Chapter Vocabulary

- absolute value function (p. 342)
- direct variation (p. 299)
- extrapolation (p. 334)
- interpolation (p. 334)
- linear equation (p. 306)
- line of best fit (p. 336)
- negative correlation (p. 333)
- no correlation (p. 333)
- opposite reciprocals (p. 328)
- parallel lines (p. 327)
- perpendicular lines (p. 328)
- point-slope form (p. 313)
- positive correlation (p. 333)
- rate of change (p. 292)
- scatter plot (p. 333)
- slope (p. 293)
- slope-intercept form (p. 306)
- standard form of a linear equation (p. 320)
- trend line (p. 334)
- x-intercept (p. 320)
- y-intercept (p. 306)

Choose the vocabulary term that correctly completes the sentence.

1. Estimating a value between two known values in a data set is called __?__.

2. The slope of a line models the __?__ of a function.

3. The form of a linear equation that shows the slope and one point is the __?__.

4. Two lines are perpendicular when their slopes are __?__.

5. The line that most accurately models data in a scatter plot is the __?__.

5-1 Rate of Change and Slope

Quick Review

Rate of change shows the relationship between two changing quantities. The **slope** of a line is the ratio of the vertical change (the rise) to the horizontal change (the run).

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$

The slope of a horizontal line is 0, and the slope of a vertical line is undefined.

Example

What is the slope of the line that passes through the points $(1, 12)$ and $(6, 22)$?
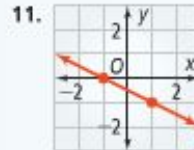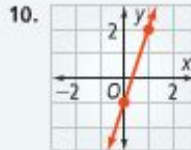
$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{22 - 12}{6 - 1} = \frac{10}{5} = 2$$

Exercises

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

6. $(2, 2), (3, 1)$ **7.** $(4, 2), (0, 2)$

8. $(-1, 2), (0, 5)$ **9.** $(-3, -2), (-3, 2)$

Find the slope of each line.

10.

11.

5-2 Direct Variation

Quick Review

A function represents a **direct variation** if it has the form $y = kx$, where $k \neq 0$. The coefficient k is the **constant of variation**.

Example

Suppose y varies directly with x, and $y = 15$ when $x = 5$. Write a direct variation equation that relates x and y. What is the value of y when $x = 9$?

$y = kx$	Start with the general form of a direct variation.
$15 = k(5)$	Substitute 5 for x and 15 for y.
$3 = k$	Divide each side by 5 to solve for k.
$y = 3x$	Write an equation. Substitute 3 for k in $y = kx$.

The equation $y = 3x$ relates x and y. When $x = 9$, $y = 3(9)$, or 27.

Exercises

Suppose y varies directly with x. Write a direct variation equation that relates x and y. Then find the value of y when $x = 7$.

12. $y = 8$ when $x = -4$.   **13.** $y = 15$ when $x = 6$.

14. $y = 3$ when $x = 9$.   **15.** $y = -4$ when $x = 4$.

For the data in each table, tell whether y varies directly with x. If it does, write an equation for the direct variation.

16.

x	y
−1	−6
2	3
5	12
9	24

17.

x	y
−3	7.5
−1	2.5
2	−5
5	−12.5

5-3, 5-4, and 5-5 Forms of Linear Equations

Quick Review

The graph of a linear equation is a line. You can write a linear equation in different forms.

The **slope-intercept form** of a linear equation is $y = mx + b$, where m is the slope and b is the **y-intercept.**

The **point-slope form** of a linear equation is $y - y_1 = m(x - x_1)$, where m is the slope and (x_1, y_1) is a point on the line.

The **standard form** of a linear equation is $Ax + By = C$, where A, B, and C are real numbers, and A and B are not both zero.

Example

What is an equation of the line that has slope -4 and passes through the point $(-1, 7)$?

$y - y_1 = m(x - x_1)$	Use point-slope form.
$y - 7 = -4(x - (-1))$	Substitute $(-1, 7)$ for (x_1, y_1) and -4 for m.
$y - 7 = -4(x + 1)$	Simplify inside grouping symbols.

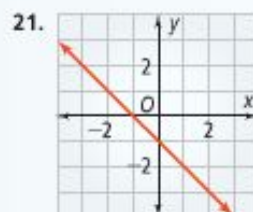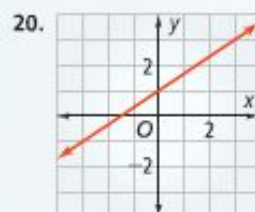An equation of the line is $y - 7 = -4(x + 1)$.

Exercises

Write an equation in slope-intercept form of the line that passes through the given points.

18. $(-3, 4), (1, 4)$ **19.** $(3, -2), (6, 1)$

Write an equation of each line.

20.

21.

Graph each equation.

22. $y = 4x - 3$ **23.** $y = 2$

24. $y + 3 = 2(x - 1)$ **25.** $x + 4y = 10$

5-6 Parallel and Perpendicular Lines

Quick Review

Parallel lines are lines in the same plane that never intersect. Two lines are **perpendicular** if they intersect to form right angles.

Example

Are the graphs of $y = \frac{4}{3}x + 5$ and $y = -\frac{3}{4}x + 2$ parallel, perpendicular, or neither? Explain.

The slope of the graph of $y = \frac{4}{3}x + 5$ is $\frac{4}{3}$.

The slope of the graph of $y = -\frac{3}{4}x + 2$ is $-\frac{3}{4}$.

$$\frac{4}{3}\left(-\frac{3}{4}\right) = -1$$

The slopes are opposite reciprocals, so the graphs are perpendicular.

Exercises

Write an equation of the line that passes through the given point and is parallel to the graph of the given equation.

26. $(2, -1); y = 5x - 2$ **27.** $(0, -5); y = 9x$

Determine whether the graphs of the two equations are parallel, perpendicular, or neither. Explain.

28. $y = 6x + 2$ **29.** $2x - 5y = 0$

$\quad\;\; 18x - 3y = 15$ $\quad\;\; y + 3 = \frac{5}{2}x$

Write an equation of the line that passes through the given point and is perpendicular to the graph of the given equation.

30. $(3, 5); y = -3x + 7$ **31.** $(4, 10); y = 8x - 1$

5-7 Scatter Plots and Trend Lines

Quick Review

A **scatter plot** displays two sets of data as ordered pairs. A **trend line** for a scatter plot shows the correlation between the two sets of data. The most accurate trend line is the **line of best fit**. To estimate or predict values on a scatter plot, you can use **interpolation** or **extrapolation**.

Example

Estimate the length of the kudzu vine in Week 3.

Kudzu Vine Growth

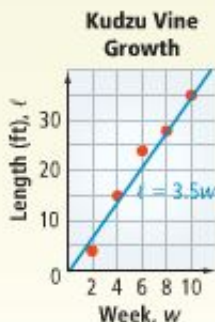When $w = 3$, $\ell \approx 10$. So in Week 3, the length of the kudzu vine was about 10 ft.

Predict the length of the kudzu vine in Week 11.

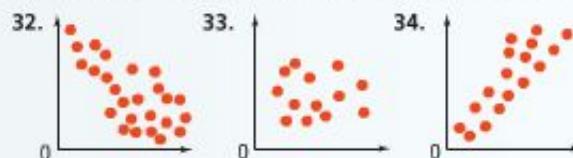| $\ell = 3.5w$ | Use the equation of the trend line. |
| $\ell = 3.5(11)$ | Substitute 11 for w. |
| $\ell = 38.5$ | Simplify. |

The length of the vine in Week 11 will be about 38.5 ft.

Exercises

Describe the type of correlation the scatter plot shows.

32.   33.   34.

35. a. Make a scatter plot of the data below.

Heights and Arm Spans						
Height (m)	1.5	1.8	1.7	2.0	1.7	2.1
Arm Span (m)	1.4	1.7	1.7	1.9	1.6	2.0

b. Write an equation of a reasonable trend line or use a graphing calculator to find the equation of the line of best fit.

c. Estimate the arm span of someone who is 1.6 m tall.

d. Predict the arm span of someone who is 2.2 m tall.

5-8 Graphing Absolute Value Functions
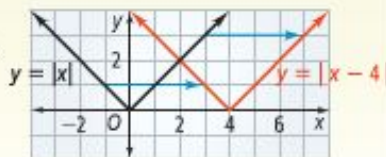
Quick Review

The graph of an **absolute value function** is a V-shaped graph that opens upward or downward.

A **translation** shifts a graph either vertically, horizontally, or both. To graph an absolute value function, you can translate $y = |x|$.

Example

Graph the absolute value function $y = |x - 4|$.

Start with the graph of $y = |x|$. Translate the graph right 4 units.

Exercises

Graph each function by translating $y = |x|$.

36. $y = |x| + 2$ **37.** $y = |x| - 7$

38. $y = |x + 3|$ **39.** $y = |x - 5|$

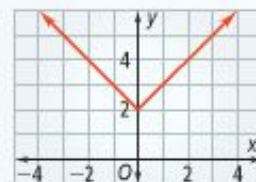Write an equation for each translation of $y = |x|$.

40. 5.5 units down   **41.** 11 units left

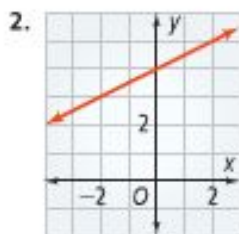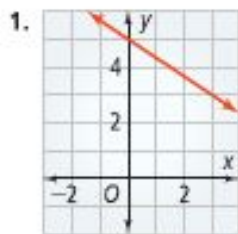**42.** 13 units up   **43.** 6.5 units right

44. Write an equation for the absolute value function at the right.

Practice Test

Do you know HOW?

Write an equation in slope-intercept form of each line.

1.

2.

Write an equation in point-slope form of the line through the given point and with the given slope.

3. $(5, 1)$; $m = \frac{1}{3}$

4. $(-2, 3)$; $m = -2$

Write each equation in standard form using integers.

5. $y = \frac{3}{4}x + 5$

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

Graph each equation.

7. $y = 4x - 3$

8. $y = 7$

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

10. $-3x + 5y = 15$

Determine whether each equation represents a direct variation. If it does, find the constant of variation.

11. $2x + 3y = 0$

12. $4x + 6y = 3$

Graph each function.

13. $y = |x - 4|$

14. $y = |x| + 3$

15. Pet Grooming You start a pet grooming service. You spend $30 on supplies. You plan to charge $5 to groom each pet.
   a. Write an equation to relate your profit y to the number of pets x you groom.
   b. Graph the equation. What are the x- and y-intercepts?

16. Make a scatter plot and draw a trend line for the data in the table. Interpolate or extrapolate to estimate the number of inventors applying for patents in 2006 and in 2015.

Number of Inventors Applying for Patents

Year	Inventors
1999	22,052
2001	20,588
2003	18,462
2005	14,039
2007	13,748

Source: U.S. Patent Office

17. What is an equation of the line parallel to $y = -x + 1$ and through $(4, 4)$?

18. What is an equation of the line perpendicular to $y = -x - 2$ and through $(-2, 4)$?

Do you UNDERSTAND?

19. Writing How are lines of best fit and other trend lines used with scatter plots?

20. Open-Ended Write an equation whose graph is parallel to the graph of $y = 0.5x - 10$.

21. Compare and Contrast Is an equation that represents a direct variation a type of linear equation? Explain.

22. Vocabulary What does it mean when a line of best fit has a correlation coefficient close to 1?

23. Reasoning How many lines can you draw that are parallel to the line and through the point shown at the right? Explain.