

Chapter 3

3.1 Exercises

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

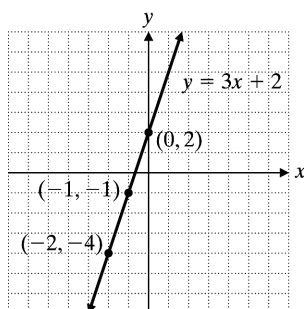
4. If you substitute $x = 5$ and $y = 1$ in $2x - 3y = 7$ you get $2(5) - 3(1) = 10 - 3 = 7$, a true statement. $(5, 1)$ is a solution.

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 $-x + 2y = -7$.

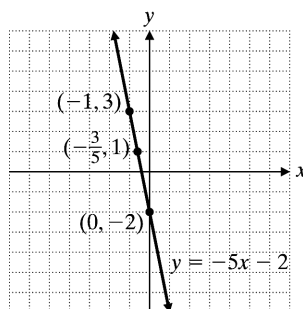
10. $y = 3x + 2$

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



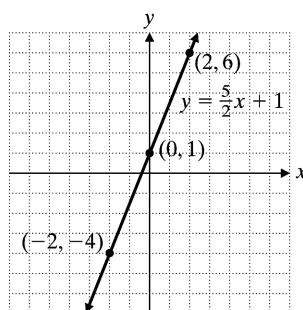
12. $y = -5x - 2$

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



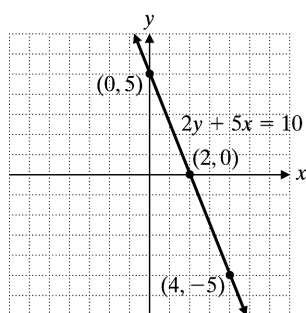
14. $y = \frac{5}{2}x + 1$

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



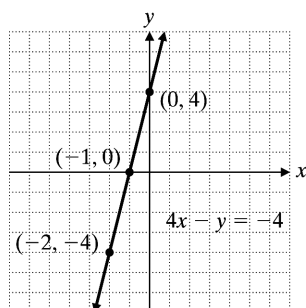
18. $4x - y = -4$

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



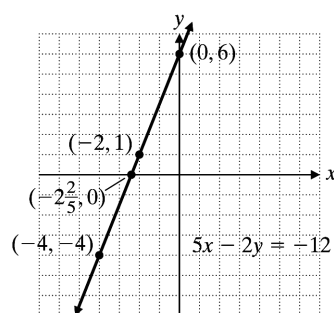
20. $5x - 2y = -12$

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

$4x + 6y = 0$

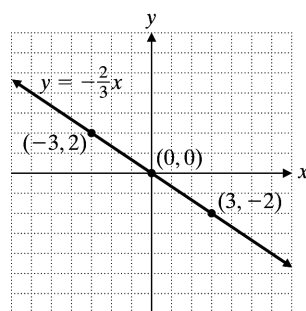
$y = -\frac{2}{3}x$

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

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

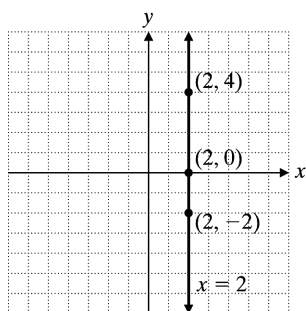
Let $x = 3$: $y = -\frac{2}{3}(3)$
 $y = -2$

x	y
-3	2
0	0
3	-2



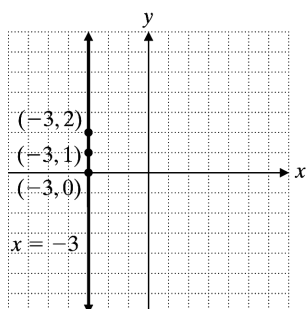
24. $x = 2$, vertical line

x	y
2	4
2	0
2	-2



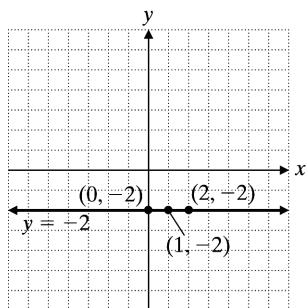
26. $2x - 3 = 3x \Rightarrow -x = 3$
 $x = -3$ vertical line

x	y
-3	2
-3	1
-3	0



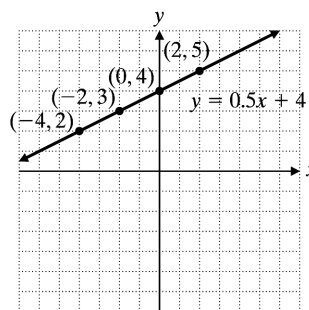
28. $5y + 6 = 2y$, $3y = -6$, $y = -2$
 The graph is a horizontal line.

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



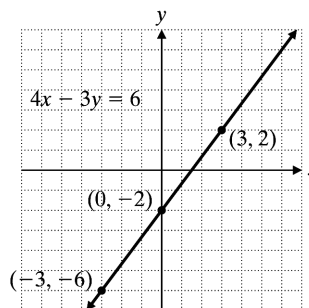
32. $4x - 3y = 6$

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

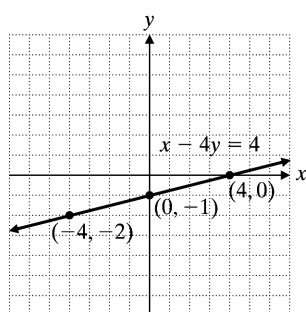
$x - 4y = 4$

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

Let $x = 0$: $0 - 4y = 4$
 $y = -1$

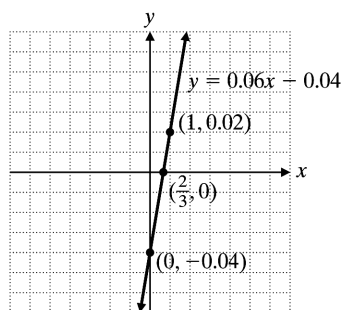
Let $y = 0$: $x - 4(0) = 4$
 $x = 4$

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

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.

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

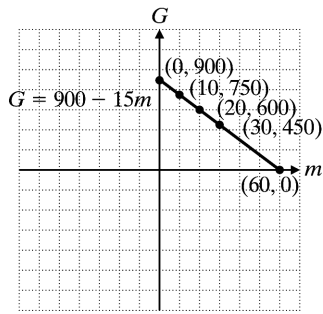
From the table, the median weekly earnings of men and women had the smallest difference in 2005.

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

$$\begin{aligned} 45. \quad 36 \div (8 - 6)^2 + 3(-4) &= 36 \div 2^2 + (-12) \\ &= 36 \div 4 + (-12) \\ &= 9 + (-12) \\ &= -3 \end{aligned}$$

$$\begin{aligned} 46. \quad 3(x - 6) + 2 &\leq 4(x + 2) - 21 \\ 3x - 18 + 2 &\leq 4x + 8 - 21 \\ 3x - 16 &\leq 4x - 13 \\ 3x - 4x &\leq 16 - 13 \\ -x &\leq 3 \\ x &\geq -3 \end{aligned}$$

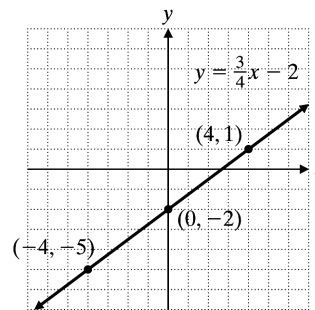
$$\begin{aligned} 47. \quad R &= 2G \\ B &= 3R \\ 2W &= Y \\ 2Y &= R \\ W &= 130 \\ Y &= 2W = 260 \\ R &= 2Y = 520 \\ G &= \frac{1}{2}R = 260 \\ B &= 3R = 1560 \\ \text{There are 520 red, 1560 blue, 260 yellow,} \\ &\text{260 green, and 130 white.} \end{aligned}$$

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

Classroom Quiz 3.1

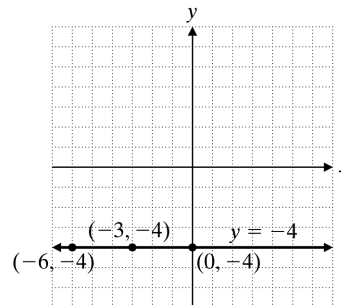
$$1. \quad y = \frac{3}{4}x - 2$$

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



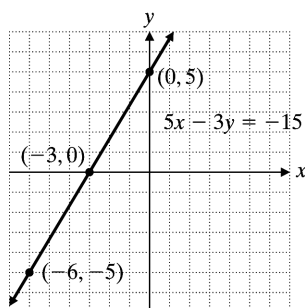
$$\begin{aligned} 2. \quad 3y + 5 &= -7 \\ 3y &= -12 \\ y &= -4 \end{aligned}$$

This is a horizontal line.



$$\begin{aligned} 3. \quad 5x - 3y &= -15 \\ \text{Let } x = 0: 5(0) - 3y &= -15 \\ y &= 5 \\ \text{Let } y = 0: 5x - 3(0) &= -15 \\ x &= -3 \\ \text{Let } x = -6: 5(-6) - 3y &= -15 \\ y &= -5 \end{aligned}$$

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.

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

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

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

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

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

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

undefined slope

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

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

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

The grade is 0.1 or 10%.

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

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

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

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

182 = rise

It falls 182 feet vertically.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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} .

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

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

$$42. \quad \text{a.} \quad \frac{y - 4300}{4.8 - 2} = \frac{4300 - 3000}{2 - 1}$$

$$y = 7940$$

Its altitude will be 7940 feet.

$$\text{b.} \quad \frac{6000 - 4300}{x - 2} = \frac{4300 - 3000}{2 - 1}$$

$$x \approx 3.3$$

It will be 3.3 miles from the airport.

$$\text{c.} \quad \frac{4300 - 3000}{2 - 1} = 1300, \text{ Cessna}$$

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

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

Cumulative Review

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

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

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

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.

$$46. \quad 3x + 1 > 10 \quad \text{or} \quad -2x - 3 > 1$$

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

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

$$x > 3 \text{ or } x < -3$$

Classroom Quiz 3.2

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

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

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

$$m = 8$$

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

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

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

$$m = 0$$

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

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

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

3.3 Exercises

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

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

$$\begin{aligned}
 6. \quad y &= mx + b, & y &= \frac{5}{6}x + \frac{1}{3} \\
 & & 6y &= 5x + 2 \\
 & & 5x - 6y &= -2
 \end{aligned}$$

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

$$y = 2x - 12$$

$$m = 2, b = -12, \text{ y-intercept } (0, -12)$$

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

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

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

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

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

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

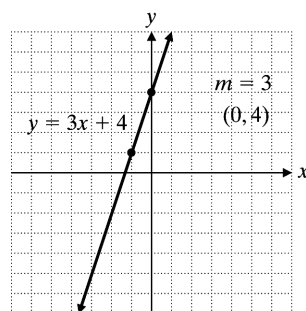
$$y = -\frac{1}{6}x + \frac{7}{2}$$

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

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

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

x	y
0	4
-1	1

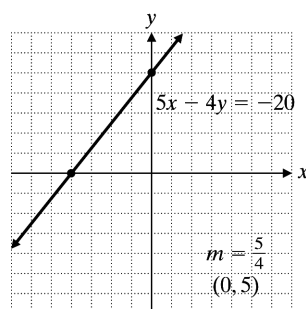


$$\begin{aligned}
 24. \quad 5x - 4y &= -20 \\
 -4y &= -5x - 20
 \end{aligned}$$

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

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

x	y
0	5
-4	0



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

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

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

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

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

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

$$y = -3x + 24$$

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

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

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

$$3y = -5x - 3$$

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

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

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

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

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

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

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

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

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

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

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

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

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

$$y = 8$$

$$38. \quad x - y = 4$$

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

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

$$y = x + 5$$

$$x - y = -5$$

$$40. \quad 2y + x = 7$$

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

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

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

$$2y + 8 = -x - 5$$

$$x + 2y = -13$$

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

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

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

$$x + 3y = 3$$

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

$$m_{\perp} = -4$$

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

$$y + 1 = -4x + 12$$

$$4x + y = 11$$

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

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

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

The lines are perpendicular.

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

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

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

The lines are neither parallel nor perpendicular.

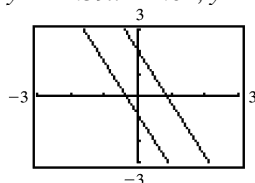
$$50. \quad y = \frac{3}{7}x - \frac{1}{14}, m_1 = \frac{3}{7}$$

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

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

The lines are neither parallel nor perpendicular.

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

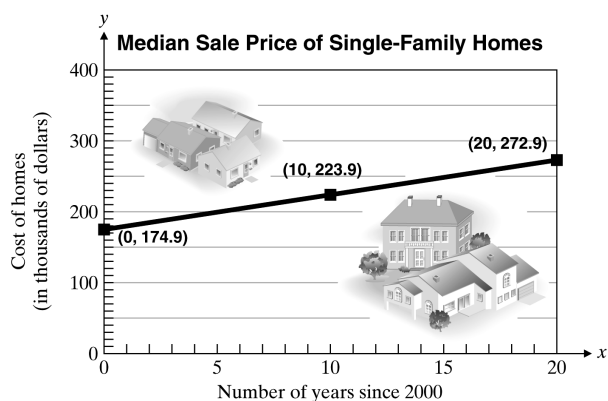


Yes, the lines appear to be parallel.

54. $m = \frac{y_2 - y_1}{x_1 - x_2}$
 $m = \frac{223.9 - 174.9}{10 - 0}$
 $m = 4.9$
 $b = (0, 174.9)$
 $y = 4.9x + 174.9$

56. $2020 - 2000 = 20$

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



Cumulative Review

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

59. $0.3x + 0.1 = 0.27x - 0.02$
 $30x + 10 = 27x - 2$
 $3x = -12$
 $x = -4$

60. $\frac{5}{4} - \frac{3}{4}(2x + 1) = x - 2$
 $5 - 3(2x + 1) = 4x - 8$
 $5 - 6x - 3 = 4x - 8$
 $10x = 10$
 $x = 1$

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. $5x - 8y = -13$
 $-8y = -13 - 5x$
 $8y = 13 + 5x$
 $y = \frac{5}{8}x + \frac{13}{8}$
 $m = \frac{5}{8}$, $b = \frac{13}{8}$
 y -intercept $\left(0, \frac{13}{8}\right)$

2. $m = \frac{y_2 - y_1}{x_2 - x_1}$
 $m = \frac{-8 - (-12)}{7 - 6}$
 $m = \frac{4}{1}$
 $m = 4$
 $y - y_1 = m(x - x_1)$
 $y - (-8) = 4(x - 7)$
 $y + 8 = 4x - 28$
 $4x - y = 36$

3. $m = \frac{4}{5}$, y -intercept $(0, -8)$
 $b = -8$
 $y = mx + b$
 $y = \frac{4}{5}x - 8$

How Am I Doing? Sections 3.1–3.3

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

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

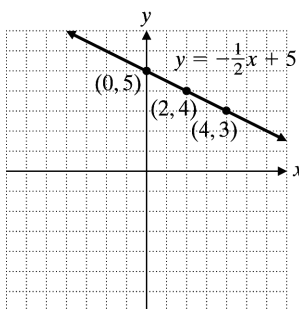
$5a + 12 = -12$

$5a = -24$

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

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

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



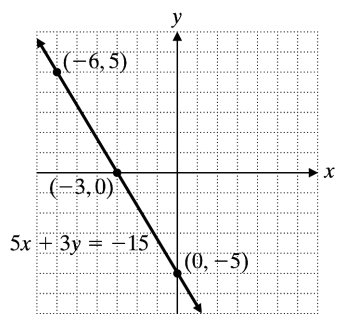
3. $5x + 3y = -15$

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

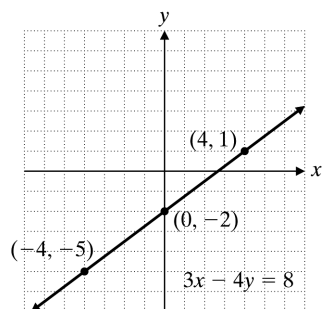


4. $4y + 6x = -8 + 9x$

$4y = 3x - 8$

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

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. $m = \frac{y_2 - y_1}{x_2 - x_1}$
 $m = \frac{3 - (-6)}{-2 - (-1)} = \frac{9}{-1}$
 $m = -9$

6. $m = \frac{y_2 - y_1}{x_2 - x_1}$
 $m = \frac{4 - (-2)}{\frac{2}{3} - \frac{5}{6}} = \frac{6}{-\frac{1}{6}}$
 $m = -36$
 $m_{\parallel} = m = -36$

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

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

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

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

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

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

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

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

$$\text{rise} = 65$$

The road rises vertically 65 feet.

$$9. \quad 2x - 4y = 10$$

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

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

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

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

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

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

$$y + 3 = -2x + 14$$

$$y = -2x + 11$$

$$11. \quad 3x - 5y = 10$$

$$5y = 3x - 10$$

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

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

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

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

$$3y = -5x - 11$$

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

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

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

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

$$y = 2x + 6 + 1$$

$$y = 2x + 7$$

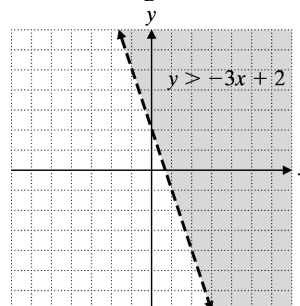
3.4 Exercises

2. The boundary line should be solid when graphing a linear inequality that contains the $\leq$ or $\geq$ 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 $(0, 0)$.



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

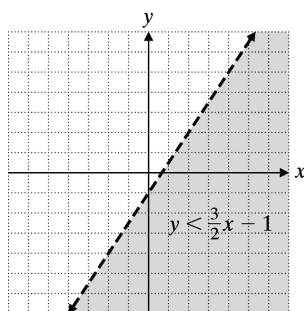
Graph $y = \frac{3}{2}x - 1$ using a dashed line.

Test point $(0, -2)$

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

$$-2 < -1 \quad \text{True}$$

Shade the region containing $(0, -2)$.



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

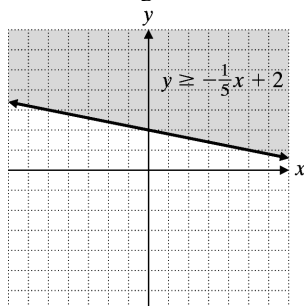
Graph $y = -\frac{1}{5}x + 2$ using a solid line.

Test point: (0, 0)

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

$$0 \geq 2, \text{ False}$$

Shade the region not containing (0, 0).



14. $6y - x \leq 12$

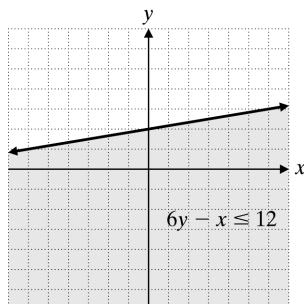
Graph $6y - x = 12$ using a solid line.

Test point: (0, 0)

$$6(0) - 0 \leq 12$$

$$0 \leq 12 \text{ True}$$

Shade the region containing (0, 0).



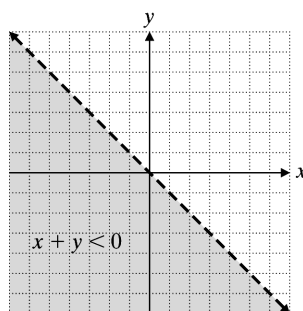
16. $x + y < 0$

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

Test point: (1, 1)

$$1 + 1 = 2 < 0, \text{ False}$$

Shade the region not containing (1, 1).



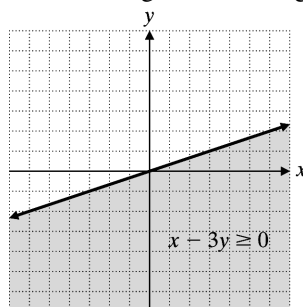
18. $x - 3y \geq 0$

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

Test point: (3, 0)

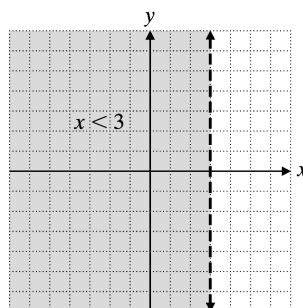
$$3 - (0) \geq 0 \Rightarrow 3 \geq 0 \text{ True}$$

Shade the region containing (3, 0).



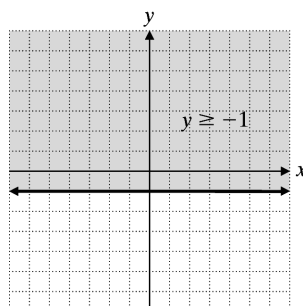
20. $x < 3$

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

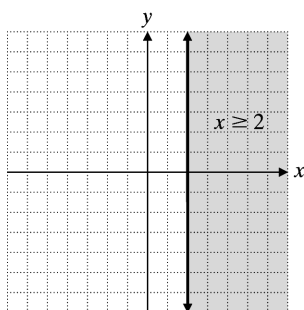


22. $y \geq -1$

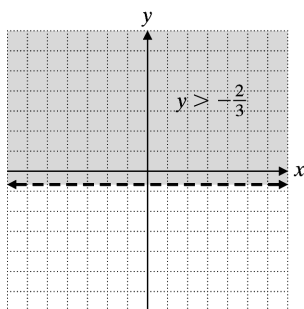
Graph $y = -1$ using a solid line. Shade above the line.



24. $-5x \leq -10, x \geq 2$

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. $2x + 5 \leq 5$ or $-x + 4 \leq 2$

$2x \leq 0$

$-x \leq -2$

$x \leq 0$

$x \geq 2$

$x \leq 0$ or $x \geq 2$

Classroom Quiz 3.4

1. $y < -5x + 2$

Test point $(-3, -2)$

?

$-2 < -5(-3) + 2$

?

$-2 < 17$ True

The graph of the region lies below the line.

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

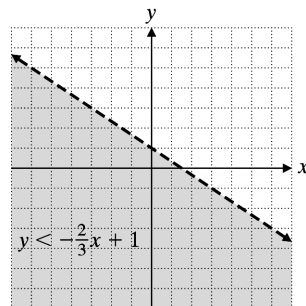
Graph $y = -\frac{2}{3}x + 1$ using a dashed line.

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. $-4x + 3y \geq -9$

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

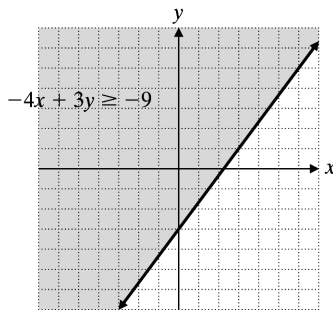
x	y
0	-3
$\frac{9}{4}$	0

Test point: $(0, 0)$

$-4(0) + 3(0) \geq -9$

$0 \geq -9$ 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 = $\{\text{Nepal/Tibet, Pakistan/China, India/Nepal}\}$
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. $g(x) = |x^2 + 5|$

$$g(-4) = |(-4)^2 + 5|$$

$$g(-4) = |16 + 5|$$

$$g(-4) = 21$$

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

$$\text{Range} = \{1, 2, 3, 4, 5\}$$

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

$$\text{Domain} = \{-6, -2, 1, 12\}$$

Cumulative Review

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

$$3x - 2 = 1 \quad \text{and} \quad 3x - 2 = -1$$

$$3x = 1 + 2$$

$$3x = 3$$

$$x = 1$$

$$3x = -1 + 2$$

$$3x = 1$$

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

51. $|x - 5| \leq 3$

$$-3 \leq x - 5 \leq 3$$

$$-3 + 5 \leq x - 5 + 5 \leq 3 + 5$$

$$2 \leq x \leq 8$$

52. $2x - 5y = 10$

$$\text{Let } x = 0: 2(0) - 5y = 10$$

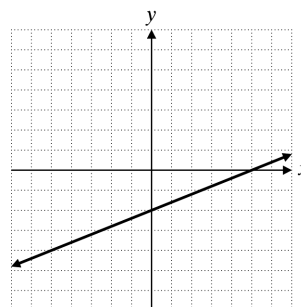
$$y = -2$$

$$\text{Let } y = 0: 2x - 5(0) = 10$$

$$x = 5$$

$$\text{Let } x = -5: 2(-5) - 5y = 10$$

$$y = -4$$



Classroom Quiz 3.5

1. Domain = $\{-6, -4, 4, 6\}$

$$\text{Range} = \{9, 8, -8\}$$

2. $p(x) = |x^2 - 10|$

$$p(-2) = |(-2)^2 - 10|$$

$$p(-2) = |4 - 10|$$

$$p(-2) = |-6|$$

$$p(-2) = 6$$

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

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

$$f(-3) = 3(-27) - 2(9) + 4(-3) - 7$$

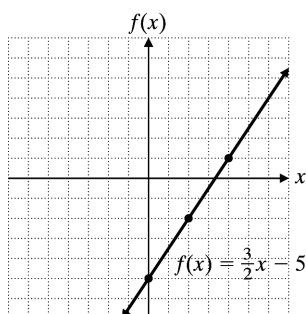
$$f(-3) = -81 - 18 - 12 - 7$$

$$f(-3) = -118$$

3.6 Exercises

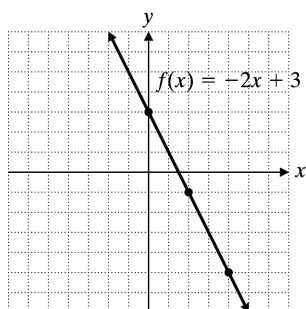
2. $f(x) = \frac{3}{2}x - 5$

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



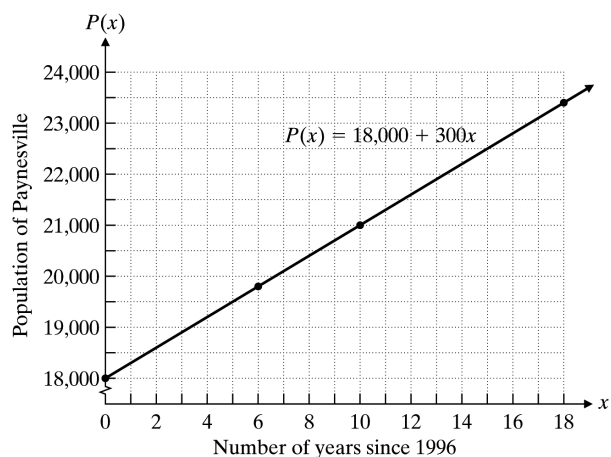
4. $f(x) = -2x + 3$

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



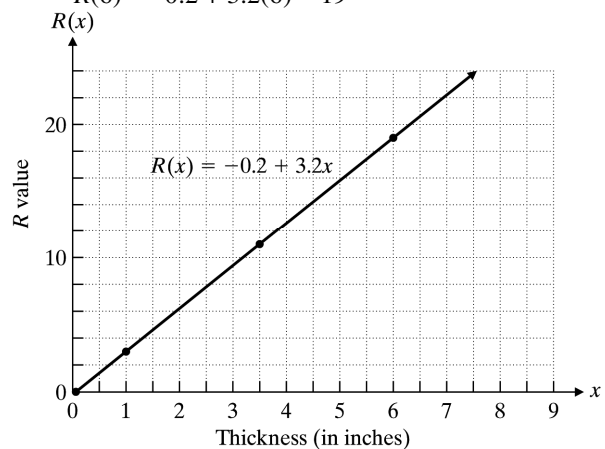
8. $R(x) = -0.2 + 3.2x$

$R(0) = -0.2 + 3.2(0) = -0.2$

$R(1) = -0.2 + 3.2(1) = 3$

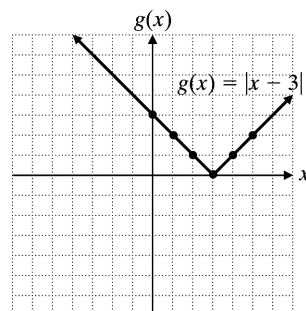
$R(3.5) = -0.2 + 3.2(3.5) = 11$

$R(6) = -0.2 + 3.2(6) = 19$



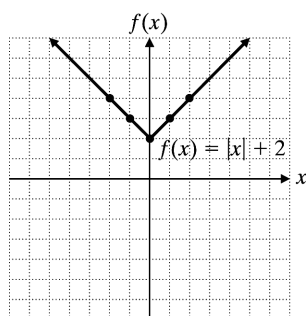
10. $g(x) = |x - 3|$

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



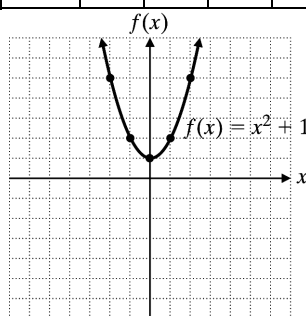
12. $f(x) = |x| + 2$

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



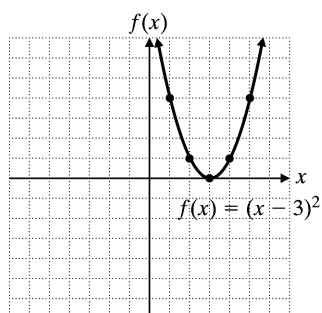
14. $f(x) = x^2 + 1$

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



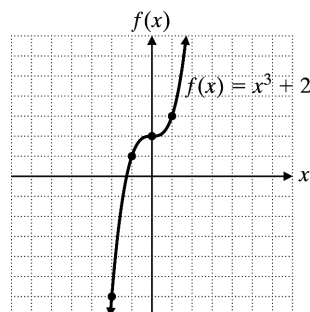
16. $f(x) = (x-3)^2$

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



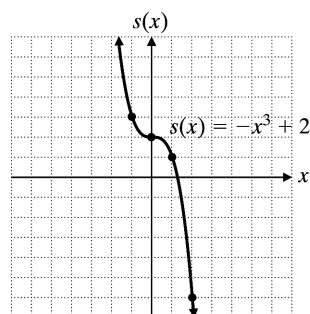
18. $f(x) = x^3 + 2$

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



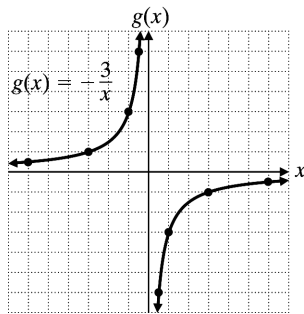
20. $s(x) = -x^3 + 2$

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



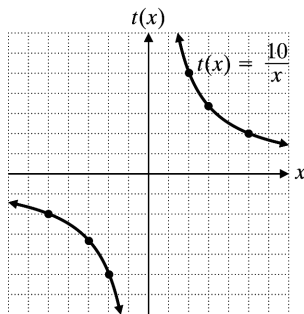
22. $g(x) = -\frac{3}{x}$

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



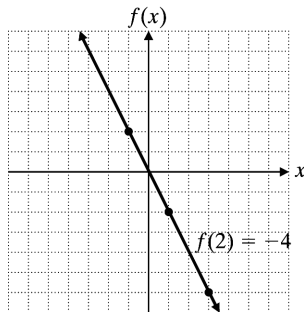
24. $t(x) = \frac{10}{x}$

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



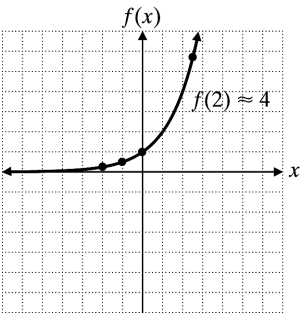
26. From the graph, $f(2) = -4$.

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



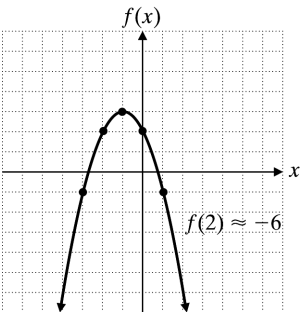
28. From the graph, $f(2) = 4$.

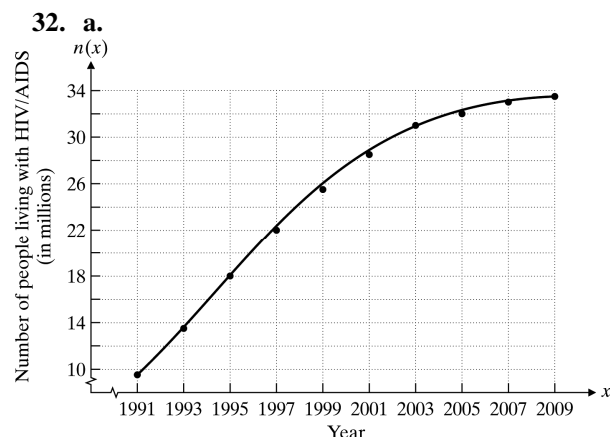
x	$f(x)$
-2	0.25
-1	0.5
0	1
2.5	5.7



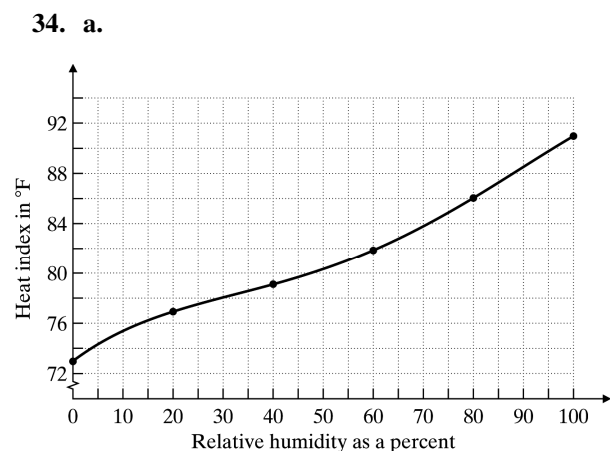
30. From the graph, $f(2) = -6$.

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





- 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.



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

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

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

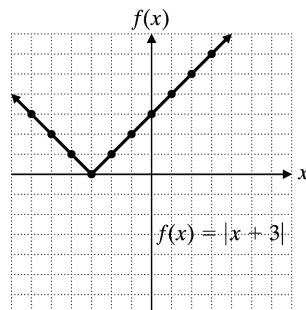
$$37. \quad m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 5}{2 - (-1)} = \frac{-6}{3} = -2$$

$$\begin{aligned}
 38. \quad y &= 3x + 1, m = 3, m_{\perp} = -\frac{1}{3} \\
 y - (-4) &= -\frac{1}{3}(x - 2) \\
 3y + 12 &= -x + 2 \\
 x + 3y &= -10
 \end{aligned}$$

Classroom Quiz 3.6

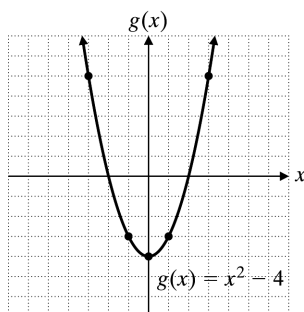
$$1. \quad f(x) = |x + 3|$$

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



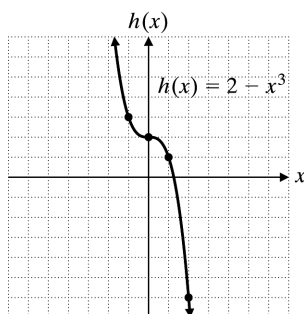
2. $g(x) = x^2 - 4$

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

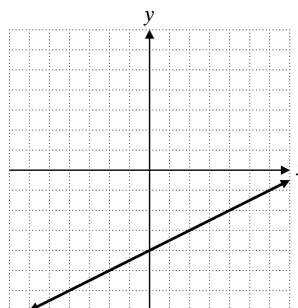
1. $x - 2y = 8$

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

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 $x = \frac{1}{2}$. It is a vertical line. This line has an undefined slope.

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

$$m = \frac{1}{2}.$$

b. A line perpendicular to $y = 2x + 3$ has slope

$$m = -\frac{1}{2}.$$

7. $y = 2(x - 4)$
 $y = 2x - 8$
 $-2x + y = -8$
 $2x - y = 8$

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

The slope is $\frac{1}{4}$; the y -intercept is $\left(0, -\frac{3}{4}\right)$.

b. $-2x + y = 5$
 $y = 2x + 5$

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

9. Find the slope.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 4}{8 - (-2)} = \frac{-4}{10} = -\frac{2}{5}$$

Use the point-slope form.

$$y - 0 = -\frac{2}{5}(x - 8)$$

$$y = -\frac{2}{5}x + \frac{16}{5}$$

10. $y - 2x \leq 4$

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.

$$y - 2x \leq 4$$

$$?$$

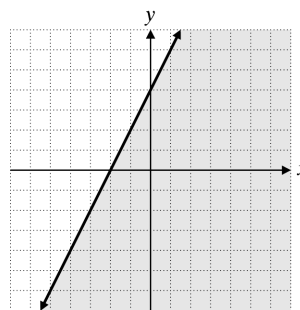
$$0 - 2(0) \leq 4$$

$$?$$

$$0 - 0 \leq 4$$

$$0 \leq 4$$

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. $g(x) = x^2 - x + 6$

$$g(-1) = (-1)^2 - (-1) + 6$$

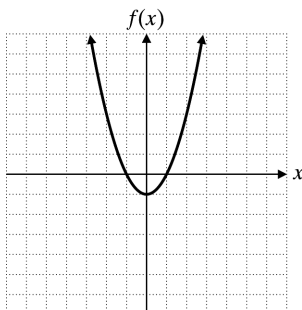
$$= 1 - (-1) + 6$$

$$= 1 + 1 + 6$$

$$= 8$$

15.

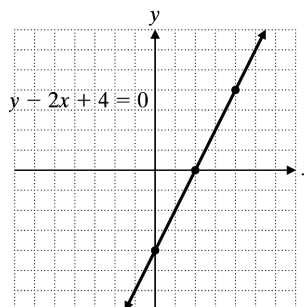
x	y
-2	3
-1	0
0	-1
1	0
2	3



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

$$y = 2x - 4$$

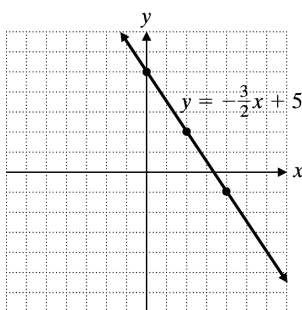
x	$y = 2x - 4$	y
0	$y = 2(0) - 4$	-4
2	$y = 2(2) - 4$	0
4	$y = 2(4) - 4$	4



Chapter 3 Review Problems

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

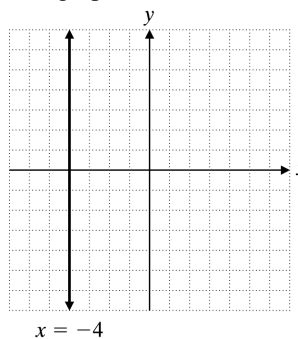
x	$y = -\frac{3}{2}x + 5$	y
0	$y = -\frac{3}{2}(0) + 5$	5
2	$y = -\frac{3}{2}(2) + 5$	2
4	$y = -\frac{3}{2}(4) + 5$	-1



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

$$x = -4$$

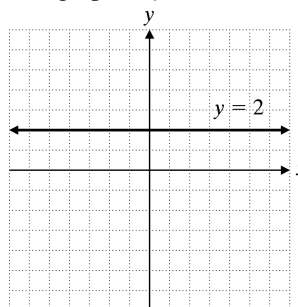
The graph of $x = -4$ is a vertical line.



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

$$y = 2$$

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



$$\begin{aligned}
 5. \quad m &= \frac{y_2 - y_1}{x_2 - x_1} \\
 m &= \frac{-3 - (-4)}{2 - (-8)} = \frac{-3 + 4}{2 + 8} \\
 m &= \frac{1}{10}
 \end{aligned}$$

$$\begin{aligned}
 6. \quad m &= \frac{y_2 - y_1}{x_2 - x_1} \\
 m &= \frac{-1 - (-1)}{7.5 - 0.3} \\
 m &= \frac{0}{7.2} = 0
 \end{aligned}$$

$$\begin{aligned}
 7. \quad -x + 3y &= 12 \\
 3y &= x + 12 \\
 y &= \frac{1}{3}x + 4
 \end{aligned}$$

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

$$\begin{aligned}
 8. \quad m &= \frac{y_2 - y_1}{x_2 - x_1} = \frac{\frac{1}{3} - 2}{\frac{2}{3} - 4} = \frac{-\frac{5}{3}}{-\frac{10}{3}} = \frac{1}{2} \\
 m_{\perp} &= -\frac{1}{m} \\
 m_{\perp} &= -\frac{1}{\frac{1}{2}} = -2
 \end{aligned}$$

$$\begin{aligned}
 9. \quad m &= \frac{1}{3}, \quad b = 5 \\
 y &= \frac{1}{3}x + 5 \\
 x - 3y &= -15
 \end{aligned}$$

$$\begin{aligned}
 10. \quad y - y_1 &= m(x - x_1) \\
 y - (-2) &= -4\left(x - \frac{1}{2}\right) \\
 y + 2 &= -4x + 2 \\
 4x + y &= 0
 \end{aligned}$$

$$\begin{aligned}
 11. \quad y - y_1 &= m(x - x_1) \\
 y - 1 &= 0(x - (-3)) \\
 y - 1 &= 0 \\
 y &= 1
 \end{aligned}$$

$$\begin{aligned}
 12. \quad \text{a.} \quad P &= 140x - 2000 \text{ has } m = 140. \\
 \text{The slope is } &140.
 \end{aligned}$$

$$\begin{aligned}
 \text{b.} \quad P &= 140x - 2000 = 0 \\
 140x &= 2000 \\
 x &= 14\frac{2}{7}
 \end{aligned}$$

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

$$\begin{aligned}
 13. \quad m &= \frac{y_2 - y_1}{x_2 - x_1} = \frac{6 - \frac{-1}{2}}{5 - (-1)} = \frac{13}{12} \\
 y - y_1 &= m(x - x_1) \\
 y - 6 &= \frac{13}{12}(x - 5) \\
 12y - 72 &= 13x - 65 \\
 13x - 12y &= -7
 \end{aligned}$$

$$\begin{aligned}
 14. \quad &\text{A line with undefined slope is a vertical line,} \\
 &x = -6.
 \end{aligned}$$

$$\begin{aligned}
 15. \quad 7x + 8y - 12 &= 0 \\
 8y &= -7x + 12 \\
 y &= -\frac{7}{8}x + \frac{3}{2} \\
 m &= -\frac{7}{8}, \quad m_{\perp} = -\frac{1}{m} = -\frac{1}{-\frac{7}{8}} = \frac{8}{7}
 \end{aligned}$$

$$\begin{aligned}
 y - y_1 &= m_{\perp}(x - x_1) \\
 y - 5 &= \frac{8}{7}(x - (-2))
 \end{aligned}$$

$$\begin{aligned}
 7y - 35 &= 8x + 16 \\
 8x - 7y &= -51
 \end{aligned}$$

$$\begin{aligned}
 16. \quad 3x - 2y &= 8 \\
 2y &= 3x - 8 \\
 y &= \frac{3}{2}x - 4 \\
 m &= \frac{3}{2} \Rightarrow m_{\parallel} = \frac{3}{2} \\
 y - y_1 &= m_{\parallel}(x - x_1)
 \end{aligned}$$

$$\begin{aligned}
 y - 1 &= \frac{3}{2}(x - 5) \\
 2y - 2 &= 3x - 15 \\
 3x - 2y &= 13
 \end{aligned}$$

$$\begin{aligned}
 17. \quad &\text{From the graph } m = -2 \text{ and y-intercept } (0, 6) \text{ or } \\
 &b = 6. \\
 y &= mx + b \\
 y &= -2x + 6
 \end{aligned}$$

18. From the graph $m = 0$ and $b = 2$.

$$y = mx + b$$

$$y = 0x + 2$$

$$y = 2$$

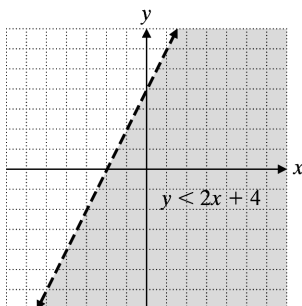
19. $y < 2x + 4$

Graph $y = 2x + 4$ with a dashed line.

Test point: $(0, 0)$

$$0 < 2(0) + 4, 0 < 4 \text{ True}$$

Shade the region containing $(0, 0)$.



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

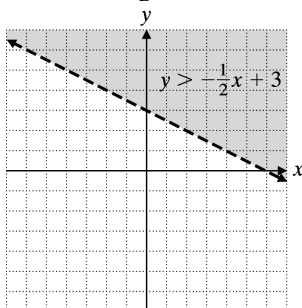
Graph $y = -\frac{1}{2}x + 3$ with a dashed line.

Test point: $(0, 0)$

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

$$0 > 3 \text{ False}$$

Shade the region not containing $(0, 0)$.



21. $3x + 4y \leq -12$

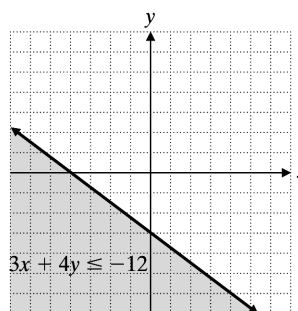
Graph $3x + 4y = -12$ with a solid line.

Test point: $(0, 0)$

$$3(0) + 4(0) \leq -12$$

$$0 \leq -12 \text{ False}$$

Shade the region not containing $(0, 0)$.



22. $x \leq 3y$

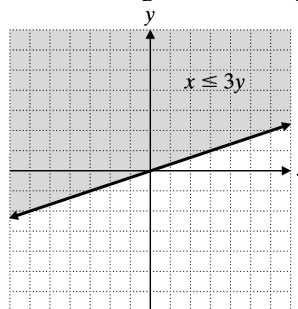
Graph $x = 3y$ with a solid line.

Test point: $(0, 3)$

$$0 \leq 3(3)$$

$$0 \leq 9 \text{ True}$$

Shade the region containing $(0, 3)$.

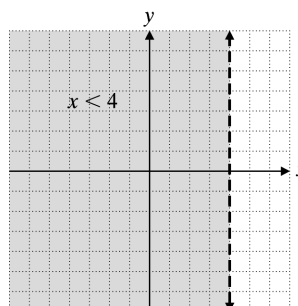


23. $3x - 5 < 7$

$$3x < 12$$

$$x < 4$$

Graph $x = 4$ with a dashed line. Shade the region to the left of the line.

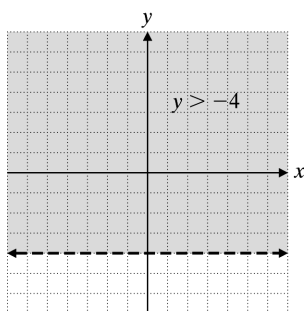


24. $5y - 2 > 3y - 10$

$$2y > -8$$

$$y > -4$$

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

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

$$f(-1) = 12$$

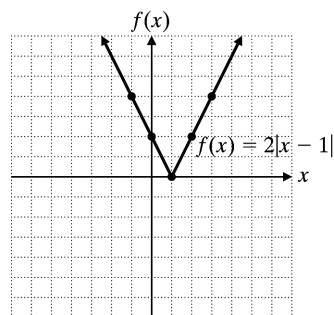
$$f(-5) = -2(-5) + 10$$

$$f(-5) = 20$$

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

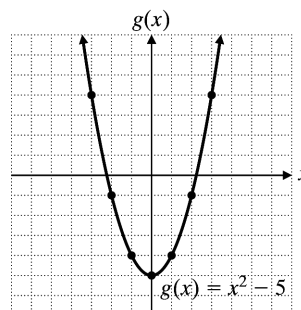
31. $f(x) = 2|x - 1|$

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



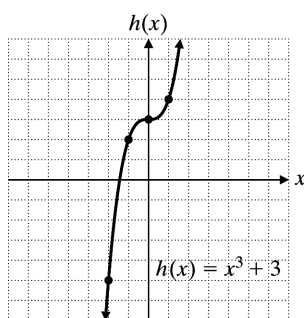
32. $g(x) = x^2 - 5$

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



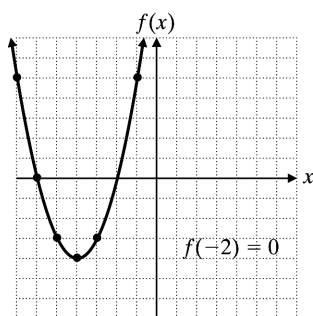
33. $h(x) = x^3 + 3$

x	$y = h(x)$
-2	-5
-1	2
0	3
1	4



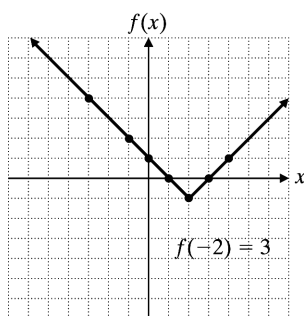
34. From the graph, $f(-2) = 0$.

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. $y = 5x - 2$, $m = 5$, $m_{\parallel} = 5$
 $y - y_1 = m_{\parallel}(x - x_1)$
 $y - 10 = 5(x - 4)$
 $y - 10 = 5x - 20$
 $y = 5x - 10$

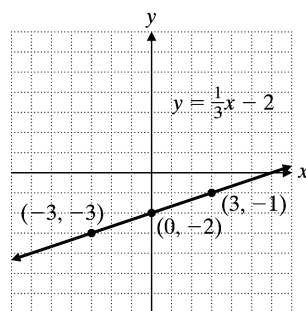
$$43. m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6 - 3}{5 - (-7)} = \frac{3}{12} = \frac{1}{4}$$

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

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

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

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



$$44. 3x - 6y = 9$$

$$6y = 3x - 9$$

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

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

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

$$y + 1 = -2x - 4$$

$$2x + y = -5$$

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

$$2x = 4$$

$$x = 2$$

x	y
2	-2
2	0
2	2

$$45. \text{Vertical lines have the form } x = c.$$

$$(5, 6) \rightarrow x = 5$$

$$46. m = 0.20$$

$$b = 40$$

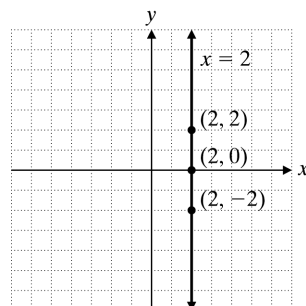
$$f(x) = 0.20x + 40$$

$$47. m = 200$$

$$b = 24,000$$

$$f(x) = 200x + 24,000$$

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



How Am I Doing? Chapter 3 Test

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

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

$$3. 5x + 3y = 9$$

$$\text{Let } x = 0: 5(0) + 3y = 9$$

$$y = 3$$

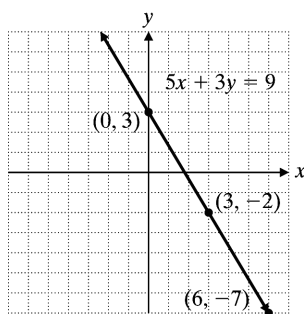
$$\text{Let } y = -2: 5x + 3(-2) = 9$$

$$x = 3$$

$$\text{Let } x = 6: 5(6) + 3y = 9$$

$$y = -7$$

x	y
0	3
3	-2
6	-7



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

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

$y = -2$

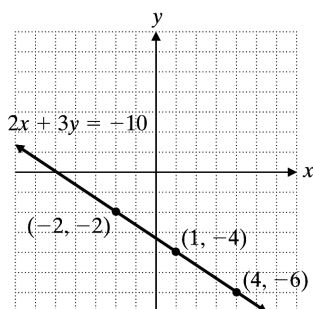
Let $x = 1$: $2(1) + 3y = -10$

$y = -4$

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

$y = -6$

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



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

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

6. $m = \frac{y_2 - y_1}{x_2 - x_1}$
 $m = \frac{5 - 5}{-7 - 6}$
 $m = 0$

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

$5y = 2x + 15$

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

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

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

$7y = 6x - 1$

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

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

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

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

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

$6y + 12 = -7x$

$7x + 6y = -12$

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

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

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

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

$8y + 16 = -x + 5$

$x + 8y = -11$

10. $y = 2$

11. $y = mx + b$

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

$y = -5x - 8$

12. $y \geq -4x$

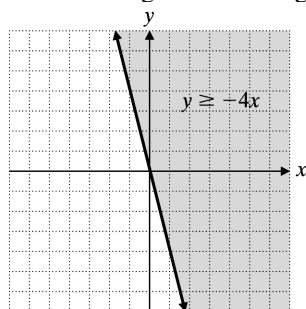
Graph $y = -4x$ with a solid line.

Test point: (2, 2)

$2 \geq -4(2)$

$2 \geq -8$ True

Shade the region containing (2, 2).



13. $4x - 2y < -6$

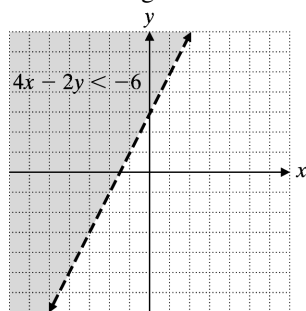
Graph $4x - 2y = -6$ with a dashed line.

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. $g(x) = \frac{1}{2}x^2 + 3$

$g(-4) = \frac{1}{2}(-4)^2 + 3$

$g(-4) = 8 + 3$

$g(-4) = 11$

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

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

$$h(-9) = |10|$$

$$h(-9) = 10$$

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

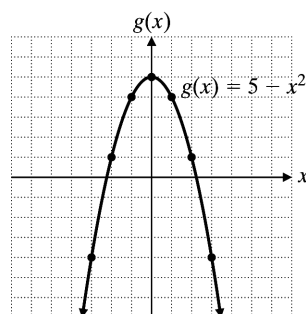
$p(-2) = -2(-2)^3 + 3(-2)^2 + (-2) - 4$

$p(-2) = 16 + 12 - 2 - 4$

$p(-2) = 22$

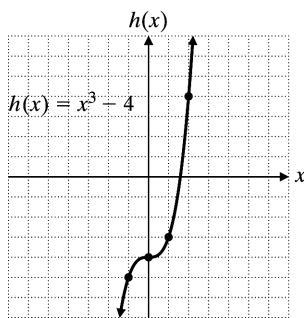
19. $g(x) = 5 - x^2$

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

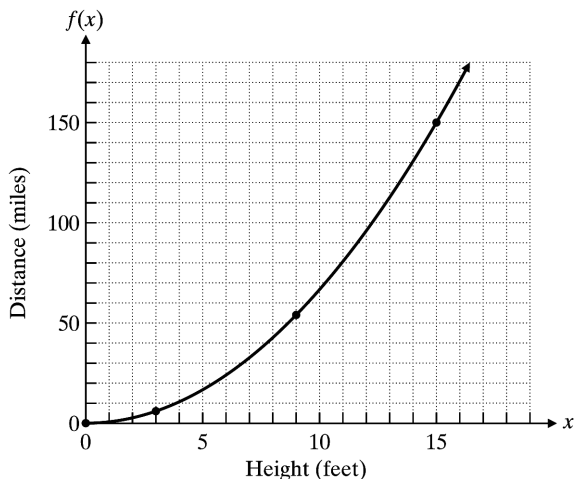


20. $h(x) = x^3 - 4$

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

$$\begin{aligned} 2. \quad 3(4-6)^2 + \sqrt{16} + 12 \div (-3) &= 3(-2)^2 + 4 + (-4) \\ &= 3(4) + 4 + (-4) \\ &= 12 + 4 + (-4) \\ &= 12 \end{aligned}$$

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

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

$$\begin{aligned} 5. \quad 4(2x^2 - 1) - 2x(3x - 5y) &= 8x^2 - 4 - 6x^2 + 10xy \\ &= 2x^2 + 10xy - 4 \end{aligned}$$

6. Replace x with -1 and y with 4 .

$$\begin{aligned} 2x^2 - 3xy - y^2 &= 2(-1)^2 - 3(-1)(4) - (4)^2 \\ &= 2(1) - 3(-1)(4) - 16 \\ &= 2 + 12 - 16 \\ &= -2 \end{aligned}$$

$$7. \quad 0.000437 = 4.37 \times 10^{-4}$$

$$8. \quad A = \frac{1}{2}\pi r^2$$

$$A = \frac{1}{2}(3.14)(3)^2$$

$$A = 14.13$$

The area of the semicircle is 14.13 in.^2 .

$$\begin{aligned} 9. \quad \frac{1}{2}(x-5) + \frac{2}{3}(x+1) &= \frac{1}{2} \\ 6\left[\frac{1}{2}(x-5) + \frac{2}{3}(x+1)\right] &= 6\left(\frac{1}{2}\right) \\ 3(x-5) + 4(x+1) &= 3 \\ 3x - 15 + 4x + 4 &= 3 \\ 7x - 11 &= 3 \\ 7x - 11 + 11 &= 3 + 11 \\ 7x &= 14 \\ \frac{7x}{7} &= \frac{14}{7} \\ x &= 2 \end{aligned}$$

$$10. \quad |4x + 3| = 7$$

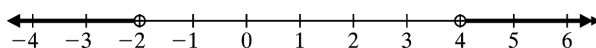
$$\begin{aligned} 4x + 3 &= 7 \quad \text{or} \quad 4x + 3 = -7 \\ 4x &= 4 \quad \quad 4x &= -10 \\ x &= 1 \quad \quad x &= \frac{-10}{4} \\ & & x &= -\frac{5}{2} \end{aligned}$$

$$11. \quad |x - 2| \leq 5$$

$$\begin{aligned} -5 &\leq x - 2 \leq 5 \\ -5 + 2 &\leq x - 2 + 2 \leq 5 + 2 \\ -3 &\leq x \leq 7 \end{aligned}$$

$$12. \quad 3(x-2) > 6 \quad \text{or} \quad 5-3(x+1) > 8$$

$$\begin{aligned} 3x - 6 &> 6 \quad \quad 5 - 3x - 3 > 8 \\ 3x &> 12 \quad \quad -3x > 6 \\ x &> 4 \quad \quad x < -2 \end{aligned}$$



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

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

$$-9x = -6a - y$$

$$9x = 6a + y$$

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

$$14. \quad \text{Let } w = \text{the width.}$$

$$P = 2l + 2w$$

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

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

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

$$3w = 45$$

$$w = 15$$

$$2w + 1 = 31$$

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

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

$$0.04x + 490 - 0.07x = 391$$

$$-0.03x = 391 - 490$$

$$x = 3300$$

$$7000 - x = 3700$$

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

$$16. \quad 4x - 6y = 10$$

$$\text{Let } x = -2: 4(-2) - 6y = 10$$

$$y = -3$$

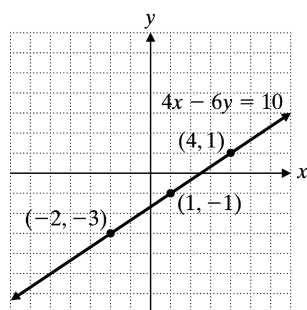
$$\text{Let } x = 1: 4(1) - 6y = 10$$

$$y = -1$$

$$\text{Let } x = 4: 4(4) - 6y = 10$$

$$y = 1$$

x	y
-2	-3
1	-1
4	1



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

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

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

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

$$y - 1 = -2x + 10$$

$$2x + y = 11$$

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

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

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

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

$$y = 3x + 3 + 4$$

$$y - 3x = 7$$

$$3x - y = -7$$

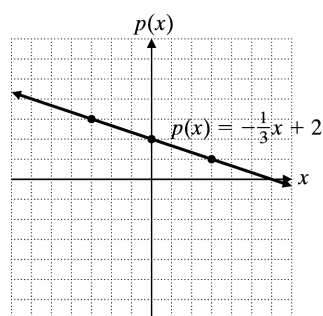
$$20. \quad D = \left\{ \frac{1}{2}, 2, 3, 5 \right\}$$

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

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

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

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

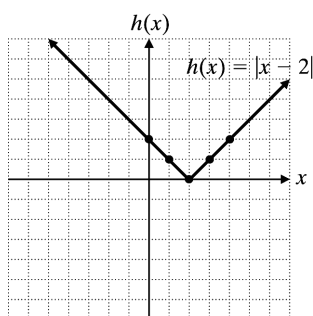


Chapter 3: Equations and Inequalities in Two Variables and Functions

ISM: Intermediate Algebra

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

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



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.

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

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

Test point: (0, 0)

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

$$0 \leq 3 \text{ True}$$

Shade the region containing (0, 0).

