)$
10. $y - 6 = 3\left(x - \frac{1}{3}\right)$
11. $y + 4 = -2(x + 5)$
12. $y + \frac{5}{3} = \frac{1}{2}(x - 2)$
Write an equation in point-slope form for the line that passes through each point with the given slope.

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

Write each equation in standard form.

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

Write each equation in slope-intercept form.

19. \(y - 4 = 3(x - 2)\)
20. \(y + 2 = -(x + 4)\)
21. \(y - 6 = -2(x + 2)\)
22. \(y + 1 = -5(x - 3)\)
23. \(y - 3 = 6(x - 1)\)
24. \(y - 8 = 3(x + 5)\)
25. \(y - 2 = \frac{1}{2}(x + 6)\)
26. \(y + 1 = -\frac{1}{3}(x + 9)\)
27. \(y - \frac{1}{2} = x + \frac{1}{2}\)
Write an equation in point-slope form for the line that passes through each point with the given slope.

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

Write each equation in standard form.

7. \(y - 11 = 3(x - 2)\)  
8. \(y - 10 = -(x - 2)\)  
9. \(y + 7 = 2(x + 5)\)  
10. \(y - 5 = \frac{3}{2}(x + 4)\)  
11. \(y + 2 = -\frac{3}{4}(x + 1)\)  
12. \(y - 6 = \frac{4}{3}(x - 3)\)  
13. \(y + 4 = 1.5(x + 2)\)  
14. \(y - 3 = -2.4(x - 5)\)  
15. \(y - 4 = 2.5(x + 3)\)

Write each equation in slope-intercept form.

16. \(y + 2 = 4(x + 2)\)  
17. \(y + 1 = -7(x + 1)\)  
18. \(y - 3 = -5(x + 12)\)  
19. \(y - 5 = \frac{3}{2}(x + 4)\)  
20. \(y - \frac{1}{4} = -3\left(x + \frac{1}{4}\right)\)  
21. \(y - \frac{2}{3} = -2\left(x - \frac{1}{4}\right)\)

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 \(x\).
   
   b. Write the equation in slope-intercept form.
   
   c. What is the fee for the use of a trash dumpster?

23. **MOVING** There is a 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 a one-day rental with \(x\) miles driven.
   
   b. Write the equation in slope-intercept form.
   
   c. What is the daily fee?
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 an equation for the relationship between distance and time in point-slope form.

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

3. **NATURE** The frequency of a male cricket’s chirp is related to 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 from the graph below to write an equation for the line in point-slope form.

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 point-slope form to find the total distance \( y \) for any number of hours \( x \).

5. **AVIATION** A jet plane takes off and consistently climbs 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 trajectory.

   b. Write the equation from part a in slope-intercept form.

   c. Write the equation in standard form.
Collinearity

You have learned how to find the slope between two points on a line. Does it matter which two points you use? How does your choice of points affect the slope-intercept form of the equation of the line?

1. Choose three different pairs of points from the graph at the right. Write the slope-intercept form of the line using each pair.

2. How are the equations related?

3. What conclusion can you draw from your answers to Exercises 1 and 2?

When points are contained in the same line, they are said to be collinear. Even though points may look like they form a line when connected, it does not mean that they actually do. By checking pairs of points on a graph you can determine whether the graph represents a linear relationship.

4. Choose several pairs of points from the graph at the right and write the slope-intercept form of the line containing each pair.

5. What conclusion can you draw from your equations in Exercise 4? Is this a line?
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, \( \text{LinReg}(ax + b) \), is found under the 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 \(L1\) and the \(y\)-coordinates into \(L2\). Use the linear regression function to write the equation of the line.

Keystrokes: \(\text{STAT} \quad \text{ENTER} \quad 3 \quad \text{ENTER} \quad 6 \quad \text{ENTER} \quad \boxed{-} \quad 2 \quad \text{ENTER} \quad 4 \quad \text{ENTER} \quad \text{STAT} \quad \text{ENTER} \quad \boxed{4} \quad \text{2nd} \quad \boxed{L1} \quad \text{2nd} \quad \boxed{L2} \quad \text{ENTER}\).

The equation is \(y = 2x - 8\).

If you have already written the equation of a line, you can use the given information to verify your equation.

Example 2
Verify that the equation of the line passing through \((2, -3)\) with slope \(-\frac{3}{4}\) 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 \(L1\) and the \(y\)-coordinates into \(L2\). Use \(\text{LinReg}(ax + b)\) to determine the slope-intercept form of the equation.

The slope-intercept form of the equation is \(y = -0.75x - 1.5\) or \(y = -\frac{3}{4}x - \frac{3}{2}\).

This can be rewritten in standard form as \(3x + 4y = -6\).

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

5. \(x\)-intercept: 1, \(y\)-intercept: \(-\frac{1}{2}\)  
6. passes through \((-18, 11)\), \(y\)-intercept: 3
Parallel 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.

\[
y - y_1 = m(x - x_1) \quad \text{Point-slope form} \\
y - 6 = 2(x - (-1)) \quad m = 2; (x_1, y_1) = (-1, 6) \\
y - 6 = 2(x + 1) \quad \text{Simplify.} \\
y - 6 = 2x + 2 \quad \text{Distributive Property} \\
y = 2x + 8 \quad \text{Slope-intercept form}
\]

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

4. \((-2, 4), y = -3x + 10\)  
5. \((-1, 6), 3x + y = 12\)  
6. \((4, -6), x + 2y = 5\)  

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

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

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

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 \(2x - 3y = 9\).

\[
2x - 3y = 9 \quad \text{Original equation}
\]

\[
-3y = -2x + 9 \quad \text{Subtract } 2x \text{ from each side.}
\]

\[
y = \frac{2}{3}x - 3 \quad \text{Divide each side by } -3.
\]

The slope of \(y = \frac{2}{3}x - 3\) is \(\frac{2}{3}\). 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 \(-\frac{3}{2}\).

Use the point-slope form to find the equation.

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

\[
y - 2 = -\frac{3}{2}(x - (-4)) \quad m = -\frac{3}{2}, (x_1, y_1) = (-4, 2)
\]

\[
y - 2 = -\frac{3}{2}(x + 4) \quad \text{Simplify.}
\]

\[
y - 2 = -\frac{3}{2}x - 6 \quad \text{Distributive Property}
\]

\[
y = -\frac{3}{2}x - 4 \quad \text{Slope-intercept form}
\]

Exercises

1. ARCHITECTURE On the architect’s plans for a new high school, a wall represented by \(\overline{MN}\) has endpoints \(M(-3, -1)\) and \(N(2, 1)\). A wall represented by \(\overline{PQ}\) has endpoints \(P(4, -4)\) and \(Q(-2, 11)\). Are the walls perpendicular? Explain.

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

2. \(2x + y = -7, x - 2y = -4, 4x - y = 5\)

3. \(y = 3x, 6x - 2y = 7, 3y = 9x - 1\)

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. \((4, 2), y = \frac{1}{2}x + 1\)  
5. \((2, -3), y = -\frac{2}{3}x + 4\)  
6. \((6, 4), y = 7x + 1\)

7. \((-8, -7), y = -x - 8\)  
8. \((6, -2), y = -3x - 6\)  
9. \((-5, -1), y = \frac{5}{2}x - 3\)
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 the given equation.

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

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

7. \((0, 0), y = \frac{1}{2}x - 1\)

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

11. \(y = \frac{2}{3}x + 3, y = \frac{3}{2}x, 2x - 3y = 8\)

12. \(y = 4x, x + 4y = 12, 4x + y = 1\)

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

13. \((-3, -2), y = x + 2\)
14. \((4, -1), y = 2x - 4\)
15. \((-1, -6), x + 3y = 6\)

16. \((-4, 5), y = -4x - 1\)
17. \((-2, 3), y = \frac{1}{4}x - 4\)
18. \((0, 0), y = \frac{1}{2}x - 1\)
4-4 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 the given equation.

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

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

7. (−3, 4), \( 3y = 2x − 3 \)
8. (−1, −2), \( 3x − y = 5 \)
9. (−8, 2), \( 5x − 4y = 1 \)

10. (−1, −4), \( 9x + 3y = 8 \)
11. (−5, 6), \( 4x + 3y = 1 \)
12. (3, 1), \( 2x + 5y = 7 \)

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

13. (−2, −2), \( y = −\frac{1}{3}x + 9 \)
14. (−6, 5), \( x − y = 5 \)
15. (−4, −3), \( 4x + y = 7 \)

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

19. (−4, 1), \( 4x + 7y = 6 \)
20. (10, 5), \( 5x + 4y = 8 \)
21. (4, −5), \( 2x − 5y = −10 \)

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

25. GEOMETRY Quadrilateral \( ABCD \) has diagonals \( \overline{AC} \) and \( \overline{BD} \).
   Determine whether \( \overline{AC} \) is perpendicular to \( \overline{BD} \). Explain.

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.
1. **BUSINESS** Brady’s Books is a retail store. The store’s average daily profits $y$ are given by the equation $y = 2x + 3$ where $x$ is the number of hours available for customer purchases. Brady’s adds an online shopping option. Write an equation in slope-intercept form to show a new profit line with the same profit rate containing the point $(0, 12)$.

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 $y = -\frac{5}{3}x + 13$. 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 the 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 $ABCD$ 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?
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 $y = m(x - 2)$, 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 $y = mx + 3m - 2$, where $m$ is any real number
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**.

**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**

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.**

   ![Graph](image1)

   **Source:** *The World Almanac*

2. **Average Jogging Speed**

   ![Graph](image2)

3. **Average U.S. Hourly Earnings**

   ![Graph](image3)

   **Source:** U.S. Dept. of Labor

4. **U.S. Imports from Mexico**

   ![Graph](image4)

   **Source:** U.S. Census Bureau
Use Lines of Fit

Example

The table shows the number of students per computer in Easton High School for certain school years from 1996 to 2008.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Students per Computer</td>
<td>22</td>
<td>18</td>
<td>14</td>
<td>10</td>
<td>6.1</td>
<td>5.4</td>
<td>4.9</td>
</tr>
</tbody>
</table>

a. Draw a scatter plot and determine what relationship exists, if any.
   Since \( y \) decreases as \( x \) increases, the correlation is negative.

b. Draw a line of fit for the scatter plot.
   Draw a line that passes close to most of the points. A line of fit is shown.

c. Write the slope-intercept form of an equation for the line of fit.
   The line of fit shown passes through \((1999, 16)\) and \((2005, 5.7)\). Find the slope.
   \[
   m = \frac{5.7 - 16}{2005 - 1999} = \frac{-10.3}{6} = -1.7
   \]
   Find \( b \) in \( y = -1.7x + b \).
   \[
   16 = -1.7 \cdot 1999 + b
   \]
   \[
   3404 = b
   \]
   Therefore, an equation of a line of fit is \( y = -1.7x + 3404 \).

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.
4-5 Skills Practice

Scatter Plots and Lines 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. Calories Burned During Exercise

2. Library Fines

3. Weight-Lifting

4. Car Dealership Revenue

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.
4-5 Practice

Scatter Plots and Lines 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. Temperature versus Rainfall

2. State Elevations

3. 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.
   b. Draw a line of fit for the scatter plot.
   c. Write the slope-intercept form of an equation for the line of fit.

4. ZOOS The table shows the average and maximum longevity of various animals in captivity.
   a. Draw a scatter plot and determine what relationship, if any, exists in the data.
   b. Draw a line of fit for the scatter plot.
   c. Write the slope-intercept form of an equation for the line of fit.
   d. Predict the maximum longevity for an animal with an average longevity of 33 years.
4-5 Word Problem Practice

Scatter Plots and Lines of Fit

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?

![Graph of CDs sold from 1999 to 2005](source: RIAA)

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.

<table>
<thead>
<tr>
<th>Child’s Age</th>
<th>Cost of Raising a Child Born in 2003 ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>10,700</td>
</tr>
<tr>
<td>6</td>
<td>11,700</td>
</tr>
<tr>
<td>9</td>
<td>12,600</td>
</tr>
<tr>
<td>12</td>
<td>15,000</td>
</tr>
<tr>
<td>15</td>
<td>16,700</td>
</tr>
</tbody>
</table>

![Graph of child’s age vs. annual cost](source: The World Almanac)

3. HOUSING The median price of an existing home was $160,000 in 2000 and $240,000 in 2007. If \( x \) represents the number of years since 2000, use these data points to determine a line of best fit for the trends in the price of existing homes. Write the equation in slope-intercept form.

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

<table>
<thead>
<tr>
<th>Average Length of Major League Baseball Games</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>Time (min)</td>
</tr>
</tbody>
</table>

![Graph of baseball game time](source: Elias Sports Bureau)

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

b. Explain what the scatter plot shows.

c. Draw a line of fit for the scatter plot.
Latitude and Temperature

The \textit{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 mean January temperature? At the right is a table containing the latitudes and January mean temperatures for fifteen U.S. cities.

<table>
<thead>
<tr>
<th>U.S. City</th>
<th>Latitude</th>
<th>January Mean Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany, New York</td>
<td>42:40 N</td>
<td>20.7°F</td>
</tr>
<tr>
<td>Albuquerque, New Mexico</td>
<td>35:07 N</td>
<td>34.3°F</td>
</tr>
<tr>
<td>Anchorage, Alaska</td>
<td>61:11 N</td>
<td>14.9°F</td>
</tr>
<tr>
<td>Birmingham, Alabama</td>
<td>33:32 N</td>
<td>41.7°F</td>
</tr>
<tr>
<td>Charleston, South Carolina</td>
<td>32:47 N</td>
<td>47.1°F</td>
</tr>
<tr>
<td>Chicago, Illinois</td>
<td>41:50 N</td>
<td>21.0°F</td>
</tr>
<tr>
<td>Columbus, Ohio</td>
<td>39:59 N</td>
<td>26.3°F</td>
</tr>
<tr>
<td>Duluth, Minnesota</td>
<td>46:47 N</td>
<td>7.0°F</td>
</tr>
<tr>
<td>Fairbanks, Alaska</td>
<td>64:50 N</td>
<td>-10.1°F</td>
</tr>
<tr>
<td>Galveston, Texas</td>
<td>29:14 N</td>
<td>52.9°F</td>
</tr>
<tr>
<td>Honolulu, Hawaii</td>
<td>21:19 N</td>
<td>72.9°F</td>
</tr>
<tr>
<td>Las Vegas, Nevada</td>
<td>36:12 N</td>
<td>45.1°F</td>
</tr>
<tr>
<td>Miami, Florida</td>
<td>25:47 N</td>
<td>67.3°F</td>
</tr>
<tr>
<td>Richmond, Virginia</td>
<td>37:32 N</td>
<td>35.8°F</td>
</tr>
<tr>
<td>Tucson, Arizona</td>
<td>32:12 N</td>
<td>51.3°F</td>
</tr>
</tbody>
</table>

Sources: National Weather Service

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.

3. Use your equation to predict the January mean temperature of Juneau, Alaska, which has latitude 58:23 N.

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

5. Was your conjecture about the relationship between latitude and temperature correct?

6. Research the latitudes and temperatures for cities in the southern hemisphere. Does your conjecture hold for these cities as well?
4-5 Spreadsheet Activity

Scatter Plots

A spreadsheet program can create scatter plots of data that you enter. You can also have the spreadsheet graph a line of fit, called a *trendline*, automatically.

**Example**

The table below shows the number of metric tons of gold produced in mines in the United States in selected years.

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>353</td>
<td>335</td>
<td>298</td>
<td>277</td>
<td>247</td>
<td>256</td>
<td>252</td>
<td>238</td>
<td>233</td>
<td>210</td>
</tr>
</tbody>
</table>

Source: U.S. Geological Survey

Use a spreadsheet to draw a scatter plot and a trendline for the data. Let \( x \) represent the number of years since 2000 and let \( y \) represent the number of metric tons of gold. Then predict the number of ounces of gold produced in 2013.

**Step 1**

Use Column A for the years since 2000 and Column B for the number of metric tons of gold. To create a graph from the data, select the data in Columns A and B and choose Chart from the Insert menu. Select an XY (Scatter) chart to show the data points.

**Step 2**

Add a trendline to the graph by choosing the Chart menu. Add a linear trendline. Use the options menu to have the trendline forecast 5 years forward.

Using this trendline, it appears that the gold production for 2013 will be approximately 150 metric tons.

---

**Exercises**

The table shows the number of millions of dollars of direct political contributions received by Democrats and Republicans in selected years.

1. Use a spreadsheet to draw a scatter plot and a trendline for the data. Let \( x \) represent the number of years since 1990 and let \( y \) represent direct political contributions in millions of dollars.

<table>
<thead>
<tr>
<th>Year</th>
<th>Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>281</td>
</tr>
<tr>
<td>1994</td>
<td>337</td>
</tr>
<tr>
<td>1998</td>
<td>445</td>
</tr>
<tr>
<td>2002</td>
<td>717</td>
</tr>
<tr>
<td>2006</td>
<td>1085</td>
</tr>
</tbody>
</table>

Source: Open Secrets

2. Predict the amount of direct political contributions for the 2010 election.
4-6 Study Guide and Intervention

Regression and Median-Fit Lines

Equations of Best-Fit Lines  Many graphing calculators utilize an algorithm called linear regression to find a precise line of fit called the best-fit line. The calculator computes the data, writes an equation, and gives you the correlation coefficient, a measure of how closely the equation models the data.

Example  GAS PRICES  The table shows the price of a gallon of regular gasoline at a station in Los Angeles, California on January 1 of various years.

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Price</td>
<td>$1.47</td>
<td>$1.82</td>
<td>$2.15</td>
<td>$2.49</td>
<td>$2.83</td>
<td>$3.04</td>
</tr>
</tbody>
</table>

Source: U.S. Department of Energy

a. Use a graphing calculator to write an equation for the best-fit line for that data. Enter the data by pressing STAT and selecting the Edit option. Let the year 2005 be represented by 0. Enter the years since 2005 into List 1 (L_1). Enter the average price into List 2 (L_2).

Then, perform the linear regression by pressing STAT and selecting the CALC option. Scroll down to LinReg (ax+b) and press ENTER. The best-fit equation for the regression is shown to be \( y = 0.321x + 1.499 \).

b. Name the correlation coefficient. The correlation coefficient is the value shown for \( r \) on the calculator screen. The correlation coefficient is about 0.998.

Exercises

Write an equation of the regression line for the data in each table below. Then find the correlation coefficient.

1. OLYMPICS  Below is a table showing the number of gold medals won by the United States at the Winter Olympics during various years.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Medals</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: International Olympic Committee

2. INTEREST RATES  Below is a table showing the U.S. Federal Reserve’s prime interest rate on January 1 of various years.

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime Rate (percent)</td>
<td>7.25</td>
<td>8.25</td>
<td>7.25</td>
<td>3.25</td>
<td>3.25</td>
</tr>
</tbody>
</table>

Source: Federal Reserve Board
**4-6 Study Guide and Intervention (continued)**

**Regression and Median-Fit Lines**

**Equations of Median-Fit Lines** A graphing calculator can also find another type of best-fit line called the **median-fit line**, which is found using the medians of the coordinates of the data points.

---

**Example**

**ELECTIONS** The table shows the total number of people in millions who voted in the U.S. Presidential election in the given years.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voters</td>
<td>86.5</td>
<td>92.7</td>
<td>91.6</td>
<td>104.4</td>
<td>96.3</td>
<td>122.3</td>
<td>131.3</td>
</tr>
</tbody>
</table>

Source: George Mason University

**a. Find an equation for the median-fit line.** Enter the data by pressing **STAT** and selecting the Edit option. Let the year 1980 be represented by 0. Enter the years since 1980 into List 1 (L1). Enter the number of voters into List 2 (L2).

Then, press **STAT** and select the CALC option. Scroll down to Med-Med option and press **ENTER**. The value of **a** is the slope, and the value of **b** is the **y**-intercept.

The equation for the median-fit line is \( y = 1.55x + 83.57 \).

**b. Estimate the number of people who voted in the 2000 U.S. Presidential election.**

Graph the best-fit line. Then use the **TRACE** feature and the arrow keys until you find a point where \( x = 20 \).

When \( x = 20 \), \( y \approx 115 \). Therefore, about 115 million people voted in the 2000 U.S. Presidential election.

---

**Exercises**

Write an equation of the regression line for the data in each table below. Then find the correlation coefficient.

1. **POPULATION GROWTH** Below is a table showing the estimated population of Arizona in millions on July 1st of various years.

<table>
<thead>
<tr>
<th>Year</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>5.30</td>
<td>5.44</td>
<td>5.58</td>
<td>5.74</td>
<td>5.94</td>
<td>6.17</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau

**a. Find an equation for the median-fit line.**

**b. Predict the population of Arizona in 2009.**

2. **ENROLLMENT** Below is a table showing the number of students enrolled at Happy Days Preschool in the given years.

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2004</th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>130</td>
<td>168</td>
<td>184</td>
<td>201</td>
<td>234</td>
</tr>
</tbody>
</table>

**a. Find an equation for the median-fit line.**

**b. Estimate how many students were enrolled in 2007.**
Write an equation of the regression line for the data in each table below. Then find the correlation coefficient.

1. **SOCCER** The table shows the number of goals a soccer team scored each season since 2005.

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals Scored</td>
<td>42</td>
<td>48</td>
<td>46</td>
<td>50</td>
<td>52</td>
<td>48</td>
</tr>
</tbody>
</table>

2. **PHYSICAL FITNESS** The table shows the percentage of seventh grade students in public school who met all six of California’s physical fitness standards each year since 2002.

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>24.0%</td>
<td>36.4%</td>
<td>38.0%</td>
<td>40.8%</td>
<td>37.5%</td>
</tr>
</tbody>
</table>

*Source: California Department of Education*

3. **TAXES** The table shows the estimated sales tax revenues, in billions of dollars, for Massachusetts each year since 2004.

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax Revenue</td>
<td>3.75</td>
<td>3.89</td>
<td>4.00</td>
<td>4.17</td>
<td>4.47</td>
</tr>
</tbody>
</table>

*Source: Beacon Hill Institute*

4. **PURCHASING** The SureSave supermarket chain closely monitors how many diapers are sold each year so that they can reasonably predict how many diapers will be sold in the following year.

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diapers Sold</td>
<td>60,200</td>
<td>65,000</td>
<td>66,300</td>
<td>65,200</td>
<td>70,600</td>
</tr>
</tbody>
</table>

a. Find an equation for the median-fit line.

b. How many diapers should SureSave anticipate selling in 2011?

5. **FARMING** Some crops, such as barley, are very sensitive to how acidic the soil is. To determine the ideal level of acidity, a farmer measured how many bushels of barley he harvests in different fields with varying acidity levels.

<table>
<thead>
<tr>
<th>Soil Acidity (pH)</th>
<th>5.7</th>
<th>6.2</th>
<th>6.6</th>
<th>6.8</th>
<th>7.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bushels Harvested</td>
<td>3</td>
<td>20</td>
<td>48</td>
<td>61</td>
<td>73</td>
</tr>
</tbody>
</table>

a. Find an equation for the regression line.

b. According to the equation, how many bushels would the farmer harvest if the soil had a pH of 10?

c. Is this a reasonable prediction? Explain.
Write an equation of the regression line for the data in each table below. Then find the correlation coefficient.

1. **TURTLES** The table shows the number of turtles hatched at a zoo each year since 2006.

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turtles Hatched</td>
<td>21</td>
<td>17</td>
<td>16</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>

2. **SCHOOL LUNCHES** The table shows the percentage of students receiving free or reduced price school lunches at a certain school each year since 2006.

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>14.4%</td>
<td>15.8%</td>
<td>18.3%</td>
<td>18.6%</td>
<td>20.9%</td>
</tr>
</tbody>
</table>

*Source: KidsData*

3. **SPORTS** Below is a table showing the number of students signed up to play lacrosse after school in each age group.

<table>
<thead>
<tr>
<th>Age</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacrosse Players</td>
<td>17</td>
<td>14</td>
<td>6</td>
<td>9</td>
<td>12</td>
</tr>
</tbody>
</table>

4. **LANGUAGE** The State of California keeps track of how many millions of students are learning English as a second language each year.

<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Learners</td>
<td>1.600</td>
<td>1.599</td>
<td>1.592</td>
<td>1.570</td>
<td>1.569</td>
</tr>
</tbody>
</table>

*Source: California Department of Education*

a. Find an equation for the median-fit line.

b. Predict the number of students who were learning English in California in 2001.

c. Predict the number of students who were learning English in California in 2010.

5. **POPULATION** Detroit, Michigan, like a number of large cities, is losing population every year. Below is a table showing the population of Detroit each decade.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (millions)</td>
<td>1.67</td>
<td>1.51</td>
<td>1.20</td>
<td>1.03</td>
<td>0.95</td>
</tr>
</tbody>
</table>

*Source: U.S. Census Bureau*

a. Find an equation for the regression line.

b. Find the correlation coefficient and explain the meaning of its sign.

1. **FOOTBALL** Rutgers University running back Ray Rice ran for 1732 total yards in the 2007 regular season. The table below shows his cumulative total number of yards ran after select games.

<table>
<thead>
<tr>
<th>Game Number</th>
<th>1</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative Yards</td>
<td>184</td>
<td>431</td>
<td>818</td>
<td>1257</td>
<td>1732</td>
</tr>
</tbody>
</table>

*Source: Rutgers University Athletics*

Use a calculator to find an equation for the regression line showing the total yards $y$ scored after $x$ games. What is the real-world meaning of the value returned for $a$?

2. **GOLD** Ounces of gold are traded by large investment banks in commodity exchanges much the same way that shares of stock are traded. The table below shows the cost of a single ounce of gold on the last day of trading in given years.

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$346.70</td>
<td>$414.80</td>
<td>$438.10</td>
<td>$517.20</td>
<td>$636.30</td>
</tr>
</tbody>
</table>

*Source: Global Financial Data*

Use a calculator to find an equation for the regression line. Then predict the price of an ounce of gold on the last day of trading in 2009. Is this a reasonable prediction? Explain.

3. **GOLF SCORES** Emmanuel is practicing golf as part of his school’s golf team. Each week he plays a full round of golf and records his total score. His scorecard after five weeks is below.

<table>
<thead>
<tr>
<th>Week</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golf Score</td>
<td>112</td>
<td>107</td>
<td>108</td>
<td>104</td>
<td>98</td>
</tr>
</tbody>
</table>

Use a calculator to find an equation for the median-fit line. Then estimate how many games Emmanuel will have to play to get a score of 86.

4. **STUDENT ELECTIONS** The vote totals for five of the candidates participating in Montvale High School’s student council elections and the number of hours each candidate spent campaigning are shown in the table below.

<table>
<thead>
<tr>
<th>Hours Campaigning</th>
<th>1</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Votes Received</td>
<td>9</td>
<td>22</td>
<td>24</td>
<td>46</td>
<td>78</td>
</tr>
</tbody>
</table>

**a.** Use a calculator to find an equation for the median-fit line.

**b.** Plot the data points and draw the median-fit line on the graph below.

**c.** Suppose a sixth candidate spends 7 hours campaigning. Estimate how many votes that candidate could expect to receive.
### 4-6 Enrichment

#### Quadratic Regression Parabolas

For some sets of data, a linear equation in the form \(y = ax + b\) does not adequately describe the relationship between data points. The “QuadReg” function on a graphing calculator will output an equation in the form \(y = ax^2 + bx + c\). The value of \(R^2\), the **coefficient of determination** tells you how closely the parabola fits the data.

#### Example

The table shows the population of Atlanta in various years.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>497,000</td>
<td>425,000</td>
<td>394,017</td>
<td>416,474</td>
<td>470,688</td>
<td>498,109</td>
</tr>
</tbody>
</table>

*Source: U.S. Census Bureau*

**a. Find the equation of a quadratic-regression parabola for the data.**

Running a linear regression on the data provides an \(r\) value of 0.03, which indicates a poor fit. The data appears to be a good candidate for a quadratic regression.

**Step 1** Enter the data by pressing \(\text{STAT}\) and selecting the Edit option. Enter the years since 1970 as your \(x\)-values (L1) and enter the population figures as your \(y\)-values (L2).

**Step 2** Perform the quadratic regression by pressing \(\text{STAT}\) and selecting the CALC option. Scroll down to QuadReg and press \(\text{ENTER}\).

**Step 3** Write the equation of the best-fit parabola by rounding the \(a\), \(b\), and \(c\) values on the screen.

The equation for the best-fit parabola is \(y = 302.8x^2 - 11,480x + 501,227\).

**b. Find the coefficient of determination.**

The coefficient of determination for the parabola is \(R^2 = 0.969\), which indicates a good fit.

**c. Use the quadratic-regression parabola to predict the population in 2010.**

Graph the best-fit parabola. Then use the \(\text{TRACE}\) feature and the arrow keys until you find a point where \(x = 40\).

When \(x \approx 40\), \(y \approx 525,000\). The estimated population will be 525,000.

#### Exercises

1. The table below shows the average high temperature in Crystal River, Florida in various months.

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan (1)</th>
<th>Mar (3)</th>
<th>May (5)</th>
<th>Jul (7)</th>
<th>Sep (9)</th>
<th>Nov (11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. High (<em>°F</em>)</td>
<td>68°</td>
<td>76°</td>
<td>87°</td>
<td>91°</td>
<td>88°</td>
<td>76°</td>
</tr>
</tbody>
</table>

*Source: Country Studies*

**a. Find the equation of the best-fit parabola.**

**b. Find the coefficient of determination.**

**c. Use the quadratic-regression parabola to predict the average high temperature in April (4th month).**
**Inverse Linear Functions**

**Inverse Relations** An inverse relation is the set of ordered pairs obtained by exchanging the $x$-coordinates with the $y$-coordinates of each ordered pair. The domain of a relation becomes the range of its inverse, and the range of the relation becomes the domain of its inverse.

**Example** Find and graph the inverse of the relation represented by line $a$.

The graph of the relation passes through $(-2, -10), (-1, -7), (0, -4), (1, -1), (2, 2), (3, 5)$, and $(4, 8)$.

To find the inverse, exchange the coordinates of the ordered pairs.

The graph of the inverse passes through the points $(-10, -2), (-7, -1), (-4, 0), (-1, 1), (2, 2), (5, 3)$, and $(8, 4)$.

Graph these points and then draw the line that passes through them.

**Exercises**

Find the inverse of each relation.

1. $\{(4, 7), (6, 2), (9, -1), (11, 3)\}$
2. $\{(-5, -9), (-4, -6), (-2, -4), (0, -3)\}$
3. $\begin{array}{c|c}
 x & y \\
-8 & -15 \\
-2 & -11 \\
1 & -8 \\
5 & 1 \\
11 & 8 \\
\end{array}$
4. $\begin{array}{c|c}
 x & y \\
-8 & 3 \\
-2 & 9 \\
2 & 13 \\
6 & 18 \\
8 & 19 \\
\end{array}$
5. $\begin{array}{c|c}
 x & y \\
-6 & 14 \\
-5 & 11 \\
-4 & 8 \\
-3 & 5 \\
-2 & 2 \\
\end{array}$

Graph the inverse of each relation.
Inverse Functions A linear relation that is described by a function has an inverse function that can generate ordered pairs of the inverse relation. The inverse of the linear function \( f(x) \) can be written as \( f^{-1}(x) \) and is read \( f \) of \( x \) inverse or the inverse of \( f \) of \( x \).

**Example** Find the inverse of \( f(x) = \frac{3}{4}x + 6 \).

**Step 1**

\[
f(x) = \frac{3}{4}x + 6 \quad \text{Original equation}
\]

**Step 2**

\[
y = \frac{3}{4}x + 6 \quad \text{Replace } f(x) \text{ with } y.
\]

**Step 3**

\[
x = \frac{3}{4}y + 6 \quad \text{Interchange } y \text{ and } x.
\]

**Step 4**

\[
\frac{4}{3}(x - 6) = y \quad \text{Subtract 6 from each side.}
\]

\[
\frac{4}{3}(x - 6) = f^{-1}(x) \quad \text{Multiply each side by } \frac{4}{3}.
\]

The inverse of \( f(x) = \frac{3}{4}x + 6 \) is \( f^{-1}(x) = \frac{4}{3}(x - 6) \) or \( f^{-1}(x) = \frac{4}{3}x - 8 \).

**Exercises**

Find the inverse of each function.

1. \( f(x) = 4x - 3 \)
2. \( f(x) = -3x + 7 \)
3. \( f(x) = \frac{3}{2}x - 8 \)
4. \( f(x) = 16 - \frac{1}{3}x \)
5. \( f(x) = 3(x - 5) \)
6. \( f(x) = -15 - \frac{2}{5}x \)

**7. TOOLS** Jimmy rents a chainsaw from the department store to work on his yard. The total cost \( C(x) \) in dollars is given by \( C(x) = 9.99 + 3.00x \), where \( x \) is the number of days he rents the chainsaw.

a. Find the inverse function \( C^{-1}(x) \).

b. What do \( x \) and \( C^{-1}(x) \) represent in the context of the inverse function?

c. How many days did Jimmy rent the chainsaw if the total cost was $27.99?
**4-7 Skills Practice**

**Inverse Linear Functions**

Find the inverse of each relation.

1. \[
\begin{array}{c|c}
 x & y \\
-9 & -1 \\
-7 & -4 \\
-5 & -7 \\
-3 & -10 \\
-1 & -13 \\
\end{array}
\]

2. \[
\begin{array}{c|c}
 x & y \\
1 & 8 \\
2 & 6 \\
3 & 4 \\
4 & 2 \\
5 & 0 \\
\end{array}
\]

3. \[
\begin{array}{c|c}
 x & y \\
-4 & -2 \\
-2 & -1 \\
0 & 1 \\
2 & 0 \\
4 & 2 \\
\end{array}
\]

4. \{(-3, 2), (-1, 8), (1, 14), (3, 20)\}

5. \{(5, -3), (2, -9), (-1, -15), (-4, -21)\}

6. \{(4, 6), (3, 1), (2, -4), (1, -9)\}

7. \{(-1, 16), (-2, 12), (-3, 8), (-4, 4)\}

Graph the inverse of each function.

8. 

9. 

10. 

Find the inverse of each function.

11. \(f(x) = 8x - 5\)

12. \(f(x) = 6(x + 7)\)

13. \(f(x) = \frac{3}{4}x + 9\)

14. \(f(x) = -16 + \frac{2}{5}x\)

15. \(f(x) = \frac{3x + 5}{4}\)

16. \(f(x) = \frac{-4x + 1}{5}\)

17. **LEMONADE** Chrissy spent $5.00 on supplies and lemonade powder for her lemonade stand. She charges $0.50 per glass.

   a. Write a function \(P(x)\) to represent her profit per glass sold.

   b. Find the inverse function, \(P^{-1}(x)\).

   c. What do \(x\) and \(P^{-1}(x)\) represent in the context of the inverse function?

   d. How many glasses must Chrissy sell in order to make a $3 profit?
4-7 Practice

Inverse Linear Functions

Find the inverse of each relation.

1. \{(-2, 1), (-5, 0), (-8, -1), (-11, 2)\}        2. \{(3, 5), (4, 8), (5, 11), (6, 14)\}

3. \{(5, 11), (1, 6), (-3, 1), (-7, -4)\}        4. \{(0, 3), (2, 3), (4, 3), (6, 3)\}

Graph the inverse of each function.

5. 

6. 

7. 

Find the inverse of each function.

8. \(f(x) = \frac{6}{5}x - 3\)        9. \(f(x) = \frac{4x + 2}{3}\)

10. \(f(x) = \frac{3x - 1}{6}\)

11. \(f(x) = 3(3x + 4)\)        12. \(f(x) = -5(-x - 6)\)

13. \(f(x) = \frac{2x - 3}{7}\)

Write the inverse of each equation in \(f^{-1}(x)\) notation.

13. \(4x + 6y = 24\)        14. \(-3y + 5x = 18\)

15. \(x + 5y = 12\)

16. \(5x + 8y = 40\)        17. \(-4y - 3x = 15 + 2y\)

18. \(2x - 3 = 4x + 5y\)

19. CHARITY Jenny is running in a charity event. One donor is paying an initial amount of $20.00 plus an extra $5.00 for every mile that Jenny runs.

   a. Write a function \(D(x)\) for the total donation for \(x\) miles run.

   b. Find the inverse function, \(D^{-1}(x)\).

   c. What do \(x\) and \(D^{-1}(x)\) represent in the context of the inverse function?
1. BUSINESS Alisha started a baking business. She spent $36 initially on supplies and can make 5 dozen brownies at a cost of $12. She charges her customers $10 per dozen brownies.
   a. Write a function $C(x)$ to represent Alisha’s total cost per dozen brownies.
   b. Write a function $E(x)$ to represent Alisha’s earnings per dozen brownies sold.
   c. Find $P(x) = E(x) - C(x)$. What does $P(x)$ represent?
   d. Find $C^{-1}(x)$, $E^{-1}(x)$, and $P^{-1}(x)$.
   e. How many dozen brownies does Alisha need to sell in order to make a profit?

2. GEOMETRY The area of the base of a cylindrical water tank is 66 square feet. The volume of water in the tank is dependent on the height of the water $h$ and is represented by the function $V(h) = 66h$. Find $V^{-1}(h)$. What will the height of the water be when the volume reaches 2310 cubic feet?

3. SERVICE A technician is working on a furnace. He is paid $150 per visit plus $70 for every hour he works on the furnace.
   a. Write a function $C(x)$ to represent the total charge for every hour of work.
   b. Find the inverse function, $C^{-1}(x)$.
   c. How long did the technician work on the furnace if the total charge was $640?

4. FLOORING Kara is having baseboard installed in her basement. The total cost $C(x)$ in dollars is given by $C(x) = 125 + 16x$, where $x$ is the number of pieces of wood required for the installation.
   a. Find the inverse function $C^{-1}(x)$.
   b. If the total cost was $269 and each piece of wood was 12 feet long, how many total feet of wood were used?

5. BOWLING Libby’s family went bowling during a holiday special. The special cost $40 for pizza, bowling shoes, and unlimited drinks. Each game cost $2. How many games did Libby bowl if the total cost was $112 and the six family members bowled an equal number of games?
One-to-One and Onto Functions

In a function, there is exactly one output for every input. In other words, every element in the domain pairs with exactly one element in the range. When a function is one-to-one, each element of the domain pairs with exactly one unique element in the range. When a function is onto, each element of the range corresponds to an element in the domain.

If a function is both one-to-one and onto, then the inverse is also a function.

Determine whether each relation is a function. If it is a function, determine if it is one-to-one, onto, both, or neither.

1. 

2. 

3. 

4. 

5. 

6. 

Determine whether the inverse of each function is also a function.

7. 

8. 

9.
4 Student Recording Sheet

Use this recording sheet with pages 280–281 of the Student Edition.

Multiple Choice

Read each question. Then fill in the correct answer.

1. ⭕  
2. ⭕  
3. ⭕  
4. ⭕  
5. ⭕  
6. ⭕  

Short Response/Gridded Response

Record your answer in the blank.

For gridded response questions, also enter your answer in the grid by writing each number or symbol in a box. Then fill in the corresponding circle for that number or symbol.

7. 
8. (grid in)
9. 
10a. 
10b. 
11a. 
11b. 
11c. 

Extended Response

Record your answers for Question 12 on the back of this paper.
Rubric for Scoring Extended Response Test

General Scoring Guidelines

• If a student gives only a correct numerical answer to a problem but does not show how he or she arrived at the answer, the student will be awarded only 1 credit. All extended response questions require the student to show work.

• A fully correct answer for a multiple-part question requires correct responses for all parts of the question. For example, if a question has three parts, the correct response to one or two parts of the question that required work to be shown is not considered a fully correct response.

• Students who use trial and error to solve a problem must show their method. Merely showing that the answer checks or is correct is not considered a complete response for full credit.

Exercise 12 Rubric

<table>
<thead>
<tr>
<th>Score</th>
<th>Specific Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Student explain that the slopes of the lines must be compared. If two lines have the same slope, they are parallel. If their slopes are opposite reciprocals, they are perpendicular.</td>
</tr>
<tr>
<td>3</td>
<td>A generally correct solution, but may contain minor flaws in reasoning or computation.</td>
</tr>
<tr>
<td>2</td>
<td>A partially correct interpretation and/or solution to the problem.</td>
</tr>
<tr>
<td>1</td>
<td>A correct solution with no evidence or explanation.</td>
</tr>
<tr>
<td>0</td>
<td>An incorrect solution indicating no mathematical understanding of the concept or task, or no solution is given.</td>
</tr>
</tbody>
</table>
Chapter 4 Quiz 1
(Lessons 4-1 and 4-2)

For Questions 1 and 2, write an equation in slope-intercept form for each situation.

1. slope: \( \frac{1}{4} \), y-intercept: –5
   1. ________________

2. line passing through (9, 2) and (–2, 6)
   2. ________________

3. Graph \( 4x + 3y = 12 \).

4. Write a linear equation in slope-intercept form to model a tree 4 feet tall that grows 3 inches per year.

5. MULTIPLE CHOICE The table of ordered pairs shows the coordinates of the two points on the graph of a function. Which equation describes the function?
<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>–2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>–1</td>
</tr>
</tbody>
</table>

   A. \( y = –2x + 1 \)
   B. \( y = \frac{1}{2}x – 1 \)
   C. \( y = –\frac{1}{2}x + 1 \)
   D. \( y = –\frac{1}{2}x – 1 \)

Chapter 4 Quiz 2
(Lessons 4-3 and 4-4)

1. Write an equation in point-slope form for a line that passes through (3, 6) with a slope of \( -\frac{1}{3} \).
   1. ________________

2. Write \( y – 9 = –(x + 2) \) in slope-intercept form.
   2. ________________

3. Write an equation in point-slope form for a horizontal line that passes through (–4, –1).
   3. ________________

4. Write an equation in slope-intercept form for the line that passes through (5, 3) and is parallel to \( x + 3y = 6 \).
   4. ________________

5. MULTIPLE CHOICE Line \( DE \) contains the points \( D(–1, –4) \) and \( E(3, 3) \). Line \( FG \) contains the point \( F(–3, 3) \). Which set of coordinates for point \( G \) makes the two lines perpendicular?
   A. (1, 7)
   B. (1, 10)
   C. (1, 4)
   D. (4, –1)

   5. ________________
4 Chapter 4 Quiz 3
(Lessons 4-5 and 4-6)

For Questions 1–5, use the table.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>26</th>
<th>27</th>
<th>28</th>
<th>29</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Income ($1000)</td>
<td>16.8</td>
<td>19.1</td>
<td>23.3</td>
<td>25.8</td>
<td>33.9</td>
</tr>
</tbody>
</table>

1. Make a scatter plot relating age to median income. Then draw a fit line for the scatter plot.

2. 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.

3. Write an equation of the best-fit line for the data in the table.

4. Use the line of fit to predict the median income for 32-year olds.

5. MULTIPLE CHOICE What is the correlation coefficient for the best-fit line?
   A 4.09  B −90.74  C 0.943  D 0.971

4 Chapter 4 Quiz 4
(Lesson 4-7)

1. Find the inverse of {(1, 3), (4, −1), (7, −5), (10, −9)}.

2. Graph the inverse of the function graphed at the right.

Find the inverse of each function.

3. \( f(x) = 4x + 6 \)  
   4. \( f(x) = \frac{3}{4}x - 8 \)

5. MULTIPLE CHOICE Write the inverse of \( 3x + 4y = 12 \) in \( f^{-1}(x) \) notation.
   A \( f^{-1}(x) = \frac{12 - 4x}{3} \)  
   B \( f^{-1}(x) = \frac{12 - 3x}{4} \)  
   C \( f^{-1}(x) = 12 - 3x \)  
   D \( f^{-1}(x) = \frac{12 - 4y}{3} \)
Part I  Write the letter for the correct answer in the blank at the right of each question.

1. Which is the slope-intercept form of an equation for the line containing (0, –3) with slope –1?
   A  \( y = -x - 3 \)  B  \( y = -3x - 1 \)  C  \( y = x + 3 \)  D  \( x = -3y - 1 \)  1._____

2. Write an equation in slope-intercept form of the line with a slope of \(-\frac{3}{4}\) and \(y\)-intercept of –5.
   F  \( y = 5x - \frac{3}{4} \)  G  \( 3x + 4y = 20 \)  H  \( y = -\frac{3}{4}x - 5 \)  J  \( y = -\frac{3}{4}x + 5 \)  2._____

3. Write an equation of the line that passes through (–2, 8) and (–4, –4).
   A  \( y = 2x + 12 \)  B  \( y = 6x + 20 \)  C  \( y = -6x - 4 \)  D  \( y = \frac{1}{6}x + \frac{25}{3} \)  3._____

4. Write \( y - 3 = \frac{2}{3}(x - 2) \) in standard form.
   F  \( 2x - 3y = 5 \)  G  \( y = \frac{2}{3}x + \frac{5}{3} \)  H  \( -2x + 3y = -5 \)  J  \( 2x - 3y = -5 \)  4._____

5. Write \( y - 1 = 2\left(x - \frac{3}{2}\right) \) in slope-intercept form.
   A  \( 2x - y = 2 \)  B  \( \frac{1}{2}y + \frac{1}{2} = x \)  C  \( y = 2x - \frac{1}{2} \)  D  \( y = 2x - 2 \)  5._____

6. A cell phone company charges $42 per month of service. The cost of a new cell phone, plus 8 months of service, is $415.99. How much does it cost to buy a new cell phone and 3 months of service?
   F  $79.99  G  $126.00  H  $205.99  J  $289.99  6._____

Part II

For Questions 7–10, use the following information.

Nikko needs to get his air-conditioner fixed. The technician will charge Nikko a flat fee of $50 plus an additional $20 for each hour of work.

7. Write an equation to represent Nikko’s total cost to repair his air-conditioner. Use \( t \) for total cost and \( h \) for hours. 7.____________

8. Graph this equation.

9. How much will it cost Nikko if the technician has to spend 4 hours working on the air-conditioner? 9.____________

10. How many hours must the technician work for it to cost Nikko $180? 10.____________
Choose from the terms above to complete each sentence.

1. If two lines have slopes that are negative reciprocals of each other, then they are ____________.

2. A(n) ____________ is the set of ordered pairs obtained by exchanging the x-coordinates with the y-coordinates of each ordered pair of a relation or function.

3. A graph of data points is sometimes called a ____________.

4. If two lines have slopes that are the same, then they are ____________.

5. The number that describes how closely a best-fit line models a set of data is called the ____________.

6. The leftmost data point in a set is (3, 27) and the rightmost point is (12, 13). If you use a linear prediction equation to find the corresponding y-value for \( x = 10 \), you are using a method called ____________.

7. The leftmost data point in a set is (1997, 24) and the rightmost point is (2011, 38). If you use a linear prediction equation to find the corresponding y-value for \( x = 2012 \), you are using a method called ____________.

8. The equation \( y = -3x + 12 \) is written in ____________ form.

9. The equation \( y + 6 = 2(x - 4) \) is written in ____________ form.

Define each term in your own words.

10. line of fit

11. linear extrapolation
Chapter 4 Test, Form 1

Write the letter for the correct answer in the blank at the right of each question.

For Questions 1–5, find the equation in slope-intercept form that describes each line.

1. a line with slope \(-2\) and \(y\)-intercept \(4\)
   \(A\) \(y = -2x\) \(B\) \(y = 4x - 2\) \(C\) \(y = -2x + 4\) \(D\) \(y = 2x - 4\) \(1.\)______

2. a line through (2, 4) with slope 0
   \(F\) \(y = 2\) \(G\) \(x = 2\) \(H\) \(y = 4\) \(J\) \(x = 4\) \(2.\)______

3. a line through (4, 2) with slope \(\frac{1}{2}\)
   \(A\) \(y = -\frac{1}{2}x\) \(B\) \(y = \frac{1}{2}x - 4\) \(C\) \(y = 2x - 10\) \(D\) \(y = \frac{1}{2}x\) \(3.\)______

4. a line through \((-1, 1)\) and \((2, 3)\)
   \(F\) \(y = \frac{2}{3}x + \frac{5}{3}\) \(G\) \(y = -\frac{2}{3}x + \frac{5}{3}\) \(H\) \(y = \frac{2}{3}x - \frac{5}{3}\) \(J\) \(y = -\frac{2}{3}x - \frac{5}{3}\) \(4.\)______

5. the line graphed at the right
   \(A\) \(y = \frac{2}{3}x - 1\) \(C\) \(y = \frac{2}{3}x + \frac{3}{2}\)
   \(B\) \(y = \frac{3}{2}x - 1\) \(D\) \(y = \frac{3}{2}x + \frac{3}{2}\) \(5.\)______

6. If 5 deli sandwiches cost $29.75, how much will 8 sandwiches cost?
   \(F\) $37.75 \(G\) $29.75 \(H\) $47.60 \(J\) $0.16 \(6.\)______

7. What is the standard form of \(y - 8 = 2(x + 3)\)?
   \(A\) \(2x + y = 14\) \(B\) \(y = 2x + 14\) \(C\) \(2x - y = -14\) \(D\) \(y = 2x + 11\) \(7.\)______

8. Which is the graph of \(3x - 4y = 6\)?
   \(F\) \(G\) \(H\) \(J\) \(8.\)______

9. Which is the point-slope form of an equation for the line that passes through \((0, -5)\) with slope 2?
   \(A\) \(y = 2x - 5\) \(B\) \(y + 5 = 2x\) \(C\) \(y - 5 = x - 2\) \(D\) \(y = 2(x + 5)\) \(9.\)______

10. What is the slope-intercept form of \(y + 6 = 2(x + 2)\)?
    \(F\) \(y = 2x - 6\) \(G\) \(y = 2x - 2\) \(H\) \(y = 2x + 6\) \(J\) \(2x - y = 6\) \(10.\)______

11. When are two lines parallel?
    \(A\) when the slopes are opposite
    \(B\) when the slopes are equal
    \(C\) when the slopes are positive
    \(D\) when the product of the slopes is \(-1\) \(11.\)______
12. Find the slope-intercept form of an equation for the line that passes through \((-1, 2)\) and is parallel to \(y = 2x - 3\).
   \[ F \quad y = 2x + 4 \quad G \quad y = 0.5x + 4 \quad H \quad y = 2x + 3 \quad J \quad y = -0.5x - 4 \]

13. Find the slope-intercept form of an equation of the line perpendicular to the graph of \(x - 3y = 5\) and passing through \((0, 6)\).
   \[ A \quad y = \frac{1}{3}x - 2 \quad B \quad y = -3x + 6 \quad C \quad y = \frac{1}{3}x + 2 \quad D \quad y = 3x - 6 \]

For Questions 14 and 15, use the scatter plot shown.

14. How would you describe the relationship between the \(x\)- and \(y\)-values in the scatter plot?
   \[ F \quad \text{strong negative correlation} \quad G \quad \text{weak negative correlation} \quad H \quad \text{weak positive correlation} \quad J \quad \text{strong positive correlation} \]

15. Based on the data in the scatter plot, what would you expect the \(y\)-value to be for \(x = 2020\)?
   \[ A \quad \text{greater than 80} \quad B \quad \text{between 80 and 65} \quad C \quad \text{between 65 and 50} \quad D \quad \text{less than 50} \]

16. Which equation has a slope of 2 and a \(y\)-intercept of \(-5\)?
   \[ F \quad y = -5x + 2 \quad G \quad y = 5x + 2 \quad H \quad y = 2x + 5 \quad J \quad y = 2x - 5 \]

17. Which correlation coefficient corresponds to the best-fit line that most closely models its set of data?
   \[ A \quad 0.84 \quad B \quad 0.13 \quad C \quad -0.87 \quad D \quad -0.15 \]

18. The table below shows Mia’s bowling score each week she participated in a bowling league.

<table>
<thead>
<tr>
<th>Week</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>122</td>
<td>131</td>
<td>130</td>
<td>133</td>
<td>145</td>
<td>139</td>
</tr>
</tbody>
</table>

   Use the median-fit line to estimate Mia’s score for week 16.
   \[ F \quad 173 \quad G \quad 180 \quad H \quad 182 \quad J \quad 257 \]

19. If \(f(x) = 6x + 3\), find \(f^{-1}(x)\).
   \[ A \quad f^{-1}(x) = 6x - 3 \quad B \quad f^{-1}(x) = \frac{x - 6}{3} \quad C \quad f^{-1}(x) = \frac{x - 3}{6} \quad D \quad f^{-1}(x) = -3 - 6x \]

20. If \(f(x) = 4(3x - 5)\), find \(f^{-1}(x)\).
   \[ F \quad f^{-1}(x) = \frac{x + 5}{12} \quad G \quad f^{-1}(x) = \frac{x + 20}{12} \quad H \quad f^{-1}(x) = \frac{x - 20}{12} \quad J \quad f^{-1}(x) = \frac{x + 5}{4} \]

Bonus Find the value of \(r\) in \((4, r), (r, 2)\) so that the slope of the line containing them is \(-\frac{5}{3}\).

\[ B: \quad \text{_______________} \]
Write the letter for the correct answer in the blank at the right of each question.

1. What is the slope-intercept form of the equation of a line with a slope of 5 and a y-intercept of −8?
   A $y = -8x + 5$  B $y = 8x - 5$  C $5x - y = -8$  D $y = 5x - 8$  1.____

2. Which equation is graphed at the right?
   F $2y - x = 10$  H $2x - y = 5$
   G $2x + y = -5$  J $2y + x = -5$  2.____

3. Which is an equation of the line that passes through $(2, -5)$ and $(6, 3)$?
   A $y = \frac{1}{2}x - 6$  C $y = 2x + 12$
   B $y = \frac{1}{2}x$  D $y = 2x - 9$  3.____

4. What is an equation of the line through $(0, -3)$ with slope $\frac{2}{3}$?
   F $-5x + 2y = 15$  H $2x - 5y = 15$
   G $-5x - 2y = -15$  J $2x + 5y = 15$  4.____

5. Which is an equation of the line with slope $-3$ and a y-intercept of 5?
   A $y = -3(x + 5)$  B $y - 5 = -3x$  C $-3x + y = 5$  D $y = 5x - 3$  5.____

6. What is the equation of the line through $(-2, -3)$ with a slope of 0?
   F $x = -2$  G $y = -3$  H $-2x - 3y = 0$  J $-3x + 2y = 0$  6.____

7. Find the slope-intercept form of the equation of the line that passes through $(-5, 3)$ and is parallel to $12x - 3y = 10$.
   A $y = -4x - 17$  B $y = 4x - 13$  C $y = -4x + 13$  D $y = 4x + 23$  7.____

8. If line $q$ has a slope of $-\frac{3}{8}$, what is the slope of any line perpendicular to $q$?
   F $-\frac{3}{8}$  G $\frac{3}{8}$  H $\frac{8}{3}$  J $-\frac{8}{3}$  8.____

9. A line of fit might be defined as
   A a line that connects all the data points.
   B a line that might best estimate the data and be used for predicting values.
   C a vertical line halfway through the data.
   D a line that has a slope greater than 1.  9.____

10. A scatter plot of data comparing the number of years since Holbrook High School introduced a math club and the number of students participating contains the ordered pairs $(3, 19)$ and $(8, 42)$. Which is the slope-intercept form of an equation for the line of fit?
    F $y = 4.6x + 5.2$  G $y = 3x + 1$
    H $y = 5.2x + 4.6$  J $y = 0.22x - 1.13$  10.____

11. Use the equation from Question 10 to estimate the number of students who will be in the math club during the 15th year.
    A 53  B 61  C 65  D 74  11.____

Chapter 4  57  Glencoe Algebra 1
For Questions 12–14, use the scatter plot shown.

12. Which data are shown by the scatter plot?
   - H (1995, 5.5), (2000, 6.6), (2005, 8.0)
   - J (1995, 5.5), (1997, 6.6), (2005, 8.0)

13. Which is true about the data?
   - A The slope of a best-fit line would be negative.
   - B There is a positive correlation.
   - C There is no correlation.
   - D There is a negative correlation.

14. Based on the data in the scatter plot, what would you expect the y-value to be for x = 2010?
   - F between 7 and 8
   - G higher than 8
   - H between 5 and 7
   - J impossible to tell

15. To calculate the charge for a load of bricks, including delivery, the Redstone Brick Co. uses the equation \( C = 0.42b + 25 \), where C is the charge and b is the number of bricks. What is the delivery fee per load?
   - A $42
   - B $67
   - C $25
   - D It depends on the number of bricks

For Questions 16 and 17, use the table shown.

<table>
<thead>
<tr>
<th>Shots on Goal</th>
<th>22</th>
<th>25</th>
<th>28</th>
<th>29</th>
<th>33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points Scored</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>

16. Find the slope of the best-fit line.
   - F \(-0.561\)
   - G \(0.283\)
   - H \(0.631\)
   - J \(0.794\)

17. Estimate how many points would be scored if 80 shots were taken on the goal using the best-fit line.
   - A 18
   - B 19
   - C 22
   - D 24

18. Find the inverse of \{(4, -1), (3, -2), (6, 9), (8, 5)\}.
   - F \{(8, 5), (6, 9), (3, -2), (4, -1)\}
   - G \{(-4, 1), (-3, 2), (-6, -9), (-8, -5)\}
   - H \{(-1, 4), (-2, 3), (9, 6), (5, 8)\}
   - J \{(-1, -2), (9, 5), (4, 3), (6, 8)\}

19. If \( f(x) = 3x - 4 \), find \( f^{-1}(x) \).
   - A \( f^{-1}(x) = 4x - 3 \)
   - B \( f^{-1}(x) = \frac{x + 4}{3} \)
   - C \( f^{-1}(x) = \frac{x - 4}{3} \)
   - D \( f^{-1}(x) = -4 - 3x \)

20. If \( f(x) = 8(5x - 2) \), find \( f^{-1}(x) \).
   - F \( f^{-1}(x) = \frac{5x + 2}{8} \)
   - G \( f^{-1}(x) = \frac{5x - 2}{8} \)
   - H \( f^{-1}(x) = \frac{x - 16}{40} \)
   - J \( f^{-1}(x) = \frac{x + 16}{40} \)

**Bonus** What is the \( y \)-intercept of a line through (2, 7) and perpendicular to the graph of \( y = -\frac{3}{2}x + 6 \)?

   B: ____________
Write the letter for the correct answer in the blank at the right of each question.

1. What is the slope-intercept form of the equation of the line with a slope of \( \frac{1}{4} \) and \( y \)-intercept at the origin?
   A \( y = 4x \)   B \( y = \frac{1}{4}x \)   C \( y = x + \frac{1}{4} \)   D \( y + \frac{1}{4} = x \)  1._____

2. Which equation is graphed at the right?
   F \( y - 2x = -4 \)   H \( 2x + y = 4 \)
   G \( 2x + y = -4 \)   J \( y - 4 = 2x \)  2._____

3. Which is an equation of the line that passes through \((4, -5)\) and \((6, -9)\)?
   A \( y = \frac{1}{2}x - 3 \)   B \( y = \frac{1}{2}x + 3 \)   C \( y = -2x + 3 \)   D \( y = 2x - 3 \)  3._____

4. What is the standard form of the equation of the line through \((6, -3)\) with a slope of \( \frac{2}{3} \)?
   F \( -2x + 3y = 24 \)   G \( 2x - 3y = 21 \)   H \( 3x - 2y = 24 \)   J \( 3x - 2y = -21 \)  4._____

5. Which is an equation of the line with a slope of \(-3\) that passes through \((2, 4)\)?
   A \( y - 4 = -3(x - 2) \)   C \( y + 4 = -3(x + 2) \)
   B \( y - 4 = -3x - 2 \)   D \( y - 2 = -3(x - 4) \)  5._____

6. What is the equation of the line through \((-2, -3)\) with an undefined slope?
   F \( x = -2 \)   G \( y = -3 \)   H \( -2x - 3y = 0 \)   J \( -3x + 2y = 0 \)  6._____

7. Find the slope-intercept form of the equation of the line that passes through \((-1, 5)\) and is parallel to \(4x + 2y = 8\).
   A \( y = -2x + 9 \)   B \( y = 2x - 9 \)   C \( y = 4x - 9 \)   D \( y = -2x + 3 \)  7._____

8. If line \( q \) has a slope of \(-2\), what is the slope of any line perpendicular to \( q \)?
   F \( 2 \)   G \( -2 \)   H \( \frac{1}{2} \)   J \( -\frac{1}{2} \)  8._____

9. The graph of data that has a strong negative correlation has
   A a narrow linear pattern from lower left to upper right.
   B a narrow linear pattern from upper left to lower right.
   C a narrow horizontal pattern below the \( x \)-axis.
   D all negative \( x \)-values.  9._____

10. A scatter plot of data comparing the time in minutes Beverly spends studying for her math test and the score she received on the test contains the ordered pairs \((45, 89)\) and \((60, 94)\). Which is the slope-intercept form of an equation for the line of fit?
    F \( 0.573x + 63.2 = y \)   G \( \frac{1}{3}x + 74 = y \)
    H \( 3x - 46 = y \)   J \( -\frac{1}{3}x + 104 = y \)  10._____

11. Estimate how well Beverly would score on her next test if she spent 20 minutes studying.
    A 75   B 81   C 84   D 90  11._____

Chapter 4
For Questions 12–14, use the scatter plot shown.

12. Which data are shown by the scatter plot?
   H (47, 1985), (31, 1995), (24, 2001)  

13. Based on the data in the scatter plot, which statement is true?
   A As \( x \) increases, \( y \) increases.  
   B As \( x \) increases, \( y \) decreases.  
   C There is no relationship between \( x \) and \( y \).  
   D There are not enough data to determine the relationship between \( x \) and \( y \).  

14. Based on the scatter plot, what would you expect the \( y \)-value to be for \( x = 1992 \)?
   F between 40 and 45  
   H between 30 and 40  
   G higher than 45  
   J impossible to tell  

15. A baby blue whale weighed 3 tons at birth. Ten days later, it weighed 4 tons. Assuming the same rate of growth, which equation shows the weight \( w \) when the whale is \( d \) days old?
   A \( w = 10d + 3 \)  
   B \( w = 10d + 4 \)  
   C \( w = 0.1d + 3 \)  
   D \( w = d + 10 \)  

For Questions 16 and 17, use the table shown.

<table>
<thead>
<tr>
<th>Times at Bat</th>
<th>4</th>
<th>5</th>
<th>8</th>
<th>12</th>
<th>22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hits</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

16. Find the correlation coefficient of the best-fit line.
   F -0.631  
   G 0.317  
   H 0.920  
   J 0.959  

17. Estimate how many hits a batter would get with 72 times at bat using the best-fit line.
   A 18  
   B 19.6  
   C 20  
   D 22  

18. Find the inverse of \( \{(2, -1), (5, -2), (6, 9), (7, 5)\} \).
   F \( \{(-2, 1), (-5, 2), (-6, -9), (-7, -5)\} \)  
   G \( \{(-1, 2), (-2, 5), (6, 9), (7, 5)\} \)  

19. If \( f(x) = 4x + 3 \), find \( f^{-1}(x) \).
   A \( f^{-1}(x) = 4x - 3 \)  
   B \( f^{-1}(x) = \frac{x - 3}{4} \)  
   C \( f^{-1}(x) = \frac{x - 4}{3} \)  
   D \( f^{-1}(x) = -3 - 4x \)  

20. If \( f(x) = 7(2x - 9) \), find \( f^{-1}(x) \).
   F \( f^{-1}(x) = \frac{x + 9}{7} \)  
   G \( f^{-1}(x) = \frac{2x + 9}{7} \)  
   H \( f^{-1}(x) = \frac{x + 63}{14} \)  
   J \( f^{-1}(x) = \frac{x - 63}{14} \)  

Bonus For what value of \( k \) does \( kx + 7y = 10 \) have a slope of 3?  
B: __________________

Chapter 4  
Glencoe Algebra 1

60
1. Write a linear equation in slope-intercept form to model the situation: A telephone company charges $28.75 per month plus $0.10 a minute for long-distance calls.

2. Write an equation in standard form of the line that passes through (7, −3) and has a y-intercept of 2.

3. Write the slope-intercept form of an equation for the line graphed at the right.

4. Graph the line with a y-intercept of 3 and slope $-\frac{3}{4}$.

5. Write an equation in slope-intercept form for the line that passes through (−1, −2) and (3, 4).

6. Write an equation in standard form for the line that has an undefined slope and passes through (−6, 4).

7. Write an equation in point-slope form for the line that has slope $\frac{1}{3}$ and passes through (−2, 8).

8. Write the standard form of the equation $y + 4 = -\frac{12}{7}(x - 1)$.

9. Write the slope-intercept form of the equation $y - 2 = 3(x - 4)$.

10. Write the slope-intercept form of the equation of the line parallel to the graph of $2x + y = 5$ that passes through (0, 1).

11. Write the slope-intercept form of the equation of the line perpendicular to the graph of $y = -\frac{3}{2}x - 7$ that passes through (3, −2).

12. A scatter plot of data showing the percentage of total Internet users who visited an online store on a given day in December includes the points (2008, 2.0) and (2010, 4.5). Write the slope-intercept form of an equation for the line of fit.
For Questions 13–15, use the data in the table.

<table>
<thead>
<tr>
<th>Time Spent Studying (min)</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score Received (percent)</td>
<td>53</td>
<td>67</td>
<td>78</td>
<td>87</td>
<td>95</td>
</tr>
</tbody>
</table>

13. Make a scatter plot relating time spent studying to the score received.

14. Write the slope-intercept form of the equation for a line of fit for the data. Use your equation to predict a student’s score if the student spent 35 minutes studying.

15. Is it reasonable to use the equation to estimate the score received for any length of time spent studying?

For Questions 16 and 17, use the data in the table showing the number of congressional seats apportioned to California each decade.

<table>
<thead>
<tr>
<th>Decade</th>
<th>1940s</th>
<th>1950s</th>
<th>1970s</th>
<th>1990s</th>
<th>2000s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seats</td>
<td>23</td>
<td>30</td>
<td>43</td>
<td>52</td>
<td>53</td>
</tr>
</tbody>
</table>

Source: Office of the Clerk, U.S. House of Representatives

16. Find an equation for the median-fit line.

17. Predict the number of seats apportioned to California in the 1930s.

18. Graph the inverse of the function graphed at the right.

19. If \( f(x) = \frac{5 - 4x}{15} \), find \( f^{-1}(x) \).

20. Write the inverse of \( 6x + 8y = 13 \) in \( f^{-1}(x) \) notation.

**Bonus** In a certain lake, a 1-year-old bluegill fish is 3 inches long, while a 4-year-old bluegill fish is 6.6 inches long. Assuming the growth rate can be approximated by a linear equation, write an equation in slope-intercept form for the length \( \ell \) of a bluegill fish in inches after \( t \) years. Then use the equation to determine the age of a 9-inch bluegill.

B: __________________
1. Write a linear equation in slope-intercept form to model the situation: An Internet company charges $4.95 per month plus $2.50 for each hour of use.

2. Write an equation in standard form of the line that passes through (3, 1) and has a y-intercept of $-2$.

3. Write the slope-intercept form of an equation for the line graphed at the right.

4. Graph the line with y-intercept 2 and slope $\frac{1}{2}$.

5. Write an equation in slope-intercept form for the line that passes through (5, 4) and (6, $-1$).

6. Write an equation in standard form for the line that has an undefined slope and passes through (5, $-3$).

7. Write an equation in point-slope form for the line that has a slope of $\frac{4}{3}$ and passes through (3, 0).

8. Write the standard form of the equation $y - 3 = \frac{2}{3}(x + 5)$.

9. Write the slope-intercept form of the equation $y - 1 = \frac{3}{4}(x - 3)$.

10. Write the slope-intercept form of the equation of the line parallel to the graph of $9x + 3y = 6$ that passes through (5, 3).

11. Write the slope-intercept form of the equation of the line perpendicular to the graph of $4x - y = 12$ that passes through (8, 2).

12. A scatter plot of data showing the percentage of total Internet users who visit a video sharing Web site on a given day in December includes the points (2010, 17.0) and (2008, 0.3). Write the slope-intercept form of an equation for the line of fit.
For Questions 13–15, use the data that shows age and percent of budget spent on entertainment in the table.

<table>
<thead>
<tr>
<th>Age</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Spent on Entertainment</td>
<td>6.1</td>
<td>6.0</td>
<td>5.4</td>
<td>5.0</td>
<td>4.7</td>
<td>3.4</td>
</tr>
</tbody>
</table>

13. Make a scatter plot relating the age to the percent of the person’s budget spent on entertainment.

14. Write the slope-intercept form of the equation for a line of fit for the data. Use your equation to predict the percent of a 65-year-old person’s budget.

15. Is it reasonable to use the equation to estimate the entertainment spending for any age?

For Questions 16 and 17, use the data in the table showing the number of congressional seats apportioned to Texas each decade.

<table>
<thead>
<tr>
<th>Decade</th>
<th>1960s</th>
<th>1970s</th>
<th>1980s</th>
<th>1990s</th>
<th>2000s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seats</td>
<td>23</td>
<td>24</td>
<td>27</td>
<td>30</td>
<td>32</td>
</tr>
</tbody>
</table>

Source: Office of the Clerk, U.S. House of Representatives

16. Find an equation for the median-fit line.

17. Predict the number of seats that will be apportioned to Texas in the 2010s.

18. Graph the inverse of the graph shown.

19. If \( f(x) = \frac{8 - 3x}{18} \), find \( f^{-1}(x) \).

20. Write the inverse of \( 5x - 17 = 11 + 3y \) in \( f^{-1}(x) \) notation.

Bonus Write an equation in slope-intercept form of the line with \( y \)-intercept \(-6\) and parallel to a line perpendicular to \( 5x + 6y - 13 = 0 \).
Chapter 4 Test, Form 3

For Questions 1–4, write an equation in slope-intercept form of the line satisfying the given conditions.

1. has \( y \)-intercept \(-8\) and slope 3

2. has slope \(\frac{5}{2}\) and passes through \((4, -1)\)

3. passes through \((-3, 7)\) and \((2, 4)\)

4. is horizontal and passes through \((-4, 6)\)

5. Write the point-slope form of an equation of the line that has a slope of \(-\frac{3}{5}\) and passes through \((2, 1)\).

6. Write an equation in standard form of the line that passes through \((2, -3)\) and \((-3, 7)\).

7. Graph a line that has an \(x\)-intercept of 5 and a slope of \(-\frac{3}{5}\).

8. Write \(y + 4 = -\frac{2}{3}(x - 9)\) in standard form.

9. Write the point-slope form of the equation for the line that has \(x\)-intercept -3 and \(y\)-intercept -2.

For Questions 10–13, write an equation in slope-intercept form of the line satisfying the given conditions.

10. is parallel to the \(y\)-axis and has an \(x\)-intercept of 3

11. is perpendicular to \(4y = 3x - 8\) and passes through \((-12, 7)\)

12. is parallel to \(3x - 5y = 7\) and passes through \((0, -6)\)

13. is perpendicular to the \(y\)-axis and passes through \((-2, 5)\)
For Questions 14–16, use the data in the table.

14. Make a scatter plot relating the verbal scores and the math scores.

<table>
<thead>
<tr>
<th>Year</th>
<th>Verbal Score</th>
<th>Math Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>460</td>
<td>488</td>
</tr>
<tr>
<td>1985</td>
<td>424</td>
<td>466</td>
</tr>
<tr>
<td>1995</td>
<td>410</td>
<td>463</td>
</tr>
<tr>
<td>2005</td>
<td>420</td>
<td>460</td>
</tr>
</tbody>
</table>

15. Does the scatter plot in Question 14 show a positive, a negative, or no correlation? What does that relationship represent?

16. Write the equation for a line of fit. Predict the corresponding math score for a verbal score of 445.

17. The data in the table show the number of congressional seats apportioned to the state of New York each decade.

<table>
<thead>
<tr>
<th>Decade</th>
<th>1940s</th>
<th>1960s</th>
<th>1980s</th>
<th>2000s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seats</td>
<td>45</td>
<td>41</td>
<td>34</td>
<td>29</td>
</tr>
</tbody>
</table>

Source: Office of the Clerk, U.S. House of Representatives

Find an equation for the median-fit line and predict the number of seats that will be apportioned to New York in the 2020s.

18. Graph the inverse of the function graphed at the right.

19. If \( f(x) = \frac{3(4 - 5x)}{8} \), find \( f^{-1}(x) \).

20. Write the inverse of \( 4x - 13 = 2x + 3y \) in \( f^{-1}(x) \) notation.

Bonus The area of a circle varies directly as the square of the radius. If the radius is tripled, by what factor will the area increase?

B: ____________________
Demonstrate your knowledge by giving a clear, concise solution to each problem. Be sure to include all relevant drawings and justify your answers. You may show your solution in more than one way or investigate beyond the requirements of the problem.

1. You are told that a line passes through \((-2, 3)\).
   a. Discuss what other information you would need to graph this line.
   b. Then describe how you would use that information to graph the line and write its equation.

2. Refer to the scatter plot at the right.
   a. Describe the pattern of points in the scatter plot and the relationship between \(x\) and \(y\).
   b. Give at least two examples of real-life situations that, if graphed, would result in a correlation like the one shown in this scatter plot.
   c. Add a scale and heading to each axis. Then write an equation that would model the points represented by this plot.

3. The table gives the life expectancy of a child born in the United States in a given year.
   a. Make a scatter plot of the data.
   b. Can you use the data to claim that the increase in life expectancy is due to improved health care? Explain your response.
   c. Use the data to predict the life expectancy of a baby born in 2000. Explain how you determined your answer.

<table>
<thead>
<tr>
<th>Year of Birth</th>
<th>Life Expectancy (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>54.1</td>
</tr>
<tr>
<td>1930</td>
<td>59.7</td>
</tr>
<tr>
<td>1940</td>
<td>62.9</td>
</tr>
<tr>
<td>1950</td>
<td>68.2</td>
</tr>
<tr>
<td>1960</td>
<td>69.7</td>
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<tr>
<td>1970</td>
<td>70.8</td>
</tr>
<tr>
<td>1980</td>
<td>73.7</td>
</tr>
<tr>
<td>1985</td>
<td>74.7</td>
</tr>
<tr>
<td>1990</td>
<td>75.4</td>
</tr>
<tr>
<td>1995</td>
<td>75.8</td>
</tr>
</tbody>
</table>

Source: National Center for Health Statistics
Standardized Test Practice
(Chapters 1–4)

Part 1: Multiple Choice

Instructions: Fill in the appropriate circle for the best answer.

1. If \(a = 2\), \(b = 6\), and \(c = 4\), then \(\frac{(4a - b)^2}{(b + c)} = \) ? (Lesson 1-2)
   - A 4
   - B 0.4
   - C 40
   - D 0.04
   1. @ @ @ @

2. If \(4 + 7 + 6 = 4 + 7 + 6 + n\), what is the value of \(n\)? (Lesson 1-3)
   - F 0
   - G 1
   - H 4
   - J 6
   2. @ @ @ @

3. Lynn has 4 more books than José. If Lynn gives José 6 of her books, how many more will José have than Lynn? (Lesson 1-2)
   - A 2
   - B 4
   - C 8
   - D 10
   3. @ @ @ @

4. If \(x = \frac{16}{24}\), which value of \(x\) does not form a proportion? (Lesson 2-6)
   - F \(\frac{2}{3}\)
   - G \(\frac{3}{4}\)
   - H \(\frac{12}{18}\)
   - J \(\frac{32}{48}\)
   4. @ @ @ @

5. Two-thirds of a number added to itself is 20. What is the number? (Lesson 2-1)
   - A 12
   - B 13
   - C 30
   - D 33
   5. @ @ @ @

6. 16\% of 980 is 9.8\% of what number? (Lesson 2-4)
   - F 1.6
   - G 16
   - H 160
   - J 1600
   6. @ @ @ @

7. For what value(s) of \(r\) is \(3r - 6 = 7 + 3r\)? (Lesson 2-7)
   - A all numbers
   - B all negative integers
   - C 0
   - D no values of \(r\)
   7. @ @ @ @

8. The range of a relation includes the integers \(\frac{x}{4}\), \(\frac{x}{5}\), and \(\frac{x}{8}\). What could be a value for \(x\) in the domain? (Lesson 1-6)
   - F 20
   - G 30
   - H 32
   - J 40
   8. @ @ @ @

9. A line with a slope of \(-1\) passes through points at (2, 3) and (5, \(y\)). Find the value of \(y\). (Lesson 3-3)
   - A \(-6\)
   - B \(-3\)
   - C 0
   - D 6
   9. @ @ @ @

10. If a line passes through \((0, -6)\) and has a slope of \(-3\), what is an equation for the line? (Lesson 4-2)
    - F \(y = -6x - 3\)
    - G \(x = -6y - 3\)
    - H \(y = -3x - 6\)
    - J \(x = -3y - 6\)
   10. @ @ @ @
11. If \( f(x) = \frac{21 - 6x}{5} \), find \( f^{-1}(x) \).

- **A** \( f^{-1}(x) = \frac{5x - 21}{6} \)
- **B** \( f^{-1}(x) = \frac{21 - 5x}{6} \)
- **C** \( f^{-1}(x) = \frac{21 + 5x}{6} \)
- **D** \( f^{-1}(x) = \frac{21 - 6x}{5} \)

12. If \( \frac{x + 2x + 3x}{2} = 6 \), find \( x \). (Lesson 2-3)

- **F** \( \frac{1}{2} \)
- **G** 1
- **H** 2
- **J** 4

13. Find the slope of the line that passes through (2, 2) and (7, 7). (Lesson 3-3)

- **A** -1
- **B** 1
- **C** -5
- **D** 5

14. What is an equation of the line that passes through (1, 2) and (0, -1)? (Lesson 4-2)

- **F** \( y = x - 3 \)
- **G** \( y = -x + 3 \)
- **H** \( y = -3x + 1 \)
- **J** \( y = 3x - 1 \)

15. The formula for the volume of a rectangular solid is \( V = Bh \). A packing crate has a height of 4.5 inches and a base area of 18.2 square inches. What is the volume of the crate in cubic inches? (Lesson 2-8)

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16. Find the slope of a line parallel to the graph of \( \frac{1}{2}y = x + 6 \). (Lesson 4-4)

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</tbody>
</table>
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Part 2: Gridded Response

Instructions: Enter your answers by writing each digit of the answer in a column box and then shading in the appropriate circle that corresponds to that entry.
17. Write $2 \cdot r \cdot r \cdot t \cdot t$ using exponents. (Lesson 1-1)

18. Evaluate $2xy - y^2$ if $x = 6$ and $y = 12$. (Lesson 1-2)

Simplify each expression. (Lessons 1-2 through 1-5)

19. $12 - 6 \times 5$

20. $6(2 + 3) - 9$

21. $(2 \cdot 3)^2 - 2^2$

22. $4 \cdot 9 - 2 \cdot 10$

23. $4(2y + y) - 6(4y + 3y)$

24. $\frac{12a - 18b}{-6}$

For Questions 25–27, solve each equation. (Lessons 2-2 and 2-3)

25. $13 - m = 21$

26. $\frac{3}{4}x = \frac{2}{3}$

27. $4x + 12 = -16$

28. Solve $x - 2y = 12$ if the domain is $\{-3, -1, 0, 2, 5\}$. (Lesson 3-1)

29. Determine whether $\{(1, 4), (2, 6), (3, 7), (4, 4)\}$ is a function, and explain your reasoning. (Lesson 1-7)

30. Write an equation for the relationship between the variables in the chart. (Lesson 3-6)

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>11</td>
</tr>
</tbody>
</table>

31. Determine the slope of the line passing through $(2, 7)$ and $(-5, 2)$. (Lesson 4-3)

32. Write an equation in slope-intercept form for the line passing through $(2, 6)$ with a slope of $-3$. (Lesson 4-1)

33. Write an equation for the line passing through $(-6, 5)$ and $(-6, -4)$. (Lesson 4-2)

34. Lucy owns a bakery. In 2006, she sold pies for $9.50 each.
In 2010, she sold pies for $17.50 each. (Lesson 3-3)
   a. Find the rate of change for the price of a pie from 2006 to 2010.
   b. How much do you think Lucy will sell a pie for in 2014?
**4 Anticipation Guide**

**Equations of Linear Functions**

**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 A, D, or NS</th>
<th>Statement</th>
<th>STEP 2 A or D</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>
</tr>
<tr>
<td>2.</td>
<td>The y-intercept of $y = 12x - 8$ is 8.</td>
<td>D</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>
</tr>
<tr>
<td>4.</td>
<td>An equation in the form $y = mx + b$ is in point-slope form.</td>
<td>D</td>
</tr>
<tr>
<td>5.</td>
<td>If a pair of lines are parallel, then they have the same slope.</td>
<td>A</td>
</tr>
<tr>
<td>6.</td>
<td>Lines that intersect at right angles are called perpendicular lines.</td>
<td>A</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 relationship between $x$ and $y$.</td>
<td>D</td>
</tr>
<tr>
<td>8.</td>
<td>The closer the correlation coefficient is to zero, the more closely the best-fit line models a set of data.</td>
<td>D</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>
</tr>
<tr>
<td>10.</td>
<td>An inverse relation is obtained by exchanging the $x$-coordinates with the $y$-coordinates of each ordered pair of the original relation.</td>
<td>A</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.

---

**4-1 Study Guide and Intervention**

**Graphing Equations in Slope-Intercept Form**

**Slope-Intercept Form**

$y = mx + b$, where $m$ is the slope and $b$ is the $y$-intercept

**Example 1** Write an equation in slope-intercept form for the line with a slope of $-4$ and a $y$-intercept of $3$.

$y = -4x + 3$

**Example 2** Graph $3x - 4y = 8$.

$y = \frac{3}{4}x - 2$

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. $m = 8$, $b = -3$
2. $m = -2$, $b = -1$
3. $m = -1$, $b = -7$

$y = 8x - 3$
$y = -2x - 1$
$y = -x - 7$

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. $y = -x - 1$
4-1 Study Guide and Intervention (continued)

Graphing Equations in Slope-Intercept Form

Modeling Real-World Data

Example MEDIA 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 \( N \) = the number of millions of music cassettes sold.

Let \( x \) = the number of years since 1999. An equation is \( N = −27x + 124 \).

d. Graph the equation.

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

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

\( N = −27(3) + 124 \) Replace \( x \) with 3.

\( N = 16 \) Simplify.

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. \( \frac{0.5}{3.4} \approx 0.15 \)

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

c. Find the percent of recorded music sold as full-length cassettes in 2004. 1.9%

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. \( \frac{2.5}{0.002} \approx 1250 \)

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

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

4-1 Skills 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: 5, \( y \)-intercept: −3 \( y = 5x − 3 \)
2. slope: −2, \( y \)-intercept: 7 \( y = −2x + 7 \)
3. slope: −6, \( y \)-intercept: −2 \( y = −6x − 2 \)
4. slope: 7, \( y \)-intercept: 1 \( y = 7x + 1 \)
5. slope: 3, \( y \)-intercept: 2 \( y = 3x + 2 \)
6. slope: −4, \( y \)-intercept: −9 \( y = −4x − 9 \)
7. slope: 1, \( y \)-intercept: −12 \( y = x − 12 \)
8. slope: 0, \( y \)-intercept: 8 \( y = 8 \)

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

\( y = 2x − 3 \)

\( y = −3x + 2 \)

\( y = −x − 1 \)

Graph each equation.

\( y = x + 4 \)

\( y = −2x − 1 \)

\( x + y = −3 \)

13. 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 renting 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: \( \frac{1}{2} \), y-intercept: 3  
   \( y = \frac{1}{2}x + 3 \)

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. \( y = \frac{2}{5}x + 2 \)

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

7. \( y = -\frac{2}{3}x - 2 \)

Graph each equation.

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

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. 85

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 2005? 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 **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 \( x \), 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 5 gallons of gasoline and a car wash for $24. Write an equation to find the total cost of gasoline and a car wash is shown below. Write the equation in slope-intercept form for the line.

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 \( x \) 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.
   \( y = 40d + 20 \)
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 don’t overlap, you are small-boned. Small-boned people should decrease their calculated ideal weight by 10%. Large-boned people should increase the value by 10%.

Calculate the ideal weights 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
   1872 lb
4. You, if you are at least 5 ft tall
   Answers will vary.

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, his proper weight y is given by the formula y = 6(x – 60) + 106 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 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 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 of a small-boned male with height x inches. y = 5.4x – 226.8
9. Find the heights at which the ideal weights of normal-boned males and large-boned females would be the same. 68 in., or 5 ft 8 in.
Chapter 4

4-2 Study Guide and Intervention (continued)

Writing Equations in Slope-Intercept Form

Write an Equation Given Two Points

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.

\[ m = \frac{y_2 - y_1}{x_2 - x_1} \]

\[ m = \frac{-2 - 2}{3 - 1} \]

\[ m = -2 \]

\[ y = mx + b \]

\[ y = -2x + b \]

Replace m with -2, y with 2, and x with 1.

\[ 2 = -2(1) + b \]

\[ 2 = -2 + b \]

\[ 4 = b \]

Therefore, the equation is \( y = -2x + 4 \).

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

1. \( y = 4x - 3 \)
2. \( y = -x + 4 \)
3. \( y = \frac{2}{3}x + 1 \)
4. \((-1, 6), (7, -10)\)
5. \((0, 2), (1, 7)\)
6. \((6, -25), (-1, 3)\)
7. \((-2, -1), (2, 11)\)
8. \((10, -1), (4, 2)\)
9. \((-14, -2), (7, 7)\)
10. \((4, 0), (0, 2)\)
11. \((-3, 0), (0, 5)\)
12. \((0, 16), (-10, 0)\)

13. \((1, 3), (-3, -5)\)
14. \((1, 4), (6, -1)\)
15. \((1, -1), (3, 5)\)
16. \((-2, 4), (0, 6)\)
17. \((3, 3), (1, -3)\)
18. \((-1, 6), (3, -2)\)

19. 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.

$65
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); slope -3
5. (4, 3); slope \(\frac{1}{2}\)
6. (1, -5); slope \(-\frac{3}{2}\)
7. (3, 7); slope \(\frac{2}{3}\)
8. (-2, \frac{3}{2}); slope \(-\frac{1}{2}\)
9. (5, 0); 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. 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 \(x\) lessons. Then use the equation to find the cost of 4 lessons. \(C = 10x + 12\); $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. They 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. 4

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 \(k\), Mr. Kimball's salary after \(t\) years at this company if his performance reviews are always satisfactory. \(k = 3000t + 41,250\)

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 \(p\) represents the number of years after 1990, write a linear equation to find \(p\), Laredo's population for any year after 1990. \(p = 5441t + 123,000\)

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? \(y = 40; \) slope 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>3</th>
<th>5.5</th>
<th>4</th>
<th>5</th>
<th>5.5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Source: DansonShpt UK

a. Write a linear equation to determine any U.S. size \(y\) if you are given the U.K. size \(x\).
\(y = x + 2.5\)
b. What are 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.
Example 2

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 \( y = ax^2 + bx + c \), equations of the tangent lines 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 2

Find an equation of the line tangent 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 \((2, 12)\).

Step 1: Find two points on the curve. 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 passes through these two points.

\[ m = \frac{20 - 6}{3 - 1} = 7 \]

Step 3: Now use this slope and the point \((2, 12)\) to find an equation of the tangent line.

\[ y - y_1 = m(x - x_1) \]

Replace \( x_1 \) with 2, \( y_1 \) with 12, and \( m \) with 7.

\[ y - 12 = 7(x - 2) \]

Solve for \( b \).

\[ -2 = b \]

So, an equation of the tangent line to \( y = x^2 + 3x + 2 \) through the point \((2, 12)\) is \( y = 7x - 2 \).

Exercises

Find an equation of the line 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. \( y = 5 - x^2 \), \((1, 4)\)

\[ y = x + 3 \]

\[ y = -20x - 53 \]

\[ y = -2x + 6 \]

4. Find the slope of the line tangent to the curve at \( x = 0 \) for the general equation \( y = ax^2 + bx + c \) at \( x \) by finding the slope of the line through the points \((0, c)\) and \((2a, 4ax^2 + 2bx + c)\). Does this equation find the same slope for \( x = 0 \) as you found in Exercise 4? \( m = 2ax + b \), yes

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

6. Write an equation in point-slope form for a horizontal line that passes through \((-5, 6)\), \( y = 0 \)

7. Write an equation in point-slope form for a horizontal line that passes through \((5, 0)\), \( y = 0 \)

8. Write an equation in point-slope form for a nonvertical line that passes through \((4, -1)\) with a slope of \( -\frac{5}{2} \).

\[ y - y_1 = m(x - x_1) \]

\[ y - 1 = -\frac{5}{2}(x - 6) \]

Therefore, the equation is \( y - 1 = -\frac{5}{2}(x - 6) \).

9. Write an equation in point-slope form for a nonvertical line that passes through \((4, 5)\) and \((1, 0)\).

\[ m = \frac{5 - 0}{4 - 1} = \frac{5}{3} \]

\[ y - 5 = \frac{5}{3}(x - 4) \]

Therefore, the equation is \( y + 1 = 0 \).


**Chapter 4**

### 4-3 Study Guide and Intervention (continued)

#### Writing Equations in Point-Slope Form

**Forms of Linear Equations**

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

**Example 1**

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

\[
y + 5 = \frac{2}{3}(x - 6)
\]

\[
3y + 15 = 2x - 12
\]

\[
x - 2y = 3
\]

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.

\[
y - 2 = -\frac{1}{4}(x - 8)
\]

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

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

**Exercises**

Write each equation in standard form.

1. \( y + 2 = -3(x - 1) \)
   \[
   3x + y = 1
   \]
2. \( y - 1 = -\frac{1}{3}(x - 6) \)
   \[
   x + 3y = 9
   \]
3. \( y + 2 = -\frac{2}{3}(x - 9) \)
   \[
   2x - 3y = 24
   \]
4. \( y + 3 = -\frac{2}{3}(x - 5) \)
   \[
   5y - 4 = \frac{2}{3}(x + 3)
   \]
5. \( x + y = 2 \)
   \[
   5x - 3y = -27
   \]
6. \( y = 2x - 14 \)

Write each equation in slope-intercept form.

1. \( y = 4x - 12 \)
   \[
   y = 3x + 3
   \]
2. \( y = -2x + 14 \)
   \[
   y = -\frac{1}{2}x - 8
   \]
3. \( y = 3x + 5 \)

**4-3 Skills Practice**

#### Writing Equations in Point-Slope Form

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

1. \( y + 2 = 3(x + 1) \)
   \[
   y + 2 = -(x - 1)
   \]
2. \( y + 3 = 0 \)
3. \( y + 2 = -3(x - 1) \)
4. \( m = 0 \)
   \[
   y - 1 = 0
   \]
5. \( m = 8 \)
   \[
   y - 6 = 8(x + 4)
   \]
6. \( m = -4 \)
   \[
   y + 3 = -4(x - 1)
   \]
7. \( m = 1 \)
   \[
   y + 6 = x - 4
   \]
8. \( m = \frac{4}{3} \)
   \[
   y - 3 = \frac{4}{3}(x - 3)
   \]
9. \( m = -\frac{5}{4} \)
   \[
   y + 1 = -\frac{5}{4}(x + 5)
   \]

Write each equation in standard form.

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

Writing Equations in Point-Slope Form

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

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

5. (-8, 5), \( m = -\frac{3}{5} \)  
   \[ y - 5 = -\frac{2}{5}(x + 8) \]

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

Write each equation in standard form.

7. \[ 7y - 11 = 3x - 2 \]  
   \[ 3x - y = -5 \]

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

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

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

11. \[ 12y - 6 = \frac{3}{4}(x - 3) \]  
    \[ 12x - 2y = -22 \]

12. \[ 13y + 4 = 1.5(x + 2) \]  
    \[ 14y - 3 = -2.4(x - 5) \]

13. \[ 15y - 4 = 2.5(x + 3) \]  
    \[ 12x + 5y = 75 \]

14. \[ 16x - 2 = 2 \]  
    \[ 17y + 1 = -7(x + 1) \]

15. \[ 18y - 3 = -5(x + 12) \]  
    \[ y = 4x + 6 \]

16. \[ 18y = -7x - 8 \]  
    \[ y = 4x + 6 \]

17. \[ 19y - 5 = \frac{3}{2}(x + 4) \]  
    \[ 20y - \frac{1}{2} = -3[x + \frac{1}{4}] \]

18. \[ 21y - \frac{3}{2} = -2[x + \frac{1}{4}] \]  
    \[ y = \frac{3}{2}x + 11 \]

19. \[ y = -3x - \frac{1}{2} \]  
    \[ y = -2x + \frac{7}{6} \]

20. 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 \( y \) in terms of hours \( x \). \( y = 15x + 30 \)
   
   b. Write the equation in slope-intercept form. \( y = 15x + 60 \)
   
   c. What is the fee for the use of a trash dumpster? $60

21. MOVING There is a daily fee for renting a moving truck, plus a charge of $0.50 per mile driven. It costs $86 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 a one-day rental with \( x \) miles driven. \( y = 64 + 0.5(x - 48) \)
   
   b. Write the equation in slope-intercept form. \( y = 0.5x + 40 \)
   
   c. What is the daily fee? $40

4-3 Word Problem Practice

Writing Equations in 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 the distance traveled. Write an 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 its 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 The frequency of a male cricket’s chirp is related to 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 from the graph below to write an equation for the line in point-slope form.

   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 point-slope form to find the total distance \( y \) traveled for any number of hours \( x \).

   \[ y - 18 = 3.5(x - 5) \]

5. AVIATION A jet plane takes off and consistently climbs 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 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, \text{LinReg} (ax + b), is found under the \text{STAT CALC} menu.

\textbf{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 \(L1\) and the \(y\)-coordinates into \(L2\). Use the linear regression function to write the equation of the line.

Keystrokes:
\begin{align*}
\text{STAT} & \rightarrow \text{EDIT} \rightarrow \text{Select L1 \& L2} \rightarrow \text{STAT} \rightarrow \text{CALC} \rightarrow \text{LinReg} \rightarrow \text{L1} \rightarrow \text{L2} \rightarrow \boxed{Y=} \\
& \rightarrow \text{ENTER} \rightarrow \boxed{3} \rightarrow \boxed{6} \rightarrow \boxed{4} \rightarrow \boxed{2} \rightarrow \boxed{ENTER} \rightarrow \boxed{3} \rightarrow \text{ENTER} \\
& \rightarrow \text{STAT} \rightarrow \text{STAT} \rightarrow \boxed{L1} \rightarrow \text{ENTER} \rightarrow \boxed{2nd} \rightarrow \boxed{L2} \rightarrow \text{ENTER} \\
& \rightarrow \boxed{-2} \rightarrow \text{ENTER} \rightarrow \boxed{4} \rightarrow \text{ENTER} \rightarrow \boxed{3} \rightarrow \text{ENTER} \\
& \rightarrow \boxed{4} \rightarrow \text{ENTER} \\
\end{align*}

The equation is \(y = 2x - 8\).

If you have already written the equation of a line, you can use the given information to verify your equation.

\textbf{Example 2}

Verify that the equation of the line passing through \((2, -3)\) with slope \(-\frac{3}{4}\) 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 \(L1\) and the \(y\)-coordinates into \(L2\) Use \text{LinReg} \((ax + b)\) to determine the slope-intercept form of the equation.

The slope-intercept form of the equation is \(y = -0.75x - 1.5\) or \(y = -\frac{3}{4}x - \frac{3}{2}\).

This can be rewritten in standard form as \(3x + 4y = -6\).

\textbf{Exercises}

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

1. \(y = -8x + 7\); \(84x + y = 7\)
2. \(y = -\frac{3}{4}x + 4; 3x - 5y = -20\)
3. \(y = -\frac{3}{2}x - 8; 2x - 3y = 24\)
4. \(y = -4x + 17; 4x + y = 17\)
5. \(y = \frac{1}{2}x - \frac{1}{2}; x - 2y = 1\)
6. \(y = \frac{4}{9}x + 3; 4x + 9y = 27\)
**4-4 Study Guide and Intervention**

**Parallel and Perpendicular Lines**

**Parallel 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.

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

\[
y - 6 = 2(x - (-1)) \quad m = 2; (x_1, y_1) = (-1, 6)
\]

\[
y - 6 = 2(x + 1) \quad \text{Simplify}
\]

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

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

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. \(y = x - 4\)
2. \(y = -\frac{1}{2}x + 3\)
3. \(y = \frac{4}{3}x + 7\)
4. \((-2, 2), y = 4x - 2\)
5. \((6, 4), y = \frac{2}{3}x + 1\)
6. \((4, -2), y = -2x + 3\)
7. \((-2, 4), y = -3x + 10\)
8. \((-1, 6), 3x + y = 12\)
9. \((4, -6), x + 2y = 5\)
10. Find an equation of the line that has a \(y\)-intercept of 2 that is parallel to the graph of the line \(4x + 2y = 8\). \(y = -2x + 2\)
11. Find an equation of the line that has a \(y\)-intercept of \(-1\) that is parallel to the graph of the line \(x - 3y = 6\). \(y = \frac{1}{3}x - 1\)
12. Find an equation of the line that has a \(y\)-intercept of \(-4\) that is parallel to the graph of the line \(y = 6\). \(y = -4\)

---

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

**Parallel and Perpendicular Lines**

**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 \(2x - 3y = 9\).

\[
2x - 3y = 9 \quad \text{Original equation}
\]

\[
-3y = -2x + 9 \quad \text{Subtract 2x from each side.}
\]

\[
y = \frac{2}{3}x - 3 \quad \text{Divide each side by -3.}
\]

The slope of \(y = \frac{2}{3}x - 3\) is \(\frac{2}{3}\). 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 \(-\frac{3}{2}\).

Use the point-slope form to find the equation.

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

\[
y - 2 = -\frac{3}{2}(x + 4) \quad m = \frac{2}{3}; (x_1, y_1) = (-4, 2)
\]

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

\[
y = -\frac{3}{2}x - 4 \quad \text{Distribute Property}
\]

\[
y = -\frac{3}{2}x - 4 \quad \text{Slope-intercept form}
\]

**Exercises**

1. **ARCHITECTURE** On the architect’s plans for a new high school, a wall represented by \(MN\) has endpoints \(M(-3, -1)\) and \(N(2, 1)\). A wall represented by \(PQ\) has endpoints \(P(4, -4)\) and \(Q(-2, 11)\). Are the walls perpendicular? Explain.

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

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

2. \(2x + y = -7, x - 2y = -4, 4x - y = 5\) first two are perpendicular
3. \(y = 3x, 6x - 2y = 7, 3y = 9x - 1\) all are parallel

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

**Chapter 4** 24  **Glencoe Algebra 1**  

**Chapter 4** 25  **Glencoe Algebra 1**
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 the given equation.

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

13. \(y = \frac{2}{3}x + 3\)
14. \(y = \frac{3}{2}x + 2\)
15. \(y = 3x - 3\)

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 the given equation.

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

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

7. \((-3, 4), y = 2x - 3\)
8. \((-1, -2), 3x - y = 5\)
9. \((-8, 2), 5x - 4y = 1\)

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

13. \((-1, -4), 9x + 2y = 8\)
14. \((-5, 6), 4x + 3y = 1\)
15. \((3, 1), 2x + 5y = 7\)

16. \(y = -3x - 7\)
17. \(y = \frac{3}{2}x - \frac{5}{3}\)
18. \(y = \frac{7}{3}x + 5\)

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

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

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

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

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

25. GEOMETRY Quadrilateral \(ABCD\) has diagonals \(\overline{AC}\) and \(\overline{BD}\). Determine whether \(\overline{AC}\) is perpendicular to \(\overline{BD}\). Explain.

Yes; they are perpendicular because their slopes are 7 and \(-\frac{1}{7}\), 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.
1. **BUSINESS** Brady’s Books is a retail store. The store’s average daily profits \( y \) are given by the equation \( y = 2x + 3 \) where \( x \) is the number of hours available for customer purchases. Brady’s adds an online shopping option. Write an equation in slope-intercept form to show a new profit line with the same profit rate containing the point \((0, 12)\).

\[ y = 2x + 12 \]

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.

\[ y = -x + 10 \]

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.

\[ y = \frac{2}{3}x + 3 \]

4. **GEOMETRY** A parallelogram is created by the intersections of the lines \( x = 2 \), \( x = 6 \), \( y = \frac{3}{2}x + 2 \), 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.)

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

5. **INTERIOR DESIGN** Pamela is planning to install an island in her kitchen. She draws the shape she likes by connecting the 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 \( ABCD \) she designed? Explain.

1 pair: \( BC \) and \( AD \) are parallel because their slopes are both 0.5.

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

2 pairs: \( BC \perp AB \) and \( AB \perp AD \) because \( AB \) has a slope of \(-2\), which is the opposite reciprocal of the slopes of \( BC \) and \( AD \), 0.5.

c. What is the shape of her new island? a trapezoid

---

**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 \( y = mx + 3m - 2 \), where \( m \) is any real number.
4-5 Study Guide and Intervention

Chapter 4

Study Guide and Intervention (continued)

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.

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

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

Use Lines of Fit

Use Lines of Fit

Example

The table shows the number of students per computer in Easton High School for certain school years from 1996 to 2008.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Students per Computer</td>
<td>22</td>
<td>18</td>
<td>14</td>
<td>10</td>
<td>6.1</td>
<td>5.4</td>
<td>4.9</td>
</tr>
</tbody>
</table>

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

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

A line of fit is shown.

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

The line of fit shown passes through (1999, 16) and (2005, 5.7). Find the slope.

\[ m = \frac{5.7 - 16}{2005 - 1999} \]

\[ m = -1.7 \]

Find b in \( y = -1.7x + b \).

\[ 16 = -1.7 \cdot 1993 + b \]

\[ 3404 = b \]

Therefore, an equation of a line of fit is \( y = -1.7x + 3404 \).

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.

The points (0, 5.08) and (3, 5.81) give \( y = 0.243x + 5.08 \) as a line of fit.
4-5 Skills Practice

Scatter Plots and Lines 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. Calories Burned During Exercise
   - Positive; the longer the exercise, the more Calories burned.

2. Library Fines
   - No correlation

3. Weight-Lifting
   - Negative; as weight increases, the number of repetitions decreases.

4. Car Dealership Revenue
   - 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. Positive; as the year increases, the price increases.
     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.
        \[ y = 1.08x - 2144.24 \]
     c. Predict the price of a ticket in 2009. About $25.48

3. 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. Negative correlation; as the year increases, the number of cases decreases.
     b. Draw a line of fit for the scatter plot.
        Sample answer given.
     c. Write the slope-intercept form of an equation for the line of fit. Sample answer: \( y = -129.75x + 906 \)

4. Zoos
   - The table shows the average and maximum longevity of various animals in captivity.
     a. Draw a scatter plot and determine what relationship, if any, exists in the data. Positive correlation; as the average increases, the maximum increases.
     b. Draw a line of fit for the scatter plot.
        Sample answer: Use (15, 40), (35, 70).
     c. Write the slope-intercept form of an equation for the line of fit. Sample answer: \( y = 1.5x + 17.5 \)
     d. Predict the maximum longevity for an animal with an average longevity of 33 years. About 67 yr

Source: National Oceanic and Atmospheric Administration
Source: Centers for Disease Control
Source: Centers for Disease Control
Source: Walker's Mammals of the World
Source: Team Marketing Report, Chicago
**4-5 Word Problem Practice**

### Scatter Plots and Lines of Fit

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?

![Scatter plot]

Source: RIAA

Sample answer: around 700 million CDs

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.

<table>
<thead>
<tr>
<th>Child's Age (years)</th>
<th>Annual Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10,700</td>
</tr>
<tr>
<td>1</td>
<td>11,700</td>
</tr>
<tr>
<td>2</td>
<td>12,600</td>
</tr>
<tr>
<td>3</td>
<td>13,500</td>
</tr>
<tr>
<td>4</td>
<td>14,400</td>
</tr>
<tr>
<td>5</td>
<td>15,300</td>
</tr>
</tbody>
</table>

Source: The World Almanac

3. **HOUSING** The median price of an existing home was $160,000 in 2000 and $240,000 in 2007. If the trend continued, about how many CDs were sold in 2006?

Sample answer: around 700 million CDs

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td>170</td>
</tr>
<tr>
<td>96</td>
<td>171</td>
</tr>
<tr>
<td>97</td>
<td>168</td>
</tr>
<tr>
<td>98</td>
<td>178</td>
</tr>
<tr>
<td>99</td>
<td>172</td>
</tr>
<tr>
<td>00</td>
<td>167</td>
</tr>
<tr>
<td>01</td>
<td>177</td>
</tr>
<tr>
<td>02</td>
<td>173</td>
</tr>
<tr>
<td>03</td>
<td>174</td>
</tr>
<tr>
<td>04</td>
<td>172</td>
</tr>
</tbody>
</table>

Source: Elias Sports Bureau

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

![Scatter plot](https://via.placeholder.com/150)

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

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.

5. **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 mean January temperature? At the right is a table containing the latitudes and January mean temperatures for fifteen U.S. cities.

<table>
<thead>
<tr>
<th>U.S. City</th>
<th>Latitude</th>
<th>January Mean Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany, New York</td>
<td>42:40 N</td>
<td>20.7°F</td>
</tr>
<tr>
<td>Albuquerque, NM</td>
<td>35:07 N</td>
<td>34.3°F</td>
</tr>
<tr>
<td>Anchorage, Alaska</td>
<td>61:11 N</td>
<td>14.9°F</td>
</tr>
<tr>
<td>Birmingham, AL</td>
<td>33:32 N</td>
<td>41.7°F</td>
</tr>
<tr>
<td>Charleston, SC</td>
<td>32:47 N</td>
<td>47.1°F</td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>41:50 N</td>
<td>21.0°F</td>
</tr>
<tr>
<td>Columbus, OH</td>
<td>39:59 N</td>
<td>26.3°F</td>
</tr>
<tr>
<td>Duluth, MN</td>
<td>46:47 N</td>
<td>7.0°F</td>
</tr>
<tr>
<td>Fairbanks, AK</td>
<td>64:50 N</td>
<td>-10.1°F</td>
</tr>
<tr>
<td>Galveston, TX</td>
<td>29:14 N</td>
<td>52.9°F</td>
</tr>
<tr>
<td>Honolulu, HI</td>
<td>21:19 N</td>
<td>72.9°F</td>
</tr>
<tr>
<td>Las Vegas, NV</td>
<td>36:12 N</td>
<td>45.1°F</td>
</tr>
<tr>
<td>Miami, FL</td>
<td>25:47 N</td>
<td>67.3°F</td>
</tr>
<tr>
<td>Richmond, VA</td>
<td>37:32 N</td>
<td>35.8°F</td>
</tr>
<tr>
<td>Tucson, AZ</td>
<td>32:12 N</td>
<td>51.3°F</td>
</tr>
</tbody>
</table>

Sample answers are given.

Sample answer:

- There is a positive correlation.
- The higher the latitude, the lower the temperature.

6. Research the latitudes and temperatures for cities in the southern hemisphere. Does your conjecture hold for these cities as well? Yes.

**4-5 Enrichment**

### Latitude and Temperature

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<tr>
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<td>32:47 N</td>
<td>47.1°F</td>
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<td>41:50 N</td>
<td>21.0°F</td>
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<td>64:50 N</td>
<td>-10.1°F</td>
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<td>29:14 N</td>
<td>52.9°F</td>
</tr>
<tr>
<td>Honolulu, HI</td>
<td>21:19 N</td>
<td>72.9°F</td>
</tr>
<tr>
<td>Las Vegas, NV</td>
<td>36:12 N</td>
<td>45.1°F</td>
</tr>
<tr>
<td>Miami, FL</td>
<td>25:47 N</td>
<td>67.3°F</td>
</tr>
<tr>
<td>Richmond, VA</td>
<td>37:32 N</td>
<td>35.8°F</td>
</tr>
<tr>
<td>Tucson, AZ</td>
<td>32:12 N</td>
<td>51.3°F</td>
</tr>
</tbody>
</table>

Sample answers are given.

Sample answer:

- There is a positive correlation.
- The higher the latitude, the lower the temperature.

6. Research the latitudes and temperatures for cities in the southern hemisphere. Does your conjecture hold for these cities as well? Yes.
4-5 Spreadsheet Activity

Scatter Plots

A spreadsheet program can create scatter plots of data that you enter. You can also have the spreadsheet graph a line of fit, called a trendline, automatically.

Example

The table below shows the number of metric tons of gold produced in mines in the United States in selected years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Gold (metric tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>353</td>
</tr>
<tr>
<td>2001</td>
<td>335</td>
</tr>
<tr>
<td>2002</td>
<td>298</td>
</tr>
<tr>
<td>2003</td>
<td>277</td>
</tr>
<tr>
<td>2004</td>
<td>264</td>
</tr>
<tr>
<td>2005</td>
<td>252</td>
</tr>
<tr>
<td>2006</td>
<td>238</td>
</tr>
<tr>
<td>2007</td>
<td>233</td>
</tr>
<tr>
<td>2008</td>
<td>210</td>
</tr>
</tbody>
</table>

Use a spreadsheet to draw a scatter plot and a trendline for the data. Let \( x \) represent the number of years since 2000 and let \( y \) represent the number of metric tons of gold. Then predict the number of ounces of gold produced in 2013.

Step 1

Use Column A for the years since 2000 and Column B for the number of metric tons of gold. To create a graph from the data, select the data in Columns A and B and choose Chart from the Insert menu. Select an X:Y (Scatter) chart to show the data points.

Step 2

Add a trendline to the graph by choosing the Chart menu. Add a linear trendline. Use the options menu to have the trendline forecast 3 years forward.

Using this trendline, it appears that the gold production for 2013 will be approximately 150 metric tons.

Exercises

Write an equation of the regression line for the data in each table below. Then find the correlation coefficient.

Exercise 1.

The table shows the number of millions of dollars of direct political contributions received by Democrats and Republicans in selected years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>283</td>
</tr>
<tr>
<td>1994</td>
<td>337</td>
</tr>
<tr>
<td>1998</td>
<td>445</td>
</tr>
<tr>
<td>2002</td>
<td>717</td>
</tr>
</tbody>
</table>

Exercise 2.

Predict the amount of direct political contributions for the 2010 election.

Sample answer: $1169 million or $1.169 billion

Exercise 2.

The best-fit equation for the regression is shown.

\[ y = 0.25x + 5.41; r = 0.843 \]

Exercise 2.

The table shows the price of a gallon of regular gasoline at a station in Los Angeles, California on January 1 of various years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>$1.47</td>
</tr>
<tr>
<td>2006</td>
<td>$1.82</td>
</tr>
<tr>
<td>2007</td>
<td>$2.15</td>
</tr>
<tr>
<td>2008</td>
<td>$2.49</td>
</tr>
<tr>
<td>2009</td>
<td>$2.83</td>
</tr>
<tr>
<td>2010</td>
<td>$3.04</td>
</tr>
</tbody>
</table>

Exercise 2.

A spreadsheet program can create scatter plots of data that you enter. You can also have the spreadsheet graph a line of fit, called the best-fit line. The calculator computes the data, writes an equation, and gives you the correlation coefficient, a measure of how closely the equation models the data.
### 4-6 Study Guide and Intervention (continued)

#### Regression and Median-Fit Lines

**Equations of Median-Fit Lines** A graphing calculator can also find another type of best-fit line called the median-fit line, which is found using the medians of the coordinates of the data points.

**Example ELECTIONS** The table shows the total number of people in millions who voted in the U.S. Presidential election in the given years.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voters</td>
<td>130</td>
<td>168</td>
<td>184</td>
<td>201</td>
<td>234</td>
<td>252</td>
<td>235</td>
<td>251</td>
</tr>
</tbody>
</table>

*Source:* George Mason University

a. Find an equation for the median-fit line. Enter the data by pressing \( \text{STAT} \) and selecting the Edit option. Let the year 1980 be represented by 0. Enter the years since 1980 into List 1 (L1). Enter the number of voters into List 2 (L2). Then, press \( \text{STAT} \) and select the CALC option. Scroll down to Med-Med and press \( \text{ENTER} \). The value of \( a \) is the slope, and the value of \( b \) is the \( y \)-intercept.

The equation for the median-fit line is \( y = 5.58x + 83.57 \).

b. Estimate the number of people who voted in the 2000 U.S. Presidential election. Graph the best-fit line. Then use the \( \text{TRACE} \) feature and the arrow keys until you find a point where \( x = 20 \).

When \( x = 20 \), \( y \approx 115 \). Therefore, about 115 million people voted in the 2000 U.S. Presidential election.

### Exercises

Write an equation of the regression line for the data in each table below. Then find the correlation coefficient.

#### 1. POPULATION GROWTH

Below is a table showing the estimated population of Arizona in millions on July 1st of various years.

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>5.30</td>
<td>5.44</td>
<td>5.58</td>
<td>5.74</td>
<td>5.94</td>
</tr>
</tbody>
</table>

a. Find an equation for the median-fit line. \( y = 0.171x + 5.267 \)

b. Predict the population of Arizona in 2009. **about 6.63 million**

#### 2. ENROLLMENT

Below is a table showing the number of students enrolled at Happy Days Preschool in the given years.

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>130</td>
<td>168</td>
<td>184</td>
<td>201</td>
<td>234</td>
</tr>
</tbody>
</table>

a. Find an equation for the median-fit line. \( y = 11.42x + 137.83 \)

b. Estimate how many students were enrolled in 2007. **about 195 students**

#### 3. SOCCER

The table shows the number of goals a soccer team scored each season since 2005.

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals Scored</td>
<td>42</td>
<td>48</td>
<td>46</td>
<td>50</td>
<td>52</td>
<td>48</td>
</tr>
</tbody>
</table>

a. Find an equation for the regression line. \( y = 1.31x + 44.38; \ r = 0.714 \)

b. According to the equation, how many goals would the team score in 2007? \( y = 57.48 \) goals

c. Is this a reasonable prediction? Explain. No, because goal-scoring may not follow a linear pattern.
4-6 Practice

Regression and Median-Fit Lines

Write an equation of the regression line for the data in each table below. Then find the correlation coefficient.

1. TURTLES The table shows the number of turtles hatched at a zoo each year since 2006.

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turtles Hatched</td>
<td>21</td>
<td>17</td>
<td>16</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>

\[ y = -1.5x + 19.8; \ r = -0.916 \]

2. SCHOOL LUNCHES The table shows the percentage of students receiving free or reduced price school lunches at a certain school each year since 2006.

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>14.4%</td>
<td>15.8%</td>
<td>18.3%</td>
<td>18.6%</td>
<td>20.9%</td>
</tr>
</tbody>
</table>

\[ y = 1.58x + 14.44; \ r = 0.983 \]

3. SPORTS Below is a table showing the number of students signed up to play lacrosse after school in each age group.

<table>
<thead>
<tr>
<th>Age</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacrosse Players</td>
<td>17</td>
<td>14</td>
<td>6</td>
<td>9</td>
<td>12</td>
</tr>
</tbody>
</table>

\[ y = -1.5x + 34.1; \ r = -0.554 \]

4. LANGUAGE The State of California keeps track of how many millions of students are learning English as a second language each year.

<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Learners</td>
<td>1.600</td>
<td>1.599</td>
<td>1.592</td>
<td>1.570</td>
<td>1.569</td>
</tr>
</tbody>
</table>

\[ y = 0.019x + 1.607 \]

5. POPULATION Detroit, Michigan, like a number of large cities, is losing population every year. Below is a table showing the population of Detroit each decade.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (millions)</td>
<td>1.67</td>
<td>1.51</td>
<td>1.20</td>
<td>1.03</td>
<td>0.95</td>
</tr>
</tbody>
</table>

\[ y = -0.019x + 1.656 \]

Use a calculator to find an equation for the regression line. Then predict the number of students who were learning English in California in 2001. about 1,627,000 students

b. Predict the number of students who were learning English in California in 2001. about 1,627,000 students

c. Predict the number of students who were learning English in California in 2010. about 1,627,000 students

d. Find an equation for the median-fit line. [y = -0.019x + 1.656]

e. Predict the number of students who were learning English in California in 2001. about 1,627,000 students

4-6 Word Problem Practice

Regression and Median-Fit Lines

1. FOOTBALL Rutgers University running back Ray Rice ran for 172 total yards in the 2007 regular season. The table below shows his cumulative total number of yards ran after select games.

<table>
<thead>
<tr>
<th>Game</th>
<th>1</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative Yards</td>
<td>184</td>
<td>431</td>
<td>818</td>
<td>1257</td>
<td>1732</td>
</tr>
</tbody>
</table>

Source: Rutgers University Athletics

Use a calculator to find an equation for the regression line showing the total yards y scored after x games. What is the real-world meaning of the value returned for a?

\[ y = 140.4x + 13.8; \ a \ represents \ the \ number \ of \ yards \ Ray \ Rice \ can \ be \ expected \ to \ run \ per \ game. \]

2. GOLDS Gold ounces of gold are traded by large investment banks in commodity exchanges much the same way that shares of stock are traded. The table below shows the cost of a single ounce of gold on the last day of trading in given years.

<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$346.70</td>
<td>$414.80</td>
<td>$438.10</td>
<td>$517.20</td>
<td>$636.30</td>
</tr>
</tbody>
</table>

Source: Global Financial Data

Use a calculator to find an equation for the regression line. Then predict the price of an ounce of gold on the last day of trading in 2009. Is this a reasonable prediction? Explain.

\[ y = 68.16x + 334.3; \ S811.42; \ The \ prediction \ may \ not \ be \ reasonable, \ because \ the \ value \ of \ an \ investment \ can \ fluctuate. \]

3. GOLF SCORES Emmanuel is practicing golf as part of his school’s golf team. Each week he plays a full round of golf and records his total score. His scorecard after five weeks is below.

<table>
<thead>
<tr>
<th>Week</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Score</td>
<td>112</td>
<td>107</td>
<td>108</td>
<td>104</td>
<td>98</td>
</tr>
</tbody>
</table>

Use a calculator to find an equation for the median-fit line. Then estimate how many games Emmanuel will have to play to get a score of 86.

\[ y = -2.83x + 114.67; \ about \ 10 \ games \]

4. STUDENT ELECTIONS The vote totals for five of the candidates participating in Montvale High School’s student council elections and the number of hours each candidate spent campaigning are shown in the table below.

<table>
<thead>
<tr>
<th>Campaign Time (h)</th>
<th>1</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Votes Received</td>
<td>9</td>
<td>22</td>
<td>46</td>
<td>46</td>
<td>78</td>
</tr>
</tbody>
</table>

Source: Montvale High School student council

Use a calculator to find an equation for the median-fit line. Then estimate how many votes each candidate could expect to receive.

a. Use a calculator to find an equation for the median-fit line.

\[ y = 9.3x + 70 \]

b. Plot the data points and draw the median-fit line on the graph below.

c. Suppose a sixth candidate spends 7 hours campaigning. Estimate how many votes that candidate could expect to receive. about 59
4-6 Enrichment

Quadratic Regression Parabolas

For some sets of data, a linear equation in the form \( y = ax + b \) does not adequately describe the relationship between data points. The “QuadReg” function on a graphing calculator will output an equation in the form \( y = ax^2 + bx + c \). The value of \( R^2 \), the coefficient of determination, tells you how closely the parabola fits the data.

Example: The table shows the population of Atlanta in various years.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>423,000</td>
<td>425,000</td>
<td>394,017</td>
<td>416,674</td>
<td>470,698</td>
<td>498,709</td>
</tr>
</tbody>
</table>

Source: US Census Bureau

a. Find the equation of a quadratic-regression parabola for the data.

Running a linear regression on the data provides an \( r \) value of 0.63, which indicates a poor fit. The data appears to be a good candidate for a quadratic regression.

Step 1 Enter the data by pressing \( STAT \) and selecting the Edit option. Enter the years since 1970 as your \( x \)-values (L1) and enter the population figures as your \( y \)-values (L2).

Step 2 Perform the quadratic regression by pressing \( STAT \) and selecting the CALC option. Scroll down to QuadReg and press \( ENTER \).

Step 3 Write the equation of the best-fit parabola by rounding the \( a \), \( b \), and \( c \) values on the screen.

The equation for the best-fit parabola is \( y = 302.8x^2 - 11,440x + 501,227 \).

b. Find the coefficient of determination.

The coefficient of determination for the parabola is \( R^2 = 0.969 \), which indicates a good fit.

c. Use the quadratic-regression parabola to predict the population in 2010.

Graph the best-fit parabola. Then use the \( TRACE \) feature and the arrow keys until you find a point where \( x = 40 \).

When \( x = 40 \), \( y = 525,000 \). The estimated population will be 525,000.

Exercises

1. The table below shows the average high temperature in Crystal River, Florida in various months.

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan (1)</th>
<th>Mar (3)</th>
<th>May (5)</th>
<th>Jul (7)</th>
<th>Sep (9)</th>
<th>Nov (11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. High (°F)</td>
<td>68°</td>
<td>76°</td>
<td>87°</td>
<td>91°</td>
<td>88°</td>
<td>76°</td>
</tr>
</tbody>
</table>

Source: County Studies

a. Find the equation of the best-fit parabola. \( y = -0.696x^2 + 9.5x + 57200 \)

b. Find the coefficient of determination. \( R^2 = 0.943 \)

c. Use the quadratic-regression parabola to predict the average high temperature in April (4th month). \( \text{about 84°F} \)

4-7 Study Guide

Inverse Linear Functions

Inverse Relations An inverse relation is the set of ordered pairs obtained by exchanging the \( x \)-coordinates with the \( y \)-coordinates of each ordered pair. The domain of a relation becomes the range of its inverse, and the range of the relation becomes the domain of its inverse.

Example: Find and graph the inverse of the relation represented by line \( a \).

The graph of the relation passes through \((-2, -10), (-1, -7), (0, -4), (1, -1), (2, 2), (3, 5), \) and \((4, 8)\).

To find the inverse, exchange the coordinates of the ordered pairs.

The graph of the inverse passes through the points \((-10, 2), (-7, -1), (-4, 0), (-1, 1), (2, 2), (3, 3), \) and \((8, 4)\).

Graph these points and then draw the line that passes through them.

Exercises

Find the inverse of each relation.

1. \{(4, 7), (6, 2), (9, -1), (11, 3)\}
2. \{(-5, -9), (-4, -6), (-2, -4), (0, -3)\}
3. \{-8, -16\}, \{-2, -4\}, \{1, -2\}, \{5, 1\}, \{11, 8\}
4. \{-8, 3\}, \{-2, 9\}, \{2, 13\}, \{6, 18\}, \{8, 15\}
5. \{-2, 2\}

Graph the inverse of each relation.

6. \{( -15, -8), (-11, -2)\}, \{(3, -8), (9, -2)\}, \{(13, -2), (18, 6), (19, 8)\}
7. \{( -14, -6), (11, -5)\}, \{(8, -4), (5, -3)\}, \{(2, -2)\}

8. \{( -15, -8), (-11, -2)\}, \{(3, -8), (9, -2)\}, \{(13, -2), (18, 6), (19, 8)\}
Inverse Functions A linear relation that is described by a function has an inverse function that can generate ordered pairs of the inverse relation. The inverse of the linear function $f(x)$ can be written as $f^{-1}(x)$ and is read $f$ of $x$ inverse or the inverse of $f$ of $x$.

**Example**  
Find the inverse of $f(x) = \frac{3}{4}x + 6$.

**Step 1**  
Original equation  
\[ f(x) = \frac{3}{4}x + 6 \]

**Step 2**  
Replace $f(x)$ with $y$.  
\[ y = \frac{3}{4}x + 6 \]

**Step 3**  
Interchange $y$ and $x$.  
\[ x = \frac{3}{4}y + 6 \]

**Step 4**  
Subtract 6 from each side.  
\[ \frac{3}{4}(x - 6) = y \]

Multiply each side by $\frac{4}{3}$.

The inverse of $f(x) = \frac{3}{4}x + 6$ is $f^{-1}(x) = \frac{3}{3}x - 6$ or $f^{-1}(x) = \frac{4}{3}x - 8$.

**Exercises**

Find the inverse of each function.

1. $f(x) = 4x - 3$  
   $f^{-1}(x) = \frac{x + 3}{4}$

2. $f(x) = -3x + 7$  
   $f^{-1}(x) = \frac{7 - x}{3}$

3. $f(x) = \frac{3}{4}x - 8$  
   $f^{-1}(x) = \frac{2}{3}x + \frac{16}{3}$

4. $f(x) = 16 - \frac{1}{3}x$  
   $f^{-1}(x) = -3x + 48$

5. $f(x) = 3x - 5$  
   $f^{-1}(x) = \frac{x}{3} + 5$

6. $f(x) = -15 - \frac{2}{3}x$  
   $f^{-1}(x) = -\frac{5}{2}x + 15$

7. **TOOLS** Jimmy rents a chainsaw from the department store to work on his yard. The total cost $C(x)$ in dollars is given by $C(x) = 9.99 + 3.00x$, where $x$ is the number of days he rents the chainsaw.

   a. Find the inverse function $C^{-1}(x)$.  
      \[ C^{-1}(x) = \frac{x - 9.99}{3} \]

   b. What do $x$ and $C^{-1}(x)$ represent in the context of the inverse function?

   x represents the total cost and $C^{-1}(x)$ represents the number of days of days he rents the chainsaw.

   c. How many days did Jimmy rent the chainsaw if the total cost was $27.99? 6 days

8.  

9.  

10.  

Find the inverse of each function.

11. $f(x) = 8x - 5$  
   $f^{-1}(x) = \frac{x + 5}{8}$

12. $f(x) = 6x + 7$  
   $f^{-1}(x) = \frac{x - 7}{6}$

13. $f(x) = \frac{3}{5}x + 9$  
   $f^{-1}(x) = \frac{5}{3}x - 9$

14. $f(x) = -16 + \frac{5}{3}x$  
   $f^{-1}(x) = \frac{3}{5}x - \frac{5}{3}$

15. $f(x) = \frac{3}{5}x + 4$  
   $f^{-1}(x) = \frac{x}{3} - \frac{1}{3}$

16. $f(x) = -\frac{4}{5}x + 1$  
   $f^{-1}(x) = \frac{5}{4}x - \frac{1}{5}$

17. **LEMONADE** Chrissy spent $5.00 on supplies and lemonade powder for her lemonade stand. She charges $0.50 per glass.  

   a. Write a function $P(x)$ to represent her profit per glass sold.  
      \[ P(x) = 0.50x - 5.00 \]

   b. Find the inverse function, $P^{-1}(x)$.  
      \[ P^{-1}(x) = \frac{x}{5} + 5.00 \]

   c. What do $x$ and $P^{-1}(x)$ represent in the context of the inverse function?  
      \[ x \] represents the total profit and $P^{-1}(x)$ represents the number of glasses sold.

   d. How many glasses must Chrissy sell in order to make a $3 profit? 16
4-7 Practice
Inverse Linear Functions

Find the inverse of each relation.

1. \((-2, 1), (-5, 0), (-8, -1), (-11, 2)\)
2. \((3, 5), (4, 8), (5, 11), (6, 14)\)
3. \((5, 11), (1, 6), (-3, 1), (-7, -4)\)
4. \((0, 3), (2, 3), (4, 3), (6, 3)\)

Graph the inverse of each function.

5. 
6. 
7. 

Find the inverse of each function.

8. \(f(x) = \frac{3}{2}x - 3\) 
9. \(f(x) = 4x + 2\) 
10. \(f(x) = \frac{3x - 1}{6}\)

\(f^{-1}(x) = \frac{5}{6}(x + 3)\) 
\(f^{-1}(x) = \frac{3x - 2}{4}\) 
\(f^{-1}(x) = \frac{6x + 1}{3}\)

11. \(f(x) = 3(3x + 4)\) 
12. \(f(x) = -5(x - 6)\) 
13. \(f(x) = \frac{3x + 6}{7}\)

\(f^{-1}(x) = \frac{x - 4}{3}\) 
\(f^{-1}(x) = \frac{x}{5} - 6\) 
\(f^{-1}(x) = \frac{7x + 3}{4}\)

Write the inverse of each equation in \(f^{-1}(x)\) notation.

13. \(4x + 6y = 24\) 
14. \(-3y + 5x = 18\) 
15. \(x + 5y = 12\)

\(f^{-1}(x) = \frac{24 - 6x}{4}\) 
\(f^{-1}(x) = \frac{3x + 18}{5}\) 
\(f^{-1}(x) = -5x + 12\)

16. \(5x + 8y = 40\) 
17. \(-4y - 3x = 15 + 2y\) 
18. \(2x - 3 = 4x + 5y\)

\(f^{-1}(x) = \frac{40 - 6x}{5}\) 
\(f^{-1}(x) = -2x - 5\) 
\(f^{-1}(x) = -\frac{5x - 3}{2}\)

19. CHARITY Jenny is running in a charity event. One donor is paying an initial amount of $20.00 plus an extra $5.00 for every mile that Jenny runs.

a. Write a function \(D(x)\) for the total donation for \(x\) miles run. \(D(x) = 5x + 20\)

b. Find the inverse function, \(D^{-1}(x)\). \(D^{-1}(x) = x - 20\)

c. What do \(x\) and \(D^{-1}(x)\) represent in the context of the inverse function? \(x\) represents the total donation and \(D^{-1}(x)\) represents the number of miles run.

4-7 Word Problem Practice
Inverse Linear Functions

1. BUSINESS Alisha started a baking business. She spent $36 initially on supplies and can make 5 dozen brownies at a cost of $12. She charges her customers $10 per dozen brownies.
   a. Write a function \(C(x)\) to represent Alisha’s total cost per dozen brownies. \(C(x) = 36 + 2.4x\)
   b. Write a function \(E(x)\) to represent Alisha’s earnings per dozen brownies sold. \(E(x) = 10x\)
   c. Find \(P(x) = E(x) - C(x)\). What does \(P(x)\) represent? \(P(x) = 76x - 36\); \(P(x)\) represents the profit that Alisha earns.
   d. Find \(C^{-1}(x), E^{-1}(x),\) and \(P^{-1}(x)\).
      \(C^{-1}(x) = \frac{x - 36}{2.4}\) 
      \(E^{-1}(x) = \frac{x}{10}\) 
      \(P^{-1}(x) = \frac{x + 36}{76}\)
   e. How many dozen brownies does Alisha need to sell in order to make a profit? \(x > 5\) or more

2. GEOMETRY The area of the base of a cylindrical water tank is 66 square feet. The volume of water in the tank is dependent on the height of the water \(h\) and is represented by the function \(V(h) = 66h\). Find \(x^{-1}(x)\). What will the height of the water be when the volume reaches 2310 cubic feet? \(x^{-1}(x) = \frac{2310}{66} - 35\) feet

3. SERVICE A technician is working on a furnace. He is paid $150 per hour plus $70 for every hour he works on the furnace.
   a. Write a function \(C(x)\) to represent the total charge for every hour of work. \(C(x) = 70x + 150\)
   b. Find the inverse function, \(C^{-1}(x)\).
      \(C^{-1}(x) = \frac{x - 150}{70}\)
   c. How long did the technician work on the furnace if the total charge was $640? 7 hours

4. FLOORING Kara is having baseboard installed in her basement. The total cost \(C(x)\) in dollars is given by \(C(x) = 125 + 16x\), where \(x\) is the number of pieces of wood required for the installation.
   a. Find the inverse function \(C^{-1}(x)\). \(C^{-1}(x) = \frac{x - 125}{16}\)
   b. If the total cost was $289 and each piece of wood was 12 feet long, how many total feet of wood were used? 108 feet

5. BOWLING Libby’s family went bowling during a holiday special. The special cost $40 for pizza, bowling shoes, and unlimited drinks. Each game cost $2.
   How many games did Libby bowl if the total cost was $112 and the six family members bowled an equal number of games? 6
In a function, there is exactly one output for every input. In other words, every element in the domain pairs with exactly one element in the range. When a function is one-to-one, each element of the domain pairs with exactly one unique element in the range. When a function is onto, each element of the range corresponds to an element in the domain.

If a function is both one-to-one and onto, then the inverse is also a function.

Determine whether each relation is a function. If it is a function, determine if it is one-to-one, onto, both, or neither.

1. neither
2. both
3. onto
4. onto
5. neither
6. one-to-one

Determine whether the inverse of each function is also a function.

7. no
8. no
9. yes
Chapter 4 Assessment Answer Key

Quiz 1 (Lessons 4-1 and 4-2)
Page 51

1. \( y = \frac{1}{4}x - 5 \)

2. \( y = -\frac{4}{11}x + \frac{58}{11} \)

3. Positive correlation; the older a person is, the higher the median income

4. About $36,000

5. C

Quiz 2 (Lessons 4-3 and 4-4)
Page 51

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

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

3. \( y + 1 = 0 \)

4. \( y = -\frac{1}{3}x + \frac{14}{3} \)

5. D

Quiz 3 (Lessons 4-5 and 4-6)
Page 52

1. \( y = 4.09x - 90.74 \)

2. \( y = 4.09x - 90.74 \)

3. About $36,000

4. D

Mid-Chapter Test
Page 53

1. A

2. H

3. B

4. J

5. D

6. H

7. \( t = 20h + 50 \)

8. Total Cost ($) vs. Hours

9. $130

10. 6.5 hours
1. perpendicular lines
2. inverse relation
3. scatter plot
4. parallel lines
5. correlation coefficient
6. linear interpolation
7. linear extrapolation
8. slope-intercept
9. point-slope
   Sample answer: A line of fit is a line that comes close to the data points for a scatter plot, even if all the data points do not lie on that line.
10. Sample answer: Linear extrapolation is the process of using a linear equation to predict a $y$-value for an $x$-value that lies beyond the extremes of the domain of the relation.
11. 
12. 
13. 
14. 
15. 
16. 
17. 
18. 
19. 
20. 

B: 7
### Chapter 4 Assessment Answer Key

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1. D
2. H
3. D
4. H
5. B
6. G
7. D
8. H
9. B
10. F
11. D
12. F
13. B
14. G
15. C
16. G
17. C
18. H
19. B
20. J

B: \[ \frac{17}{3} \]

12. F
13. B
14. F
15. C
16. J
17. D
18. J
19. B
20. H

B: \[ -21 \]
Chapter 4 Assessment Answer Key

Form 2C
Page 61

1. \[ y = 0.10x + 28.75 \]

2. \[ 5x + 7y = 14 \]

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

4. \[ y = \frac{3}{2}x - \frac{1}{2} \]

5. \[ x = -6 \]

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

7. \[ 12x + 7y = -16 \]

8. \[ y = 3x - 10 \]

9. \[ y = -2x + 1 \]

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

11. \[ y = 1.25x + 2508 \]

13. (Graph showing data points and line)

Sample answer: using data points (20, 67) and (40, 87), \( y = x + 47; 82 \)

14. No, because the maximum score is 100%, even for very large amounts of time studying.

15. (Graph showing line)

16. \[ y = 0.52x - 983.73 \]

17. \[ 30 \]

18. (Graph showing line)

19. \[ f^{-1}(x) = \frac{5 - 15x}{4} \]

20. \[ f^{-1}(x) = \frac{13 - 8x}{6} \]

B: \[ \ell = 1.2t + 1.8; 6 \text{ years} \]
1. \( y = 2.50x + 4.95 \)

2. \( x - y = 2 \)

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

4. \( y = 8.35x - 16,766.5 \)

5. \( y = -5x + 29 \)

6. \( x = 5 \)

7. \( y = \frac{4}{3}(x - 3) \)

8. \( 2x + 3y = -1 \)

9. \( y = \frac{3}{4}x - \frac{5}{4} \)

10. \( y = -3x + 18 \)

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

12. \( y = 6 \frac{1}{5}x - 6 \)

13. \( y = -0.035x + 7.15; \) about 4.9

14. No, younger people are likely to spend a significant percentage on entertainment because of a lack of other expenses.

15. \( y = 0.25x - 467.83 \)

16. Sample answer: using data points (30, 6.1) and (70, 4.7), \( y = -0.035x + 7.15; \) about 4.9

17. \( f^{-1}(x) = \frac{8 - 18x}{3} \)

18. \( f^{-1}(x) = \frac{28 + 3x}{5} \)
1. \( y = 3x - 8 \)
2. \( y = \frac{5}{2}x - 11 \)
3. \( y = -\frac{3}{5}x + \frac{26}{5} \)
4. \( y = 6 \)
5. \( y - 1 = -\frac{3}{5}(x - 2) \)
6. \( 2x + y = 1 \)
7. \( y = -\frac{2}{3}x \)
8. \( 2x + 3y = 6 \)
9. \( y + 2 = -\frac{2}{3}x \)
10. \( x = 3 \)
11. \( y = -\frac{4}{3}x - 9 \)
12. \( y = \frac{3}{5}x - 6 \)
13. \( y = 5 \)

14. \( y = -2.67x + 45.17; \) about 24 seats

15. Positive; a verbal score is closely associated with the math score.

16. \( y = \frac{12 - 8x}{15} \)

17. \( f^{-1}(x) = \frac{13 + 3x}{2} \)

18. \( \)
## Chapter 4 Assessment Answer Key

**Page 67, Extended-Response Test**

### Scoring Rubric

<table>
<thead>
<tr>
<th>Score</th>
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| 4     | **Superior**  
A correct solution that is supported by well-developed, accurate explanations | • Shows thorough understanding of the concepts of slope, various forms of a linear equation, graphing lines from an equation, scatter plots, correlation, and predicting data.  
• Uses appropriate strategies to solve problems.  
• Computations are correct.  
• Written explanations are exemplary.  
• Graphs are accurate and appropriate.  
• Goes beyond requirements of some or all problems. |
| 3     | **Satisfactory**  
A generally correct solution, but may contain minor flaws in reasoning or computation | • Shows an understanding of the concepts of slope, various forms of a linear equation, graphing lines from an equation, scatter plots, correlation, and predicting data.  
• Uses appropriate strategies to solve problems.  
• Computations are mostly correct.  
• Written explanations are effective.  
• Graphs are mostly accurate and appropriate.  
• Satisfies all requirements of problems. |
| 2     | **Nearly Satisfactory**  
A partially correct interpretation and/or solution to the problem | • Shows an understanding of most of the concepts of slope, various forms of a linear equation, graphing lines from an equation, scatter plots, correlation, and predicting data.  
• May not use appropriate strategies to solve problems.  
• Computations are mostly correct.  
• Written explanations are satisfactory.  
• Graphs are mostly accurate.  
• Satisfies the requirements of most of the problems. |
| 1     | **Nearly Unsatisfactory**  
A correct solution with no supporting evidence or explanation | • Final computation is correct.  
• No written explanations or work is shown to substantiate the final computation.  
• Graphs may be accurate but lack detail or explanation.  
• Satisfies minimal requirements of some of the problems. |
| 0     | **Unsatisfactory**  
An incorrect solution indicating no mathematical understanding of the concept or task, or no solution is given | • Shows little or no understanding of most of the concepts of slope, various forms of a linear equation, graphing lines from an equation, scatter plots, correlation, and predicting data.  
• Does not use appropriate strategies to solve problems.  
• Computations are incorrect.  
• Written explanations are unsatisfactory.  
• Graphs are inaccurate or inappropriate.  
• Does not satisfy requirements of problems.  
• No answer may be given. |
Chapter 4 Assessment Answer Key

Page 67, Extended-Response Test
Sample Answers

In addition to the scoring rubric found on page A31, the following sample answers may be used as guidance in evaluating extended-response assessment items.

1a. In order to graph the line through \((-2, 3)\) you need to know the slope of the line, another point on the line, or the equation of the line.

1b. If you knew the slope of the line, you could plot another point using the rise and run on a coordinate plane. If you knew another point, you could graph that point and draw a line through \((-2, 3)\) and the other point. If you knew the equation of the line, you could use the slope-intercept form of the equation to find the slope and intercept for graphing or you could use the equation and substitution to find another point on the line.

2a. The points have a strong negative correlation. This means that as \(x\) increases, \(y\) decreases.

2b. One example is the longer a candle burns, the shorter it gets. Another is the longer you run a car, the less gasoline is left in the tank.

2c. See students’ work.

3a. See students’ work.

3b. While students’ knowledge from other experiences may lead them to that conclusion, there may be other factors that contribute to increased longevity. The information on the graph only leads us to claim that life expectancy is increasing.

3c. A regression equation calculated by a graphing calculator would yield a prediction of 78.9 years. However, students may look at the era since 1980 and notice that each 5-year period is about 0.3 year less than the previous 5-year period increase. This pattern would yield a prediction of about 75.9 years.
Chapter 4 Assessment Answer Key

Standardized Test Practice
Page 68

1. ○ ○ ○ ○

2. ● ● ● ●

3. ● ● ● ●

4. ○ ● ● ●

5. ● ● ● ●

6. ○ ○ ● ●

7. ○ ○ ● ●

8. ○ ○ ● ●

9. ○ ○ ● ●

10. ○ ○ ● ●

Page 69

11. ○ ● ○ ○

12. ○ ○ ● ○

13. ○ ● ○ ○

14. ○ ○ ○ ●

15. ☐ ☐ ☐ ☐

16. ☐ ☐ ☐ ☐
Chapter 4 Assessment Answer Key

Standardized Test Practice
Page 70

17. \(2r^2t^2\)

18. 0

19. -18

20. 21

21. 32

22. 16

23. -30y

24. -2a + 3b

25. -8

26. \(\frac{8}{9}\)

27. -7

28. \{-7.5, -6.5, -6, -5, -3.5\}

Yes; exactly one member of the range is paired with each member of the domain.

29. 

30. \(y = \frac{3}{2}x + 2\)

31. \(\frac{5}{7}\)

32. \(y = -3x + 12\)

33. \(x = -6\)

34a. $2 per year

34b. $21.50