Glencoe

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Glencoe/McGraw-Hill
8787 Orion Place
Columbus, OH 43240-4027

ISBN: 0-02-834177-5

Printed in the United States of America.

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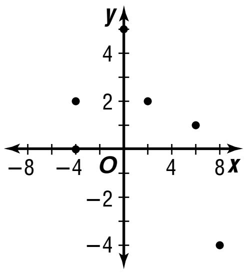
Chapter 1 Linear Relations and Functions

1-1 Relations and Functions

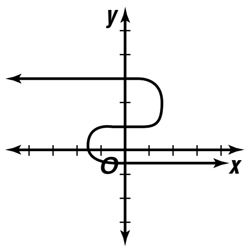
Pages 8–9 Check for Understanding

1.

x	y
-4	2
6	1
0	5
8	-4
2	2
-4	0



2. Sample answer:



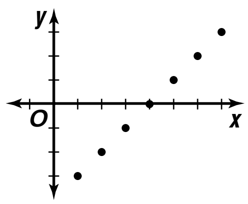
3. Determine whether a vertical line can be drawn through the graph so that it passes through more than one point on the graph. Since it does, the graph does not represent a function.

4. Keisha is correct. Since a function can be expressed as a set of ordered pairs, a function is always a relation. However, in a function, there is exactly one y-value for each x-value. Not all relations have this constraint.

5. Table:

x	y
1	-3
2	-2
3	-1
4	0
5	1
6	2
7	3

Graph:



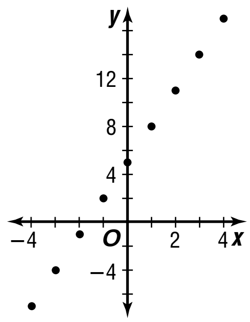
Equation: $y = x - 4$

6. $\{(-3, 4), (0, 0), (3, -4), (6, -8)\}$; $D = \{-3, 0, 3, 6\}$; $R = \{-8, -4, 0, 4\}$

7. $\{(-6, 1), (-4, 0), (-2, -4), (1, 3), (4, 3)\}$; $D = \{-6, -4, -2, 1, 4\}$; $R = \{-4, 0, 1, 3\}$

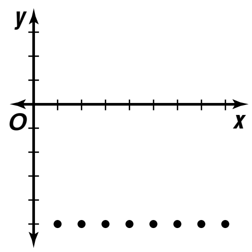
8.

x	y
-4	-7
-3	-4
-2	-1
-1	2
0	5
1	8
2	11
3	14
4	17



9.

x	y
1	-5
2	-5
3	-5
4	-5
5	-5
6	-5
7	-5
8	-5



10. $\{-3, 0, 1, 2\}$; $\{-6, 0, 2, 4\}$; yes; Each member of the domain is matched with exactly one member of the range.

11. $\{-3, 3, 6\}$; $\{-6, -2, 0, 4\}$; no; 6 is matched with two members of the range.

12a. domain: all reals; range: all reals

12b. Yes; the graph passes vertical line test.

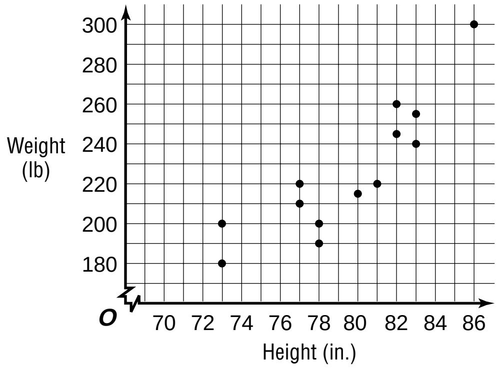
13. $f(-3) = 4(-3)^3 + (-3)^2 - 5(-3)$
$= -108 + 9 + 15 \quad \text{or} \quad -84$

14. $g(m + 1) = 2(m + 1)^2 - 4(m + 1) + 2$
$= 2(m^2 + 2m + 1) - 4m - 4 + 2$
$= 2m^2 + 4m + 2 - 4m - 4 + 2$
$= 2m^2$

15. $x + 1 < 0$
$x < -1$
The domain excludes numbers less than -1.
The domain is $\{x \mid x \geq -1\}$.

16a. {(83, 240), (81, 220), (82, 245), (78, 200), (83, 255), (73, 200), (80, 215), (77, 210), (78, 190), (73, 180), (86, 300), (77, 220), (82, 260)}; {73, 77, 78, 80, 81, 82, 83, 86}; {180, 190, 200, 210, 215, 220, 240, 245, 255, 260, 300}

16b.



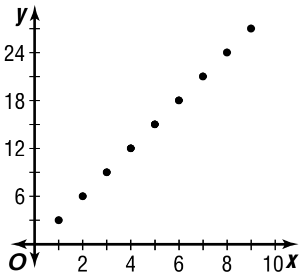
16c. No; a vertical line at $x = 77$, $x = 78$, $x = 82$, or $x = 83$ would pass through two points.

Pages 10–12 Exercises

17. Table

x	y
1	3
2	6
3	9
4	12
5	15
6	18
7	21
8	24
9	27

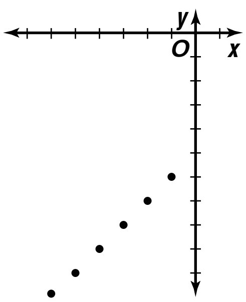
Graph:



Equation: $y = 3x$

18. Table:

x	y
−6	−11
−5	−10
−4	−9
−3	−8
−2	−7
−1	−6

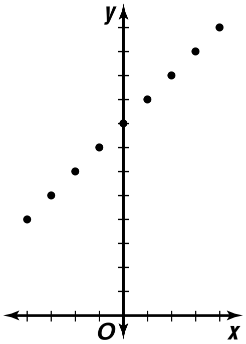


Equation: $y = x - 5$

19. Table:

x	y
−4	4
−3	5
−2	6
−1	7
0	8
1	9
2	10
3	11
4	12

Graph:



Equation: $y = 8 + x$

20. $\{(-5, -5), (-3, -3), (-1, -1), (1, 1)\}$; $D = \{-5, -3, -1, 1\}$; $R = \{-5, -3, -1, 1\}$

21. $\{(-10, 0), (-5, 0), \{0, 0), (5, 0)\}$; $D = \{-10, -5, 0, 5\}$; $R = \{0\}$

22. $\{(4, 0), (5, 1), (8, 0), (13, 1)\}$; $D = \{4, 5, 8, 13\}$; $R = \{0, 1\}$

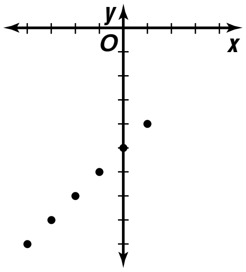
23. $\{(-3, -2), (-1, 1), (0, 0), (1, 1)\}$; $D = \{-3, -1, 0, 1\}$; $R = \{-2, 0, 1\}$

24. $\{(-5, 5), (-3, 3), (-1, 1), (2, -2), (4, -4)\}$; $D = \{-5, -3, -1, 2, 4\}$; $R = \{-4, -2, 1, 3, 5\}$

25. $\{(3, -4), (3, -2), (3, 0), (3, 1), (3, 3)\}$; $D = \{3\}$; $R = \{-4, -2, 0, 1, 3\}$

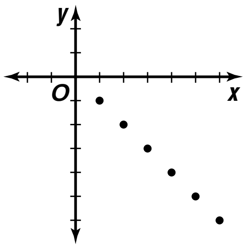
26.

x	y
−4	−9
−3	−8
−2	−7
−1	−6
0	−5
1	−4



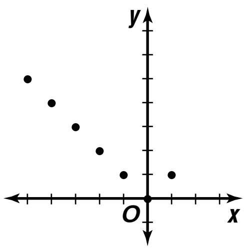
27.

x	y
1	−1
2	−2
3	−3
4	−4
5	−5
6	−6



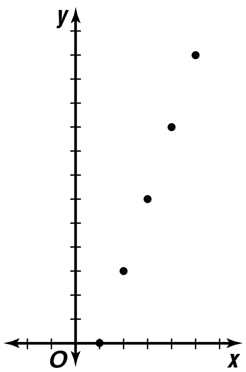
28.

x	y
−5	5
−4	4
−3	3
−2	2
−1	1
0	0
1	1



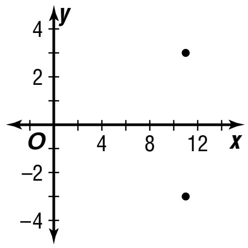
29.

x	y
1	0
2	3
3	6
4	9
5	12



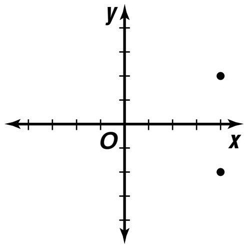
30.

x	y
11	3
11	−3



31.

x	y
4	2
4	−2



32. {4, 5, 6}; {4}; yes; Each x-value is paired with exactly one y-value.

33. {1}; {−6, −2, 0, 4}; no; The x-value 1 is paired with more than one y-value.

34. {0, 1, 4); {−2, −1, 0, 1, 2}; no; The x-values 1 and 4 are paired with more than one y-value.

35. {0, 2, 5}; {−8, −2, 0, 2, 8}; no; The x-values 2 and 5 are paired with more than one y-value.

36. {−1.1, −0.4, −0.1}; {−2, −1}; yes; Each x-value is paired with exactly one y-value.

37. {−9, 2, 8, 9}; {−3, 0, 8}; yes; Each x-value is paired with exactly one y-value.

38. domain: all reals; range: all reals; Not a function because it fails the vertical line test.

39. domain: {−3, −2, −1, 1, 2, 3}; range: {−1, 1, 2, 3}; A function because each x-value is paired with exactly one y-value.

40. domain: $\{x \mid -8 \le x \le 8\}$; range: $\{y \mid -8 \le y \le 8\}$; Not a function because it fails the vertical line test.

41. $f(3) = 2(3) + 3$
$= 6 + 3$ or 9

42. $g(-2) = 5(-2)^2 + 3(-2) - 2$
$= 20 - 6 - 2$ or 12

43. $h(0.5) = \frac{1}{0.5}$
$= 2$

44. $j(2a) = 1 - 4(2a)^3$
$= 1 - 4(8a^3)$
$= 1 - 32a^3$

45. $f(n-1) = 2(n-1)^2 - (n-1) + 9$
$= 2(n^2 - 2n + 1) - n + 1 + 9$
$= 2n^2 - 4n + 2 - n + 1 + 9$
$= 2n^2 - 5n + 12$

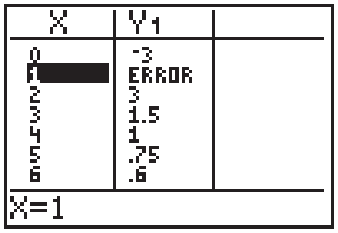
46. $g(b^2+1) = \frac{3 - (b^2+1)}{5 + (b^2+1)}$
$= \frac{3 - b^2 - 1}{6 + b^2}$ or $\frac{2 - b^2}{6 + b^2}$

47. $f(5m) = |(5m)^2 - 13|$
$= |25m^2 - 13|$

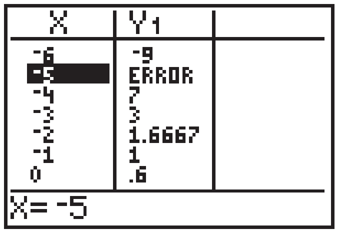
48. $x^2 - 5 = 0$
$x^2 = 5$
$x = \pm\sqrt{5}$; $x \ne \pm\sqrt{5}$

49. $x^2 - 9 < 0$
$x^2 < 9$
$-3 < x < 3$; $x < -3$ or $x \ge 3$

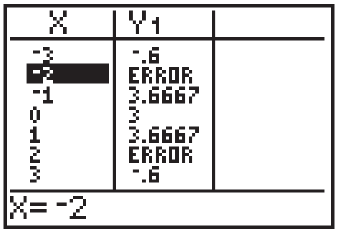
50. $x^2 - 7 \le 0$
$x^2 \le 7$
$-\sqrt{7} \le x \le \sqrt{7}$; $x < -\sqrt{7}$ or $x > \sqrt{7}$

51a.


$x \ne 1$

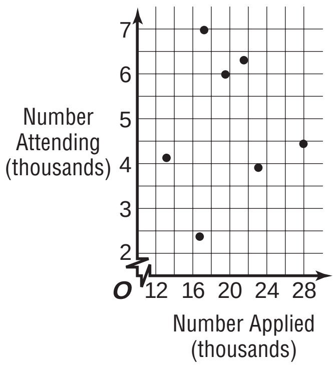
51b.


$x \ne -5$

51c.


$x \ne -2, 2$

52a. {(13,264, 4184), (27,954, 4412), (21,484, 6366), (23,117, 3912), (16,849, 2415), (19,563, 5982), (17,284, 6949)}; {13,264, 16,849, 17,284, 19,563, 21,484, 23,117, 27,954}; {2415, 3912, 4184, 4412, 5982, 6366, 6949}

52b.


52c. Yes; no member of the domain is paired with more than one member of the range.

53. $x = 2m + 1$, so $\frac{x-1}{2} = m$.
Substitute $\frac{x-1}{2}$ for m in $f(2m+1)$ to solve for $f(x)$,
$24m^3 + 36m^2 + 26m$
$= 24\left(\frac{x-1}{2}\right)^3 + 36\left(\frac{x-1}{2}\right)^2 + 26\left(\frac{x-1}{2}\right)$
$= 24\left(\frac{x^3 - 3x^2 + 3x - 1}{8}\right) + 36\left(\frac{x^2 - 2x + 1}{4}\right) + 26\left(\frac{x-1}{2}\right)$
$= 3x^3 - 9x^2 + 9x - 3 + 9x^2 - 18x + 9 + 13x - 13$
$= 3x^3 + 4x - 7$

54a. $t(500) = 95 - 0.005(500)$
$= 92.5°F$

54b. $t(750) = 95 - 0.005(750)$
$= 91.25°F$

54c. $t(1000) = 95 - 0.005(1000)$
$= 90°F$

54d. $t(5000) = 95 - 0.005(5000)$
$= 70°F$

54e. $t(30{,}000) = 95 - 0.005(30{,}000)$
$= -55°F$

55a. $d(0.05) = 299{,}792{,}458(0.05)$
$= 14{,}989{,}622.9$ m

$d(0.02) = 299{,}792{,}458(0.2)$
$= 59{,}958{,}491.6$ m

$d(1.4) = 299{,}792{,}458(1.4)$
$= 419{,}709{,}441.2$ m

$d(5.9) = 299{,}792{,}458(5.9)$
$= 1{,}768{,}775{,}502$ m

55b. $d(0.008) = 299{,}792{,}458(0.08)$
$= 23{,}983{,}396.64$ m

56. $P(4) = \frac{(1)(2) + 1}{3} = 1$

$P(5) = \frac{(2)(3) + 1}{1} = 7$

$P(6) = \frac{(3)(1) + 1}{7} = \frac{4}{7}$

57. $7^2 - (3^2 + 4^2) = 49 - (9 + 16)$
$= 49 - 25$ or 24

The correct choice is B.

1-2 Composition of Functions

Page 13 Graphing Calculator Exploration

1.

X	Y1	Y2
0	-1	2
1	1	5
2	3	8
3	5	11
4	7	14
5	9	17
6	11	20

Y1=-1

X	Y2	Y3
0	2	-3
1	5	-4
2	8	-5
3	11	-6
4	14	-7
5	17	-8
6	20	-9

Y3=-3

2.

X	Y1	Y2
0	-1	2
1	1	5
2	3	8
3	5	11
4	7	14
5	9	17
6	11	20

X=0

X	Y2	Y3
0	2	-2
1	5	5
2	8	24
3	11	55
4	14	98
5	17	153
6	20	220

Y3=-2

3.

X	Y1	Y2
0	-1	2
1	1	5
2	3	8
3	5	11
4	7	14
5	9	17
6	11	20

X=0

X	Y2	Y3
0	2	-.5
1	5	.2
2	8	.375
3	11	.45455
4	14	.5
5	17	.52941
6	20	.55

Y3=-.5

4. Sample answer: The (sum/difference/product/quotient) of the function values is the function values of the (sum/difference/product/quotient) of the functions.

5. Sample answer: For functions $f(x)$ and $g(x)$, $(f + g)(x) = f(x) + g(x)$; $(f - g)(x) = f(x) - g(x)$; $(f \cdot g)(x) = f(x) \cdot g(x)$; and $\left(\frac{f}{g}\right)(x) = \left(\frac{f(x)}{g(x)}\right)$, $g(x) \neq 0$

Page 17 Check for Understanding

1. Sample answer: $f(x) = 2x - 1$ and $g(x) = x + 6$; Sample explanation: Factor $2x^2 + 11x - 6$.

2. Iteration is composing a function on itself by evaluating the function for a value and then evaluating the function on that function value.

3. No; $[f \circ g](x)$ is the function $f(x)$ performed on $g(x)$ and $[g \circ f](x)$ is the function $g(x)$ performed on $f(x)$. See students' counter examples.

4. Sample answer: Composition of functions is performing one function after another. An everyday example is putting on socks and then putting shoes on top of the socks. Buying an item on sale is an example of when a composition of functions is used in a real-world situation.

5. $f(x) + g(x) = 3x^2 + 4x - 5 + 2x + 9$
$= 3x^2 + 6x + 4$

$f(x) - g(x) = 3x^2 + 4x - 5 - (2x + 9)$
$= 3x^2 + 2x - 14$

$f(x) \cdot g(x) = (3x^2 + 4x - 5)(2x + 9)$
$= 6x^3 + 35x^2 + 26x - 45$

$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$
$= \frac{3x^2 + 4x - 5}{2x + 9}, x \neq -\frac{9}{2}$

6. $[f \circ g](x) = f(g(x))$
$= f(3 + x)$
$= 2(3 + x) + 5$
$= 2x + 11$

$[g \circ f](x) = g(f(x))$
$= g(2x + 5)$
$= 3 + (2x + 5)$
$= 2x + 8$

7. $[f \circ g](x) = f(g(x))$
$= f(x^2 - 2x)$
$= 2(x^2 - 2x) - 3$
$= 2x^2 - 4x - 3$

$[g \circ f](x) = g(f(x))$
$= g(2x - 3)$
$= (2x - 3)^2 - 2(2x - 3)$
$= (4x^2 - 12x + 9) - 4x + 6$
$= 4x^2 - 16x + 15$

8. Domain of $f(x)$: $x \neq 1$
Domain of $g(x)$: all reals
$g(x) = 1$
$x + 3 = 1$
$x = -2$
Domain of $[f \circ g](x)$ is $x \neq -2$.

9. $x_1 = f(x_0) = f(2)$
$= 2(2) + 1$ or 5
$x_2 = f(x_1) = f(5)$
$= 2(5) + 1$ or 11
$x_3 = f(x_2) = f(11)$
$= 2(11) + 1$ or 23
5, 11, 23

10a. $[K \circ C](F) = K(C(F))$
$= K\left(\frac{5}{9}(F - 32)\right)$
$= \frac{5}{9}(F - 32) + 273.15$

10b. $K(-40) = \frac{5}{9}(-40 - 32) + 273.15$
$= -40 + 273.15$ or 233.15
$K(-12) = \frac{5}{9}(-12 - 32) + 273.15$
$= -24.44 + 273.15$ or 248.71
$K(0) = \frac{5}{9}(0 - 32) + 273.15$
$= -17.78 + 273.15$ or 255.37
$K(32) = \frac{5}{9}(32 - 32) + 273.15$
$= 0 + 273.15$ or 273.15
$K(212) = \frac{5}{9}(212 - 32) + 273.15$
$= 100 + 273.15$ or 373.15

Pages 17–19 Exercises

11. $f(x) + g(x) = x^2 - 2x + x + 9$
$= x^2 - x + 9$
$f(x) - g(x) = x^2 - 2x - (x + 9)$
$= x^2 - 3x - 9$
$f(x) \cdot g(x) = (x^2 - 2x)(x + 9)$
$= x^3 + 7x^2 - 18x$
$\left(\frac{f}{g}\right)(x) = \frac{x^2 - 2x}{x + 9}, x \neq 9$

12. $f(x) + g(x) = \frac{x}{x + 1} + x^2 - 1$
$= \frac{x}{x + 1} + \frac{(x^2 - 1)(x + 1)}{x + 1}$
$= \frac{x}{x + 1} + \frac{x^3 + x^2 - x - 1}{x + 1}$
$= \frac{x^3 + x^2 - 1}{x + 1}, x \neq -1$

$f(x) - g(x) = \frac{x}{x + 1} - (x^2 - 1)$
$= \frac{x}{x + 1} - \frac{(x^2 - 1)(x + 1)}{x + 1}$
$= \frac{x}{x + 1} - \frac{x^3 + x^2 - x - 1}{x + 1}$
$= \frac{-x^3 - x^2 + 2x + 1}{x + 1}, x \neq -1$

$f(x) + g(x) = \frac{x}{x + 1} \cdot (x^2 - 1)$
$= \frac{x(x + 1)(x - 1)}{x + 1}$
$= x^2 - x, x \neq -1$

$\left(\frac{f}{g}\right)(x) = \frac{\frac{x}{x + 1}}{x^2 - 1}$
$= \frac{x}{x + 1} \cdot \frac{1}{x^2 - 1}$
$= \frac{x}{x^3 + x^2 - x - 1}, x \neq -1$ or 1

13. $f(x) + g(x) = \frac{3}{x - 7} + x^2 + 5x$
$= \frac{3}{x - 7} + \frac{(x^2 + 5x)(x - 7)}{x - 7}$
$= \frac{3}{x - 7} + \frac{x^3 - 7x^2 + 5x^2 - 35x}{x - 7}$
$= \frac{x^3 - 2x^2 - 35x + 3}{x - 7}, x \neq 7$

$f(x) - g(x) = \frac{3}{x - 7} - (x^2 + 5x)$
$= \frac{3}{x - 7} - \frac{(x^2 + 5x)(x - 7)}{x - 7}$
$= \frac{3}{x - 7} - \frac{x^3 - 7x^2 + 5x^2 - 35x}{x - 7}$
$= -\frac{x^3 - 2x^2 - 35x - 3}{x - 7}, x \neq 7$

$f(x) \cdot g(x) = \frac{3}{x - 7} \cdot (x^2 + 5x)$
$= \frac{3x^2 + 15x}{x - 7}, x \neq 7$

$\left(\frac{f}{g}\right)(x) = \frac{\frac{3}{x - 7}}{x^2 + 5x}$
$= \frac{3}{x - 7} \cdot \frac{1}{x^2 + 5x}$
$= \frac{3}{x^3 - 2x^2 - 35x}, x \neq -5, 0, 7$

14. $f(x) + g(x) = x + 3 + \frac{2x}{x - 5}$
$= \frac{(x + 3)(x - 5)}{x - 5} + \frac{2x}{x - 5}$
$= \frac{x^2 - 2x - 15}{x - 5} + \frac{2x}{x - 5}$
$= \frac{x^2 - 15}{x - 5}, x \neq 5$

$f(x) - g(x) = x + 3 - \left(\frac{2x}{x - 5}\right)$
$= \frac{(x + 3)(x - 5)}{x - 5} - \frac{2x}{x - 5}$
$= \frac{x^2 - 2x - 15}{x - 5} - \frac{2x}{x - 5}$
$= \frac{x^2 - 4x - 15}{x - 5}, x \neq 5$

$f(x) \cdot g(x) = (x + 3) - \left(\frac{2x}{x - 5}\right)$
$= \frac{2x^2 + 6x}{x - 5}, x \neq 5$

$\left(\frac{f}{g}\right)(x) = \frac{x + 3}{\frac{2x}{x - 5}}$
$= x + 3 \cdot \frac{x - 5}{2x}$
$= \frac{x^2 - 2x - 15}{2x}, x \neq 0$ or 5

15. $[f \circ g](x) = f(g(x))$
$= f(x + 4)$
$= (x + 4)^2 - 9$
$= x^2 + 8x + 16 - 9$
$= x^2 + 8x + 7$

$[g \circ f](x) = g(f(x))$
$= g(x^2 - 9)$
$= x^2 - 9 + 4$
$= x^2 - 5$

16. $[f \circ g](x) = f(g(x))$
$= f(x + 6)$
$= \frac{1}{2}(x + 6) - 7$
$= \frac{1}{2}x + 3 - 7$
$= \frac{1}{2}x - 4$

$[g \circ f](x) = g(f(x))$
$= g(\frac{1}{2}x - 7)$
$= \frac{1}{2}x - 7 + 6$
$= \frac{1}{2}x - 1$

17. $[f \circ g](x) = f(g(x))$
$= f(3x^2)$
$= 3x^2 - 4$

$[g \circ f](x) = g(f(x))$
$= g(x - 4)$
$= 3(x - 4)^2$
$= 3(x^2 - 8x + 16)$
$= 3x^2 - 24x + 48$

18. $[f \circ g](x) = f(g(x))$
$= f(5x^2)$
$= (5x^2)^2 - 1$
$= 25x^4 - 1$

$[g \circ f](x) = g(f(x))$
$= g(x^2 - 1)$
$= 5(x^2 - 1)^2$
$= 5(x^4 - 2x^2 + 1)$
$= 5x^4 - 10x^2 + 5$

19. $[f \circ g](x) = f(g(x))$
$= f(x^3 + x^2 + 1)$
$= 2(x^3 + x^2 + 1)$
$= 2x^3 + 2x^2 + 2$

$[g \circ f](x) = g(f(x))$
$= g(2x)$
$= (2x)^3 + (2x)^2 + 1$
$= 8x^3 + 4x^2 + 1$

20. $[f \circ g](x) = f(g(x))$
$= f(x^2 + 5x + 6)$
$= 1 + x^2 + 5x + 6$
$= x^2 + 5x + 7$

$[g \circ f](x) = g(f(x))$
$= g(1 + x)$
$= (x + 1)^2 + 5(x + 1) + 6$
$= x^2 + 2x + 1 + 5x + 5 + 6$
$= x^2 + 7x + 12$

21. $[f \circ g](x) = f\left(g(x)\right)$
$= f\left(\frac{1}{x - 1}\right)$
$= \frac{1}{x - 1} + 1$
$= \frac{1}{x - 1} + \frac{x - 1}{x - 1}$
$= \frac{x}{x - 1}, x \neq 1$

$[g \circ f](x) = g(f(x))$
$= g(x + 1)$
$= \frac{1}{x + 1 - 1}$
$= \frac{1}{x}, x \neq 0$

22. Domain of $f(x)$: all reals
Domain of $g(x)$: all reals
Domain of $[f \circ g](x)$: all reals

23. Domain of $f(x)$: $x \neq 0$
Domain of $g(x)$: all reals
$g(x) = 0$
$7 - x = 0$
$7 = x$
Domain of $[f \circ g](x)$ is $x \neq 7$.

24. Domain of $f(x)$: $x \geq 2$
Domain of $g(x)$: $x \neq 0$
$g(x) \geq 2$
$\frac{1}{4}x \geq 2$
$1 \geq 8x$
$\frac{1}{8} \geq x$
Domain of $[f \circ g](x)$ is $x \leq \frac{1}{8}, x \neq 0$.

25. $x_1 = f(x_0) = f(2)$
$= 9 - 2$ or 7
$x_2 = f(x_1) = f(7)$
$= 9 - 7$ or 2
$x_3 = f(x_2) = f(2)$
$= 9 - 2$ or 7
7, 2, 7

26. $x_1 = f(x_0) = f(1)$
$= (1)^2 + 1$ or 2
$x_2 = f(x_1) = f(2)$
$= (2)^2 + 1$ or 5
$x_3 = f(x_2) = f(5)$
$= (5)^2 + 1$ or 26
2, 5, 26

27. $x_1 = f(x_0) = f(1)$
$= 1(3 - 1)$ or 2
$x_2 = f(x_1) = f(2)$
$= 2(3 - 2)$ or 2
$x_3 = f(x_2) = f(2)$
$= 2(3 - 2)$ or 2
2, 2, 2

28. \$43.98 + \$38.59 + \$31.99 = \$114.56

Let x = the original price of the clothes, or \$114.56.

Let $T(x) = 1.0825x$. (The cost with 8.25% tax rate)

Let $S(x) = 0.75x$. (The cost with 25% discount)

The cost of clothes is $[T \circ S](x)$.

$$\begin{aligned}[T \circ S](x) &= T(S(x)) \\ &= T(0.75x) \\ &= T(0.75(114.56)) \\ &= T(85.92) \\ &= 1.0825(85.92) \\ &= 93.0084\end{aligned}$$

Yes; the total with the discount and tax is \$93.01.

29. Yes; If $f(x)$ and $g(x)$ are both lines, they can be represented as $f(x) = m_1x + b_1$ and $g(x) = m_2x + b_2$. Then $[f \circ g](x) = m_1(m_2x + b_2) + b_1$
$= m_1m_2x + m_1b_2 + b_1$

Since m_1 and m_2 are constants, m_1m_2 is a constant. Similarly, m_1, b_2, and b_1 are constants, so $m_1b_2 + b_1$ is a constant. Thus, $[f \circ g](x)$ is a linear function if $f(x)$ and $g(x)$ are both linear.

30a. $$\begin{aligned}W_n &= W_p - W_f \\ &= F_pd - F_fd \\ &= d(F_p - F_f)\end{aligned}$$

30b. $$\begin{aligned}W_n &= d(F_p - F_f) \\ &= 50(95 - 55) \\ &= 2000 \text{ J}\end{aligned}$$

31a. $h[f(x)]$, because you must subtract before figuring the bonus

31b. $$\begin{aligned}h[f(x)] &= h[f(400{,}000)] \\ &= h(400{,}000 - 275{,}000) \\ &= h(125{,}000) \\ &= 0.03(125{,}000) \\ &= \$3750\end{aligned}$$

32. $$\begin{aligned}(f \circ g)(x) &= f(g(x)) \\ &= f(1 - x^2) \\ &= \frac{x^2(x^2 + 1)}{1 + x^2} \\ &= x^2 \\ &= -(1 - x^2) + 1\end{aligned}$$

So, $f(x) = -x + 1$ and $f\left(\frac{1}{2}\right) = -\frac{1}{2} + 1 = \frac{1}{2}$.

33a. $v(p) = \frac{7p}{47}$

33b. $r(v) = 0.84v$

33c. $$\begin{aligned}r(p) &= r(v(p)) \\ &= r\left(\frac{7p}{47}\right) \\ &= 0.84\left(\frac{7p}{47}\right) \\ &= \frac{5.88p}{47} \text{ or } \frac{147p}{1175}\end{aligned}$$

33d. $$\begin{aligned}r(423.18) &= \frac{147(423.18)}{1175} \\ &= \$52.94 \\ r(225.64) &= \frac{147(225.64)}{1175} \\ &= \$28.23 \\ r(797.05) &= \frac{147(797.05)}{1175} \\ &= \$99.72\end{aligned}$$

34a. $$\begin{aligned}I &= prt \\ &= 5000(0.08)(1) \\ &= 400\end{aligned}$$
$$\begin{aligned}I &= prt \\ &= 5400(0.08)(1) \\ &= 432\end{aligned}$$
$$\begin{aligned}I &= prt \\ &= 5832(0.08)(1) \\ &= 466.56\end{aligned}$$
$$\begin{aligned}I &= prt \\ &= 6298.56(0.08)(1) \\ &= 503.88\end{aligned}$$
$$\begin{aligned}I &= prt \\ &= 6802.44(0.08)(1) \\ &= 544.20\end{aligned}$$

(year, interest): (1, \$400), (2,\$432), (3, \$466.56), (4, \$503.88), (5, \$544.20)

34b. {1, 2, 3, 4, 5}; {\$400, \$432, \$466.56, \$503.88, \$544.20}

34c. Yes; for each element of the domain there is exactly one corresponding element of the range.

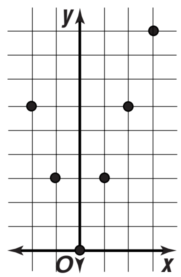
35. $\{(-1, 8), (0, 4), (2, -6), (5, -9)\}$; $D = \{-1, 0, 2, 5\}$; $R = \{-9, -6, 4, 8\}$

36. $D = \{1, 2, 3, 4\}$; $R = \{5, 6, 7, 8\}$; Yes, every element in the domain is paired with exactly one element of the range.

37. $$\begin{aligned}g(-4) &= \frac{(-4)^3 + 5}{4(-4)} \\ &= \frac{-64 + 5}{-16} \\ &= \frac{-59}{-16} \text{ or } 3\tfrac{11}{16}\end{aligned}$$

38.

x	y
−2	6
−1	3
0	0
1	3
2	6
3	9



39. $$\begin{aligned}f(n - 1) &= 2(n - 1)^2 - (n - 1) + 9 \\ &= 2(n^2 - 2n + 1) - n + 1 + 9 \\ &= 2n^2 - 5n + 12\end{aligned}$$

The correct choice is C.

1-3 Graphing Linear Equations

Page 23 Check for Understanding

1. m represents the slope of the graph and b represents the y-intercept
2. 7; the line intercepts the x-axis at (7, 0)
3. Sample answer: Graph the y-intercept at (0, 2). Then move down 4 units and right 1 unit to graph a second point. Draw a line to connect the points.

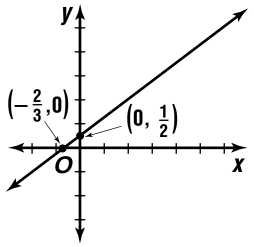
4. Sample answer: Both graphs are lines. Both lines have a y-intercept of 8. The graph of $y = 5x + 8$ slopes upward as you move from left to right on the graph and the graph of $y = -5y + 8$ slopes downward as you move from left to right on the graph.

5. $3x - 4(0) + 2 = 0$ $\quad$ $3(0) - 4y + 2 = 0$

$3x + 2 = 0$ $\quad$ $-4y + 2 = 0$

$3x = -2$ $\quad$ $-4y = -2$

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

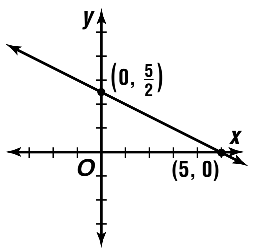


6. $x + 2(0) - 5 = 0$ $\quad$ $0 + 2y - 5 = 0$

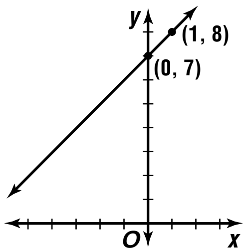
$x - 5 = 0$ $\quad$ $2y - 5 = 0$

$x = 5$ $\quad$ $2y = 5$

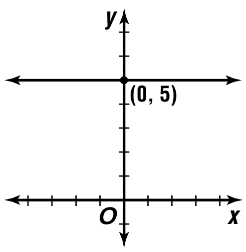
$y = \frac{5}{2}$



7. The y-intercept is 7. Graph (0, 7). The slope is 1.



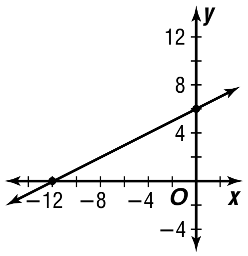
8. The y-intercept is 5. Graph (0, 5). The slope is 0.



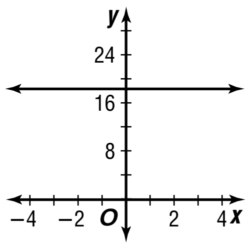
9. $\frac{1}{2}x + 6 = 0$

$\frac{1}{2}x = -6$

$x = -12$



10. Since $m = 0$ and $b = 19$, this function has no x-intercept, and therefore no zeros.



11a. (38.500, 173), (44.125, 188)

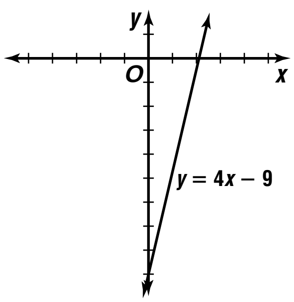
11b. $m = \frac{188 - 173}{44.125 - 38.500}$

$= \frac{15}{5.625}$ or about 2.667

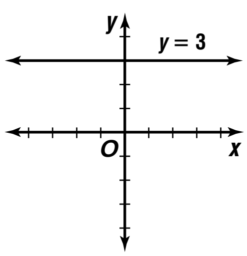
11c. For each 1 centimeter increase in the length of a man's tibia, there is an 2.667-centimeter increase in the man's height.

Pages 24–25 Exercises

12. The y-intercept is -9. The slope is 4.



13. The y-intercept is 3. The slope is 0.

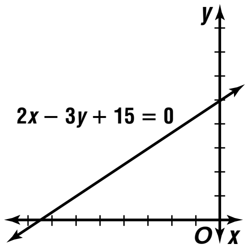


14. $2x - 3y + 15 = 0$

$-3y = -2x - 15$

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

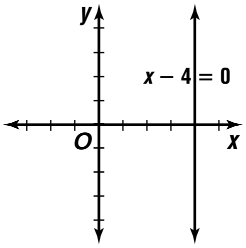
The y-intercept is 5. The slope is $\frac{2}{3}$.



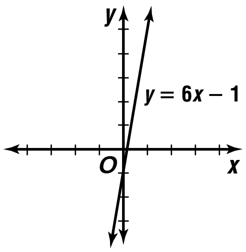
15. $x - 4 = 0$

$x = 4$

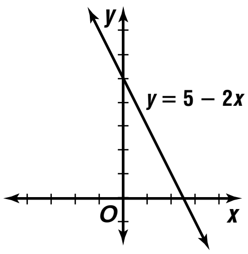
There is no slope. The x-intercept is 4.



16. The y-intercept is -1. The slope is 6.



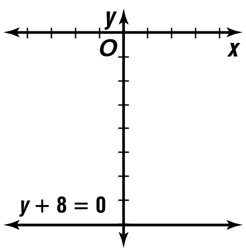
17. The y-intercept is 5. The slope is -2.



18. $y + 8 = 0$

$y = -8$

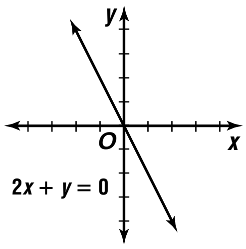
The y-intercept is -8. The slope is 0.



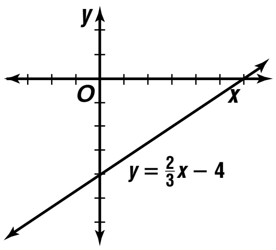
19. $2x + y = 0$

$y = -2x$

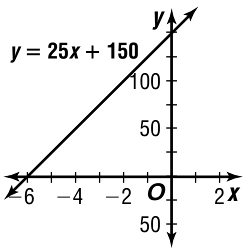
The y-intercept is 0. The slope is -2.



20. The y-intercept is -4. The slope is $\frac{2}{3}$.



21. The y-intercept is 150. The slope is 25.

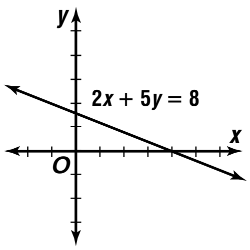


22. $2x + 5y = 8$

$5y = -2x + 8$

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

The y-intercept is $\frac{8}{5}$. The slope is $-\frac{2}{5}$.

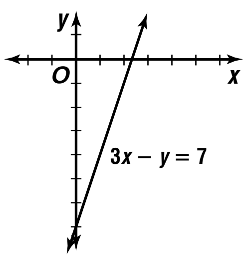


23. $3x - y = 7$

$-y = -3x + 7$

$y = 3x - 7$

The y-intercept is -7. The slope is 3.

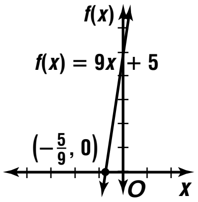


24. $9x + 5 = 0$

$9x = -5$

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

The y-intercept is 5.

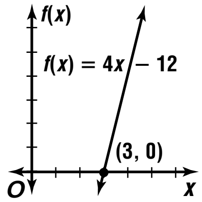


25. $4x - 12 = 0$

$4x = 12$

$x = 3$

The y-intercept is -12.

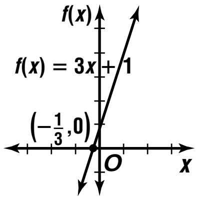


26. $3x + 1 = 0$

$3x = -1$

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

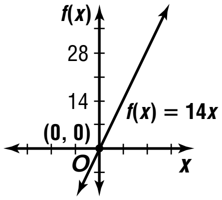
The y-intercept is 1.



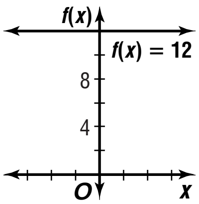
27. $14x = 0$

$x = 0$

The slope is 14.



28. None; since $m = 0$ and $b = 12$, this function has no x-intercepts, and therefore no zeros.

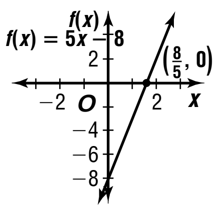


29. $5x - 8 = 0$

$5x = 8$

$x = \frac{8}{5}$

The y-intercept is -8.



30. $5x - 2 = 0$

$5x = 2$

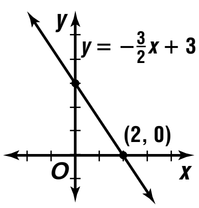
$x = \frac{2}{5}$

31. The y-intercept is 3. The slope is $-\frac{3}{2}$.

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

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

$x = 2$



32. Sample answer: $f(x) = 5$; $f(x) = 0$

33a. (1.0, 12.0), (10.0, 8.4)

$m = \frac{8.4 - 12.0}{10.0 - 1.0}$

$= \frac{-3.6}{9}$ or -0.4

$-(-0.4) = 0.4$ ohms

33b. $-0.4 = \frac{12 - v}{1.0 - 25.0}$

$-0.4 = \frac{12 - v}{-24}$

$9.6 = 12 - v$

$v = 2.4$ volts

34. $m = \frac{9 - 7}{-4 - 3}$

$= \frac{2}{-7}$

$-\frac{2}{7} = \frac{1 - 9}{a - (-4)}$

$-\frac{2}{7} = \frac{-8}{a + 4}$

$-2(a + 4) = -56$

$-2a - 8 = -56$

$-2a = -48$

$a = 24$

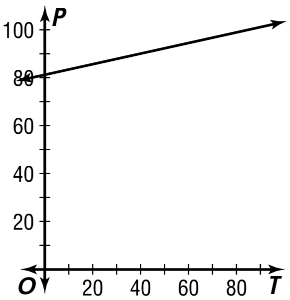
35a. (86.85, 90), (126.85, 100)

$m = \frac{100 - 90}{126.85 - 86.85}$

$= \frac{10}{40}$ or $\frac{1}{4}$

35b. For each 1 degree increase in the temperature, there is a $\frac{1}{4}$-pascal increase in the pressure.

35c.



36. No; the product of two positives is positive, so for the product of the slopes to be -1, one of the slopes must be positive and the other must be negative.

37a. $10{,}440 - 290t = 0$

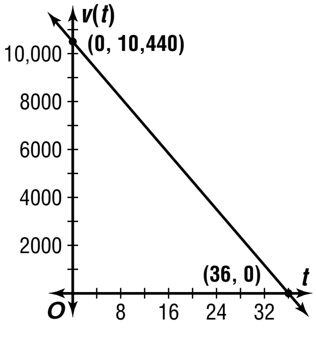
$-290t = -10{,}440$

$t = 36$

The software has no monetary value after 36 months.

37b. -290; For every 1-month change in the number of months, there is a \$290 decrease in the value of the software.

37c.



38. A function with a slope of 0 has no zeros if its y-intercept is not 0; a function with a slope of 0 has an infinite number of zeros if its y-intercept is 0; a function with any slope other than 0 has exactly 1 zero.

39a. (56, 50), (76, 67.2)

$$m = \frac{67.2 - 50}{76 - 56} = \frac{17.2}{20} \text{ or } 0.86$$

39b. $1805(0.86) = \$1552.30$

39c. $1 - \text{MPC} = 1 - 0.86 = 0.14$

39d. $1805(0.14) = \$252.70$

40. $(f + g)(x) = 2x + x^2 - 4$ or $x^2 + 2x - 4$

$(f - g)(x) = 2x - (x^2 - 4) = -x^2 + 2x + 4$

41a. $1 - 0.12 = 0.88$

$d(p) = 0.88p$

41b. $r(d) = d - 100$

41c. $r(d(p)) = r(0.88p) = 0.88p - 100$

41d. $r(799.99) = 0.88(799.99) - 100 = 603.9912$ or about \$603.99

$r(999.99) = 0.88(999.99) - 100 = 779.9912$ or about \$779.99

$r(1499.99) = 0.88(1499.99) - 100 = 1219.9912$ or about \$1219.99

42. $[f \circ g](-3) = f(g(-3)) = f(-3 - 2) = f(-5) = (-5)^2 - 4(-5) + 5 = 25 + 20 + 5$ or 50

$[g \circ f](-3) = g(f(-3)) = g((-3)^2 - 4(-3) + 5) = g(9 + 12 + 5) = g(26) = 26 - 2$ or 24

43. $f(9) = 4 + 6(9) - (9)^3 = 4 + 54 - 729$ or -671

44. No; the graph fails the vertical line test.

45.

x	y
−3	14
−2	13
−1	12
0	11

{(−3, 14), (−2, 13), (−1, 12), (0, 11)}, yes

46. Let s = sum.

$\frac{s}{4} = 15$

$s = 60$

The correct choice is D.

1-3B Graphing Calculator Exploration: Analyzing Families of Linear Graphs

Page 26

1. See students' graphs. All of the graphs are lines with y-intercept at (0, −2). Each line has a different slope.
2. A line parallel to the ones graphed in the Example and passing through (0, −2).
3. See students' sketches. Sample answer: The graphs of lines with the same value of m are parallel. The graphs of lines with the same value for b have the same y-intercept.

1-4 Writing Linear Equations

Page 29 Check for Understanding

1. slope and y-intercept; slope and any point; two points
2. Sample answer:

Use point-slope form:

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

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

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

$x - 4y - 19 = 0$

Use slope-intercept form.

$y = mx + b$

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

$-\frac{19}{4} = b$

Substitute the slope and intercept into the general form.

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

Write in standard form.

$x - 4y - 19 = 0$

3. 55 represents the hourly rate and 49 represents the fee for coming to the house.
4. $m = \frac{-3 - 0}{0 - 6} = \frac{-3}{-6}$ or $\frac{1}{2}$ $y = \frac{1}{2}x - 3$
5. Sample answer: When given the slope and the y-intercept, use slope-intercept form. When given the slope and a point, use point-slope form. When given two points, find the slope, then use point-slope form.
6. $y = mx + b \rightarrow y = -\frac{1}{4}x - 10$
7. $y - 2 = 4(x - 3)$; $y - 2 = 4x - 12$; $y = 4x - 10$
8. $m = \frac{9 - 2}{7 - 5} = \frac{7}{2}$; $y - 2 = \frac{7}{2}(x - 5)$; $y - 2 = \frac{7}{2}x - \frac{35}{2}$; $y = \frac{7}{2}x - \frac{31}{2}$
9. $y - 2 = 0(x - (-9))$; $y - 2 = 0$; $y = 2$

10a. $y = 5.9x + 2$

10b. $y = 5.9(7) + 2$
$= 41.3 + 2$ or 43.3 in.

10c. Sample answer: No; the grass could not support it own weight if it grew that tall.

Pages 30–31 Exercises

11. $y = mx + b \rightarrow y = 5x - 2$

12. $y - 5 = 8(x - (-7))$
$y - 5 = 8x + 56$
$y = 8x + 61$

13. $y = mx + b \rightarrow y = -\frac{3}{4}x$

14. $y = mx + b \rightarrow y = -12x + \frac{1}{2}$

15. $y - 5 = 6(x - 4)$
$y - 5 = 6x - 24$
$y = 6x - 19$

16. $x = 12$

17. $m = \frac{9 - 5}{-8 - 1}$
$= \frac{4}{-9}$
$y - 5 = -\frac{4}{9}(x - 1)$
$y - 5 = -\frac{4}{9}x + \frac{4}{9}$
$y = -\frac{4}{9}x + \frac{49}{9}$

18. $(-8, 0), (0, 5)$
$m = \frac{5 - 0}{0 - (-8)}$
$= \frac{5}{8}$
$y - 0 = \frac{5}{8}(x - (-8))$
$y = \frac{5}{8}x + 5$

19. $m = \frac{1 - 1}{-3 - 8}$
$= \frac{0}{-11}$ or 0
$y - 1 = 0(x - 8)$
$y - 1 = 0$
$y = 1$

20. $x = -4$

21. $x = 0$

22. $y - 0 = 0.25(x - 24)$
$y = 0.25x - 6$

23. $y - (-4) = -\frac{1}{2}(x - (-2))$
$y + 4 = -\frac{1}{2}x - 1$
$\frac{1}{2}x + y + 5 = 0$
$x + 2y + 10 = 0$
$x + 2y = -10$

24. $m = \frac{-3 - 0}{1 - (-2)}$
$= \frac{-3}{3}$
$= -1$
$y - 0 = -1(x + 2)$
$y = -x - 2$
$x + y = -2$

25a. $t = 2 + \frac{x - 7000}{2000}$

25b. $t = 2 + \frac{14{,}494 - 7000}{2000}$
$= 2 + 3.747$ or 5.747; about 5.7 weeks

26. $Ax + By + C = 0$
$By = -Ax - C$
$y = -\frac{A}{B}x - \frac{C}{B}$; $m = -\frac{A}{B}$

27a. Sample answer: using (20, 28) and (27, 37),
$m = \frac{37 - 28}{27 - 20}$
$= \frac{9}{7}$
$y - 28 = \frac{9}{7}(x - 20)$
$y - 28 = \frac{9}{7}x - \frac{180}{7}$
$y = \frac{9}{7}x + \frac{16}{7}$

27b. Using sample answer from part a,
$y = \frac{9}{7}(19) + \frac{16}{7}$
$= \frac{171}{7} + \frac{16}{7}$ or $\frac{187}{7}$ or about 26.7 mpg

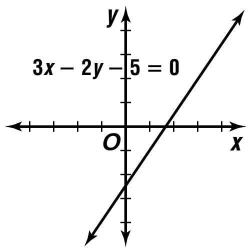
27c. Sample answer: The estimate is close but not exact since only two points were used to write the equation.

28a. See students' work.

28b. Sample answer: Only two points were used to make the prediction equation, so many points lie off of the line.

29. Yes; the slope of the line through (5, 9) and (−3, 3) is $\frac{3 - 9}{-3 - 5}$ or $\frac{3}{4}$. The slope of the line through (−3, 3), and (1, 6) is $\frac{6 - 3}{1 - (-3)}$ or $\frac{3}{4}$. Since these two lines would have the same slope and would share a point, their equations would be the same. Thus, they are the same line and all three points are collinear.

30. $3x - 2y - 5 = 0$
$-2y = -3x + 5$
$y = \frac{3}{2}x - \frac{5}{2}$



31a. (1995, 70,583), (1997, 82,805)
$m = \frac{82{,}805 - 70{,}583}{1997–1999}$
$= \frac{12{,}222}{2}$ or 6111; \$6111 billion

31b. The rate is the slope.

32. $g[f(-2)] = g(f(-2))$
$= g((-2)^3)$
$= g(-8)$
$= 3(-8)$ or -24

33. $(f \cdot g)(x) = f(x) \cdot g(x)$
$= x^3(x^2 - 3x + 7)$
$= x^5 - 3x^4 + 7x^3$
$\left(\frac{f}{g}\right)(x) = \frac{x^3}{x^2 - 3x + 7}$, where $g(x) \neq 0$

34.

x	y
−4	16
−3	9
−2	4

{(−4, 16), (−3, 9), (−2, 4)}, yes

35. $x = \frac{1}{y}$
$\frac{y + 1}{y} = \frac{\frac{y^2}{y} + \frac{1}{y}}{2}$
$= \frac{\frac{y^2 + 1}{y}}{2}$
$= \frac{y^2 + 1}{y} \cdot \frac{1}{2}$
$= \frac{y^2 + 1}{2y}$

The correct choice is A.

Page 31 Mid-Chapter Quiz

1. $\{-2, 2, 4\}$, $\{-8, -3, 3, 7\}$; No, -2 in the domain is paired with more than one element of the range.

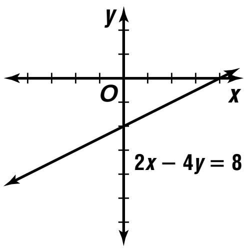
2. $f(4) = 7 - 4^2$
$= 7 - 16$ or 9

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

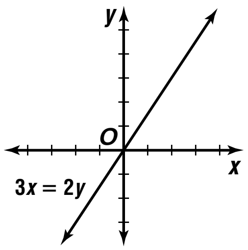
4. Let x = original price of jacket
Let $T(x) = 1.055x$. (The cost with 5.5% tax rate)
Let $S(x) = 0.67x$. (The cost with 33% discount)
The cost of the jacket is $[T \circ S](x)$.
$[T \circ S](x) = T(S(x))$
$= T(0.67x)$
$= 1.055(0.67x)$
The amount paid was \$49.95.
$45.95 = 1.055(0.67x)$
$43.55 \approx 0.67x$
$65 \approx x$; \$65

5. $[f \circ g](x) = f(g(x))$
$= f(x + 1)$
$= \frac{1}{x + 1 - 1}$
$= \frac{1}{x}, x \neq 0$
$[g \circ f](x) = g(f(x))$
$= g(\frac{1}{x - 1})$
$= \frac{1}{x - 1} + 1$
$= \frac{1}{x - 1} + \frac{x - 1}{x - 1}$
$= \frac{x}{x - 1}, x \neq 1$

6. $2x - 4y = 8$
$-4y = -2x + 8$
$y = \frac{1}{2}x - 2$



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



8. $5x - 3 = 0$
$5x = 3$
$x = \frac{3}{5}$

9. $m = \frac{8 - 5}{7 - 2}$
$= \frac{3}{5}$
$y - 5 = \frac{3}{5}(x - 2)$
$y - 5 = \frac{3}{5}x - \frac{6}{5}$
$-\frac{3}{5}x + y - \frac{19}{5} = 0$
$3x - 5y + 19 = 0$

10a. (1990, 6,478,216), (2000, 8,186,453)
$m = \frac{8{,}186{,}453 - 6{,}478{,}216}{2000 - 1990}$
$= \frac{1{,}708{,}237}{10}$ or about 170,823.7

10b. $y - 6{,}478{,}216 = 170{,}823.7(x - 1990)$
$y - 6{,}478{,}216 = 170{,}823.7x - 339{,}939{,}163$
$y = 170{,}823.7x - 333{,}460{,}947$

1-5 Writing Equations of Parallel and Perpendicular Lines

Pages 35–36 Check for Understanding

1. If A, B, and C are the same or the ratios of the As and the Bs and the Cs are proportional, then the lines are coinciding. If A and B are the same and C is different, or the ratios of the As and the Bs are proportional, but the ratio of the Cs is not, then the lines are parallel.

2. They have no slope.

3. $4x + 3y + 19 = 0$
$y = -\frac{4}{3}x - \frac{19}{3}$
$-\frac{4}{3}; \frac{3}{4}$

4. All vertical lines have undefined slope and only horizontal lines are perpendicular to them. The slope of a horizontal line is 0.

5. none of these

6. perpendicular

7. $y = x - 6$
$x - y + 8 = 0$
$y = x + 8$
parallel

8. $y = 2x - 8$
$4x - 2y - 16 = 0$
$y = 2x - 8$
coinciding

9. $y - 9 = 5(x - 5)$
$y - 9 = 5x - 25$
$5x - y - 16 = 0$

10. $6x - 5y = 24$
$y = \frac{6}{5}x - \frac{24}{5}$
$y - (-5) = -\frac{5}{6}(x - (-10))$
$y + 5 = -\frac{5}{6}x - \frac{25}{3}$
$6y + 30 = -5x - 50$
$5x + 6y + 80 = 0$

11. m of EF: $m = \frac{8 - 4}{4 - 3}$
$= \frac{4}{1}$ or 4
m of EH: $m = \frac{2 - 4}{6 - 3}$
$= -\frac{2}{3}$
m of GH: $m = \frac{2 - 6}{6 - 7}$
$= \frac{-4}{-1}$ or 4
m of FG: $m = \frac{6 - 8}{7 - 4}$
$= -\frac{2}{3}$
parallelogram

Pages 36–37 Exercises

12. $y = 5x - 18$
$2x + 10y + 10 = 0$
$y = -\frac{1}{5}x + 1$
slopes are opposite reciprocals; perpendicular

13. $y - 7x + 5 = 0$ $\quad$ $y - 7x - 9 = 0$

$y = 7x - 5$ $\quad$ $y = 7x + 9$

same slopes, different y-intercepts; parallel

14. different slopes, not reciprocals; none of these

15. horizontal line, vertical line; perpendicular

16. $y = 4x - 3$ $\quad$ $4.8x - 1.2y = 3.6$

$y = 4x - 3$

same slopes, same y-intercepts; coinciding

17. $4x - 6y = 11$ $\quad$ $3x + 2y = 9$

$y = \frac{2}{3}x - \frac{11}{6}$ $\quad$ $y = -\frac{3}{2}x + \frac{9}{2}$

Slopes are opposite reciprocals; perpendicular.

18. $y = 3x + 2$ $\quad$ $3x + y = 2$

$y = -3x + 2$

different slopes, not reciprocals; none of these

19. $5x + 9y = 14$ $\quad$ $y = -\frac{5}{9}x + \frac{14}{9}$

$y = -\frac{5}{9}x + \frac{14}{9}$

same slopes, same y-intercepts; coinciding

20. $y + 4x - 2 = 0$ $\quad$ $y + 4x + 1 = 0$

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

same slopes, different y-intercepts; parallel

21. None of these; the slopes are not the same nor opposite reciprocals.

22. $y - (-8) = 2(x - 0)$

$y + 8 = 2x$

$2x - y - 8 = 0$

23. $m = -\frac{4}{(-9)}$ or $\frac{4}{9}$

$y - (-15) = \frac{4}{9}(x - 12)$

$y + 15 = \frac{4}{9}x - \frac{16}{3}$

$9y + 135 = 4x - 48$

$4x - 9y - 183 = 0$

24. $y - (-11) = 0(x - 4)$

$y + 11 = 0$

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

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

$5y + 15 = -x$

$x + 5y + 15 = 0$

26. $m = -\frac{6}{(-1)}$ or 6; perpendicular slope is $-\frac{1}{6}$

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

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

$6y + 12 = -x + 7$

$x + 6y + 5 = 0$

27. $x = 12$ is a vertical line; perpendicular slope is 0.

$y - (-13) = 0(x - 6)$

$y + 13 = 0$

28a. $5y - 4x = 10$

$4x - 5y + 10 = 0$ $\quad$ $m = -\frac{4}{(-5)}$ or $\frac{4}{5}$

$y - 8 = \frac{4}{5}(x - (-15))$

$y - 8 = \frac{4}{5}x + 12$

$5y - 40 = 4x + 60$

$4x - 5y + 100 = 0$

28b. perpendicular slope: $-\frac{5}{4}$

$y - 8 = -\frac{5}{4}(x - (-15))$

$y - 8 = -\frac{5}{4}x - \frac{75}{4}$

$4y - 32 = -5x - 75$

$5x + 4y + 43 = 0$

29a. $8x - 14y + 3 = 0$ $\quad$ $kx - 7y + 10 = 0$

$m = -\frac{8}{(-14)}$ or $\frac{4}{7}$ $\quad$ $m = -\frac{k}{(-7)}$ or $\frac{k}{7}$

$\frac{4}{7} = \frac{k}{7} \rightarrow k = 4$

29b. $\frac{k}{7} = -\frac{7}{4}$

$4k = -49$

$k = -\frac{49}{4}$

30a. Sample answer: $y - 1 = 0$, $x - 1 = 0$

30b. Sample answer: $x - 7 = 0$, $x - 9 = 0$

31. altitude from A to BC:

m of $BC = \frac{-5 - (-5)}{10 - 4}$

$= \frac{0}{6}$ or 0

m of altitude is undefined; $x = 7$

altitude from B to AC:

m of $AC = \frac{-5 - 10}{4 - 7}$

$= \frac{-15}{-3}$ or 5

m of altitude $= -\frac{1}{5}$

$y - (-5) = -\frac{1}{5}(x - 10)$

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

$5y + 25 = -x + 10$

$x + 5y + 15 = 0$

altitude from C to AB:

m of $AB = \frac{-5 - 10}{10 - 7}$

$= \frac{-15}{3}$ or -5

m of altitude $= \frac{1}{5}$

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

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

$5y + 25 = x - 4$

$x - 5y - 29 = 0$

32. We are given $y = m_1x + b_1$ and $y = m_2x + b_2$ with $m_1 = m_2$ and $b_1 \neq b_2$. Assume that the lines intersect at point (x_1, y_1). Then $y_1 = m_1x_1 + b_1$ and $y_1 = m_2x_1 + b_2$. Substitute $m_1x_1 + b_1$ for y_1 in $y_1 = m_2x_1 + b_2$. Then $m_1x_1 + b_1 = m_2x_1 + b_2$. Since $m_1 = m_2$, substitute m_1 for m_2. The result is $m_1x_1 + b_1 = m_1x_1 + b_2$. Subtract m_1x_1 from each side to find $b_1 = b_2$. However, this contradicts the given information that $b_1 \neq b_2$. Thus, the assumption is incorrect and the lines do not share any points.

33a. Let x = regular espressos.
Let y = large espressos.

$216x + 162y = 783 \qquad 248x + 186y = 914$

$y = -\frac{4}{3}x + \frac{29}{6} \qquad y = -\frac{4}{3}x + \frac{457}{93}$

No; the lines that represent the situation do not coincide.

33b. Let x = regular espressos.
Let y = large espressos.

$216x + 162y = 783 \qquad 344x + 258y = 1247$

$y = -\frac{4}{3}x + \frac{29}{6} \qquad y = -\frac{4}{3}x + \frac{29}{6}$

Yes; the lines that represent the situation coincide.

34a. (15, 1939.20), (16, 1943.09)

$m = \frac{1943.09 - 1939.20}{16 - 15}$

$= \frac{3.89}{1}$ or 3.89

$y - 1943.09 = 3.89(x - 16)$

$y - 1943.09 = 3.89x - 62.24$

$y = 3.89x + 1880.85$

(16, 1943.09), (17, 1976.76)

$m = \frac{1976.76 - 1943.09}{17 - 16}$

$= \frac{33.67}{1}$ or 33.67

$y - 1976.76 = 33.67(x - 17)$

$y - 1976.76 = 33.67x - 572.39$

$y = 33.67x + 1404.37$

(17, 1976.76), (18, 1962.44)

$m = \frac{1962.44 - 1976.76}{18 - 17}$

$= \frac{-14.32}{1}$ or -14.32

$y - 1962.44 = -14.32(x - 18)$

$y - 1962.44 = -14.32x + 257.76$

$y = -14.32 + 2220.2$

(18, 1962.44), (19, 1940.47)

$m = \frac{1940.47 - 1962.44}{19 - 18}$

$= \frac{-21.97}{1}$ or -21.97

$y - 1940.47 = -21.97(x - 19)$

$y - 1940.47 = -21.97x + 417.43$

$y = -21.97x + 2357.9$

34b. parallel lines or the same line; no

34c. $y = 3.89(22) + 1880.85$
$= 1966.43$

$y = 33.67(22) + 1404.37$
$= 2145.11$

$y = -14.32(22) + 2220.2$
$= 1905.16$

$y = -21.97(22) + 2357.9$
$= 1874.56$

No; the equations take only one pair of days into account.

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

$y - 5 = -2x + 2$

$y = -2x + 7$

36a. (40, 295), (80, 565)

$m = \frac{565 - 295}{80 - 40}$

$= \frac{270}{40}$ or 6.75

$y - 565 = 6.75(x - 80)$

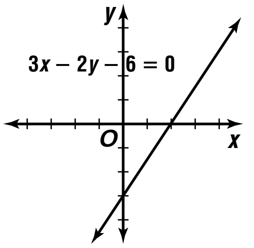
$y - 565 = 6.75x - 540$

$y = 6.75x + 25$

36b. \$6.75 **36c.** \$25

37. $3x - 2y - 6 = 0$

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



38. $[g \circ h](x) = g(h(x))$

$= g(x^2)$

$= x^2 - 1$

39. Sample answer: {(2, 4), (2, −4), (1, 2), (1, −2), (0, 0)}; because the x-values 1 and 2 are paired with more than one y-value.

40. $2x + y = 12$

$y = -2x + 12$

$x + 2y = -6$

$x + 2(-2x + 12) = -6$

$x - 4x + 24 = -6$

$-3x = -30$

$x = 10$

$2(10) + y = 12$

$y = -8$

$2x + 2y = 2(10) + 2(-8)$

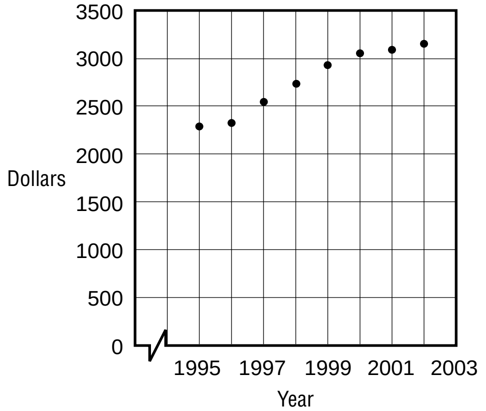
$= 20 + (-16)$ or 4

1-6 Modeling Real-World Data with Linear Functions

Pages 41–42 Check for Understanding

1. the rate of change
2. Choose two ordered pairs of data and find the equation of the line that contains their graphs. Find a median-fit line by separating the data into three sets and using the medians to locate a line. Use a graphing calculator to find a regression equation.
3. Sample answer: age of a car and its value

4a. **Personal Consumption on Durable Goods**



4b. Sample answer: using (1995, 2294) and (2002, 3158)

$m = \frac{3158 - 2294}{2002 - 1995}$

$= \frac{864}{7}$ or 123.4

$y - 3158 = 123.4(x - 2002)$

$y = 123.4x - 243{,}888.8$

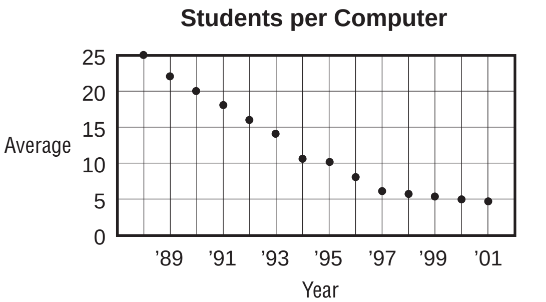
4c. $y = 132.8x - 262{,}621.2$; $r \approx 0.98$

4d. $y = 132.8(2010) - 262{,}621.2$

$= 4306.8$

\$4306.80; yes, the correlation coefficient shows a strong correlation.

5a.



5b. Sample answer: using (1997, 6.1) and (2001, 4.9)

$m = \frac{4.9 - 6.1}{2001 - 1997}$

$= \frac{-1.2}{4}$ or -0.3

$y - 6.1 = -0.3(x - 1997)$

$y = -0.3x + 605.2$

5c. $y = -1.61x + 3231.43$; $r \approx -0.97$

5d. $1 = -1.61x + 3231.43$

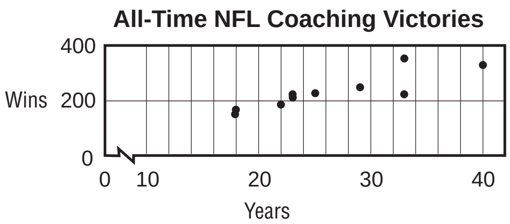
$-3230.43 = -1.61x$

$2006.47 = x$

2006; yes, the number of students per computer is decreasing steadily.

Pages 42–44 Exercises

6a.



6b. Sample answer: using (18, 170) and (40, 324)

$m = \frac{324 - 170}{40 - 18}$

$= \frac{154}{22}$ or 7

$y - 324 = 7(x - 40)$

$y = 7x + 44$

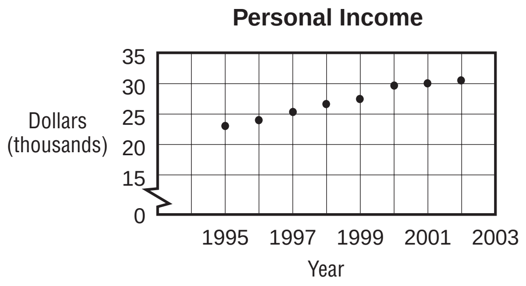
6c. $y = 7.57x + 33.38$; $r \approx 0.88$

6d. $y = 7.57(16) + 33.38$

$= 154.5$

155; yes, r is fairly close to 1. (Actual data is 159.)

7a.



7b. Sample answer: using (1995, 23,255) and (2002, 30,832)

$m = \frac{30{,}832 - 23{,}255}{2002 - 1995}$

$= \frac{7577}{7}$ or 1082.43

$y - 23{,}255 = 1082.43(x - 1995)$

$y = 1082.43x - 2{,}136{,}192.85$

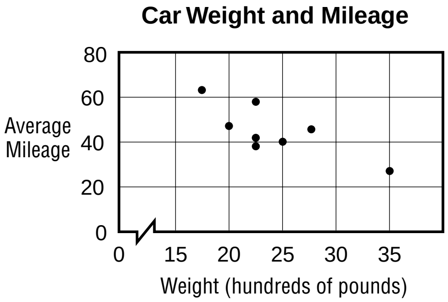
7c. $y = 1164.11x - 2{,}299{,}128.75$; $r \approx 0.99$

7d. $y = 1164.11(2010) - 2{,}299{,}128.75$

$= 40{,}732.35$

\$40,732.35; yes, r shows a strong relationship.

8a.



8b. Sample answer: using (17.5, 65.4) and (35.0, 27.7)

$m = \frac{27.7 - 65.4}{35.0 - 17.5}$

$= \frac{-37.7}{17.5}$ or -2.15

$y - 65.4 = -2.15(x - 17.5)$

$y = -2.15x + 103.0$

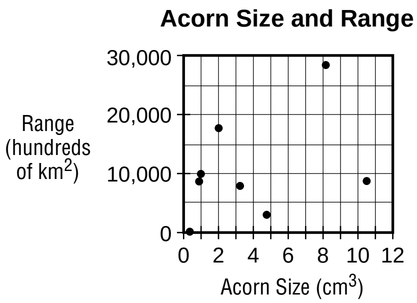
8c. $y = -1.72x + 87.59$; $r \approx -0.77$

8d. $y = -1.72(45.0) + 87.59$

$y = 10.19$

10.19; no, r doesn't show a particularly strong relationship.

9a.



9b. Sample answer: using (0.3, 233) and (3.4, 7900)

$m = \frac{7900 - 233}{3.4 - 0.3}$

$= \frac{7667}{3.1}$ or 2473.23

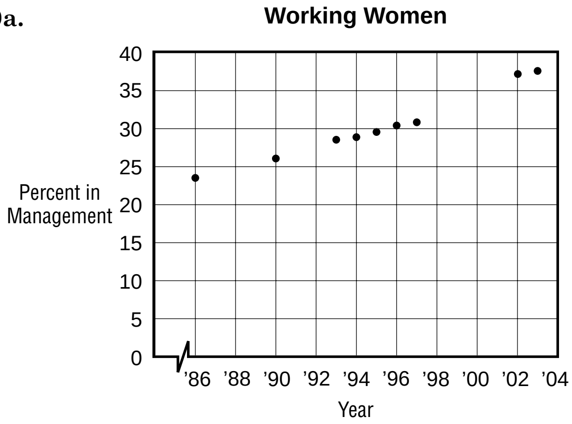
$y - 7900 = 2473.23(x - 3.4)$

$y = 2473.23x - 508.97$

9c. $y = 885.82 + 6973.14$; $r \approx 0.38$

9d. The correlation value does not show a strong or moderate relationship.

10a.



10b. Sample answer: using (1990, 26.2) and (2003, 37.6)

$m = \frac{37.6 - 26.2}{2003 - 1990}$

$= \frac{11.4}{13}$ or 0.88

$y - 26.2 = 0.88(x - 1990)$

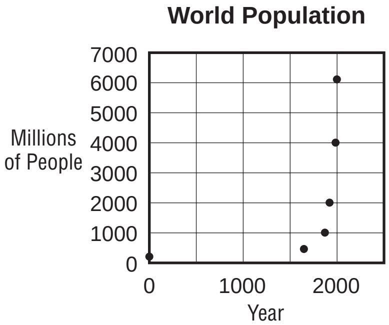
$y = 0.88x - 1725$

10c. $y = 0.84x - 1648.27$; $r \approx 0.984$

10d. $y = 0.84(2008) - 1648.27$ or 38.45

38.45%; yes, r is very close to 1.

11a.



11b. Sample answer: using (1, 200) and (2000, 6050)

$m = \frac{6050 - 200}{2000 - 1}$

$= \frac{5850}{1999}$ or 2.93

$y - 200 = 2.93(x - 1)$

$y = 2.93x + 197.07$

11c. $y = 1.65x - 289.00$; $r \approx 0.56$

11d. $y = 1.65(2010) - 289.00$

$= 3027.5$

3028 million; no, the correlation value is not showing a very strong relationship.

12a. Sample answer: the space shuttle; because anything less than perfect could endanger the lives of the astronauts.

12b. Sample answer: a medication that proves to help delay the progress of a disease; because any positive correlation is better than none or a negative correlation.

12c. Sample answer: comparing a dosage of medicine to the growth factor of cancer cells; because the greater the dosage the fewer cells that are produced.

13.

Men's Median Salary	Women's Median Salary
LinReg	LinReg
$y = ax + b$	$y = ax + b$
$a = 885.2867133$	$a = 625.041958$
$b = -1{,}742{,}768.136$	$b = -1{,}234{,}368.061$
$r = .9716662959$	$r = .9869509009$

The rate of growth, which is the slope of the graphs of the regression equations, for the women is less than that of the men's rate of growth. If that trend continues, the men's median salary will always be more than the women's.

14a. Let x = computers.

Let y = printers.

$24x + 40y = 38{,}736$

$y = -0.6x + 968.4$

$30x + 50y = 51{,}470$

$y = -0.6x + 1029.4$

No; the lines do not coincide.

14b. Let x = computers.

Let y = printers.

$24x + 40y = 38{,}736$

$y = -0.6x + 968.4$

$30x + 50y = 48{,}420$

$y = -0.6x + 968.4$

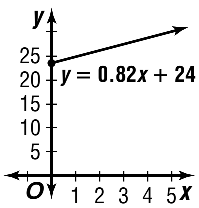
Yes; the lines coincide.

15. $y - (-4) = -6(x - (-3))$

$y + 4 = -6x - 18$

$6x + y + 22 = 0$

16a.



16b. $24 billion

16c. If the nation had no disposable income, personal consumption expenditures would be $24 billion. For each 1 billion increase in disposable income, there is a 0.82 billion dollar increase in personal consumption expenditures.

17. $[f \circ g](x) = f(g(x))$

$= f(x + 1)$

$= (x + 1)^3$

$= x^3 + 3x^2 + 3x + 1$

$[g \circ f](x) = g(f(x))$

$= g(x^3)$

$= x^3 + 1$

18. Yes; each domain value is paired with exactly one range value.

19. The y-intercept is 1.
The slope is -3 (move down 3 and right 1).
The correct choice is C.

1-7 Piecewise Functions

Pages 48–49 Check for Understanding

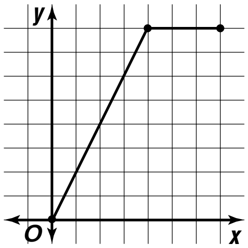
1. $f(x) = \begin{cases} x \text{ if } x \geq 0 \\ -x \text{ if } x < 0 \end{cases}$

2. reals, even integers

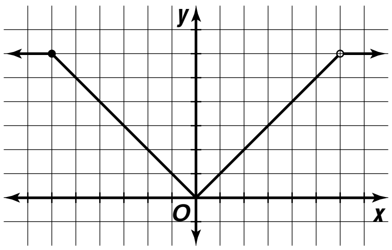
3. $f(x) = \begin{cases} x + 2 \text{ if } x \leq 0 \\ x \text{ if } 0 < x \leq 4 \\ x - 2 \text{ if } x > 4 \end{cases}$

4. Alex is correct because he is applying the definition of a function.

5.

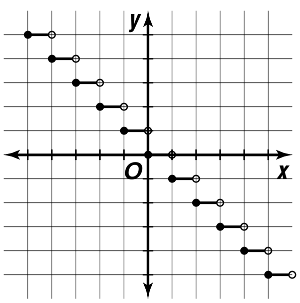


6.



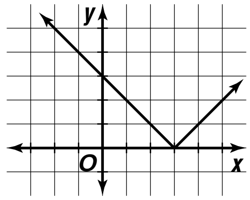
7.

x	$f(x)$
$-3 \leq x < -2$	3
$-2 \leq x < -1$	2
$-1 \leq x < 0$	1
$0 \leq x < 1$	0
$1 \leq x < 2$	-1
$2 \leq x < 3$	-2
$3 \leq x < 4$	-3
$4 \leq x < 5$	-4



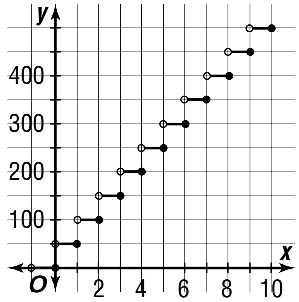
8.

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



9. greatest integer function; h is hours, $c(h)$ is the cost, $c(h) = \begin{cases} 50h \text{ if } [[h]] = h \\ 50[[h + 1]] \text{ if } [[h]] < h \end{cases}$

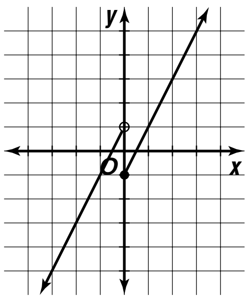
x	$f(x)$
$0 < x \leq 1$	50
$1 < x \leq 2$	100
$2 < x \leq 3$	150
$3 < x \leq 4$	200



10. long term lot:
$2(6) + 3(1) = 12 + 3$ or 15
shuttle facility:
$4(3) = 12$
shuttle facility

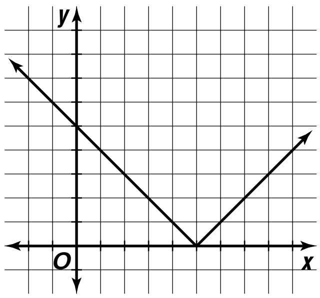
Pages 49–51 Exercises

11.



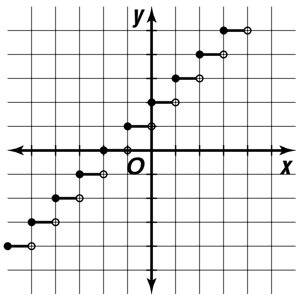
12.

x	$f(x)$
1	4
3	2
5	0
7	2
9	4



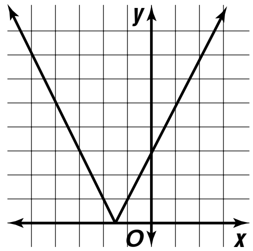
13.

x	$f(x)$
$-2 \leq x < -1$	0
$-1 \leq x < 0$	1
$0 \leq x < 1$	2
$1 \leq x < 2$	3
$2 \leq x < 3$	4



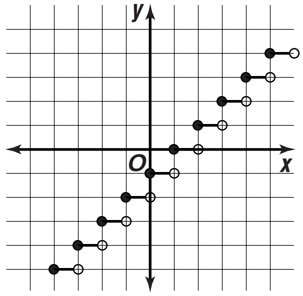
14.

x	$f(x)$
-5	7
-3	3
-1.5	0
0	3
2	7

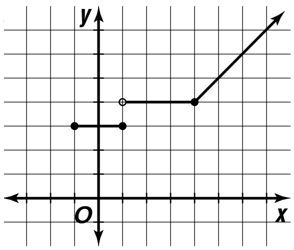


15.

x	$f(x)$
$-2 \le x < -1$	-3
$-1 \le x < 0$	-2
$0 \le x < 1$	-1
$1 \le x < 2$	0
$2 \le x < 3$	1

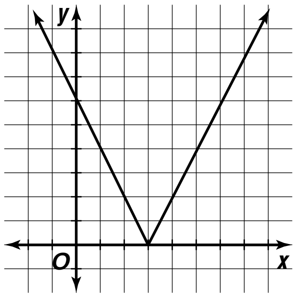


16.



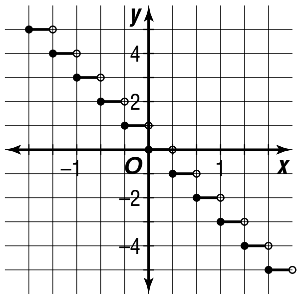
17.

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

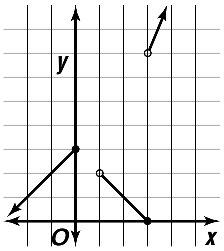


18.

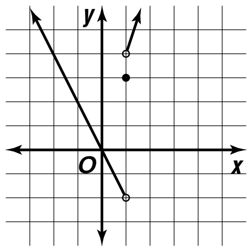
x	$f(x)$
$-1 \le x < -\frac{2}{3}$	3
$-\frac{2}{3} \le x < -\frac{1}{3}$	2
$-\frac{1}{3} \le x < 0$	1
$0 \le x < \frac{1}{3}$	0
$\frac{1}{3} \le x < \frac{2}{3}$	-1
$\frac{2}{3} \le x < 1$	-2



19.

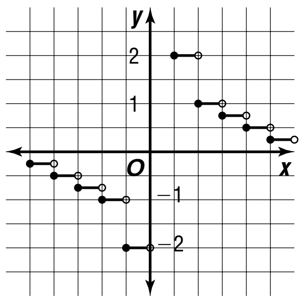


20.



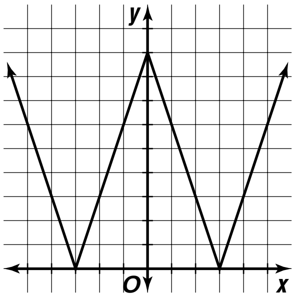
21.

x	$f(x)$
$-5 \le x < -4$	$-\frac{2}{5}$
$-4 \le x < -3$	$-\frac{1}{2}$
$-3 \le x < -2$	$-\frac{2}{3}$
$-2 \le x < -1$	-1
$-1 \le x < 0$	-2
$1 \le x < 2$	2
$2 \le x < 3$	1
$3 \le x < 4$	$\frac{2}{3}$
$4 \le x < 5$	$\frac{1}{2}$
$5 \le x < 6$	$\frac{2}{5}$



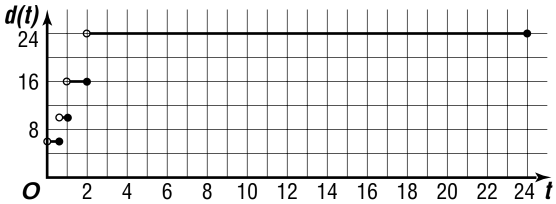
22.

x	$f(x)$
−5	6
−3	0
−1	6
0	9
1	6
3	0
5	6



23. Step; t is the time in hours, $c(t)$ is the cost in dollars,

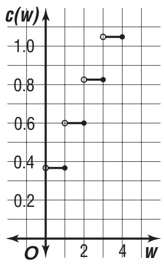
$$c(t) = \begin{cases} 6 \text{ if } t \leq \frac{1}{2} \\ 10 \text{ if } \frac{1}{2} < t \leq 1 \\ 16 \text{ if } 1 < t \leq 2 \\ 24 \text{ if } 2 < t \leq 24 \end{cases}$$



24. Greatest integer; w is the weight in ounces, $c(w)$ is the cost in dollars,

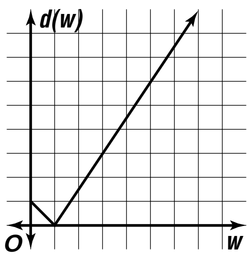
$$c(w) = \begin{cases} 0.37 + 0.23(w - 1) \text{ if } [[w]] = w \\ 0.37 + 0.23[[w]] \text{ if } [[w]] < w \end{cases}$$

x	$f(x)$
$0 < x < 1$	0.37
1	0.37
$1 < x < 2$	0.60
2	0.60
$2 < x < 3$	0.83
3	0.83



25. Absolute value; w is the weight in pounds, $d(w)$ is the discrepancy, $d(w) = |1 - w|$

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

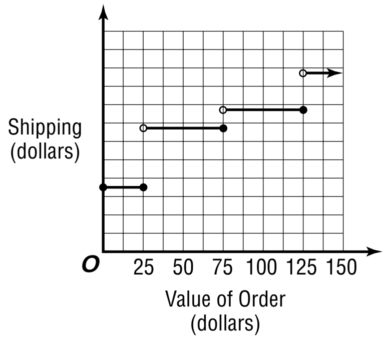


26a. step

26b. v is the value of the order, $s(v)$ is the shipping,

$$s(v) = \begin{cases} 3.50 \text{ if } 0.00 \leq v \leq 25.00 \\ 5.95 \text{ if } 25.01 \leq v \leq 75.00 \\ 7.95 \text{ if } 75.01 \leq v \leq 125.00 \\ 9.95 \text{ if } 125.01 \leq v \end{cases}$$

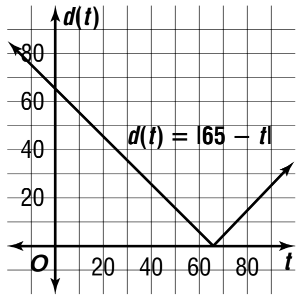
26c.



27. If n is any integer, then all ordered pairs (x, y) where x and y are both in the interval $[n, n + 1)$ are solutions.

28a. absolute value **28b.** $d(t) = |65 - t|$

28c.



28d. $d(63) = |65 - 63|$ or 2

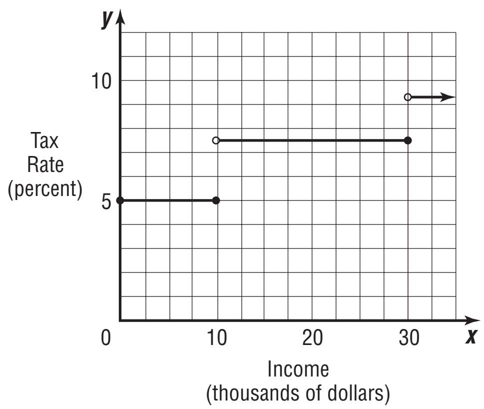
$d(28) = |65 - 28|$ or 37

$\frac{2 + 37}{2} = 19.5$ heating degree days

29a. step

29b. $t(x) = \begin{cases} 5\% \text{ if } x \leq \$10{,}000 \\ 7.5\% \text{ if } \$10{,}000 < x \leq \$30{,}000 \\ 9.3\% \text{ if } x > \$30{,}000 \end{cases}$

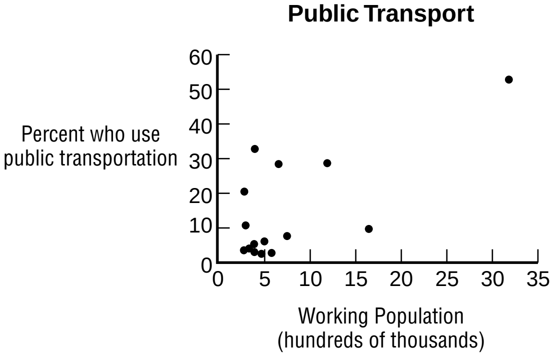
29c.



29d. 9.5%

30. No; the functions are the same if x is positive. However, if x is negative, the functions yield different values. For example, $[g \circ f](1.5) = 1$ and $[f \circ g](1.5) = 1$; $[g \circ f](-1.5) = 2$ and $[f \circ g](-1.5) = 1$.

31a.



31b. Sample answer: using (3,183,088, 53.4) and (362,777, 3.3)

$$m = \frac{3.3 - 53.4}{362{,}777 - 3{,}183{,}088}$$
$$= \frac{-50.1}{-2{,}820{,}311} \text{ or } 0.0000178$$
$$y - 53.4 = 0.0000178(x - 3{,}183{,}088)$$
$$y = 0.0000178x - 3.26$$

31c. $y = 0.0000136x + 4.55$, $r \approx 0.68$

31d. $y = 0.0000136(307{,}679) + 4.55$

$y = 8.73$

8.73%; No, the actual value is 22%.

32.
$$y - 2 = 2(x - 4)$$
$$y - 2 = 2x - 8$$
$$2x - y - 6 = 0$$

33a. (39, 29), (32, 15)

33b. $m = \frac{15 - 29}{32 - 39}$

$= \frac{-14}{-7}$ or 2

33c. The average number of points scored each minute.

34. $p(x) = (r - c)(x)$

$= (400x - 0.2x^2) - (0.1x + 200)$

$= 399.9x - 0.2x^2 - 200$

35. Let x = the original price, or $59.99.

Let $T(x) = 1.065x$. (The cost with 6.5% tax rate)

Let $S(x) = 0.75x$. (The cost with 25% discount)

$[T \circ S](x) = (T(S(x))$

$= (T(0.75x))$

$= (T(0.75(59.99))$

$= (T(44.9925)$

$= 1.065(44.9925)$

$= \$47.92$

36. {−7, −2, 0, 4, 9}; {−2, 0, 2, 3, 11}; Yes; no element of the domain is paired with more than one element of the range.

37. $5 \times 6^{12} = 10{,}883{,}911{,}680$

$5 + 6^{12} = 2{,}176{,}782{,}341$

So, $5 + 6^{12}$ is not greater than 5×6^{12}.

The correct choice is A.

1-8 Graphing Linear Inequalities

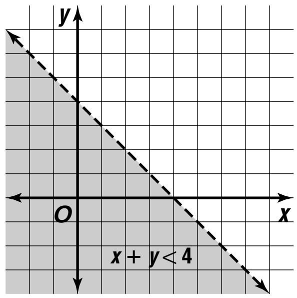
Pages 54–55 Check for Understanding

1. $y \geq 2x - 6$

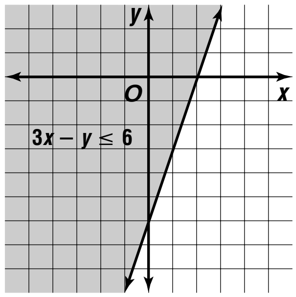
2. Graph the lines $-3 = 2x + y$ and $2x + y = 7$. The graph of $-3 = 2x + y$ is solid and the graph of $2x + y = 7$ is dashed. Test points to determine which region(s) should be shaded. Then shade the correct region(s).

3. Sample answer: The boundaries separate the plane into regions. Each point in a region either does or does not satisfy the inequality. Using a test point allows you to determine whether all of the points in a region satisfy the inequality.

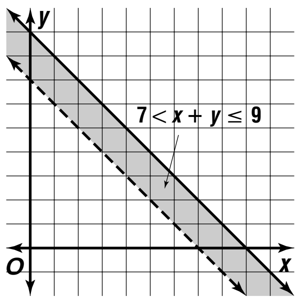
4.



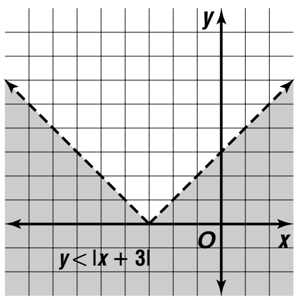
5.



6.

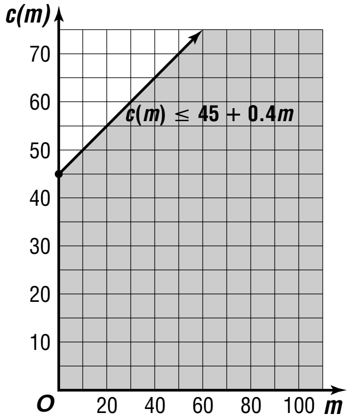


7.



8a. $c(m) \le 45 + 0.4m$

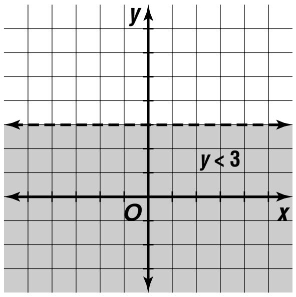
8b.



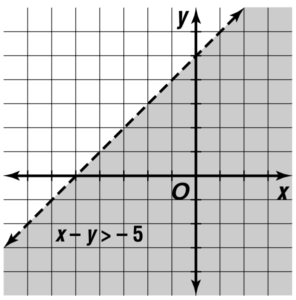
8c. Sample answer: (0, 45), (10, 49), (20, 50)

Pages 55–56 Exercises

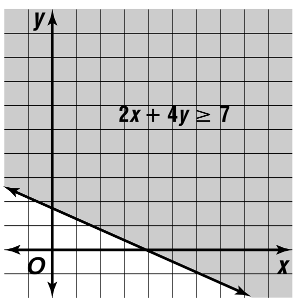
9.



10.



11.



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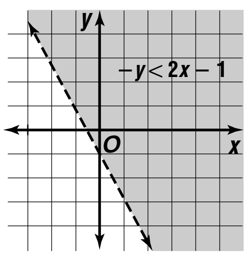

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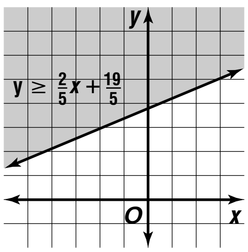

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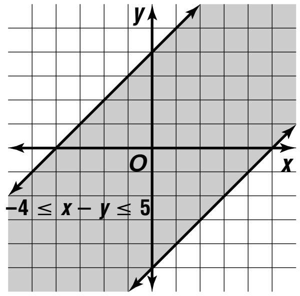

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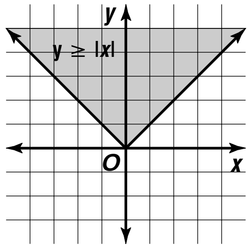

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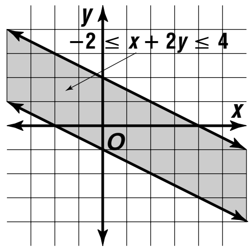

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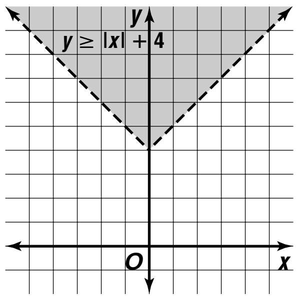

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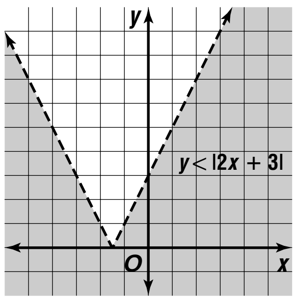

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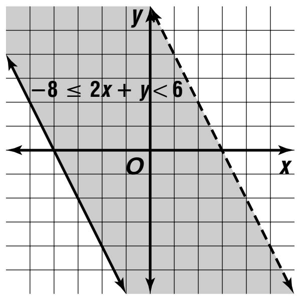

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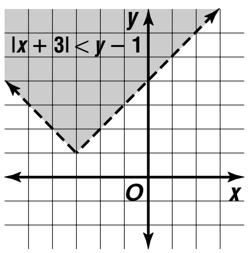

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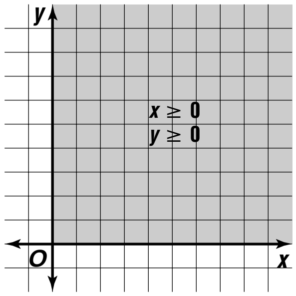

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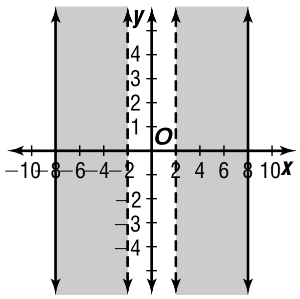
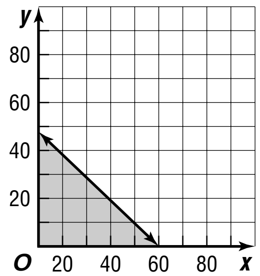


23a. $8x + 10y \le 8(60)$
$8x + 10y \le 480$

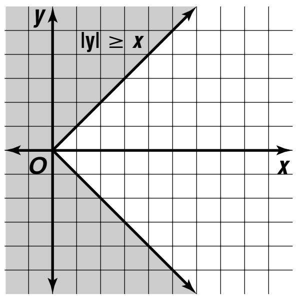
23b.



23c. Sample answer: (0, 48) (60, 0), (45, 6)

23d. Sample answer: using complex computer programs and systems of inequalities.

24.



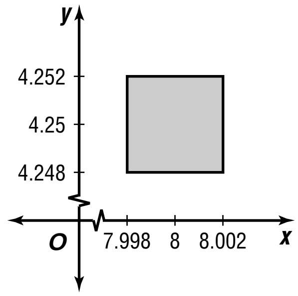
25a. points in the first and third quadrants

25b. If x and y satisfy the inequality, then either $x \ge 0$ and $y \ge 0$ or $x \le 0$ and $y \le 0$. If $x \ge 0$ and $y \ge 0$, then $|x| = x$ and $|y| = y$. Thus, $|x| + |y| = x + y$. Since $x + y$ is positive, $|x + y| = x + y$.

If $x \le 0$ and $y \le 0$, then $|x| = -x$ and $|y| = -y$. Then $|x| + |y| = -x + (-y)$ or $-(x + y)$. Since both x and y are negative, $(x + y)$ is negative, and $|x + y| = -(x + y)$.

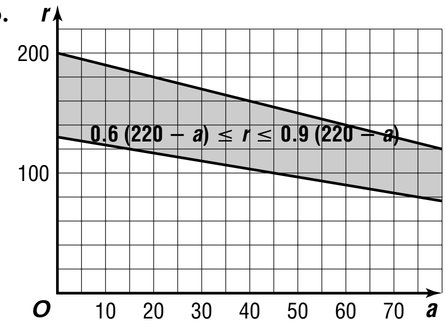
26a. $|8 - x| \le \frac{1}{500}$; $|4\frac{1}{4} - y| \le \frac{1}{500}$

26b.



27a. $0.6(220 - a) \le r \le 0.9(220 - a)$

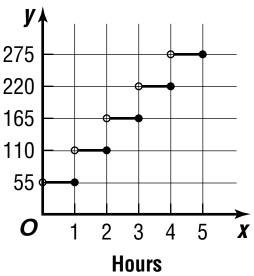
27b.



28a. step

28b. Let $c(h)$ represent the cost for h hours.
Then $c(h) = \begin{cases} 55h \text{ if } [[h]] = h \\ 55[[h + 1]] \text{ if } [[h]] < h \end{cases}$

28c.



29a. $3x - y = 10$
$y = 3x - 10$
$y - (-2) = 3(x - 0)$
$3x - y - 2 = 0$

29b. perpendicular slope: $-\frac{1}{3}$
$y - (-2) = -\frac{1}{3}(x - 0)$
$y + 2 = -\frac{1}{3}x$
$3y + 6 = -x$
$x + 3y + 6 = 0$

30. $m = \frac{7 - 4}{5 - 1}$ $\quad y - 7 = \frac{3}{4}(x - 5)$
$= \frac{3}{4}$ $\quad y = \frac{3}{4}x + 3\frac{1}{4}$

31a. (0, 23), (16, 48);
$m = \frac{48 - 23}{16 - 0}$
$= \frac{25}{16}$ or 1.5625

31b. the average change in the temperature per hour

32. $\frac{9^5 - 9^4}{8} = \frac{59{,}049 - 6561}{8}$
$= \frac{52{,}488}{8}$ or 6561 or 9^4

The correct choice is E.

Chapter 1 Study Guide and Assessment

Page 57 Understanding the Vocabulary

1. c
2. f
3. d
4. g
5. i
6. a
7. h
8. j
9. e
10. b

Pages 58–60 Skills and Concepts

11. $f(4) = 5(4) - 10$
$= 20 - 10$ or 10

12. $g(2) = 7 - (2)^2$
$= 7 - 4$ or 3

13. $f(-3) = 4(-3)^2 - 4(-3) + 9$
$= 36 + 12 + 9$ or 57

14. $h(0.2) = 6 - 2(0.2)^3$
$= 6 - 0.016$ or 5.984

15. $g\left(\frac{1}{3}\right) = \dfrac{2}{5\left(\frac{1}{3}\right)}$
$= \dfrac{2}{\frac{5}{3}}$ or $\dfrac{6}{5}$

16. $k(4c) = (4c)^2 + 2(4c) - 4$
$= 16c^2 + 8c - 4$

17. $f(m + 1) = |(m + 1)^2 + 3(m + 1)|$
$= |m^2 + 2m + 1 + 3m + 3|$
$= |m^2 + 5m + 4|$

18. $(f + g)(x) = f(x) + g(x)$
$= 6x - 4 + 2$
$= 6x - 2$

$(f - g)(x) = f(x) - g(x)$
$= 6x - 4 - (2)$
$= 6x - 6$

$(f \cdot g)(x) = f(x) \cdot g(x)$
$= (6x - 4)(2)$
$= 12x - 8$

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

19. $(f + g)(x) = f(x) + g(x)$
$= x^2 + 4x + x - 2$
$= x^2 + 5x - 2$

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

$(f \cdot g)(x) = f(x) \cdot g(x)$
$= (x^2 + 4x)(x - 2)$
$= x^3 + 2x^2 - 8x$

$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)})$
$= \frac{x^2 + 4x}{x - 2}, x \neq 2$

20. $(f + g)(x) = f(x) + g(x)$
$= 4 - x^2 + 3x$ or $4 + 3x - x^2$

$(f - g)(x) = f(x) - g(x)$
$= 4 - x^2 - (3x)$
$= 4 - 3x - x^2$

$(f \cdot g)(x) = f(x) \cdot g(x)$
$= (4 - x^2)(3x)$
$= 12x - 3x^3$

$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$
$= \frac{4 - x^2}{3x}, x \neq 0$

21. $(f + g)(x) = f(x) + g(x)$
$= x^2 + 7x + 12 + x + 4$
$= x^2 + 8x + 16$

$(f - g)(x) = f(x) - g(x)$
$= x^2 + 7x + 12 - (x + 4)$
$= x^2 + 6x + 8$

$(f \cdot g)(x) = f(x) \cdot g(x)$
$= (x^2 + 7x + 12)(x + 4)$
$= x^3 + 11x^2 + 40x + 48$

$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$
$= \frac{x^2 + 7x + 12}{x + 4}$
$= \frac{(x + 4)(x + 3)}{x + 4}$
$= x + 3, x \neq -4$

22. $(f + g)(x) = f(x) + g(x)$
$= x^2 - 1 + x + 1$
$= x^2 + x$

$(f - g)(x) = f(x) - g(x)$
$= x^2 - 1 - (x + 1)$
$= x^2 - x - 2$

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

$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$
$= \frac{x^2 - 1}{x + 1}$
$= \frac{(x - 1)(x + 1)}{x + 1}$
$= x + 1, x \neq -1$

23. $(f + g)(x) = f(x) + g(x)$
$= x^2 - 4x + \frac{4}{x - 4}$
$= \frac{x^3 - 8x^2 + 16x + 4}{x - 4}$
$= x^2 - 4x + \frac{4}{x - 4}, x \neq 4$

$(f - g)(x) = f(x) - g(x)$
$= x^2 - 4x - \left(\frac{4}{x - 4}\right)$
$= \frac{x^3 - 8x^2 + 16x - 4}{x - 4}$
$= x^2 - 4x - \frac{4}{x - 4}, x \neq 4$

$(f \cdot g)(x) = f(x) \cdot g(x)$
$= (x^2 - 4x)\left(\frac{4}{x - 4}\right)$
$= 4x, x \neq 4$

$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$
$= \dfrac{x^2 - 4x}{\frac{4}{x - 4}}$ or $\dfrac{x^3 - 8x^2 + 16x}{4}, x \neq 4$

24. $[f \circ g](x) = f(g(x))$
$= f(2x)$
$= (2x)^2 - 4$
$= 4x^2 - 4$

$[g \circ f](x) = g(f(x))$
$= g(x^2 - 4)$
$= 2(x^2 - 4)$
$= 2x^2 - 8$

25. $[f \circ g](x) = f(g(x))$
$= f(3x^2)$
$= 0.5(3x^2) + 5$
$= 1.5x^2 + 5$

$[g \circ f](x) = g(\mathrm{f}(\mathrm{x}))$
$= g(0.5x + 5)$
$= 3(0.5x + 5)^2$
$= 0.75x^2 + 15x + 75$

26. $[f \circ g](x) = f(g(x))$
$= f(3x)$
$= 2(3x)^2 + 6$
$= 18x^2 + 6$

$[g \circ f](x) = g(f(x))$
$= g(2x^2 + 6)$
$= 3(2x^2 + 6)$
$= 6x^2 + 18$

27. $[f \circ g](x) = f(g(x))$
$= f(x^2 - x + 1)$
$= 6 + (x^2 - x + 1)$
$= x^2 - x + 7$

$[g \circ f](x) = g(f(x))$
$= g(6 + x)$
$= (6 + x)^2 - (6 + x) + 1$
$= x^2 + 11x + 31$

28. $[f \circ g](x) = f(g(x))$
$= f(x + 1)$
$= (x + 1)^2 - 5$
$= x^2 + 2x - 4$

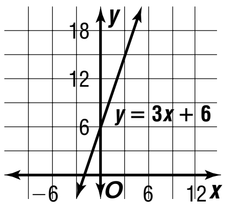
$[g \circ f](x) = g(f(x))$
$= g(x^2 - 5)$
$= x^2 - 5 + 1$
$= x^2 - 4$

29. $[f \circ g](x) = f(g(x))$
$= f(2x^2 + 10)$
$= 3 - (2x^2 + 10)$
$= -2x^2 - 7$

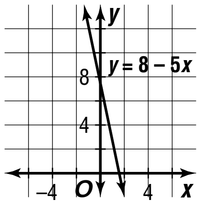
$[g \circ f](x) = g(f(x))$
$= g(3 - x)$
$= 2(3 - x)^2 + 10$
$= 2x^2 - 12x + 28$

30. Domain of $f(x)$: $x \geq 16$
Domain of $g(x)$: all reals
$g(x) \geq 16$
$5 - x \geq 16$
$x \leq -11$
Domain of $[f \circ g](x)$ is $x \leq -11$.

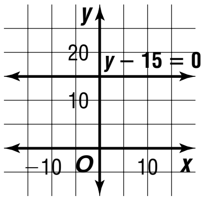
31. The y-intercept is 6. The slope is 3.



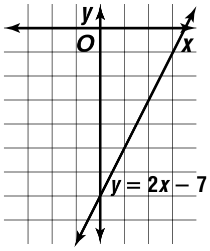
32. The y-intercept is 8. The slope is -5.



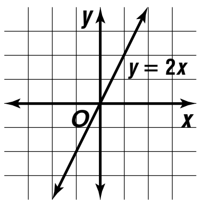
33. $y - 15 = 0$
$y = 15$
The y-intercept is 15. The slope is 0.



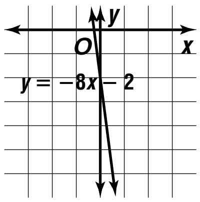
34. $0 = 2x - y - 7$
$y = 2x - 7$
The y-intercept is -7. The slope is 2.



35. The y-intercept is 0. The slope is 2.



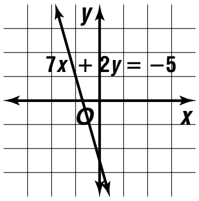
36. The y-intercept is -2. The slope is -8.



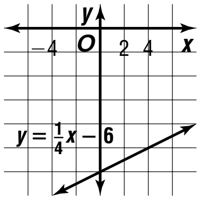
37. $7x + 2y = -5$

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

The y-intercept is $-\frac{5}{2}$. The slope is $-\frac{7}{2}$.



38. The y-intercept is -6. The slope is $\frac{1}{4}$.



39. $y = 2x - 3$

40. $y = -x + 1$

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

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

$y = \frac{1}{2}x + \frac{9}{2}$

42. $m = \frac{5 - 2}{2 - (-4)}$

$= \frac{3}{6}$ or $\frac{1}{2}$

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

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

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

43. $(1, 0), (0, -4)$

$m = \frac{-4 - 0}{0 - 1}$

$= \frac{-4}{-1}$ or 4

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

$y + 4 = 4x$

$y = 4x - 4$

44. $y = -1$

45. $y = 0$

46. $y - 0 = 0.1(x - 1)$

$y = 0.1x - 0.1$

47. $y - 1 = 1(x - 1)$

$y - 1 = x - 1$

$x - y = 0$

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

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

$3y - 18 = x + 1$

$x - 3y + 19 = 0$

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

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

$y - 2 = -2x - 6$

$2x + y + 4 = 0$

50. $y - (-8) = \frac{1}{2}(x - 4)$

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

$2y + 16 = x - 4$

$x - 2y - 20 = 0$

51. $m = -\frac{4}{(-2)}$ or 2, perpendicular slope is $-\frac{1}{2}$

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

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

$2y - 8 = -x + 1$

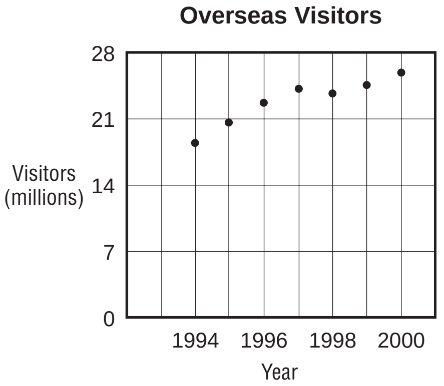
$x + 2y - 9 = 0$

52. $x = -8$ is a vertical line; perpendicular slope is 0.

$y - (-6) = 0(x - 4)$

$y + 6 = 0$

53a.



53b. Sample answer: using (1994, 18,458) and (2000, 25,975)

$m = \frac{25{,}975 - 18{,}458}{2000 - 1994}$

$= \frac{7517}{6}$ or 1252.8

$y - 25{,}975 = 1252.8(x - 2000)$

$y = 1252.8x - 2{,}479{,}625$

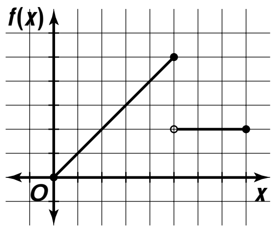
53c. $y = 1115.9x - 2{,}205{,}568$; $r = 0.9441275744$

53d. $y = 1115.9(2008) - 2{,}205{,}568$

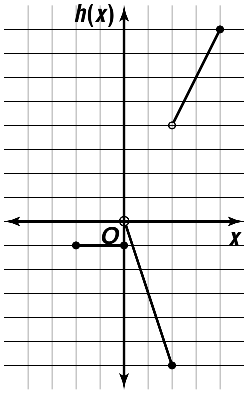
$= 35{,}159.2$

35,159,200 visitors; Sample answer: This is a good prediction, because the r value indicates a strong relationship.

54.

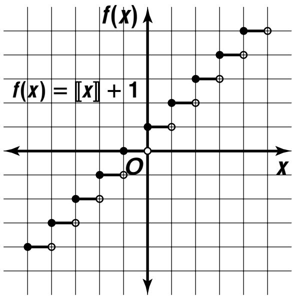


55.



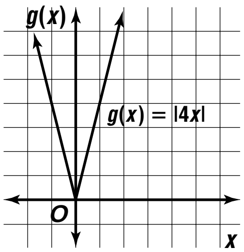
56.

x	$f(x)$
$-2 \le x < -1$	-1
$-1 \le x < 0$	0
$0 \le x < 1$	1
$1 \le x < 2$	2
$2 \le x < 3$	3



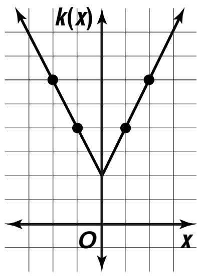
57.

x	$f(x)$
-2	8
-1	4
0	0
1	4
2	8



58.

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



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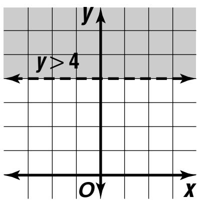

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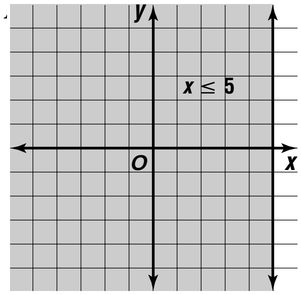

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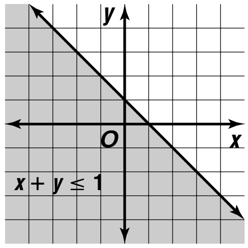
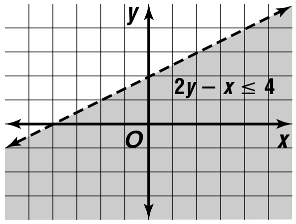
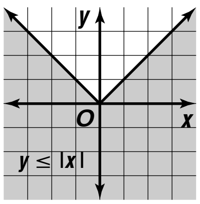


62.



63.



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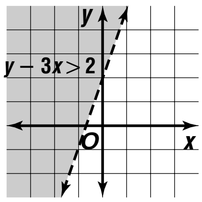

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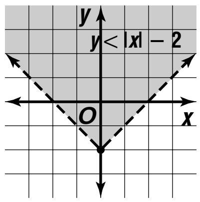

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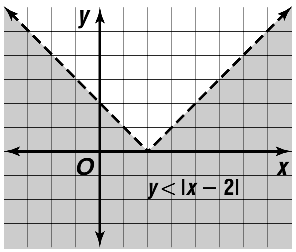

Page 61 Applications and Problem Solving

67a. $d = \frac{1}{2}(20)(1)^2$
$= 10$
$d = \frac{1}{2}(20)(2)^2$
$= 40$
$d = \frac{1}{2}(20)(3)^2$
$= 90$
$d = \frac{1}{2}(20)(4)^2$
$= 160$
$d = \frac{1}{2}(20)(5)^2$
$= 250$
10 m, 40 m, 90 m, 160 m, 250 m

67b. Yes; each element of the domain is paired with exactly one element of the range.

68a. (1999, 500) and (2004, 636)
$m = \frac{636 - 500}{2004 - 1999}$
$= \frac{136}{5}$ or 27.2; about \$27.2 billion

68b. $y - 500 = 27.2(x - 1999)$
$y = 27.2x - 53{,}872.8$

69. $y = -0.284x + 12.964$; The correlation is moderately negative, so the regression line is somewhat representative of the data.

Page 61 Open-Ended Assessment

1. Possible answer: $f(x) = 4x - 4$, $g(x) = x^2$;
$[f \circ g](x) = f(g(x)) = 4(x^2) - 4 = 4x^2 - 4$

2a. No; Possible explanation: If the lines have the same x-intercept, then they either intersect on the x-axis or they are the same line. In either case, they cannot be parallel.

2b. Yes; Possible explanation: If the lines have the same x-intercept, they can intersect on the x-axis. If they have slopes that are negative reciprocals, then they are perpendicular.

3a. $y = \begin{cases} 4 \text{ if } x < 4 \\ 2x - 4 \text{ if } x \geq 4 \end{cases}$

3b. $y = \begin{cases} x - 1 \text{ if } x < -1 \\ 3x + 1 \text{ if } x \geq -1 \end{cases}$

Chapter 1
SAT & ACT Preparation

Page 65 SAT and ACT Practice

1. Prime factorization of a number is a product of prime numbers that equals the number. Choices A, B, and E contain numbers that are not prime. Choice C does not equal 54. Choice D, $3 \times 3 \times 3 \times 2$, is the prime factorization of 54. The correct choice is D.

2. Since this is a multiple-choice question, you can try each choice. Choice A, 16, is not divisible by 12, so eliminate it. Choice B, 24, is divisible by both 8 and 12. Choice C, 48, is also divisible by both 8 and 12. Choice D, 96, is also divisible by both 8 and 12. It cannot be determined from the information given. The correct choice is E.

3. Write the mixed numbers as fractions.
$4\frac{1}{3} = \frac{13}{3}$ $\quad 2\frac{3}{5} = \frac{13}{5}$
Remember that dividing by a fraction is equivalent to multiplying by its reciprocal
$$\frac{4\frac{1}{3}}{2\frac{3}{5}} = \frac{\frac{13}{3}}{\frac{13}{5}} = \frac{13}{3} \times \frac{5}{13} = \frac{5}{3}$$
The correct choice is B.

4. Since this is a multiple-choice question, try each choice to see if it answers the question. Start with 10, because it is easy to calculate with tens. If 10 adult tickets are sold, then 20 student tickets must be sold. Check to see if the total sales exceeds \$90.
Students sales + Adult sales > \$90
20(\$2.00) + 10(\$5.00) = 40 + 50 = \$90
So 10 is too low a number for adult tickets. This eliminates answer choices A, B, C, and D. Check choice E. Eleven is the minimum number of adult tickets.
19(\$2.00) + 11(\$5.00) = 38 + 55 = \$93
The correct choice is E.

5. Recall the definition of absolute value: the number of units a number is from zero on the number line. Simplify the expression by writing it without the absolute value symbols.
$|-7| = 7$
$-|-7| = -7$
$-|-7| - |-5| - 3|-4| = -7 - 5 - 12 = -24$
The correct choice is A.

6. Write each part of the expression without exponents.
$(-4)^2 = 16$
$(2)^{-4} = \frac{1}{2^4} = \frac{1}{16}$
$16 + \frac{1}{16} + \frac{3}{4} = 16 + \frac{13}{16} = 16\frac{13}{16}$
The correct choice is A.

7. Use your calculator. First find the total amount per year by adding.
\$12.90 + \$16.00 + \$18.00 + \$21.90 = \$68.80
Then find one half of this, which is the amount paid in equal payments.
\$68.80 ÷ 2 = \$34.40
Then divide this amount by 4 to get each of 4 monthly payments.
\$34.40 ÷ 4 = \$8.60.
The correct choice is A.

8. First combine the numbers inside the square root symbol. Then find the square root of the result.
$\sqrt{64 + 36} = \sqrt{100} = 10$
The correct choice is A.

9. $60 = 2 \times 2 \times 3 \times 5$
$= 2^2 \times 3 \times 5$
The number of distinct prime factors of 60 is 3.
The correct choice is C.

10. First find the number of fish that are not tetras.
$\left(\frac{1}{8}\right)(24)$ or 3 are tetras. $24 - 3$ or 21 are not tetras. Then $\frac{2}{3}$ of these are guppies.
$\left(\frac{2}{3}\right)(21) = 14$
The answer is 14.