Chapter 3

3.1 Exercises

2. The x-axis and the y-axis intersect at the origin.

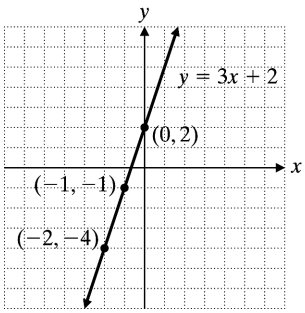
4. If you substitute $x = 5$ and $y = 1$ in $2x - 3y = 7$ you get $2(5) - 3(1) = 10 - 3 = 7$, a true statement. (5, 1) is a solution.

6. $y = 4 - 3x$
$y = 4 - 3(-3) = -13$
$(-3, 13)$ is a solution of $y = 4 - 3x$.

8.
$$-x + 2y = -7$$
$$-x + 2\left(\frac{1}{2}\right) = -7$$
$$-x + 1 = -7$$
$$-x = -8$$
$$x = 8$$
$\left(8, \frac{1}{2}\right)$ is a solution of $-x + 2y = -7$.

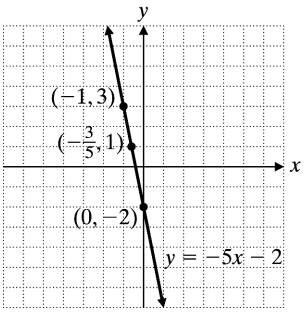
10. $y = 3x + 2$

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



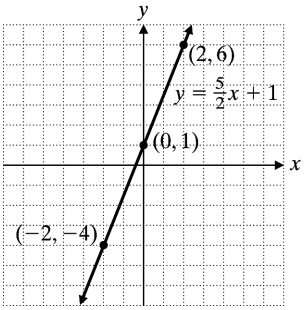
12. $y = -5x - 2$

x	$y = -5x - 2$	y
0	$y = -5(0) - 2$	-2
-1	$y = -5(-1) - 2$	3
$-\frac{3}{5}$	$y = -5\left(-\frac{3}{5}\right) - 2$	1



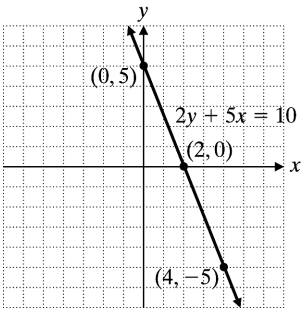
14. $y = \frac{5}{2}x + 1$

x	$y = \frac{5}{2}x + 1$	y
0	$y = \frac{5}{2}(0) + 1$	1
-2	$y = \frac{5}{2}(-2) + 1$	-4
2	$y = \frac{5}{2}(2) + 1$	6



16. $2y + 5x = 10$
Let $x = 0$: $2y + 5(0) = 10$
$y = 5$
Let $y = 0$: $2(0) + 5x = 10$
$x = 2$
Let $x = 4$: $2y + 5(4) = 10$
$y = -5$

x	y
0	5
2	0
4	-5



18. $4x - y = -4$

Let $x = -2$: $4(-2) - y = -4$

$y = -4$

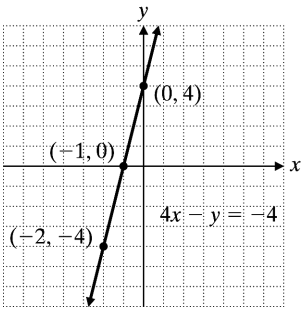
Let $x = 0$: $4(0) - y = -4$

$y = 4$

Let $y = 0$: $4x - 0 = -4$

$x = -1$

x	y
-2	-4
-1	0
0	4



20. $5x - 2y = -12$

Let $x = 0$: $5(0) - 2y = -12$

$y = 6$

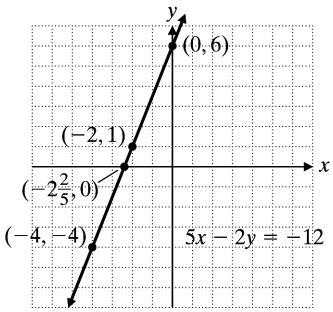
Let $x = 0$: $5x - 2(0) = -12$

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

Let $x = -2$: $5(-2) - 2y = -12$

$y = 1$

x	y
0	6
$-\frac{12}{5}$	0
-2	1



22. $4x + 6y + 2 = 2$

$4x + 6y = 0$

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

Let $x = -3$: $y = -\frac{2}{3}(-3)$

$y = 2$

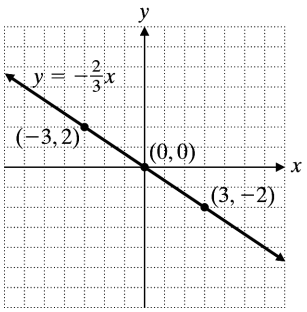
Let $x = 0$: $y = -\frac{2}{3}(0)$

$y = 0$

Let $x = 3$: $y = -\frac{2}{3}(3)$

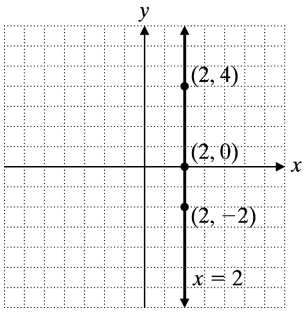
$y = -2$

x	y
-3	2
0	0
3	-2



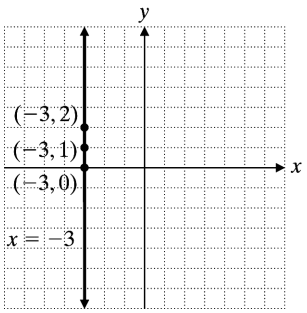
24. $x = 2$, vertical line

x	y
2	4
2	0
2	-2



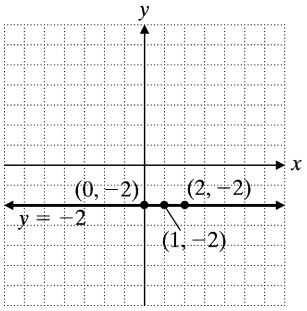
26. $2x - 3 = 3x \Rightarrow -x = 3$
$x = -3$ vertical line

x	y
−3	2
−3	1
−3	0



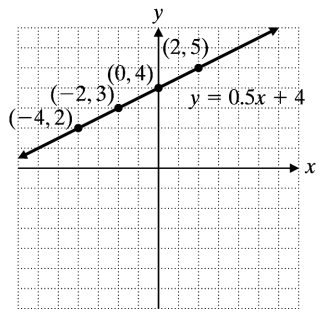
28. $5y + 6 = 2y$, $3y = -6$, $y = -2$
The graph is a horizontal line.

x	y
0	−2
2	−2
1	−2



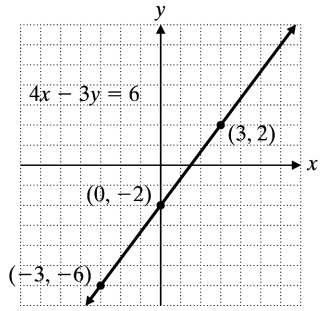
30. $y = 0.5x + 4$

x	$y = 0.5x + 4$	y
−4	$y = 0.5(-4) + 4$	2
−2	$y = 0.5(-2) + 4$	3
0	$y = 0.5(0) + 4$	4



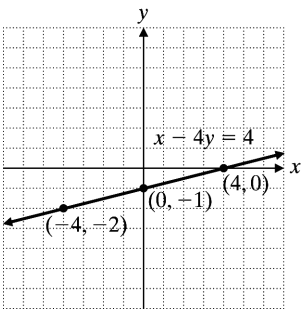
32. $4x - 3y = 6$
Let $x = -3$: $4(-3) - 3y = 6$
$y = -6$
Let $x = 0$: $4(0) - 3y = 6$
$y = -2$
Let $x = 3$: $4(3) - 3y = 6$
$y = 2$

x	y
−3	−6
0	−2
3	2



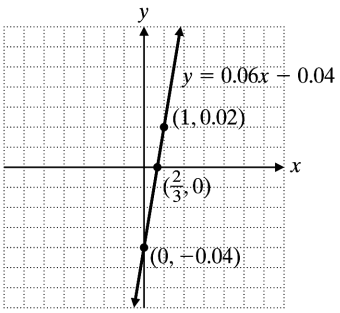
34. $5x - 4y - 4 = 4x$
$x - 4y = 4$
Let $x = -4$: $-4 - 4y = 4$
$y = -2$
Let $x = 0$: $0 - 4y = 4$
$y = -1$
Let $y = 0$: $x - 4(0) = 4$
$x = 4$

x	y
–4	–2
0	–1
4	0



36. $y = 0.06x - 0.04$

x	$y = 0.06x - 0.04$	y
0	$y = 0.06(0) - 0.04$	–0.04
1	$y = 0.06(1) - 0.04$	0.02
$\frac{2}{3}$	$y = 0.06\left(\frac{2}{3}\right) - 0.04$	0



Vertical scale: 1 square = 0.01 unit

38.

2-year period	increase
1999–2001	512 – 473 = 39
2001–2003	552 – 512 = 40
2003–2005	585 – 552 = 33
2005–2007	614 – 585 = 29
2007–2009	657 – 614 = 43

From the table, the greatest increase in median weekly earnings of women occurred between 2007 and 2009.

40.

year	difference
1999	619 – 473 = 146
2001	670 – 512 = 158
2003	695 – 552 = 143
2005	722 – 585 = 137
2007	766 – 614 = 152
2009	819 – 657 = 162

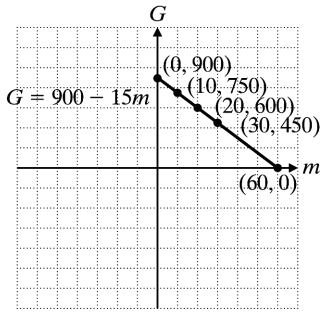
From the table, the median weekly earnings of men and women had the smallest difference in 2005.

42. $(819 - 619) \div 619 \cdot 100\% \approx 32.3\%$
The percent increase was 32.3%.

44. a. $G(m) = 900 - 15m$

m	$G(m) = 900 - 15m$
0	900 – 15(0) = 900
10	900 – 15(10) = 750
20	900 – 15(20) = 600
30	900 – 15(30) = 450
60	900 – 15(60) = 0

b.



Vertical scale: Each square = 200 units
Horizontal scale: Each square = 10 units

c. $m = 61$ has no meaning since the tank is empty after $m = 60$ minutes.

Cumulative Review

45. $36 \div (8-6)^2 + 3(-4) = 36 \div 2^2 + (-12)$
$= 36 \div 4 + (-12)$
$= 9 + (-12)$
$= -3$

46. $3(x-6)+2 \le 4(x+2)-21$
$3x-18+2 \le 4x+8-21$
$3x-16 \le 4x-13$
$3x-4x \le 16-13$
$-x \le 3$
$x \ge -3$

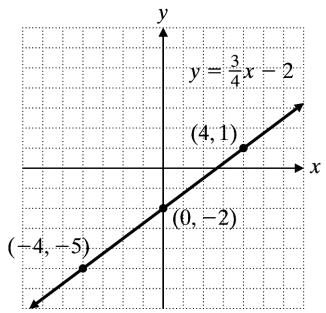
47. $R = 2G$
$B = 3R$
$2W = Y$
$2Y = R$
$W = 130$
$Y = 2W = 260$
$R = 2Y = 520$
$G = \frac{1}{2}R = 260$
$B = 3R = 1560$
There are 520 red, 1560 blue, 260 yellow, 260 green, and 130 white.

48. Let x = sales price of house.
$9100 = 0.07(100{,}000) + 0.03(x - 100{,}000)$
$9100 = 7000 + 0.03x - 3000$
$0.03x = 5100$
$x = 170{,}000$
The selling price was \$170,000.

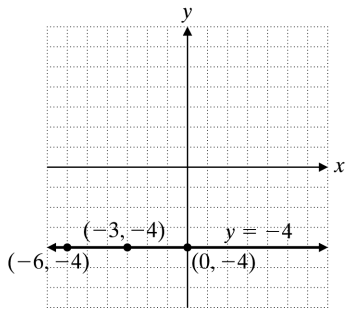
Classroom Quiz 3.1

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

x	$y = \frac{3}{4}x - 2$	y
0	$y = \frac{3}{4}(0) - 2$	-2
4	$y = \frac{3}{4}(4) - 2$	1
-4	$y = \frac{3}{4}(-4) - 2$	-5

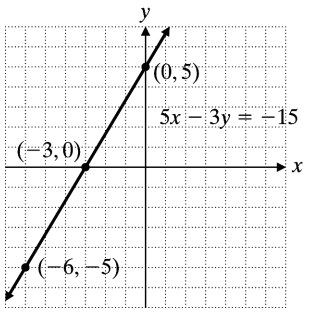


2. $3y + 5 = -7$
$3y = -12$
$y = -4$
This is a horizontal line.



3. $5x - 3y = -15$
Let $x = 0$: $5(0) - 3y = -15$
$y = 5$
Let $y = 0$: $5x - 3(0) = -15$
$x = -3$
Let $x = -6$: $5(-6) - 3y = -15$
$y = -5$

x	y
0	5
–3	0
–6	–5



3.2 Exercises

2. A positive slope indicates the line slopes upward to the right.

4. Two different lines are parallel if their slopes are equal.

6. $\frac{-3-5}{-6-(-4)} = 4, \frac{5-(-3)}{-4-(-6)} = 4$

The results are the same. Each expression gives the slope of the line through the two points.

8. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1-3}{2-6} = \frac{-4}{-4} = 1$

10. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3-\frac{3}{2}}{5-1} = \frac{\frac{3}{2}}{4} = \frac{3}{8}$

12. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5.2-(-1.6)}{-2-4.8} = \frac{6.8}{-6.8} = -1$

14. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6-\frac{1}{6}}{\frac{7}{3}-\frac{7}{3}} = \frac{-\frac{37}{6}}{0}$

undefined slope

16. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{12-12}{-5-4} = \frac{0}{-9} = 0$

18. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\frac{1}{3}-0}{2-4} = \frac{\frac{1}{3}}{-2} = -\frac{1}{6}$

20. $m = \frac{\text{rise}}{\text{run}} = \frac{22.5}{225} = 0.1$ or 10%

The grade is 0.1 or 10%.

22. $m = \frac{\text{rise}}{\text{run}} = \frac{3.15}{10.50} = \frac{3}{10} = 0.3$

The pitch of the roof is $\frac{3}{10}$ or 0.3.

24. $m = \frac{\text{rise}}{\text{run}}$

$\frac{13}{3} = \frac{\text{rise}}{42}$

$182 = \text{rise}$

It falls 182 feet vertically.

26. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5-(-10)}{32-17} = \frac{5}{15} = \frac{1}{3}$

$m_{\|} = m = \frac{1}{3}$

28. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0-2}{4-(3.8)} = -10$

$m_{\|} = m = -10$

30. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\frac{5}{2}-2}{1-\frac{1}{3}} = \frac{3}{4}$

$m_{\|} = m = \frac{3}{4}$

32. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{11-1}{4-(-2)} = \frac{10}{6} = \frac{5}{3}$

$m_{\perp}$ is the negative reciprocal of m.

$m_{\perp} = -\frac{1}{\frac{5}{3}} = -\frac{3}{5}$

34. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1-\frac{1}{2}}{\frac{1}{4}-\frac{5}{4}} = \frac{-\frac{3}{2}}{-1} = \frac{3}{2}$

$m_{\perp}$ is the negative reciprocal of m.

$m_{\perp} = -\frac{2}{3}$

36. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{0-(-5)}{-2-0} = -\dfrac{5}{2}$

$m_\perp$ is the negative reciprocal of m.

$m_\perp = \dfrac{2}{5}$

38. $m_k = \dfrac{4-2}{-4-4} = -\dfrac{1}{4}$, $m_h = \dfrac{1-(-3)}{-8-8} = -\dfrac{1}{4}$

Lines k and h are parallel because they have the same slope.

40. For $A(-1, -2)$, $B(2, -1)$, $C(8, 1)$ to lie on a straight line m_{AB} must be equal to m_{BC}.

$m_{AB} = \dfrac{-2-(-1)}{-1-2} = \dfrac{1}{3}$, $m_{BC} = \dfrac{-1-1}{2-8} = \dfrac{1}{3}$

Since $m_{AB} = m_{BC}$ and B is a common point, A, B, C lie on a straight line.

42. a. $\dfrac{y-4300}{4.8-2} = \dfrac{4300-3000}{2-1}$

$y = 7940$

Its altitude will be 7940 feet.

b. $\dfrac{6000-4300}{x-2} = \dfrac{4300-3000}{2-1}$

$x \approx 3.3$

It will be 3.3 miles from the airport.

c. $\dfrac{4300-3000}{2-1} = 1300$, Cessna

$\dfrac{4040-3000}{1.8-1} = 1300$, Lear jet

Yes, they are being flown at the same rate of climb.

Cumulative Review

43. $\dfrac{-15x^6y^3}{-3x^{-4}y^6} = \dfrac{5x^{6+4}}{y^{6-3}} = \dfrac{5x^{10}}{y^3}$

44. $8x(x-1) - 2(x+y) = 8x^2 - 8x - 2x - 2y$

$= 8x^2 - 10x - 2y$

45. Let W = width of the rug.
Then $W + 2$ = length.

$P = 2L + 2W$
$36 = 2(W+2) + 2W$
$36 = 2W + 4 + 2W$
$36 = 4W + 4$
$32 = 4W$
$8 = W$
$W + 2 = 10$

The length is 10 feet, and the width is 8 feet.

46. $3x + 1 > 10$ or $-2x - 3 > 1$

$3x > 9$ $\quad$ $-2x > 4$

$x > 3$ $\quad$ $x < -2$

$x > 3$ or $x < -3$

Classroom Quiz 3.2

1. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$m = \dfrac{-5-7}{\frac{1}{2}-2}$

$m = \dfrac{-12}{-\frac{3}{2}}$

$m = 8$

2. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$m = \dfrac{9-9}{-6-(-3)}$

$m = \dfrac{0}{-3}$

$m = 0$

3. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{9-2}{-7-(-13)} = \dfrac{7}{6}$

$m_\perp$ is the negative reciprocal of m.

$m_\perp = -\dfrac{6}{7}$

3.3 Exercises

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

4. $y = mx + b \Rightarrow y = -\dfrac{2}{3}x + 5$

6. $y = mx + b, \qquad y = \frac{5}{6}x + \frac{1}{3}$

$6y = 5x + 2$

$5x - 6y = -2$

8. From the graph,

$m = \frac{2}{3}, b = -2 \Rightarrow y = \frac{2}{3}x - 2.$

10. From the graph,

$m = \frac{5}{5} = 1, \ b = -5 \Rightarrow y = x - 5.$

12. From the graph,

$m = \frac{2}{5}, \ b = 0 \Rightarrow \ y = \frac{2}{5}x.$

14. From the graph,

$m = \frac{-5}{2}, \ b = 3 \Rightarrow \ y = -\frac{5}{2}x + 3.$

16. $2x - y = 12 \Rightarrow 2x - 12 = y$

$y = 2x - 12$

$m = 2, b = -12$, y-intercept $(0, -12)$

18. $2x - 3y = -8 \Rightarrow -3y = -8 - 2x$

$3y = 2x + 8 \Rightarrow \ y = \frac{2}{3}x + \frac{8}{3}$

$m = \frac{2}{3}, b = \frac{8}{3}, \ y\text{-intercept } \left(0, \frac{8}{3}\right)$

20. $\frac{1}{3}x + 2y = 7$

$2y = -\frac{1}{3}x + 7$

$y = \left(\frac{1}{2}\right)\left(-\frac{1}{3}x\right) + \frac{1}{2}(7)$

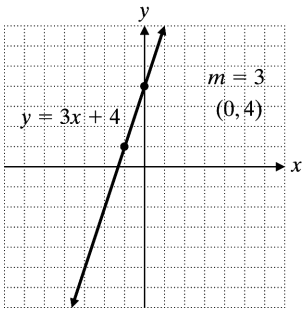
$y = -\frac{1}{6}x + \frac{7}{2}$

$m = -\frac{1}{6}, b = \frac{7}{2}$

y-intercept $\left(0, \frac{7}{2}\right)$

22. $y = 3x + 4$, $m = 3$, $b = 4$, y-intercept $(0, 4)$

x	y
0	4
–1	1



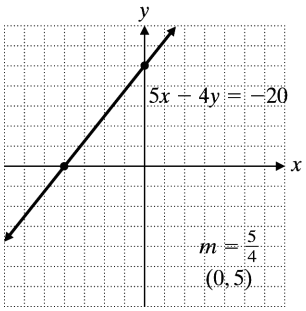
24. $5x - 4y = -20$

$-4y = -5x - 20$

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

$m = \frac{5}{4}, \ y$-intercept $(0, 5)$

x	y
0	5
–4	0



26. $y - y_1 = m(x - x_1)$

$y - 5 = \frac{1}{3}(x - 6)$

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

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

28. $y - y_1 = m(x - x_1)$

$y - 0 = -3(x - 8)$

$y = -3x + 24$

30. $y - y_1 = m(x - x_1)$

$y - (-1) = -\frac{5}{3}(x - 0)$

$3y + 3 = -5x$

$3y = -5x - 3$

$y = -\frac{5}{3}x - 1$

32. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3 - (-4)}{5 - 1} = \frac{1}{4}$

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

$y - (-3) = \frac{1}{4}(x - 5)$

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

$y = \frac{1}{4}x - \frac{5}{4} - 3$

$y = \frac{1}{4}x - \frac{17}{4}$

34. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 0}{\frac{7}{6} - \left(-\frac{1}{3}\right)} = \frac{2}{3}$

$y - y_1 = m(x - x_1) \Rightarrow y - 1 = \frac{2}{3}\left(x - \frac{7}{6}\right)$

$3y - 3 = 2x - \frac{7}{3} \Rightarrow 3y = 2x + \frac{2}{3}$

$y = \frac{2}{3}x + \frac{2}{9}$

36. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8 - 8}{4 - (-3)} = \frac{0}{7} = 0$

$y - y_1 = m(x - x_1) \Rightarrow y - 8 = 0(x - 4)$

$y = 8$

38. $x - y = 4$

$y = x - 4,\ m = 1,\ m_{\parallel} = 1$

$y - 2 = 1(x - (-3))$

$y = x + 5$

$x - y = -5$

40. $2y + x = 7$

$2y = -x + 7,\ y = -\frac{1}{2}x + \frac{7}{2},\ m = -\frac{1}{2}$

$m_{\parallel} = -\frac{1}{2}$

$y - (-4) = -\frac{1}{2}(x - (-5))$

$2y + 8 = -x - 5$

$x + 2y = -13$

42. $y = 3x,\ m = 3,\ m_{\perp} = -\frac{1}{3}$

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

$3y - 6 = -x - 3$

$x + 3y = 3$

44. $x - 4y = 2,\ y = \frac{1}{4}x - 2,\ m = \frac{1}{4}$

$m_{\perp} = -4$

$y - (-1) = -4(x - 3)$

$y + 1 = -4x + 12$

$4x + y = 11$

46. $5x - 6y = 19,\ y = \frac{5}{6}x - \frac{19}{6},\ m_1 = \frac{5}{6}$

$6x + 5y = -30,\ y = -\frac{6}{5}x - 6,\ m_2 = -\frac{6}{5}$

$m_1 m_2 = \frac{5}{6}\left(-\frac{6}{5}\right) = -1$

The lines are perpendicular.

48. $y = \frac{2}{3}x + 6,\ m_1 = \frac{2}{3}$

$-2x - 3y = -12,\ y = -\frac{2}{3}x + 4,\ m_2 = -\frac{2}{3}$

$m_1 \neq m_2,\ m_1 m_2 = -\frac{4}{9} \neq -1$

The lines are neither parallel nor perpendicular.

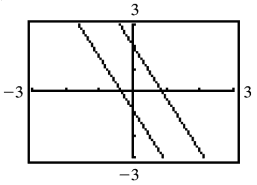
50. $y = \frac{3}{7}x - \frac{1}{14},\ m_1 = \frac{3}{7}$

$14y + 6x = 3,\ y = -\frac{3}{7}x + \frac{3}{14},\ m_2 = -\frac{3}{7}$

$m_1 \neq m_2,\ m_1 m_2 = \frac{3}{7}\left(-\frac{3}{7}\right) = -\frac{9}{49} \neq -1$

The lines are neither parallel nor perpendicular.

52. $y = -2.39x + 2.04$, $y = -2.39x - 0.87$



Yes, the lines appear to be parallel.

54. $m = \dfrac{y_2 - y_1}{x_1 - x_2}$

$m = \dfrac{223.9 - 174.9}{10 - 0}$

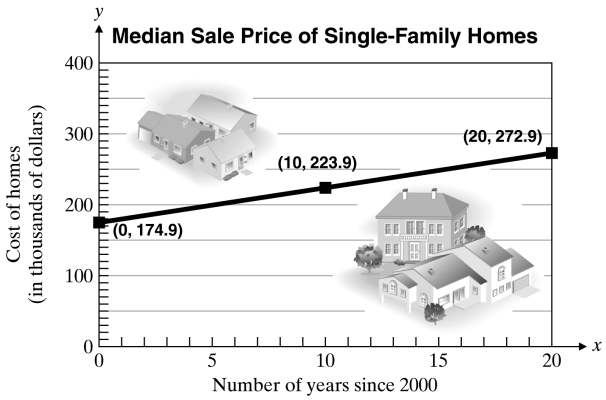
$m = 4.9$

$b = (0, 174.9)$

$y = 4.9x + 174.9$

56. $2020 - 2000 = 20$

x	$y = 4.9x + 174.9$
0	174.9
10	223.9
20	272.9



Source: www.census.gov

Cumulative Review

58. Area $= \pi(5)^2 = 25\pi \approx 25(3.14) = 78.5 \text{ mm}^2$

59. $0.3x + 0.1 = 0.27x - 0.02$

$30x + 10 = 27x - 2$

$3x = -12$

$x = -4$

60. $\dfrac{5}{4} - \dfrac{3}{4}(2x + 1) = x - 2$

$5 - 3(2x + 1) = 4x - 8$

$5 - 6x - 3 = 4x - 8$

$10x = 10$

$x = 1$

61. Let x = amount invested at 4%.
Then $9000 - x$ = amount at 6%.

$0.04x + 0.06(9000 - x) = 480$

$0.04x + 540 - 0.06x = 480$

$-0.02x + 540 = 480$

$-0.02x = -60$

$x = 3000$

$9000 - x = 6000$

Geoff invested \$3000 at 4% and \$6000 at 6%.

Classroom Quiz 3.3

1. $5x - 8y = -13$

$-8y = -13 - 5x$

$8y = 13 + 5x$

$y = \dfrac{5}{8}x + \dfrac{13}{8}$

$m = \dfrac{5}{8}, \quad b = \dfrac{13}{8}$

y-intercept $\left(0, \dfrac{13}{8}\right)$

2. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$m = \dfrac{-8 - (-12)}{7 - 6}$

$m = \dfrac{4}{1}$

$m = 4$

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

$y - (-8) = 4(x - 7)$

$y + 8 = 4x - 28$

$4x - y = 36$

3. $m = \dfrac{4}{5}$, y-intercept $(0, -8)$

$b = -8$

$y = mx + b$

$y = \dfrac{4}{5}x - 8$

How Am I Doing? Sections 3.1–3.3

1. $5x+2y=-12$

$5a+2(6)=-12$

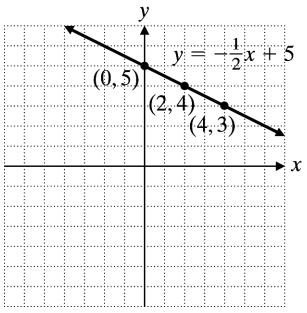
$5a+12=-12$

$5a=-24$

$a=-\dfrac{24}{5}=-4.8$

2. $y=-\dfrac{1}{2}x+5$

x	$y=-\frac{1}{2}x+5$	y
0	$y=-\frac{1}{2}(0)+5$	5
2	$y=-\frac{1}{2}(2)+5$	4
4	$y=-\frac{1}{2}(4)+5$	3



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

Let $x=-6$: $5(-6)+3y=-15$

$y=5$

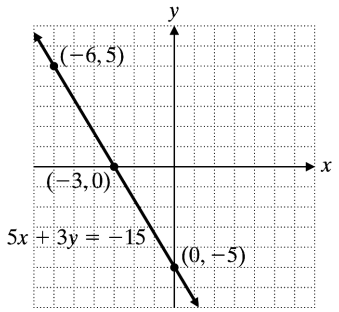
Let $y=0$: $5x+3(0)=-15$

$x=-3$

Let $x=0$: $5(0)+3y=-15$

$y=-5$

x	y
−6	5
−3	0
0	−5

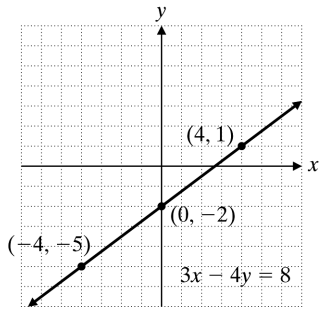


4. $4y+6x=-8+9x$

$4y=3x-8$

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

x	$y=\frac{3}{4}x-2$	y
−4	$y=\frac{3}{4}(-4)-2$	−5
0	$y=\frac{3}{4}(0)-2$	−2
4	$y=\frac{3}{4}(4)-2$	1



5. $m=\dfrac{y_2-y_1}{x_2-x_1}$

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

$m=-9$

6. $m=\dfrac{y_2-y_1}{x_2-x_1}$

$m=\dfrac{4-(-2)}{\frac{2}{3}-\frac{5}{6}}=\dfrac{6}{-\frac{1}{6}}$

$m=-36$

$m_{||}=m=-36$

7. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$m = \dfrac{0-(-4)}{5-(-13)} = \dfrac{4}{18}$

$m = \dfrac{2}{9}$

$m_\perp$ is the negative reciprocal of m.

$m_\perp = -\dfrac{9}{2}$

8. $m = 0.13 = \dfrac{\text{rise}}{\text{run}}$

$0.13 = \dfrac{\text{rise}}{500 \text{ ft}}$

$\text{rise} = 0.13(500)$

$\text{rise} = 65$

The road rises vertically 65 feet.

9. $2x - 4y = 10$

$-4y = -2x + 10$

$y = \dfrac{1}{2}x - \dfrac{5}{2}$

$m = \dfrac{1}{2}$, $b = -\dfrac{5}{2}$

y-intercept $\left(0, -\dfrac{5}{2}\right)$

10. $y - y_1 = m(x - x_1)$

$y - (-3) = -2(x - 7)$

$y + 3 = -2x + 14$

$y = -2x + 11$

11. $3x - 5y = 10$

$5y = 3x - 10$

$y = \dfrac{3}{5}x - 2$, $m = \dfrac{3}{5}$, $m_\perp = -\dfrac{5}{3}$

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

$y - (-2) = -\dfrac{5}{3}(x - (-1))$

$3y + 6 = -5x - 5$

$3y = -5x - 11$

$y = -\dfrac{5}{3}x - \dfrac{11}{3}$

12. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{5-1}{-1-(-3)} = \dfrac{4}{2} = 2$

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

$y - 1 = 2(x - (-3))$

$y = 2x + 6 + 1$

$y = 2x + 7$

3.4 Exercises

2. The boundary line should be solid when graphing a linear inequality that contains the ≤ or ≥ symbol.

4. When graphing $y < -6$ the region below the line $y = -6$ should be shaded.

6. When graphing $4x - 3y \geq 0$, (0, 0) can't be used as a test point because it is on the line. Using (6, −5) as a test point gives $4(6) - 3(-5) = 39 \geq 0$, a true statement.

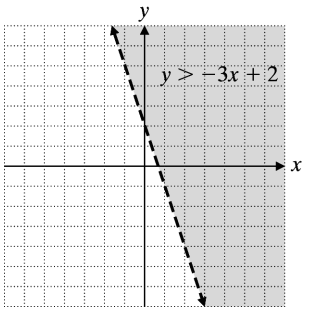
8. $y > -3x + 2$

Graph $y = -3x + 2$ using a dashed line.

Test point: (0, 0)

$0 > -2(0) + 2$, $0 > 2$, False

Shade the region not containing (0, 0).



10. $y < \dfrac{3}{2}x - 1$

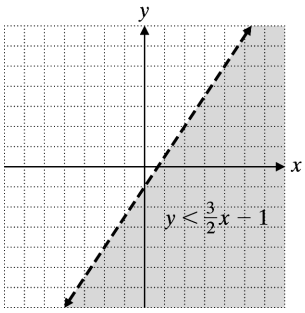
Graph $y = \dfrac{3}{2}x - 1$ using a dashed line.

Test point (0, −2)

$-2 < \dfrac{3}{2}(0) - 1$

$-2 < -1$ True

Shade the region containing (0, −2).



12. $y \geq -\frac{1}{5}x + 2$

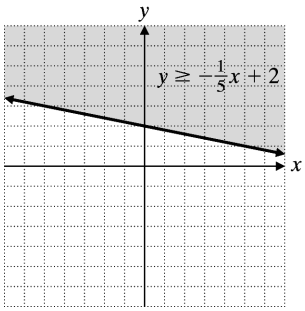
Graph $y = -\frac{1}{5}x + 2$ using a solid line.

Test point: (0, 0)

$0 \geq -\frac{1}{5}(0) + 2$

$0 \geq 2$, False

Shade the region not containing (0, 0).



14. $6y - x \leq 12$

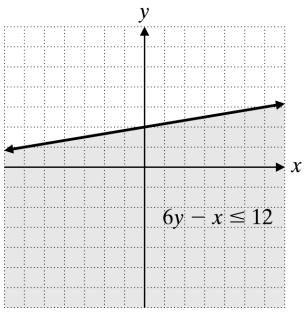
Graph $6y - x = 12$ using a solid line.

Test point: (0, 0)

$6(0) - 0 \leq 12$

$0 \leq 12$ True

Shade the region containing (0, 0).



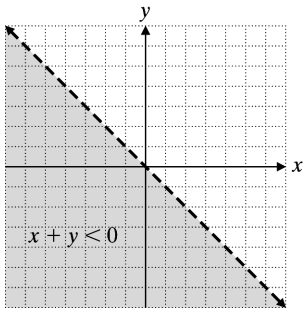
16. $x + y < 0$

Graph $x + y = 0$ using a dashed line.

Test point: (1, 1)

$1 + 1 = 2 < 0$, False

Shade the region not containing (1, 1).



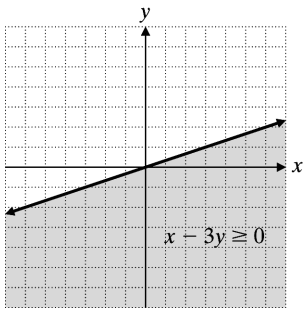
18. $x - 3y \geq 0$

Graph $x - 3y = 0$ using a solid line.

Test point: (3, 0)

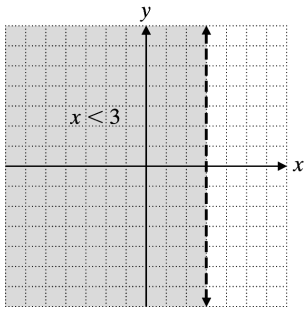
$3 - (0) \geq 0 \Rightarrow 3 \geq 0$ True

Shade the region containing (3, 0).



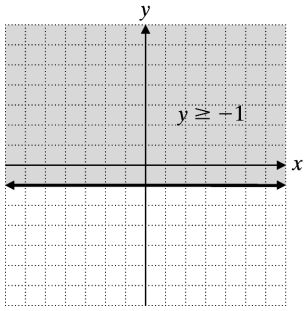
20. $x < 3$

Graph $x = 3$ using a dashed line. Shade to the left of the line.

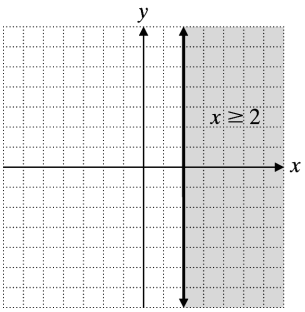


22. $y \geq -1$

Graph $y = -1$ using a solid line. Shade above the line.

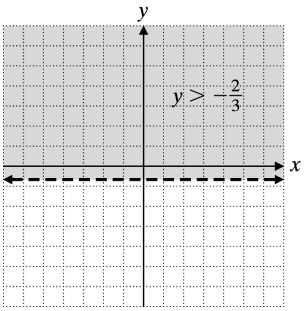


24. $-5x \le -10,\ x \ge 2$
Graph $x = 2$ using a solid line. Shade to the right of the line.



26. $3y + 2 > 0 \Rightarrow\ y > -\frac{2}{3}$

Graph $y = -\frac{2}{3}$ using a dashed line. Shade above the line.



Cumulative Review

27. Let W = width of runner.
Then $3W + 5$ = length of runner.
$P = 2L + 2W$
$34 = 2(3W + 5) + 2W$
$34 = 6W + 10 + 2W$
$34 = 8W + 10$
$24 = 8W$
$3 = W$
$3W + 5 = 14$
The length is 14 feet, and the width is 3 feet.

28. $x - 5 < 2$ and $3x + 1 > -2$
$x < 7$ $3x > -3$
$x > -1$
$-1 < x < 7$

29. $2x + 5 \le 5$ or $-x + 4 \le 2$
$2x \le 0$ $-x \le -2$
$x \le 0$ $x \ge 2$
$x \le 0$ or $x \ge 2$

Classroom Quiz 3.4

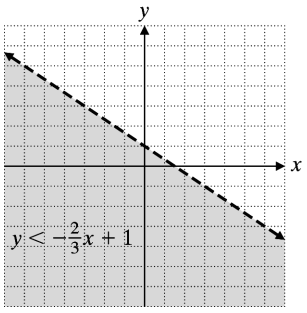
1. $y < -5x + 2$
Test point $(-3, -2)$
$-2 \overset{?}{<} -5(-3) + 2$
$-2 \overset{?}{<} 17$ True
The graph of the region lies below the line.

2. $y < -\frac{2}{3}x + 1$

Graph $y = -\frac{2}{3}x + 1$ using a dashed line.

x	y
0	1
$\frac{3}{2}$	0

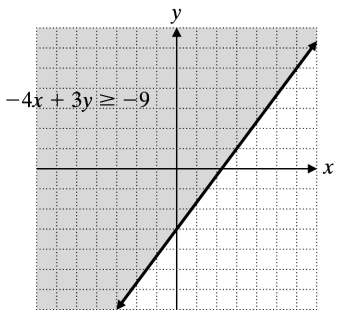
Test point: (0, 0)
$0 < -\frac{2}{3}(0) + 1$
$0 < 1$ True
Shade the region containing (0, 0).



3. $-4x + 3y \ge -9$
Graph $-4x + 3y = -9$ using a solid line.

x	y
0	−3
$\frac{9}{4}$	0

Test point: (0, 0)
$-4(0) + 3(0) \ge -9$
$0 \ge -9$ True
Shade the region containing (0, 0).



3.5 Exercises

2. The domain consists of all the first items of each ordered pair in a relation. The range consists of all the second items of each ordered pair in a relation.

4. $f(-5) = 8$, $(-5, 8)$, $x = -5$, $y = 8$

6. Domain $= \left\{\frac{1}{2}, -3, \frac{3}{2}\right\}$
Range = {5, 7, −1}
Relation is *not* a function since $\left(\frac{1}{2}, 5\right)$ and $\left(\frac{1}{2}, -1\right)$ have the same first coordinate.

8. Domain = {40, −18, 38, 57}
Range = {10, 27, −15}
Relation is a function since no two different ordered pairs have the same first item.

10. Domain $= \left\{7, 7\frac{1}{2}, 8, 8\frac{1}{2}, 9\right\}$
Range = {39, 40, 41, 42, 43}
Relation is a function since no two different ordered pairs have the same first item.

12. Domain = {Nepal/Tibet, Pakistan/China, India/Nepal}
Range = {8850, 8611, 8586, 8516, 8463}
Relation is *not* a function since (Nepal/Tibet, 8850), (Nepal/Tibet, 8516), and (Nepal/Tibet, 8463) have the same first item.

14. Domain = {1, 2, 3, 4, 5}
Range = {1.61, 3.22, 4.83, 6.44, 8.05}
Relation is a function since no two different ordered pairs have the same first item.

16. Domain = {1, 2, 3, 4, 5, 6}
Range = {3.79, 7.57, 11.36, 15.14, 18.93, 22.71}
Relation is a function since no two different ordered pairs have the same first item.

18. Function since it passes the vertical line test.

20. Not a function since it fails the vertical line test.

22. Function since it passes the vertical line test.

24. Not a function since it fails the vertical line test.

26. $g(x) = 2x - 5$
$g(-3) = 2(-3) - 5 = -6 - 5 = -11$

28. $g(x) = 2x - 5$
$$g\left(\frac{1}{3}\right) = 2\left(\frac{1}{3}\right) - 5 = \frac{2}{3} - \frac{15}{3} = -\frac{13}{3}$$

30. $h(x) = \frac{3}{4}x + 1$
$h(0) = \frac{3}{4}(0) + 1$
$h(0) = 0 + 1$
$h(0) = 1$

32. $h(x) = \frac{3}{4}x + 1$
$h\left(\frac{1}{3}\right) = \frac{3}{4} \cdot \frac{1}{3} + 1$
$h\left(\frac{1}{3}\right) = \frac{1}{4} + \frac{4}{4}$
$h\left(\frac{1}{3}\right) = \frac{5}{4}$

34. $r(x) = 2x^2 - 4x + 1$
$r(1) = 2(1)^2 - 4(1) + 1 = 2 - 4 + 1 = -1$

36. $r(x) = 2x^2 - 4x + 1$
$r(0.1) = 2(0.1)^2 - 4(0.1) + 1$
$= 0.02 - 0.4 + 1$
$= 0.62$

38. $t(x) = x^3 - 3x^2 + 2x - 3$
$t(10) = (10)^3 - 3(10)^2 + 2(10) - 3$
$t(10) = 1000 - 300 + 20 - 3$
$t(10) = 717$

40. $t(x) = x^2 - 3x^2 + 2x - 3$
$t(-1) = (-1)^3 - 3(-1)^2 + 2(-1) - 3$
$t(-1) = -1 - 3 - 2 - 3$
$t(-1) = -9$

42. $f(x) = \sqrt{x+10}$
$f(-6) = \sqrt{-6+10}$
$f(-6) = \sqrt{4}$
$f(-6) = 2$

44. $g(x) = \left|x^2 + 5\right|$
$g(-4) = \left|(-4)^2 + 5\right|$
$g(-4) = \left|16 + 5\right|$
$g(-4) = 21$

46. $f(x) = x + 3$

x	$f(x) = x + 3$	$f(x) = x + 3$
-2	$f(-2) = -2 + 3$	1
-1	$f(-1) = -1 + 3$	2
0	$f(0) = 0 + 3$	3
1	$f(1) = 1 + 3$	4
2	$f(2) = 2 + 3$	5

Range = {1, 2, 3, 4, 5}

48. $h(x) = \frac{1}{2}x + 3$

$y = \frac{1}{2}x + 3,\ x = 2y - 6$	$x = 2y - 6$	y
-6	$x = 2(0) - 6$	0
-2	$x = 2(2) - 6$	2
1	$x = 2\left(\frac{7}{2}\right) - 6$	$\frac{7}{2}$
12	$x = 2(9) - 6$	9

Domain = {−6, −2, 1, 12}

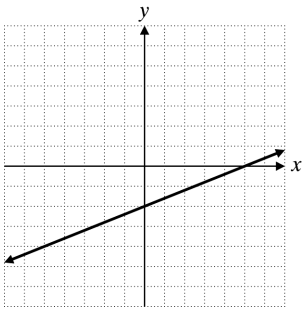
Cumulative Review

50. $|3x - 2| = 1$

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

51. $|x - 5| \le 3$
$-3 \le x - 5 \le 3$
$-3 + 5 \le x - 5 + 5 \le 3 + 5$
$2 \le x \le 8$

52. $2x - 5y = 10$
Let $x = 0$: $2(0) - 5y = 10$
$y = -2$
Let $y = 0$: $2x - 5(0) = 10$
$x = 5$
Let $x = -5$: $2(-5) - 5y = 10$
$y = -4$



Classroom Quiz 3.5

1. Domain = {−6, −4, 4, 6}
Range = {9, 8, −8}

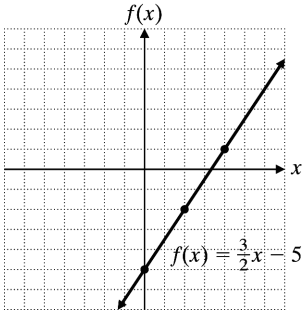
2. $p(x) = \left|x^2 - 10\right|$
$p(-2) = \left|(-2)^2 - 10\right|$
$p(-2) = \left|4 - 10\right|$
$p(-2) = \left|-6\right|$
$p(-2) = 6$

3. $f(x) = 3x^3 - 2x^2 + 4x - 7$
$f(-3) = 3(-3)^3 - 2(-3)^2 + 4(-3) - 7$
$f(-3) = 3(-27) - 2(9) + 4(-3) - 7$
$f(-3) = -81 - 18 - 12 - 7$
$f(-3) = -118$

3.6 Exercises

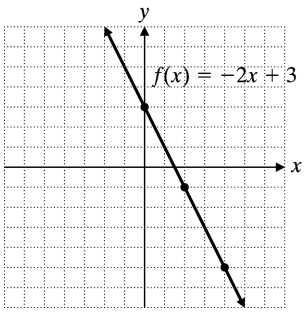
2. $f(x)=\frac{3}{2}x-5$

x	$f(x)=\frac{3}{2}x-5$
4	1
2	–2
0	–5



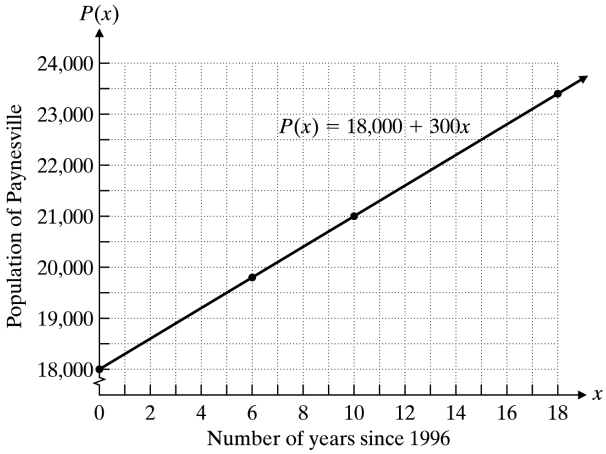
4. $f(x) = -2x + 3$

x	$f(x)$
0	3
2	–1
4	–5

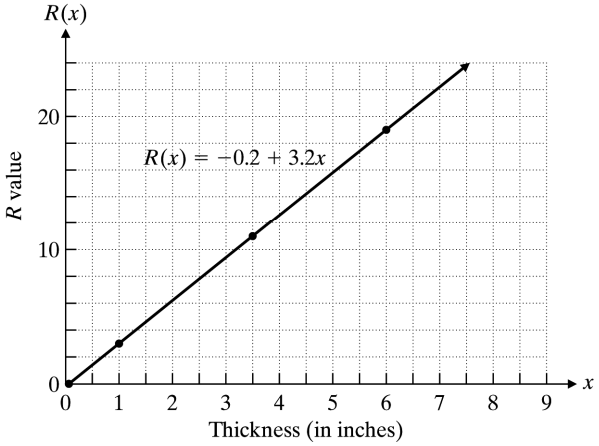


6. $m = 300$
$b = (0, 18{,}000)$
$P(x) = 18{,}000 + 300x$

x	$P(x) = 18{,}000 + 300x$
0	18,000
6	19,600
10	21,000
18	23,400

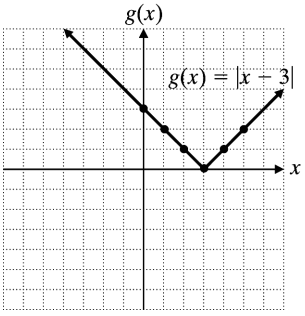


8. $R(x) = -0.2 + 3.2x$
$R(0) = -0.2 + 3.2(0) = -0.2$
$R(1) = -0.2 + 3.2(1) = 3$
$R(3.5) = -0.2 + 3.2(3.5) = 11$
$R(6) = -0.2 + 3.2(6) = 19$



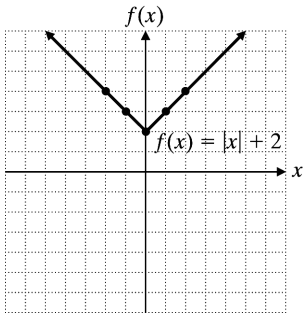
10. $g(x) = |x - 3|$

x	0	1	2	3	4	5
$g(x)$	3	2	1	0	1	2



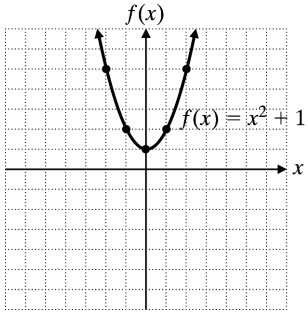
12. $f(x) = |x| + 2$

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



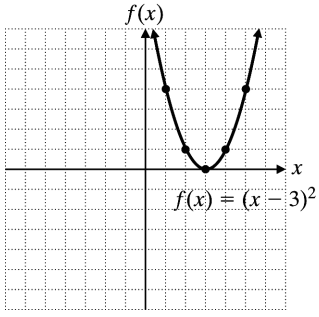
14. $f(x) = x^2 + 1$

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



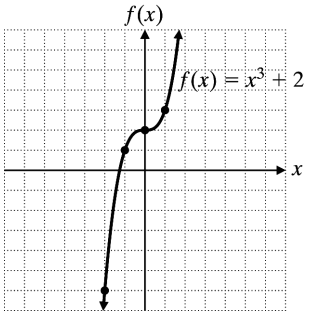
16. $f(x) = (x-3)^2$

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



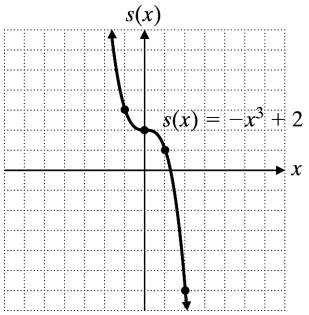
18. $f(x) = x^3 + 2$

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



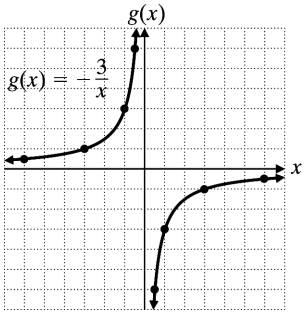
20. $s(x) = -x^3 + 2$

x	$s(x)$
-1	3
0	2
1	1



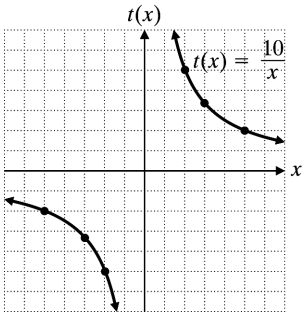
22. $g(x) = -\dfrac{3}{x}$

x	-6	-3	-1	$-\frac{1}{3}$	$\frac{1}{3}$	1	3	6
$g(x)$	$\frac{1}{2}$	1	3	9	-9	-3	-1	$-\frac{1}{2}$



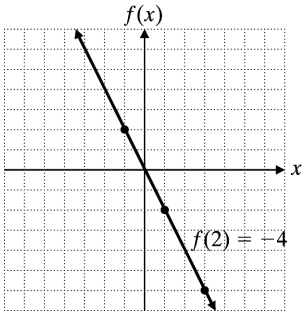
24. $t(x) = \dfrac{10}{x}$

x	−5	−3	−2	2	3	5
$t(x)$	−2	$-\frac{10}{3}$	−5	5	$\frac{10}{3}$	2



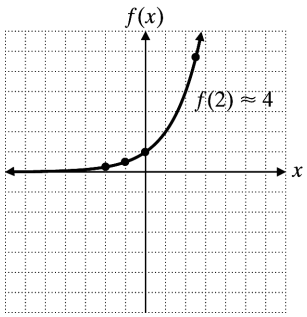
26. From the graph, $f(2) = -4$.

x	$f(x)$
−1	2
1	−2
3	−6



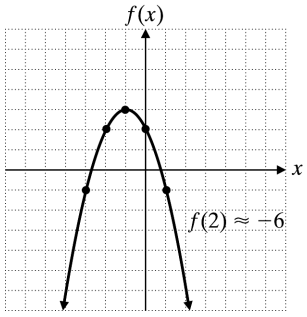
28. From the graph, $f(2) = 4$.

x	$f(x)$
−2	0.25
−1	0.5
0	1
2.5	5.7

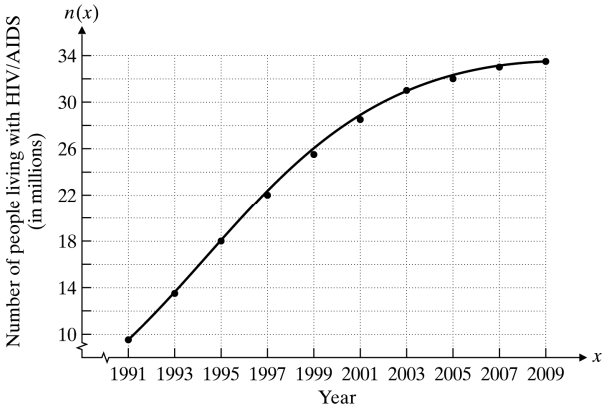


30. From the graph, $f(2) = -6$.

x	$f(x)$
−3	−1
−2	2
−1	3
0	2
1	−1



32. a.



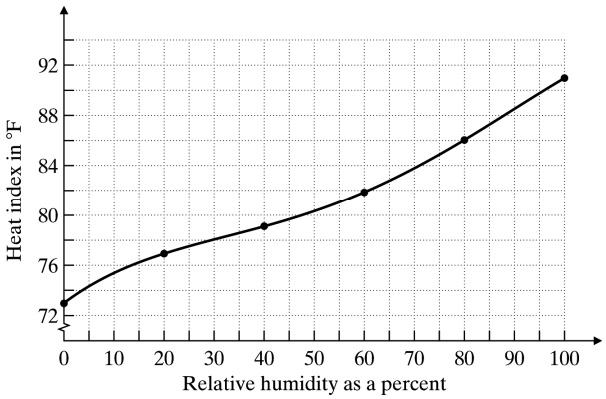
b. From the graph, $n(x)$ was about 24 million in 1998.

c. From the graph, $n(x)$ will be about 34 million in 2011.

d. The number of people living with HIV/AIDS increased at a greater rate from 1991 to 1999 than from 1999 to 2009.

e. The number reached 20 million in 1996.

34. a.



The function is not linear. There is not a constant rate of change because the slope keeps changing. The slope of a straight line does not change.

b. The value of the function when the relative humidity is 50% is about 80.5°F.

c. The heat index increases fastest for the relative humidity between 80% and 100%.

d. 80°F has a heat index of 80°F when level of humidity is between 45% and 50%.

e. At 20% humidity 80°F feels like 77°F or cooler than the actual temperature.

Cumulative Review

35.
$$\begin{aligned} 2(3ax-4y) &= 5(ax+3) \\ 6ax-8y &= 5ax+15 \\ ax &= 8y+15 \\ x &= \frac{8y+15}{a} \end{aligned}$$

36.
$$\begin{aligned} 0.12(x-4) &= 1.16x-8.02 \\ 0.12x-0.48 &= 1.16x-8.02 \\ 1.04x &= 7.54 \\ x &= 7.25 \end{aligned}$$

37. $m = \dfrac{y_2-y_1}{x_2-x_1} = \dfrac{-1-5}{2-(-1)} = \dfrac{-6}{3} = -2$

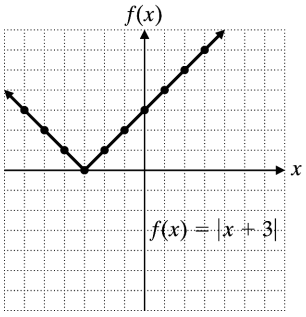
38. $y = 3x + 1,\ m = 3,\ m_\perp = -\dfrac{1}{3}$

$$\begin{aligned} y-(-4) &= -\frac{1}{3}(x-2) \\ 3y+12 &= -x+2 \\ x+3y &= -10 \end{aligned}$$

Classroom Quiz 3.6

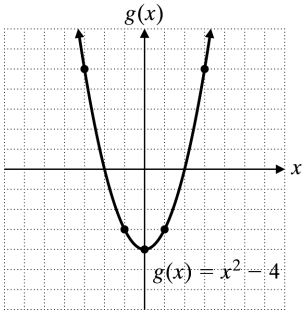
1. $f(x) = |x + 3|$

x	y	
-3	0	(vertex)
-5	2	
-1	2	



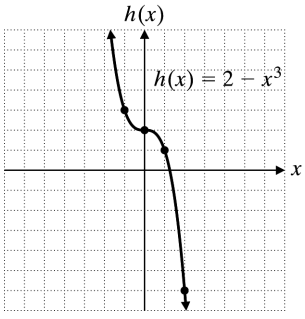
2. $g(x) = x^2 - 4$

x	y	
2	0	
–2	0	
0	–4	(vertex)
3	5	
–3	5	



3. $h(x) = 2 - x^3$

x	y
–2	10
–1	3
0	2
1	1
2	–6



Use Math to Save Money

1. $1000 + 36 \times 388.06 = 1000 + 13{,}970.16$
$= 14{,}970.16$
Louvy would pay $14,970.16 over the entire length of the lease.

2. $1000 + 36 \times 669.28 = 1000 + 24{,}094.08$
$= 25{,}094.08$
Louvy would pay $25,094.08 over the entire length of the loan.

3. 14,970.16 + 11,000.00 = 25,970.16
This would bring the total cost up to $25,970.16.

4. 25,970.16 − 25,094.08 = 876.08
Louvy saves $876.08 if he buys the car instead of leasing it.

5. 669.28 − 388.06 = 281.22
He will save $281.22 each month in car payments.

6. To get the best overall price, Louvy should buy the car since he will save $876.08 on the total price. To get a lower monthly payment, Louvy should lease the car since he will save $281.22 each month in car payments.

7. Answers will vary.

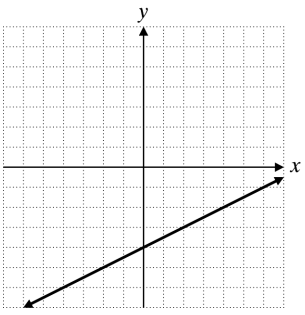
8. Answers will vary.

9. Answers will vary.

You Try It

1. $x - 2y = 8$
Let $x = 0$; then $y = -4$.
Let $y = 0$; then $x = 8$.
Let $x = 4$; then $y = -2$.

x	y
0	–4
8	0
4	–2



2. $-3x + 5y = -15$
If $x = 0$, $5y = -15$ and $y = -3$. The y-intercept is $(0, -3)$. If $y = 0$, $-3x = -15$ and $x = 5$. The x-intercept is $(5, 0)$.

3. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{1-2}{-3-(-5)} = \dfrac{-1}{2} = -\dfrac{1}{2}$

4. $-3y = 3$
This equation can be simplified to $y = -1$. It is a horizontal line; the slope is zero.

5. $4x = 2$
This equation can be simplified to $x = \dfrac{1}{2}$. It is a vertical line. This line has an undefined slope.

6. a. A line parallel to $y = \dfrac{1}{2}x - 5$ has slope $m = \dfrac{1}{2}$.

b. A line perpendicular to $y = 2x + 3$ has slope $m = -\dfrac{1}{2}$.

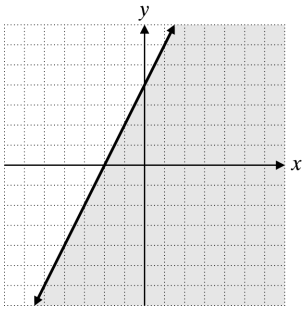
7.
$$\begin{aligned} y &= 2(x-4) \\ y &= 2x-8 \\ -2x + y &= -8 \\ 2x - y &= 8 \end{aligned}$$

8. a. $y = \dfrac{1}{4}x - \dfrac{3}{4}$
The slope is $\dfrac{1}{4}$; the y-intercept is $\left(0, -\dfrac{3}{4}\right)$.

b. $-2x + y = 5$
$y = 2x + 5$
The slope is 2; the y-intercept is $(0, 5)$.

9. Find the slope.
$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{0-4}{8-(-2)} = \dfrac{-4}{10} = -\dfrac{2}{5}$
Use the point-slope form.
$y - 0 = -\dfrac{2}{5}(x - 8)$
$y = -\dfrac{2}{8}x + \dfrac{16}{5}$

10. $y - 2x \le 4$
Graph the boundary line $y - 2x = 4$ as a solid line passing through $(0, 4)$ and $(-2, 0)$. Pick $(0, 0)$ as a test point.
$$\begin{aligned} y - 2x &\le 4 \\ 0 - 2(0) &\overset{?}{\le} 4 \\ 0 - 0 &\overset{?}{\le} 4 \\ 0 &\le 4 \end{aligned}$$
This statement is true. Shade the side that contains $(0, 0)$.



11. $B = \{(0, 2), (-1, 3), (4, 1), (0, -1)\}$
Domain = $\{0, -1, 4\}$
Range = $\{2, 3, 1, -1\}$

12. a. $E = \{(6, 1), (2, -3), (4, 1), (2, 3)\}$
E is not a function. Two different pairs have the same first coordinate. They are $(2, -3)$ and $(2, 3)$.

b. $F = \{(2, 4), (5, 0), (0, -4)\}$
F is a function. There are no different pairs with the same first coordinate.

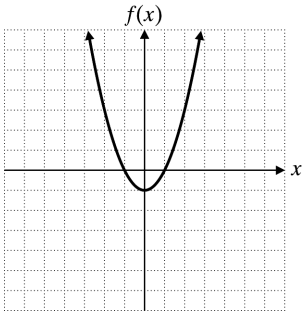
13. a. This is not a function. There are at least two different ordered pairs with the same first coordinate.

b. This is a function. No vertical line can be drawn that intersects the graph more than once.

14. $g(x) = x^2 - x + 6$
$$\begin{aligned} g(-1) &= (-1)^2 - (-1) + 6 \\ &= 1 - (-1) + 6 \\ &= 1 + 1 + 6 \\ &= 8 \end{aligned}$$

15.

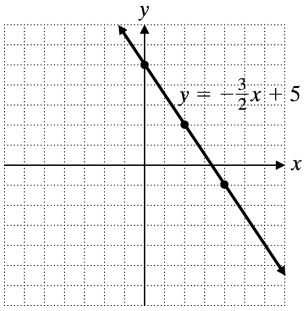
x	y
–2	3
–1	0
0	–1
1	0
2	3



Chapter 3 Review Problems

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

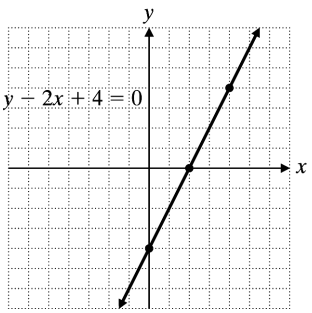
x	$x = -\frac{3}{2}x + 5$	y
0	$y = -\frac{3}{2}(0) + 5$	5
2	$y = -\frac{3}{2}(2) + 5$	2
4	$y = -\frac{3}{2}(4) + 5$	–1



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

$y = 2x - 4$

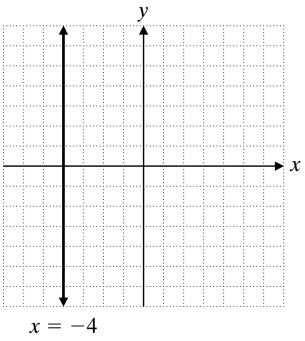
x	$y = 2x - 4$	y
0	$y = 2(0) - 4$	–4
2	$y = 2(2) - 4$	0
4	$y = 2(4) - 4$	4



3. $5x - 3 = 9x + 13$

$x = -4$

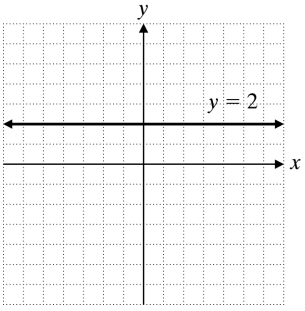
The graph of $x = -4$ is a vertical line.



4. $8y + 5 = 10y + 1$

$y = 2$

The graph of $y = 2$ is a horizontal line.



5. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$m = \dfrac{-3-(-4)}{2-(-8)} = \dfrac{-3+4}{2+8}$

$m = \dfrac{1}{10}$

6. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$m = \dfrac{-1-(-1)}{7.5-0.3}$

$m = \dfrac{0}{7.2} = 0$

7. $-x + 3y = 12$

$3y = x + 12$

$y = \dfrac{1}{3}x + 4$

The slope is $m = \dfrac{1}{3}$; the y-intercept is (0, 4).

8. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{\frac{1}{3}-2}{\frac{2}{3}-4} = \dfrac{-\frac{5}{3}}{-\frac{10}{3}} = \dfrac{1}{2}$

$m_\perp = -\dfrac{1}{m}$

$m_\perp = -\dfrac{1}{\frac{1}{2}} = -2$

9. $m = \dfrac{1}{3},\ b = 5$

$y = \dfrac{1}{3}x + 5$

$x - 3y = -15$

10. $y - y_1 = m(x - x_1)$

$y - (-2) = -4\left(x - \dfrac{1}{2}\right)$

$y + 2 = -4x + 2$

$4x + y = 0$

11. $y - y_1 = m(x - x_1)$

$y - 1 = 0(x - (-3))$

$y - 1 = 0$

$y = 1$

12. a. $P = 140x - 2000$ has $m = 140$.
The slope is 140.

b. $P = 140x - 2000 = 0$

$140x = 2000$

$x = 14\dfrac{2}{7}$

The company must sell at least 15 microcomputers each day to make a profit.

13. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{6 - \frac{-1}{2}}{5-(-1)} = \dfrac{13}{12}$

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

$y - 6 = \dfrac{13}{12}(x - 5)$

$12y - 72 = 13x - 65$

$13x - 12y = -7$

14. A line with undefined slope is a vertical line, $x = -6$.

15. $7x + 8y - 12 = 0$

$8y = -7x + 12$

$y = -\dfrac{7}{8}x + \dfrac{3}{2}$

$m = -\dfrac{7}{8},\ m_\perp = -\dfrac{1}{m} = -\dfrac{1}{-\frac{7}{8}} = \dfrac{8}{7}$

$y - y_1 = m_\perp(x - x_1)$

$y - 5 = \dfrac{8}{7}(x - (-2))$

$7y - 35 = 8x + 16$

$8x - 7y = -51$

16. $3x - 2y = 8$

$2y = 3x - 8$

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

$m = \dfrac{3}{2} \Rightarrow m_{\|} = \dfrac{3}{2}$

$y - y_1 = m_{\|}(x - x_1)$

$y - 1 = \dfrac{3}{2}(x - 5)$

$2y - 2 = 3x - 15$

$3x - 2y = 13$

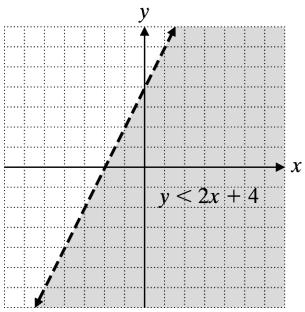
17. From the graph $m = -2$ and y-intercept (0, 6) or $b = 6$.

$y = mx + b$

$y = -2x + 6$

18. From the graph $m = 0$ and $b = 2$.
$y = mx + b$
$y = 0x + 2$
$y = 2$

19. $y < 2x + 4$
Graph $y = 2x + 4$ with a dashed line.
Test point: (0, 0)
$0 < 2(0) + 4$, $0 < 4$ True
Shade the region containing (0, 0).



20. $y > -\frac{1}{2}x + 3$

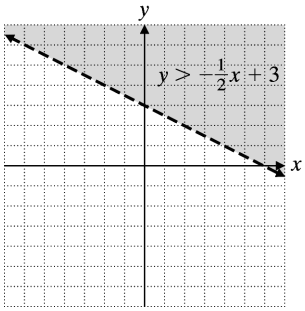
Graph $y = -\frac{1}{2}x + 3$ with a dashed line.

Test point: (0, 0)

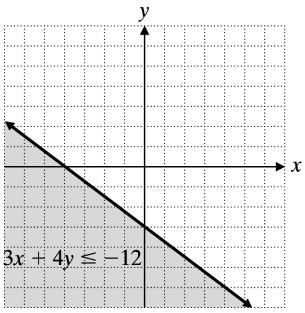
$0 > -\frac{1}{2}(0, 0) + 3$

$0 > 3$ False

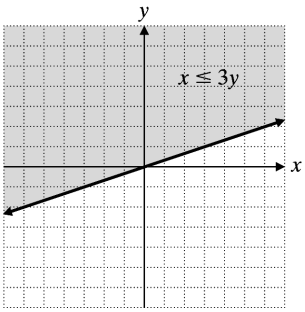
Shade the region not containing (0, 0).



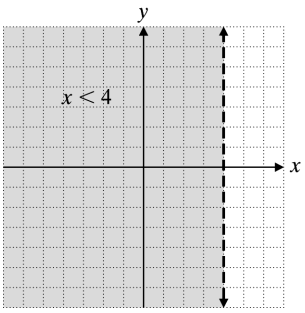
21. $3x + 4y \le -12$
Graph $3x + 4y = -12$ with a solid line.
Test point: (0, 0)
$3(0) + 4(0) \le -12$
$0 \le -12$ False
Shade the region not containing (0, 0).



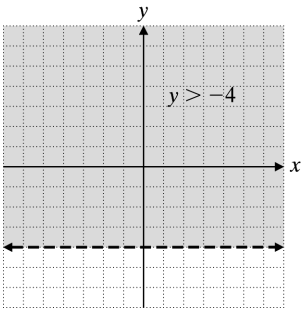
22. $x \le 3y$
Graph $x = 3y$ with a solid line.
Test point: (0, 3)
$0 \le 3(3)$
$0 \le 9$ True
Shade the region containing (0, 3).



23. $3x - 5 < 7$
$3x < 12$
$x < 4$
Graph $x = 4$ with a dashed line. Shade the region to the left of the line.



24. $5y - 2 > 3y - 10$
$2y > -8$
$y > -4$
Graph $y = -4$ with a dashed line. Shade the region above the line.



25. Domain = {−20, −18, −16, −12}
Range: {14, 16, 18}
Relation is a function since no two different ordered pairs have the same first coordinate.

26. Domain: {0, 1, 2, 3}
Range: {0, 1, 4, 9, 16}
Relation is not a function since the ordered pairs (1, 1) and (1, 16) have the same first coordinates.

27. Function, no two ordered pairs have the same first coordinate by the vertical line test.

28. Not a function, from the vertical line test at least two ordered pairs have the same first coordinate.

29. $f(x) = -2x + 10$

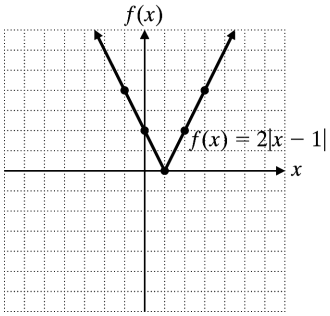
$f(-1) = -2(-1) + 10$
$f(-1) = 12$

$f(-5) = -2(-5) + 10$
$f(-5) = 20$

30. $h(x) = x^3 + 2x^2 - 5x + 8$
$h(-1) = (-1)^3 + 2(-1)^2 - 5(-1) + 8$
$h(-1) = -1 + 2 + 5 + 8$
$h(-1) = 14$

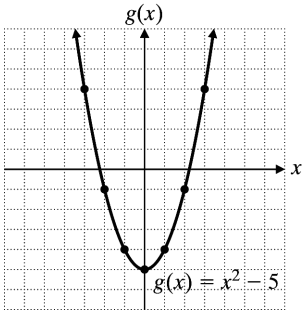
31. $f(x) = 2|x - 1|$

x	$f(x) = 2\|x - 1\|$
−2	6
0	2
1	0
2	2
3	4



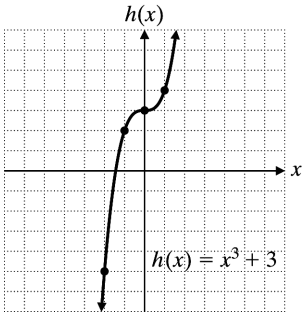
32. $g(x) = x^2 - 5$

x	$y = g(x)$
−3	4
−2	−1
−1	−4
0	−5
1	−4
2	−1
3	4



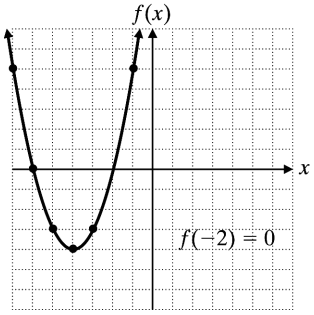
33. $h(x) = x^3 + 3$

x	$y = h(x)$
−2	−5
−1	2
0	3
1	4



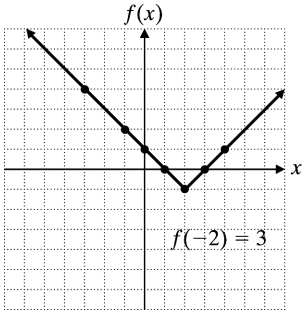
34. From the graph, $f(-2) = 0$.

x	–1	–3	–4	–5	–6	–7
$f(x)$	5	–3	–4	–3	0	5



35. From the graph, $f(-2) = 3$.

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



36. $f(x) = -\frac{4}{5}x + 3$

x	$f(x) = -\frac{4}{5}x + 3$
–5	7
0	3
10	–5

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

x	$f(x) = 2x^2 - 3x + 4$
–3	31
0	4
4	24

38. $3x - 2y = 9$

$-2y = -3x + 9$

$y = \frac{3}{2}x - \frac{9}{2}$

The slope is $m = \frac{3}{2}$; the y-intercept is $\left(0, -\frac{9}{2}\right)$.

39. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6-9}{-3-1} = \frac{3}{4}$

m_n is the negative reciprocal of m.

$m_n = -\frac{4}{3}$

40. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8-(-6)}{4.5-2.5} = \frac{14}{2} = 7$

$m_p = m = 7$

41. $y = mx + b$

$y = \frac{5}{6}x + (-5)$

$6y = 5x - 30$

$5x - 6y = 30$

42. $y = 5x - 2$, $m = 5$, $m_{\|} = 5$

$y - y_1 = m_{\|}(x - x_1)$

$y - 10 = 5(x - 4)$

$y - 10 = 5x - 20$

$y = 5x - 10$

43. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{6-3}{5-(-7)} = \dfrac{3}{12} = \dfrac{1}{4}$

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

$y - 6 = \dfrac{1}{4}(x - 5)$

$y - 6 = \dfrac{1}{4}x - \dfrac{5}{4}$

$y = \dfrac{1}{4}x + \dfrac{19}{4}$

44. $3x - 6y = 9$

$6y = 3x - 9$

$y = \dfrac{1}{2}x - \dfrac{3}{2}$, $m = \dfrac{1}{2}$, $m_\perp = -2$

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

$y - (-1) = -2(x - (-2))$

$y + 1 = -2x - 4$

$2x + y = -5$

45. Vertical lines have the form $x = c$.
$(5, 6) \rightarrow x = 5$

46. $m = 0.20$
$b = 40$
$f(x) = 0.20x + 40$

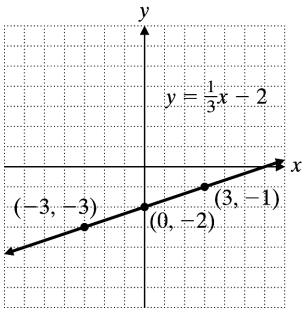
47. $m = 200$
$b = 24{,}000$
$f(x) = 200x + 24{,}000$

48. $f(x) = 18{,}000 - 65x$

How Am I Doing? Chapter 3 Test

1. $y = \dfrac{1}{3}x - 2$

x	$y = \frac{1}{3}x - 2$	y
-3	$y = \frac{1}{3}(-3) - 2$	-3
0	$y = \frac{1}{3}(0) - 2$	-2
3	$y = \frac{1}{3}(3) - 2$	-1

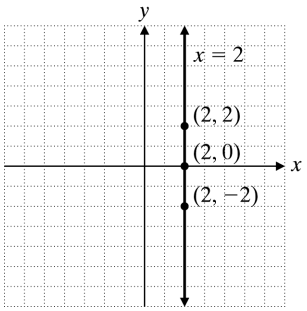


2. $2x - 3 = 1$

$2x = 4$

$x = 2$

x	y
2	-2
2	0
2	2



3. $5x + 3y = 9$

Let $x = 0$: $5(0) + 3y = 9$

$y = 3$

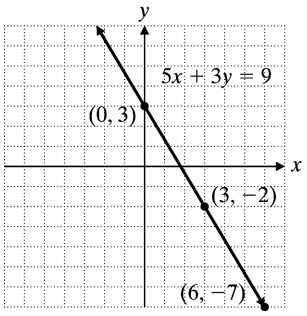
Let $y = -2$: $5x + 3(-2) = 9$

$x = 3$

Let $x = 6$: $5(6) + 3y = 9$

$y = -7$

x	y
0	3
3	-2
6	-7



4. $2x + 3y = -10$

Let $x = -2$: $2(-2) + 3y = -10$

$y = -2$

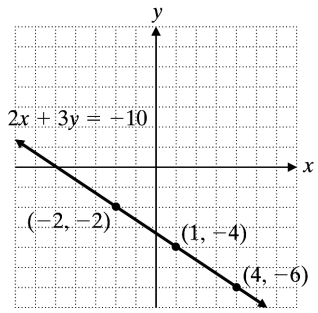
Let $x = 1$: $2(1) + 3y = -10$

$y = -4$

Let $x = 4$: $2(4) + 3y = -10$

$y = -6$

x	y
-2	-2
1	-4
4	-6



5. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

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

$m = \dfrac{3}{\frac{3}{2}}$

$m = 2$

6. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$m = \dfrac{5 - 5}{-7 - 6}$

$m = 0$

7. $-2x + 5y = 15$

$5y = 2x + 15$

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

The slope is $m = \dfrac{2}{5}$; the y-intercept is (0, 3).

8. $6x - 7y - 1 = 0$

$7y = 6x - 1$

$y = \dfrac{6}{7}x - \dfrac{1}{7}$

$m = \dfrac{6}{7}$, $m_\perp = -\dfrac{7}{6}$

$y - y_1 = m_\perp(x - x_1)$

$y - (-2) = -\dfrac{7}{6}(x - 0)$

$y + 2 = -\dfrac{7}{6}x$

$6y + 12 = -7x$

$7x + 6y = -12$

9. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$m = \dfrac{-2 - (-1)}{5 - (-3)} = -\dfrac{1}{8}$

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

$y - (-2) = -\dfrac{1}{8}(x - 5)$

$8y + 16 = -x + 5$

$x + 8y = -11$

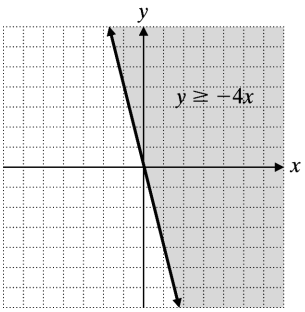
10. $y = 2$

11. $y = mx + b$

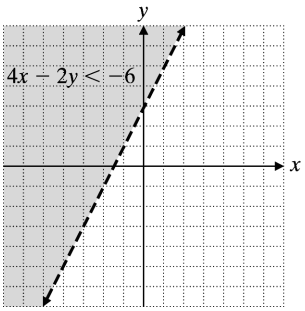
$y = -5x + (-8)$

$y = -5x - 8$

12. $y \geq -4x$
Graph $y = -4x$ with a solid line.
Test point: (2, 2)
$2 \geq -4(2)$
$2 \geq -8$ True
Shade the region containing (2, 2).



13. $4x - 2y < -6$
Graph $4x - 2y = -6$ with a dashed line.
Test point: (0, 0)
$4(0) - 2(0) < -6$
$0 < -6$ False
Shade the region not containing (0, 0).



14. Domain = {0, 1, 2}
Range = {−4, −1, 0, 1, 4}

15. $f(x) = 2x - 3$
$f\left(\frac{3}{4}\right) = 2\left(\frac{3}{4}\right) - 3$
$f\left(\frac{3}{4}\right) = \frac{3}{2} - \frac{6}{2}$
$f\left(\frac{3}{4}\right) = -\frac{3}{2}$

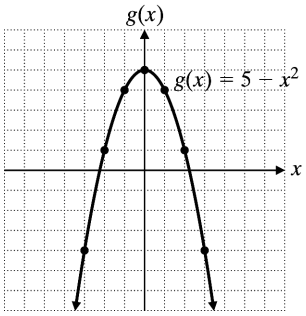
16. $g(x) = \frac{1}{2}x^2 + 3$
$g(-4) = \frac{1}{2}(-4)^2 + 3$
$g(-4) = 8 + 3$
$g(-4) = 11$

17. $h(x) = \left|-\frac{2}{3}x + 4\right|$
$h(-9) = \left|-\frac{2}{3}(-9) + 4\right|$
$h(-9) = |10|$
$h(-9) = 10$

18. $p(x) = -2x^3 + 3x^2 + x - 4$
$p(-2) = -2(-2)^3 + 3(-2)^2 + (-2) - 4$
$p(-2) = 16 + 12 - 2 - 4$
$p(-2) = 22$

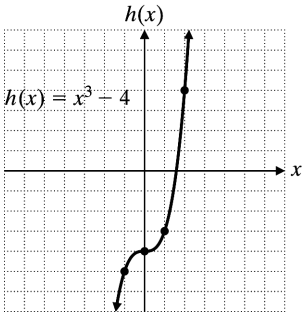
19. $g(x) = 5 - x^2$

x	$g(x)$
−2	1
−1	4
0	5
1	4
2	1

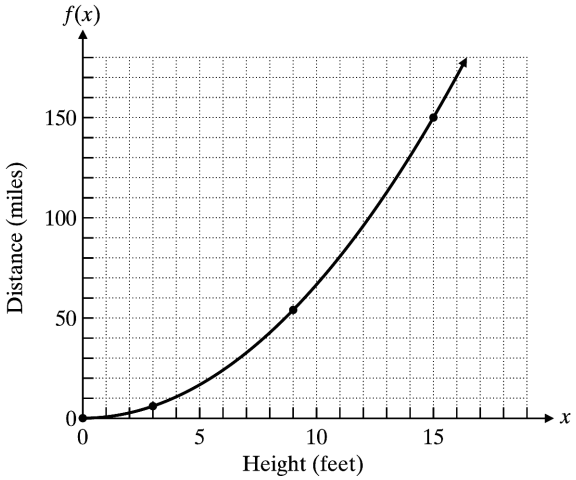


20. $h(x) = x^3 - 4$

x	y
0	−4
1	−3
2	4



21.



From the graph, $f(4) = 10$.
You can see 10 miles if you are 4 feet above the water.

Cumulative Test for Chapters 1–3

1. Inverse property of addition

2. $3(4-6)^2+\sqrt{16}+12\div(-3)=3(-2)^2+4+(-4)$
$=3(4)+4+(-4)$
$=12+4+(-4)$
$=12$

3. $(2a^{-3}b^4)^{-2}=2^{-2}a^{-3(-2)}b^{4(-2)}=\dfrac{a^6}{2^2b^8}=\dfrac{a^6}{4b^8}$

4. $\dfrac{20a^4b}{25ab^3}=\dfrac{20}{25}\cdot\dfrac{a^4}{a}\cdot\dfrac{b}{b^3}=\dfrac{4}{5}a^3b^{-2}=\dfrac{4a^3}{5b^2}$

5. $4(2x^2-1)-2x(3x-5y)=8x^2-4-6x^2+10xy$
$=2x^2+10xy-4$

6. Replace x with -1 and y with 4.
$2x^2-3xy-y^2=2(-1)^2-3(-1)(4)-(4)^2$
$=2(1)-3(-1)(4)-16$
$=2+12-16$
$=-2$

7. $0.000437=4.37\times10^{-4}$

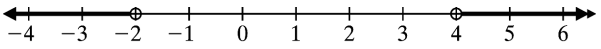
8. $A=\dfrac{1}{2}\pi r^2$
$A=\dfrac{1}{2}(3.14)(3)^2$
$A=14.13$
The area of the semicircle is 14.13 in.^{2}.

9. $\dfrac{1}{2}(x-5)+\dfrac{2}{3}(x+1)=\dfrac{1}{2}$
$6\left[\dfrac{1}{2}(x-5)+\dfrac{2}{3}(x+1)\right]=6\left(\dfrac{1}{2}\right)$
$3(x-5)+4(x+1)=3$
$3x-15+4x+4=3$
$7x-11=3$
$7x-11+11=3+11$
$7x=14$
$\dfrac{7x}{7}=\dfrac{14}{7}$
$x=2$

10. $|4x+3|=7$
$4x+3=7$ or $4x+3=-7$
$4x=4$ $\quad$ $4x=-10$
$x=1$ $\quad$ $x=\dfrac{-10}{4}$
$x=-\dfrac{5}{2}$

11. $|x-2|\le 5$
$-5\le x-2\le 5$
$-5+2\le x-2+2\le 5+2$
$-3\le x\le 7$

12. $3(x-2)>6$ or $5-3(x+1)>8$
$3x-6>6$ $\quad$ $5-3x-3>8$
$3x>12$ $\quad$ $-3x>6$
$x>4$ $\quad$ $x<-2$



13. $2a - x = \frac{1}{3}(6x - y)$

$6a - 3x = 6x - y$

$-9x = -6a - y$

$9x = 6a + y$

$x = \frac{6a + y}{9}$

14. Let w = the width.

$P = 2l + 2w$

$92 = 2(2w + 1) + 2w$

$46 = (2w + 1) + w = 2w + 1 + w$

$46 = 3w + 1 \Rightarrow 3w + 1 = 46$

$3w = 45$

$w = 15$

$2w + 1 = 31$

The width is 15 cm and the length is 31 cm.

15. $0.04x + 0.07(7000 - x) = 391$

$0.04x + 490 - 0.07x = 391$

$-0.03x = 391 - 490$

$x = 3300$

$7000 - x = 3700$

Marissa invested \$3300 at 4% and \$3700 at 7%.

16. $4x - 6y = 10$

Let $x = -2$: $4(-2) - 6y = 10$

$y = -3$

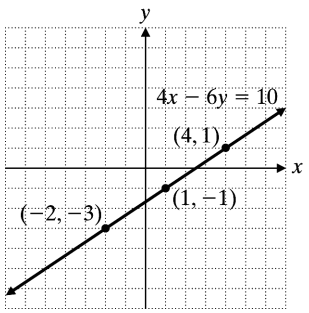
Let $x = 1$: $4(1) - 6y = 10$

$y = -1$

Let $x = 4$: $4(4) - 6y = 10$

$y = 1$

x	y
-2	-3
1	-1
4	1



17. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 1}{6 - (-2)} = \frac{4}{8} = \frac{1}{2}$

18. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 1}{4 - 5} = \frac{2}{-1} = -2$

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

$y - 1 = -2(x - 5)$

$y - 1 = -2x + 10$

$2x + y = 11$

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

$m = -\frac{1}{3}$, $m_\perp = 3$

$y - y_1 = m_\perp(x - x_1)$

$y - 4 = 3(x + 1)$

$y = 3x + 3 + 4$

$y - 3x = 7$

$3x - y = -7$

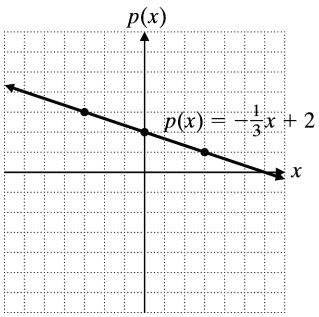
20. $D = \left\{\frac{1}{2}, 2, 3, 5\right\}$

$R = \{-1, 2, 7, 8\}$

Yes, the relation is a function since no two different ordered pairs have the same first coordinate.

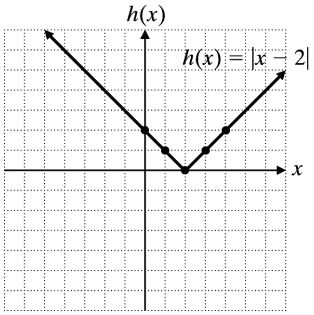
21. $p(x) = -\frac{1}{3}x + 2$

x	$p(x) = -\frac{1}{3}x + 2$	$p(x) = -\frac{1}{3}x + 2$
-3	$-\frac{1}{3}(-3) + 2$	3
0	$-\frac{1}{3}(0) + 2$	2
3	$-\frac{1}{3}(3) + 2$	1



22. $h(x) = |x - 2|$

x	$h(x) = \|x - 2\|$
0	2
1	1
2	0
3	1
4	2



23. $y \le -\frac{3}{2}x + 3$

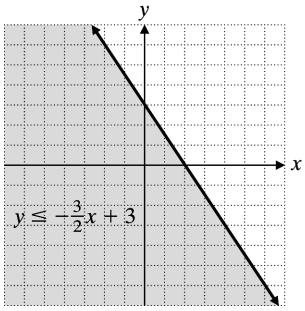
Graph $y = -\frac{3}{2}x + 3$ with a solid line.

Test point: (0, 0)

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

$0 \le 3$ True

Shade the region containing (0, 0).



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

x	$f(x) = -2x^3 + 4$
−2	$-2(-2)^3 + 4 = 20$
0	$-2(0)^3 + 4 = 4$
3	$-2(3)^3 + 4 = -50$

25. a. $m = 1.5$
$b = 31.1$
$f(x) = 31.1 + 1.5x$

b. $x = 2012 - 2000 = 12$
$f(12) = 31.1 + 1.5(12) = 49.1$
It is predicted that 49.1 million people will be living below the poverty level in 2012.