Solutions for Intermediate Algebra 13th Edition by Bittinger

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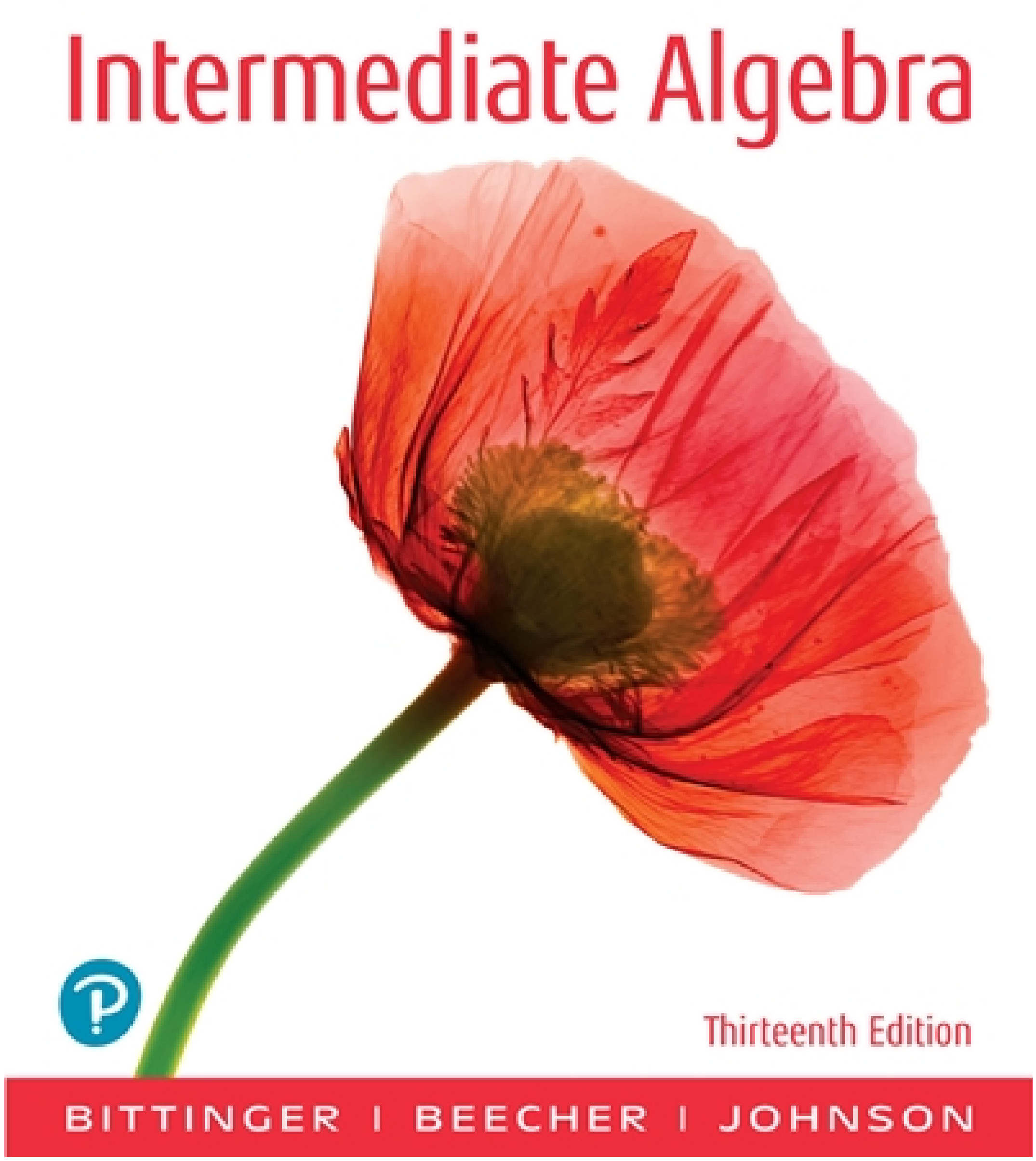

Solutions

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Chapter 2

Graphs, Functions, and Applications

Exercise Set 2.1

RC2. False

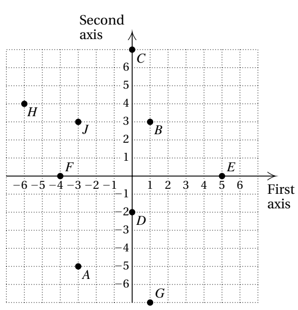
RC4. True

RC6. False

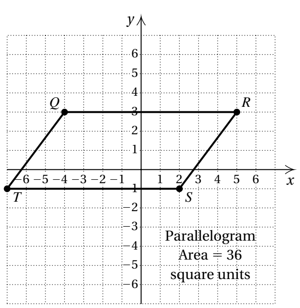
CC2.
$$\begin{aligned} 4y - 3x &= 0 \\ 4y &= 3x \\ y &= \frac{3}{4}x \end{aligned}$$
The answer is (b).

CC4.
$$\begin{aligned} 3y + 4x &= -12 \\ 3y &= -4x - 12 \\ y &= -\frac{4}{3}x - 4 \end{aligned}$$
The answer is (c).

2.



4.



Parallelogram

$A = bh = 9 \cdot 4 = 36$ square units

6.
$$\begin{array}{c|l} \multicolumn{2}{c}{t = 4 - 3s} \\ \hline 4 \;?\; & 4 - 3 \cdot 3 \\ & 4 - 9 \\ & -5 \qquad \text{FALSE} \end{array}$$

Since $4 = -5$ is false, $(3, 4)$ is not a solution of $t = 4 - 3s$.

8.
$$\begin{array}{r|l} \multicolumn{2}{c}{4r + 3s = 5} \\ \hline 4 \cdot 2 + 3 \cdot (-1) & ?\; 5 \\ 8 - 3 & \\ 5 & \end{array}$$
Substituting 2 for r and -1 for s (alphabetical order of variables)

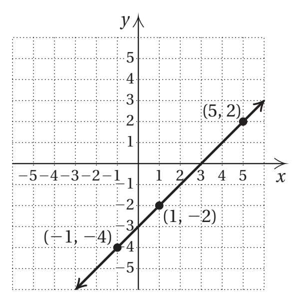
Since $5 = 5$ is true, $(2, -1)$ is a solution of $4r + 3s = 5$.

10.
$$\begin{array}{r|l} \multicolumn{2}{c}{2p - 3q = -13} \\ \hline 2(-5) - 3 \cdot 1 & ?\; -13 \\ -10 - 3 & \\ -13 & \end{array}$$
Substituting -5 for p and 1 for q

Since $-13 = -13$ is true, $(-5, 1)$ is a solution of $2p - 3q = -13$.

12.
$$\begin{array}{c|l} \multicolumn{2}{c}{y = x - 3} \\ \hline 2 \;?\; & 5 - 3 \\ & 2 \qquad \text{TRUE} \end{array} \qquad \begin{array}{c|l} \multicolumn{2}{c}{y = x - 3} \\ \hline -4 \;?\; & -1 - 3 \\ & -4 \qquad \text{TRUE} \end{array}$$

Plot the points $(5, 2)$ and $(-1, -4)$ and draw the line through them.

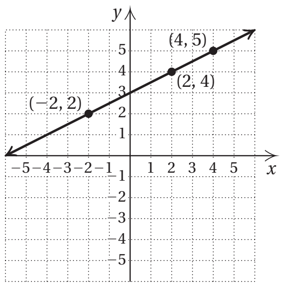


The line appears to pass through $(0, -3)$ as well. We check to see if $(0, -3)$ is a solution of $y = x - 3$.
$$\begin{array}{c|l} \multicolumn{2}{c}{y = x - 3} \\ \hline -3 \;?\; & 0 - 3 \\ & -3 \qquad \text{TRUE} \end{array}$$

$(0, -3)$ is a solution. Other correct answers include $(-3, -6)$, $(-2, -5)$, $(1, -2)$, $(2, -1)$, $(3, 0)$, and $(4, 1)$.

14.
$$\begin{array}{c|l} \multicolumn{2}{c}{y = \frac{1}{2}x + 3} \\ \hline 5 \;?\; & \frac{1}{2} \cdot 4 + 3 \\ & 2 + 3 \\ & 5 \qquad \text{TRUE} \end{array} \qquad \begin{array}{c|l} \multicolumn{2}{c}{y = \frac{1}{2}x + 3} \\ \hline 2 \;?\; & \frac{1}{2}(-2) + 3 \\ & -1 + 3 \\ & 2 \qquad \text{TRUE} \end{array}$$

Plot the points $(4, 5)$ and $(-2, 2)$ and draw the line through them.



The line appears to pass through $(2, 4)$ as well. We check to see if $(2, 4)$ is a solution of $y = \frac{1}{2}x + 3$.

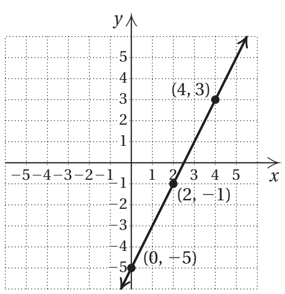
$$\begin{array}{c|l} y = \frac{1}{2}x + 3 & \\ \hline 4 \ ? & \frac{1}{2} \cdot 2 + 3 \\ & 1 + 3 \\ & 4 \qquad \text{TRUE} \end{array}$$

$(2, 4)$ is a solution. Other correct answers include $(-6, 0)$, $(-4, 1)$, $(0, 3)$, and $(6, 6)$.

16.

$$\begin{array}{r|l} 4x - 2y = 10 & \\ \hline 4 \cdot 0 - 2(-5) \ ? & 10 \\ 0 + 10 & \\ 10 & \quad \text{TRUE} \end{array} \qquad \begin{array}{r|l} 4x - 2y = 10 & \\ \hline 4 \cdot 4 - 2 \cdot 3 \ ? & 10 \\ 16 - 6 & \\ 10 & \quad \text{TRUE} \end{array}$$

Plot the points $(0, -5)$ and $(4, 3)$ and draw the line through them.



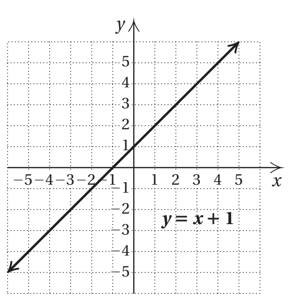
The line appears to pass through $(5, 5)$ as well. We check to see if $(5, 5)$ is a solution of $4x - 2y = 10$.

$$\begin{array}{r|l} 4x - 2y = 10 & \\ \hline 4 \cdot 5 - 2 \cdot 5 \ ? & 10 \\ 20 - 10 & \\ 10 & \quad \text{TRUE} \end{array}$$

$(5, 5)$ is a solution. Other correct answers include $(1, -3)$, $(2, -1)$, and $(3, 1)$.

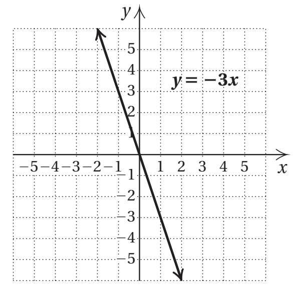
18.

x	y
-2	-1
-1	0
0	1
1	2
2	3
3	4



20.

x	y
-2	6
-1	3
0	0
1	-3
2	-6
3	-9



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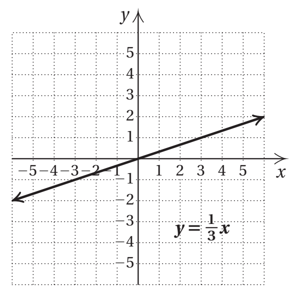

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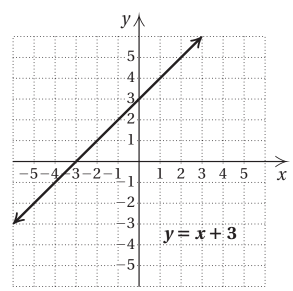

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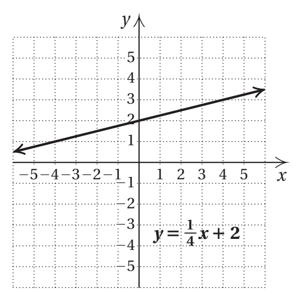

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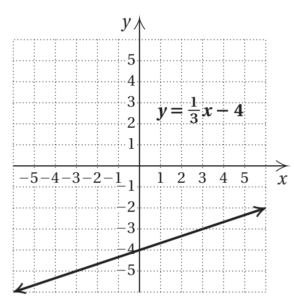

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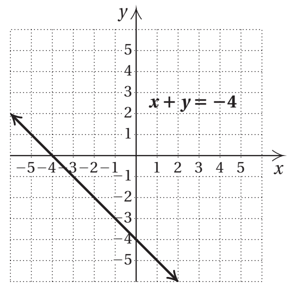

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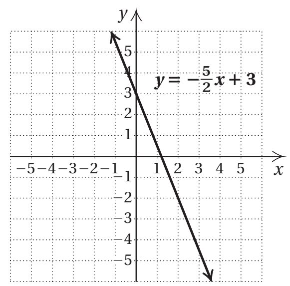

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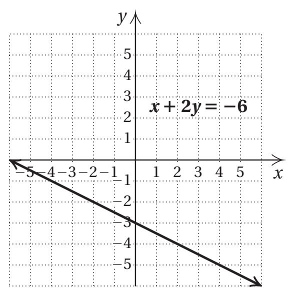

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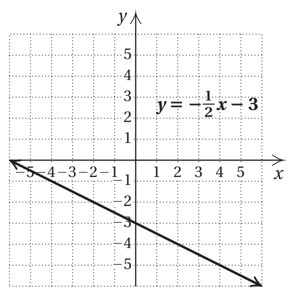

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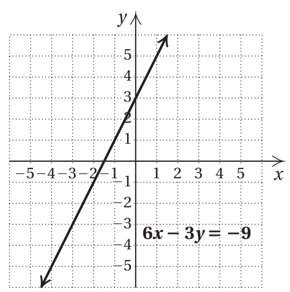

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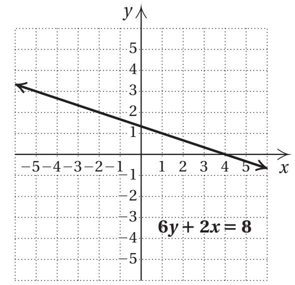
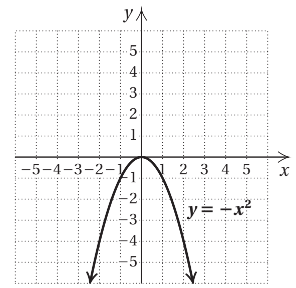


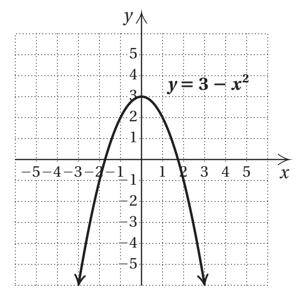
42.

x	y
-2	-4
-1	-1
0	0
1	-1
2	-4



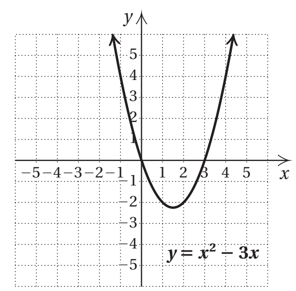
44.

x	y
-3	-6
-2	-1
-1	2
0	3
1	2
2	-1



46.

x	y
-1	4
0	0
1	-2
2	-2
3	0
4	4



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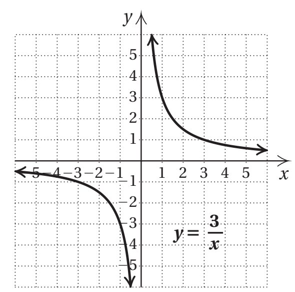

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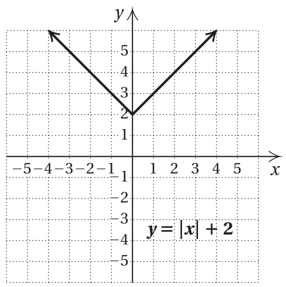

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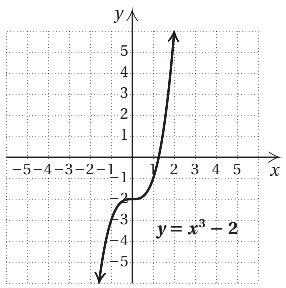


54.

$$2x - 5 \geq -10 \quad or \quad -4x - 2 < 10$$
$$2x \geq -5 \quad or \quad -4x < 12$$
$$x \geq -\frac{5}{2} \quad or \quad x > -3$$

The solution set is $\{x|x > -3\}$, or $(-3, \infty)$.

56.

$$-13 < 3x + 5 < 23$$
$$-18 < 3x < 18$$
$$-6 < x < 6$$

The solution set is $\{x| -6 < x < 6\}$, or $(-6, 6)$.

58. Let h = the height of the triangle, in feet.

Solve: $\frac{1}{2} \cdot 16 \cdot h = 200$

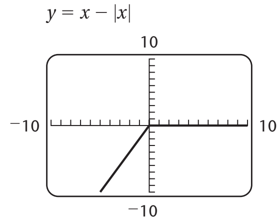
$h = 25$ ft

60. Let x = the selling price of the house. Then $x - 100,000$ = the amount that exceeds \$100,000.

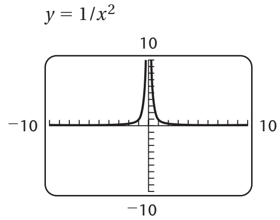
Solve:

$$0.07(100,000) + 0.04(x - 100,000) = 16,200$$
$$x = \$330,000$$

62.



64.



66. Each y-coordinate is 3 times the corresponding x-coordinate, so the equation is $y = 3x$.

68. Each y-coordinate is 5 less the square of the corresponding x-coordinate, so the equation is $y = 5 - x^2$.

Exercise Set 2.2

RC2. A relation is a correspondence between a first set, called the domain, and a second set, called the range, such that each member of the domain corresponds to at least one member of the range.

CC2. $f(0) = 3$

CC4. $f(3) = 0$

2. Yes; each member of the domain is matched to only one member of the range.

4. No; a member of the domain (6) is matched to more than one member of the range.

6. Yes; each member of the domain is matched to only one member of the range.

8. Yes; each member of the domain is matched to only one member of the range.

10. This correspondence is a function, since each person in a family has only one height, in inches.

12. This correspondence is not a function, since each state has two senators.

14.
a) $g(0) = 0 - 6 = -6$
b) $g(6) = 6 - 6 = 0$
c) $g(13) = 13 - 6 = 7$
d) $g(-1) = -1 - 6 = -7$
e) $g(-1.08) = -1.08 - 6 = -7.08$
f) $g\left(\frac{7}{8}\right) = \frac{7}{8} - 6 = -5\frac{1}{8}$

16.
a) $f(6) = -4 \cdot 6 = -24$
b) $f\left(-\frac{1}{2}\right) = -4\left(-\frac{1}{2}\right) = 2$
c) $f(0) = -4 \cdot 0 = 0$
d) $f(-1) = -4(-1) = 4$
e) $f(3a) = -4 \cdot 3a = -12a$
f) $f(a - 1) = -4(a - 1) = -4a + 4$

18.
a) $h(4) = 19$
b) $h(-6) = 19$
c) $h(12) = 19$
d) $h(0) = 19$
e) $h\left(\frac{2}{3}\right) = 19$
f) $h(a + 3) = 19$

20. a) $f(0) = 3 \cdot 0^2 - 2 \cdot 0 + 1 = 1$

b) $f(1) = 3 \cdot 1^2 - 2 \cdot 1 + 1 = 3 - 2 + 1 = 2$

c) $f(-1) = 3(-1)^2 - 2(-1) + 1 = 3 + 2 + 1 = 6$

d) $f(10) = 3 \cdot 10^2 - 2 \cdot 10 + 1 = 300 - 20 + 1 = 281$

e) $f(-3) = 3(-3)^2 - 2(-3) + 1 = 27 + 6 + 1 = 34$

f) $f(2a) = 3(2a)^2 - 2(2a) + 1 = 3 \cdot 4a^2 - 4a + 1 = 12a^2 - 4a + 1$

22. a) $g(4) = |4 - 1| = |3| = 3$

b) $g(-2) = |-2 - 1| = |-3| = 3$

c) $g(-1) = |-1 - 1| = |-2| = 2$

d) $g(100) = |100 - 1| = |99| = 99$

e) $g(5a) = |5a - 1|$

f) $g(a + 1) = |a + 1 - 1| = |a|$

24. a) $f(1) = 1^4 - 3 = 1 - 3 = -2$

b) $f(-1) = (-1)^4 - 3 = 1 - 3 = -2$

c) $f(0) = 0^4 - 3 = 0 - 3 = -3$

d) $f(2) = 2^4 - 3 = 16 - 3 = 13$

e) $f(-2) = (-2)^4 - 3 = 16 - 3 = 13$

f) $f(-a) = (-a)^4 - 3 = a^4 - 3$

26. In 2011, $x = 2011 - 2009 = 2$.

$T(2) = 3.72(2) + 55.54 \approx 63$ million visitors

In 2014, $x = 2014 - 2009 = 5$.

$T(5) = 3.72(5) + 55.54 \approx 74$ million visitors

28. $T(5) = 10 \cdot 5 + 20 = 50 + 20 = 70°\text{C}$

$T(20) = 10 \cdot 20 + 20 = 200 + 20 = 220°\text{C}$

$T(1000) = 10 \cdot 1000 + 20 = 10{,}000 + 20 = 10{,}020°\text{C}$

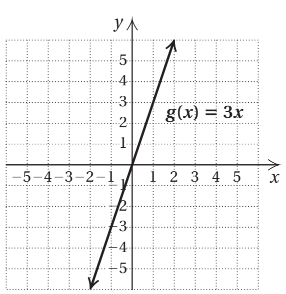
30. $C(62) = \frac{5}{9}(62 - 32) = \frac{5}{9} \cdot 30 = \frac{50}{3} = 16\frac{2}{3}°\text{C}$

$C(77) = \frac{5}{9}(77 - 32) = \frac{5}{9} \cdot 45 = 25°\text{C}$

$C(23) = \frac{5}{9}(23 - 32) = \frac{5}{9}(-9) = -5°\text{C}$

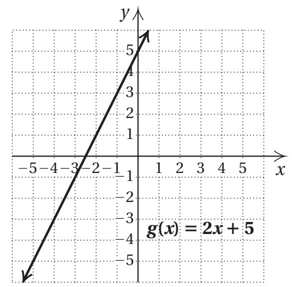
32.

x	$g(x)$
-1	-3
0	0
1	3
2	6



34.

x	$g(x)$
-3	-1
-2	1
-1	3
0	5



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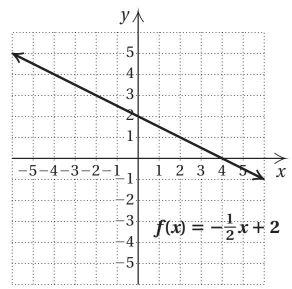

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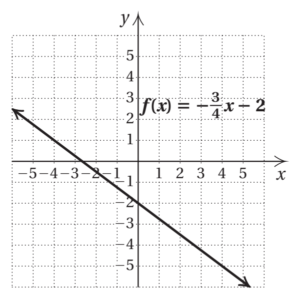
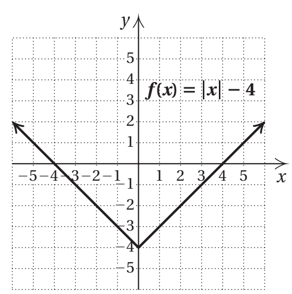


40.

x	$f(x)$
-3	-1
-2	-2
-1	-3
0	-4
1	-3
2	-2
3	-1



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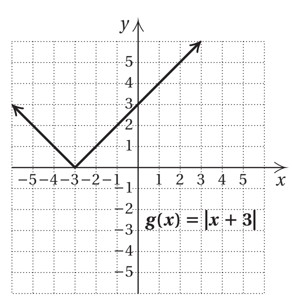
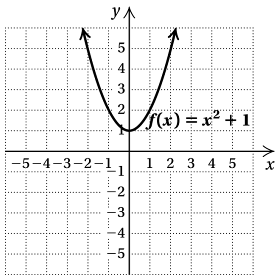


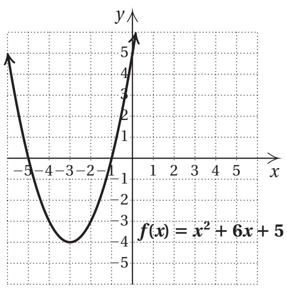
44.

x	$f(x)$
-2	5
-1	2
0	1
1	2
2	5



46.

x	y
-5	0
-4	-3
-3	-4
-2	-3
-1	0
0	5
1	12



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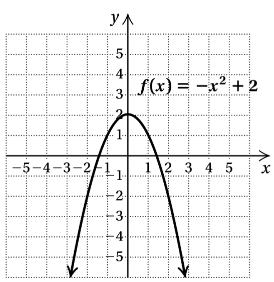
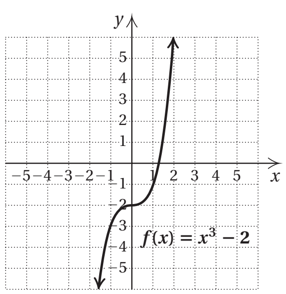


50.

x	$f(x)$
-2	-10
-1	-3
0	-2
1	-1
2	6



52. No; it fails the vertical line test.

54. Yes; it passes the vertical line test.

56. Yes; it passes the vertical line test.

58. No; it fails the vertical line test.

60. About \$175,000

62. About 820 million passengers

64. About 730 million passengers

66. $\frac{2}{3}(4x-2) \geq 60$

$4x - 2 \geq 90$

$4x \geq 92$

$x \geq 23$

$\{x|x \geq 23\}$, or $[23, \infty)$

68. $6x - 31 = 11 + 6(x-7)$

$6x - 31 = 11 + 6x - 42$

$6x - 31 = 6x - 31$

$-31 = -31$

We get a true equation, so all real numbers are solutions.

70. $\frac{1}{16}x + 4 = \frac{5}{8}x - 1$

$5 = \frac{9}{16}x$

$\frac{80}{9} = x$

72. $x + 5 = 3$ when $x = -2$. Find $h(-2)$.

$h(-2) = (-2)^2 - 4 = 4 - 4 = 0$

74. $g(-1) = 2(-1) + 5 = 3$, so $f(g(-1)) = f(3) = 3 \cdot 3^2 - 1 = 26$.

$f(-1) = 3(-1)^2 - 1 = 2$, so $g(f(-1)) = g(2) = 2 \cdot 2 + 5 = 9$.

Exercise Set 2.3

RC2. $5 - x = 0$ for $x = 5$, so the domain is $\{x|x$ is a real number *and* $x \neq 5\}$. The answer is (b).

RC4. $|x - 5| = 0$ for $x = 5$, so the domain is $\{x|x$ is a real number *and* $x \neq 5\}$. The answer is (b).

RC6. $x + 5 = 0$ for $x = -5$, so the domain is $\{x|x$ is a real number *and* $x = -5\}$. The answer is (d).

2. a) $f(1) = 1$

b) The set of all x-values in the graph is $\{-3, -1, 1, 3, 5\}$.

c) The only point whose second coordinate is 2 is $(3, 2)$, so the x-value for which $f(x) = 2$ is 3.

d) The set of all y-values in the graph is $\{-1, 0, 1, 2, 3\}$.

4. a) $f(1) = -2$

b) The set of all x-values in the graph is $\{x| -4 \leq x \leq 2\}$, or $[-4, 2]$.

c) The only point whose second coordinate is 2 is about $(-2, 2)$, so the x-value for which $f(x) = 2$ is about -2.

d) The set of all y-values in the graph is $\{y| -3 \leq y \leq 3\}$, or $[-3, 3]$.

6. a) $f(1) = -1$

b) No endpoints are indicated and we see that the graph extends indefinitely both horizontally and vertically, so the domain is the set of all real numbers.

c) The only point whose second coordinate is 2 is $(-2, 2)$, so the x-value for which $f(x) = 2$ is -2.

d) The range is the set of all real numbers. (See part (b) above.)

8. a) $f(1) = 3$

b) No endpoints are indicated and we see that the graph extends indefinitely horizontally, so the domain is the set of all real numbers.

c) There are two points for which the second coordinate is 2. They are about $(-1.4, 2)$ and $(1.4, 2)$, so the x-values for which $f(x) = 2$ are about -1.4 and 1.4.

d) The largest y-value is 4. No endpoints are indicated and we see that the graph extends downward indefinitely from $(0, 4)$, so the range is $\{y|y \le 4\}$, or $(-\infty, 4]$.

10. $f(x) = \dfrac{7}{5-x}$

Solve: $5 - x = 0$

$x = 5$

The domain is $\{x|x$ is a real number *and* $x \ne 5\}$, or $(-\infty, 5) \cup (5, \infty)$.

12. $f(x) = 4 - 5x$

We can calculate $4 - 5x$ for any value of x, so the domain is the set of all real numbers.

14. $f(x) = x^2 - 2x + 3$

We can calculate $x^2 - 2x + 3$ for any value of x, so the domain is the set of all real numbers.

16. $f(x) = \dfrac{x-2}{3x+4}$

Solve: $3x + 4 = 0$

$x = -\dfrac{4}{3}$

The domain is $\left\{x|x \text{ is a real number } \textit{and } x \ne -\dfrac{4}{3}\right\}$, or $\left(-\infty, -\dfrac{4}{3}\right) \cup \left(-\dfrac{4}{3}, \infty\right)$.

18. $f(x) = |x - 4|$

We can calculate $|x - 4|$ for any value of x, so the domain is the set of all real numbers.

20. $f(x) = \dfrac{4}{|2x-3|}$

Solve: $|2x - 3| = 0$

$x = \dfrac{3}{2}$

The domain is $\left\{x|x \text{ is a real number } \textit{and } x \ne \dfrac{3}{2}\right\}$, or $\left(-\infty, \dfrac{3}{2}\right) \cup \left(\dfrac{3}{2}, \infty\right)$.

22. $g(x) = \dfrac{-11}{4+x}$

Solve: $4 + x = 0$

$x = -4$

The domain is $\{x|x$ is a real number *and* $x \ne -4\}$, or $(-\infty, -4) \cup (-4, \infty)$.

24. $g(x) = 8 - x^2$

We can calculate $8 - x^2$ for any value of x, so the domain is the set of all real numbers.

26. $g(x) = 4x^3 + 5x^2 - 2x$

We can calculate $4x^3 + 5x^2 - 2x$ for any value of x, so the domain is the set of all real numbers.

28. $g(x) = \dfrac{2x-3}{6x-12}$

Solve: $6x - 12 = 0$

$x = 2$

The domain is $\{x|x$ is a real number *and* $x \ne 2\}$, or $(-\infty, 2) \cup (2, \infty)$.

30. $g(x) = |x| + 1$

We can calculate $|x| + 1$ for any value of x, so the domain is the set of all real numbers.

32. $g(x) = \dfrac{x^2+2x}{|10x-20|}$

Solve: $|10x - 20| = 0$

$x = 2$

The domain is $\{x|x$ is a real number *and* $x \ne 2\}$, or $(-\infty, 2) \cup (2, \infty)$.

34. $\{x|x$ is an integer$\}$

36. $|x| = -8$

Since absolute value must be nonnegative, the solution set is $\{\ \}$ or $\emptyset$.

38. $|2x + 3| = 13$

$$\begin{aligned} 2x+3 &= -13 \quad \textit{or} \quad 2x+3 = 13 \\ 2x &= -16 \quad \textit{or} \quad 2x = 10 \\ x &= -8 \quad \textit{or} \quad x = 5 \end{aligned}$$

The solution set is $\{-8, 5\}$.

40. $|5x - 6| = |3 - 8x|$

$$\begin{aligned} 5x-6 = 3-8x \quad &\textit{or} \quad 5x-6 = -(3-8x) \\ 13x = 9 \quad &\textit{or} \quad 5x-6 = -3+8x \\ x = \frac{9}{13} \quad &\textit{or} \quad -3x = 3 \\ x = \frac{9}{13} \quad &\textit{or} \quad x = -1 \end{aligned}$$

The solution set is $\left\{-1, \dfrac{9}{13}\right\}$.

42. $|3x-8|=0$

$3x-8=0$

$3x=8$

$x=\dfrac{8}{3}$

The solution set is $\left\{\dfrac{8}{3}\right\}$.

44. Graph each function on a graphing calculator, and determine the range from the graph.

For the function in Exercise 22, the range is $\{x|x$ is a real number *and* $x\neq 0\}$, or $(-\infty,0)\cup(0,\infty)$.

For the function in Exercise 23, the range is $\{x|x\geq 0\}$, or $[0,\infty)$.

For the function in Exercise 24, the range is $\{x|x\leq 8\}$, or $(-\infty,8]$.

For the function in Exercise 30, the range is $\{x|x\geq 1\}$, or $[1,\infty)$.

46. We must have $2-x\geq 0$, or $2\geq x$. Thus, the domain is $\{x|x\leq 2\}$, or $(-\infty,2]$.

Chapter 2 Mid-Chapter Review

1. True; a function is a special type of relation in which each member of the domain is paired with exactly one member of the range.

2. False; see the definition of a function in the text.

3. True; for a function $f(x)=c$, where c is a constant, all the inputs have the output c.

4. True; see the vertical-line test in the text.

5. False; for example, see Exercise 3 above.

6. The y-value that is paired with the input 0 is 1.

The x-value that is paired with the y-value -2 is 2.

The y-value that is paired with the x-value -2 is 4.

The y-value that is paired with the x-value 4 is -5.

7. The y-value that is paired with the x-value -2 is 0.

The x-values that are paired with the y-value 0 are -2 and 3.

The y-value that is paired with the x-value 0 is -6.

The y-value that is paired with the x-value 2 is -4.

We see above that the y-value -4 is paired with the x-value 2. In addition, we see from the graph that the y-value -4 is also paired with the x-value -1.

8. We substitute -2 for x and -1 for y (alphabetical order of variables.)

$$\begin{array}{r|l}
\multicolumn{2}{c}{5y+6=4x} \\ \hline
5(-1)+6 \;?& \;4(-2) \\
-5+6 & -8 \\
1 & \qquad\qquad \text{FALSE}
\end{array}$$

Thus, $(-2,-1)$ is not a solution of the equation.

9. We substitute $\dfrac{1}{2}$ for a and 0 for b (alphabetical order of variables.)

$$\begin{array}{r|l}
\multicolumn{2}{c}{8a=4-b} \\ \hline
8\cdot\dfrac{1}{2} \;?& \;4-0 \\
4 & 4 \qquad \text{TRUE}
\end{array}$$

Thus, $\left(\dfrac{1}{2},0\right)$ is a solution of the equation.

10. Yes; each member of the domain is matched to only one member of the range.

11. No; the number 15 in the domain is matched to 2 numbers of the range, 25 and 30.

12. The set of all x-values on the graph extends from -3 through 3, so the domain is $\{x|-3\leq x\leq 3\}$, or $[-3,3]$.

The set of all y-values on the graph extends from -2 through 1, so the range is $\{y|-2\leq y\leq 1\}$, or $[-2,1]$.

13. $g(x)=2+x$

$g(-5)=2+(-5)=-3$

14. $f(x)=x-7$

$f(0)=0-7=-7$

15. $h(x)=8$

$h\left(\dfrac{1}{2}\right)=8$

16. $f(x)=3x^2-x+5$

$f(-1)=3(-1)^2-(-1)+5=3\cdot 1+1+5=3+1+5=9$

17. $g(p)=p^4-p^3$

$g(10)=10^4-10^3=10,000-1000=9000$

18. $f(t)=\dfrac{1}{2}t+3$

$f(-6)=\dfrac{1}{2}(-6)+3=-3+3=0$

19. No vertical line will intersect the graph more than once. Thus, the graph is the graph of a function.

20. It is possible for a vertical line to intersect the graph more than once. Thus, the graph is not the graph of a function.

21. No vertical line will intersect the graph more than once. Thus, the graph is the graph of a function.

22. $g(x) = \dfrac{3}{12-3x}$

Since $\dfrac{3}{12-3x}$ cannot be calculated when the denominator is 0, we find the x-value that causes $12 - 3x$ to be 0:

$$12 - 3x = 0$$
$$12 = 3x$$
$$4 = x$$

Thus, the domain of g is $\{x|x$ is a real number *and* $x \neq 4\}$, or $(-\infty, 4) \cup (4, \infty)$.

23. $f(x) = x^2 - 10x + 3$

Since we can calculate $x^2 - 10x + 3$ for any real number x, the domain is the set of all real numbers.

24. $h(x) = \dfrac{x-2}{x+2}$

Since $\dfrac{x-2}{x+2}$ cannot be calculated when the denominator is 0, we find the x-value that causes $x + 2$ to be 0:

$$x + 2 = 0$$
$$x = -2$$

Thus, the domain of g is $\{x|x$ is a real number *and* $x \neq -2\}$, or $(-\infty, -2) \cup (-2, \infty)$.

25. $f(x) = |x - 4|$

Since we can calculate $|x - 4|$ for any real number x, the domain is the set of all real numbers.

26. $y = -\dfrac{2}{3}x - 2$

We find some ordered pairs that are solutions.

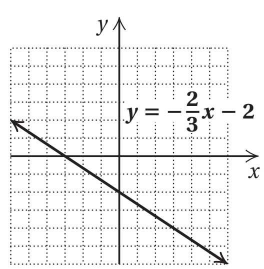
When $x = -3$, $y = -\dfrac{2}{3}(-3) - 2 = 2 - 2 = 0$.

When $x = 0$, $y = -\dfrac{2}{3} \cdot 0 - 2 = 0 - 2 = -2$.

When $x = 3$, $y = -\dfrac{2}{3} \cdot 3 - 2 = -2 - 2 = -4$.

x	y
-3	0
0	-2
3	-4

Plot these points, draw the line they determine, and label it $y = -\dfrac{2}{3}x - 2$.



27. $f(x) = x - 1$

We find some ordered pairs that are solutions.

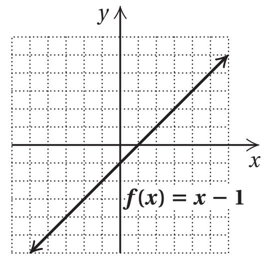
$f(-3) = -3 - 1 = -4$.

$f(0) = 0 - 1 = -1$.

$f(4) = 4 - 1 = 3$.

x	$f(x)$
-3	-4
0	-1
4	3

Plot these points, draw the line they determine, and label it $f(x) = x - 1$.



28. $h(x) = 2x + \dfrac{1}{2}$

We find some ordered pairs that are solutions.

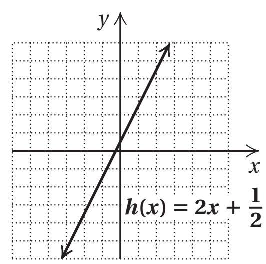
When $x = -2$, $y = 2(-2) + \dfrac{1}{2} = -4 + \dfrac{1}{2} = -3\dfrac{1}{2}$.

When $x = 0$, $y = 2 \cdot 0 + \dfrac{1}{2} = 0 + \dfrac{1}{2} = \dfrac{1}{2}$.

When $x = 2$, $y = 2 \cdot 2 + \dfrac{1}{2} = 4 + \dfrac{1}{2} = 4\dfrac{1}{2}$.

x	$h(x)$
-2	$-3\frac{1}{2}$
0	$\frac{1}{2}$
2	$4\frac{1}{2}$

Plot these points, draw the line they determine, and label it $h(x) = 2x + \dfrac{1}{2}$.



29. $g(x) = |x| - 3$

We find some ordered pairs that are solutions.

$g(-4) = |-4| - 3 = 4 - 3 = 1$

$g(-1) = |-1| - 3 = 1 - 3 = -2$

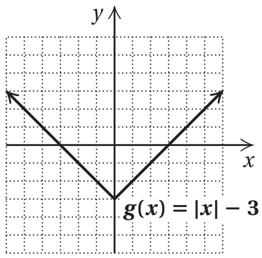
$g(0) = |0| - 3 = 0 - 3 = -3$

$g(2) = |2| - 3 = 2 - 3 = -1$

$g(3) = |3| - 3 = 3 - 3 = 0$

x	$g(x)$
-4	1
-1	-2
0	-3
2	-1
3	0

Plot these points, draw the line they determine, and label it $g(x) = |x| - 3$.



30. $y = 1 + x^2$

We find some ordered pairs that are solutions.

When $x = -2$, $y = 1 + (-2)^2 = 1 + 4 = 5$.

When $x = -1$, $y = 1 + (-1)^2 = 1 + 1 = 2$.

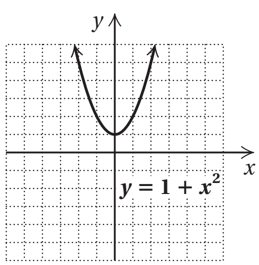
When $x = 0$, $y = 1 + 0^2 = 1 + 0 = 1$.

When $x = 1$, $y = 1 + 1^2 = 1 + 1 = 2$.

When $x = 2$, $y = 1 + 2^2 = 1 + 4 = 5$.

x	y
-2	5
-1	2
0	1
1	2
2	5

Plot these points, draw the line they determine, and label it $y = 1 + x^2$.



31. $f(x) = -\frac{1}{4}x$

We find some ordered pairs that are solutions.

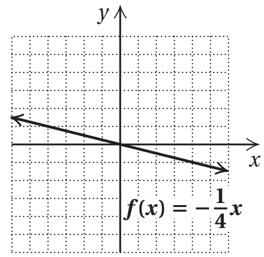
$f(-4) = -\frac{1}{4}(-4) = 1$

$f(0) = -\frac{1}{4} \cdot 0 = 0$

$f(4) = -\frac{1}{4} \cdot 4 = -1$

x	$f(x)$
-4	1
0	0
4	-1

Plot these points, draw the line they determine, and label it $f(x) = -\frac{1}{4}x$.



32. No; since each input has exactly one output, the number of outputs cannot exceed the number of inputs.

33. When $x < 0$, then $y < 0$ and the graph contains points in quadrant III. When $0 < x < 30$, then $y < 0$ and the graph contains points in quadrant IV. When $x > 30$, then $y > 0$ and the graph contains points in quadrant I. Thus, the graph passes through three quadrants.

34. The output -3 corresponds to the input 2. The number -3 in the range is paired with the number 2 in the domain. The point $(2, -3)$ is on the graph of the function.

35. The domain of a function is the set of all inputs, and the range is the set of all outputs.

Exercise Set 2.4

RC2. If $m = 0$, the graph is horizontal.

CC2. $m = \frac{-3 - 0}{-3 - (-2)} = \frac{-3}{-1} = 3$

The answer is (b).

2. Slope is -5; y-intercept is $(0, 10)$.

4. Slope is -5; y-intercept is $(0, 7)$.

6. Slope is $\frac{15}{7}$; y-intercept is $\left(0, \frac{16}{5}\right)$.

8. Slope is -3.1; y-intercept is $(0, 5)$.

10.
$$\begin{aligned} -8x - 7y &= 24 \\ -7y &= 8x + 24 \\ y &= -\frac{8}{7}x - \frac{24}{7} \end{aligned}$$

Slope is $-\frac{8}{7}$; y-intercept is $\left(0, -\frac{24}{7}\right)$.

12.
$$\begin{aligned} 9y + 36 - 4x &= 0 \\ 9y &= 4x - 36 \\ y &= \frac{4}{9}x - 4 \end{aligned}$$

Slope is $\frac{4}{9}$; y-intercept is $(0, -4)$.

14.
$$\begin{aligned} 5x &= \frac{2}{3}y - 10 \\ 5x + 10 &= \frac{2}{3}y \\ \frac{15}{2}x + 15 &= y \end{aligned}$$

Slope is $\frac{15}{2}$; y-intercept is $(0, 15)$.

16.
$$\begin{aligned} 3y - 2x &= 5 + 9y - 2x \\ -6y &= 5 \\ y &= -\frac{5}{6}, \text{ or } 0x - \frac{5}{6} \end{aligned}$$

Slope is 0; y-intercept is $\left(0, -\frac{5}{6}\right)$.

18. We can use any two points on the line, such as $(-3, -4)$ and $(0, -3)$.

$$\begin{aligned} m &= \frac{\text{change in } y}{\text{change in } x} \\ &= \frac{-3-(-4)}{0-(-3)} = \frac{1}{3} \end{aligned}$$

20. We can use any two points on the line, such as $(2, 4)$ and $(4, 0)$.

$$\begin{aligned} m &= \frac{\text{change in } y}{\text{change in } x} \\ &= \frac{0-4}{4-2} = \frac{-4}{2} = -2 \end{aligned}$$

22. Slope $= \frac{-1-7}{2-8} = \frac{-8}{-6} = \frac{4}{3}$

24. Slope $= \frac{-15-(-12)}{-9-17} = \frac{-3}{-26} = \frac{3}{26}$

26. Slope $= \frac{-17.6-(-7.8)}{-12.5-14.4} = \frac{-9.8}{-26.9} = \frac{98}{269}$

28. $m = \frac{43.33}{1238} = \frac{7}{200}$, or about 3.5%

30. $m = \frac{7}{11} = 0.\overline{63} = 63.\overline{63}\%$

32. Rate of change $= \frac{12.1-5.6}{2015-2009} = \frac{6.5}{6} \approx 1.08$ million vehicles per year

34. We can use the coordinates of any two points on the line. We'll use $(0, 100)$ and $(9, 40)$.

Slope $= \frac{\text{change in } y}{\text{change in } x} = \frac{40-100}{9-0} = \frac{-60}{9} = -\frac{20}{3}$,

or $-6\frac{2}{3}$m per second

36. Rate of change $= \frac{14.3-9.8}{2017-2010} = \frac{4.5}{7} \approx \$0.64$ trillion, or \$640 million, per year

38.
$$\begin{aligned} & 9\{2x - 3[5x + 2(-3x + y^0 - 2)]\} \\ &= 9\{2x - 3[5x + 2(-3x + 1 - 2)]\} \quad (y^0 = 1) \\ &= 9\{2x - 3[5x + 2(-3x - 1)]\} \\ &= 9\{2x - 3[5x - 6x - 2]\} \\ &= 9\{2x - 3[-x - 2]\} \\ &= 9\{2x + 3x + 6\} \\ &= 9\{5x + 6\} \\ &= 45x + 54 \end{aligned}$$

40.
$$\begin{aligned} & 5^4 \div 625 \div 5^2 \cdot 5^7 \div 5^3 \\ &= 1 \div 5^2 \cdot 5^7 \div 5^3 \\ &= 5^{-2} \cdot 5^7 \div 5^3 \\ &= 5^5 \div 5^3 \\ &= 5^2, \text{ or } 25 \end{aligned}$$

42. $|5x - 8| \geq 32$

$$\begin{aligned} 5x - 8 \leq -32 \quad &\textit{or} \quad 5x - 8 \geq 32 \\ 5x \leq -24 \quad &\textit{or} \quad 5x \geq 40 \\ x \leq -\frac{24}{5} \quad &\textit{or} \quad x \geq 8 \end{aligned}$$

The solution set is $\left\{x \middle| x \leq -\frac{24}{5} \textit{ or } x \geq 8\right\}$, or $\left(-\infty, -\frac{24}{5}\right] \cup [8, \infty)$.

44. $|5x - 8| = 32$

$$\begin{aligned} 5x - 8 = -32 \quad &\textit{or} \quad 5x - 8 = 32 \\ 5x = -24 \quad &\textit{or} \quad 5x = 40 \\ x = -\frac{24}{5} \quad &\textit{or} \quad x = 8 \end{aligned}$$

The solution set is $\left\{-\frac{24}{5}, 8\right\}$.

Exercise Set 2.5

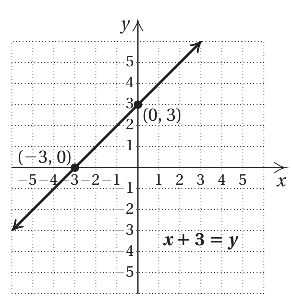
RC2. True

RC4. False

CC2. The y-intercept of $y = -2x + 7$ is $\underline{(0, 7)}$.

CC4. The graphs of the lines $y = -13$ and $\underline{y = \frac{2}{7}}$ are parallel.

2.



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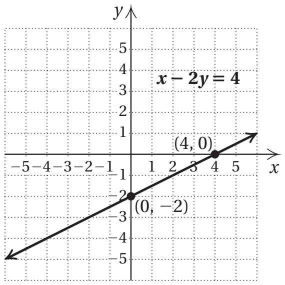

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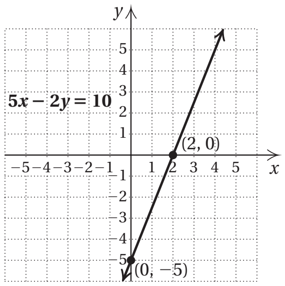

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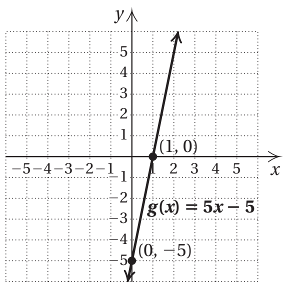

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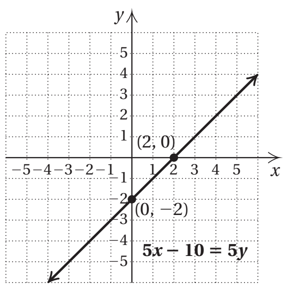

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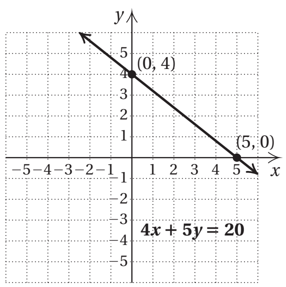

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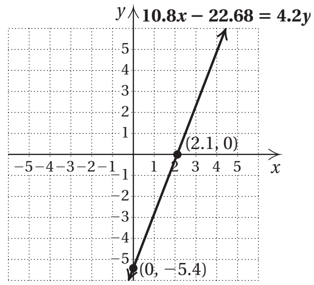

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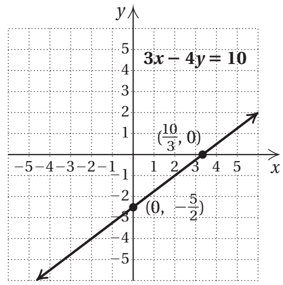
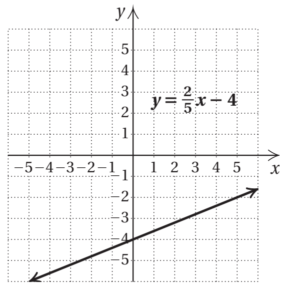


18. $y = \dfrac{2}{5}x - 4$

Slope: $\dfrac{2}{5}$; y-intercept: $(0, -4)$

Starting at $(0, -4)$, find another point by moving 2 units up and 5 units to the right to $(5, -2)$.

Starting at $(0, -4)$ again, move 2 units down and 5 units to the left to $(-5, -6)$.

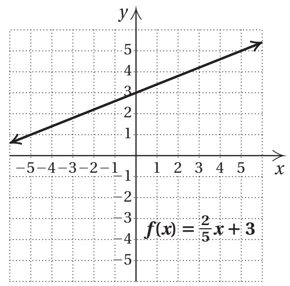


20. $y = \dfrac{2}{5}x + 3$

Slope: $\dfrac{2}{5}$; y-intercept: $(0, 3)$

Starting at $(0, 3)$, find another point by moving 2 units up and 5 units to the right to $(5, 5)$.

Starting at $(0, 3)$ again, move 2 units down and 5 units to the left to $(-5, 1)$.



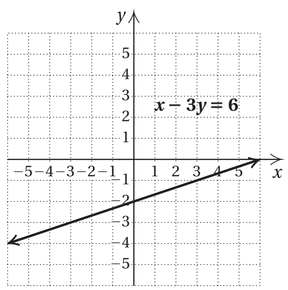
22. $x - 3y = 6$

$$-3y = -x + 6$$
$$y = \frac{1}{3}x - 2$$

Slope: $\frac{1}{3}$; y-intercept: $(0, -2)$

Starting at $(0, -2)$, find another point by moving 1 unit up and 3 units to the right to $(3, -1)$.

From $(3, -1)$, move 1 unit up and 3 units to the left again to $(6, 0)$.

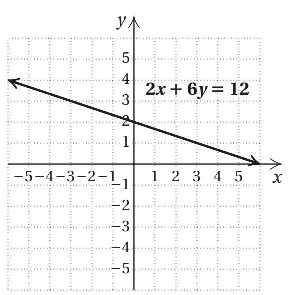


24. $2x + 6y = 12$

$$6y = -2x + 12$$
$$y = -\frac{1}{3}x + 2$$

Slope: $-\frac{1}{3}$; y-intercept: $(0, 2)$

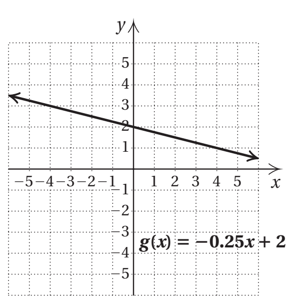
Starting at $(0, 2)$, find another point by moving 1 unit up and 3 units to the left to $(-3, 3)$. Starting at $(0, 2)$ again, move 1 unit down and 3 units to the right to $(3, 1)$.



26. $g(x) = -0.25x + 2$

Slope: -0.25, or $-\frac{1}{4}$; y-intercept: $(0, 2)$

Starting at $(0, 2)$, find another point by moving 1 unit up and 4 units to the left to $(-4, 3)$. Starting at $(0, 2)$ again, move 1 unit down and 4 units to the right to $(4, 1)$.

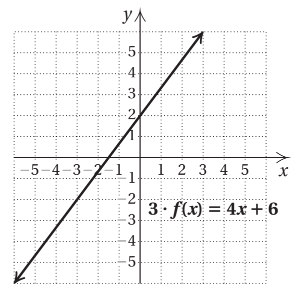


28. $3 \cdot f(x) = 4x + 6$

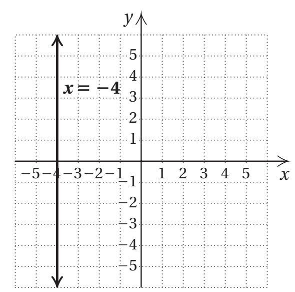
$$f(x) = \frac{4}{3}x + 2$$

Slope: $\frac{4}{3}$; y-intercept: $(0, 2)$

Starting at $(0, 2)$, find another point by moving 4 units up and 3 units to the right to $(3, 6)$. Starting at $(0, 2)$ again, move 4 units down and 3 units to the left to $(-3, -2)$.

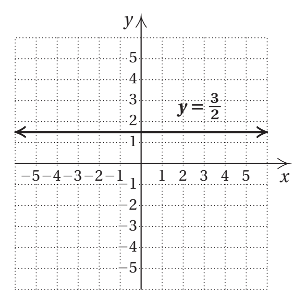


30.



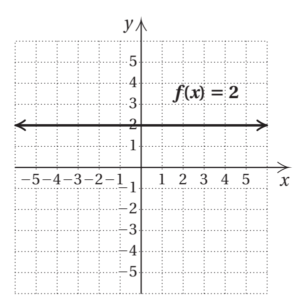
The slope is not defined.

32.



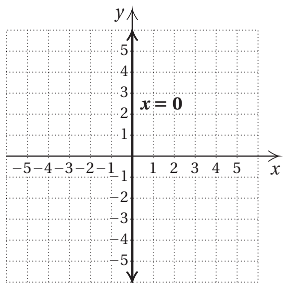
The slope is 0.

34.



The slope is 0.

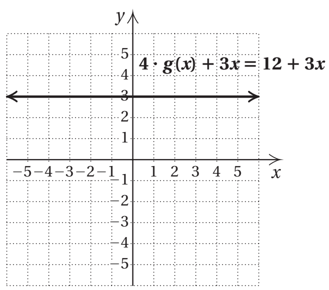
36.



The slope is not defined.

38. $4 \cdot g(x) + 3x = 12 + 3x$

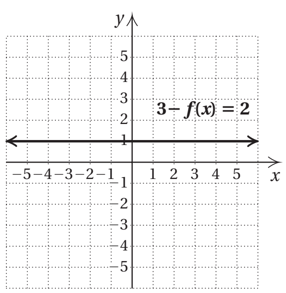
$$4 \cdot g(x) = 12$$
$$g(x) = 3$$



The slope is 0.

40. $3 - f(x) = 2$

$$1 = f(x)$$



The slope is 0.

42. Write both equations in slope-intercept form.

$$y = 2x - 7 \qquad (m = 2)$$
$$y = 2x + 8 \qquad (m = 2)$$

The slopes are the same and the y-intercepts are different, so the lines are parallel.

44. Write both equations in slope-intercept form.

$$y = -6x - 8 \qquad (m = -6)$$
$$y = 2x + 5 \qquad (m = 2)$$

The slopes are not the same, so the lines are not parallel.

46. Write both equations in slope-intercept form.

$$y = -7x - 9 \qquad (m = -7)$$
$$y = -7x - \frac{7}{3} \qquad (m = -7)$$

The slopes are the same and the y-intercepts are different, so the lines are parallel.

48. The graph of $5y = -2$, or $y = -\frac{2}{5}$, is a horizontal line; the graph of $\frac{3}{4}x = 16$, or $x = \frac{64}{3}$, is a vertical line. Thus, the graphs are not parallel.

50. Write both equations in slope-intercept form.

$$y = \frac{2}{5}x + \frac{3}{5} \qquad \left(m = \frac{2}{5}\right)$$
$$y = -\frac{2}{5}x + \frac{4}{5} \qquad \left(m = -\frac{2}{5}\right)$$

$\frac{2}{5}\left(-\frac{2}{5}\right) = -\frac{4}{25} \neq -1$, so the lines are not perpendicular.

52. $y = -x + 7 \qquad (m = -1)$

$y = x + 3 \qquad (m = 1)$

$-1 \cdot 1 = -1$, so the lines are perpendicular.

54. $y = x \qquad (m = 1)$

$y = -x \qquad (m = -1)$

$1(-1) = -1$, so the lines are perpendicular.

56. Since the graphs of $-5y = 10$, or $y = -2$, and $y = -\frac{4}{9}$ are both horizontal lines, they are not perpendicular.

58. Move the decimal point 5 places to the right. The number is small, so the exponent is negative.

$$0.000047 = 4.7 \times 10^{-5}$$

60. Move the decimal point 7 places to the left. The number is large, so the exponent is positive.

$$99,902,000 = 9.9902 \times 10^{7}$$

62. The exponent is positive, so the number is large. Move the decimal point 8 places to the right.

$$9.01 \times 10^{8} = 901,000,000$$

64. The exponent is negative, so the number is small. Move the decimal point 2 places to the left.

$$8.5677 \times 10^{-2} = 0.085677$$

66. $12a + 21ab = 3a(4 + 7b)$

68. $64x - 128y + 256 = 64(x - 2y + 4)$

70. $x + 7y = 70$

$$y = -\frac{1}{7}x + 10 \qquad \left(m = -\frac{1}{7}\right)$$

$y + 3 = kx$

$$y = kx - 3 \qquad (m = k)$$

In order for the graphs to be perpendicular, the product of the slopes must be -1.

$$-\frac{1}{7} \cdot k = -1$$
$$k = 7$$

72. The x-coordinate must be -4, and the y-coordinate must be 5. The point is $(-4, 5)$.

74. All points on the y-axis are pairs of the form $(0, y)$. Thus any number for y will do and x must be 0. The equation is $x = 0$. The graph fails the vertical-line test, so the equation is not a function.

76.
$$\begin{aligned} 2y &= -7x + 3b \\ 2(-13) &= -7 \cdot 0 + 3b \\ -26 &= 3b \\ -\frac{26}{3} &= b \end{aligned}$$

Exercise Set 2.6

RC2. The point-slope equation of a line with slope m and passing through (x_1, y_1) is $\underline{y - y_1 = m(x - x_1)}$.

CC2. $y = -5$ is a horizontal line, so its slope is 0.

a) 0

b) not defined

CC4. $y = -\frac{5}{6}x + \frac{4}{3}$

a) $-\frac{5}{6}$

b) $\frac{6}{5}$

CC6.
$$\begin{aligned} 10x + 5y &= 14 \\ 5y &= -10x + 14 \\ y &= -2x + \frac{14}{5} \end{aligned}$$

a) -2

b) $\frac{1}{2}$

2. $y = 5x - 3$

4. $y = -9.1x + 2$

6. $f(x) = \frac{4}{5}x + 28$

8. $f(x) = -\frac{7}{8}x - \frac{7}{11}$

10. Using the point-slope equation:
$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 2 &= 4(x - 5) \\ y - 2 &= 4x - 20 \\ y &= 4x - 18 \end{aligned}$$
Using the slope-intercept equation:
$$\begin{aligned} y &= mx + b \\ 2 &= 4 \cdot 5 + b \\ -18 &= b \end{aligned}$$
$$y = 4x - 18$$

12. Using the point-slope equation:
$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 8 &= -2(x - 2) \\ y - 8 &= -2x + 4 \\ y &= -2x + 12 \end{aligned}$$
Using the slope-intercept equation:
$$\begin{aligned} y &= mx + b \\ 8 &= -2 \cdot 2 + b \\ 12 &= b \end{aligned}$$
$$y = -2x + 12$$

14. Using the point-slope equation:
$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - (-2) &= 3(x - (-2)) \\ y + 2 &= 3(x + 2) \\ y + 2 &= 3x + 6 \\ y &= 3x + 4 \end{aligned}$$
Using the slope-intercept equation:
$$\begin{aligned} y &= mx + b \\ -2 &= 3(-2) + b \\ 4 &= b \end{aligned}$$
$$y = 3x + 4$$

16. Using the point-slope equation:
$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 0 &= -3(x - (-2)) \\ y &= -3(x + 2) \\ y &= -3x - 6 \end{aligned}$$
Using the slope-intercept equation:
$$\begin{aligned} y &= mx + b \\ 0 &= -3(-2) + b \\ -6 &= b \end{aligned}$$
$$y = -3x - 6$$

18. Using the point-slope equation:
$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 4 &= 0(x - 0) \\ y - 4 &= 0 \\ y &= 4 \end{aligned}$$
Using the slope-intercept equation:
$$\begin{aligned} y &= mx + b \\ 4 &= 0 \cdot 0 + b \\ 4 &= b \end{aligned}$$
$$y = 0x + 4, \text{ or } y = 4$$

20. Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - 3 = -\frac{4}{5}(x - 2)$$
$$y - 3 = -\frac{4}{5}x + \frac{8}{5}$$
$$y = -\frac{4}{5}x + \frac{23}{5}$$

Using the slope-intercept equation:

$$y = mx + b$$
$$3 = -\frac{4}{5} \cdot 2 + b$$
$$\frac{23}{5} = b$$

$$y = -\frac{4}{5}x + \frac{23}{5}$$

22. $m = \frac{7-5}{4-2} = \frac{2}{2} = 1$

Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - 5 = 1(x - 2)$$
$$y - 5 = x - 2$$
$$y = x + 3$$

Using the slope-intercept equation:

$$y = mx + b$$
$$5 = 1 \cdot 2 + b$$
$$3 = b$$

$y = 1 \cdot x + 3$, or $y = x + 3$

24. $m = \frac{9-(-1)}{9-(-1)} = \frac{10}{10} = 1$

Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - 9 = 1(x - 9)$$
$$y - 9 = x - 9$$
$$y = x$$

Using the slope-intercept equation:

$$y = mx + b$$
$$9 = 1 \cdot 9 + b$$
$$0 = b$$

$y = 1 \cdot x + 0$, or $y = x$

26. $m = \frac{0-(-5)}{3-0} = \frac{5}{3}$

Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - 0 = \frac{5}{3}(x - 3)$$
$$y = \frac{5}{3}x - 5$$

Using the slope-intercept equation:

$$y = mx + b$$
$$-5 = \frac{5}{3} \cdot 0 + b$$
$$-5 = b$$

$$y = \frac{5}{3}x - 5$$

28. $m = \frac{-1-(-7)}{-2-(-4)} = \frac{6}{2} = 3$

Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - (-7) = 3(x - (-4))$$
$$y + 7 = 3(x + 4)$$
$$y + 7 = 3x + 12$$
$$y = 3x + 5$$

Using the slope-intercept equation:

$$y = mx + b$$
$$-7 = 3(-4) + b$$
$$5 = b$$

$$y = 3x + 5$$

30. $m = \frac{7-0}{-4-0} = -\frac{7}{4}$

Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - 0 = -\frac{7}{4}(x - 0)$$
$$y = -\frac{7}{4}x$$

Using the slope-intercept equation:

$$y = mx + b$$
$$0 = -\frac{7}{4} \cdot 0 + b$$
$$0 = b$$

$y = -\frac{7}{4}x + 0$, or $y = -\frac{7}{4}x$

32. $m = \dfrac{\frac{5}{6} - \frac{3}{2}}{-3 - \frac{2}{3}} = \dfrac{-\frac{4}{6}}{-\frac{11}{3}} = \frac{2}{11}$

Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - \frac{5}{6} = \frac{2}{11}(x - (-3))$$
$$y - \frac{5}{6} = \frac{2}{11}(x + 3)$$
$$y - \frac{5}{6} = \frac{2}{11}x + \frac{6}{11}$$
$$y = \frac{2}{11}x + \frac{91}{66}$$

Using the slope-intercept equation:

$$y = mx + b$$
$$\frac{5}{6} = \frac{2}{11}(-3) + b$$
$$\frac{91}{66} = b$$
$$y = \frac{2}{11}x + \frac{91}{66}$$

34. $2x - y = 7$ Given line

$$y = 2x - 7 \qquad m = 2$$

Using the slope, 2, and the y-intercept $(0, 3)$, we write the equation of the line: $y = 2x + 3$.

36. $2x + y = -3$ Given line

$$y = -2x - 3 \qquad m = -2$$

Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - (-5) = -2(x - (-4))$$
$$y + 5 = -2(x + 4)$$
$$y + 5 = -2x - 8$$
$$y = -2x - 13$$

Using the slope-intercept equation:

$$y = mx + b$$
$$-5 = -2(-4) + b$$
$$-13 = b$$
$$y = -2x - 13$$

38. $5x + 2y = 6$ Given line

$$y = -\frac{5}{2} + 3 \qquad m = -\frac{5}{2}$$

Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - 0 = -\frac{5}{2}(x - (-7))$$
$$y = -\frac{5}{2}(x + 7)$$
$$y = -\frac{5}{2}x - \frac{35}{2}$$

Using the slope-intercept equation:

$$y = mx + b$$
$$0 = -\frac{5}{2}(-7) + b$$
$$-\frac{35}{2} = b$$
$$y = -\frac{5}{2}x - \frac{35}{2}$$

40. $x - 3y = 9$ Given line

$$y = \frac{1}{3}x - 3 \qquad m = \frac{1}{3}$$

Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - 1 = -3(x - 4)$$
$$y - 1 = -3x + 12$$
$$y = -3x + 13$$

Using the slope-intercept equation:

$$y = mx + b$$
$$1 = -3 \cdot 4 + b$$
$$13 = b$$
$$y = -3x + 13$$

42. $5x - 2y = 4$ Given line

$$y = \frac{5}{2}x - 2 \qquad m = \frac{5}{2}$$

Using the point-slope equation:

$$y - y_1 = m(x - x_1)$$
$$y - (-5) = -\frac{2}{5}(x - (-3))$$
$$y + 5 = -\frac{2}{5}(x + 3)$$
$$y + 5 = -\frac{2}{5}x - \frac{6}{5}$$
$$y = -\frac{2}{5}x - \frac{31}{5}$$

Using the slope-intercept equation:

$$y = mx + b$$
$$-5 = -\frac{2}{5}(-3) + b$$
$$-\frac{31}{5} = b$$
$$y = -\frac{2}{5}x - \frac{31}{5}$$

44. $-3x + 6y = 2$ Given line

$$y = \frac{1}{2}x + \frac{1}{3} \qquad m = \frac{1}{2}$$

Using the point-slope equation:

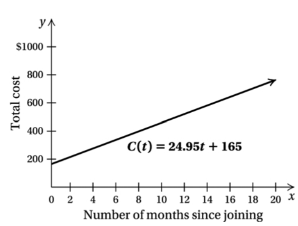
$$y - y_1 = m(x - x_1)$$
$$y - (-4) = -2(x - (-3))$$
$$y + 4 = -2(x + 3)$$
$$y + 4 = -2x - 6$$
$$y = -2x - 10$$

Using the slope-intercept equation:

$$y = mx + b$$
$$-4 = -2(-3) + 6$$
$$-10 = b$$
$$y = -2x - 10$$

46. a) $C(t) = 24.95t + 165$

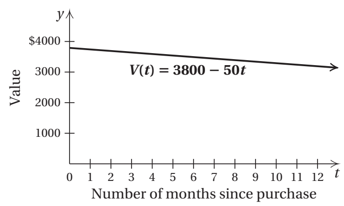
b)



c) $C(14) = 24.95(14) + 165 = \$514.30$

48. a) $V(t) = 3800 - 50t$

b)



c) $V(10.5) = 3800 - 50(10.5) = \$3275$

50. a) The data points are $(0, 10.667)$ and $(6, 16.974)$.

$$m = \frac{16.974 - 10.667}{6 - 0} = \frac{6.307}{6} \approx 1.051$$

Using the slope and the y-intercept, we write the function.

$$R(x) = 1.051x + 10.667$$

b) In 2014, $x = 2014 - 2010 = 4$.

$R(4) = 1.051(4) + 10.667 = \$14.871$ billion

In 2021, $x = 2021 - 2010 = 11$.

$R(11) = 1.051(11) + 10.667 = \$22.228$ billion

52. a) The data points are $(0, 24.1)$ and $(8, 20.3)$.

$$m = \frac{20.3 - 24.1}{8 - 0} = \frac{-3.8}{8} = -0.475$$

Using the slope and the y-intercept, we write the function.

$$G(x) = -0.475x + 24.1.$$

b) In 2019, $x = 2019 - 2017 = 2$.

$G(2) = -0.475(2) + 24.1 = \$23.15$ billion

In 2023, $x = 2023 - 2017 = 6$

$G(6) = -0.475(6) + 24.1 = \$21.25$ billion

c) Solve: $-0.475x + 24.1 = 19.8$

$$x \approx 9$$

At this rate of decrease, the gas tax revenue will be \$19.8 billion about 9 years after 2017, or in 2026.

54. a) The data points are $(0, 79.27)$ and $(12, 89.52)$.

$$m = \frac{89.52 - 79.27}{12 - 0} = \frac{10.25}{12} \approx 0.854$$

Using the slope and the y-intercept we write the function:

$E(t) = 0.854t + 79.27$, where t is the number of years since 2003.

b) In 2020, $t = 2020 - 2003 = 17$.

$E(17) = 0.854(17) + 79.27 \approx 93.79$ years

56.
$$2x + 3 \le 5x - 4$$
$$7 \le 3x$$
$$\frac{7}{3} \le x$$

The solution set is $\left\{x \middle| x \ge \frac{7}{3}\right\}$, or $\left[\frac{7}{3}, \infty\right)$.

58. $|2x + 3| = |x - 4|$

$$2x + 3 = x - 4 \quad or \quad 2x + 3 = -(x - 4)$$
$$x = -7 \quad or \quad 2x + 3 = -x + 4$$
$$x = -7 \quad or \quad 3x = 1$$
$$x = -7 \quad or \quad x = \frac{1}{3}$$

The solution set is $\left\{-7, \frac{1}{3}\right\}$.

60. First find the slope of the line through $(-1, 3)$ and $(2, 9)$.

$$m = \frac{9 - 3}{2 - (-1)} = \frac{6}{3} = 2$$

Then the slope of a line perpendicular to this line is $-\frac{1}{2}$.

Now we find the equation of the line with slope $-\frac{1}{2}$ passing through $(4, 5)$.

$$y - y_1 = m(x - x_1)$$
$$y - 5 = -\frac{1}{2}(x - 4)$$
$$y - 5 = -\frac{1}{2}x + 2$$
$$y = -\frac{1}{2}x + 7$$

Chapter 2 Vocabulary Reinforcement

1. The graph of $x = a$ is a vertical line with x-intercept $(a, 0)$.
2. The point-slope equation of a line with slope m and passing through (x_1, y_1) is $y - y_1 = m(x - x_1)$.
3. A function is a correspondence between a first set, called the domain, and a second set, called the range, such that each member of the domain corresponds to exactly one member of the range.
4. The slope of a line containing points (x_1, y_1) and (x_2, y_2) is given by $m =$ the change in y/the change in x, also described as rise/run.
5. Two lines are perpendicular if the product of their slopes is -1.
6. The equation $y = mx + b$ is called the slope-intercept equation of a line with slope m and y-intercept $(0, b)$.
7. Lines are parallel if they have the same slope and different y-intercepts.

Chapter 2 Concept Reinforcement

1. False; the slope of a vertical line is not defined.
2. True
3. False; parallel lines have the same slope and *different* y-intercepts.

Chapter 2 Study Guide

1. A member of the domain is matched to more than one member of the range, so the correspondence is not a function.

2. $g(x) = \frac{1}{2}x - 2$

$g(0) = \frac{1}{2} \cdot 0 - 2 = 0 - 2 = -2$

$g(-2) = \frac{1}{2}(-2) - 2 = -1 - 2 = -3$

$g(6) = \frac{1}{2} \cdot 6 - 2 = 3 - 2 = 1$

3. $y = \frac{2}{5}x - 3$

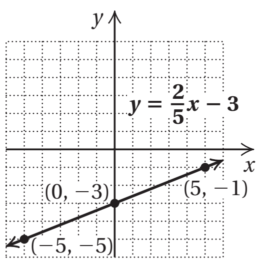
We find some ordered pairs that are solutions, plot them, and draw and label the line.

When $x = -5$, $y = \frac{2}{5}(-5) - 3 = -2 - 3 = -5$.

When $x = 0$, $y = \frac{2}{5} \cdot 0 - 3 = 0 - 3 = -3$.

When $x = 5$, $y = \frac{2}{5} \cdot 5 - 3 = 2 - 3 = -1$.

x	y
-5	-5
0	-3
5	-1



4. No vertical line can cross the graph at more than one point, so the graph is that of a function.

5. The set of all x-values on the graph extends from -4 through 5, so the domain is $\{x| -4 \le x \le 5\}$, or $[-4, 5]$.

The set of all y-values on the graph extends from -2 through 4, so the range is $\{y| -2 \le y \le 4\}$, or $[-2, 4]$.

6. Since $\frac{x-3}{3x+9}$ cannot be calculated when $3x + 9$ is 0, we solve $3x + 9 = 0$.

$$3x + 9 = 0$$
$$3x = -9$$
$$x = -3$$

Thus, the domain of g is $\{x|x$ is a real number *and* $x \ne -3\}$, or $(-\infty, -3) \cup (-3, \infty)$.

7. $m = \frac{-8-2}{2-(-3)} = \frac{-10}{5} = -2$

8.
$$3x = -6y + 12$$
$$3x - 12 = -6y$$
$$-\frac{1}{2}x + 2 = y \qquad \text{Dividing by } -6$$

The slope is $-\frac{1}{2}$, and the y-intercept is $(0, 2)$.

9. $3y - 3 = x$

To find the y-intercept, let $x = 0$ and solve for y.

$$3y - 3 = 0$$
$$3y = 3$$
$$y = 1$$

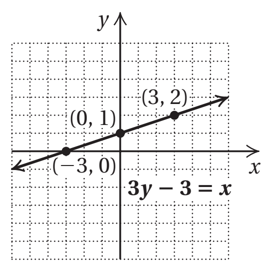
The y-intercept is $(0, 1)$.

To find the x-intercept, let $y = 0$ and solve for x.

$$3 \cdot 0 - 3 = x$$
$$0 - 3 = x$$
$$-3 = x$$

The x-intercept is $(-3, 0)$.

We plot these points and draw the line.



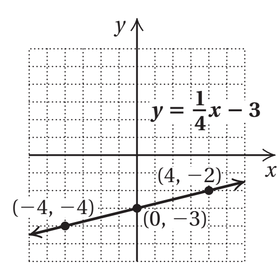
We find a third point as a check. Let $x = 3$.

$$3y - 3 = 3$$
$$3y = 6$$
$$y = 2$$

We see that the point $(3, 2)$ is on the line.

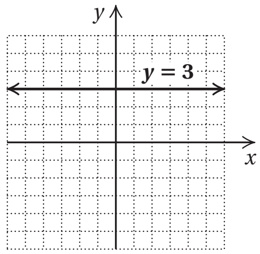
10. $y = \frac{1}{4}x - 3$

First we plot the y-intercept $(0, -3)$. Then we consider the slope $\frac{1}{4}$. Starting at the y-intercept, we find another point by moving 1 unit up and 4 units to the right. We get to the point $(4, -2)$. We can also think of the slope as $\frac{-1}{-4}$. We again start at the y-intercept and move down 1 unit and 4 units to the left. We get to a third point $(-4, -4)$. We plot the points and draw the graph.



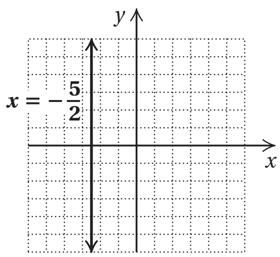
11. $y = 3$

All ordered pairs $(x, 3)$ are solutions. The graph is a horizontal line that intersects the y-axis at $(0, 3)$.



12. $x = -\frac{5}{2}$

All points $\left(-\frac{5}{2}, y\right)$ are solutions. The graph is a vertical line that intersects the x-axis at $\left(-\frac{5}{2}, 0\right)$.



13. We first solve for y and determine the slope of each line.

$$-3x + 8y = -8$$
$$8y = 3x - 8$$
$$y = \frac{3}{8}x - 1$$

The slope of $-3x + 8y = -8$ is $\frac{3}{8}$.

$$8y = 3x + 40$$
$$y = \frac{3}{8}x + 5$$

The slope of $8y = 3x + 40$ is $\frac{3}{8}$.

The slopes are the same and the y-intercepts, $(0, -1)$ and $(0, 5)$ are different, so the lines are parallel.

14. We first solve for y and determine the slope of each line.

$$5x - 2y = -8$$
$$-2y = -5x - 8$$
$$y = \frac{5}{2}x + 4$$

The slope of $5x - 2y = -8$ is $\frac{5}{2}$.

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

The slope of $2x + 5y = 15$ is $-\frac{2}{5}$.

The slopes are different, so the lines are not parallel. The product of the slopes is $\frac{5}{2}\left(-\frac{2}{5}\right) = -1$, so the lines are perpendicular.

15. $y = mx + b$ Slope-intercept equation

$y = -8x + 0.3$

16. Using the point-slope equation:

$$y - (-3) = -4\left(x - \frac{1}{2}\right)$$
$$y + 3 = -4x + 2$$
$$y = -4x - 1$$

Using the slope intercept equation:

$$-3 = -4\left(\frac{1}{2}\right) + b$$
$$-3 = -2 + b$$
$$-1 = b$$

Then, substituting in $y = mx + b$, we have $y = -4x - 1$.

17. We first find the slope:

$$m = \frac{-3 - 7}{4 - (-2)} = \frac{-10}{6} = -\frac{5}{3}$$

We use the point-slope equation.

$$y - 7 = -\frac{5}{3}[x - (-2)]$$
$$y - 7 = -\frac{5}{3}(x + 2)$$
$$y - 7 = -\frac{5}{3}x - \frac{10}{3}$$
$$y = -\frac{5}{3}x + \frac{11}{3}$$

18. First we find the slope of the given line:

$$4x - 3y = 6$$
$$-3y = -4x + 6$$
$$y = \frac{4}{3}x - 2$$

A line parallel to this line has slope $\frac{4}{3}$.

We use the slope-intercept equation.

$$-5 = \frac{4}{3}(2) + b$$
$$-5 = \frac{8}{3} + b$$
$$-\frac{23}{3} = b$$

Then we have $y = \frac{4}{3}x - \frac{23}{3}$.

19. From Exercise 18 above we know that the slope of the given line is $\frac{4}{3}$. The slope of a line perpendicular to this line is $-\frac{3}{4}$.

We use the point-slope equation.

$$y-(-5)=-\frac{3}{4}(x-2)$$
$$y+5=-\frac{3}{4}x+\frac{3}{2}$$
$$y=-\frac{3}{4}x-\frac{7}{2}$$

Chapter 2 Review Exercises

1. No; a member of the domain, 3, is matched to more than one member of the range.

2. Yes; each member of the domain is matched to only one member of the range.

3. $g(x)=-2x+5$

$g(0)=-2\cdot 0+5=0+5=5$

$g(-1)=-2(-1)+5=2+5=7$

4. $f(x)=3x^2-2x+7$

$f(0)=3\cdot 0^2-2\cdot 0+7=0-0+7=7$

$f(-1)=3(-1)^2-2(-1)+7=3\cdot 1-2(-1)+7=3+2+7=12$

5. $G(t)=6.22t+76.22$

$G(10)=6.22(10)+76.22=62.2+76.22\approx \$138$ billion

6. $y=-3x+2$

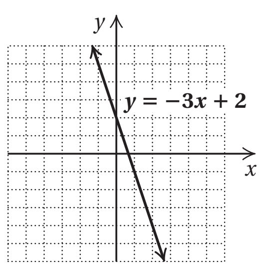
We find some ordered pairs that are solutions, plot them, and draw and label the line.

When $x=-1$, $y=-3(-1)+2=3+2=5$.

When $x=1$, $y=-3\cdot 1+2=-3+2=-1$

When $x=2$, $y=-3\cdot 2+2=-6+2=-4$.

x	y	(x,y)
-1	5	$(-1,5)$
1	-1	$(1,-1)$
2	-4	$(2,-4)$



7. $y=\frac{5}{2}x-3$

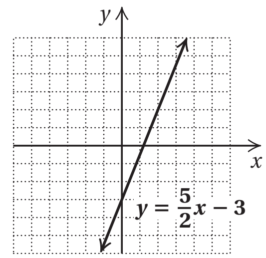
We find some ordered pairs that are solutions, using multiples of 2 to avoid fractions. Then we plot these points and draw and label the line.

When $x=0$, $y=\frac{5}{2}\cdot 0-3=0-3=-3$.

When $x=2$, $y=\frac{5}{2}\cdot 2-3=5-3=2$.

When $x=4$, $y=\frac{5}{2}\cdot 4-3=10-3=7$.

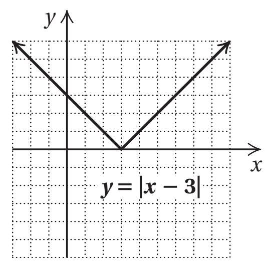
x	y	(x,y)
0	-3	$(0,-3)$
2	2	$(2,2)$
4	7	$(4,7)$



8. $y=|x-3|$

To find an ordered pair, we choose any number for x and then determine y. For example, if $x=5$, then $y=|5-3|=|2|=2$. We find several ordered pairs, plot them, and connect them.

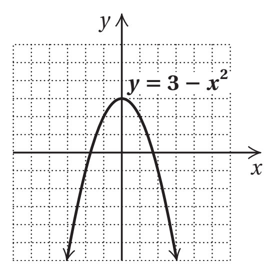
x	y
5	2
3	0
2	1
-1	4
-2	5
-3	6



9. $y=3-x^2$

To find an ordered pair, we choose any number for x and then determine y. For example, if $x=2$, then $3-2^2=3-4=-1$. We find several ordered pairs, plot them, and connect them with a smooth curve.

x	y
-2	-1
-1	2
0	3
1	2
2	-1
3	-6



10. No vertical line will intersect the graph more than once. Thus, the graph is the graph of a function.

11. It is possible for a vertical line to intersect the graph more than once. Thus, this is not the graph of a function.

12. a) Locate 2 on the horizontal axis and then find the point on the graph for which 2 is the first coordinate. From that point, look to the vertical axis to find the corresponding y-coordinate, 3. Thus, $f(2)=3$.

b) The set of all x-values in the graph extends from -2 to 4, so the domain is $\{x|-2\le x\le 4\}$, or $[-2,4]$.

c) To determine which member(s) of the domain are paired with 2, locate 2 on the vertical axis. From there look left and right to the graph to find any points for which 2 is the second coordinate. One such point exists. Its first coordinate appears to be -1. Thus, the x-value for which $f(x)=2$ is -1.

d) The set of all y-values in the graph extends from 1 to 5, so the range is $\{y|1\le y\le 5\}$, or $[1,5]$.

13. $f(x)=\dfrac{5}{x-4}$

Since $\dfrac{5}{x-4}$ cannot be calculated when the denominator is 0, we find the x-value that causes $x-4$ to be 0:

$$x-4=0$$
$$x=4 \quad \text{Adding 4 on both sides}$$

Thus, 4 is not in the domain of f, while all other real numbers are. The domain of f is

$\{x|x \text{ is a real number } \textit{and } x \neq 4\}$, or $(-\infty,4)\cup(4,\infty)$.

14. $g(x)=x-x^2$

Since we can calculate $x-x^2$ for any real number x, the domain is the set of all real numbers.

15.
$$f(x) = \underset{\uparrow}{-3}x + \underset{\uparrow}{2}$$
$$f(x) = mx + b$$

The slope is -3, and the y-intercept is $(0,2)$.

16. First we find the slope-intercept form of the equation by solving for y. This allows us to determine the slope and y-intercept easily.

$$4y+2x=8$$
$$4y=-2x+8$$
$$\frac{4y}{4}=\frac{-2x+8}{4}$$
$$y=-\frac{1}{2}x+2$$

The slope is $-\dfrac{1}{2}$, and the y-intercept is $(0,2)$.

17. Slope $=\dfrac{\text{change in } y}{\text{change in } x}=\dfrac{-4-7}{10-13}=\dfrac{-11}{-3}=\dfrac{11}{3}$

18. $2y+x=4$

To find the x-intercept we let $y=0$ and solve for x.

$$2y+x=4$$
$$2\cdot 0+x=4$$
$$x=4$$

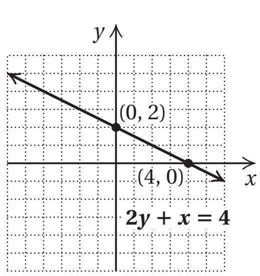
The x-intercept is $(4,0)$.

To find the y-intercept we let $x=0$ and solve for y.

$$2y+x=4$$
$$2y+0=4$$
$$2y=4$$
$$y=2$$

The y-intercept is $(0,2)$.

We plot these points and draw the line.



We use a third point as a check. We choose $x=-2$ and solve for y.

$$2y+(-2)=4$$
$$2y=6$$
$$y=3$$

We plot $(-2,3)$ and note that it is on the line.

19. $2y=6-3x$

To find the x-intercept we let $y=0$ and solve for x.

$$2y=6-3x$$
$$2\cdot 0=6-3x$$
$$0=6-3x$$
$$3x=6$$
$$x=2$$

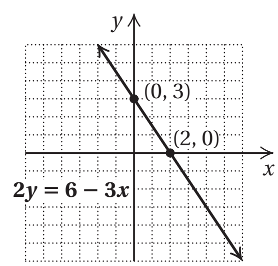
The x-intercept is $(2,0)$.

To find the y-intercept we let $x=0$ and solve for y.

$$2y=6-3x$$
$$2y=6-3\cdot 0$$
$$2y=6$$
$$y=3$$

The y-intercept is $(0,3)$.

We plot these points and draw the line.



We use a third point as a check. We choose $x=4$ and solve for y.

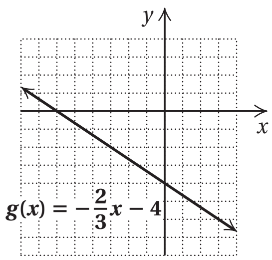
$$2y=6-3\cdot 4$$
$$2y=6-12$$
$$2y=-6$$
$$y=-3$$

We plot $(4,-3)$ and note that it is on the line.

20. $g(x)=-\dfrac{2}{3}x-4$

First we plot the y-intercept $(0,-4)$. We can think of the slope as $\dfrac{-2}{3}$. Starting at the y-intercept and using the slope, we find another point by moving 2 units down and 3 units to the right. We get to a new point $(3,-6)$.

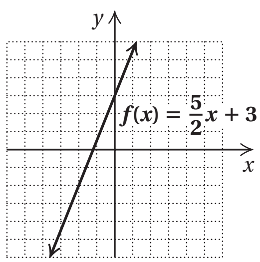
We can also think of the slope as $\dfrac{2}{-3}$. We again start at the y-intercept $(0,-4)$. We move 2 units up and 3 units to the left. We get to another new point $(-3,-2)$. We plot the points and draw the line.



21. $f(x) = \frac{5}{2}x + 3$

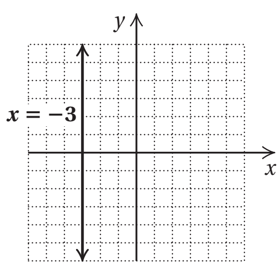
First we plot the y-intercept $(0, 3)$. Then we consider the slope $\frac{5}{2}$. Starting at the y-intercept and using the slope, we find another point by moving 5 units up and 2 units to the right. We get to a new point $(2, 8)$.

We can also think of the slope as $\frac{-5}{-2}$. We again start at the y-intercept $(0, 3)$. We move 5 units down and 2 units to the left. We get to another new point $(-2, -2)$. We plot the points and draw the line.



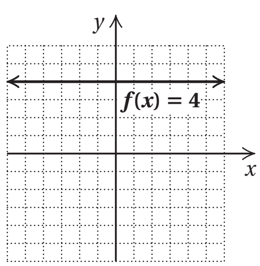
22. $x = -3$

Since y is missing, all ordered pairs $(-3, y)$ are solutions. The graph is parallel to the y-axis.



23. $f(x) = 4$

Since x is missing, all ordered pairs $(x, 4)$ are solutions. The graph is parallel to the x-axis.



24. We first solve each equation for y and determine the slope of each line.

$$y + 5 = -x$$
$$y = -x - 5$$

The slope of $y + 5 = -x$ is -1.

$$x - y = 2$$
$$x = y + 2$$
$$x - 2 = y$$

The slope of $x - y = 2$ is 1.

The slopes are not the same, so the lines are not parallel. The product of the slopes is $-1 \cdot 1$, or -1, so the lines are perpendicular.

25. We first solve each equation for y and determine the slope of each line.

$$3x - 5 = 7y$$
$$\frac{3}{7}x - \frac{5}{7} = y$$

The slope of $3x - 5 = 7y$ is $\frac{3}{7}$.

$$7y - 3x = 7$$
$$7y = 3x + 7$$
$$y = \frac{3}{7}x + 1$$

The slope of $7y - 3x = 7$ is $\frac{3}{7}$.

The slopes are the same and the y-intercepts are different, so the lines are parallel.

26. We first solve each equation for y and determine the slope of each line.

$$4y + x = 3$$
$$4y = -x + 3$$
$$y = -\frac{1}{4}x + \frac{3}{4}$$

The slope of $4y + x = 3$ is $-\frac{1}{4}$.

$$2x + 8y = 5$$
$$8y = -2x + 5$$
$$y = -\frac{1}{4}x + \frac{5}{8}$$

The slope of $2x + 8y = 5$ is $-\frac{1}{4}$.

The slopes are the same and the y-intercepts are different, so the lines are parallel.

27. $x = 4$ is a vertical line and $y = -3$ is a horizontal line, so the lines are perpendicular.

28. We use the slope-intercept equation and substitute 4.7 for m and -23 for b..

$$y = mx + b$$
$$y = 4.7x - 23$$

29. Using the point-slope equation:

Substitute 3 for x_1, -5 for y_1, and -3 for m.

$$y - y_1 = m(x - x_1)$$
$$y - (-5) = -3(x - 3)$$
$$y + 5 = -3x + 9$$
$$y = -3x + 4$$

Using the slope-intercept equation:

Substitute 3 for x, -5 for y, and -3 for m in $y = mx + b$ and solve for b.

$$y = mx + b$$
$$-5 = -3 \cdot 3 + b$$
$$-5 = -9 + b$$
$$4 = b$$

Then we use the equation $y = mx + b$ and substitute -3 for m and 4 for b.

$$y = -3x + 4$$

30. First find the slope of the line:

$$m = \frac{6-3}{-4-(-2)} = \frac{3}{-2} = -\frac{3}{2}$$

Using the point-slope equation:

We choose to use the point $(-2, 3)$ and substitute -2 for x_1, 3 for y_1, and $-\frac{3}{2}$ for m.

$$y - y_1 = m(x - x_1)$$
$$y - 3 = -\frac{3}{2}(x - (-2))$$
$$y - 3 = -\frac{3}{2}(x + 2)$$
$$y - 3 = -\frac{3}{2}x - 3$$
$$y = -\frac{3}{2}x$$

Using the slope-intercept equation:

We choose $(-2, 3)$ and substitute -2 for x, 3 for y, and $-\frac{3}{2}$ for m in $y = mx + b$. Then we solve for b.

$$3 = -\frac{3}{2}(-2) + b$$
$$3 = 3 + b$$
$$0 = b$$

Finally, we use the equation $y = mx + b$ and substitute $-\frac{3}{2}$ for m and 0 for b.

$$y = -\frac{3}{2}x + 0, \text{ or } y = -\frac{3}{2}x$$

31. First solve the equation for y and determine the slope of the given line.

$$5x + 7y = 8 \qquad \text{Given line}$$
$$7y = -5x + 8$$
$$y = -\frac{5}{7}x + \frac{8}{7}$$

The slope of the given line is $-\frac{5}{7}$. The line through $(14, -1)$ must have slope $-\frac{5}{7}$.

Using the point-slope equation:

Substitute 14 for x_1, -1 for y_1, and $-\frac{5}{7}$ for m.

$$y - y_1 = m(x - x_1)$$
$$y - (-1) = -\frac{5}{7}(x - 14)$$
$$y + 1 = -\frac{5}{7}x + 10$$
$$y = -\frac{5}{7}x + 9$$

Using the slope-intercept equation:

Substitute 14 for x, -1 for y, and $-\frac{5}{7}$ for m and solve for b.

$$y = mx + b$$
$$-1 = -\frac{5}{7} \cdot 14 + b$$
$$-1 = -10 + b$$
$$9 = b$$

Then we use the equation $y = mx + b$ and substitute $-\frac{5}{7}$ for m and 9 for b.

$$y = -\frac{5}{7}x + 9$$

32. First solve the equation for y and determine the slope of the given line.

$$3x + y = 5 \qquad \text{Given line}$$
$$y = -3x + 5$$

The slope of the given line is -3. The slope of the perpendicular line is the opposite of the reciprocal of -3. Thus, the line through $(5, 2)$ must have slope $\frac{1}{3}$.

Using the point-slope equation:

Substitute 5 for x_1, 2 for y_1, and $\frac{1}{3}$ for m.

$$y - y_1 = m(x - x_1)$$
$$y - 2 = \frac{1}{3}(x - 5)$$
$$y - 2 = \frac{1}{3}x - \frac{5}{3}$$
$$y = \frac{1}{3}x + \frac{1}{3}$$

Using the slope-intercept equation:

Substitute 5 for x, 2 for y, and $\frac{1}{3}$ for m and solve for b.

$$y = mx + b$$
$$2 = \frac{1}{3} \cdot 5 + b$$
$$2 = \frac{5}{3} + b$$
$$\frac{1}{3} = b$$

Then we use the equation $y = mx + b$ and substitute $\frac{1}{3}$ for m and $\frac{1}{3}$ for b.

$$y = \frac{1}{3}x + \frac{1}{3}$$

CLICK HERE TO ACCESS THE COMPLETE Solutions

33. a) We form pairs of the type (x, R) where x is the number of years since 1972 and R is the record. We have two pairs, $(0, 44.66)$ and $(44, 43.03)$. These are two points on the graph of the linear function we are seeking.

First we find the slope:

$m = \frac{43.03 - 44.66}{44 - 0} = \frac{-1.63}{44} \approx -0.037.$

Using the slope and the y-intercept, we write the function: $R(x) = -0.037x + 44.66$, where x is the number of years after 1972.

b) 2000 is 28 years after 1972, so to estimate the record in 2000, we find $R(28)$:

$$\begin{aligned} R(28) &= -0.037(28) + 44.66 \\ &\approx 43.62 \end{aligned}$$

The estimated record was about 43.62 seconds in 2000.

2010 is 38 years after 1972, so to estimate the record in 2010, we find $R(38)$:

$$\begin{aligned} R(38) &= -0.037(38) + 44.66 \\ &\approx 43.25 \end{aligned}$$

The estimated record was about 43.25 seconds in 2010.

34. $f(x) = \frac{x+3}{x-2}$

We cannot calculate $\frac{x+3}{x-2}$ when the denominator is 0, so we solve $x - 2 = 0$.

$$\begin{aligned} x - 2 &= 0 \\ x &= 2 \end{aligned}$$

Thus, the domain of f is $(-\infty, 2) \cup (2, \infty)$. Answer C is correct.

35. First we find the slope of the given line.

$$\begin{aligned} 3y - \frac{1}{2}x &= 0 \\ 3y &= \frac{1}{2}x \\ y &= \frac{1}{6}x \end{aligned}$$

The slope is $\frac{1}{6}$. The slope of a line perpendicular to the given line is -6. We use the point-slope equation.

$$\begin{aligned} y - 1 &= -6[x - (-2)] \\ y - 1 &= -6(x + 2) \\ y - 1 &= -6x - 12 \\ y &= -6x - 11, \text{ or} \\ 6x + y &= -11 \end{aligned}$$

Answer A is correct.

36. The cost of x jars of preserves is \$2.49x, and the shipping charges are \$3.75 + \$0.60x. Then the total cost is \$2.49x + \$3.75 + \$0.60x, or \$3.09x + \$3.75. Thus, a linear function that can be used to determine the cost of buying and shipping x jars of preserves is $f(x) = 3.09x + 3.75$.

Chapter 2 Discussion and Writing Exercises

1. A line's x- and y-intercepts are the same only when the line passes through the origin. The equation for such a line is of the form $y = mx$.

2. The concept of slope is useful in describing how a line slants. A line with positive slope slants up from left to right. A line with negative slope slants down from left to right. The larger the absolute value of the slope, the steeper the slant.

3. Find the slope-intercept form of the equation.

$$\begin{aligned} 4x + 5y &= 12 \\ 5y &= -4x + 12 \\ y &= -\frac{4}{5}x + \frac{12}{5} \end{aligned}$$

This form of the equation indicates that the line has a negative slope and thus should slant down from left to right. The student apparently graphed $y = \frac{4}{5}x + \frac{12}{5}$.

4. For $R(t) = 50t + 35$, $m = 50$ and $b = 35$; 50 signifies that the cost per hour of a repair is \$50; 35 signifies that the minimum cost of a repair job is \$35.

5. $m = \frac{\text{change in } y}{\text{change in } x}$

As we move from one point to another on a vertical line, the y-coordinate changes but the x-coordinate does not. Thus, the change in y is a non-zero number while the change in x is 0. Since division by 0 is undefined, the slope of a vertical line is undefined.

As we move from one point to another on a horizontal line, the y-coordinate does not change but the x-coordinate does. Thus, the change in y is 0 while the change in x is a non-zero number, so the slope is 0.

6. Using algebra, we find that the slope-intercept form of the equation is $y = \frac{5}{2}x - \frac{3}{2}$. This indicates that the y-intercept is $\left(0, -\frac{3}{2}\right)$, so a mistake has been made. It appears that the student graphed $y = \frac{5}{2}x + \frac{3}{2}$.

Chapter 2 Test

1. Yes; each member of the domain is matched to only one member of the range.

2. No; a member of the domain, Lake Placid, is matched to more than one member of the range.

3. $f(x) = -3x - 4$

$f(0) = -3 \cdot 0 - 4 = 0 - 4 = -4$

$f(-2) = -3(-2) - 4 = 6 - 4 = 2$

4. $g(x) = x^2 + 7$

$g(0) = 0^2 + 7 = 0 + 7 = 7$

$g(-1) = (-1)^2 + 7 = 1 + 7 = 8$

5. $h(x) = -6$

$h(-4) = -6$

$h(-6) = -6$

6. $f(x) = |x + 7|$

$f(-10) = |-10 + 7| = |-3| = 3$

$f(-7) = |-7 + 7| = |0| = 0$

7. $y = -2x - 5$

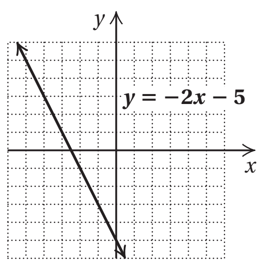
We find some ordered pairs that are solutions, plot them, and draw and label the line.

When $x = 0$, $y = -2 \cdot 0 - 5 = 0 - 5 = -5$.

When $x = -2$, $y = -2(-2) - 5 = 4 - 5 = -1$.

When $x = -4$, $y = -2(-4) - 5 = 8 - 5 = 3$.

x	y
0	−5
−2	−1
−4	3



8. $f(x) = -\frac{3}{5}x$

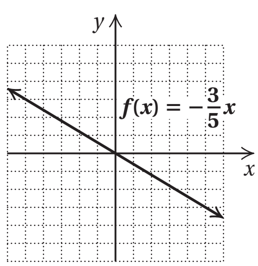
We find some function values, plot the corresponding points, and draw the graph.

$f(-5) = -\frac{3}{5}(-5) = 3$

$f(0) = -\frac{3}{5} \cdot 0 = 0$

$f(5) = -\frac{3}{5} \cdot 5 = -3$

x	$f(x)$
−5	3
0	0
5	−3



9. $g(x) = 2 - |x|$

We find some function values, plot the corresponding points, and draw the graph.

$g(-4) = 2 - |-4| = 2 - 4 = -2$

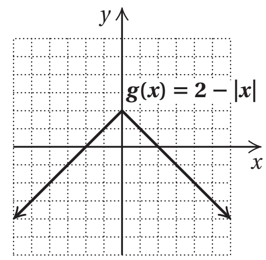
$g(-2) = 2 - |-2| = 2 - 2 = 0$

$g(0) = 2 - |0| = 2 - 0 = 2$

$g(3) = 2 - |3| = 2 - 3 = -1$

$g(5) = 2 - |5| = 2 - 5 = -3$

x	$g(x)$
−4	−2
−2	0
0	2
3	−1
5	−3



10. $f(x) = x^2 + 2x - 3$

We find some function values, plot the corresponding points, and draw the graph.

$f(-4) = (-4)^2 + 2(-4) - 3 = 16 - 8 - 3 = 5$

$f(-3) = (-3)^2 + 2(-3) - 3 = 9 - 6 - 3 = 0$

$f(-1) = (-1)^2 + 2(-1) - 3 = 1 - 2 - 3 = -4$

$f(0) = 0^2 + 2 \cdot 0 - 3 = -3$

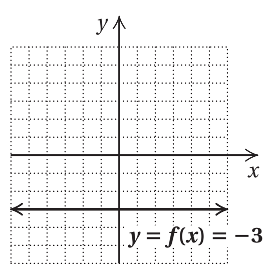
$f(1) = 1^2 + 2 \cdot 1 - 3 = 1 + 2 - 3 = 0$

$f(2) = 2^2 + 2 \cdot 2 - 3 = 4 + 4 - 3 = 5$

x	$f(x)$
−4	5
−3	0
−1	−4
0	−3
1	0
2	5

11. $y = f(x) = -3$

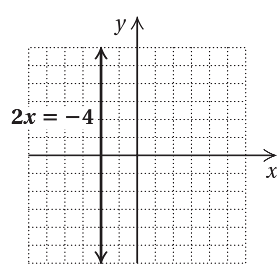
Since x is missing, all ordered pairs $(x, -3)$ are solutions. The graph is parallel to the x-axis.



12. $2x = -4$

$x = -2$

Since y is missing, all ordered pairs $(-2, y)$ are solutions. The graph is parallel to the y-axis.



13. a) In 2010, $x = 2010 - 1990 = 20$.

$A(20) = 0.22(20) + 5.87 = 4.4 + 5.87 = 10.27 \approx 10.3$ years

b) Substitute 11.6 for $A(t)$ and solve for t.

$$11.6 = 0.22t + 5.87$$
$$5.73 = 0.22t$$
$$26 \approx t$$

The median age of cars was 11.6 years about 26 years after 1990, or in 2016.

14. No vertical line will intersect the graph more than once. Thus, the graph is the graph of a function.

15. It is possible for a vertical line to intersect the graph more than once. Thus, this is not the graph of a function.

16. $f(x) = \dfrac{8}{2x+3}$

Since $\dfrac{8}{2x+3}$ cannot be calculated when the denominator is 0, we find the x-value that causes $2x + 3$ to be 0:

$$2x + 3 = 0$$
$$2x = -3$$
$$x = -\frac{3}{2}$$

Thus, $-\dfrac{3}{2}$ is not in the domain of f, while all other real numbers are. The domain of f is

$\left\{x \middle| x \text{ is a real number } \textit{and } x \neq -\dfrac{3}{2}\right\}$, or

$\left(-\infty, -\dfrac{3}{2}\right) \cup \left(-\dfrac{3}{2}, \infty\right)$.

17. $g(x) = 5 - x^2$

Since we can calculate $5 - x^2$ for any real number x, the domain is the set of all real numbers.

18. a) Locate 1 on the horizontal axis and then find the point on the graph for which 1 is the first coordinate. From that point, look to the vertical axis to find the corresponding y-coordinate, 1. Thus, $f(1) = 1$.

b) The set of all x-values in the graph extends from -3 to 4, so the domain is $\{x| -3 \leq x \leq 4\}$, or $[-3, 4]$.

c) To determine which member(s) of the domain are paired with 2, locate 2 on the vertical axis. From there look left and right to the graph to find any points for which 2 is the second coordinate. One such point exists. Its first coordinate is -3, so the x-value for which $f(x) = 2$ is -3.

d) The set of all y-values in the graph extends from -1 to 2, so the range is $\{y| -1 \leq y \leq 2\}$, or $[-1, 2]$.

19.
$$f(x) = -\frac{3}{5}x + 12$$
$$\uparrow \qquad \uparrow$$
$$f(x) = mx + b$$

The slope is $-\dfrac{3}{5}$, and the y-intercept is $(0, 12)$.

20. First we find the slope-intercept form of the equation by solving for y. This allows us to determine the slope and y-intercept easily.

$$-5y - 2x = 7$$
$$-5y = 2x + 7$$
$$\frac{-5y}{-5} = \frac{2x+7}{-5}$$
$$y = -\frac{2}{5}x - \frac{7}{5}$$

The slope is $-\dfrac{2}{5}$, and the y-intercept is $\left(0, -\dfrac{7}{5}\right)$.

21. $\text{Slope} = \dfrac{\text{change in } y}{\text{change in } x} = \dfrac{-2-3}{-2-6} = \dfrac{-5}{-8} = \dfrac{5}{8}$

22. $\text{Slope} = \dfrac{\text{change in } y}{\text{change in } x} = \dfrac{5.2 - 5.2}{-4.4 - (-3.1)} = \dfrac{0}{-1.3} = 0$

23. We can use the coordinates of any two points on the graph. We'll use $(10, 0)$ and $(25, 12)$.

$\text{Slope} = \dfrac{\text{change in } y}{\text{change in } x} = \dfrac{12-0}{25-10} = \dfrac{12}{15} = \dfrac{4}{5}$

The slope, or rate of change is $\dfrac{4}{5}$ km/min.

24. $2x + 3y = 6$

To find the x-intercept we let $y = 0$ and solve for x.

$$2x + 3y = 6$$
$$2x + 3 \cdot 0 = 6$$
$$2x = 6$$
$$x = 3$$

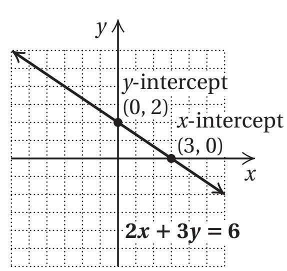
The x-intercept is $(3, 0)$.

To find the y-intercept we let $x = 0$ and solve for y.

$$2x + 3y = 6$$
$$2 \cdot 0 + 3y = 6$$
$$3y = 6$$
$$y = 2$$

The y-intercept is $(0, 2)$.

We plot these points and draw the line.



We use a third point as a check. We choose $x = -3$ and solve for y.

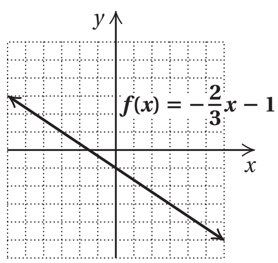
$$2(-3) + 3y = 6$$
$$-6 + 3y = 6$$
$$3y = 12$$
$$y = 4$$

We plot $(-3, 4)$ and note that it is on the line.

25. $f(x) = -\frac{2}{3}x - 1$

First we plot the y-intercept $(0, -1)$. We can think of the slope as $\frac{-2}{3}$. Starting at the y-intercept and using the slope, we find another point by moving 2 units down and 3 units to the right. We get to a new point $(3, -3)$.

We can also think of the slope as $\frac{2}{-3}$. We again start at the y-intercept $(0, -1)$. We move 2 units up and 3 units to the left. We get to another new point $(-3, 1)$. We plot the points and draw the line.



26. We first solve each equation for y and determine the slope of each line.

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

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

$$-3x + 4y = -12$$
$$4y = 3x - 12$$
$$y = \frac{3}{4}x - 3$$

The slope of $-3x + 4y = -12$ is $\frac{3}{4}$.

The slopes are the same and the y-intercepts are different, so the lines are parallel.

27. The slope of $y = -2x + 5$ is -2.

We solve the second equation for y and determine the slope.

$$2y - x = 6$$
$$2y = x + 6$$
$$y = \frac{1}{2}x + 3$$

The slopes are not the same, so the lines are not parallel. The product of the slopes is $-2 \cdot \frac{1}{2}$, or -1, so the lines are perpendicular.

28. We use the slope-intercept equation and substitute -3 for m and 4.8 for b.

$$y = mx + b$$
$$y = -3x + 4.8$$

29. $y = f(x) = mx + b$

$$f(x) = 5.2x - \frac{5}{8}$$

30. Using the point-slope equation:

Substitute 1 for x_1, -2 for y_1, and -4 for m.

$$y - y_1 = m(x - x_1)$$
$$y - (-2) = -4(x - 1)$$
$$y + 2 = -4x + 4$$
$$y = -4x + 2$$

Using the slope-intercept equation:

Substitute 1 for x, -2 for y, and -4 for m in $y = mx + b$ and solve for b.

$$y = mx + b$$
$$-2 = -4 \cdot 1 + b$$
$$-2 = -4 + b$$
$$2 = b$$

Then we use the equation $y = mx + b$ and substitute -4 for m and 2 for b.

$$y = -4x + 2$$

31. First find the slope of the line:

$$m = \frac{-6 - 15}{4 - (-10)} = \frac{-21}{14} = -\frac{3}{2}$$

Using the point-slope equation:

We choose to use the point $(4, -6)$ and substitute 4 for x_1, 6 for y_1, and $-\frac{3}{2}$ for m.

$$y - y_1 = m(x - x_1)$$
$$y - (-6) = -\frac{3}{2}(x - 4)$$
$$y + 6 = -\frac{3}{2}x + 6$$
$$y = -\frac{3}{2}x$$

Using the slope-intercept equation:

We choose $(4, -6)$ and substitute 4 for x, -6 for y, and $-\frac{3}{2}$ for m in $y = mx + b$. Then we solve for b.

$$y = mx + b$$
$$-6 = -\frac{3}{2} \cdot 4 + b$$
$$-6 = -6 + b$$
$$0 = b$$

Finally, we use the equation $y = mx + b$ and substitute $-\frac{3}{2}$ for m and 0 for b.

$$y = -\frac{3}{2}x + 0, \text{ or } y = -\frac{3}{2}x$$

32. First solve the equation for y and determine the slope of the given line.

$$x - 2y = 5 \qquad \text{Given line}$$
$$-2y = -x + 5$$
$$y = \frac{1}{2}x - \frac{5}{2}$$

The slope of the given line is $\frac{1}{2}$. The line through $(4, -1)$ must have slope $\frac{1}{2}$.

Using the point-slope equation:

Substitute 4 for x_1, -1 for y_1, and $\frac{1}{2}$ for m.

$$y - y_1 = m(x - x_1)$$
$$y - (-1) = \frac{1}{2}(x - 4)$$
$$y + 1 = \frac{1}{2}x - 2$$
$$y = \frac{1}{2}x - 3$$

Using the slope-intercept equation:

Substitute 4 for x, -1 for y, and $\frac{1}{2}$ for m and solve for b.

$$y = mx + b$$
$$-1 = \frac{1}{2}(4) + b$$
$$-1 = 2 + b$$
$$-3 = b$$

Then we use the equation $y = mx + b$ and substitute $\frac{1}{2}$ for m and -3 for b.

$$y = \frac{1}{2}x - 3$$

33. First solve the equation for y and determine the slope of the given line.

$$x + 3y = 2 \quad \text{Given line}$$
$$3y = -x + 2$$
$$y = -\frac{1}{3}x + \frac{2}{3}$$

The slope of the given line is $-\frac{1}{3}$. The slope of the perpendicular line is the opposite of the reciprocal of $-\frac{1}{3}$. Thus, the line through $(2, 5)$ must have slope 3.

Using the point-slope equation:

Substitute 2 for x_1, 5 for y_1, and 3 for m.

$$y - y_1 = m(x - x_1)$$
$$y - 5 = 3(x - 2)$$
$$y - 5 = 3x - 6$$
$$y = 3x - 1$$

Using the slope-intercept equation:

Substitute 2 for x, 5 for y, and 3 for m and solve for b.

$$y = mx + b$$
$$5 = 3 \cdot 2 + b$$
$$5 = 6 + b$$
$$-1 = b$$

Then we use the equation $y = mx + b$ and substitute 3 for m and -1 for b.

$$y = 3x - 1$$

34. a) Note that $2015 - 1970 = 45$. Thus, the data points are $(0, 23.2)$ and $(45, 29.2)$. We find the slope.

$$m = \frac{29.2 - 23.2}{45 - 0} = \frac{6}{45} \approx 0.133$$

Using the slope and the y-intercept, we write the function: $A(x) = 0.133x + 23.2$

b) In 2008, $x = 2008 - 1970 = 38$.

$A(38) = 0.133(38) + 23.2 \approx 28.25$ years

In 2019, $x = 2019 - 1970 = 49$.

$A(49) = 0.133(49) + 23.2 \approx 29.72$ years

35. Using the point-slope equation, $y - y_1 = m(x - x_1)$, with $x_1 = 3$, $y_1 = 1$, and $m = -2$ we have $y - 1 = -2(x - 3)$. Thus, answer B is correct.

36. First solve each equation for y and determine the slopes.

$$3x + ky = 17$$
$$ky = -3x + 17$$
$$y = -\frac{3}{k}x + \frac{17}{k}$$

The slope of $3x + ky = 17$ is $-\frac{3}{k}$.

$$8x - 5y = 26$$
$$-5y = -8x + 26$$
$$y = \frac{8}{5}x - \frac{26}{5}$$

The slope of $8x - 5y = 26$ is $\frac{8}{5}$.

If the lines are perpendicular, the product of their slopes is -1.

$$-\frac{3}{k} \cdot \frac{8}{5} = -1$$
$$-\frac{24}{5k} = -1$$
$$24 = 5k \quad \text{Multiplying by } -5k$$
$$\frac{24}{5} = k$$

37. Answers may vary. One such function is $f(x) = 3$.

Cumulative Review Chapters 1 - 2

1. a) Note that $2004 - 1950 = 54$, so 2004 is 54 yr after 1950. Then the data points are $(0, 3.85)$ and $(54, 3.50)$.

First we find the slope.

$$m = \frac{3.50 - 3.85}{54 - 0} = \frac{-0.35}{54} \approx -0.006$$

Using the slope and the y-intercept, $(0, 3.85)$, we write the function: $R(x) = -0.006x + 3.85$.

b) In 2008, $x = 2008 - 1950 = 58$.

$R(58) = -0.006(58) + 3.85 \approx 3.50$ min

In 2010, $x = 2010 - 1950 = 60$.

$R(60) = -0.006(60) + 3.85 \approx 3.49$ min

2. a) Locate 15 on the x-axis and the find the point on the graph for which 15 is the first coordinate. From that point, look to the vertical axis to find the corresponding y-coordinate, 6. Thus, $f(15) = 6$.

b) The set of all x-values in the graph extends from 0 to 30, so the domain is $\{x|0 \le x \le 30\}$, or $[0, 30]$.

c) To determine which member(s) of the domain are paired with 14, locate 14 on the vertical axis. From there look left and right to the graph to find any points for which 14 is the second coordinate. One such point exists. Its first coordinate is 25. Thus, the x-value for which $f(x) = 14$ is 25.

d) The set of all y-values in the graph extends from 0 to 15, so the range is $\{y|0 \le y \le 15\}$, or $[0, 15]$.

3.
$$x + 9.4 = -12.6$$
$$x + 9.4 - 9.4 = -12.6 - 9.4$$
$$x = -22$$

The solution is -22.

4.
$$\frac{2}{3}x - \frac{1}{4} = -\frac{4}{5}x$$
$$60\left(\frac{2}{3}x - \frac{1}{4}\right) = 60\left(-\frac{4}{5}x\right) \quad \text{Clearing fractions}$$
$$60 \cdot \frac{2}{3}x - 60 \cdot \frac{1}{4} = -48x$$
$$40x - 15 = -48x$$
$$40x - 15 - 40x = -48x - 40x$$
$$-15 = -88x$$
$$\frac{-15}{-88} = \frac{-88x}{-88}$$
$$\frac{15}{88} = x$$

The solution is $\frac{15}{88}$.

5.
$$-2.4t = -48$$
$$\frac{-2.4t}{-2.4} = \frac{-48}{-2.4}$$
$$t = 20$$

The solution is 20.

6.
$$4x + 7 = -14$$
$$4x = -21 \quad \text{Subtracting 7}$$
$$x = -\frac{21}{4} \quad \text{Dividing by 4}$$

The solution is $-\frac{21}{4}$.

7.
$$3n - (4n - 2) = 7$$
$$3n - 4n + 2 = 7$$
$$-n + 2 = 7$$
$$-n = 5$$
$$n = -5 \quad \text{Multiplying by } -1$$

The solution is -5.

8.
$$5y - 10 = 10 + 5y$$
$$-10 = 10 \quad \text{Subtracting } 5y$$

We get a false equation, so the original equation has no solution.

9.
$$W = Ax + By$$
$$W - By = Ax \quad \text{Subtracting } By$$
$$\frac{W - By}{A} = x \quad \text{Dividing by } A$$

10.
$$M = A + 4AB$$
$$M = A(1 + 4B) \quad \text{Factoring out } A$$
$$\frac{M}{1 + 4B} = A \quad \text{Dividing by } 1 + 4B$$

11.
$$y - 12 \le -5$$
$$y \le 7 \quad \text{Adding 12}$$

The solution set is $\{y|y \le 7\}$, or $(-\infty, 7]$.

12.
$$6x - 7 < 2x - 13$$
$$4x - 7 < -13$$
$$4x < -6$$
$$x < -\frac{3}{2}$$

The solution set is $\left\{x\middle|x < -\frac{3}{2}\right\}$, or $\left(-\infty, -\frac{3}{2}\right)$.

13.
$$5(1 - 2x) + x < 2(3 + x)$$
$$5 - 10x + x < 6 + 2x$$
$$5 - 9x < 6 + 2x$$
$$5 - 11x < 6$$
$$-11x < 1$$
$$x > -\frac{1}{11} \quad \text{Reversing the inequality symbol}$$

The solution set is $\left\{x\middle|x > -\frac{1}{11}\right\}$, or $\left(-\frac{1}{11}, \infty\right)$.

14.
$$x + 3 < -1 \quad \textit{or} \quad x + 9 \ge 1$$
$$x < -4 \quad \textit{or} \quad x \ge -8$$

The intersection of $\{x|x < -4\}$ and $\{x|x \ge -8\}$ is the set of all real numbers. This is the solution set.

15.
$$-3 < x + 4 \le 8$$
$$-7 < x \le 4$$

The solution set is $\{x| - 7 < x \le 4\}$, or $(-7, 4]$.

16.
$$-8 \le 2x - 4 \le -1$$
$$-4 \le 2x \le 3$$
$$-2 \le x \le \frac{3}{2}$$

The solution set is $\left\{x\middle| - 2 \le x \le \frac{3}{2}\right\}$, or $\left[-2, \frac{3}{2}\right]$.

17.
$$|x| = 8$$
$$x = -8 \quad \textit{or} \quad x = 8$$

The solution set is $\{-8, 8\}$.

18. $|y| > 4$

$y < -4 \quad or \quad y > 4$

The solution set is $\{y|y < -4 \text{ or } y > 4\}$, or $(-\infty, -4) \cup (4, \infty)$.

19. $|4x - 1| \leq 7$

$-7 \leq 4x - 1 \leq 7$

$-6 \leq 4x \leq 8$

$-\frac{3}{2} \leq x \leq 2$

The solution set is $\left\{x \middle| -\frac{3}{2} \leq x \leq 2\right\}$, or $\left[-\frac{3}{2}, 2\right]$.

20. First solve the equation for y and determine the slope of the given line.

$$4y - x = 3 \qquad \text{Given line}$$
$$4y = x + 3$$
$$y = \frac{1}{4}x + \frac{3}{4}$$

The slope of the given line is $\frac{1}{4}$. The slope of the perpendicular line is the opposite of the reciprocal of $\frac{1}{4}$. Thus, the line through $(-4, -6)$ must have slope -4.

Using the point-slope equation:

Substitute -4 for x_1, -6 for y_1, and -4 for m.

$$y - y_1 = m(x - x_1)$$
$$y - (-6) = -4(x - (-4))$$
$$y + 6 = -4(x + 4)$$
$$y + 6 = -4x - 16$$
$$y = -4x - 22$$

Using the slope-intercept equation:

Substitute -4 for x, -6 for y, and -4 for m.

$$y = mx + b$$
$$-6 = -4(-4) + b$$
$$-6 = 16 + b$$
$$-22 = b$$

Then we use the equation $y = mx + b$ and substitute -4 for m and -22 for b.

$$y = -4x - 22$$

21. First solve the equation for y and determine the slope of the given line.

$$4y - x = 3 \qquad \text{Given line}$$
$$4y = x + 3$$
$$y = \frac{1}{4}x + \frac{3}{4}$$

The slope of the given line is $\frac{1}{4}$. The line through $(-4, -6)$ must have slope $\frac{1}{4}$.

Using the point-slope equation:

Substitute -4 for x_1, -6 for y_1, and $\frac{1}{4}$ for m.

$$y - y_1 = m(x - x_1)$$
$$y - (-6) = \frac{1}{4}(x - (-4))$$
$$y + 6 = \frac{1}{4}(x + 4)$$
$$y + 6 = \frac{1}{4}x + 1$$
$$y = \frac{1}{4}x - 5$$

Using the slope-intercept equation:

Substitute -4 for x, -6 for y, and $\frac{1}{4}$ for m and solve for b.

$$y = mx + b$$
$$-6 = \frac{1}{4}(-4) + b$$
$$-6 = -1 + b$$
$$-5 = b$$

Then we use the equation $y = mx + b$ and substitute $\frac{1}{4}$ for m and -5 for b.

$$y = \frac{1}{4}x - 5$$

22. $y = -2x + 3$

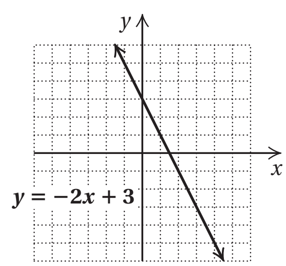
We find some ordered pairs that are solutions, plot them, and draw and label the graph.

When $x = -1$, $y = -2(-1) + 3 = 2 + 3 = 5$.

When $x = 1$, $y = -2 \cdot 1 + 3 = -2 + 3 = 1$.

When $x = 3$, $y = -2 \cdot 3 + 3 = -6 + 3 = -3$.

x	y
-1	5
1	1
3	-3



23. $3x = 2y + 6$

To find the x-intercept we let $y = 0$ and solve for x.

$$3x = 2y + 6$$
$$3x = 2 \cdot 0 + 6$$
$$3x = 6$$
$$x = 2$$

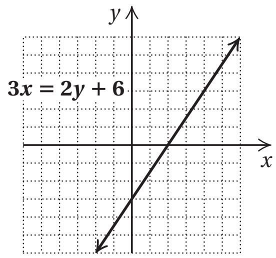
The x-intercept is $(2, 0)$.

To find the y-intercept we let $x = 0$ and solve for y.

$$3x = 2y + 6$$
$$3 \cdot 0 = 2y + 6$$
$$0 = 2y + 6$$
$$-2y = 6$$
$$y = -3$$

The y-intercept is $(0, -3)$.

We plot these points and draw the line.



We use a third point as a check. We choose $x = 4$ and solve for y.

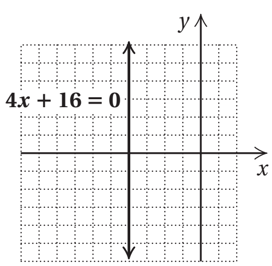
$$3 \cdot 4 = 2y + 6$$
$$12 = 2y + 6$$
$$6 = 2y$$
$$3 = y$$

We plot $(4, 3)$ and note that it is on the line.

24. $4x + 16 = 0$

$$4x = -16$$
$$x = -4$$

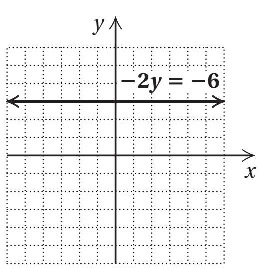
Since y is missing, all ordered pairs $(-4, y)$ are solutions. The graph is parallel to the y-axis.



25. $-2y = -6$

$$y = 3$$

Since x is missing, all ordered pairs $(x, 3)$ are solutions. The graph is parallel to the x-axis.



26. $f(x) = \frac{2}{3}x + 1$

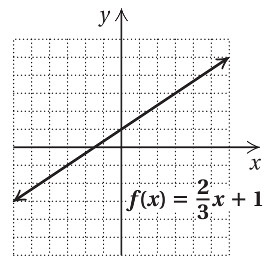
We calculate some function values, plot the corresponding points, and connect them.

$$f(-3) = \frac{2}{3}(-3) + 1 = -2 + 1 = -1$$

$$f(0) = \frac{2}{3} \cdot 0 + 1 = 0 + 1 = 1$$

$$f(3) = \frac{2}{3} \cdot 3 + 1 = 2 + 1 = 3$$

x	$f(x)$
-3	-1
0	1
3	3

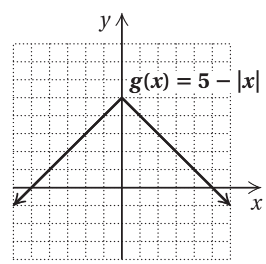


27. $g(x) = 5 - |x|$

We calculate some function values, plot the corresponding points, and connect them.

$$g(-2) = 5 - |-2| = 5 - 2 = 3$$
$$g(-1) = 5 - |-1| = 5 - 1 = 4$$
$$g(0) = 5 - |0| = 5 - 0 = 5$$
$$g(1) = 5 - |1| = 5 - 1 = 4$$
$$g(2) = 5 - |2| = 5 - 2 = 3$$
$$g(3) = 5 - |3| = 5 - 3 = 2$$

x	$g(x)$
-2	3
-1	4
0	5
1	4
2	3
3	2



28. First we find the slope-intercept form of the equation by solving for y. This allows us to determine the slope and y-intercept easily.

$$-4y + 9x = 12$$
$$-4y = -9x + 12$$
$$\frac{-4y}{-4} = \frac{-9x + 12}{-4}$$
$$y = \frac{9}{4}x - 3$$

The slope is $\frac{9}{4}$, and the y-intercept is $(0, -3)$.

29. Slope $= \frac{\text{change in } y}{\text{change in } x} = \frac{3 - 7}{-1 - 2} = \frac{-4}{-3} = \frac{4}{3}$

30. Using the point-slope equation:

Substitute 2 for x_1, -11 for y_1, and -3 for m.

$$y - y_1 = m(x - x_1)$$
$$y - (-11) = -3(x - 2)$$
$$y + 11 = -3x + 6$$
$$y = -3x - 5$$

Using the slope-intercept equation:

Substitute 2 for x, -11 for y, and -3 for m in $y = mx + b$ and solve for b.

$$y = mx + b$$
$$-11 = -3 \cdot 2 + b$$
$$-11 = -6 + b$$
$$-5 = b$$

Then use the equation $y = mx + b$ and substitute -3 for m and -5 for b.

$$y = -3x - 5$$

31. First find the slope of the line:

$$m = \frac{3-2}{-6-4} = \frac{1}{-10} = -\frac{1}{10}$$

Using the point-slope equation:

We choose to use the point $(4, 2)$ and substitute 4 for x_1, 2 for y_1, and $-\frac{1}{10}$ for m.

$$y - y_1 = m(x - x_1)$$
$$y - 2 = -\frac{1}{10}(x - 4)$$
$$y - 2 = -\frac{1}{10}x + \frac{2}{5}$$
$$y = -\frac{1}{10}x + \frac{12}{5}$$

Using the slope-intercept equation:

We choose $(4, 2)$ and substitute 4 for x, 2 for y, and $-\frac{1}{10}$ for m in $y = mx + b$. Then we solve for b.

$$y = mx + b$$
$$2 = -\frac{1}{10} \cdot 4 + b$$
$$2 = -\frac{2}{5} + b$$
$$\frac{12}{5} = b$$

Finally, we use the equation $y = mx + b$ and substitute $-\frac{1}{10}$ for m and $\frac{12}{5}$ for b.

$$y = -\frac{1}{10}x + \frac{12}{5}$$

32. ***Familiarize***. Let $w =$ the width, in meters. Then $w + 6 =$ the length. Recall that the formula for the perimeter of a rectangle is $P = 2l + 2w$.

Translate. We use the formula for perimeter.

$$80 = 2(w + 6) + 2w$$

Solve. We solve the equation.

$$80 = 2(w + 6) + 2w$$
$$80 = 2w + 12 + 2w$$
$$80 = 4w + 12$$
$$68 = 4w$$
$$17 = w$$

If $w = 17$, then $w + 6 = 17 + 6 = 23$.

Check. 23 m is 6 m more than 17 m, and $2 \cdot 23 + 2 \cdot 17 = 46 + 34 = 80$ m. The answer checks.

State. The length is 23 m and the width is 17 m.

33. ***Familiarize***. Let $s =$ David's old salary. Then his new salary is $s + 20\%s$, or $s + 0.2s$, or $1.2s$.

Translate.

$$\underbrace{\text{New salary}} \text{ is } \$27,000$$
$$\downarrow \quad \downarrow \quad \downarrow$$
$$1.2s \quad = \quad 27,000$$

Solve. We solve the equation.

$$1.2s = 27,000$$
$$s = 22,500$$

Check. 20% of \$22,500 is $0.2(\$22,500)$, or \$4500, and $\$22,500 + \$4500 = \$27,000$. The answer checks.

State. David's old salary was \$22,500.

34. First we solve each equation for y and determine the slopes.

a) $7y - 3x = 21$

$$7y = 3x + 21$$
$$y = \frac{3}{7}x + 3$$

The slope is $\frac{3}{7}$.

b) $-3x - 7y = 12$

$$-7y = 3x + 12$$
$$y = -\frac{3}{7}x - \frac{12}{7}$$

The slope is $-\frac{3}{7}$.

c) $7y + 3x = 21$

$$7y = -3x + 21$$
$$y = -\frac{3}{7}x + 3$$

The slope is $-\frac{3}{7}$.

d) $3y + 7x = 12$

$$3y = -7x + 12$$
$$y = -\frac{7}{3}x + 4$$

The slope is $-\frac{7}{3}$.

The only pair of slopes whose product is -1 is $\frac{3}{7}$ and $-\frac{7}{3}$. Thus, equations (1) and (4) represent perpendicular lines.

35. We have two data points, $(1000,\ 101,000)$ and $(1250,\ 126,000)$. We find the slope of the line containing these points.

$$m = \frac{126,000 - 101,000}{1250 - 1000} = \frac{25,000}{250} = 100$$

We will use the point-slope equation with $x_1 = 1000$, $y_1 = 101,000$ and $m = 100$.

$$y - y_1 = m(x - x_1)$$
$$y - 101,000 = 100(x - 1000)$$
$$y - 101,000 = 100x - 100,000$$
$$y = 100x + 1000$$

Now we find the value of y when $x = 1500$.

$$y = 100 \cdot 1500 + 1000 = 150,000 + 1000 = 151,000$$

Thus, when \$1500 is spent on advertising, weekly sales increase by \$151,000.

36. $x + 5 < 3x - 7 \le x + 13$

$$\begin{aligned} x + 5 < 3x - 7 \quad &\textit{and} \quad 3x - 7 \le x + 13 \\ 5 < 2x - 7 \quad &\textit{and} \quad 2x - 7 \le 13 \\ 12 < 2x \quad &\textit{and} \quad 2x \le 20 \\ 6 < x \quad &\textit{and} \quad x \le 10 \end{aligned}$$

The solution set is $\{x|6 < x \textit{ and } x \le 10\}$, or $\{x|6 < x \le 10\}$, or $(6, 10]$.

Graphs of Equations

Learning Objectives:

a Plot points associated with ordered pairs of numbers.
b Determine whether an ordered pair of numbers is a solution of an equation.
c Graph linear equations using tables.
d Graph nonlinear equations using tables.

Examples:

1. Fill in the missing information.
   a) The ordered pair (x, y) that makes an equation true is called a ____________ to that equation.

   b) $(3,4)$ is a solution to $x + y = 7$ because ____________.

   c) Three more solutions to $x + y = 7$ are ____________.

   d) When the solutions to $x + y = 7$ are graphed on the Cartesian coordinate system the result is a ____________.

2. Determine whether the given point is a solution of the equation.
   a) $(-1,2)$; $y = 2x + 4$ b) $(-3,3)$; $x - y = 9$

3. Graph.
   a) $y = x + 1$ b) $2x + y = 3$ c) $y = \frac{2}{3}x - 3$

4. Graph.
   a) $y = x^2 + 3$ b) $y = \frac{4}{x}$ c) $y = |x| - 3$

Teaching Notes:

- Some students find graphing very difficult.
- Some students do not realize they can choose any x-value at all, and solve for y to find an ordered pair that is a solution of an equation.

Answers: 1a) solution, b) $3 + 4 = 7$, c) answers vary, d) line; 2a) Yes, b) no; 3-4) See graph answer pages.

Functions and Graphs

Learning Objectives:

- a Determine whether a correspondence is a function.
- b Given a function described by an equation, find function values (outputs) for specified values (inputs).
- c Draw the graph of a function.
- d Determine whether a graph is that of a function using the vertical-line test.
- e Solve applied problems involving functions and their graphs.

Examples:

1. Determine whether each correspondence is a function.

   a) Domain Range
   $1 \to 4$
   $1 \to 6$

   b) Domain Range
   $3 \to -4$
   $8 \to 9$

   c) Domain Range
   $-2 \to -6$
   $0 \to -6$

2. Given the following functions, find the indicated values.

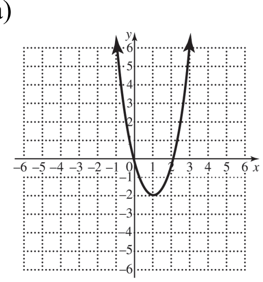
   a) $f(x) = 4 - 2x$; find $f(-1), f(4), f\left(\frac{1}{2}\right)$
   b) $f(x) = \frac{2}{5}x + 2$; find $f(-5), f(2), f\left(\frac{1}{2}\right)$
   c) $f(x) = -x^2 + 2x - 3$; find $f(-1), f(2)$
   d) $f(x) = x^3 - 4$; find $f(-1), f(10), f(-3)$

3. Graph each function.

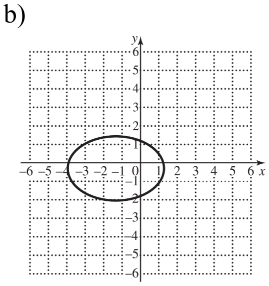
   a) $f(x) = -2x + 3$
   b) $g(x) = -x^2 + x + 2$
   c) $f(x) = |x - 2|$

4. Determine whether each of the following is the graph of a function.

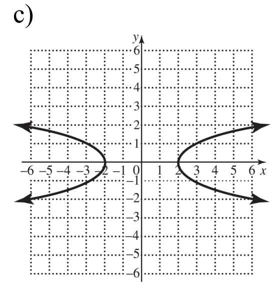
a)



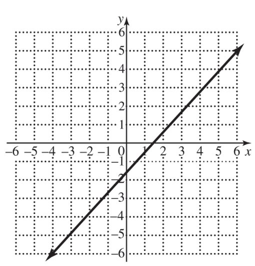
b)



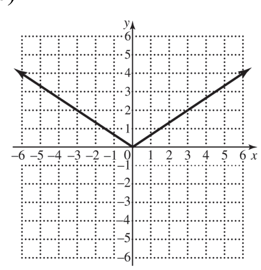
c)



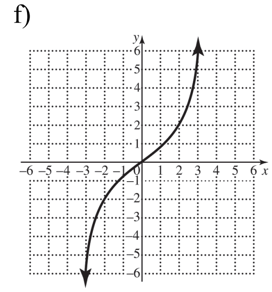
d)



e)



f)



5. Using the graph shown in Example 4e, find the output when the input is 3.

Teaching Notes:

- Some students find it helpful to calculate ordered pairs for a linear equation and discuss why a linear equation is a function.
- Many students find function notation confusing at first.

Answers: *1a) No, b) yes, c) yes; 2a)* $6, -4, 3$, *b)* $0, \frac{14}{5}, \frac{11}{5}$, *c)* $-6, -3$, *d)* $-5, 996, -31$; *3) See graph answer pages.; 4a) Function, b) not a function, c) not a function, d) function, e) function, f) function; 5) 2*

Finding Domain and Range

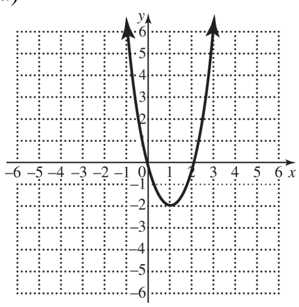
Learning Objective:

a Find the domain and the range of a function.

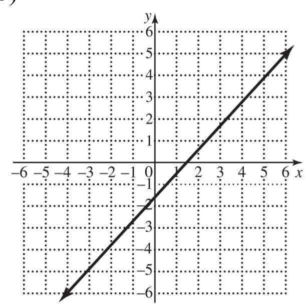
Examples:

1. The following graphs are functions. For each graph given, (i) estimate $f(1)$, (ii) determine the domain, (iii) estimate all x-values such that $f(x)=2$, and (iv) determine the range.

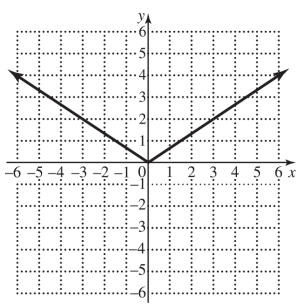
a)



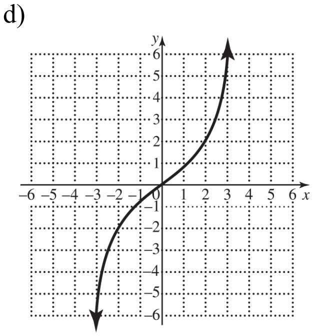
b)



c)



d)



2. Find the domain.

a) $f(x)=\dfrac{3}{x-4}$

b) $f(x)=-5x+3$

c) $f(x)=|x-5|$

d) $f(x)=\dfrac{x^3-1}{x}$

Teaching Notes:

- Students often mix up domain and range.
- Students sometimes think a numerator cannot be zero.

<u>Answers</u>: 1ai) -2, ii) all real numbers, iii) $-0.4, 2.4$, iv) $[-2,\infty)$, bi) -0.5, ii) all real numbers, iii) 3.3, iv) all real numbers, ci) 0.7, ii) all real numbers, iii) $-3, 3$, iv) $[0,\infty)$, di) 0.8, ii) all real numbers, iii) 2, iv) all real numbers; 2a) $\{x \mid x \text{ is a real number and } x \neq 4\}$, or $(-\infty,4)\cup(4,\infty)$, b) all real numbers, c) all real numbers, d) $\{x \mid x \text{ is a real number and } x \neq 0\}$, or $(-\infty,0)\cup(0,\infty)$

Linear Functions: Graphs and Slope

Learning Objectives:

a Find the *y*-intercept of a line from the equation $y = mx + b$ or $f(x) = mx + b$.

b Given two points on a line, find the slope. Given a linear equation, derive the equivalent slope-intercept equation and determine the slope and the *y*-intercept.

c Solve applied problems involving slope.

Examples:

1. Find the slope and the *y*-intercept.

   a) $y = 3x - 5$ b) $f(x) = \frac{1}{2}x$ c) $4x - 5y = 20$ d) $6x + 4 = 3y + 6x$

2. Find the slope, if possible, of the line containing the given pair of points.

   a) $(3,4)$ and $(5,8)$ b) $(-2,4)$ and $(-4,7)$ c) $(-1.5,4.5)$ and $(4.5,0)$

   d) $\left(2,\frac{3}{5}\right)$ and $\left(-7,\frac{3}{5}\right)$ e) $\left(\frac{5}{3},-2\right)$ and $\left(\frac{5}{3},-\frac{1}{6}\right)$

3. Solve.

   a) A river falls 48 ft vertically over a horizontal distance of 400 ft. Find its slope.

   b) A company's revenue is \$350,000. Two years earlier it was \$320,000. Find the rate of change.

Teaching Notes:

- Some students need to see many numeric examples of $m = \frac{rise}{run}$ shown on a graph before trying to use the slope formula.
- Many students make sign errors with the slope formula.
- Some students consistently put the change in *x* instead of the change in *y* in the numerator when calculating slope.

Answers: 1a) $m = 3$, *y-intercept* $(0,-5)$, b) $m = \frac{1}{2}$, *y-intercept* $(0,0)$, c) $m = \frac{4}{5}$, *y-intercept* $(0,-4)$, d) $m = 0$, *y-intercept* $\left(0,\frac{4}{3}\right)$; 2a) 2, b) $-\frac{3}{2}$, c) -0.75, d) 0, e) undefined; 3a) $-\frac{3}{25}$, or -0.12, b) \$15,000 per year

More on Graphing Linear Equations

Learning Objectives:

a Graph linear equations using intercepts.
b Given a linear equation in slope-intercept form, use the slope and the *y*-intercept to graph the line.
c Graph linear equations of the form $x = a$ or $y = b$.
d Given the equations of two lines, determine whether their graphs are parallel or whether they are perpendicular.

Examples:

1. Find the *x*-intercept and the *y*-intercept line. Then graph the line.
   a) $2x + 4y = 8$ b) $-3x + 5y = 6$ c) $2x + 6y + 3 = 3$

2. Graph the line, using the slope and the *y*-intercept.
   a) $y = 2x - 2$ b) $g(x) = -\frac{2}{3}x + 3$

3. Graph and, if possible, determine the slope.
   a) $x = 3$ b) $2x - 10 = 0$ c) $6 - 3y = 0$

4. Given the equations of two lines, determine whether they are *parallel, perpendicular,* or *neither.*
   a) $2x - y = 6$ and $x + 2y = -5$ b) $x + 2y = 5$ and $x + 2y = 9$
   c) $4x - 3y = 11$ and $6x - y = 13$

Teaching Note:

- Avoid using the terminology "no slope." Instead, refer to zero slope and undefined slope.

Answers: 1a) x-intercept: $(4,0)$, y-intercept: $(0,2)$, b) x-intercept: $(-2,0)$, y-intercept: $\left(0,\frac{6}{5}\right)$, c) x-intercept: $(0,0)$, y-intercept: $(0,0)$, See graph answer pages.; 2) See graph answer pages.; 3a) Not defined, b) not defined, c) 0, See graph answer pages.; 4a) Perpendicular, b) parallel, c) neither

Finding Equations of Lines; Applications

Learning Objectives:

a Find an equation of a line when the slope and the y-intercept are given.
b Find an equation of a line when the slope and a point are given.
c Find an equation of a line when two points are given.
d Given a line and a point not on the given line, find an equation of the line parallel to the line and containing the point, and find an equation of the line perpendicular to the line and containing the point.
e Solve applied problems involving linear functions.

Examples:

1. Find an equation of the line having the given slope and y-intercept.

   a) slope $= 2$, $(0,-5)$ b) slope $= -\frac{3}{4}$, $(0,2)$

2. Find an equation of the line having the given slope and containing the given point.

   a) slope $= \frac{3}{2}$, $(-5,-4)$ b) slope $= -\frac{1}{2}$, $(2,-3)$

3. Find an equation of the line containing the given pair of points.

   a) $(3,4)$ and $(5,0)$ b) $(2,3)$ and $(-1,5)$ c) $\left(\frac{1}{2},-4\right)$ and $\left(\frac{7}{2},-6\right)$

4. Find an equation of the line with the given characteristics.

   a) parallel to $3x - y = 4$, through $(0,-3)$ b) perpendicular to $2y = -5x$, and through $(2,4)$

5. A lawn aerator rents for \$25, plus \$3 per hour. Let x represent the number of hours the aerator was rented and y the total rental cost. Write an equation in the form $y = mx + b$ to represent this situation. How many hours was the aerator rented if the total cost was \$38.50?

Teaching Note:

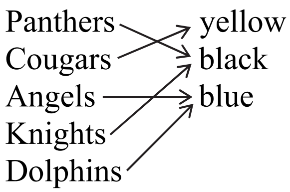
- Many students have trouble digesting all of the information in this section and need to spend extra time working on it.

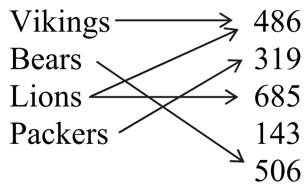
Answers: 1a) $y = 2x - 5$, b) $y = -\frac{3}{4}x + 2$; 2a) $y = \frac{3}{2}x + \frac{7}{2}$, b) $y = -\frac{1}{2}x - 2$; 3a) $y = -2x + 10$, b) $y = -\frac{2}{3}x + \frac{13}{3}$, c) $y = -\frac{2}{3}x - \frac{11}{3}$; 4a) $y = 3x - 3$, b) $y = \frac{2}{5}x + \frac{16}{5}$; 5) $y = 3x + 25$, $4\frac{1}{2}$ hours

CHAPTER 2 NAME_________________________

TEST FORM A CLASS_____SCORE_____GRADE_____

Determine whether the correspondence is a function.

1. 

2. 

Find the function values.

3. $f(x) = -5x - 4$; $f(0)$ and $f(-3)$

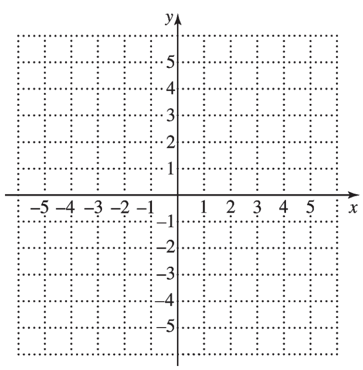
4. $g(x) = 6 + x^2$; $g(0)$ and $g(-4)$

5. $h(x) = 2$; $h(-3)$ and $h(7)$

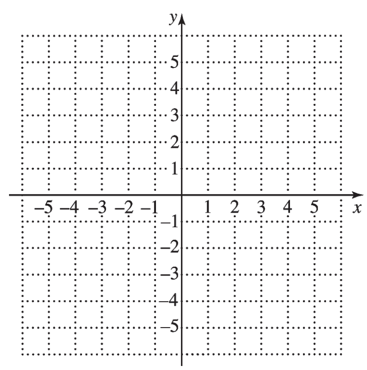
6. $f(x) = |x - 2|$; $f(-8)$ and $f(2)$

Graph.

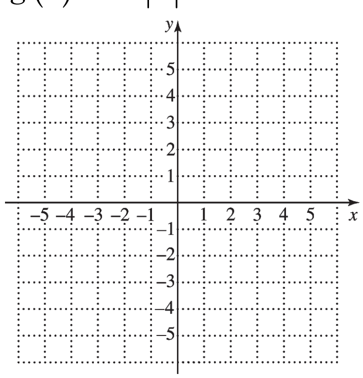
7. $y = 2x + 1$



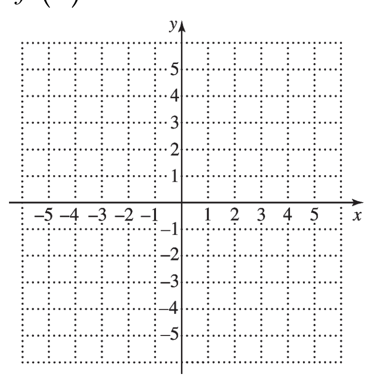
8. $f(x) = -\dfrac{3}{2}x$



9. $g(x) = 3 - |x|$



10. $f(x) = x^2 - 2x - 3$



ANSWERS

1. _______________

2. _______________

3. _______________

4. _______________

5. _______________

6. _______________

7. See graph.

8. See graph.

9. See graph.

10. See graph.

CHAPTER 2 NAME________________________

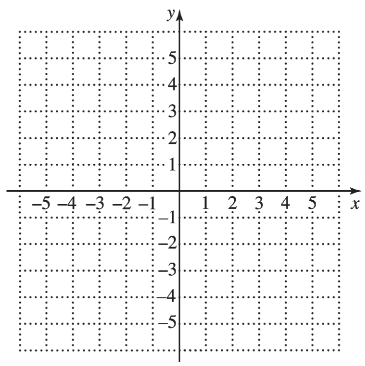
TEST FORM A

ANSWERS

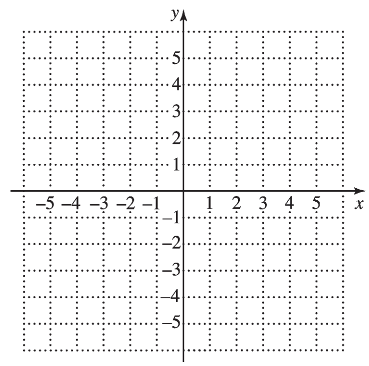
11. See graph.
12. See graph.
13. a) ____________
    b) ____________
14. ____________
15. ____________
16. ____________
17. ____________
18. a) ____________
    b) ____________
    c) ____________
    d) ____________

Graph.

11. $y = f(x) = 3$



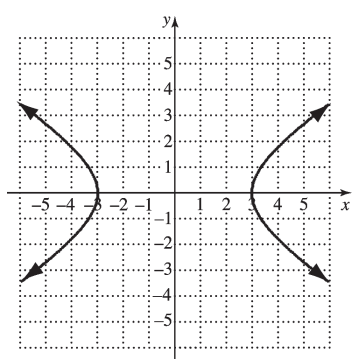
12. $-3x = 6$



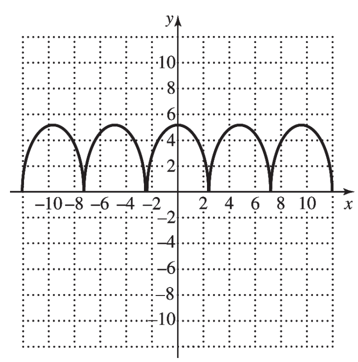
13. The function $w(t) = 170 - 2t$ can be used to estimate Janelle's weight, in pounds, t weeks after the start of a diet.
    a) Find Janelle's weight 12 weeks after the start of the diet.
    b) After how many weeks will Janelle weigh 156 lb?

Determine whether each of the following is the graph of a function.

14.



15.

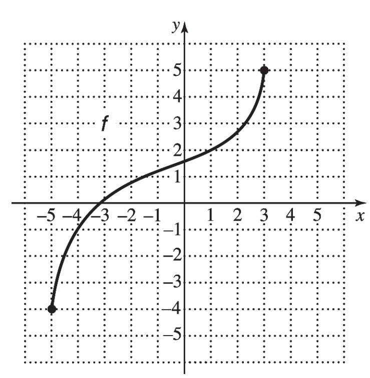


Find the domain.

16. $g(x) = 8 - x^2$

17. $f(x) = \dfrac{4}{3x - 2}$

18. For the graph of function f at right, determine
    a) $f(-4)$;
    b) the domain;
    c) all x-values such that $f(x) = 2$;
    and d) the range.



CHAPTER 2 **NAME**________________________

TEST FORM A

Find the slope and the y-intercept.

19. $f(x) = -\dfrac{1}{2}x + 3$

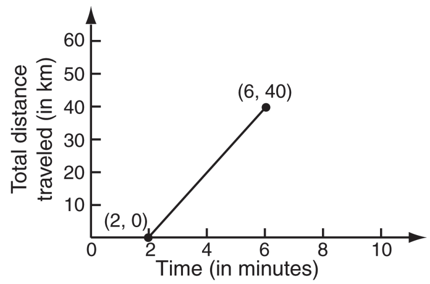
20. $3x - 5y = 15$

Find the slope, if it exists, of the line containing the following points.

21. $(4, -6)$ and $(5, -3)$

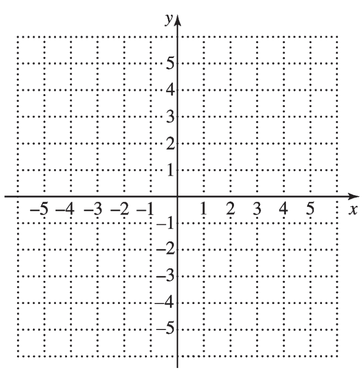
22. $(5.1, 6.4)$ and $(5.1, 2.3)$

23. Find the slope, or rate of change, of the graph at right.



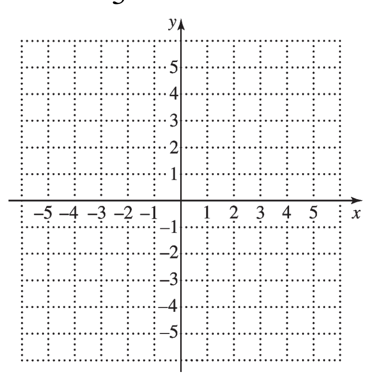
24. Find the intercepts. Then graph the equation.

$-2x + 5y = 10$



25. Graph using the slope and the y-intercept.

$f(x) = \dfrac{1}{3}x + 2$



Determine whether the graphs of the given pair of lines are parallel or perpendicular.

26. $2x + 4y = 7$,
$2y - 4x = 11$

27. $3x - 4y = 6$,
$6x = 8y + 10$

28. Find an equation of the line that has the given characteristics: slope: -5; y-intercept: $(0, 3.9)$.

ANSWERS

19. ____________

20. ____________

21. ____________

22. ____________

23. ____________

24. See graph.

25. See graph.

26. ____________

27. ____________

28. ____________

CHAPTER 2 **NAME**________________________

TEST FORM A

ANSWERS

29. ______________

30. ______________

31. ______________

32. ______________

33. ______________

34. a) ______________

b) ______________

35. ______________

36. ______________

37. ______________

29. Find a linear function $f(x)=mx+b$ whose graph has the given slope and y-intercept:
slope: 2.5; y-intercept: $\left(0,-\frac{3}{7}\right)$.

30. Find an equation of the line having the given slope and containing the given point: $m=-4$; $(7,-5)$.

31. Find an equation of the line containing the given pair of points: $(1,-6)$ and $(-3,4)$.

32. Find an equation of the line containing the given point and parallel to the given line: $(1,-3)$; $4x+y=2$.

33. Find an equation of the line containing the given point and perpendicular to the given line: $(-2,-4)$; $x+4y=6$.

A person's income is generally related to the level of education attained. Use this table of data for Exercise 34.

Number, x, of years of schooling	Median income, y (in thousands)
12	\$44
14	\$58
16	\$77

34. a) Use the two points $(12,44)$ and $(16,77)$ to find a linear function that fits the data.
b) Use the function to estimate the income of a person who has attended school 18 years.

35. Find an equation of the line having slope -4 and containing the point $(2,5)$.

A. $y+5=-4(x+2)$ B. $y-2=-4(x-5)$
C. $y-5=-4(x-2)$ D. $x-2=-4(y-5)$

---

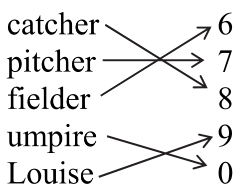
36. Find the value of k such that the graphs of $3x-4y=7$ and $y-5=kx$ are perpendicular.

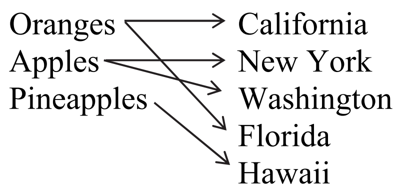
37. Write an equation of a line parallel to the x-axis and 3 units below it.

CHAPTER 2 NAME______________________________

TEST FORM B CLASS_____SCORE_____GRADE_____

Determine whether the correspondence is a function.

1. 

2. 

Find the function values.

3. $f(x) = -5x + 3$; $f(0)$ and $f(-6)$

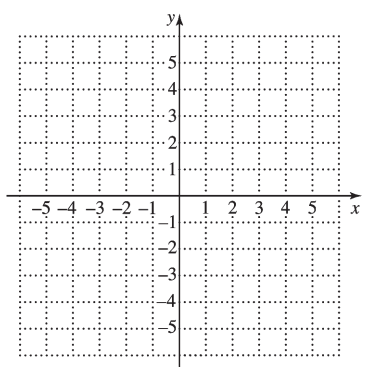
4. $g(x) = 8 - x^2$; $g(0)$ and $g(5)$

5. $h(x) = 7$; $h(-4)$ and $h(2)$

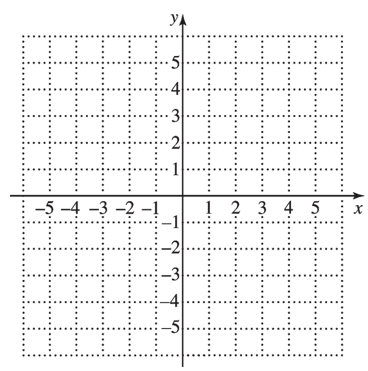
6. $f(x) = |x - 5|$; $f(-4)$ and $f(2)$

Graph.

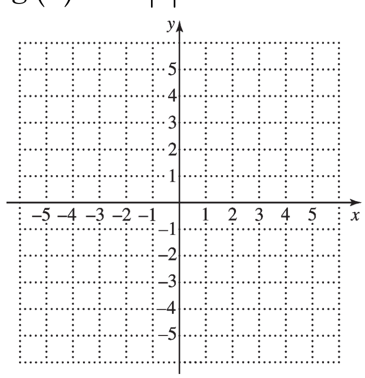
7. $y = -2x + 4$



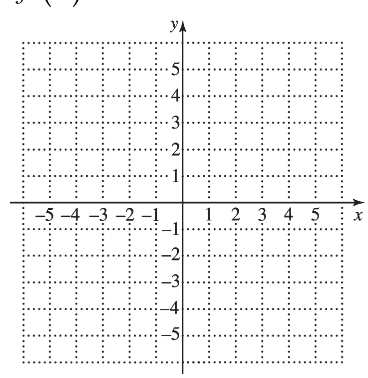
8. $f(x) = \frac{2}{5}x$



9. $g(x) = 2 + |x|$



10. $f(x) = -x^2 + 2x + 2$



ANSWERS

1. ______________
2. ______________
3. ______________
4. ______________
5. ______________
6. ______________
7. See graph.
8. See graph.
9. See graph.
10. See graph.

CHAPTER 2 NAME______________________________

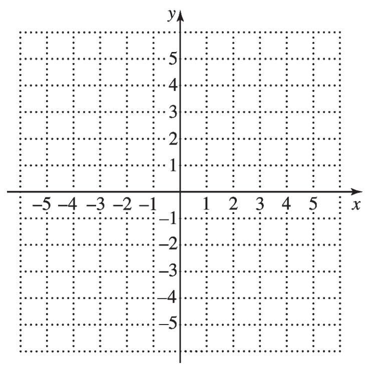
TEST FORM B

ANSWERS

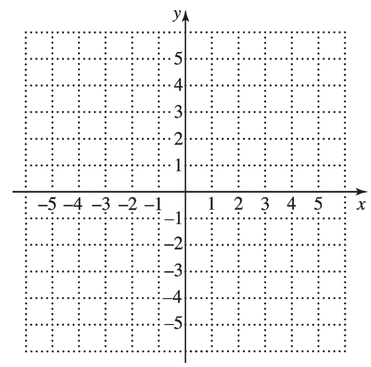
11. See graph.
12. See graph.
13. a) ____________
    b) ____________
14. ____________
15. ____________
16. ____________
17. ____________
18. a) ____________
    b) ____________
    c) ____________
    d) ____________

Graph.

11. $y = f(x) = -4$



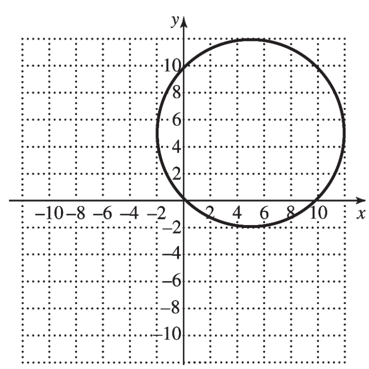
12. $2x = 8$



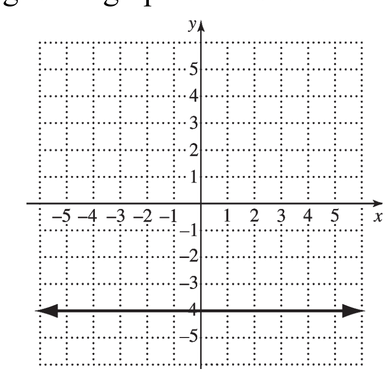
13. The function $L(t) = 1.843t + 12.327$ can be used to estimate the retail sales of lawn care items in the U.S., in billions of dollars, t years after 2004.
    a) Estimate the sales of lawn care items in the U.S. in 2017.
    b) In what year would the estimated sales be \$32.6 billion?

Determine whether each of the following is the graph of a function.

14.



15.

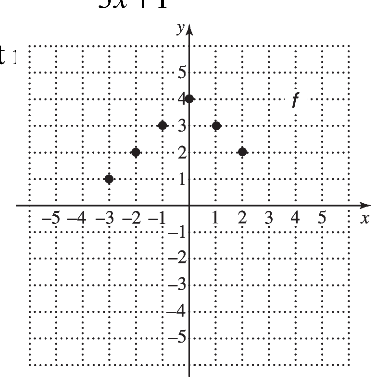


Find the domain.

16. $g(x) = |x| + 3$

17. $f(x) = \dfrac{4}{3x+1}$

18. For the graph of function f at determine
    a) $f(-1)$;
    b) the domain;
    c) all x-values such that $f(x) = 2$;
    and d) the range.



CHAPTER 2 NAME______________________________

TEST FORM B

Find the slope and the y-intercept.

19. $f(x) = 3x - \frac{1}{5}$

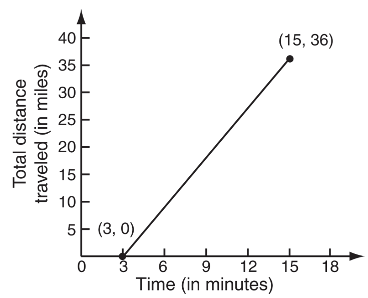
20. $4x - 3y = 12$

Find the slope, if it exists, of the line containing the following points.

21. $(7, -2)$ and $(2, 5)$

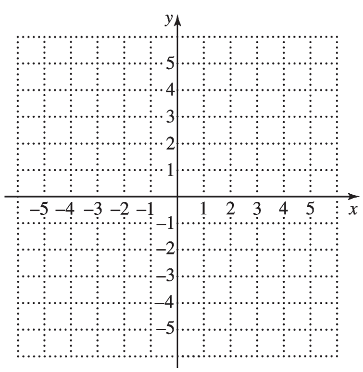
22. $(5.4, 2.1)$ and $(-8.3, 2.1)$

23. Find the slope, or rate of change, of the graph at right.



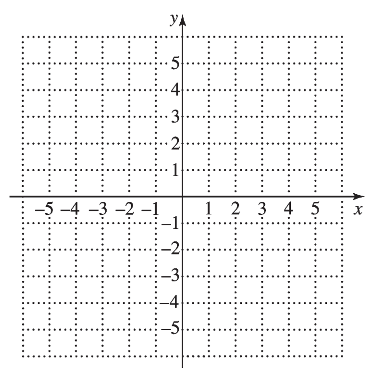
24. Find the intercepts. Then graph the equation.

$3x - 2y = 6$



25. Graph using the slope and the y-intercept.

$f(x) = -\frac{3}{2}x + 2$



Determine whether the graphs of the given pair of lines are parallel or perpendicular.

26. $2y + x = 12,$
$3x + 6y = 15$

27. $x - y = 6,$
$y - x = -5$

28. Find an equation of the line that has the given characteristics: slope: -3; y-intercept: $(0, 4.6)$.

ANSWERS

19. ____________

20. ____________

21. ____________

22. ____________

23. ____________

24. See graph.

25. See graph.

26. ____________

27. ____________

28. ____________

CHAPTER 2 **NAME**________________________

TEST FORM B

ANSWERS

29. ____________

30. ____________

31. ____________

32. ____________

33. ____________

34. a) ____________

b) ____________

35. ____________

36. ____________

37. ____________

29. Find a linear function $f(x) = mx + b$ whose graph has the given slope and y-intercept:
slope: 5.5; y-intercept: $\left(0, -\frac{4}{5}\right)$.

30. Find an equation of the line having the given slope and containing the given point: $m = \frac{1}{2}$; $(3, -8)$.

31. Find an equation of the line containing the given pair of points: $(3, -4)$ and $(-2, 5)$.

32. Find an equation of the line containing the given point and parallel to the given line: $(-2, 4)$; $2x + y = 5$.

33. Find an equation of the line containing the given point and perpendicular to the given line: $(-1, -2)$; $4x + 5y = 10$.

The average ACT scores at a small college have been increasing in recent years. Use this table of data for Exercise 34.

Year, x, since 2008	Average ACT score, y
0	20
1	22
2	22
3	24

34. a) Use the two points $(0, 20)$ and $(3, 24)$ to find a linear function that fits the data.
b) Use the function to estimate the average ACT score in 2017.

35. Find an equation of the line having slope 2 and containing the point $(-3, -4)$.

A. $y + 4 = 2(x + 3)$ B. $x + 3 = 2(y + 4)$
C. $y - 4 = 2(x - 3)$ D. $y + 3 = 2(x + 4)$

---

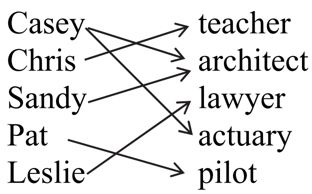
36. Find the value of a such that the graphs of $4y = ax + 2$ and $\frac{1}{5}y = \frac{1}{4}x + 7$ are parallel.

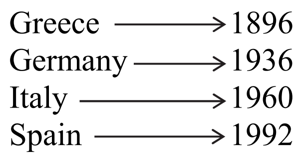
37. Find the value of m such that the graph of $y = mx + 3$ has an x-intercept of $(3, 0)$.

CHAPTER 2 NAME________________________

TEST FORM C CLASS____ SCORE____ GRADE____

Determine whether the correspondence is a function.

1. 

2. 

Find the function values.

3. $f(x) = -4x - 5$; $f(0)$ and $f(-3)$

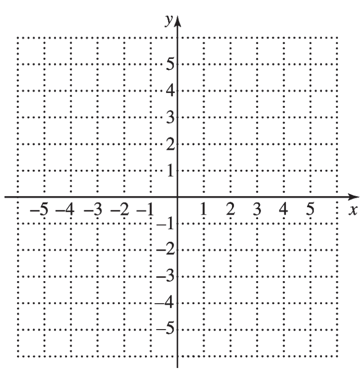
4. $g(x) = 5 + x^2$; $g(0)$ and $g(-8)$

5. $h(x) = 1$; $h(-5)$ and $h(6)$

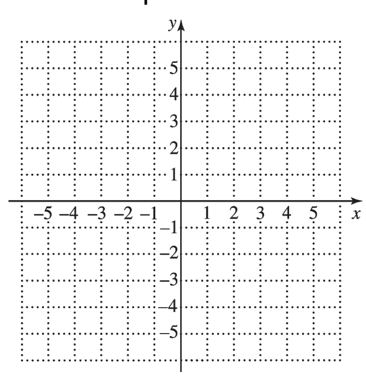
6. $f(x) = |6 - x|$; $f(-7)$ and $f(8)$

Graph.

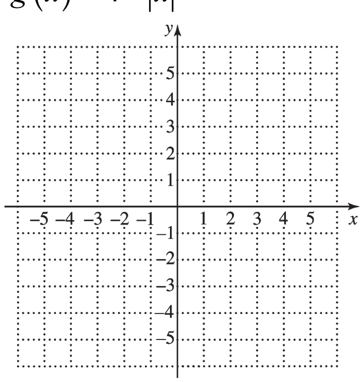
7. $y = 2x - 4$



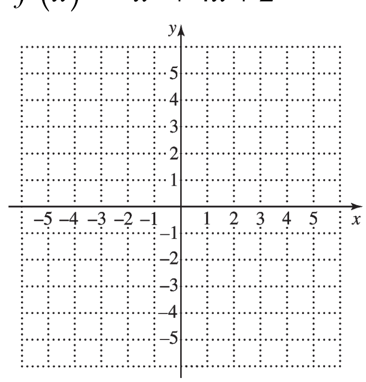
8. $f(x) = -\frac{1}{4}x$



9. $g(x) = 4 - |x|$



10. $f(x) = -x^2 + 4x + 2$



ANSWERS

1. ____________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. See graph.
8. See graph.
9. See graph.
10. See graph.

CHAPTER 2 **NAME** ____________________

TEST FORM C

ANSWERS

11. See graph.

12. See graph.

13. a) ______
    b) ______

14. ______

15. ______

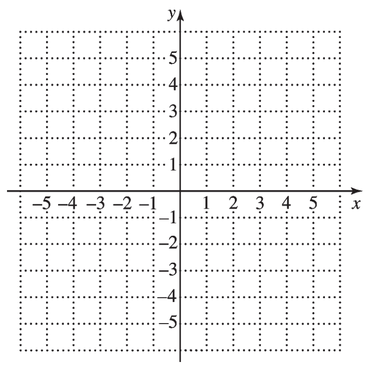
16. ______

17. ______

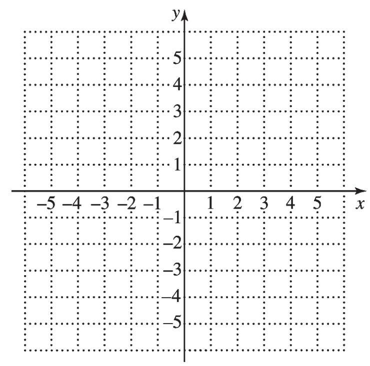
18. a) ______
    b) ______
    c) ______
    d) ______

Graph.

11. $y = f(x) = 4$



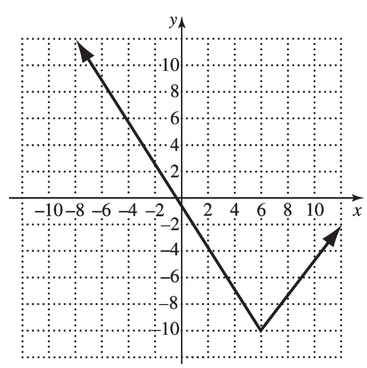
12. $-3x = 9$



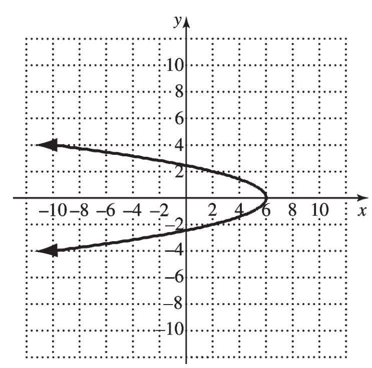
13. The function $A(t) = -700t + 53{,}000$ can be used to estimate the median size of a grocery store in the U.S., in square feet, t years after 2000.
a) Find the median size of a grocery store in 2014.
b) In what year is the median size expected to be $35{,}000\text{ ft}^2$?

Determine whether each of the following is the graph of a function.

14.



15.

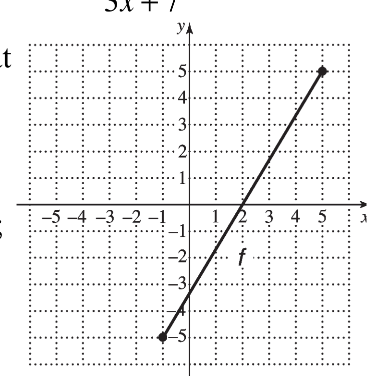


Find the domain.

16. $g(x) = 3 - x$

17. $f(x) = \dfrac{4}{3x + 7}$

18. For the graph of function f at determine
a) $f(2)$;
b) the domain;
c) all x-values such that $f(x) = -5$;
and d) the range.



CHAPTER 2 **NAME**______________________

TEST FORM C

Find the slope and the y-intercept.

19. $f(x) = -\frac{3}{4}x - 5$

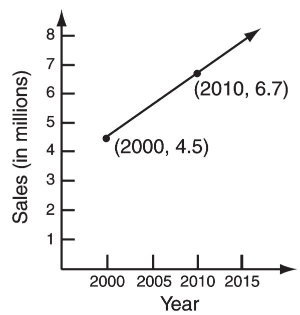
20. $x - 6y = 12$

Find the slope, if it exists, of the line containing the following points.

21. $(7, -3)$ and $(4, 1)$

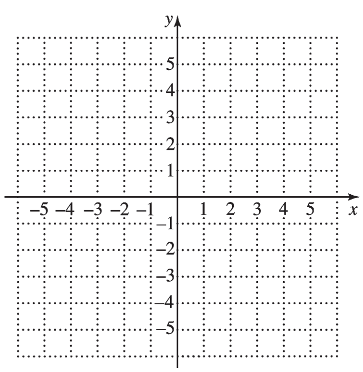
22. $(-5.1, 0)$ and $(-5.1, 7.6)$

23. Find the slope, or rate of change, of the graph at right.



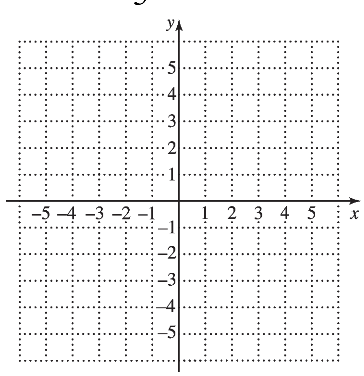
24. Find the intercepts. Then graph the equation.

$3x - 4y = 12$



25. Graph using the slope and the y-intercept.

$f(x) = -\frac{4}{3}x - 1$



Determine whether the graphs of the given pair of lines are parallel or perpendicular.

26. $2x - 3 = 2y$,
$y + x = 5$

27. $y = -2x + 3$,
$x - 2y = 14$

28. Find an equation of the line that has the given characteristics: slope: -4; y-intercept: $(0, 6.3)$.

ANSWERS

19. ______________

20. ______________

21. ______________

22. ______________

23. ______________

24. See graph.

25. See graph.

26. ______________

27. ______________

28. ______________

CHAPTER 2 **NAME**____________________________

TEST FORM C

ANSWERS

29. ______________

30. ______________

31. ______________

32. ______________

33. ______________

34. a) ______________

b) ______________

35. ______________

36. ______________

37. ______________

29. Find a linear function $f(x) = mx + b$ whose graph has the given slope and y-intercept:

slope: 5.4; y-intercept: $\left(0, -\frac{7}{8}\right)$.

30. Find an equation of the line having the given slope and containing the given point: $m = 5$; $(-4, 6)$.

31. Find an equation of the line containing the given pair of points: $(4, 3)$ and $(-3, 0)$.

32. Find an equation of the line containing the given point and parallel to the given line: $(2, -1)$; $x - 5y = 4$.

33. Find an equation of the line containing the given point and perpendicular to the given line: $(-3, 2)$; $3y + x = 5$.

The number of hours a person in Grafton spends on the Internet each year has increased recently. Use this table of data for Exercise 34.

Year, x, since 2010	Hours on Internet, y, per person per year
0	135
1	162
2	187
[illegible]	[illegible]

34. a) Use the two points $(0,\ 135)$ and $(2,\ 187)$ to find a linear function that fits the data.

b) Use the function to estimate the number of hours spent on the Internet per person in Grafton in 2015.

35. Find an equation of the line having slope -5 and containing the point $(2, -3)$.

A. $y + 3 = -5(x + 2)$ B. $y - 3 = -5(x + 3)$

C. $y - 2 = -5(x + 3)$ D. $y + 3 = -5(x - 2)$

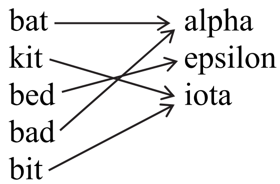
36. Given $f(x) = 5x + 1$ and $g(x) = 3x^2 - 2$, find $f(g(-1))$ and $g(f(-1))$.

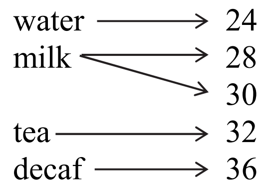
37. Write an equation of a line parallel to the y-axis and passing through $(2, -1)$.

CHAPTER 2 NAME______________________________

TEST FORM D CLASS_____SCORE_____GRADE_____

Determine whether the correspondence is a function.

1. 

2. 

Find the function values.

3. $f(x) = -3x - 7$; $f(0)$ and $f(5)$

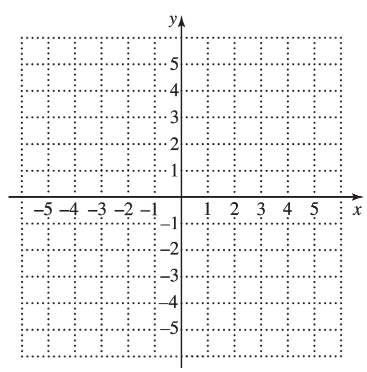
4. $g(x) = 5 + x^2$; $g(0)$ and $g(-3)$

5. $h(x) = -4$; $h(6)$ and $h(-8)$

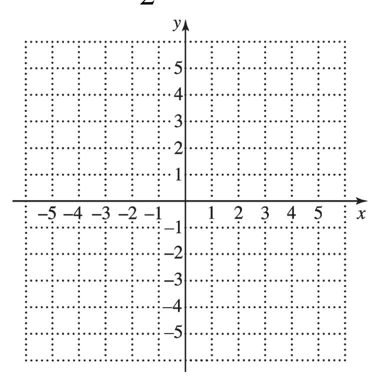
6. $f(x) = |2 - x|$; $f(-10)$ and $f(7)$

Graph.

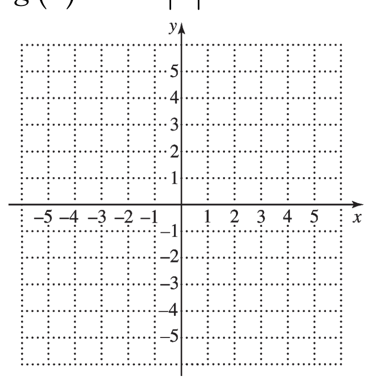
7. $y = -4x + 2$



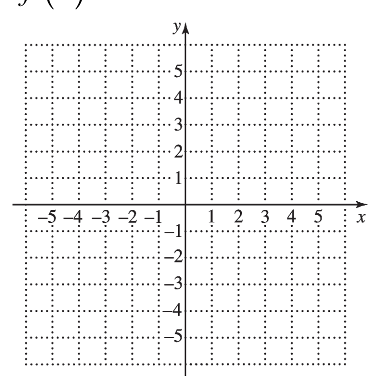
8. $f(x) = -\frac{1}{2}x$



9. $g(x) = -3 - |x|$



10. $f(x) = x^2 - 4x + 1$



ANSWERS

1. ________________
2. ________________
3. ________________
4. ________________
5. ________________
6. ________________
7. See graph.
8. See graph.
9. See graph.
10. See graph.

CHAPTER 2 **NAME**__________________________

TEST FORM D

ANSWERS

11. See graph.

12. See graph.

13. a) ____________
    b) ____________

14. ____________

15. ____________

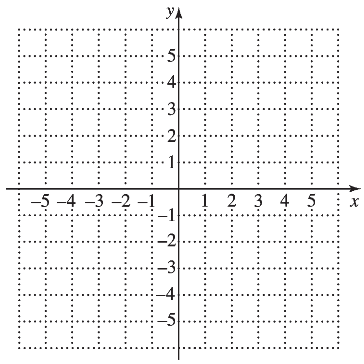
16. ____________

17. ____________

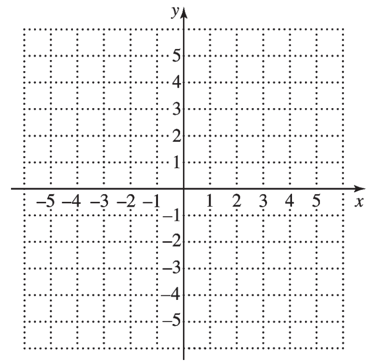
18. a) ____________
    b) ____________
    c) ____________
    d) ____________

Graph.

11. $y = f(x) = -3$



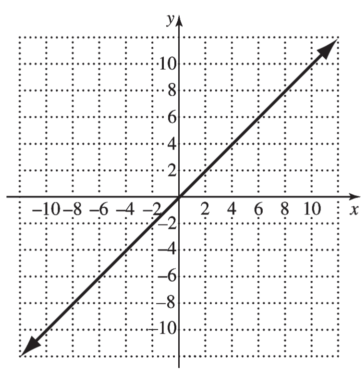
12. $2x = 4$



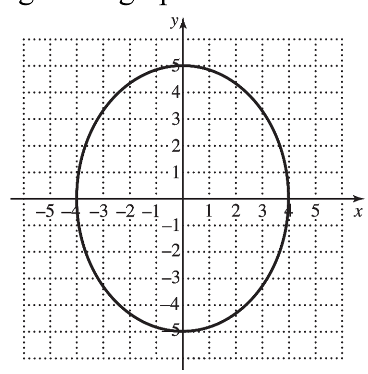
13. The function $D(t) = -309.41t + 22,800$ can be used to estimate the number of new-auto dealerships in U.S., t years after 1995.
    a) Estimate the number of new-auto dealerships in the U.S. in 2015.
    b) In what year is the number of new-auto dealerships expected to be 15,000?

Determine whether each of the following is the graph of a function.

14.



15.

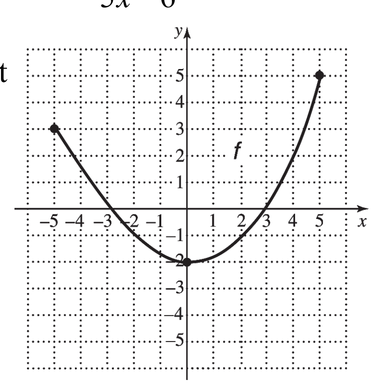


Find the domain.

16. $g(x) = x^3 + 8$

17. $f(x) = \dfrac{3}{5x-6}$

18. For the graph of function f at determine
    a) $f(4)$;
    b) the domain;
    c) all x-values such that $f(x) = -1$;
    and d) the range.



CHAPTER 2 **NAME**________________________

TEST FORM D

Find the slope and the y-intercept.

19. $f(x) = -0.5x + 3$

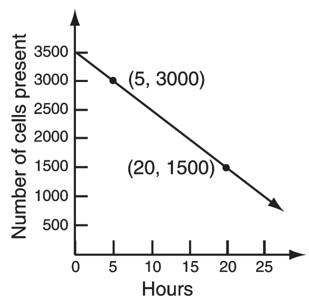
20. $-3x + 4y = 36$

Find the slope, if it exists, of the line containing the following points.

21. $(0, -3)$ and $(4, 3)$

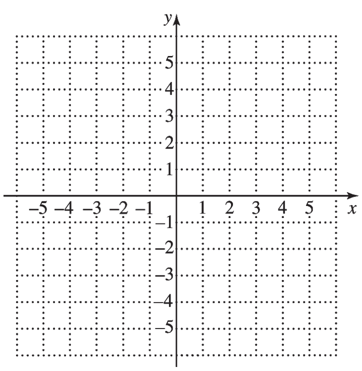
22. $(4.1, -3.5)$ and $(-2.2, -3.5)$

23. Find the slope, or rate of change, of the graph at right.



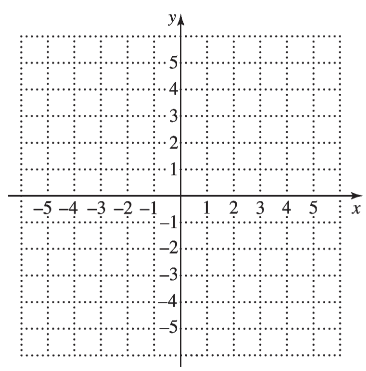
24. Find the intercepts. Then graph the equation.

$3y - 4x = -12$



25. Graph using the slope and the y-intercept.

$y = -\frac{1}{3}x + 2$



Determine whether the graphs of the given pair of lines are parallel or perpendicular.

26. $2x - y = 3,$
$2y + x = 5$

27. $2x - 5y = 12,$
$y = \frac{2}{5}x + 3$

28. Find an equation of the line that has the given characteristics: slope: 7; y-intercept: $(0, 3.6)$.

ANSWERS

19. __________

20. __________

21. __________

22. __________

23. __________

24. See graph.

25. See graph.

26. __________

27. __________

28. __________

CHAPTER 2 **NAME**______________________________

TEST FORM D

ANSWERS

29. ______________

30. ______________

31. ______________

32. ______________

33. ______________

34. a) ______________

b) ______________

35. ______________

36. ______________

37. ______________

---

29. Find a linear function $f(x) = mx + b$ whose graph has the given slope and y-intercept:
slope: -2.3; y-intercept: $\left(0, \frac{2}{9}\right)$.

30. Find an equation of the line having the given slope and containing the given point: $m = 3$; $(-6, -5)$.

31. Find an equation of the line containing the given pair of points: $(-5, 4)$ and $(-4, -2)$.

32. Find an equation of the line containing the given point and parallel to the given line: $(7, -4)$; $3x - y = 4$.

33. Find an equation of the line containing the given point and perpendicular to the given line: $(-5, -4)$; $2x - 5y = 4$.

The amount of revenue earned by a large corporation has increased in recent years. Use this table of data for Exercise 34.

Year, x, since 2010	Annual Revenue R (in billions)
0	\$2.15
1	\$2.25
2	\$2.45

34. a) Use the two points $(0, 2.15)$ and $(3, 2.42)$ to find a linear function that fits the data.
b) Use the function to estimate the annual revenue in 2016.

35. Find an equation of the line having slope $-\frac{1}{2}$ and containing the point $(7, 6)$.

A. $y - 6 = -\frac{1}{2}(x - 7)$ B. $y + 6 = -\frac{1}{2}(x + 7)$

C. $x - 7 = -\frac{1}{2}(y - 6)$ D. $y - 7 = -\frac{1}{2}(x - 6)$

---

36. Find an equation of a horizontal line that passes through the point $(-7, 3)$.

37. Find the value of k such that the graph of $5x = k + 3y$ has a y-intercept of $(0, -4)$.

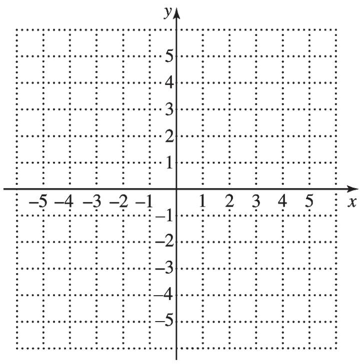
CHAPTER 2 NAME________________________

TEST FORM E CLASS_____ SCORE_____ GRADE_____

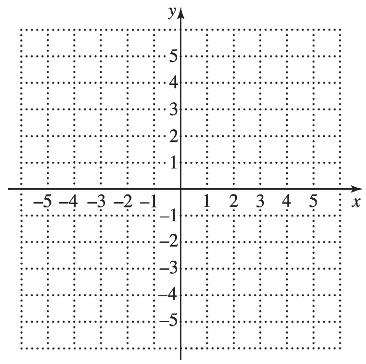
1. Determine whether the given point is a solution of the equation. $(-3,1)$; $2y-x=5$.

Graph.

2. $f(x)=\frac{2}{5}x$



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



4. Determine whether the correspondence is a function.

Saints → 7
Bucs → 11
Falcons → 9
Panthers → 10

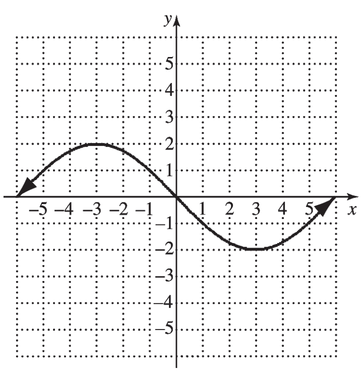
Find the function values.

5. $f(x)=2x-4$; $f(0)$ and $f(-5)$

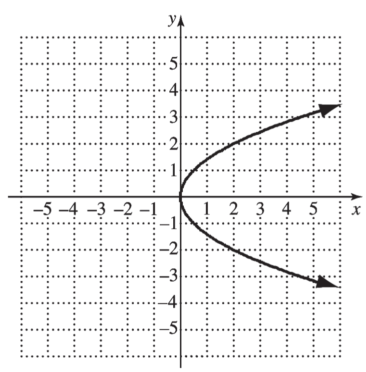
6. $g(x)=x^2-5$; $g(0)$ and $g(4)$

Determine whether each of the following is the graph of a function.

7.



8.



ANSWERS

1. ______________

2. See graph.

3. See graph.

4. ______________

5. ______________

6. ______________

7. ______________

8. ______________

CLICK HERE TO ACCESS THE COMPLETE Solutions

CHAPTER 2 NAME______________________

TEST FORM E

ANSWERS

9. a) ____________
   b) ____________

10. a) ____________
    b) ____________
    c) ____________
    d) ____________

11. ____________

12. ____________

13. ____________

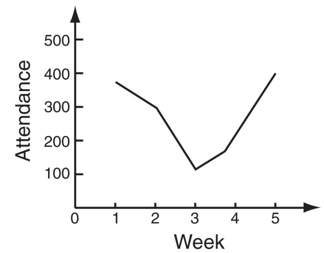
14. ____________

15. ____________

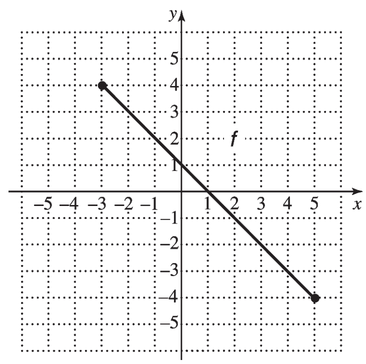
16. ____________

17. ____________

9. The graph at right shows the weekly attendance at a special exhibit at the Farley Gallery. The attendance is given as a function of the week. Use the graph to answer the following.
a) What was the attendance in week 3?
b) What was the attendance in week 5?



10. For graph of function f at right, determine
a) $f(-2)$;
b) the domain;
c) all x-values such that $f(x) = -1$;
and d) the range.



Find the domain.

11. $g(x) = x^3 - 5$

12. $f(x) = \dfrac{7}{4x-3}$

Find the slope and the y-intercept.

13. $f(x) = \dfrac{2}{5}x - 6$

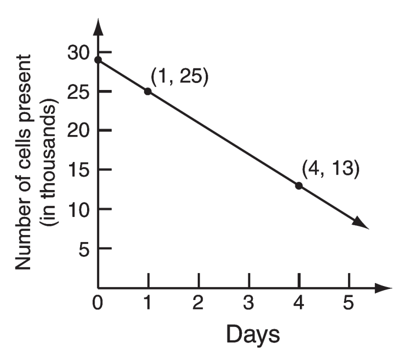
14. $5x + 4y = 15$

Find the slope, if it exists, of the line containing the following points.

15. $(2, -8)$ and $(8, -6)$

16. $(-6.5, 2.4)$ and $(-6.5, 4.6)$

17. Find the slope, or rate of change, of the graph at right.

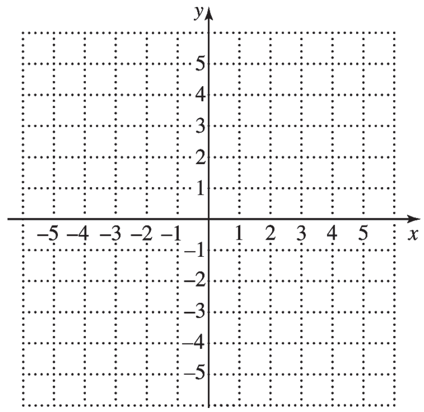


CHAPTER 2 **NAME**____________________________

TEST FORM E

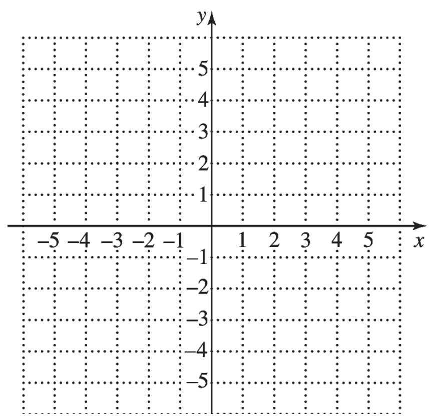
ANSWERS

18. Find the intercepts. Then graph the equation.
$3x - 5y = 15$



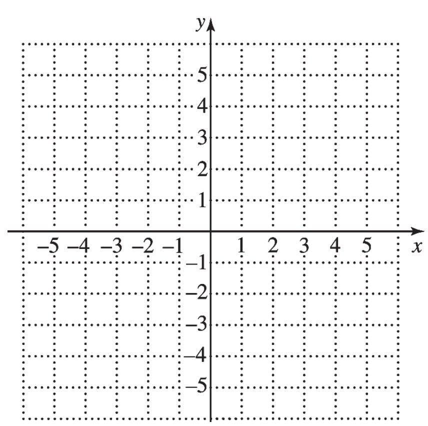
18. See graph.

19. Graph using the slope and the y-intercept.
$f(x) = -\frac{3}{4}x + 1$



19. See graph.

20. Graph: $y = f(x) = 4$.



20. See graph.

21. Determine whether the graphs of the given pair of lines are parallel or perpendicular. $3y - x = 8$,
$6x + 2y = 9$

21. ______________

CHAPTER 2 **NAME**________________________

TEST FORM E

ANSWERS

22. ____________

23. ____________

24. ____________

25. ____________

26. a) ____________

b) ____________

27. ____________

28. ____________

22. Find a linear function $f(x) = mx + b$ whose graph has the given slope and y-intercept:
slope: -5.9; y-intercept: $\left(0, \frac{1}{3}\right)$.

23. Find an equation of the line having the given slope and containing the given point: $m = \frac{1}{2}$; $(-4, 6)$.

24. Find an equation of the line containing the given pair of points: $(-2, 7)$ and $(1, 6)$.

25. Find an equation of the line containing the given point and parallel to the given line:
$(4, 5)$; $2x - 3y = 4$.

The starting salaries for first-year elementary teachers at Benton Academy have increased in recent years. Use the following table of data for Exercise 26.

Year, x, since 2010	Starting salary, s (in thousands)
0	\$32.4
1	\$32.9
2	\$33.9
3	\$34.5

26. a) Use the two points $(0, 32.4)$ and $(3, 34.5)$ to find a linear function that fits the data.
b) Use the function to estimate the starting salary for a first-year teacher in 2019.

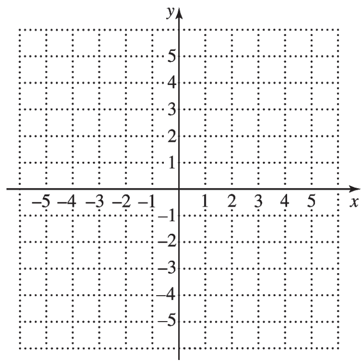
27. Find the value of m such that the graph of $y = mx - 2$ has an x-intercept of $(4, 0)$.

28. Given $f(x) = 6 + 3x^2$ and $g(x) = 2x - 1$, find $f(g(-3))$ and $g(f(-3))$.

CHAPTER 2 NAME______________________________

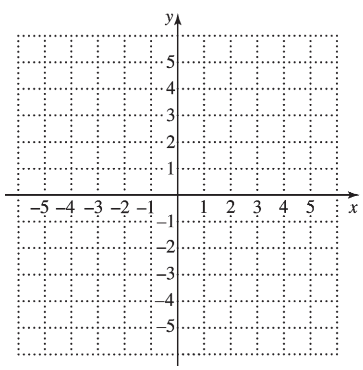
TEST FORM F CLASS_____SCORE_____GRADE_____

1. Plot and label the points: $A(3,-2)$, $B(4,3)$, $C(-5,-4)$, $D(-1,2)$, $E(0,4)$.

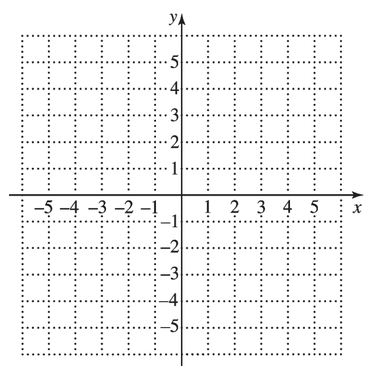


Graph.

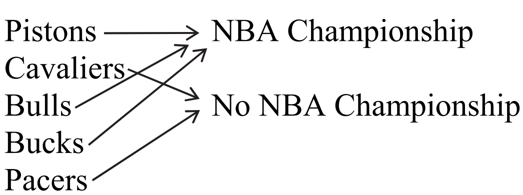
2. $y = -\frac{2}{3}x$



3. $y = |x-3|$



4. Determine whether the correspondence is a function.



ANSWERS

1. See graph.

2. See graph.

3. See graph.

4. ________________

CHAPTER 2 **NAME**______________________

TEST FORM F

ANSWERS

5. ____________
6. ____________
7. a) ____________
   b) ____________
8. ____________
9. ____________
10. a) ____________
    b) ____________
    c) ____________
    d) ____________
11. ____________
12. ____________
13. ____________
14. ____________

Find the function values.

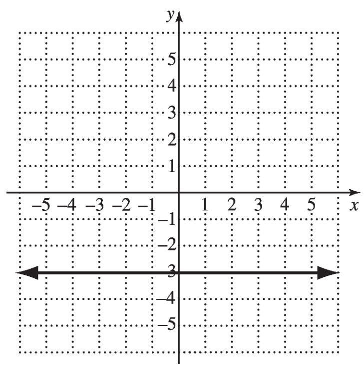
5. $f(x) = 9 - x^2$; $f(0)$ and $f(-2)$

6. $g(x) = 3x - 5$; $g(0)$ and $g(-8)$

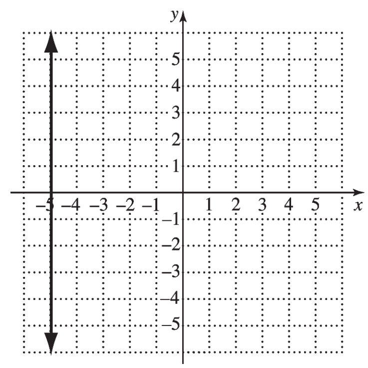
7. The function $V(t) = -1.5t + 65.4$ can be used to estimate the number of cable video customers in the U.S., in millions, t years after 2006.
   a) Estimate the number of cable video customers in 2015.
   b) In what year is the number of cable video customers expected to be 48 million?

Determine whether each of the following is the graph of a function.

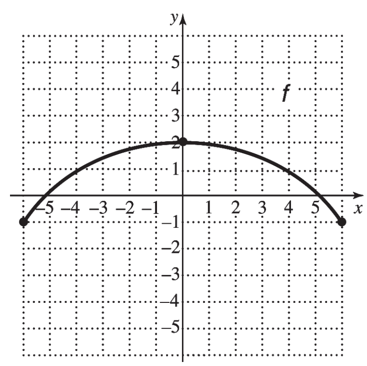
8.



9.



10. For graph of function f at right, determine
    a) $f(4)$;
    b) the domain;
    c) all x-values such that $f(x) = 0$;
    and d) the range.



Find the domain.

11. $g(x) = \dfrac{4}{2x+1}$

12. $f(x) = |4 - x|$

Find the slope and the y-intercept.

13. $f(x) = \dfrac{1}{3}x + 4$

14. $-6y - 7x = 9$

CHAPTER 2 NAME______________________________

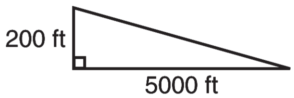
TEST FORM F

Find the slope, if it exists, of the line containing the following points.

15. $(4,5)$ and $(-3,6)$

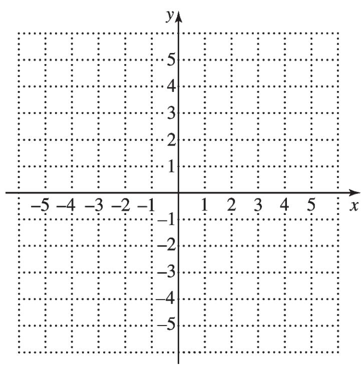
16. $(1.9,-3.1)$ and $(-4.2,-3.1)$

17. A road drops 200 ft vertically over a horizontal distance of 5000 ft. What is the slope (or grade) of the road?



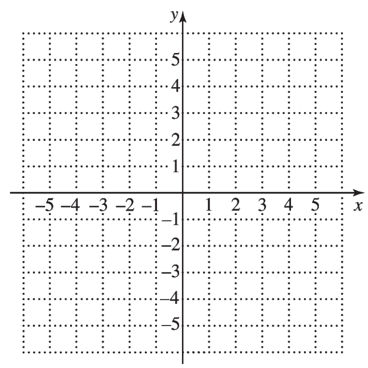
18. Find the intercepts. Then graph the equation.

$-2x+y=-4$

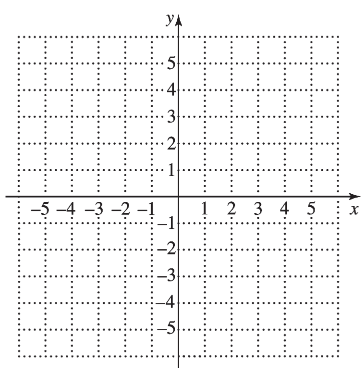


19. Graph using the slope and the y-intercept.

$f(x)=-\frac{3}{5}x+1$



20. Graph: $4y=10$.



ANSWERS

15. ______________

16. ______________

17. ______________

18. See graph.

19. See graph.

20. See graph.

CHAPTER 2 **NAME**________________________

TEST FORM F

ANSWERS

21. ____________

22. ____________

23. ____________

24. ____________

25. ____________

26. a) ____________

b) ____________

27. ____________

28. ____________

21. Determine whether the graphs of the given pair of lines are parallel or perpendicular. $y-4x=9$, $8x+5=2y$

22. Find an equation of the line that has the given characteristics: slope: 5; y-intercept: $(0,1.5)$.

23. Find an equation of the line having the given slope and containing the given point: $m=2$; $(5,-2)$.

24. Find an equation of the line containing the given pair of points: $(-4,3)$ and $(-1,5)$.

25. Find an equation of the line containing the given point and perpendicular to the given line: $(5,2)$; $y-3x=-4$.

The total revenue of Lee's Snacks has increased in recent years. Use the following table of data for Exercise 26.

Year, x, since 2010	Total revenue, R (in thousands)
0	\$21.1
1	\$24.5
2	\$27.2
3	\$29.5

26. a) Use the two points $(0, 21.1)$ and $(3, 29.5)$ to find a linear function that fits the data.
b) Use the function to estimate the total revenue in 2018.

27. Find k such that the line $3x-ky=-4$ is parallel to the line $8x+2y=11$.

28. Given $f(x)=x^2-3$ and $g(x)=5-x$, find $f(g(-2))$ and $g(f(-2))$.

CHAPTER 2 NAME______________________________

TEST FORM G CLASS_____ SCORE_____ GRADE_____

ANSWERS

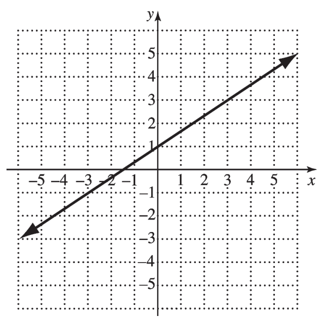
1. Which of the following is a solution of $4a-b=17$?

a) $(3,-5)$ b) $(2,-1)$ c) $(1,-3)$ d) $(-1,11)$

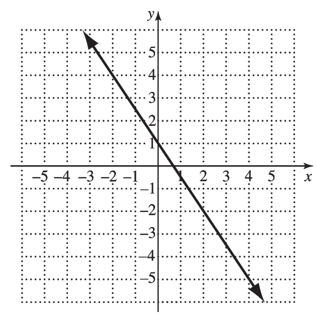
1. ______________

2. Which of the following is the graph of $y=\frac{3}{2}x+1$?

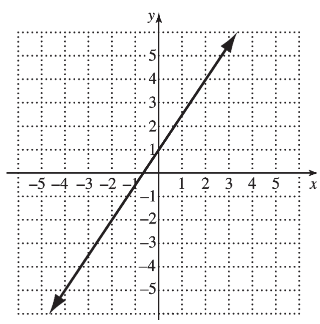
a)



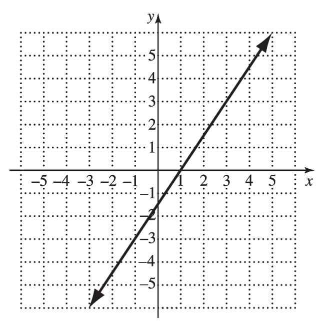
b)



c)



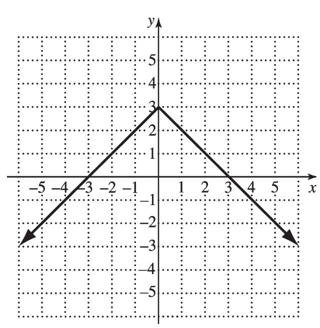
d)



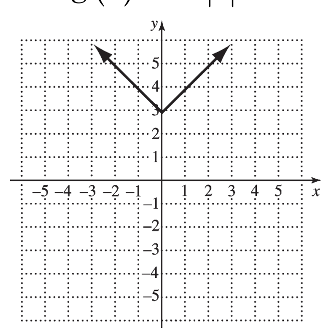
2. ______________

3. Which of the following is the graph of $g(x)=3-|x|$?

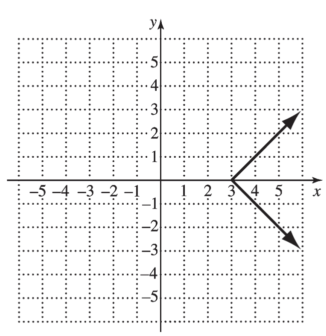
a)



b)



c)



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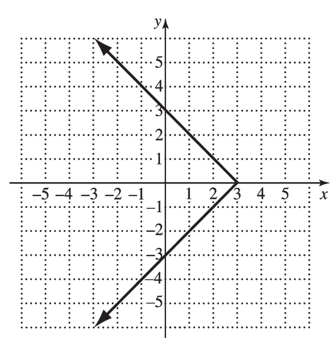


3. ______________

CHAPTER 2 **NAME**__________________________

TEST FORM G

ANSWERS

4. ______________

5. ______________

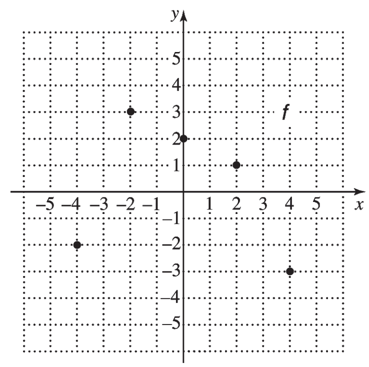
6. ______________

7. ______________

4. The function $S(t) = 0.08t + 4.5$ can be used to estimate the average salary, in millions of dollars, in the NBA t years after 2003. Estimate the average salary in the NBA in 2015.

a) \$165.7 million b) \$5.46 million
c) \$3.54 million d) \$5.7 million

5. For the graph of f at right, determine $f(2)$ and the range of f.



a) 1; $\{-3, -2, 1, 2, 3\}$
b) 1; $\{-4, -2, 0, 2, 4\}$
c) 0; $\{-3, -2, 1, 2, 3\}$
d) 1; $\{y \mid y \text{ is a real number}\}$

6. Find the domain: $f(x) = \dfrac{2-x}{x+3}$.

a) $\{x \mid x \text{ is a real number } \textit{and } x \neq 0\}$
b) All real numbers
c) $\{x \mid x \text{ is a real number } \textit{and } x \neq -3\}$
d) $\{x \mid x \text{ is a real number } \textit{and } x \neq 2\}$

7. Find the slope and the y-intercept of $-4y + 3x = -8$.

a) Slope: $\dfrac{3}{4}$; y-intercept: $(0, -2)$

b) Slope: $\dfrac{3}{4}$; y-intercept: $(0, 2)$

c) Slope: $-\dfrac{4}{3}$; y-intercept: $\left(0, -\dfrac{1}{2}\right)$

d) Slope: $-\dfrac{4}{3}$; y-intercept: $\left(0, \dfrac{1}{2}\right)$

CHAPTER 2 NAME______________________________

TEST FORM G

ANSWERS

8. Find the slope of the line containing $(4,-5)$ and $(-6,3)$.

a) $-\frac{4}{5}$ b) $-\frac{5}{4}$ c) $\frac{4}{5}$ d) -1

8. ______________

9. Find the slope of the line containing $(5.9,-5.1)$ and $(7.6,-5.1)$.

a) -6 b) 0 c) $-\frac{1}{6}$ d) Not defined

9. ______________

10. Find a linear function $f(x)=mx+b$ whose graph has slope -9 and y-intercept $(0,7)$.

a) $f(x)=-9x-7$ b) $f(x)=-\frac{1}{9}x+7$

c) $f(x)=-9x+7$ d) $f(x)=-\frac{7}{9}x+9$

10. ______________

11. Find an equation of the line containing $(2,-5)$ with slope -4.

a) $y=4x+13$ b) $y=-4x-3$

c) $y=-4x-18$ d) $y=-4x+3$

11. ______________

12. Find an equation of the line containing the points $(-1,11)$ and $(-3,7)$.

a) $y=2x+13$ b) $y=-x+4$

c) $y=x+10$ d) $y=-2x+9$

12. ______________

13. Find an equation of the line containing the point $(3,-5)$ and parallel to the line $y=-2x+6$.

a) $y=\frac{1}{2}x+\frac{7}{2}$ b) $y=-2x+1$

c) $y=-2x-7$ d) $y=-2x-5$

13. ______________

CHAPTER 2 **NAME**____________________________

TEST FORM G

ANSWERS

14. ________________

15. ________________

16. ________________

17. ________________

18. ________________

14. Find an equation of the line containing the point $(-6,-1)$ and perpendicular to the line $2x+y=7$.

a) $y=-2x-13$ b) $y=2x+11$
c) $y=\frac{1}{2}x+2$ d) $y=\frac{1}{2}x-1$

15. The dividend paid by Grover Company has increased in recent years. Use the two points $(0, 21.7)$ and $(1, 23)$ from the accompanying table to find a linear function that fits the data.

Year, *x*, since 2010	Dividends paid, *d*
0	\$21.70
1	\$23.00

a) $d(x)=1.975x+21.7$ b) $d(x)=-1.3x+21.7$
c) $d(x)=2.975x+21.7$ d) $d(x)=1.3x+21.7$

16. Use the function found in Exercise 15 to estimate the dividend paid in 2015.

a) \$28.20 b) \$29.60 c) \$30.90 d) \$34.50

17. For a linear function f, $f(-3)=2$ and $f(4)=9$. Find $f(0)$.

a) -2 b) 5 c) 7 d) 4

18. The graph of the function $f(x)=mx+b$ contains the points $(a,2)$ and $(-5,c)$. Express a in terms of c if the graph is perpendicular to the line $9x-3y=-5$.

a) $a=1-3c$ b) $a=3c-1$
c) $a=3c-11$ d) $a=11-3c$

CHAPTER 2 NAME______________________

TEST FORM H CLASS_____SCORE_____GRADE_____

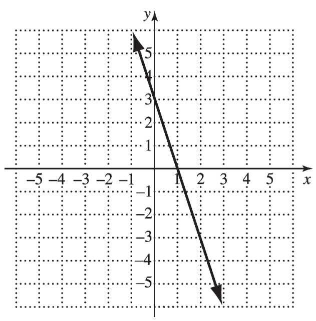
ANSWERS

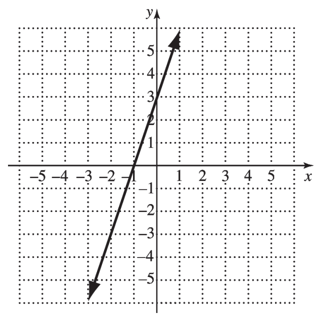
1. Which of the following is a solution of $3x+5y=11$?

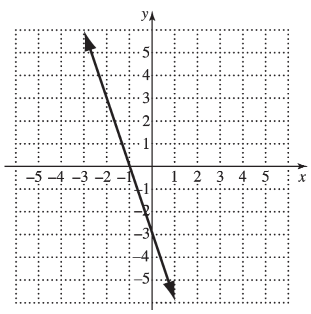
   a) $(2,1)$ b) $(6,0)$ c) $(11,-2)$ d) $(-2,3)$

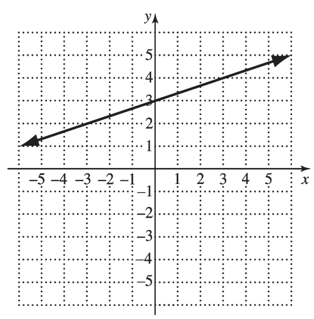
1. ______________

2. Which of the following is the graph of $y=-3x+3$?

   a)


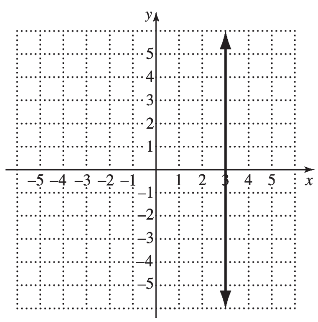
   b)


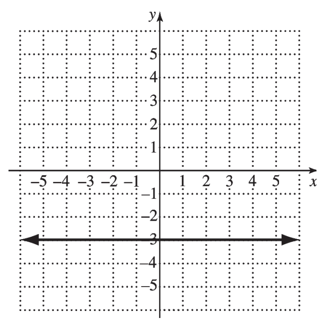
   c)


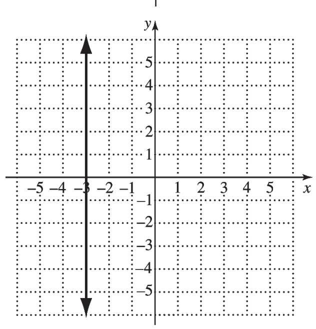
   d)


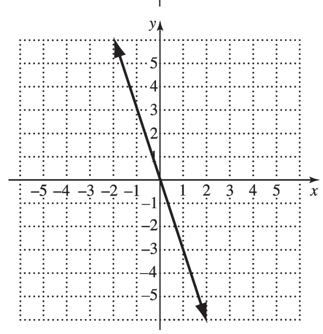
2. ______________

3. Which of the following is the graph of $-3x=9$?

   a)


   b)


   c)


   d)


3. ______________

CHAPTER 2 **NAME**________________________

TEST FORM H

ANSWERS

4. ______________

5. ______________

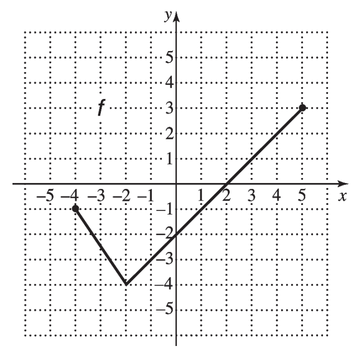
6. ______________

7. ______________

4. The function $N(t) = 3.51t + 26.85$ can be used to estimate the number of high speed internet subscribers in the U.S., t years after 2005. Estimate the number of high speed internet subscribers in 2018.

a) 71.1 million
b) 72.48 million
c) 139.87 million
d) 90.03 million

5. For the graph of f at right, determine $f(-2)$ and the domain of f.



a) -4; $\{x| \; x \geq -4\}$
b) 0; $\{x| -4 \leq x \leq 5\}$
c) -4; $\{x| -4 \leq x \leq 3\}$
d) -4; $\{x| -4 \leq x \leq 5\}$

6. Find the domain: $f(x) = x^2 - 4$.

a) $[-4, \infty)$
b) $(-\infty, -2) \cup (2, \infty)$
c) $(-\infty, -2) \cup (-2, 2) \cup (2, \infty)$
d) All real numbers

7. Find the slope and the y-intercept of $-5y + 2x = 30$.

a) Slope: $\frac{5}{2}$; y-intercept: $(0, -3)$

b) Slope: $\frac{2}{5}$; y-intercept: $(0, -6)$

c) Slope: $-\frac{5}{2}$; y-intercept: $(0, -3)$

d) Slope: $\frac{2}{5}$; y-intercept: $(0, 6)$

CHAPTER 2 NAME______________________________

TEST FORM H

8. Find the slope of the line containing $(-1,-6)$ and $(4,-8)$.

a) $-\frac{5}{2}$ b) $\frac{2}{5}$ c) $-\frac{2}{5}$ d) $\frac{14}{5}$

9. Find the slope of the line containing $(2.7,-6.2)$ and $(2.7,-7.4)$.

a) $\frac{2}{9}$ b) 0 c) $\frac{9}{2}$ d) Not defined

10. Find a linear function $f(x)=mx+b$ whose graph has slope 5 and y-intercept $(0,-6)$.

a) $f(x)=5x+6$ b) $f(x)=\frac{1}{5}x-6$

c) $f(x)=-\frac{6}{5}x$ d) $f(x)=5x-6$

11. Find an equation of the line containing $(4,-1)$ with slope -2.

a) $y=\frac{1}{2}x-3$ b) $y=-2x+7$

c) $y=-2x-1$ d) $y=-2x+2$

12. Find an equation of the line containing the points $(11,-4)$ and $(5,-8)$.

a) $y=\frac{2}{3}x+\frac{31}{3}$ b) $y=\frac{2}{3}x+4$

c) $y=\frac{2}{3}x-\frac{34}{3}$ d) $y=\frac{2}{3}x+8$

13. Find an equation of the line containing the point $(3,-5)$ and perpendicular to the line $3x-5y=6$.

a) $y=\frac{3}{5}x-\frac{21}{5}$ b) $y=-\frac{5}{3}x+10$

c) $y=-\frac{5}{3}x-\frac{16}{3}$ d) $y=-\frac{5}{3}x$

ANSWERS

8. ______________

9. ______________

10. ______________

11. ______________

12. ______________

13. ______________

CHAPTER 2 **NAME**____________________________

TEST FORM H

ANSWERS

14. ________________

15. ________________

16. ________________

17. ________________

18. ________________

14. Find an equation of the line containing the point $(1,-4)$ and parallel to the line $6y+2x=7$.

a) $y=-3x-1$ b) $y=3x-7$
c) $y=\frac{1}{3}x-\frac{13}{3}$ d) $y=-\frac{1}{3}x-\frac{11}{3}$

15. The Wellington Street Bookstore has experienced increased sales in recent years. Use the two points $(0,42)$ and $(2,60)$ from the accompanying table to find a linear model function that fits the data.

Year, x, since 2012	Sales, S, (in thousands)
0	\$42
1	\$53
2	\$60

a) $S(x)=11x+42$ b) $S(x)=9x+42$
c) $S(x)=10x+42$ d) $S(x)=-9x+42$

16. Use the function found in Exercise 15 to estimate the sales in 2017.

a) \$132,000 b) \$97,000
c) \$87,000 d) \$89,000

17. Find the y-intercept of the function given by $f(x)+3=2.9x^2+(5-3x)^2+7$.

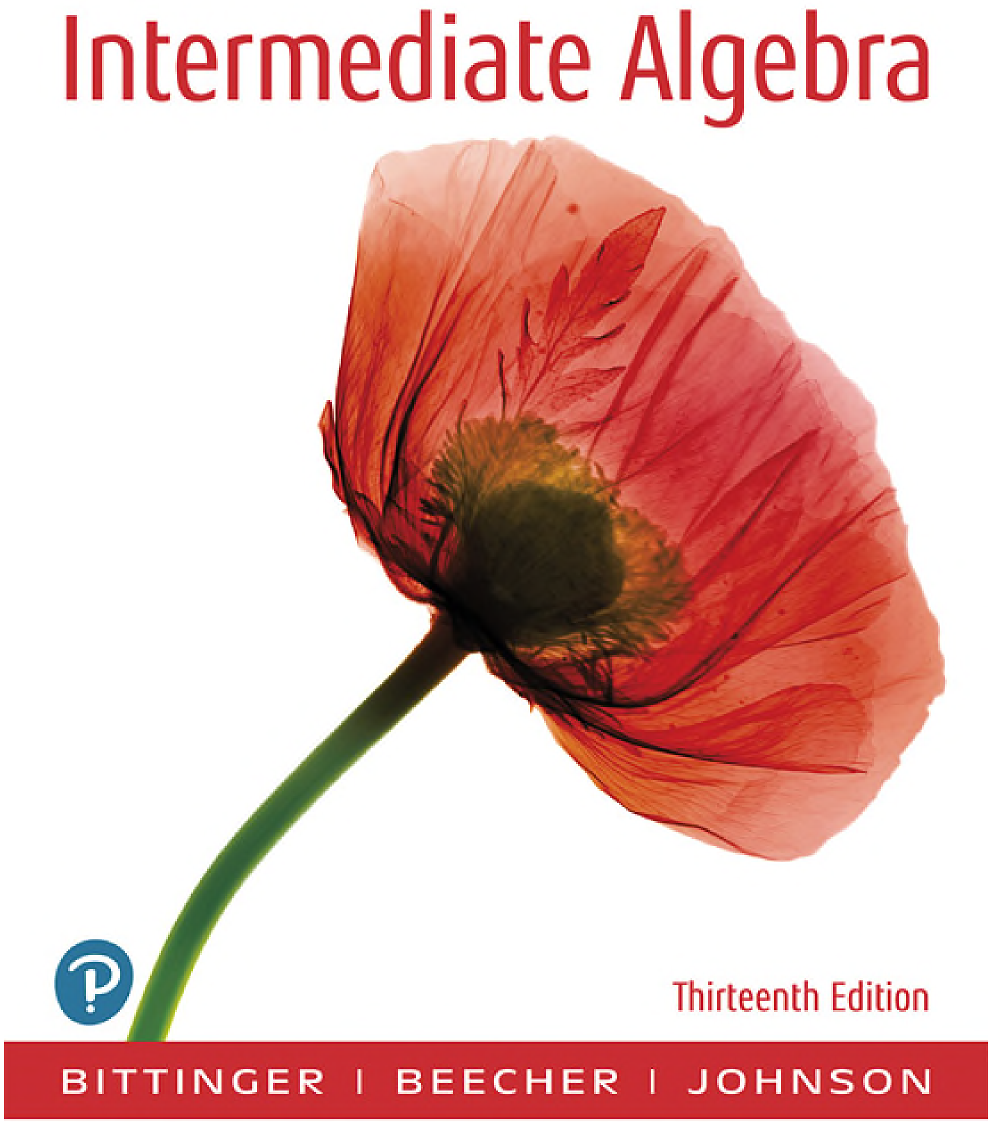
a) $(0,-3)$ b) $(0,0)$ c) $\left(0,\frac{5}{3}\right)$ d) $(0,29)$

18. Find k so that the line containing $(-3,k)$ and $(2,7)$ is perpendicular to the line containing $(3,-2)$ and $(-5,7)$.

a) $\frac{23}{9}$ b) $\frac{101}{8}$ c) $\frac{103}{9}$ d) $\frac{83}{8}$

Chapter 2

Graphs, Functions, and Applications



2.1 GRAPHS OF EQUATIONS

a. Plot points associated with ordered pairs of numbers.

b. Determine whether an ordered pair of numbers is a solution of an equation.

c. Graph linear equations using tables.

d. Graph nonlinear equations using tables.

Points and Ordered Pairs

To graph, or plot, points we use two perpendicular number lines called **axes**. The point at which the axes cross is called the **origin**. Arrows on the axes indicate the positive directions.

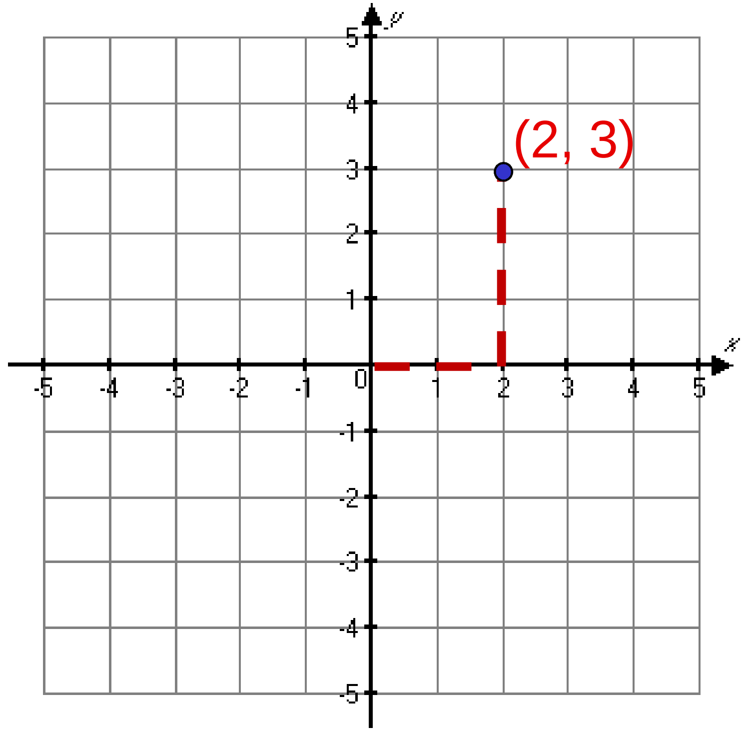
Consider the ordered pair (2, 3). The numbers in such a pair are called the **coordinates.** The **first coordinate** in this case is 2 and the **second coordinate** is 3.

Points and Ordered Pairs continued

To plot the point (2, 3) we start at the origin. Move 2 units in the positive horizontal direction (right).

The second number 3, is positive. We move 3 units in the positive vertical direction (up).

Make a “dot” and label the point.



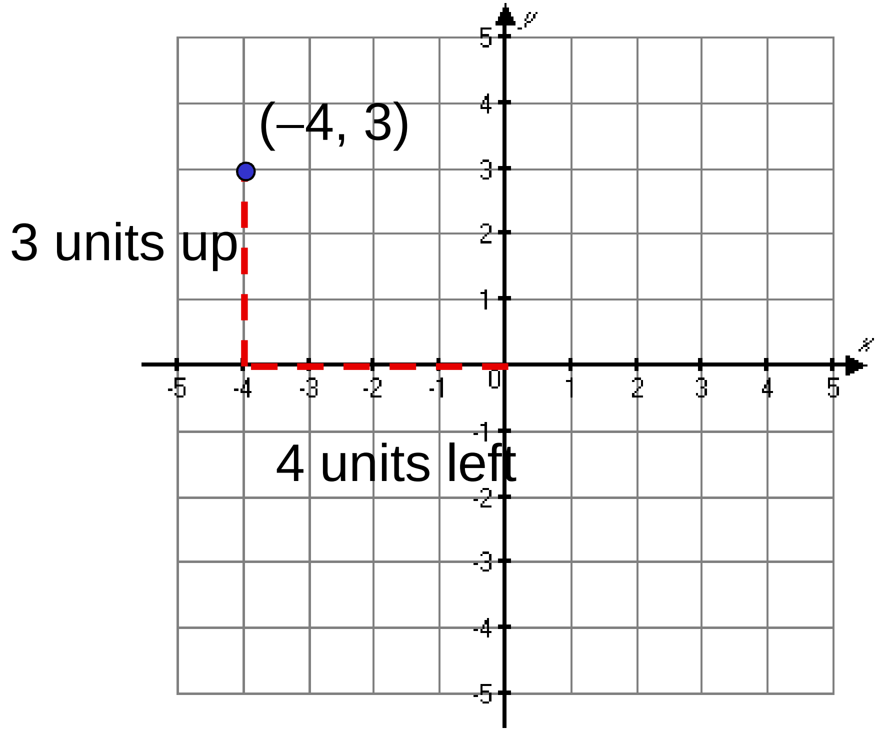
Example

Plot the point (–4, 3).

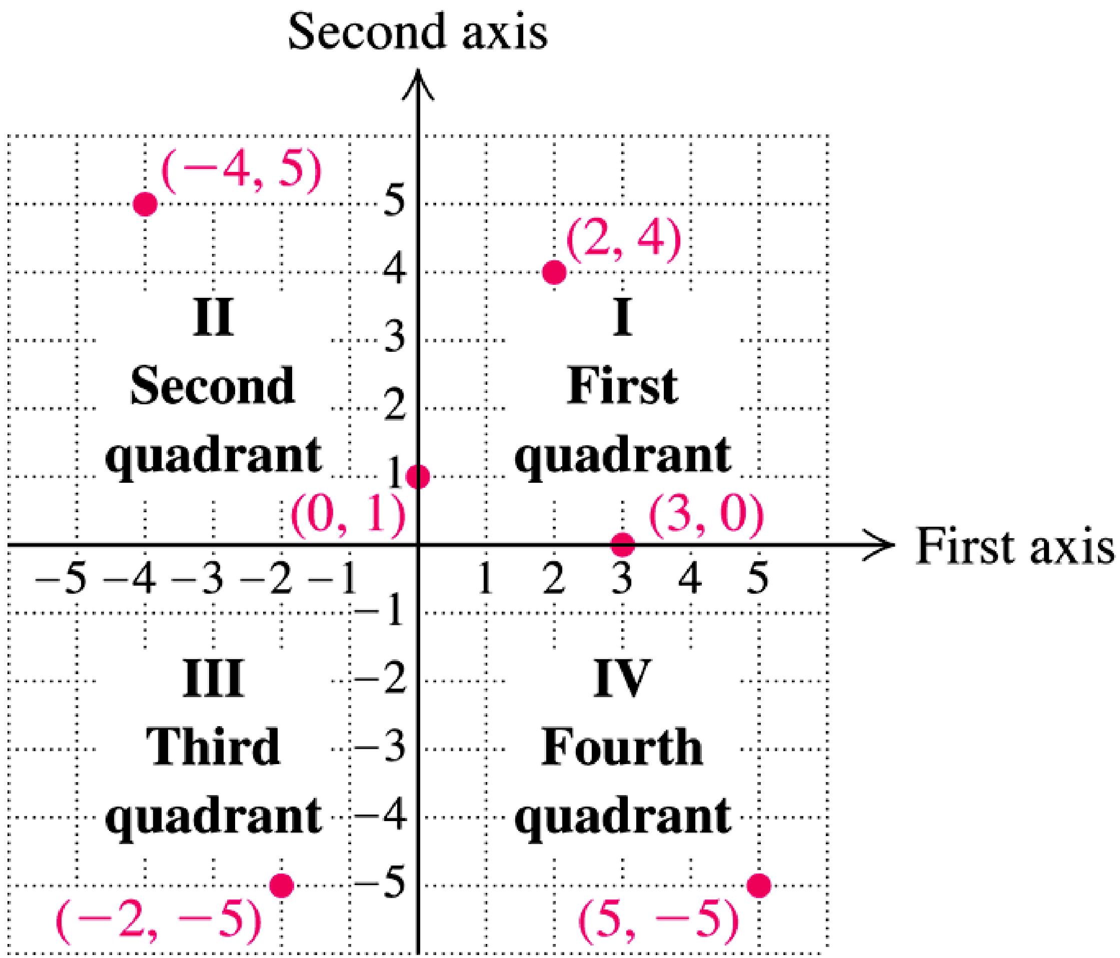
Solution

Starting at the origin, we move 4 units in the negative horizontal direction (left).

The second number, 3, is positive, so we move 3 units in the positive vertical direction (up).



The horizontal and vertical axes divide the plane into four regions, or **quadrants**.



In which quadrant is the point (3, –4) located? IV

In which quadrant is the point (–3, –4) located? III

Example

Determine whether each of the following pairs is a solution of $4y + 3x = 18$:

a) (2, 3)

b) (1, 5)

Determine whether each of the following pairs is a solution of $4y + 3x = 18$: a) (2, 3); b)(1, 5).

Solution

a) We substitute 2 for x and 3 for y.

$$\underline{4y + 3x = 18}$$
$$4 \bullet 3 + 3 \bullet 2 \mid 18$$
$$12 + 6 \mid 18$$
$$18 = 18 \quad \text{True}$$

Since 18 = 18 is *true,* the pair (2, 3) is a solution.

b) We substitute 1 for x and 5 for y.

$$\underline{4y + 3x = 18}$$
$$4 \bullet 5 + 3 \bullet 1 \mid 18$$
$$20 + 3 \mid 18$$
$$23 = 18 \quad \text{False}$$

Since 23 = 18 is *false,* the pair (1, 5) is *not* a solution.

Graph of An Equation

The **graph** of an equation is a drawing that represents all its solutions.

To Graph a Linear Equation

1. Select a value for one variable and calculate the corresponding value of the other variable. Form an ordered pair using alphabetical order as indicated by the variables.
2. Repeat step (1) to obtain at least two other ordered pairs. Two ordered pairs are essential. A third ordered point serves as a check.
3. Plot the ordered pairs and draw a straight line passing through the points.

Example

Graph $y = 3x$.

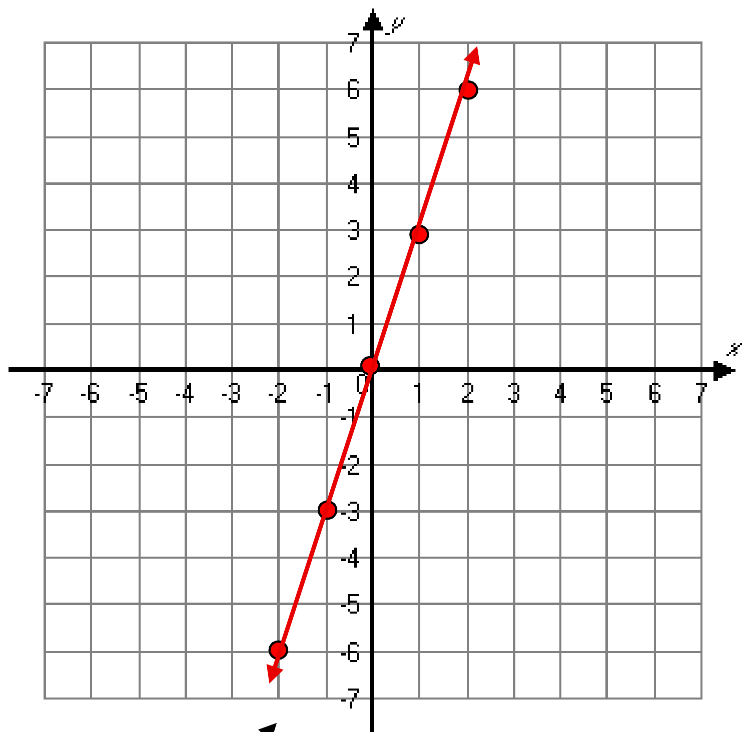
Solution Find some ordered pairs that are solutions. We choose *any* number for x and then determine y by substitution.

	y	
x	$y = 3x$	(x, y)
2	6	(2, 6)
1	3	(1, 3)
0	0	(0, 0)
–1	–3	(–1, –3)
–2	–6	(–2, –6)

(2, 6)

(1, 3)

(0, 0)



1. Choose x.
2. Compute y.
3. Form the ordered pair (x, y).
4. Plot the points.

Example

Graph: $y = -4x + 1$

Solution

We select convenient values for x and compute *y*, and form an ordered pair.

If $x = 2$, then $y = -4(2) + 1 = -7$ and $(2, -7)$ is a solution.

If $x = 0$, then $y = -4(0) + 1 = 1$ and $(0, 1)$ is a solution.

If $x = -2$, then $y = -4(-2) + 1 = 9$ and $(-2, 9)$ is a solution.

Example (continued)

Results are often listed in a table.

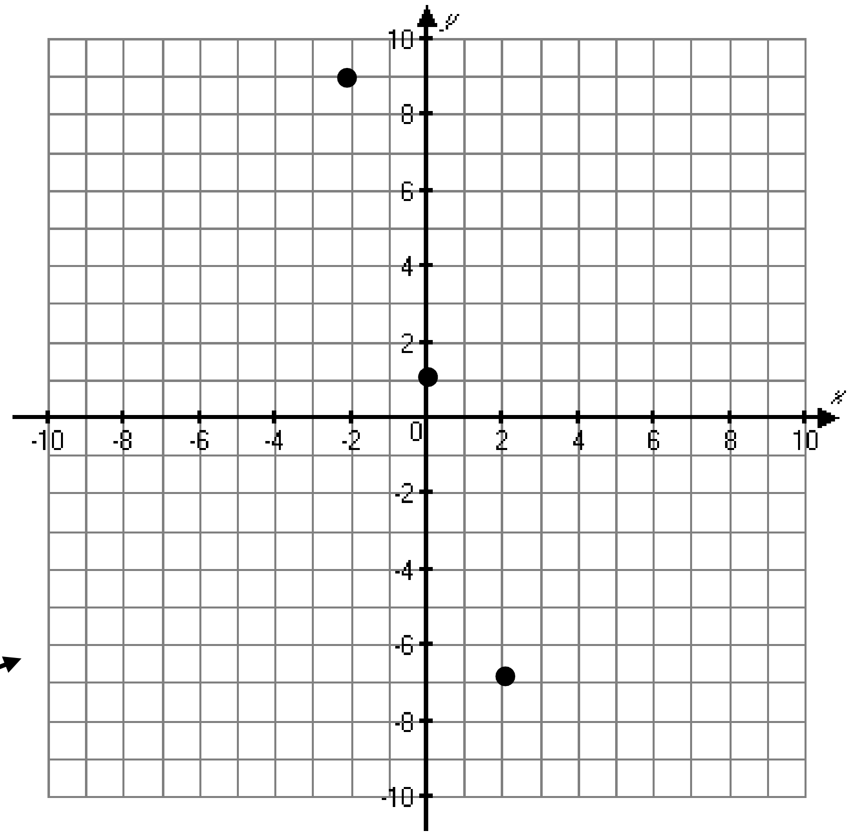
x	y	(x, y)
2	–7	(2, –7)
0	1	(0, 1)
–2	9	(–2, 9)

(1) Choose x.

(2) Compute y.

(3) Form the pair (x, y).

(4) Plot the points.

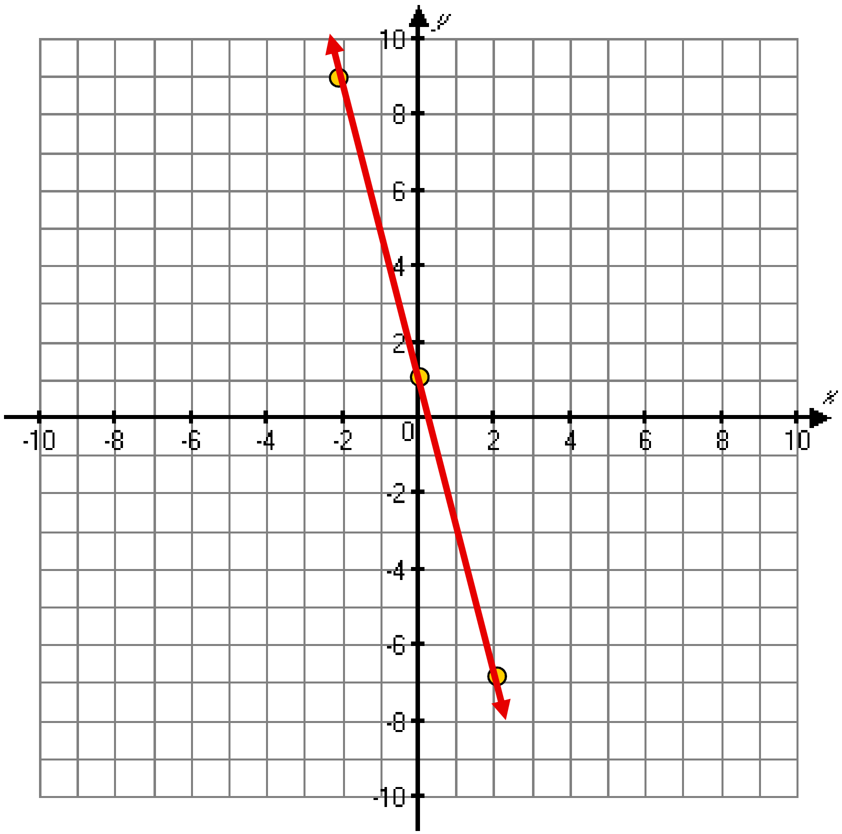


Example (continued)

Note that all three points line up. If they didn't we would know that we had made a mistake.

Finally, use a ruler or other straightedge to draw a line.

Every point on the line represents a solution of $y = -4x + 1$.



Example

Graph $x + 2y = 6$

Solution

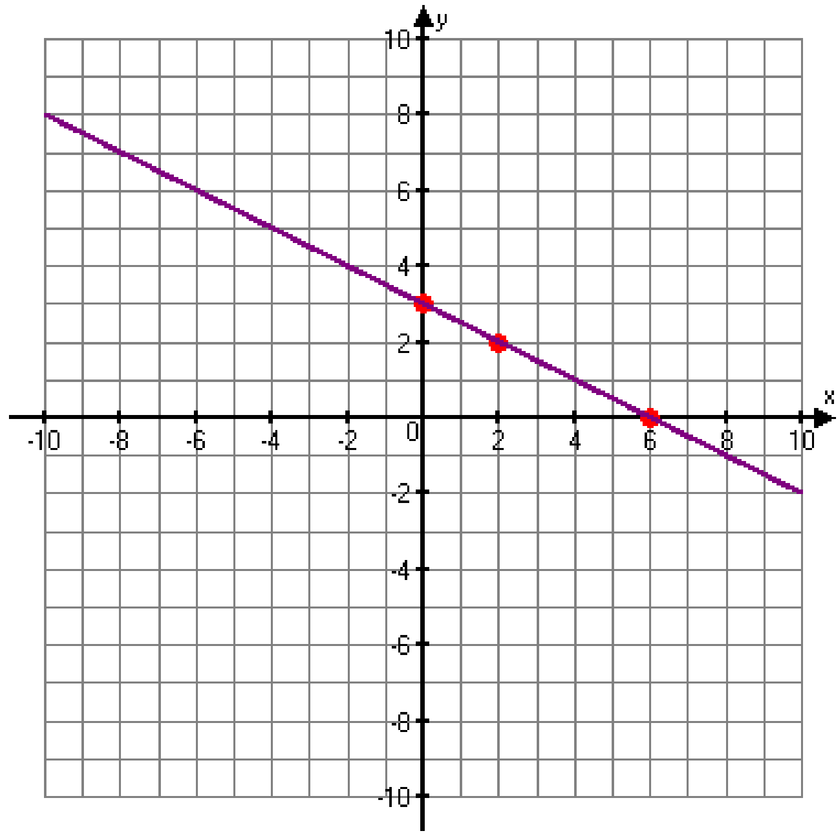
Select some convenient x-values and compute y-values.

If $x =$ 6, then $6 + 2y = 6 \rightarrow y =$ 0

If $x =$ 0, then $0 + 2y = 6 \rightarrow y =$ 3

If $x =$ 2, then $2 + 2y = 6 \rightarrow y =$ 2

x	***y***	**(*x*, *y*)**
6	0	(6, 0)
0	3	(0, 3)
2	2	(2, 2)



Nonlinear Equations

We refer to any equation whose graph is a straight line as a **linear equation**.

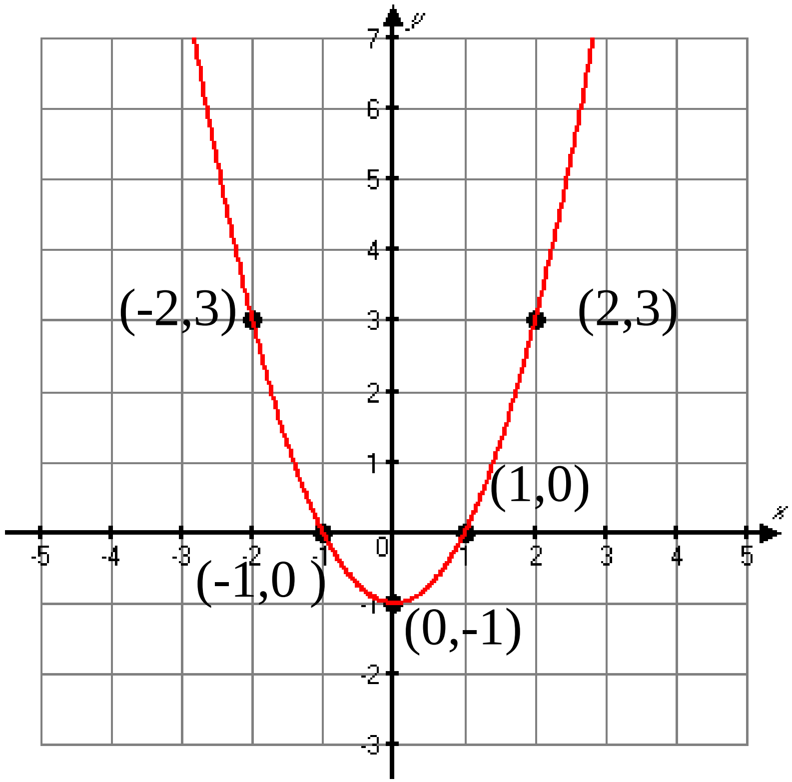
There are many equations for which the graph is not a straight line. Graphing these **nonlinear equations** often requires plotting many points to see the general shape of the graph.

Example

Graph the equation $y = x^2 - 1$.

Solution

x	y	(x, y)
0	–1	(0, –1)
1	0	(1, 0)
–1	0	(–1, 0)
2	3	(2, 3)
–2	3	(–2, 3)

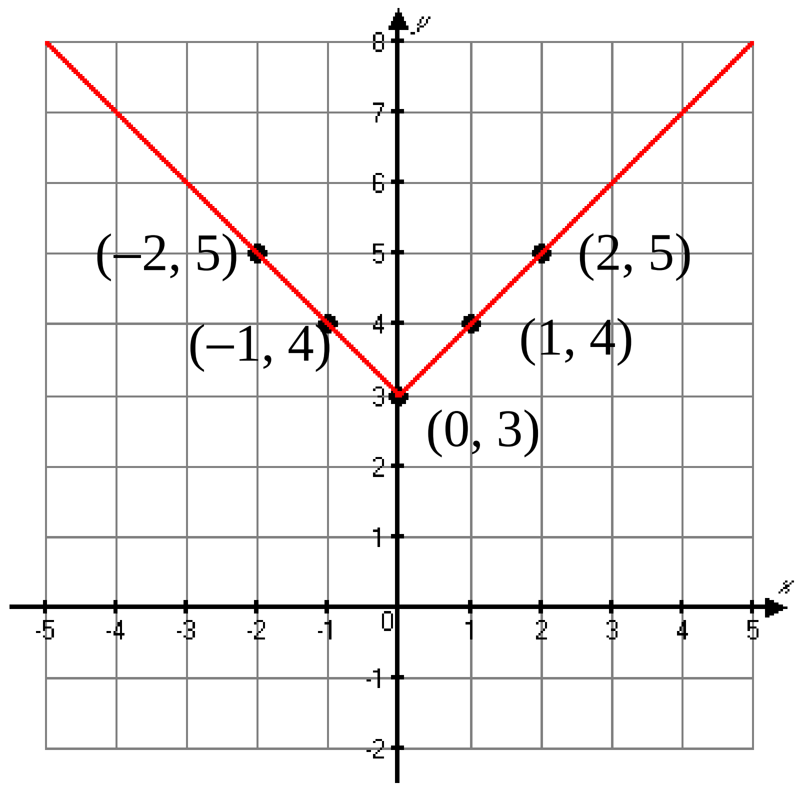


Example

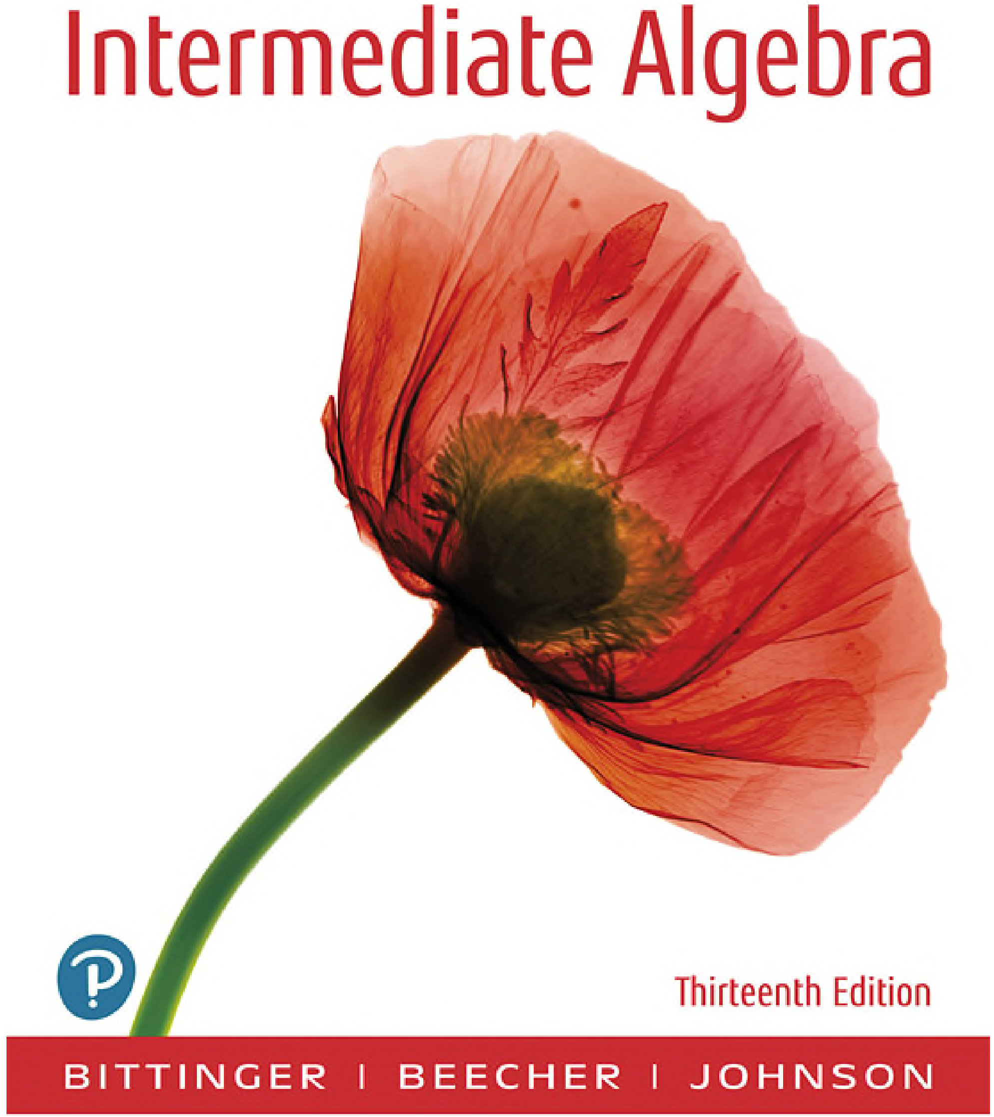
Graph the equation $y = |x| + 3$.

Solution

x	y	(x, y)
0	3	(0, 3)
1	4	(1, 4)
–1	4	(–1, 4)
2	5	(2, 5)
–2	5	(–2, 5)



Chapter 2



Graphs, Functions, and Applications

2.2 FUNCTIONS and GRAPHS

a. Determine whether a correspondence is a function.

b. Given a function described by an equation, find function values (outputs) for specified values (inputs).

c. Draw the graph of a function.

d. Determine whether a graph is that of a function using the vertical-line test.

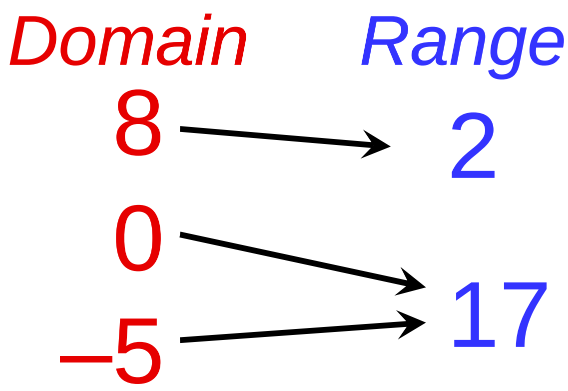
e. Solve applied problems involving functions and their graphs.

Function

A *function* is a special kind of correspondence between two sets. The first set is called the **domain**. The second set is called the **range**. For any member of the domain, there is *exactly one* member of the range to which it corresponds. This kind of correspondence is called a **function**.

Example

Determine whether the correspondence is a function.

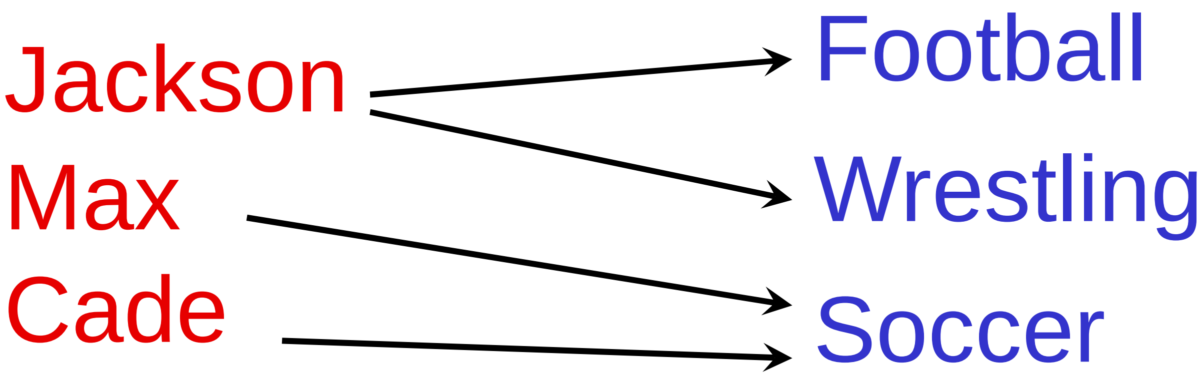


Solution

The correspondence *is* a function because each member of the domain corresponds to *exactly one* member of the range.

Example

Determine if the correspondence is a function.



Solution

The correspondence *is not* a function because a member of the domain (Jackson) corresponds to *more than one* member of the range.

Function; Domain; Range

A **function** is a correspondence between a first set, called the **domain**, and a second set, called the **range**, such that each member of the domain corresponds to **exactly one** member of the range.

Example

Determine whether the correspondence is a function.

Domain	*Correspondence*	*Range*
A set of rectangles	Each rectangle's area	A set of numbers

Solution

The correspondence *is* a function, because each rectangle has *only one* area.

Example

Determine if the correspondence is a function.

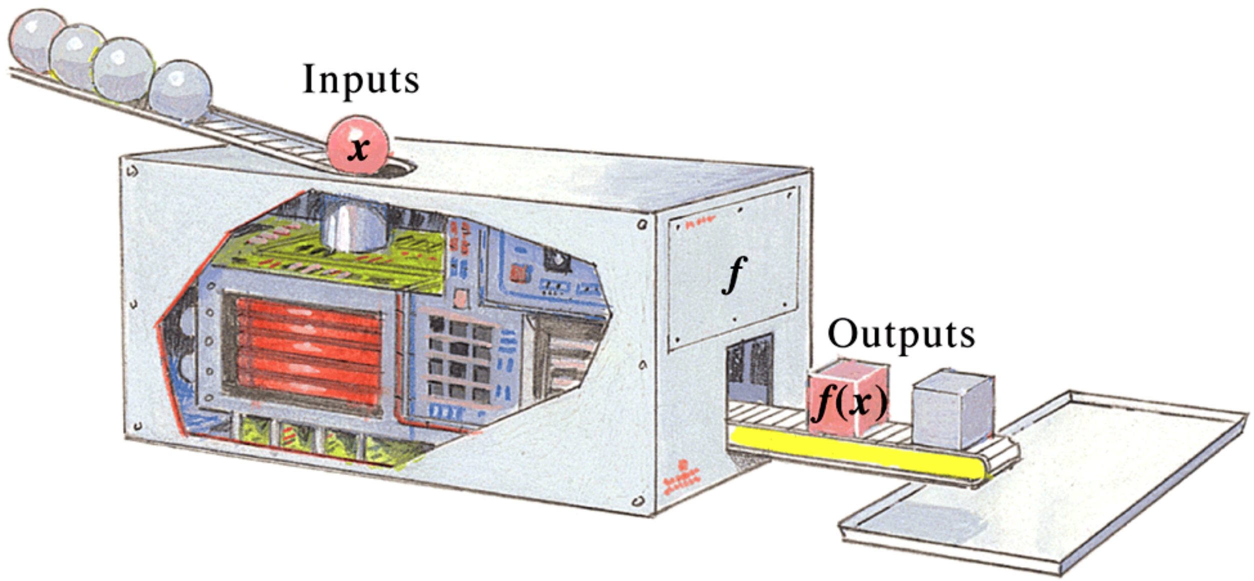
Domain	*Correspondence*	*Range*
Famous singers	A song that the singer has recorded	A set of song titles

Solution

The correspondence *is not* a function, because some singers have recorded *more than one* song.

Relation

A **relation** is a correspondence between a first set, called the **domain**, and a second set, called the **range**, such that each member of the domain corresponds to at least one member of the range.



The function pictured has been named *f.* Here *x* represents an arbitrary input, and *f*(*x*) – read “*f* of *x*,” “*f* at *x*,” or “the value of *f* at *x*” represents the corresponding output.

Most functions are described by equations. For example, $f(x) = 5x + 2$ describes the function that takes an input x, multiplies it by 5 and then adds 2.

Input

$$f(x) = 5x + 2$$

To calculate the output $f(3)$, take the input 3, multiply it by 5, and add 2 to get 17. That is, substitute 3 into the formula for $f(x)$.

$$f(3) = 5(3) + 2 = 17$$

Example

Find each indicated function value.

a) $f(-2)$, for $f(x) = 3x^2 + 2x$

b) $g(4)$, for $g(t) = 6t + 9$

c) $h(m + 2)$, for $h(x) = 8x + 1$

Solution

a) $f(-2) = 3(-2)^2 + 2(-2) = 12 - 4 = 8$

b) $g(4) = 6(4) + 9 = 24 + 9 = 33$

c) $h(m + 2) = 8(m + 2) + 1 = 8m + 16 + 1$

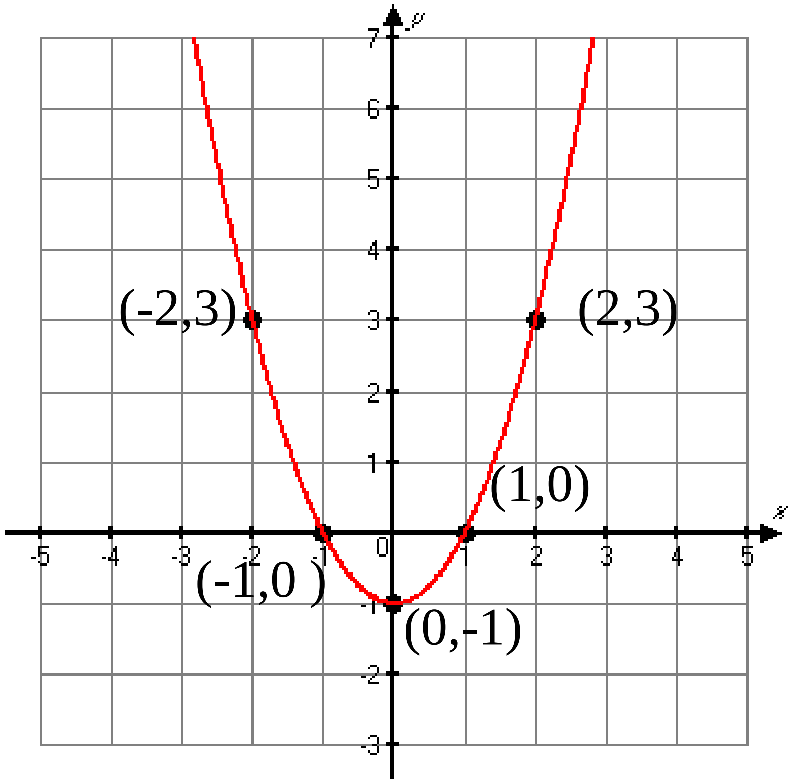
$= 8m + 17$

Example

Graph: $f(x) = x^2 - 1$.

Solution

x	y	(x, y)
0	–1	(0, –1)
1	0	(1, 0)
–1	0	(–1, 0)
2	3	(2, 3)
–2	3	(–2, 3)

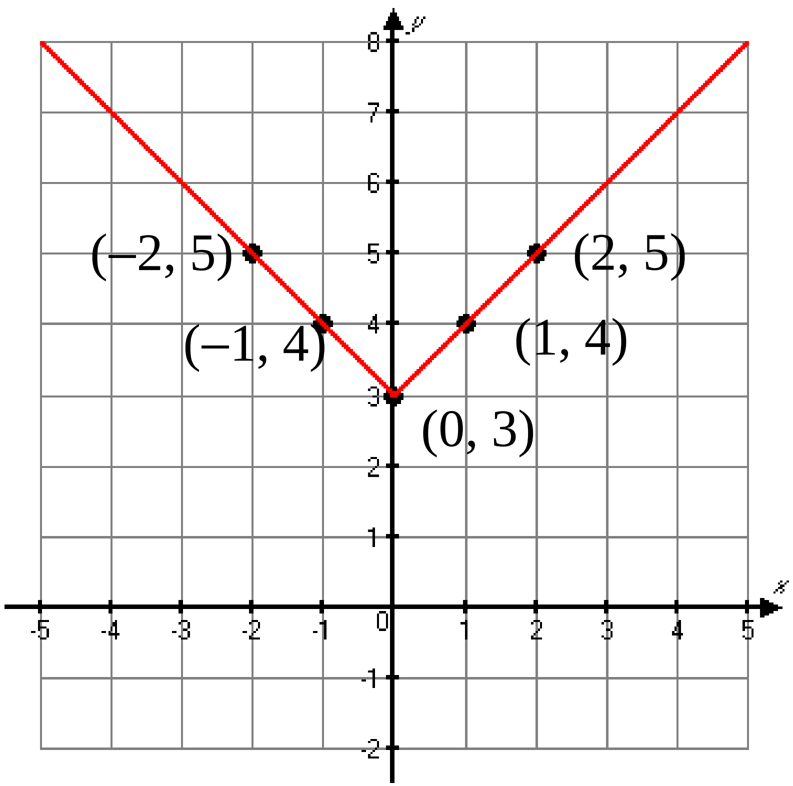


Example

Graph: $f(x) = |x| + 3$.

Solution

x	y	(x, y)
0	3	(0, 3)
1	4	(1, 4)
–1	4	(–1, 4)
2	5	(2, 5)
–2	5	(–2, 5)

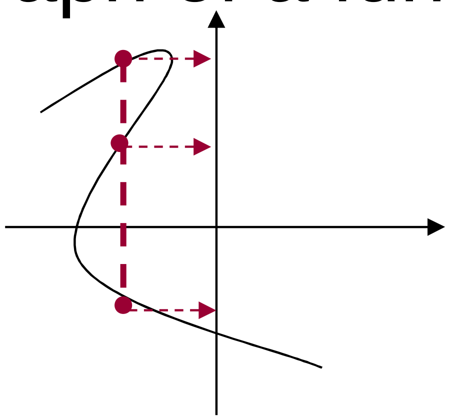


The Vertical-Line Test

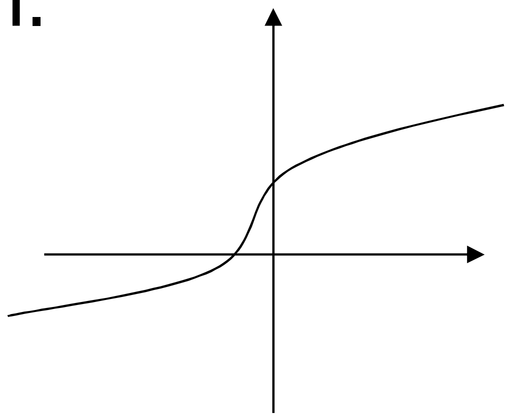
If it is possible for a vertical line to cross a graph more than once, then the graph is *not* the graph of a function.

Example

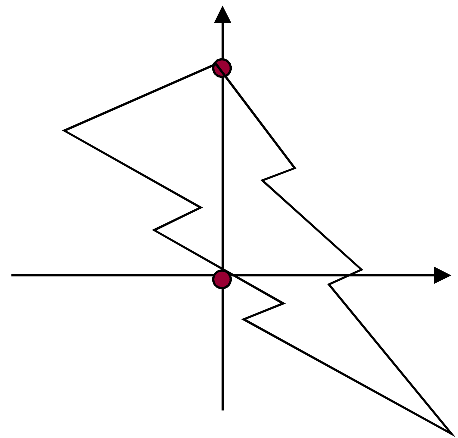
Determine whether each of the following is the graph of a function.



Not a function. Three *y*-values correspond to one *x*-value



A function



Not a function. Two *y*-values correspond to one *x*-value

Graphs that do not represent functions still do represent *relations*.

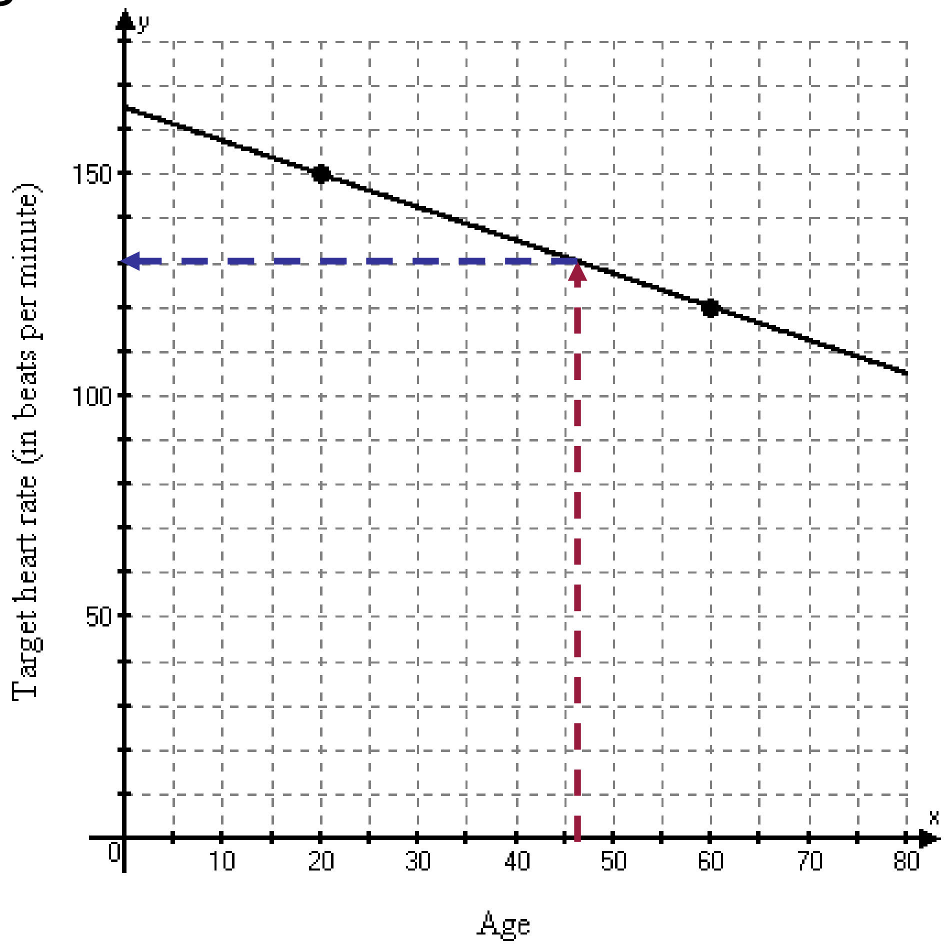
Example

The following graph represents the age of an individual and their target heart rate.

What is the target heart rate for a 46-year-old? That is, find *f*(46).

To estimate the heart rate, locate 46 on the horizontal axis and move directly up until we reach the graph.

Then move across to the vertical axis. We come to a point that is about 130.

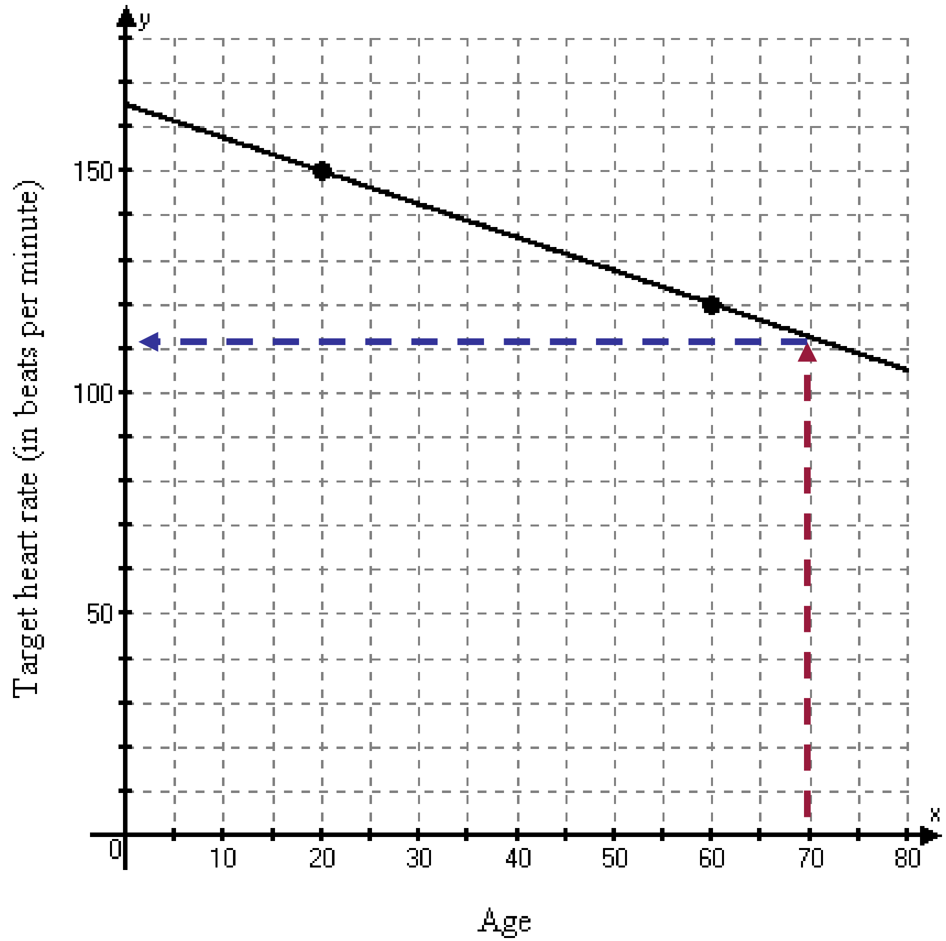


continued

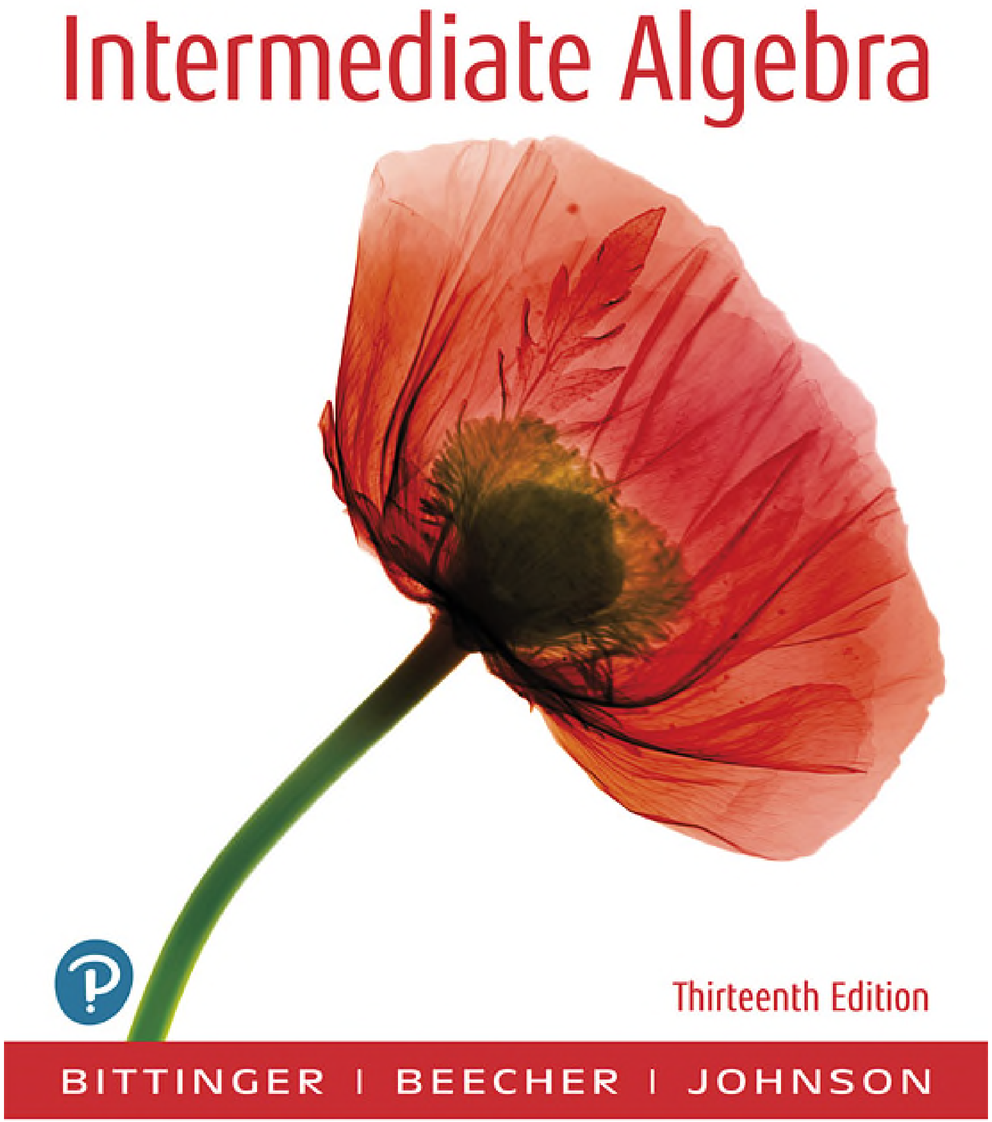
What is the target heart rate for a 70-year-old? that is, find *f*(70).

To estimate the heart rate, locate 70 on the horizontal axis and move directly up until we reach the graph.

Then move across to the vertical axis. We come to a point that is about 112.



Chapter 2



Graphs, Functions, and Applications

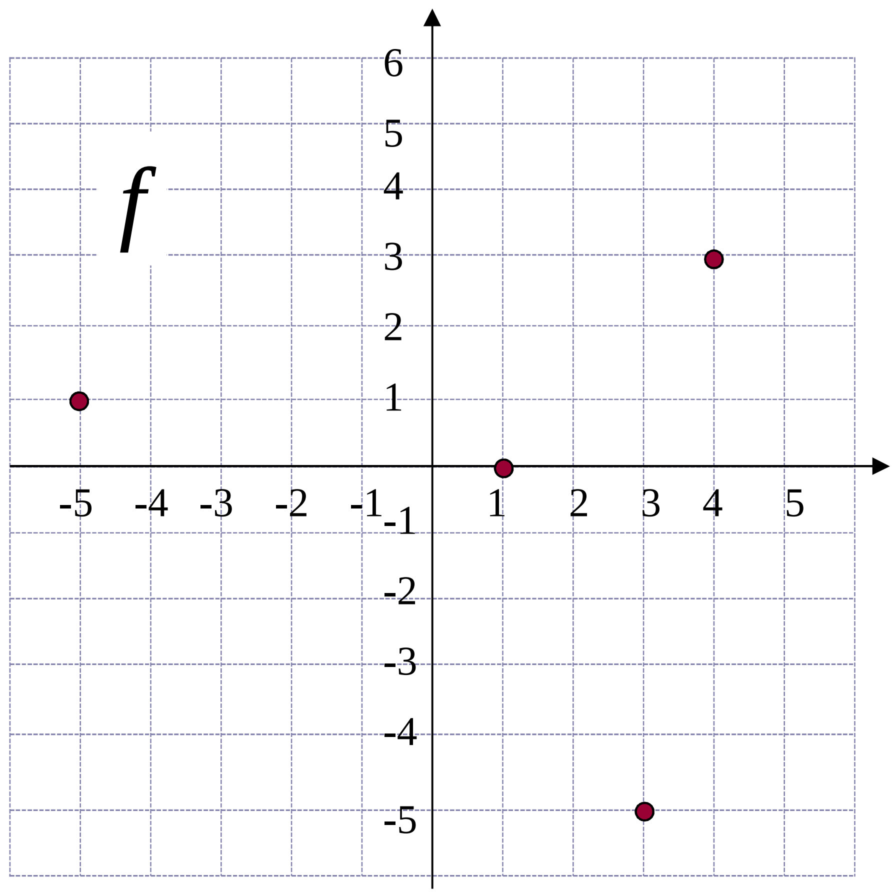
2.3 FINDING DOMAIN and RANGE

a. Find the domain and the range of a function.

The solutions of an equation in two variables consist of a set of ordered pairs. A set of ordered pairs is called a **relation**. When a set of ordered pairs is such that no two different pairs share a common first coordinate, we have a **function**. The **domain** is the set of all first coordinates and the **range** is the set of all second coordinates.

Example

Find the domain and range of the function *f* whose graph is shown below.



Solution

The function contains four ordered pairs and it can be written as

{(–5, 1), (1, 0), (3, –5), (4, 3)}.

Domain is the set of all first coordinates {–5, 1, 3, 4}.

Range is the set of all second coordinates, {1, 0, –5, 3}.

Example

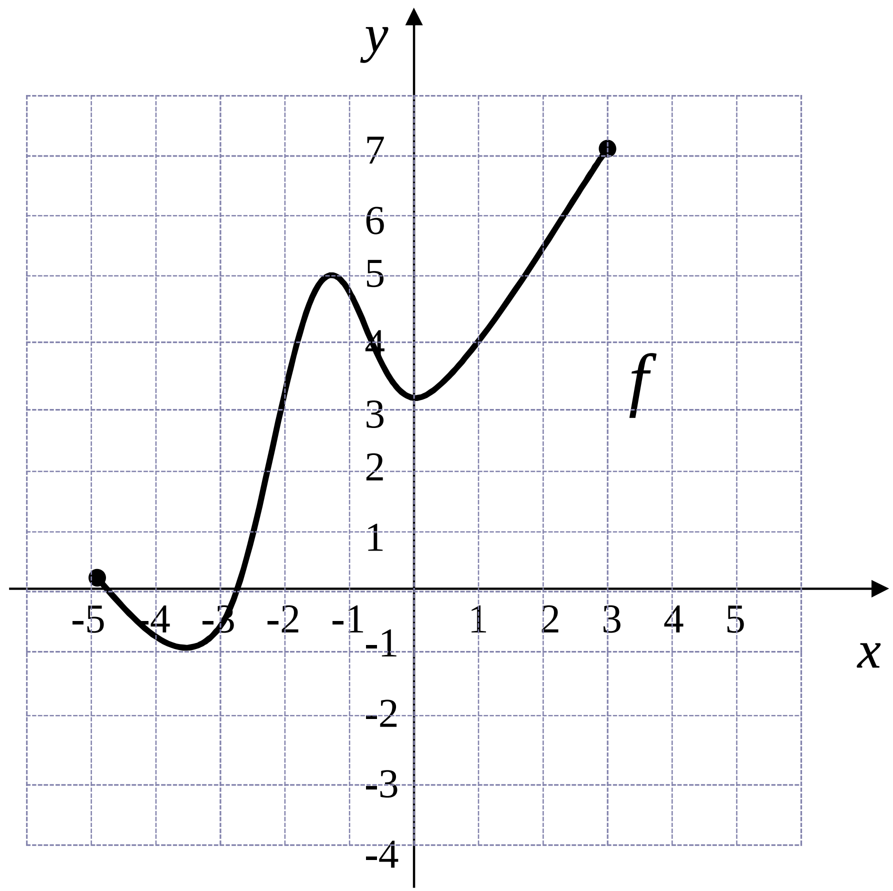
For the function *f* represented below, determine each of the following.

a) What member of the range is paired with –2

b) The domain of *f*

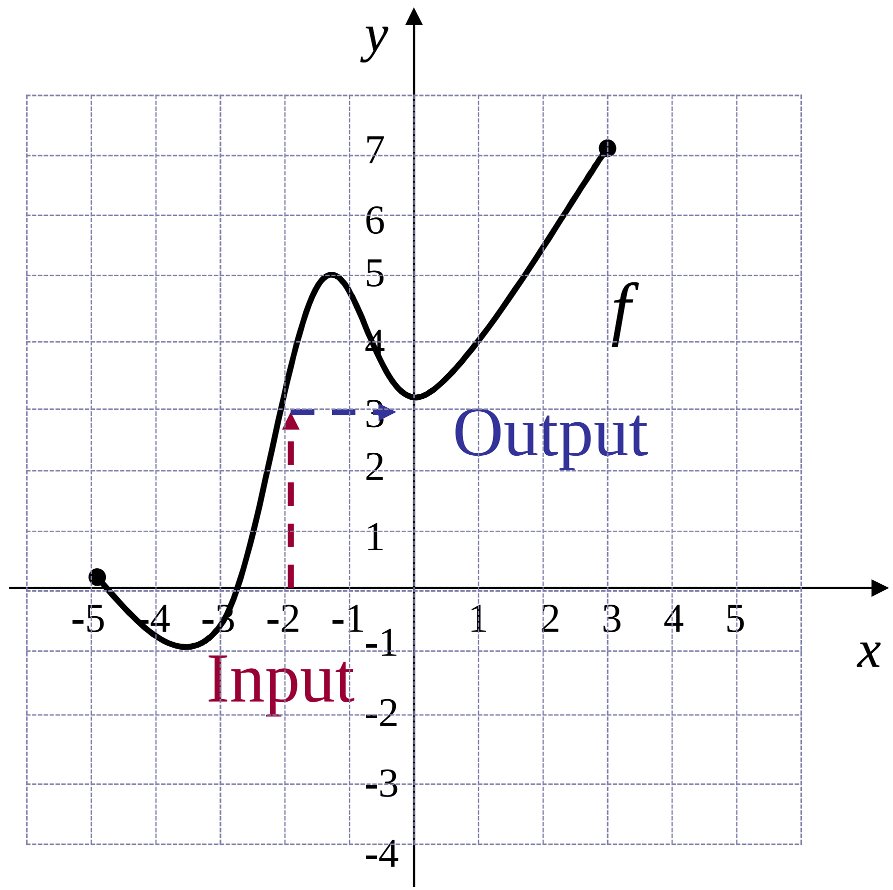
c) What member of the domain is paired with 6

d) The range of *f*



Continued

a) What member of the range is paired with –2



Solution

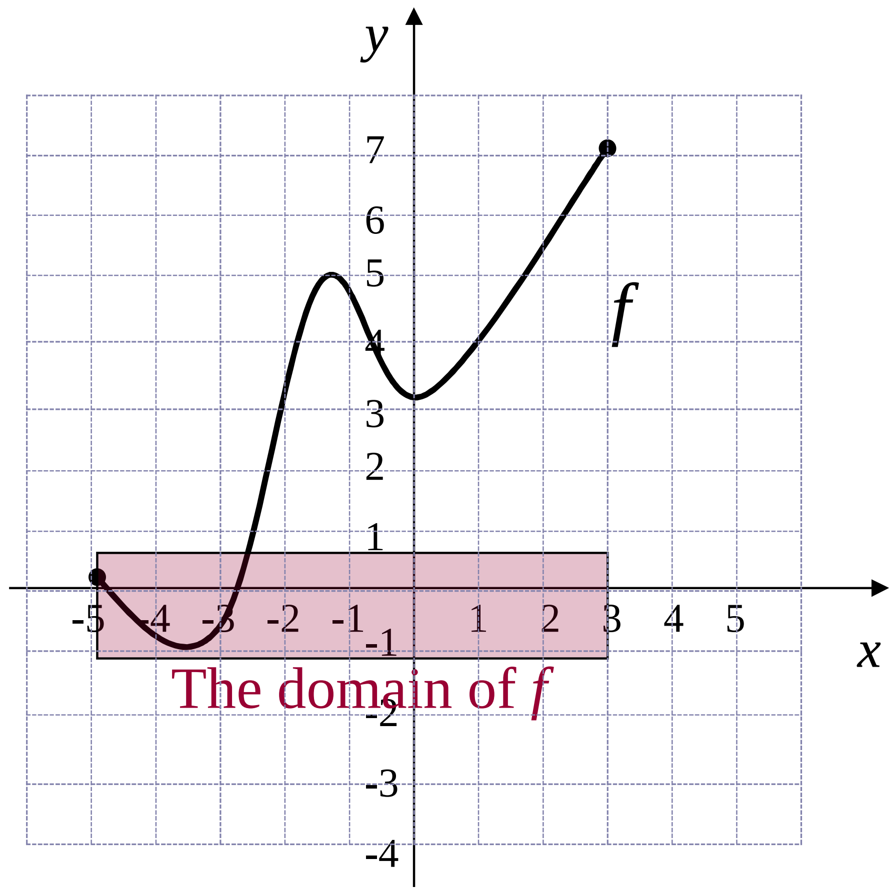
Locate –2 on the horizontal axis (this is where the domain is located). Next, find the point directly above –2 on the graph of *f*. From that point, look to the corresponding *y*-coordinate, 3. The “input” –2 has the “output” 3.

Continued

b) The domain of *f*

Solution

The domain of *f* is the set of all *x*-values that are used in the points on the curve. These extend continuously from -5 to 3 and can be viewed as the curve's shadow, or *projection,* on the *x*-axis. Thus the domain is $\{x \mid -5 \le x \le 3\}$.

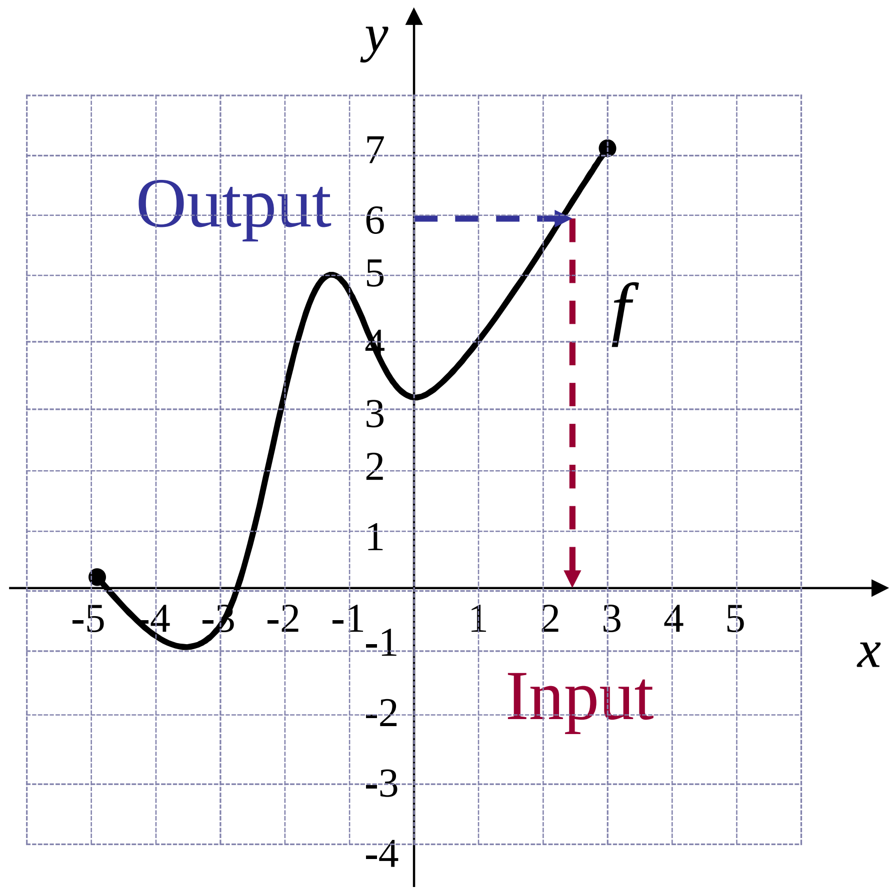


Continued

c) What member of the domain is paired with 6

Solution

Locate 6 on the vertical axis (this is where the range is located). Next, find the point to the right of 6 on the graph of *f*. From that point, look to the corresponding *x*-coordinate, 2.5. The "output" 6 has the "input" 2.5.

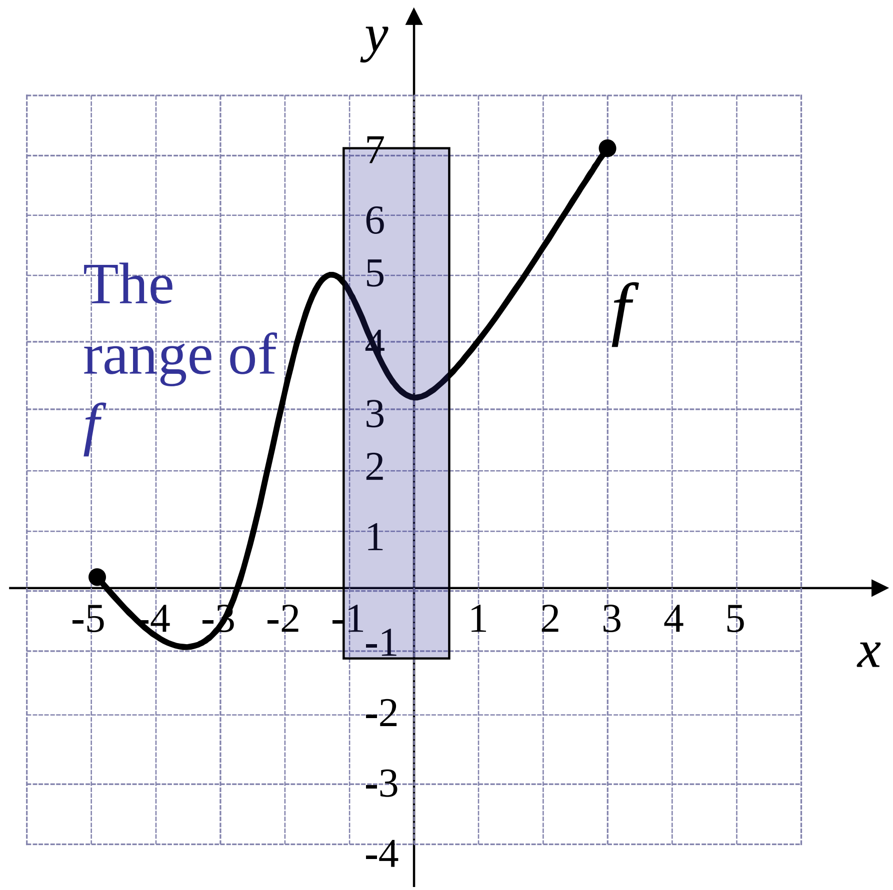


Continued

d) The range of *f*

Solution

The range of *f* is the set of all *y*-values that are used in the points on the curve. These extend continuously from −1 to 7 and can be viewed as the curve's shadow, or projection, on the *y*-axis. Thus the range is $\{y \mid -1 \leq y \leq 7\}$.



Example

Find the domain of $f(x) = \dfrac{2}{x-8}$.

Solution

We ask, "Is there any number x for which $\dfrac{2}{x-8}$ cannot be computed?" Since $\dfrac{2}{x-8}$ cannot be computed when $x – 8 = 0$ the answer is *yes.*

To determine what x-value would cause $x – 8$ to be 0, we solve an equation:

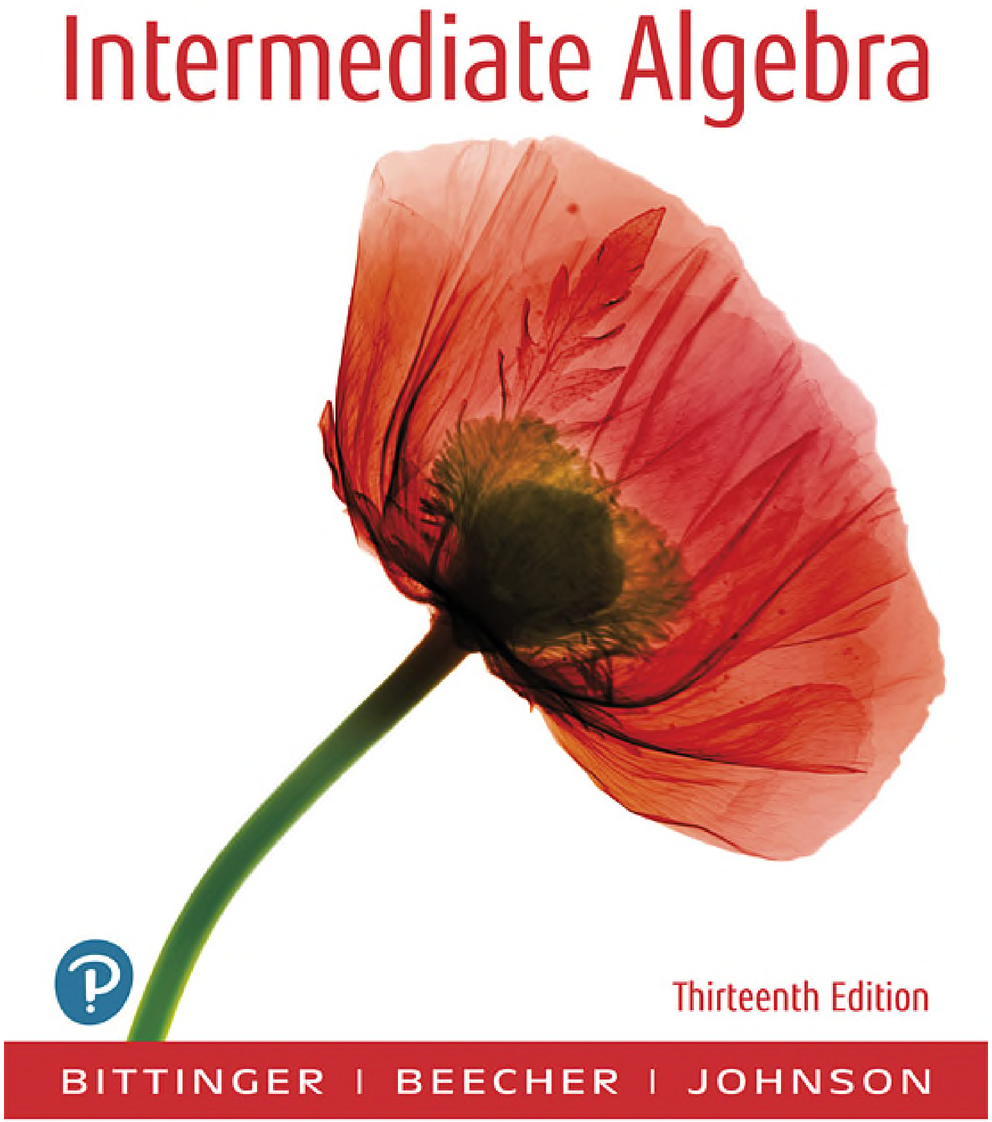
$$x - 8 = 0,$$

$$x = 8$$

Thus 8 is not in the domain of *f,* whereas all other real numbers are. The domain of *f* is $\{x \mid x \text{ is a real number } \textit{and } x \neq 8\}$.

Chapter 2

Graphs, Functions, and Applications



2.4 LINEAR FUNCTIONS: GRAPHS and SLOPES

a. Find the *y*-intercept of a line from the equations $y = mx + b$ or $f(x) = mx + b$.

b. Given two points on a line, find the slope Given a linear equation, derive the equivalent slope-intercept equation and determine the slope and the *y*-intercept.

c. Solve applied problems involving slope.

Linear Function

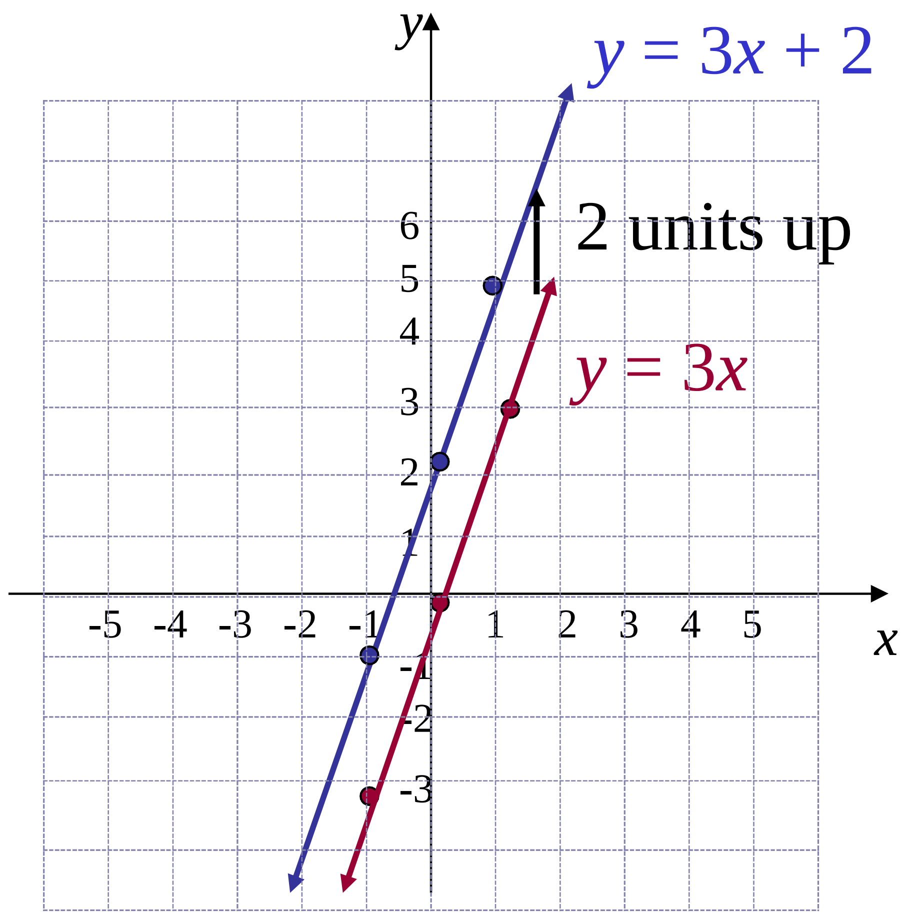
A **linear function** f is any function that can be described by $f(x) = mx + b$.

Example

Graph $f(x) = 3x$ and $g(x) = 3x + 2$ using the same set of axes.

Solution

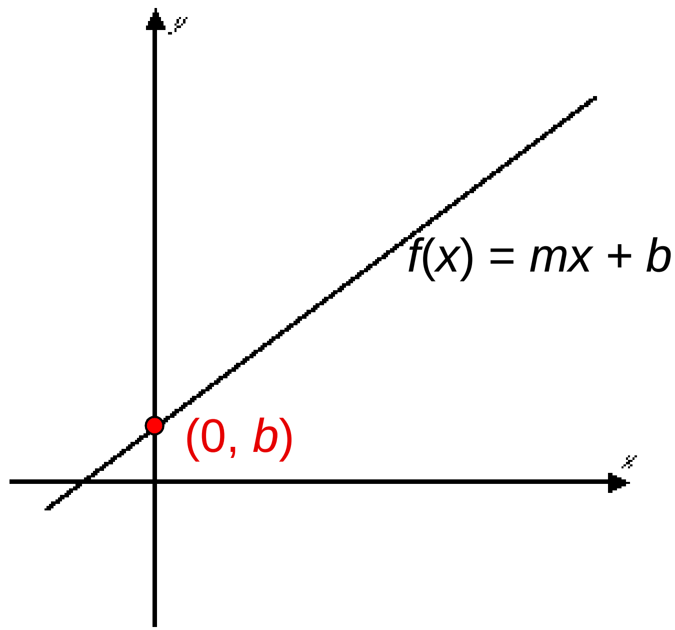
x	y $y = 3x$	y $y = 3x + 2$
0	0	2
1	3	5
–1	–3	–1



Notice that the graph of $y = 3x + 2$ is the graph of $y = 3x$ shifted, or *translated*, 2 units up.

y-Intercept of $f(x) = mx + b$

The y-intercept of the graph of $f(x) = mx + b$ is the point $(0, b)$ or, simply, b.



Example

For each equation, find the *y*-intercept.

a. $y = –3.1x + 7$ b. $f(x) = \frac{4}{3}x - 9$

Solution

a) $y = –3.1x + 7$ (0, 7) is the *y*-intercept.

b) $f(x) = \frac{4}{3}x - 9$ (0, –9) is the *y*-intercept.

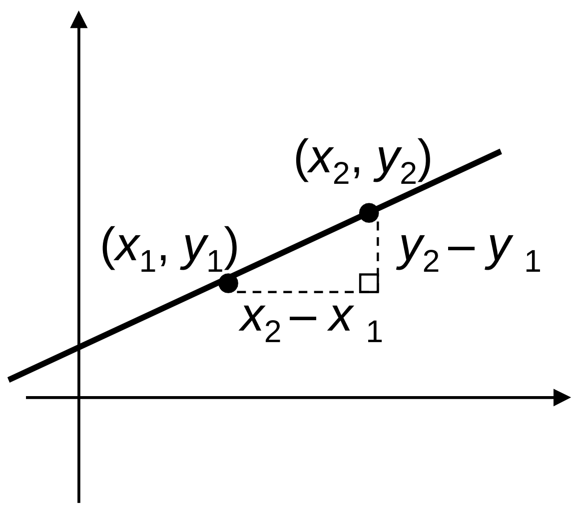
Slope

The slope *m* of the line containing points (x_1, y_1) and (x_2, y_2) is given by

$$m = \frac{\text{rise}}{\text{run}} = \frac{\text{vertical change}}{\text{horizontal change}}$$

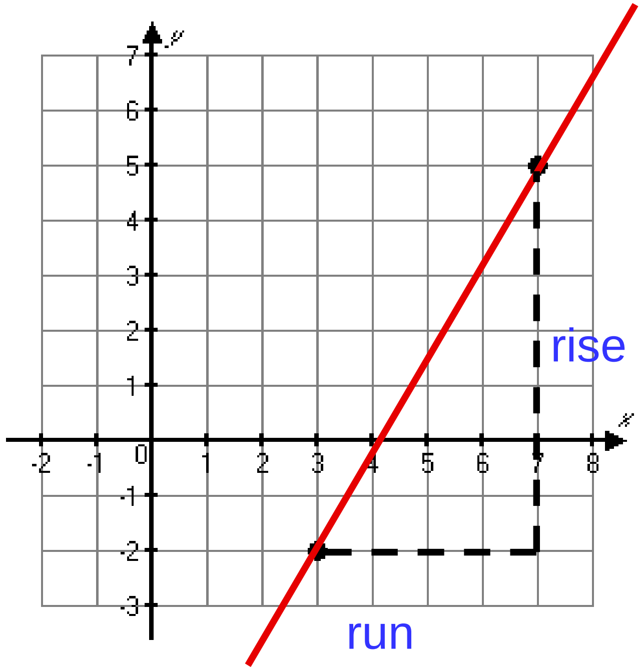
$$= \frac{\text{change in } y}{\text{change in } x}$$

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



Example

Graph the line containing the points (3, –2) and (7, 5) and find the slope.



Solution

$$m = \frac{\text{rise}}{\text{run}} = \frac{\text{difference in } y}{\text{difference in } x}$$

$$= \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - (-2)}{7 - 3} = \frac{7}{4}$$

Slope of $y = mx + b$

The **slope** of the line $y = mx + b$ is m.

Slope-Intercept Equation

The equation $y = mx + b$ is called the **slope-intercept equation.** The slope is m and the y-intercept is $(0, b)$.

Example

Determine the slope and *y*-intercept of the line given by $y = \frac{3}{5}x - 4.$

Solution

The equation is written in the form $y = mx + b$, simply read the slope and *y*-intercept from the equation.

$$y = \frac{3}{5}x - 4$$

The slope is 3/5.

The *y*-intercept is (0, –4).

Example

Determine the slope and y-intercept of the line given by $4x - 7y = 2$.

Solution

First solve for y so we can easily read the slope and y-intercept.

$$4x - 7y = 2$$
$$-7y = -4x + 2$$
$$y = \frac{4}{7}x - \frac{2}{7}$$

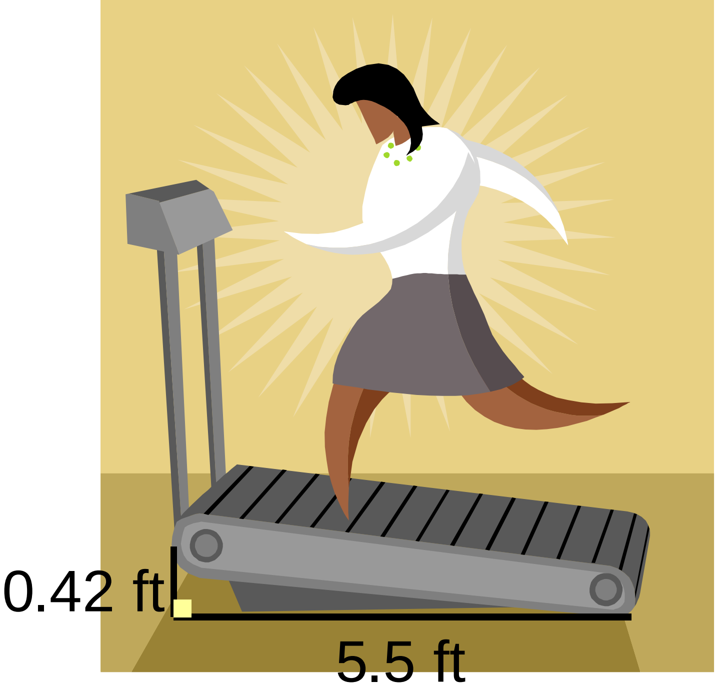
The slope is 4/7 and the y-intercept is (0, –2/7).

Some applications use slope to measure the steepness. For example, numbers like 2%, 3%, and 6% are often used to represent the **grade** of a road, a measure of a road’s steepness. That is, a 3% grade means that for every horizontal distance of 100 ft, the road rises or drops 3 ft.

Slope can also be considered as a **rate of change**.

Example

Find the slope (or grade) of the treadmill.



Solution

$$m = \frac{0.42}{5.5}$$

$$= \frac{42}{550}$$

$$= \frac{21}{275} = 7.6\%$$

The grade of the treadmill is 7.6%.

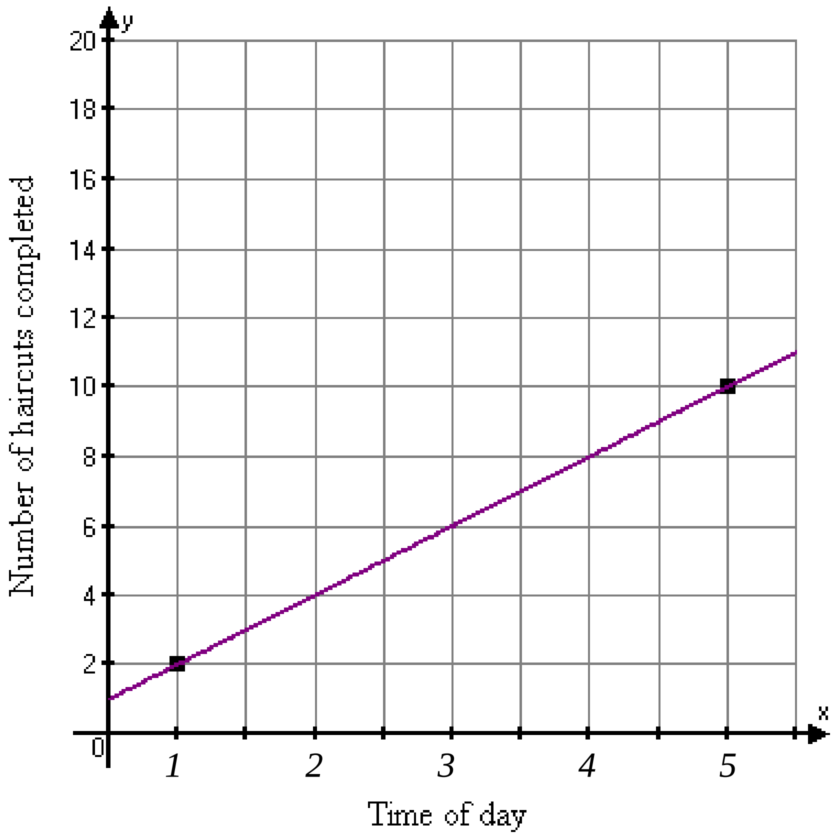
** Reminder: Grade is slope expressed as a percent.

Example

Wanda's Hair Salon has a graph displaying data from a recent day of work.

a) What rate can be determined from the graph?

b) What is that rate?

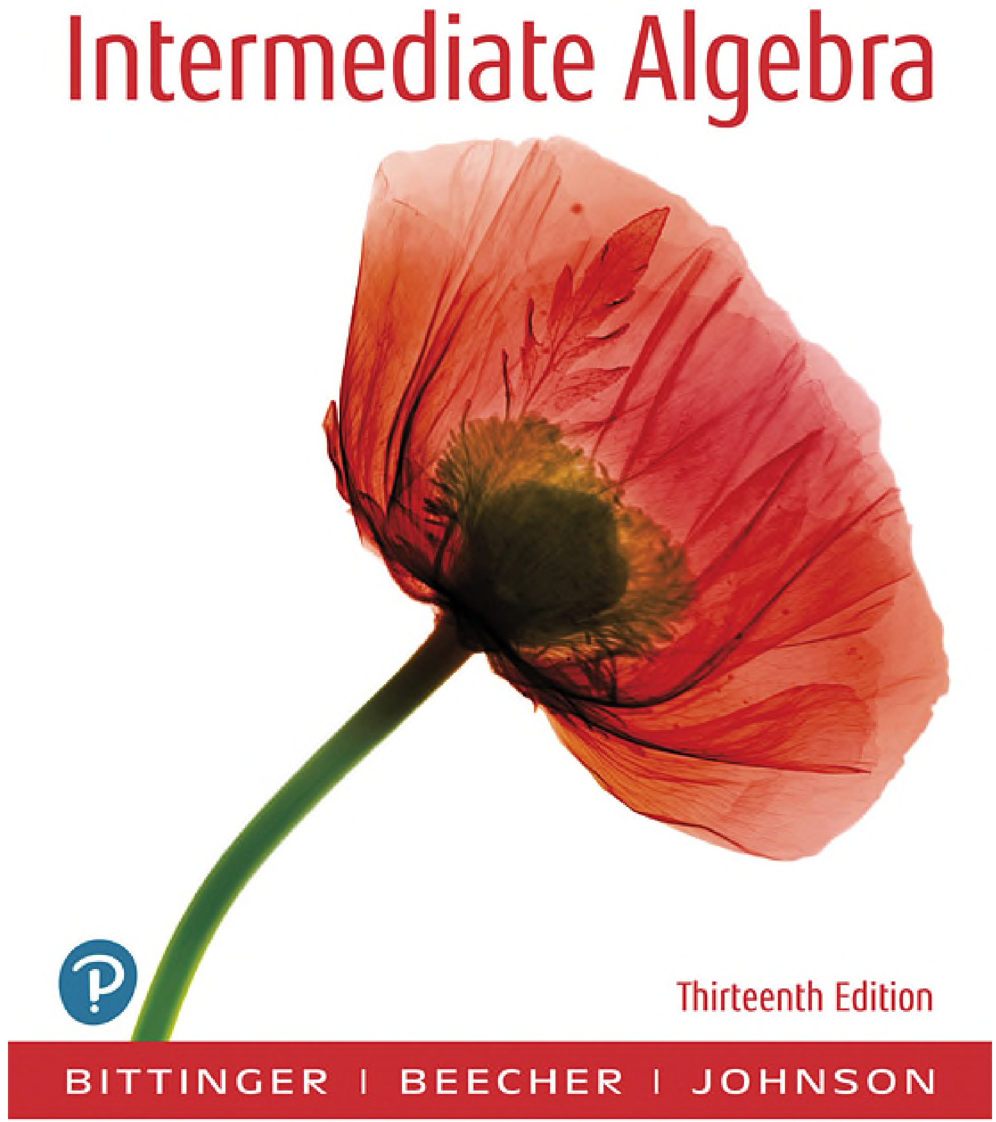


Solution

a) We can find the rate *Number of haircuts per hour*.

b) $\dfrac{10 \text{ haircuts} - 2 \text{ haircuts}}{5:00 - 1:00} = \dfrac{8 \text{ haircuts}}{4 \text{ hours}} = 2 \text{ haircuts per hour.}$

Chapter 2



Graphs, Functions, and Applications

2.5 MORE on GRAPHING LINEAR EQUATIONS

a. Graph linear equations using intercepts

b. Given a linear equation in slope-intercept form, use the slope and the *y*-intercept to graph the line.

c. Graph linear equations of the form $x = a$ or $y = b$.

d. Given the equations of two lines, determine whether their graphs are parallel or whether they are perpendicular.

x- and y-Intercepts

A ***y*-intercept** is a point (0, b). To find b, let $x = 0$ and solve for y.

An ***x*-intercept** is (a, 0). To find a, let $y = 0$ and solve for x.

Example

Find the intercepts of $5x + 2y = 10$ and then graph the line.

Solution

y-intercept: Let $x = 0$ and solve for y:

$5 \cdot 0 + 2y = 10$ Substituting 0 for x

$2y = 10$

$y = 5$

The *y*-intercept is (0, 5).

x-intercept: Let $y = 0$ and solve for x.

$5x + 2 \cdot 0 = 10$ Substituting 0 for y

$5x = 10$

$x = 2$

The *x*-intercept is (2, 0).

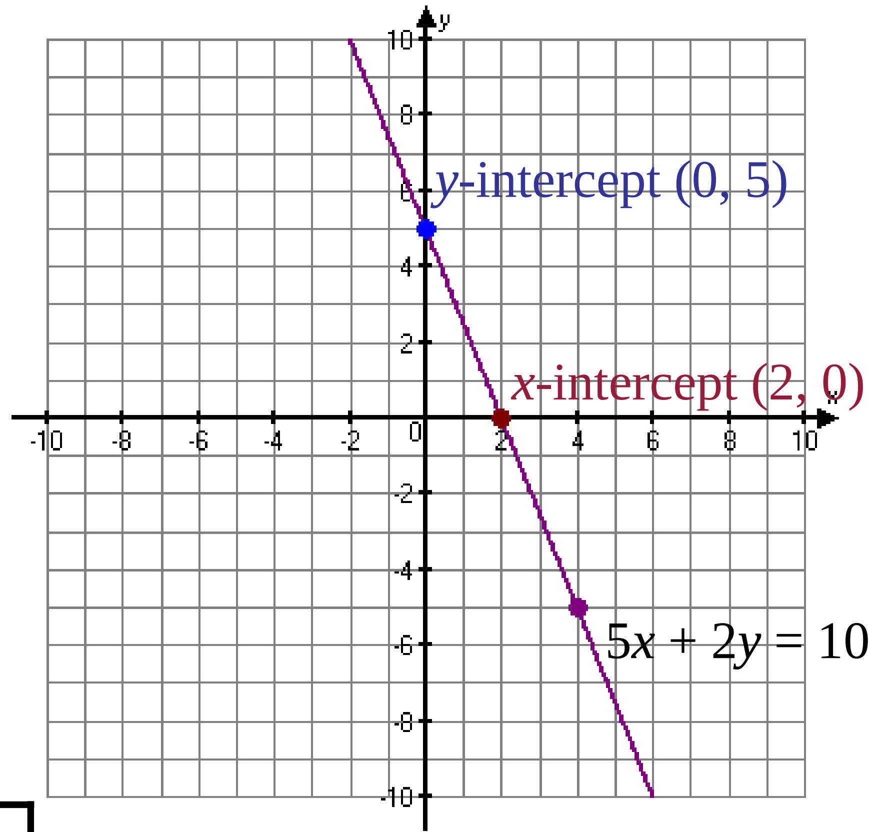
continued

We plot these points and draw the line, or graph. A third point should be used as a check. We substitute any convenient value for *x* and solve for *y.*

If we let $x = 4$, then

$$5 \bullet 4 + 2y = 10$$
$$20 + 2y = 10$$
$$2y = -10$$
$$y = -5$$

x	*y*
0	5
2	0
4	–5



Example

Graph: $y = \frac{1}{3}x + 1.$

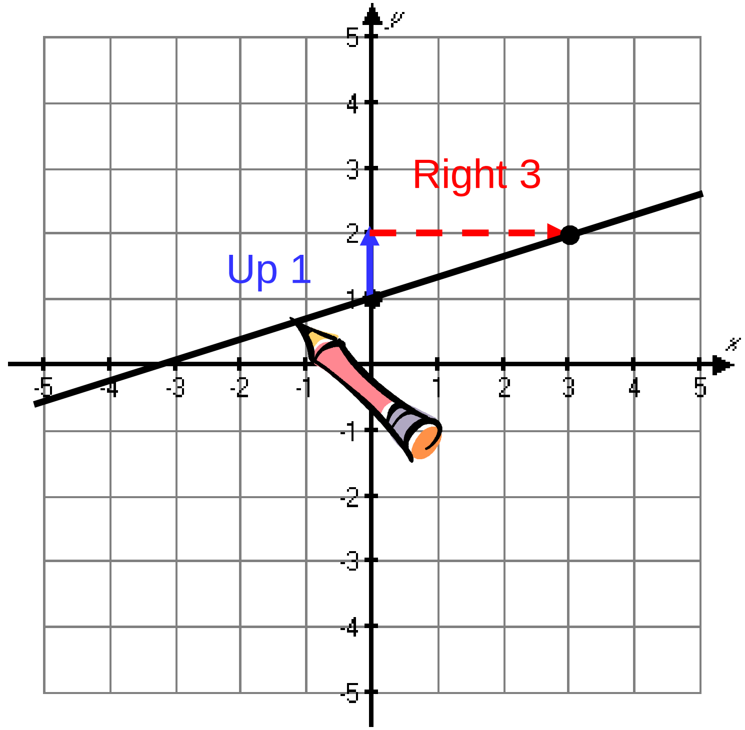
Solution

We plot (0, 1).

Move *up* 1 unit (since the numerator is positive.)

Move *to the right* 3 units (since the denominator is positive).

This locates the point (3, 2).



We plot (3, 2) and draw a line passing through both points.

Example

Graph: $y = -\frac{3}{4}x + 4.$

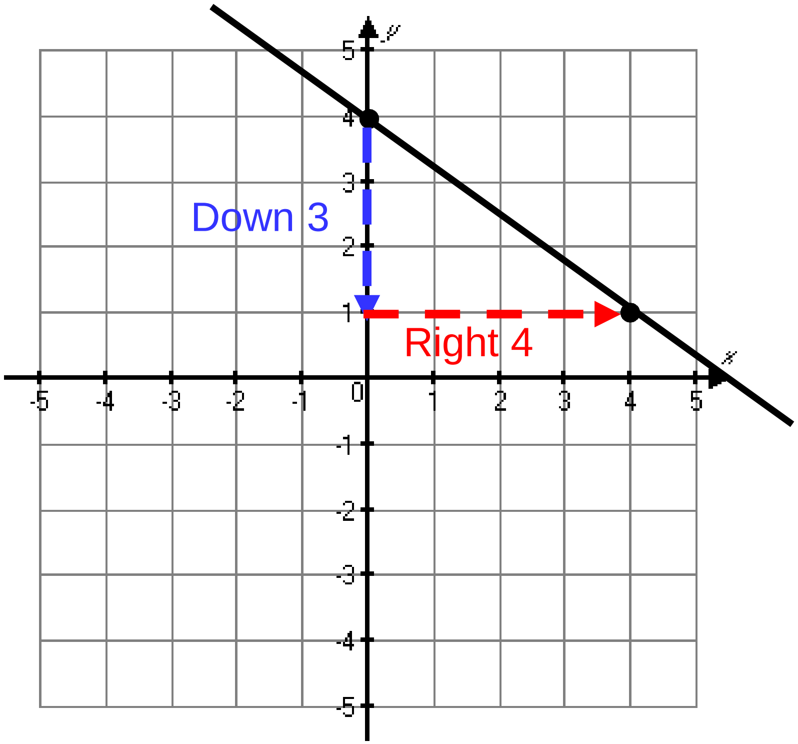
Solution

We plot (0, 4).

Move *down* 3 units (since the numerator is negative.)

Move *to the right* 4 units (since the denominator is positive).

This locates the point (4, 1).



We plot (4, 1) and draw a line passing through both points.

Example Graph $y = 2$.

Graph $y = 2$.

Solution

Since x is missing, any number for x will do.

Thus all ordered pairs $(x, 2)$ are solutions.

The graph is a **horizontal line** parallel to the x-axis.

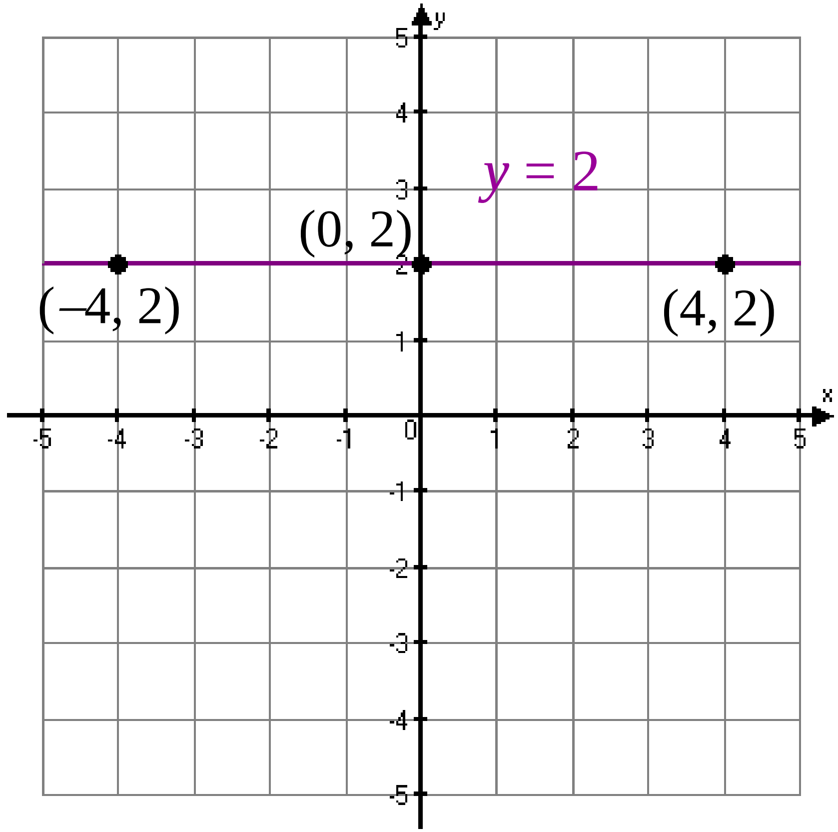
Choose any number for x. →

x	y	(x, y)
0	2	(0, 2)
4	2	(4, 2)
–4	2	(–4 , 2)

y must be 2.

continued

The slope of the line is 0.



Example

Graph: $x = 2$.

Solution

Since y is missing, any number for y will do.

Thus all ordered pairs (2, y) are solutions.

The graph is a **vertical line** parallel to the y-axis.

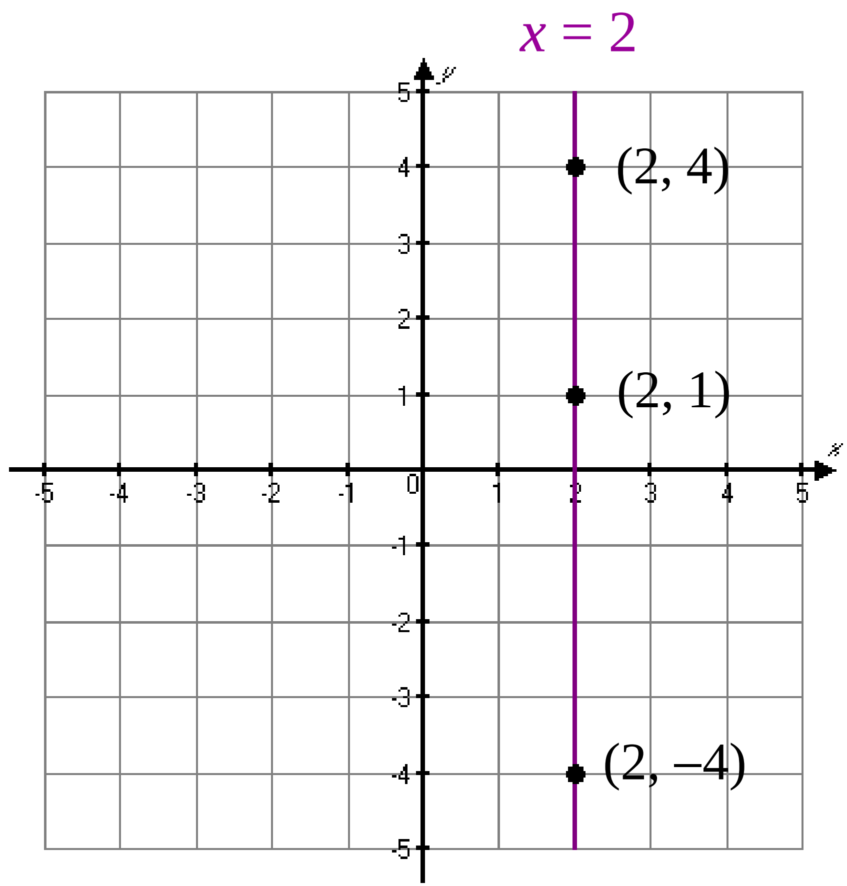
x must be 2. →

x	y	(x, y)
2	4	(2, 4)
2	1	(2, 1)
2	–4	(2, –4)

Any number can be used for y.

continued

The slope of a vertical line is undefined.



Horizontal Line; Vertical Line

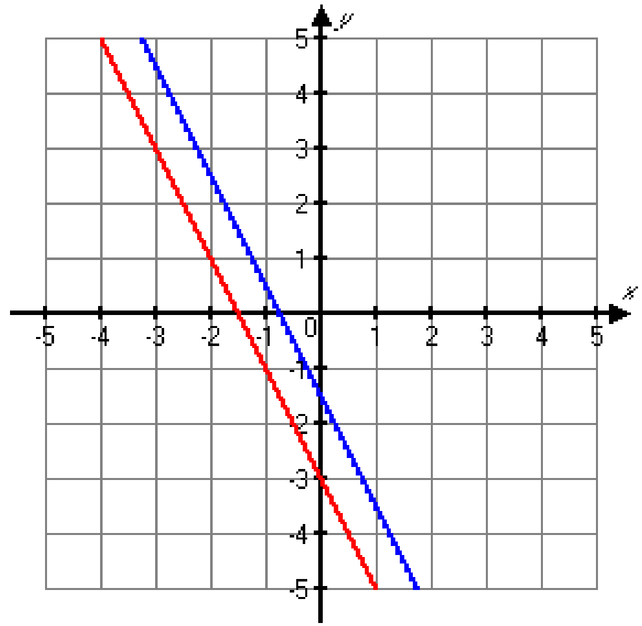
The graph of $y = b$, or $f(x) = b$, is a **horizontal line** with y-intercept $(0, b)$. It is the graph of a constant function with slope 0.

The graph of $x = a$ is a **vertical line** through the point $(a, 0)$. The slope is not defined. It is not the graph of a function.

Parallel Lines

Two nonvertical lines are **parallel** if they have the *same* slope and *different y*-intercepts.
Vertical lines are parallel.

Example



Determine whether the graphs of the lines $y = -2x - 3$ and $8x + 4y = -6$ are parallel.

Solution

Solve each equation for y.

$y = -2x - 3$ and

$$8x + 4y = -6$$
$$4y = -8x - 6$$
$$y = \frac{1}{4}(-8x - 6)$$
$$y = -2x - \frac{3}{2}$$

The slope of each line is –2 and the y-intercepts are different. The lines are parallel.

Perpendicular Lines

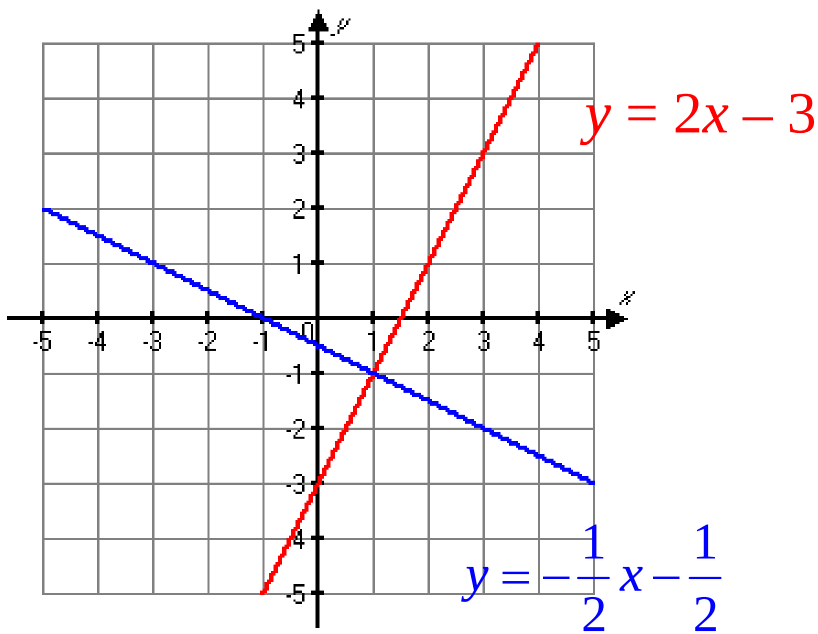
Two lines are **perpendicular** if the product of their slopes is –1. (If one line has slope *m,* the slope of the line perpendicular to it is –1/*m.* That is, to find the slope of a line perpendicular to a given line, we take the reciprocal of the given slope and change the sign.)

Lines are also perpendicular if one of them is vertical ($x = a$) and one of them is horizontal ($y = b$).

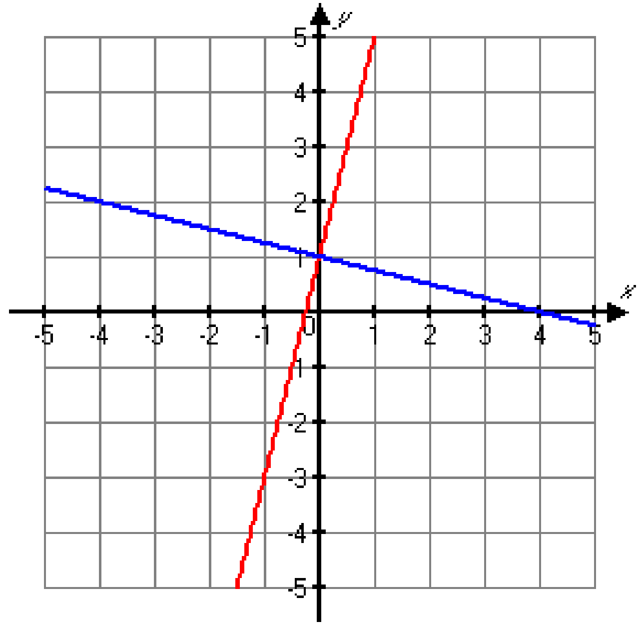
continued

Perpendicular lines in a plane are lines that intersect at a right angle. The measure of a right angle is 90 degrees.

The slopes of the lines are 2 and –1/2. Note that 2(–1/2) = –1. That is, the product of the slopes is –1.



Example



Determine whether the graphs of th lines $y = 4x + 1$ and $x + 4y = 4$ are perpendicular.

Solution

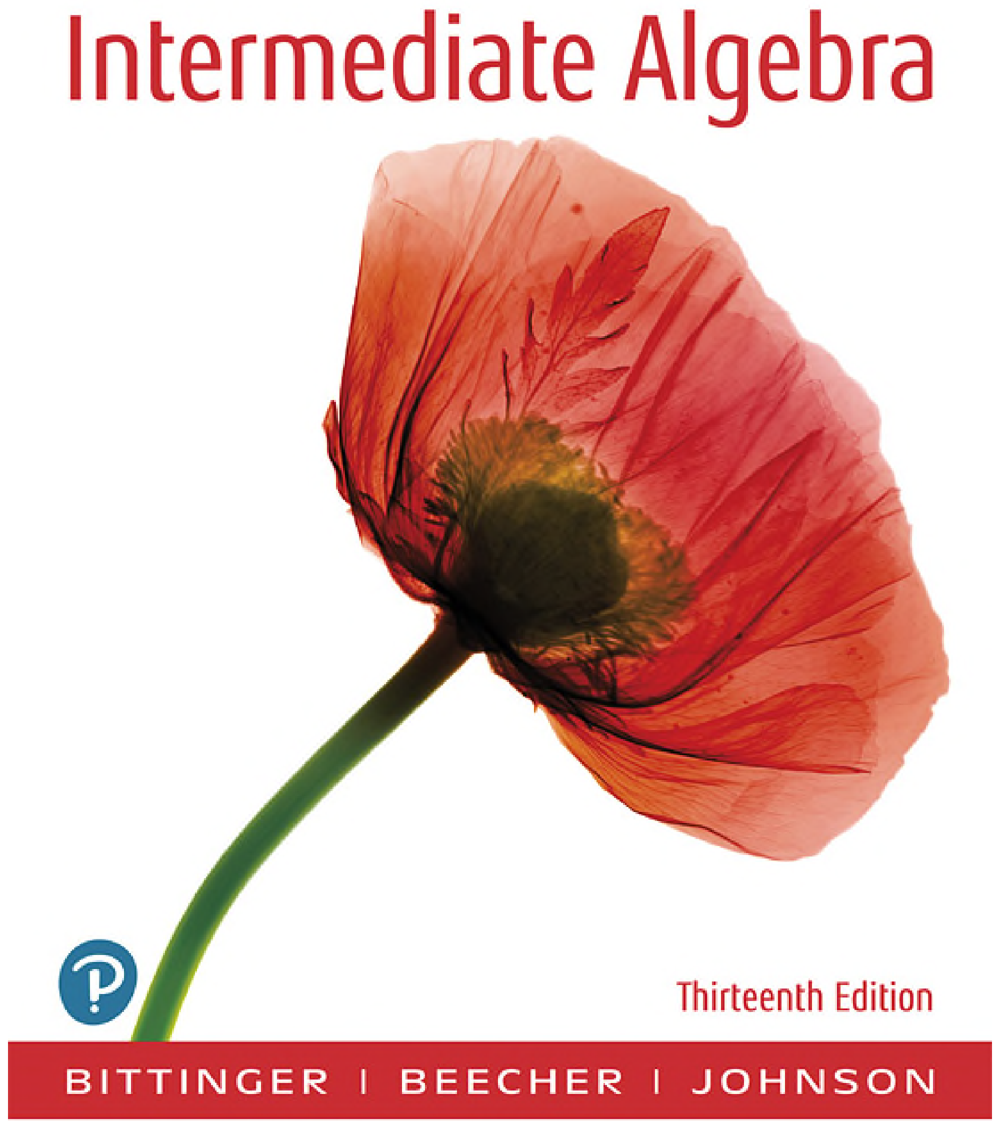
To determine whether the lines are perpendicular, we determine whether the product of their slopes is –1. Solve each equation for *y*.

$$x + 4y = 4$$
$$4y = -x + 4$$
$$y = \frac{1}{4}(-x + 4)$$
$$y = -\frac{1}{4}x + 1$$

The slopes are 4 and –1/4. The product of the slopes is –1. The lines are perpendicular.

Chapter 2

Graphs, Functions, and Applications



2.6 FINDING EQUATIONS of LINES; APPLICATIONS

a. Find an equation of a line when the slope and the *y*-intercept are given.

b. Find an equation of a line when the slope and a point are given.

c. Find an equation of a line when two points are given.

d. Given a line and a point not on the given line, find an equation of the line parallel to the line and containing the point, and find an equation of the line perpendicular to the line and containing the point.

e. Solve applied problems involving linear functions.

Example

A line has slope –3.2 and *y*-intercept (0, 5). Find an equation of the line.

Solution

We use the slope-intercept equation.

Substitute –3.2 for *m* and 5 for *b*:

$$y = mx + b$$

$$y = -3.2x + 5. \quad \text{Substituting}$$

Point-Slope Equation

The **point-slope equation** of a line with slope m, passing through (x_1, y_1), is

$$y - y_1 = m(x - x_1).$$

Example

Find an equation of the line with slope 3 containing the point (2, 7).

Solution

Using the Point-Slope Equation

The point (2, 7) is considered to be (x_1, y_1), and 3 to be the slope *m*.

$y - y_1 = m(x - x_1)$ Point-slope equation

$y - 7 = 3(x - 2)$ Substituting

$y - 7 = 3x - 6$ Simplifying

$y = 3x + 1$

The equation is $y = 3x + 1$.

continued

Using the Slope-Intercept Equation:

The point (2, 7) is on the line, so it is a solution. We can substitute 2 for x and 7 for y and solve for b.

$y = 3x + b$ Substituting 3 for m.

$7 = 3(2) + b$ Substituting 2 for x and 7 for y

$7 = 6 + b$

$1 = b$ Solving for b

The equation is $y = 3x + 1$.

Example

Find an equation of the line containing the points (2, 2) and (–6, –4).

Solution First, we find the slope:

$$m = \frac{-4-2}{-6-2} = \frac{-6}{-8} \text{ or } \frac{3}{4}$$

continued

Point-Slope Equation: Choose either point, we choose (2, 2) and substitute.

$$y - y_1 = m(x - x_1)$$

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

$$y - 2 = \frac{3}{4}x - \frac{6}{4}$$

$$y = \frac{3}{4}x - \frac{6}{4} + 2$$

$$y = \frac{3}{4}x - \frac{6}{4} + \frac{8}{4}$$

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

The equation of the line. $y = \frac{3}{4}x + \frac{1}{2}$

continued

Slope-Intercept Equation: Use either point to find *b*, we choose (2, 2).

The slope is $\frac{3}{4}$.

$$y = mx + b$$

$$y = \frac{3}{4}x + b$$

$$2 = \frac{3}{4} \cdot 2 + b$$

Substituting 2 for *x* and 2 for *y*

$$2 = \frac{6}{4} + b$$

$$\frac{1}{2} = b$$

Solving for *b*

The equation of the line.

$$y = \frac{3}{4}x + \frac{1}{2}$$

Example

Find an equation of a line containing the point (1, –5) and parallel to the line $y = -3x + 4$.

Solution

In $y = -3x + 4$, the slope is –3, so the slope of the line parallel will also be –3.

Use point-slope form.

$y_1 = -5$, $x_1 = 1$ and $m = -3$

$$y - y_1 = m(x - x_1)$$

$$y - (-5) = -3(x - 1)$$

Simplify.

$$y + 5 = -3x + 3$$

Subtract 5 from both sides to isolate y.

$$y = -3x - 2$$

Example

Find the equation of the line containing the point (7, 1) and perpendicular to $7x - 2y = -2$.

Solution

Determine the slope of the line $7x - 2y = -2$.

$$-2y = -7x - 2$$

$$y = \frac{7}{2}x + 1$$

Slope of perpendicular line: $-\frac{2}{7}$

continued

slope = $-\frac{2}{7}$; point (7, 1)

$$y - y_1 = m(x - x_1)$$

$$(y - 1) = -\frac{2}{7}(x - 7)$$

$$y - 1 = -\frac{2}{7}x + 2$$

Simplify.

$$y = -\frac{2}{7}x + 3$$

Add 1 to both sides to isolate *y*.

Example

For a service call, Calvin Appliance charges a $35 service fee and $55 per hour for labor.

a) Formulate a linear function that models the total cost of a service call $C(t)$, where t is the number of hours of the call.

b) Graph the model.

c) Use the model to determine the cost of a 2 ½ hour service call.

Solution

a) $C(t) = 55t + 35$

continued

b. Graph: The *y*-intercept is (0, 35) and the slope, or rate of change, is $55 per hour, or 55/1.

c. The cost of a 2 ½ hour call, we find $C(2.5)$.

$C(2.5) = 55(2.5) + 35$

$= 137.50 + 35$

$= 172.50$

A 2 ½ hour service call costs $172.50