

Extra Practice

Lesson 1-1

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- $D = \{-2, 1, 2\}; R = \{-4, 2, 4\}$; no
- $D = \{-3, -0.5, 0.5, 3\}; R = \{0.5, 3\}$; yes
- $D = \{-1, 0, 2, 5, 7\}; R = \{1, 2, 3, 5, 7\}$; yes
- $D = \{2, 2.3, 3.2\}; R = \{-4, -1, 3, 4\}$; no
- $f(4) = 4(4) - 2$
 $= 16 - 2$ or 14
- $g(-3) = 2(-3)^2 - (-3) + 5$
 $= 2(9) + 3 + 5$
 $= 18 + 3 + 5$ or 26
- $h(1.5) = \frac{3}{2(1.5)}$
 $= \frac{3}{3}$ or 1
- $k(5m) = |3(5m)^2 - 3|$
 $= |3(25m^2) - 3|$
 $= |75m^2 - 3|$

Lesson 1-2

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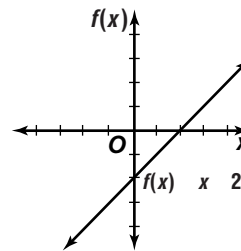
- $f(x) + g(x) = 2x - 1 + x^2 + 3x - 1$
 $= x^2 + 5x - 2$
 $f(x) - g(x) = 2x - 1 - x^2 - 3x + 1$
 $= -x^2 - x$
 $f(x) \cdot g(x) = (2x - 1)(x^2 + 3x - 1)$
 $= 2x^3 + 5x^2 - 5x + 1$
 $\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$
 $= \frac{2x - 1}{x^2 + 3x - 1}$
- $[f \circ g](x) = f(g(x))$
 $= f(4x^2)$
 $= 3 - 4x^2$
 $[g \circ f](x) = g(f(x))$
 $= g(3 - x)$
 $= 4(3 - x)^2$
 $= 36 - 24x + 4x^2$
- $[f \circ g](x) = f(g(x))$
 $= f(x + 9)$
 $= \frac{1}{3}(x + 9) - 1$
 $= \frac{1}{3}x + 2$
 $[g \circ f](x) = g(f(x))$
 $= g\left(\frac{1}{3}x - 1\right)$
 $= \frac{1}{3}x - 1 + 9$
 $= \frac{1}{3}x + 8$

- $[f \circ g](x) = f(g(x))$
 $= f(2x^3 - x^2 + x - 1)$
 $= -2(2x^3 - x^2 + x - 1)$
 $= -4x^3 + 2x^2 - 2x + 2$
 $[g \circ f](x) = g(f(x))$
 $= g(-2x)$
 $= 2(-2x)^3 - (-2x)^2 + (-2x) - 1$
 $= -16x^3 - 4x^2 - 2x - 1$

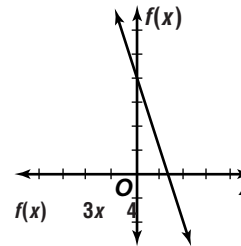
Lesson 1-3

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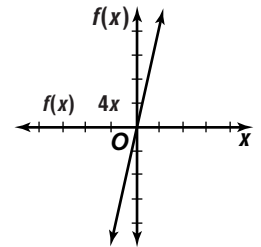
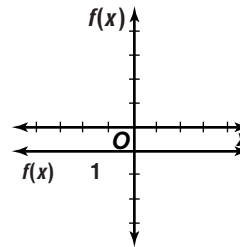
- $x - 2 = 0$
 $x = 2$



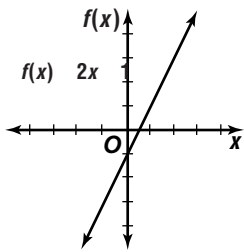
- $-3x + 4 = 0$
 $-3x = -4$
 $x = \frac{4}{3}$



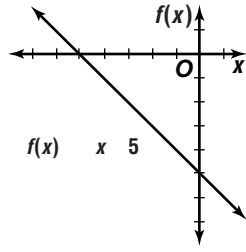
- $-1 = 0$, false
none
- $4x = 0$
 $x = 0$



$$5. \begin{aligned} 2x - 1 &= 0 \\ 2x &= 1 \\ x &= \frac{1}{2} \end{aligned}$$



$$6. \begin{aligned} x - 5 &= 0 \\ -x &= 5 \\ x &= -5 \end{aligned}$$



$$5. \begin{aligned} m &= -\left(\frac{-1}{-3}\right) \text{ or } -\frac{1}{3} \\ y - 6 &= -\frac{1}{3}(x - (-2)) \end{aligned}$$

$$\begin{aligned} -3y + 18 &= x + 2 \\ x + 3y - 16 &= 0 \end{aligned}$$

6. $x = 10$ is a horizontal line; perpendicular slope is undefined.

$$y = -15 \text{ or } y + 15 = 0$$

$$7. \begin{aligned} m &= -\left(\frac{-2}{-5}\right) \text{ or } -\frac{2}{5} \\ y - (-7) &= -\frac{2}{5}(x - 3) \end{aligned}$$

$$5y + 35 = -2x + 6$$

$$2x + 5y + 29 = 0$$

Lesson 1-4

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1. $y = mx + b \rightarrow y = 2x + 1$

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

3. $y = mx + b \rightarrow y = -\frac{1}{4}x - 3$

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

5. $m = \frac{3 - 1}{-2 - 2}$
 $= \frac{2}{-4} \text{ or } -\frac{1}{2}$
 $y - 1 = -\frac{1}{2}(x - 2)$

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

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

6. $m = \frac{6 - 0}{0 - (-1)}$
 $= \frac{6}{1} \text{ or } 6$

$$y = mx + b \rightarrow y = 6x + 6$$

7. $y = 0$

8. $y - 0 = 1.5(x - 10)$
 $y = 1.5x - 15$

Lesson 1-5

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1. None of these; the slopes are neither the same nor opposite reciprocals.

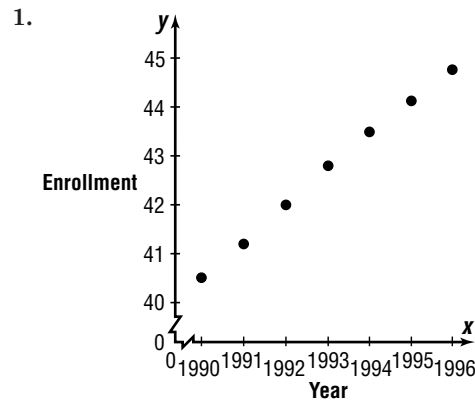
2. $y - (-2) = 1(x - 0)$
 $y + 2 = x$
 $x - y - 2 = 0$

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

4. $y = -1$ is a vertical line; parallel slope is undefined.
 $y = 12$ or $y - 12 = 0$

Lesson 1-6

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2. Sample answer: $y = 0.7167x - 1385.7$

$$m = \frac{44.8 - 40.5}{1996 - 1990}$$

$$\approx 0.7167$$

$$y - 40.5 = 0.7167(x - 1990)$$

$$y = 0.7167x - 1385.733$$

3. Sample answer: $y = 0.7214x - 1395$; $r \approx 0.99$

Enter the School Year data as List 1.

Enter the Enrollment data as List 2.

Perform a linear regression on the graphing calculator.

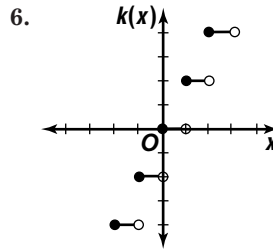
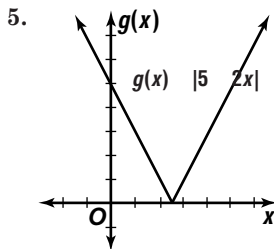
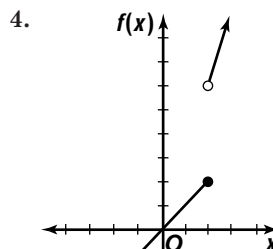
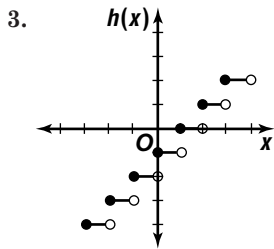
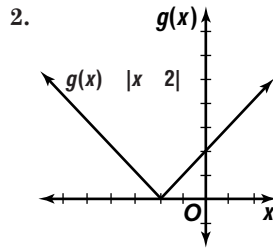
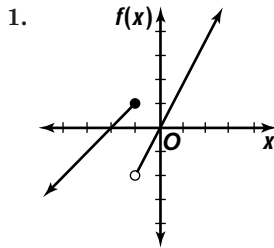
4. Sample answer: 55.7 thousand; yes; the correlation value shows a strong correlation.

$$f(2011) = 0.7214(2011) - 1395$$

$$\approx 55.7 \text{ thousand}$$

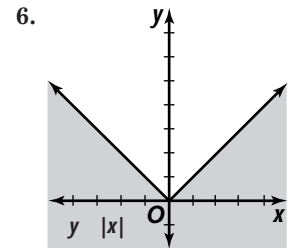
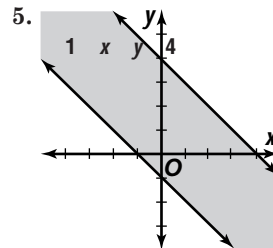
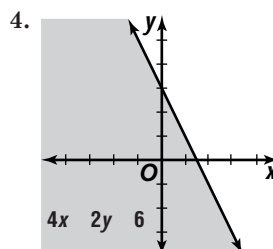
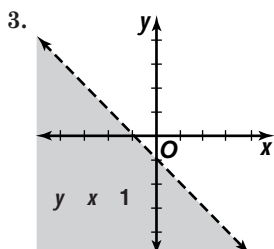
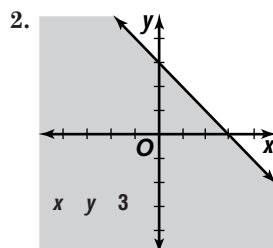
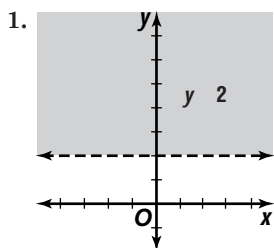
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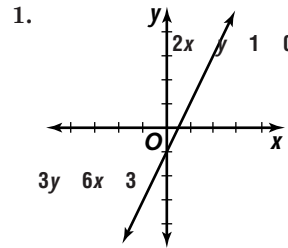
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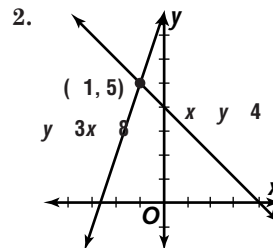


Lesson 2-1

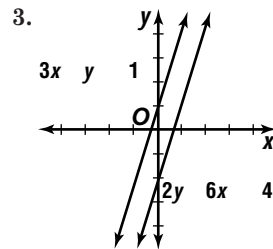
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$y = 2x - 1$; consistent and dependent



$(-1, 5)$; consistent and independent



no solution; inconsistent

$$\begin{array}{r} 5x + 2y = 1 \\ x + 2y = 5 \\ \hline 4x = -4 \\ x = -1 \end{array} \qquad \begin{array}{r} x + 2y = 5 \\ -1 + 2y = 5 \\ 2y = 6 \\ y = 3 \end{array}$$

$$\begin{array}{r} 2x + 4y = 8 \\ 2x + 3y = 8 \\ \hline y = 0 \end{array} \qquad \begin{array}{r} 2x + 3y = 8 \\ 2x + 3(0) = 8 \\ 2x = 8 \\ x = 4 \end{array}$$

$(4, 0)$

$$\begin{array}{r} 6. \quad 8x + 2y = 2 \\ \quad 3x - 4y = -23 \end{array} \quad \rightarrow \quad \begin{array}{r} 16x + 4y = 4 \\ \quad 3x - 4y = -23 \\ \hline 19x = -19 \\ x = -1 \end{array}$$

$$\begin{array}{r} 8x + 2y = 2 \\ 8(-1) + 2y = 2 \\ 2y = 10 \\ y = 5 \\ (-1, 5) \end{array}$$

Lesson 2-2

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$$\begin{array}{r} 1. \quad x + y = 6 \\ \quad x + z = -2 \\ \hline y - z = 8 \end{array}$$

$$\begin{array}{r} x + y = 6 \\ x + 5 = 6 \\ x = 1 \\ (1, 5, -3) \end{array}$$

$$\begin{array}{r} 2. \quad 2x - 2y - z = 6 \\ \quad x + y - 2z = -6 \end{array} \quad \rightarrow \quad \begin{array}{r} 4x - 4y - 2z = 12 \\ \quad x + y - 2z = -6 \\ \hline 3x - 5y = 18 \end{array}$$

$$\begin{array}{r} x + 2y - z = -7 \\ 2x - 2y - z = 6 \\ \hline -x + 4y = -13 \\ 3x - 5y = 18 \\ -x + 4y = -13 \end{array}$$

$$\begin{array}{r} -x + 4y = -13 \\ -x + 4(-3) = -13 \\ x = 1 \end{array}$$

$$(1, -3, 2)$$

$$\begin{array}{r} 3. \quad 2x - 3y + z = 1 \\ \quad x + y - z = -4 \\ \hline 3x - 2y = 3 \end{array}$$

$$\begin{array}{r} x + y - z = -4 \\ 3x - 2y + 2z = 3 \end{array}$$

$$\begin{array}{r} 3x - 2y = -3 \\ 3(-1) - 2y = -3 \\ -2y = 0 \\ y = 0 \\ (-1, 0, 3) \end{array}$$

$$\begin{array}{r} y - z = 8 \\ \quad y + z = 2 \\ \hline 2y = 10 \\ y = 5 \end{array}$$

$$\begin{array}{r} x + z = -2 \\ 1 + z = -2 \\ z = -3 \end{array}$$

$$\begin{array}{r} 4x - 4y - 2z = 12 \\ \quad x + y - 2z = -6 \\ \hline 3x - 5y = 18 \end{array}$$

$$\begin{array}{r} 3x - 5y = 18 \\ -3x + 12y = -39 \\ \hline 7y = -21 \\ y = -3 \\ x + y - 2z = -6 \\ 1 + (-3) - 2z = -6 \\ -2z = -4 \\ z = 2 \end{array}$$

$$\begin{array}{r} 2x + 2y - 2z = -8 \\ 3x - 2y + 2z = 3 \\ \hline 5x = -5 \\ x = 1 \end{array}$$

$$\begin{array}{r} x + y - z = -4 \\ -1 + 0 - z = -4 \\ -z = -3 \\ z = 3 \end{array}$$

Lesson 2-3

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$$\begin{array}{r} 1. \quad 2x + y = -1 \\ \quad y = -1 - 2x \end{array}$$

$$\begin{array}{r} x + 2y = 1 \\ x + 2(-1 - 2x) = 1 \\ -3x - 2 = 1 \\ -3x = 3 \\ x = -1 \end{array}$$

$$\begin{array}{r} y = -1 - 2(-1) \\ = 1 \\ (-1, 1) \end{array}$$

$$\begin{array}{r} 2. \quad x + 2y = 5 \\ \quad 2x - 2y = -2 \\ \hline 3x = 3 \\ x = 1 \end{array}$$

$$\begin{array}{r} x + 2y = 5 \\ 1 + 2y = 5 \\ 2y = 4 \\ y = 2 \end{array}$$

$$(1, 2)$$

$$\begin{array}{r} 3. \quad 3x = y - 7 \\ \quad 3x + 7 = y \end{array}$$

$$\begin{array}{r} 4y = 5x \\ 4(3x + 7) = 5x \\ 12x + 28 = 5x \\ 7x = -28 \\ x = -4 \end{array}$$

$$\begin{array}{r} y = 3(-4) + 7 \\ = -5 \\ (-4, -5) \end{array}$$

$$4. \quad A + C = \begin{bmatrix} 4 + 7 & -1 + (-5) \\ 1 + 0 & 5 + 1 \\ 2 + 8 & 6 + 4 \end{bmatrix}$$

$$= \begin{bmatrix} 11 & -6 \\ 1 & 6 \\ 10 & 10 \end{bmatrix}$$

$$5. \quad D - E = \begin{bmatrix} -4 - 1 & 1 - (-5) \\ 2 - (-3) & 3 - 2 \end{bmatrix}$$

$$= \begin{bmatrix} -5 & 6 \\ 5 & 1 \end{bmatrix}$$

$$6. \quad 4B = \begin{bmatrix} 4(2) & 4(0) & 4(-3) \\ 4(4) & 4(-3) & 4(2) \end{bmatrix}$$

$$= \begin{bmatrix} 8 & 0 & -12 \\ 16 & -12 & 8 \end{bmatrix}$$

7. impossible

$$8. \quad 2C + 3A = \begin{bmatrix} 2(7) & 2(-5) \\ 2(0) & 2(1) \\ 2(8) & 2(4) \end{bmatrix} + \begin{bmatrix} 3(4) & 3(-1) \\ 3(1) & 3(5) \\ 3(2) & 3(6) \end{bmatrix}$$

$$= \begin{bmatrix} 14 + 12 & -10 + (-3) \\ 0 + 3 & 2 + 15 \\ 16 + 6 & 8 + 18 \end{bmatrix}$$

$$= \begin{bmatrix} 26 & -13 \\ 3 & 17 \\ 22 & 26 \end{bmatrix}$$

9. impossible

$$\begin{array}{r} 10. \quad ED = \begin{bmatrix} 1 & -5 \\ -3 & 2 \end{bmatrix} \cdot \begin{bmatrix} -4 & 1 \\ 2 & 3 \end{bmatrix} \\ = \begin{bmatrix} 1(-4) + (-5)(2) & 1(1) + (-5)(3) \\ -3(-4) + 2(2) & -3(1) + 2(3) \end{bmatrix} \end{array}$$

$$4. \begin{vmatrix} -1 & 0 & 2 \\ -3 & 1 & -2 \\ 5 & -1 & -3 \end{vmatrix}$$

$$= -1 \begin{vmatrix} 1 & -2 \\ -1 & -3 \end{vmatrix} - 0 \begin{vmatrix} -3 & -2 \\ 5 & -3 \end{vmatrix} + 2 \begin{vmatrix} -3 & 1 \\ 5 & -1 \end{vmatrix}$$

$$= -1(-5) - 0(19) + 2(-2)$$

$$= 1$$

$$5. \begin{vmatrix} -1 & 3 & 2 \\ 4 & -2 & 1 \\ 3 & -3 & -4 \end{vmatrix}$$

$$= -1 \begin{vmatrix} -2 & 1 \\ -3 & -4 \end{vmatrix} + 3 \begin{vmatrix} 4 & 1 \\ 3 & -4 \end{vmatrix} + 2 \begin{vmatrix} 4 & -2 \\ 3 & -3 \end{vmatrix}$$

$$= -1(11) - 3(-19) + 2(-6)$$

$$= 34$$

$$6. \begin{vmatrix} 4 & 0 & -1 \\ 5 & 3 & 6 \\ -2 & -5 & 2 \end{vmatrix}$$

$$= 4 \begin{vmatrix} 3 & 6 \\ -5 & 2 \end{vmatrix} - 1 \begin{vmatrix} 5 & 3 \\ -2 & -5 \end{vmatrix} + 0(22) - 1(-19)$$

$$= 4(-9) - 1(-25) + 19$$

$$= 163$$

$$7. \frac{1}{\begin{vmatrix} 2 & 1 \\ -1 & 5 \end{vmatrix}} \begin{bmatrix} 3 & -1 \\ -1 & 2 \end{bmatrix} = \frac{1}{5} \begin{bmatrix} 3 & -1 \\ -1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} \frac{3}{5} & -\frac{1}{5} \\ -\frac{1}{5} & \frac{2}{5} \end{bmatrix}$$

$$8. \frac{1}{\begin{vmatrix} 10 & 0 \\ 5 & 4 \end{vmatrix}} \begin{bmatrix} 4 & 0 \\ -5 & 10 \end{bmatrix} = \frac{1}{40} \begin{bmatrix} 4 & 0 \\ -5 & 10 \end{bmatrix}$$

$$= \begin{bmatrix} \frac{1}{10} & 0 \\ -\frac{1}{8} & \frac{1}{4} \end{bmatrix}$$

$$9. \frac{1}{\begin{vmatrix} 5 & -6 \\ -3 & 4 \end{vmatrix}} \begin{bmatrix} 4 & 6 \\ 3 & 5 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 4 & 6 \\ 3 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 3 \\ \frac{3}{2} & \frac{5}{2} \end{bmatrix}$$

$$10. \frac{1}{\begin{vmatrix} 3 & -5 \\ 6 & 1 \end{vmatrix}} \begin{bmatrix} 1 & 5 \\ -6 & 3 \end{bmatrix} =$$

$$\frac{1}{33} \begin{bmatrix} 1 & 5 \\ -6 & 3 \end{bmatrix}$$

$$11. \begin{bmatrix} 3 & 2 \\ 1 & -2 \end{bmatrix} \cdot \begin{bmatrix} \frac{1}{33} & \frac{5}{33} \\ -\frac{2}{11} & \frac{1}{11} \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 22 \\ -6 \end{bmatrix}$$

$$\frac{1}{\begin{vmatrix} 3 & -2 \\ 1 & -2 \end{vmatrix}} \begin{bmatrix} -2 & -2 \\ -1 & 3 \end{bmatrix} = -\frac{1}{8} \begin{bmatrix} -2 & -2 \\ -1 & 3 \end{bmatrix}$$

$$= -\frac{1}{8} \begin{bmatrix} -2 & -2 \\ -1 & 3 \end{bmatrix} \begin{bmatrix} 3 & 2 \\ 1 & -2 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} \begin{bmatrix} \frac{1}{8} & \frac{1}{8} \\ -\frac{1}{8} & \frac{3}{8} \end{bmatrix} \begin{bmatrix} -2 & -2 \\ -1 & 3 \end{bmatrix} = \begin{bmatrix} 3 & 2 \\ 1 & -2 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 7 \\ 5 \end{bmatrix}$$

$$12. \begin{bmatrix} 4 & -2 \\ -3 & 4 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -6 \\ -7 \end{bmatrix}$$

$$\frac{1}{\begin{vmatrix} 4 & -2 \\ -3 & 4 \end{vmatrix}} \begin{bmatrix} 4 & -2 \\ -3 & 4 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{10} \begin{bmatrix} 4 & -2 \\ -3 & 4 \end{bmatrix} \begin{bmatrix} -6 \\ -7 \end{bmatrix}$$

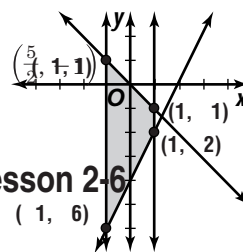
$$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{10} \begin{bmatrix} 1 & 2 \\ -3 & 4 \end{bmatrix} \begin{bmatrix} 4 & -2 \\ 3 & 1 \end{bmatrix} \begin{bmatrix} -2 \\ -1 \end{bmatrix}$$

$$13. \begin{bmatrix} 2 & 1 \\ 4 & -3 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 4 \\ 13 \end{bmatrix}$$

$$\frac{1}{\begin{vmatrix} 2 & 1 \\ 4 & -3 \end{vmatrix}} \begin{bmatrix} 2 & 1 \\ 4 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = -\frac{1}{10} \begin{bmatrix} -3 & -1 \\ -4 & 2 \end{bmatrix} \begin{bmatrix} 4 \\ 13 \end{bmatrix}$$

$$-\frac{1}{10} \begin{bmatrix} -3 & -1 \\ -4 & 2 \end{bmatrix} \begin{bmatrix} 2 & 1 \\ 4 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = -\frac{1}{10} \begin{bmatrix} -3 & -1 \\ -4 & 2 \end{bmatrix} \begin{bmatrix} 4 \\ 13 \end{bmatrix}$$

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



Lesson 2-6

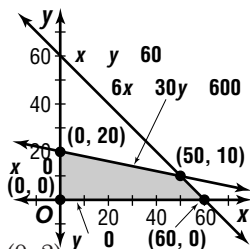
(1, 6)

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1.

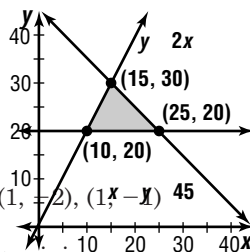
vertices: (3, 1), (0, 1), (3, 7)
 $f(x, y) = 4x + 3y$
 $f(3, 1) = 4(3) + 3(1)$ or 15
 $f(0, 1) = 4(0) + 3(1)$ or 3 → minimum
 $f(3, 7) = 4(3) + 3(7)$ or 33 → maximum

2.



vertices: (0, 3), (4, 7), (4, 2), (0, 2)
 $f(x, y) = 2x - y$
 $f(0, 3) = 2(0) - 3$ or -3 → minimum
 $f(4, 7) = 2(4) - 7$ or 1
 $f(4, 2) = 2(4) - 2$ or 6 → maximum
 $f(0, 2) = 2(0) - 2$ or -2

3.

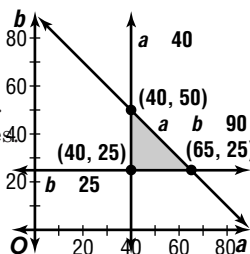


vertices: (-1, 1), (-1, -6), (1, -2), (1, -1)
 $f(x, y) = -x - y$
 $f(-1, 1) = -(-1) - 1$ or 0 → minimum
 $f(-1, -6) = -(-1) - (-6)$ or 7 → maximum
 $f(1, -2) = -1 - (-2)$ or 1
 $f(1, -1) = -1 - (-1)$ or 0 → minimum

Lesson 2-7

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- Let x = the number of cars.
 Let y = the number of buses.
 $6x + 30y \leq 600$
 $x + y \leq 60$
 $x \geq 0$
 $y \geq 0$



$C(x, y) = 3x + 8y$
 $C(0, 0) = 3(0) + 8(0)$ or 0

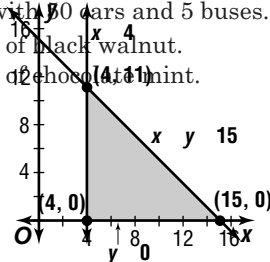
$$C(0, 20) = 3(0) + 8(20)$$
 or 160

$$C(50, 10) = 3(50) + 8(10)$$
 or 230

$$C(60, 0) = 3(60) + 8(0)$$
 or 180

The maximum income is with 50 cars and 5 buses.

- Let x = number of gallons of black walnut.
 Let y = number of gallons of cherry mint.
 $y \leq 2x$
 $x \geq 20$ thousand
 $x + y \leq 45$ thousand



$$C(x, y) = 2.95x + 2.95y$$

$$C(10, 20) = 2.95(10) + 2.95(20)$$
 or 88.50

$$C(15, 30) = 2.95(15) + 2.95(30)$$
 or 132.75

$$C(25, 20) = 2.95(25) + 2.95(20)$$
 or 132.75

alternate optimal solutions

- Let a = the number of company A's cards.
 Let b = the number of company B's cards.
 $a + b \leq 90$
 $a \geq 40$
 $b \geq 25$

$$C(a, b) = 0.30a + 0.32b$$

$$C(40, 25) = 0.30(40) + 0.32(25)$$
 or 20

$$C(40, 50) = 0.30(40) + 0.32(50)$$
 or 28

$$C(65, 25) = 0.30(65) + 0.32(25)$$
 or 27.5

The maximum profit is with 40 cards from company A and 50 cards from company B.

- Let x = the number of video store hours.
 Let y = the number of landscaping company hours.
 $y \geq 0$
 $x \geq 4$
 $x + y \leq 15$

$$C(x, y) = 5x + 7y$$

$$C(4, 0) = 5(4) + 7(0)$$
 or 20

$$C(4, 11) = 5(4) + 7(11)$$
 or 97

$$C(15, 0) = 5(15) + 7(0)$$
 or 75

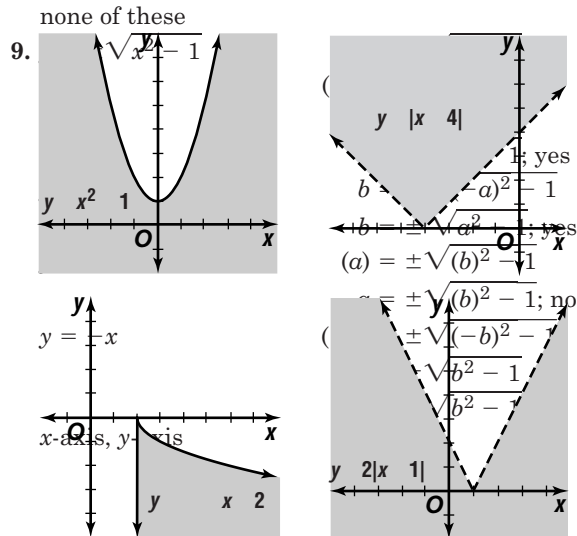
The maximum earnings is \$97.

Lesson 3-1

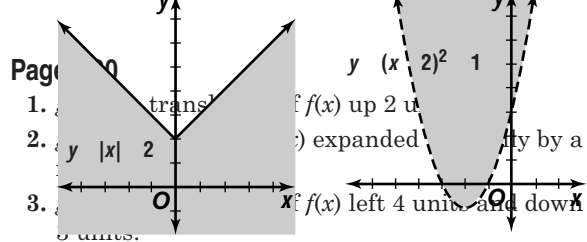
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- $f(x) = -4x$
 $f(-x) = -4(-x) = 4x$
 $-f(x) = -(-4x) = 4x$
 $f(-x) = 4x$
 yes
- $f(x) = x^2 + 3$
 $f(-x) = (-x)^2 + 3 = x^2 + 3$
 $-f(x) = -(x^2 + 3) = -x^2 - 3$
 $f(-x) = x^2 + 3$
 $-f(x) = -x^2 - 3$
 no
- $f(x) = \frac{1}{3x^3}$
 $f(-x) = \frac{1}{3(-x)^3} = -\frac{1}{3x^3}$
 $-f(x) = -\left(\frac{1}{3x^3}\right) = -\frac{1}{3x^3}$
 $f(-x) = -\frac{1}{3x^3}$
 $-f(x) = -\frac{1}{3x^3}$
 yes
- $xy = 2$ →
 x-axis
 $ab = 2$
 $a(-b) = 2$
 $-ab = 2$
 $ab = -2$; no
 $(-a)b = 2$
 $-ab = 2$
 $ab = -2$; no
 $(b)(a) = 2$
 $ab = 2$; yes
 $(-b)(-a) = 2$
 $ab = 2$; yes
 y-axis
 $y = x$
 $y = -x$
 $y = x, y = -x$
- $y + x^2 = 3$ →
 x-axis
 $b + a^2 = 3$
 $(-b) + a^2 = 3$
 $-b + a^2 = 3$; no
 y-axis
 $b + (-a)^2 = 3$
 $b + a^2 = 3$; yes
 $(a) + (b)^2 = 3$
 $a + b^2 = 3$; no
 $(-a) + (-b)^2 = 3$
 $-a + b^2 = 3$; no
 $y = x$
 $y = -x$
 y-axis
- $y^2 = \frac{2x^2}{7} + 1$ →
 x-axis
 $b^2 = \frac{2a^2}{7} + 1$
 $(-b)^2 = \frac{2a^2}{7} + 1$
 $b^2 = \frac{2a^2}{7} + 1$; yes
 y-axis
 $b^2 = \frac{2(-a)^2}{7} + 1$
 $b^2 = \frac{2a^2}{7} + 1$; yes
 $(a)^2 = \frac{2(b)^2}{7} + 1$
 $a^2 = \frac{2b^2}{7} + 1$; no
 $(-a)^2 = \frac{2(-b)^2}{7} + 1$
 $a^2 = \frac{2b^2}{7} + 1$; no
 x-axis, y-axis
- $|x| = 4y$ →
 x-axis
 $|a| = 4b$
 $|a| = 4(-b)$
 $|a| = -4b$; no
 y-axis
 $|(-a)| = 4b$
 $|a| = 4b$; yes
 $(b) = 4(a)$
 $|b| = 4a$; no
 $(-b) = 4(-a)$
 $|b| = -4a$; no
 y-axis

- $y = 3x$ →
 x-axis
 $b = 3a$
 $(-b) = 3a$
 $-b = 3a$; no
 y-axis
 $b = 3(-a)$
 $b = -3a$; no
 $(a) = 3(b)$
 $a = 3b$; no
 $(-a) = 3(-b)$
 $-a = -3b$
 $a = 3b$; no



Lesson 3-2



- translating $f(x)$ up 2 units
- () expanded vertically by a factor of 2
- $f(x)$ left 4 units and down 5 units.
- $g(x)$ is a translation of $f(x)$ right 1 unit and compressed vertically by a factor of 2.
- $y = -\left[\left[\frac{1}{2}x\right]\right] - 5$

Lesson 3-3

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- 1.
- 2.
- 3.
- 4.

10. Case 1
 $|x + 1| - 3 > 1$
 $-(x + 1) - 3 > 1$
 $-(x + 1) > 4$
 $x + 1 < -4$
 $x < -5$
 $\{x \mid x > -5 \text{ or } x > 3\}$

Case 2
 $|x + 1| - 3 > 1$
 $(x + 1) - 3 > 1$
 $x > 3$

11. Case 1
 $|2x + 3| < 27$
 $-(2x + 3) < 27$
 $2x + 3 > -27$
 $2x > -30$
 $x > -15$
 $\{x \mid -15 < x < 12\}$

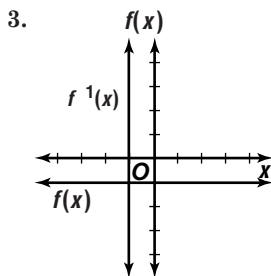
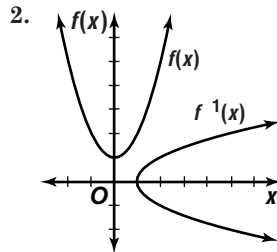
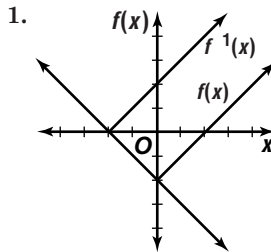
Case 2
 $|2x + 3| < 27$
 $2x + 3 < 27$
 $2x < 24$
 $x < 12$

12. Case 1
 $|3x + 4| - 3x \geq 0$
 $-(3x + 4) - 3x \geq 0$
 $-6x + 4 \geq 0$
 $-6x \geq -4$
 $x \leq \frac{2}{3}$
 all real numbers

Case 2
 $|3x + 4| - 3x \geq 0$
 $(3x + 4) - 3x \geq 0$
 $4 \geq 0$; true

Lesson 3-4

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4. $f(x) = 4x - 5$
 $y = 4x - 5$
 $x = 4y - 5$
 $x + 5 = 4y$
 $y = \frac{x + 5}{4}$
 $f^{-1}(x) = \frac{x + 5}{4}$; Yes, it is a function.

5. $f(x) = -2x + 2$
 $y = -2x + 2$
 $x = -2y + 2$
 $x - 2 = -2y$
 $y = \frac{x - 2}{-2}$
 $f^{-1}(x) = \frac{x - 2}{-2}$; Yes, it is a function.

6. $f(x) = x^2 + 6$
 $y = x^2 + 6$
 $x = y^2 + 6$
 $x - 6 = y^2$
 $y = \pm\sqrt{x - 6}$
 $f^{-1}(x) = \pm\sqrt{x - 6}$; No, it is not a function.

7. $f(x) = (x - 2)^2$
 $y = (x - 2)^2$
 $x = (y - 2)^2$
 $\pm\sqrt{x} = y - 2$
 $y = 2 \pm \sqrt{x}$
 $f^{-1}(x) = 2 \pm \sqrt{x}$; No, it is not a function.

8. $f(x) = -\frac{x}{2}$
 $y = -\frac{x}{2}$
 $x = -2y$
 $y = -2x$
 $f^{-1}(x) = -2x$; Yes, it is a function.

9. $f(x) = \frac{1}{x - 4}$
 $y = \frac{1}{x - 4}$
 $x = \frac{1}{y - 4}$
 $y - 4 = \frac{1}{x}$
 $y = \frac{1}{x} + 4$
 $f^{-1}(x) = \frac{1}{x} + 4$; Yes, it is a function.

10. $f(x) = x^2 + 8x - 2$
 $y = x^2 + 8x - 2$
 $x = y^2 + 8y - 2$
 $x + 2 = y^2 + 8y$
 $x + 2 + 16 = (y + 4)^2$
 $\pm\sqrt{x + 18} = y + 4$
 $-4 \pm \sqrt{x + 18} = y$
 $f^{-1}(x) = -4 \pm \sqrt{x + 18}$; No, it is not a function.

11. $f(x) = x^3 + 4$
 $y = x^3 + 4$
 $x = y^3 + 4$
 $\sqrt[3]{x - 4} = y^3$
 $\sqrt[3]{x - 4} = y$
 $f^{-1}(x) = \sqrt[3]{x - 4}$; Yes, it is a function.

12. $f(x) = -\frac{3}{(x + 1)^2}$
 $y = -\frac{3}{(x + 1)^2}$
 $x = -\frac{3}{(y + 1)^2}$
 $(y + 1)^2 = -\frac{3}{x}$
 $y + 1 = \pm\sqrt{-\frac{3}{x}}$
 $y = -1 \pm \sqrt{-\frac{3}{x}}$
 $f^{-1}(x) = -1 \pm \sqrt{-\frac{3}{x}}$; No, it is not a function.

Lesson 3-5

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- Yes; the function approaches 1 as x approaches 2 from both sides.
- No; the function is undefined when $x = -3$.
- No; the function is undefined when $x = 1$.
- Yes; the function approaches 1 as x approaches 3 from both sides.
- jump discontinuity
- $y \rightarrow -\infty$ as $x \rightarrow -\infty$, $y \rightarrow \infty$ as $x \rightarrow \infty$
- $y \rightarrow -\infty$ as $x \rightarrow -\infty$, $y \rightarrow -\infty$ as $x \rightarrow \infty$
- $y \rightarrow 0$ as $x \rightarrow -\infty$, $y \rightarrow 0$ as $x \rightarrow \infty$

Lesson 3-6

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- abs. max.: $(-1, 2)$
- rel. min.: $(-3, 0)$, rel. max.: $(-1, 3)$, abs. min.: $(2, -1)$

Lesson 3-7

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- $x = 2$

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

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

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

as $x \rightarrow \infty$, $y \rightarrow 3$; $y = 3$

- $x = -3$

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

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

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

no horizontal asymptotes since as $x \rightarrow \infty$, y is undefined

$$\begin{aligned} 3. h(x) &= \frac{x-5}{x^2+6x+5} \\ &= \frac{x-5}{(x+5)(x+1)} \\ x &= -5, x = -1 \end{aligned}$$

$$y = \frac{x-5}{x^2+6x+5}$$

$$y = \frac{\frac{x-5}{x^2-\frac{5}{x^2}}}{\frac{x^2}{x^2} + \frac{6x}{x^2} + \frac{5}{x^2}}$$

$$y = \frac{\frac{1}{x} - \frac{5}{x^2}}{1 + \frac{6}{x} + \frac{5}{x^2}}$$

as $x \rightarrow \infty$, $y \rightarrow 0$; $y = 0$

- yes $y = x + 5$

$$x - \sqrt{\frac{x+5}{3x^2+2x+1}} \rightarrow y = x + 5 + \frac{16}{x-3}$$

$$\frac{5x+1}{5x-15} = \frac{5x+1}{16}$$

As $x \rightarrow \infty$, $\frac{16}{x-3} \rightarrow 0$.
So, the graph of $f(x)$ will approach that of $y = x + 5$.

Lesson 3-8

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- $y = kx$

$$8 = k(2)$$

$$4 = k$$

$$y = 4x$$

$$y = 4(9)$$

$$y = 36$$

- $g = kw$

$$10 = k(-3)$$

$$-\frac{10}{3} = k$$

- $t = \frac{k}{r}$

$$-6 = \frac{k}{14}$$

$$-84 = k$$

$$g = -\frac{10}{3}w$$

$$4 = -\frac{10}{3}w$$

$$-\frac{6}{5} = w$$

$$t = \frac{-84}{r}$$

$$rt = -84$$

$$r(-7) = -84$$

$$r = 12$$

- $y = kxz$

$$60 = k(5)(4)$$

$$3 = k$$

- $y = \frac{k}{x^2}$

$$27 = \frac{k}{(3)^2}$$

$$243 = k$$

$$y = 3xz$$

$$y = 3(5)(10)$$

$$y = 150$$

$$y = \frac{243}{x^2}$$

$$yx^2 = 243$$

$$y(5)^2 = 243$$

$$y = 9.72$$

- $a = kbc^3$

$$-36 = k(3)(2)^3$$

$$-1.5 = k$$

$$a = -1.5bc^3$$

$$a = -1.5(5)(3)^3$$

$$a = -202.5$$

Lesson 4-1

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- yes; $f(x) = x^3 - 7x^2 + 2x + 40$

$$\begin{aligned} f(-2) &= (-2)^3 - 7(-2)^2 + 2(-2) + 40 \\ &= -8 - 28 - 4 + 40 \\ &= 0 \end{aligned}$$

- no; $f(x) = x^3 - 7x^2 + 2x + 40$

$$\begin{aligned} f(1) &= (1)^3 - 7(1)^2 + 2(1) + 40 \\ &= 1 - 7 + 2 + 40 \\ &= 36 \end{aligned}$$

- no; $f(x) = x^3 - 7x^2 + 2x + 40$

$$\begin{aligned} f(2) &= (2)^3 - 7(2)^2 + 2(2) + 40 \\ &= 8 - 28 + 4 + 40 \\ &= 24 \end{aligned}$$

- yes; $f(x) = x^3 - 7x^2 + 2x + 40$

$$\begin{aligned} f(5) &= (5)^3 - 7(5)^2 + 2(5) + 40 \\ &= 125 - 175 + 10 + 40 \\ &= 0 \end{aligned}$$

5. $(x - 3)(x - 4) = 0$
 $x^2 - 7x + 12 = 0$; even; 2
6. $(x - (-2))(x - (-1))(x - 2) = 0$
 $(x + 2)(x + 1)(x - 2) = 0$
 $(x + 2)(x^2 - x - 2) = 0$
 $x^3 + x^2 - 4x - 4 = 0$; odd; 3
7. $(x - (-1.5))(x - (-1))(x - 1) = 0$
 $(x + 1.5)(x + 1)(x - 1) = 0$
 $(x + 1.5)(x^2 - 1) = 0$
 $x^3 + 1.5x^2 - x - 1.5 = 0$; odd; 3
8. $(x - (-2))(x - (-i))(x - i) = 0$
 $(x + 2)(x + i)(x - i) = 0$
 $(x + 2)(x^2 + 1) = 0$
 $x^3 + 2x^2 + x + 2 = 0$; odd; 1
9. $(x - (-3i))(x - 3i)(x - (-i))(x - i) = 0$
 $(x + 3i)(x - 3i)(x + i)(x - i) = 0$
 $(x^2 + 9)(x^2 + 1) = 0$
 $x^4 + 10x^2 + 9 = 0$; even; 0
10. $(x - (-1))(x - 1)(x - 2)(x - 3) = 0$
 $(x + 1)(x - 1)(x - 2)(x - 3) = 0$
 $(x^2 - 1)(x^2 - 5x + 6) = 0$
 $x^4 - 5x^3 + 5x^2 + 5x - 6 = 0$; even; 4

Lesson 4-2

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1. $x^2 - 4x - 5 = 0$
 $x^2 - 4x = 5$
 $x^2 - 4x + 4 = 5 + 4$
 $(x - 2)^2 = 9$
 $x - 2 = \pm 3$
 $x - 2 = 3$ $x - 2 = -3$
 $x = 5$ $x = -1$
2. $x^2 + 6x + 8 = 0$
 $x^2 + 6x = -8$
 $x^2 + 6x + 9 = -8 + 9$
 $(x + 3)^2 = 1$
 $x + 3 = \pm 1$
 $x + 3 = 1$ $x + 3 = -1$
 $x = -2$ $x = -4$
3. $m^2 + 3m - 2 = 0$
 $m^2 + 3m = 2$
 $m^2 + 3m + \frac{9}{4} = 2 + \frac{9}{4}$
 $(m + \frac{3}{2})^2 = \frac{17}{4}$
 $m + \frac{3}{2} = \pm \frac{\sqrt{17}}{2}$
 $m = -\frac{3}{2} \pm \frac{\sqrt{17}}{2}$
4. $2a^2 - 8a - 6 = 0$
 $a^2 - 4a - 3 = 0$
 $a^2 - 4a = 3$
 $a^2 - 4a + 4 = 3 + 4$
 $(a - 2)^2 = 7$
 $a - 2 = \pm \sqrt{7}$
 $a = 2 \pm \sqrt{7}$

5. $h^2 - 12h = 4$
 $h^2 - 12h + 36 = 4 + 36$
 $(h - 6)^2 = 40$
 $h - 6 = \pm 2\sqrt{10}$
 $h = 6 \pm 2\sqrt{10}$
6. $x^2 - 9x + 1 = 0$
 $x^2 - 9x = -1$
 $x^2 - 9x + \frac{81}{4} = -1 + \frac{81}{4}$
 $(x - \frac{9}{2})^2 = \frac{77}{4}$
 $x - \frac{9}{2} = \pm \frac{\sqrt{77}}{2}$
 $x = \frac{9}{2} \pm \frac{\sqrt{77}}{2}$
7. $b^2 - 4ac = (-3)^2 - 4(4)(-7)$ or 121; 2 real
 $x = \frac{-(-3) \pm \sqrt{121}}{2(4)}$
 $x = \frac{3 \pm 11}{8}$
 $x = \frac{7}{4}$ or $x = -1$
8. $b^2 - 4ac = (2)^2 - 4(1)(-10)$ or 44; 2 real
 $w = \frac{-2 \pm \sqrt{44}}{2(1)}$
 $w = -1 \pm \sqrt{11}$
9. $b^2 - 4ac = (-5)^2 - 4(12)(6)$ or -263; 2 imaginary
 $t = \frac{-(-5) \pm \sqrt{-263}}{2(12)}$
 $t = \frac{5 \pm i\sqrt{263}}{24}$
10. $b^2 - 4ac = (6)^2 - 4(1)(-13)$ or 88; 2 real
 $x = \frac{-6 \pm \sqrt{88}}{2(1)}$
 $x = -3 \pm \sqrt{22}$
11. $b^2 - 4ac = (-4)^2 - 4(4)(1)$ or 0; 1 real
 $n = \frac{-(-4) \pm \sqrt{0}}{2(4)}$
 $n = \frac{1}{2}$
12. $b^2 - 4ac = (6)^2 - 4(4)(-15)$ or 276; 2 real
 $x = \frac{-6 \pm \sqrt{276}}{2(4)}$
 $x = \frac{-6 \pm 2\sqrt{69}}{8}$
 $x = \frac{-3 \pm \sqrt{69}}{4}$

Lesson 4-3

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1. $\begin{array}{r|rrr} -2 & 1 & 10 & 8 \\ & & -2 & -16 \\ \hline & 1 & 8 & -8 \end{array}$
 $x + 8, \mathbb{R} - 8$
2. $\begin{array}{r|rrr} 1 & 1 & -3 & 4 & -1 \\ & & 1 & -2 & 2 \\ \hline & 1 & -2 & 2 & 1 \end{array}$
 $x^2 - 2x + 2, \mathbb{R}1$
3. $\begin{array}{r|rrrr} -1 & 1 & 0 & -3 & -5 \\ & & -1 & 1 & 2 \\ \hline & 1 & -1 & -2 & -3 \end{array}$
 $x^2 - x - 2, \mathbb{R} - 3$

$$4. \begin{array}{r} 4 \mid 1 \quad -2 \quad -7 \quad -3 \quad -4 \\ \quad \quad 4 \quad 8 \quad 4 \quad 4 \\ \hline 1 \quad 2 \quad 1 \quad 1 \mid 0 \\ x^3 + 2x^2 + x + 1 \end{array}$$

5. $f(x) = x^2 + 2x - 8$
 $f(-4) = (-4)^2 + 2(-4) - 8$
 $= 16 - 8 - 8$
 $= 0$; yes

6. $f(x) = x^3 + 12$
 $f(1) = (1)^3 + 12$
 $= 1 + 12$ or 13; no

7. $f(x) = 4x^3 + 2x^2 + 6x + 1$
 $f(-1) = 4(-1)^3 + 2(-1)^2 + 6(-1) + 1$
 $= -4 + 2 - 6 + 1$
 $= -7$; no

8. $f(x) = x^4 - 4x^2 + 16$
 $f(4) = (4)^4 - 4(4)^2 + 16$
 $= 256 - 64 + 16$
 $= 208$; no

Lesson 4-4

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1. $p: \pm 1, \pm 2, \pm 3, \pm 6$
 $q: \pm 1$
 $\frac{p}{q}: \pm 1, \pm 2, \pm 3, \pm 6$

r	1	2	-5	-6
1	1	3	-2	-8
-1	1	1	-6	0
2	1	4	3	0
-2	1	0	-5	-16
3	1	5	10	24
-3	1	-1	-2	0

rational roots: -3, -1, 2

2. $p: \pm 1$
 $q: \pm 1, \pm 2$
 $\frac{p}{q}: \pm 1, \pm \frac{1}{2}$

r	2	-1	2	-3	1
1	2	1	3	0	1
-1	2	-3	5	-8	9
$\frac{1}{2}$	2	0	2	-2	0
$-\frac{1}{2}$	2	-2	3	$-\frac{9}{2}$	$\frac{13}{4}$

rational root: $\frac{1}{2}$

3. $p: \pm 1, \pm 2$

$q: \pm 1$
 $\frac{p}{q}: \pm 1, \pm 2$

r	1	1	0	-2
1	1	2	2	0
-1	1	0	0	-2
2	1	3	6	10
-2	1	-1	2	-6

rational root: 1

4. $p: \pm 1, \pm 2, \pm 4, \pm 8$

$q: \pm 1, \pm 2, \pm 3, \pm 6$

$\frac{p}{q}: \pm 1, \pm 2, \pm 4, \pm 8, \pm \frac{1}{2}, \pm \frac{1}{3}, \pm \frac{2}{3}, \pm \frac{4}{3}, \pm \frac{8}{3}, \pm \frac{1}{6}$

r	6	1	22	4	-8
1	6	7	29	33	25
-1	6	-5	27	-23	15
\vdots	\vdots	\vdots	\vdots	\vdots	\vdots
$-\frac{2}{3}$	6	-3	24	-12	0
$\frac{1}{2}$	6	4	24	16	0

rational roots: $-\frac{2}{3}, \frac{1}{2}$

5. 2 or 0 positive

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

1 negative

r	1	-4	-1	4
-1	1	-5	4	0

$x^2 - 5x + 4 = 0$

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

$x = 4, x = 1$

rational zeros: -1, 1, 4

6. 2 or 0 positive

$f(-x) = x^4 - x^3 + 3x^2 + 5x + 10$

2 or 0 negative

r	1	1	3	-5	10
1	1	2	5	0	10
\vdots	\vdots	\vdots	\vdots	\vdots	\vdots
-10	1	-9	93	-935	9360

rational zeros: none

7. 2 or 0 positive

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

1 negative

r	4	0	-7	3
$-\frac{3}{2}$	4	-6	2	0

$4x^2 - 6x + 2 = 0$

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

$x = \frac{1}{2}, x = 1$

rational zeros: $-\frac{3}{2}, \frac{1}{2}, 1$

8. 3 or 1 positive

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

1 negative

r	1	-1	0	-4	-4
1	1	0	0	4	0
\vdots	\vdots	\vdots	\vdots	\vdots	\vdots
-4	1	-5	20	-76	300

rational zero: 1

Lesson 4-5

Page A33

1.

r	2	-4	-5
-2	2	-8	11
-1	2	-6	1
0	2	-4	-5
1	2	-2	-7
2	2	0	-5
3	2	2	1

-1 and 0, 2 and 3

2.

r	1	0	0	-5
-2	1	-2	4	-13
-1	1	-1	1	-6
0	1	0	0	-5
1	1	1	1	-4
2	1	2	4	3

1 and 2

3.

r	1	0	1	4	2
-2	1	-2	3	-2	6
-1	1	-1	0	4	-2
0	1	0	-1	4	2
1	1	1	0	4	6
2	1	2	3	10	22

-2 and -1, -1 and 0

4-6. Use the TABLE feature of a graphing calculator.

4. 0.3, 1.3

5. -2.2, 0.3, 1.2

6. -1.3, 1.3

Lesson 4-6

Page A33

1. $\frac{6}{x} + x = 5$

$$6 + x^2 = 5x$$

$$x^2 - 5x + 6 = 0$$

$$(x - 2)(x - 3) = 0$$

$$x - 2 = 0$$

$$x = 2$$

or

$$x - 3 = 0$$

$$x = 3$$

2. $\frac{7}{y-1} - \frac{4}{y} = \frac{y}{y-1}$

$$7y - 4(y - 1) = y^2$$

$$3y + 4 = y^2$$

$$y^2 - 3y - 4 = 0$$

$$(y - 4)(y + 1) = 0$$

$$y - 4 = 0$$

$$y = 4$$

or

$$y + 1 = 0$$

$$y = -1$$

3. $\frac{5}{r+1} - \frac{4}{r-1} = \frac{1}{r^2-1}$

$$5(r - 1) - 4(r + 1) = 1$$

$$5r - 5 - 4r - 4 = 1$$

$$r = 10$$

4. $2 = \frac{1}{2-t} + \frac{4}{t-2}$

$$2 = \frac{4}{t-2} - \frac{1}{t-2}$$

$$2(t - 2) = 4 - 1$$

$$2t - 4 = 3$$

$$2t = 7$$

$$t = 3.5$$

5. $\frac{1}{3w} + \frac{4}{5w} = \frac{1}{15}$

$$5 + 12 = w$$

$$17 = w; w \neq 0$$

Test $w = -1$: $\frac{1}{3(-1)} + \frac{4}{5(-1)} \stackrel{?}{=} \frac{1}{15}$

$$-\frac{1}{3} - \frac{4}{5} \stackrel{?}{=} \frac{1}{15}$$

$$-\frac{17}{15} \stackrel{?}{=} \frac{1}{15}; \text{ true}$$

Test $w = 1$: $\frac{1}{3(1)} + \frac{4}{5(1)} \stackrel{?}{=} \frac{1}{15}$

$$\frac{1}{3} + \frac{4}{5} \stackrel{?}{=} \frac{1}{15}$$

$$\frac{8}{15} \stackrel{?}{=} \frac{1}{15}; \text{ false}$$

Test $w = 18$: $\frac{1}{3(18)} + \frac{4}{5(18)} \stackrel{?}{=} \frac{1}{15}$

$$\frac{1}{54} + \frac{4}{90} \stackrel{?}{=} \frac{1}{15}$$

$$\frac{4}{135} \stackrel{?}{=} \frac{1}{15}; \text{ true}$$

$w < 0$ or $w \geq 17$

6. $\frac{x-2}{x} = \frac{x-4}{x-6}$
 $(x-6)(x-2) = x(x-4)$
 $x^2 - 8x + 12 = x^2 - 4x$
 $12 = 4x$
 $3 = x; x \neq 0 \text{ or } 6$
 Test $x = -1$: $\frac{(-1)-2}{-1} \stackrel{?}{<} \frac{(-1)-4}{(-1)-6}$
 $3 \stackrel{?}{<} \frac{5}{7}$; false
 Test $x = 1$: $\frac{1-2}{1} \stackrel{?}{<} \frac{1-4}{1-6}$
 $-1 \stackrel{?}{<} -\frac{3}{5}$; true
 Test $x = 4$: $\frac{4-2}{4} \stackrel{?}{<} \frac{4-4}{4-6}$
 $\frac{1}{2} \stackrel{?}{<} 0$; false
 Test $x = 7$: $\frac{7-2}{7} \stackrel{?}{<} \frac{7-4}{7-6}$
 $\frac{5}{7} \stackrel{?}{<} 3$; true
 $0 < x < 3 \text{ or } x > 6$

Lesson 4-7

Page A33

1. $\sqrt{2+3t} = 4$ Check: $\sqrt{2+3(\frac{14}{3})} \stackrel{?}{=} 4$
 $2+3t = 16$ $\sqrt{16} \stackrel{?}{=} 4$
 $3t = 14$ $4 = 4 \checkmark$
 $t = \frac{14}{3}$

2. $4 - \sqrt{x-2} = 1$ Check: $4 - \sqrt{11-2} \stackrel{?}{=} 1$
 $-\sqrt{x-2} = -3$ $4 - 3 \stackrel{?}{=} 1$
 $x-2 = 9$ $1 = 1 \checkmark$
 $x = 11$

3. $\sqrt[3]{y-7} + 10 = 2$ Check: $\sqrt[3]{-505-7} + 10 \stackrel{?}{=} 2$
 $\sqrt[3]{y-7} = -8$ $-8 + 10 \stackrel{?}{=} 2$
 $y-7 = -512$ $2 = 2 \checkmark$
 $y = -505$

4. $\sqrt{a-1} - 5 = \sqrt{a-6}$
 $a-1-10\sqrt{a-1}+25 = a-6$
 $-10\sqrt{a-1} = -30$
 $\sqrt{a-1} = 3$
 $a-1 = 9$
 $a = 10$
 Check: $\sqrt{10-1} - 5 \stackrel{?}{=} \sqrt{10-6}$
 $3 - 5 \stackrel{?}{=} 2$
 $-2 \neq 2$
 no real solution

5. $\sqrt{2x+3} \leq 2$
 $2x+3 \leq 4$
 $2x \leq 1$
 $x \leq \frac{1}{2}$
 $2x+3 \geq 0$
 $2x \geq -3$
 $x \geq -\frac{3}{2}$
 Test $x = -2$: $\sqrt{2(-2)+3} \stackrel{?}{\leq} 2$
 $\sqrt{-1} \stackrel{?}{\leq} 2$; meaningless
 Test $x = 0$: $\sqrt{2(0)+3} \stackrel{?}{\leq} 2$
 $\sqrt{3} \stackrel{?}{\leq} 2$; true
 Test $x = 1$: $\sqrt{2(1)+3} \stackrel{?}{\leq} 2$
 $\sqrt{5} \stackrel{?}{\leq} 2$; false
 Solution: $-\frac{3}{2} \leq x \leq \frac{1}{2}$

6. $\sqrt[4]{6a-2} > 4$
 $6a-2 > 256$
 $6a > 258$
 $a > 43$
 $6a-2 \geq 0$
 $6a \geq 2$
 $a \geq \frac{1}{3}$
 Test $a = 0$: $\sqrt[4]{6(0)-2} \stackrel{?}{>} 4$
 $\sqrt[4]{-2} \stackrel{?}{>} 4$; meaningless
 Test $a = 1$: $\sqrt[4]{6(1)-2} \stackrel{?}{>} 4$
 $\sqrt[4]{4} \stackrel{?}{>} 4$; false
 Test $a = 44$: $\sqrt[4]{6(44)-2} \stackrel{?}{>} 4$
 $\sqrt[4]{262} \stackrel{?}{>} 4$; true
 Solution: $a > 43$

Lesson 4-8

Page A33

1. $f(x) = 0.75x - 2$
 2. $f(x) = x^3 + x^2 - x + 2$
 3. Sample answer: $f(x) = 0.51x^2 + 0.02x - 0.79$
 4a. Sample answer: $y = 0.979x + 94.493$
 4b. Sample answer: about 109.178 thousand
 $f(x) = 0.979x + 94.493$
 $f(15) = 0.979(15) + 94.493 = 109.178$

Lesson 5-1

Page A34

1. $13.75^\circ = 13^\circ + (0.75 \cdot 60)'$
 $= 13^\circ + 45'$
 $= 13^\circ 45'$

$$2. r = \frac{3}{\frac{1}{2}} \text{ or } 6 \qquad \theta = \frac{3\pi}{4} + \pi$$

$$\qquad \qquad \qquad = \frac{7\pi}{4}$$

$$6\left(\cos \frac{7\pi}{4} + i \sin \frac{7\pi}{4}\right) = 6\left(\frac{\sqrt{2}}{2} + i\left(-\frac{\sqrt{2}}{2}\right)\right)$$

$$\qquad \qquad \qquad = 3\sqrt{2} - 3\sqrt{2}i$$

$$3. r = 5 \cdot 2 \text{ or } 10 \qquad \theta = 135^\circ + 45^\circ$$

$$\qquad \qquad \qquad = 180^\circ$$

$$10(\cos 180^\circ + i \sin 180^\circ) = 10(-1 + i(0))$$

$$\qquad \qquad \qquad = -10$$

Lesson 9-8

Page A43

$$1. 4^4 \left(\cos \left(4\right)\left(\frac{\pi}{2}\right) + i \sin \left(4\right)\left(\frac{\pi}{2}\right) \right)$$

$$= 256(\cos 2\pi + i \sin 2\pi)$$

$$= 256(1 + i(0))$$

$$= 256$$

$$2. r = \sqrt{12^2 + (-5)^2} \qquad \theta = \text{Arctan} \left(\frac{12}{-5} \right) + \pi$$

$$= 13 \qquad \qquad \qquad \approx 1.965587446$$

$$13^3(\cos (3)(\theta) + i \sin (3)(\theta)) = 2035 - 828i$$

$$3. r = \sqrt{1^2 + 1^2} \qquad \theta = \text{Arctan} \left(\frac{1}{1} \right)$$

$$= \sqrt{2} \qquad \qquad \qquad = \frac{\pi}{4}$$

$$\sqrt{2}^{\frac{1}{3}} \left(\cos \left(\frac{1}{3} \right) \left(\frac{\pi}{4} \right) + i \sin \left(\frac{1}{3} \right) \left(\frac{\pi}{4} \right) \right)$$

$$= \sqrt{2}^{\frac{1}{3}} \left(\cos \frac{\pi}{12} + i \sin \frac{\pi}{12} \right)$$

$$\approx 1.08 + 0.29i$$

$$4. r = \sqrt{(-1)^2 + 0^2} \qquad \theta = \pi$$

$$= 1$$

$$1^{\frac{1}{5}} \left(\cos \left(\frac{1}{5} \right) (\pi) + i \sin \left(\frac{1}{5} \right) (\pi) \right)$$

$$= 1 \left(\cos \frac{\pi}{5} + i \sin \frac{\pi}{5} \right)$$

$$\approx 0.81 + 0.59i$$

Lesson 10-1

Page A44

$$1. d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$d = \sqrt{(4 - (-2))^2 + (5 - 2)^2}$$

$$d = \sqrt{6^2 + 3^2}$$

$$d = \sqrt{45} \text{ or } 3\sqrt{5}$$

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) = \left(\frac{-2 + 4}{2}, \frac{2 + 5}{2} \right)$$

$$\qquad \qquad \qquad = (1, 3.5)$$

$$2. d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$d = \sqrt{(8 - (-3))^2 + (-1 - 6)^2}$$

$$d = \sqrt{11^2 + (-7)^2}$$

$$d = \sqrt{170}$$

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) = \left(\frac{-3 + 8}{2}, \frac{6 + (-1)}{2} \right)$$

$$\qquad \qquad \qquad = (2.5, 2.5)$$

$$3. d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$d = \sqrt{(r - r)^2 + (-2 - 6)^2}$$

$$d = \sqrt{0^2 + (-8)^2}$$

$$d = \sqrt{64} \text{ or } 8$$

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) = \left(\frac{r + r}{2}, \frac{6 + (-2)}{2} \right)$$

$$\qquad \qquad \qquad = (r, 2)$$

$$4. \left(\frac{6 + x_2}{2}, \frac{2 + y_2}{2} \right) = (-5, 8)$$

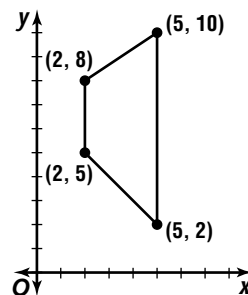
$$\frac{6 + x_2}{2} = -5 \qquad \qquad \frac{2 + y_2}{2} = 8$$

$$6 + x_2 = -10 \qquad \qquad 2 + y_2 = 16$$

$$x_2 = -16 \qquad \qquad y_2 = 14$$

Then A has coordinates $(-16, 14)$.

5. A quadrilateral is a parallelogram if both pairs of opposite sides are parallel. Since only one pair of opposite sides are parallel, the quadrilateral is not a parallelogram.



$$6a. \left(\frac{0 + 50}{2}, \frac{0 + 40}{2} \right) = (25, 20)$$

$$6b. d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$d = \sqrt{(25 - 0)^2 + (20 - 0)^2}$$

$$d = \sqrt{25^2 + 20^2}$$

$$d = \sqrt{1025}$$

$$d = 5\sqrt{41} \text{ or about } 32 \text{ ft}$$

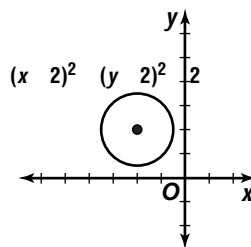
Lesson 10-2

Page A44

$$1. (x - h)^2 + (y - k)^2 = r^2$$

$$[x - (-2)]^2 + (y - 2)^2 = (\sqrt{2})^2$$

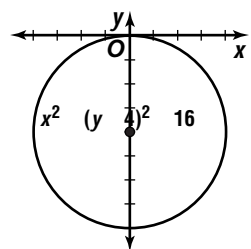
$$(x + 2)^2 + (y - 2)^2 = 2$$



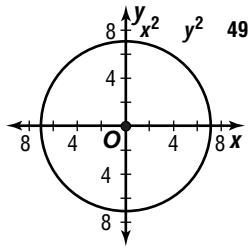
$$2. (x - h)^2 + (y - k)^2 = r^2$$

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

$$x^2 + (y + 4)^2 = 16$$



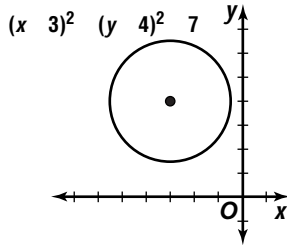
$$3. x^2 = 49 - y^2 \rightarrow x^2 + y^2 = 49$$



$$4. x^2 + y^2 + 6x - 8y + 18 = 0$$

$$(x^2 + 6x + 9) + (y^2 - 8y + 16) = -18 + 9 + 16$$

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



$$5. x^2 + y^2 + Dx + Ey + F = 0$$

$$2^2 + (-2)^2 + 2D - 2E + F = 0 \rightarrow 2D - 2E + F = -8$$

$$0^2 + (-4)^2 + 0(D) - 4E + F = 0 \rightarrow -4E + F = -16$$

$$(-2)^2 + (-2)^2 - 2D - 2E + F = 0 \rightarrow -2D - 2E + F = -8$$

$$\begin{array}{r} 2D - 2E + F = -8 \\ -2D - 2E + F = -8 \\ \hline 4D = 0 \end{array} \quad \begin{array}{r} 2(2 \cdot 0 - 2E + F) = 2(-8) \\ -4E + F = -16 \\ \hline F = 0 \end{array}$$

$$D = 0$$

$$-4E + (0) = -16$$

$$-4E = -16$$

$$E = 4$$

$$x^2 + y^2 + 4y = 0 \quad \text{center: } (0, -2)$$

$$x^2 + (y^2 + 4y + 4) = 0 + 4 \quad \text{radius: } 2$$

$$x^2 + (y + 2)^2 = 4$$

$$6. x^2 + y^2 + Dx + Ey + F = 0$$

$$(-1)^2 + 3^2 - D + 3E + F = 0 \rightarrow -D + 3E + F = -10$$

$$(-4)^2 + 6^2 - 4D + 6E + F = 0 \rightarrow -4D + 6E + F = -52$$

$$(-7)^2 + 3^2 - 7D + 3E + F = 0 \rightarrow -7D + 3E + F = -58$$

$$\begin{array}{r} 2(-D + 3E + F) = 2(-10) \\ -4D + 6E + F = -52 \\ \hline 2D + F = 32 \end{array} \quad \begin{array}{r} -4D + 6E + F = -52 \\ 2(-7D + 3E + F) = 2(-58) \\ \hline 10D - F = 64 \end{array}$$

$$\begin{array}{r} 2D + F = 32 \\ 10D - F = 64 \\ \hline 12D = 96 \end{array} \quad \begin{array}{r} -8 + 3E + F = -10 \\ -4(8) + 6E + F = -52 \\ \hline 24 - 3E = 42 \end{array}$$

$$D = 8 \quad -3E = 18 \quad E = -6$$

$$-(8) + 3(-6) + F = -10$$

$$-26 + F = -10$$

$$F = 16$$

$$x^2 + y^2 + 8x - 6y + 16 = 0$$

$$(x^2 + 8x + 16) + (y^2 - 6y + 9) = -16 + 16 + 9$$

$$(x + 4)^2 + (y - 3)^2 = 9$$

center: $(-4, 3)$
radius: 3

$$7. r = \sqrt{(4 - 2)^2 + (0 - (-5))^2}$$

$$r = \sqrt{2^2 + 5^2}$$

$$r = \sqrt{29}; r^2 = 29$$

$$(x - 4)^2 + (y - 0)^2 = 29$$

$$(x - 4)^2 + y^2 = 29$$

Lesson 10-3

Page A44

1. center: $(h, k) = (0, 0)$

$$a = \frac{10}{2} \text{ or } 5$$

$$b = \frac{6}{2} \text{ or } 3$$

$$\frac{(x - h)^2}{a^2} + \frac{(y - k)^2}{b^2} = 1$$

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

$$\frac{x^2}{25} + \frac{y^2}{9} = 1$$

$$c^2 = a^2 - b^2$$

$$c^2 = 25 - 9$$

$$c^2 = 16$$

$$c = 4$$

foci: $(\pm 4, 0)$

2. center: $(h, k) = (-2, 1)$

$$a = \frac{8}{2} \text{ or } 4$$

$$b = \frac{4}{2} \text{ or } 2$$

$$\frac{(y - k)^2}{a^2} + \frac{(x - h)^2}{b^2} = 1$$

$$\frac{(y - 1)^2}{4^2} + \frac{[x - (-2)]^2}{2^2} = 1$$

$$\frac{(y - 1)^2}{16} + \frac{(x + 2)^2}{4} = 1$$

$$c^2 = a^2 - b^2$$

$$c^2 = 16 - 4$$

$$c^2 = 12$$

$$c = \sqrt{12} \text{ or } 2\sqrt{3}$$

foci: $(-2, 1 \pm 2\sqrt{3})$

3. The major axis contains the foci and it is located on the x -axis.

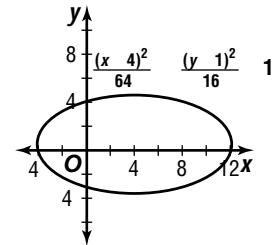
center: $(h, k) = (4, 1)$

$$c^2 = a^2 + b^2$$

$$c^2 = 64 + 16$$

$$c^2 = 80$$

$$c = \sqrt{80} \text{ or } 4\sqrt{5}$$



foci: $(h \pm c, k) = (4 \pm 4\sqrt{5}, 1)$

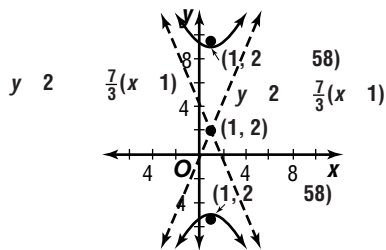
major axis vertices: $(h + a, k) = (4 \pm 8, 1)$
 $= (12, 1) \text{ and } (-4, 1)$

minor axis vertices: $(h, k \pm b) = (4, 1 \pm 4)$
 $= (4, 5) \text{ and } (4, -3)$

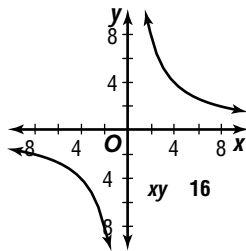
Lesson 10-4

Page A45

1.



2.



3. center: $(h, k) = (-4, 3)$

$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

$$\frac{[x - (-4)]^2}{3^2} - \frac{(y-3)^2}{2^2} = 1$$

$$\frac{(x+4)^2}{9} - \frac{(y-3)^2}{4} = 1$$

4. transverse axis: $x = h = 2$

$$\text{foci: } (h, k+c) = (2, 7) \quad k+c = 7$$

$$(h, k-c) = (2, -3) \quad k-c = -3$$

$$\frac{2k}{2} = 4$$

$$k = 2; c = 5$$

$$\text{vertices: } (h, k+a) = (2, 5) \quad 2+a = 5$$

$$(h, k-a) = (2, -1) \quad a = 3$$

$$a^2 + b^2 = c^2$$

$$3^2 + b^2 = 5^2$$

$$b^2 = 16$$

$$b = 4$$

$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$

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

$$\frac{(y-2)^2}{9} - \frac{(x-2)^2}{16} = 1$$

Lesson 10-5

Page A45

1. vertex = $(h, k) = (0, 0)$

$$4p = 4$$

$$p = 1$$

$$\text{focus: } (h+p, k) = (0+1, 0) \text{ or } (1, 0)$$

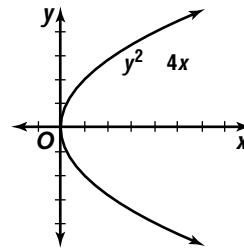
$$\text{directrix: } x = h-p$$

$$x = 0-1$$

$$x = -1$$

$$\text{axis of symmetry: } y = k$$

$$y = 0$$



2. $x^2 - 4x + 4 = 12y - 12$

$$(x-2)^2 = 12(y-1)$$

$$\text{vertex} = (h, k) = (2, 1)$$

$$4p = 12$$

$$p = 3$$

$$\text{focus: } (h, k+p) = (2, 1+3) \text{ or } (2, 4)$$

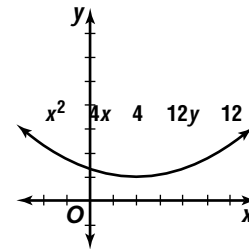
$$\text{directrix: } y = k-p$$

$$y = 1-3$$

$$y = -2$$

$$\text{axis of symmetry: } x = h$$

$$x = 2$$



3. vertex: $(h, k) = (-2, 3)$

$$\text{focus: } (h+p, k) = (0, 3)$$

$$h+p = 0, k = 3$$

$$-2+p = 0$$

$$p = 2$$

$$(y-k)^2 = 4p(x-h)$$

$$(y-3)^2 = 4(2)[x - (-2)]$$

$$(y-3)^2 = 8(x+2)$$

4. directrix: $y = k-p = -3$

$$\text{focus: } (h, k+p) = (0, -2)$$

$$k-p = -3$$

$$-2.5 + p = -2$$

$$\frac{k+p}{2} = -2$$

$$p = 0.5$$

$$\frac{2k}{2} = -5$$

$$k = -2.5$$

$$(x-h)^2 = 4p(y-k)$$

$$(x-0)^2 = 4(0.5)[y - (-2.5)]$$

$$x^2 = 2(y+2.5)$$

Lesson 10-6

Page A45

1. $A = 1$, $C = 1$; since $A = C$, the conic is a circle.

$$\begin{aligned} x^2 + y^2 - 8x + 2y + 13 &= 0 \\ (x^2 - 8x + 16) + (y^2 + 2y + 1) &= -13 + 16 + 1 \\ (x - 4)^2 + (y + 1)^2 &= 4 \end{aligned}$$

2. $A = 1$, $C = -4$; since A and C have different signs, the conic is a hyperbola.

$$\begin{aligned} x^2 - 4y^2 + 10x - 16y &= -5 \\ (x^2 + 10x + 25) - 4(y^2 + 4y + 4) &= -5 + 25 - 16 \\ (x + 5)^2 - 4(y + 2)^2 &= 4 \\ \frac{(x + 5)^2}{4} - \frac{(y + 2)^2}{1} &= 1 \end{aligned}$$

3. $A = 0$, $C = 1$; since $A = 0$, the conic is a parabola.

$$\begin{aligned} y^2 - 5x - 6y + 9 &= 0 \\ (y^2 - 6y + 9) &= 5x - 9 + 9 \\ (y - 3)^2 &= 5x \end{aligned}$$

4. $A = 1$, $C = 2$; since A and C have the same sign

$$\begin{aligned} x^2 + 2y^2 + 2x + 8y &= 15 \\ (x^2 + 2x + 1) + 2(y^2 + 4y + 4) &= 15 + 1 + 8 \\ (x + 1)^2 + 2(y + 2)^2 &= 24 \\ \frac{(x + 1)^2}{24} + \frac{(y + 2)^2}{12} &= 1 \end{aligned}$$

Lesson 10-7

Page A45

1. $B^2 - 4AC = 0^2 - 4(1)(1)$
 $= 0 - 4$ or -4

Since $-4 < 0$ and $A = C$, the graph is a circle.

$$\begin{aligned} x^2 + y^2 &= 9 \\ (x - 1)^2 + [y - (-1)]^2 &= 9 \\ (x - 1)^2 + (y + 1)^2 &= 9 \\ x^2 - 2x + 1 + y^2 + 2y + 1 &= 9 \\ x^2 + y^2 - 2x + 2y - 7 &= 0 \end{aligned}$$

2. $B^2 - 4AC = 0^2 - 4(4)(1)$
 $= 0 - 16$ or -16

Since $-16 < 0$ and $A \neq C$, the graph is an ellipse.

$$\begin{aligned} 4x^2 + y^2 &= 16 \\ 4[x - (-3)]^2 + [y - (-2)]^2 &= 16 \\ 4(x + 3)^2 + (y + 2)^2 &= 16 \\ 4(x^2 + 6x + 9) + (y^2 + 4y + 4) &= 16 \\ 4x^2 + y^2 + 24x + 4y + 24 &= 0 \end{aligned}$$

3. $B^2 - 4AC = 0^2 - 4(49)(-16)$
 $= 0 + 3136$ or 3136

Since $3136 > 0$, the graph is a hyperbola.

$$\begin{aligned} 49x^2 - 16y^2 &= 784 \\ 49\left(x' \cos \frac{\pi}{4} + y' \sin \frac{\pi}{4}\right)^2 - 16\left(-x' \sin \frac{\pi}{4} + y' \cos \frac{\pi}{4}\right)^2 &= 784 \\ 49\left(\frac{\sqrt{2}}{2}x' + \frac{\sqrt{2}}{2}y'\right)^2 - 16\left(-\frac{\sqrt{2}}{2}x' + \frac{\sqrt{2}}{2}y'\right)^2 &= 784 \\ 49\left[\frac{1}{2}(x')^2 + x'y' + \frac{1}{2}(y')^2\right] - 16\left[\frac{1}{2}(x')^2 - x'y' + \frac{1}{2}(y')^2\right] &= 784 \\ \frac{49}{2}(x')^2 + 49x'y' + \frac{49}{2}(y')^2 - 8(x')^2 + 16x'y' - 8(y')^2 &= 784 \\ 49(x')^2 + 98x'y' + 49(y')^2 - 16(x')^2 + 32x'y' - 16(y')^2 &= 1568 \\ 33(x')^2 + 130x'y' + 33(y')^2 - 1568 &= 0 \end{aligned}$$

4. $B^2 - 4AC = 0^2 - 4(4)(-25)$
 $= 0 + 400$ or 400

Since $400 > 0$, the graph is a hyperbola.

$$\begin{aligned} 4x^2 - 25y^2 &= 64 \\ 4(x' \cos 90^\circ + y' \sin 90^\circ)^2 - 25(-x' \sin 90^\circ + y' \cos 90^\circ)^2 &= 64 \\ 4(0 + y')^2 - 25(-x' + 0)^2 &= 64 \\ 4(y')^2 - 25(x')^2 - 64 &= 0 \end{aligned}$$

5. $B^2 - 4AC = (-2\sqrt{2})^2 - 4(1)(2)$
 $= 8 - 8$ or 0

parabola

$$\tan 2\theta = \frac{B}{A - C}$$

$$\tan 2\theta = \frac{-2\sqrt{2}}{1 - 2}$$

$$\tan 2\theta = 2\sqrt{2}$$

$$2\theta \approx 70.52877937^\circ$$

$$\theta \approx 35, -35^\circ$$

6. $B^2 - 4AC = 5^2 - 4(15)(5)$
 $= 25 - 300$ or -275

Since $-275 < 0$ and $A \neq C$, the graph is an ellipse.

$$\tan 2\theta = \frac{B}{A - C}$$

$$\tan 2\theta = \frac{5}{15 - 5}$$

$$\tan 2\theta = \frac{1}{2}$$

$$2\theta \approx 26.56505118^\circ$$

$$\theta \approx 13^\circ$$

Lesson 10-8

Page A45

1. $xy = 3$

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

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

$$x^2 - \left(\frac{3}{x}\right)^2 = 8$$

$$x^2 - \frac{9}{x^2} = 8$$

$$x^4 - 9 = 8x^2$$

$$x^4 - 8x^2 - 9 = 0$$

$$(x^2 - 9)(x^2 + 1) = 0$$

$$x^2 - 9 = 0 \quad \text{or} \quad x^2 + 1 = 0$$

$$x^2 = 9 \quad x^2 = -1$$

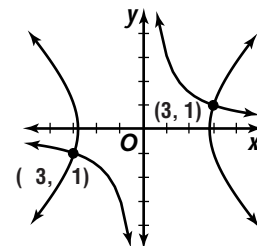
$$x = \pm 3 \quad x = \sqrt{-1} \text{ or } i$$

If $x = 3$, then $y = \frac{3}{(3)}$ or 1 .

If $x = -3$, then $y = \frac{3}{(-3)}$ or -1 .

Since $x = \sqrt{-1}$ is an imaginary number, disregard this solution.

$(3, 1)$, $(-3, -1)$



$$\begin{aligned}
 2. \quad x - y &= 4 & x^2 &= 10y^2 + 10 \\
 x &= y + 4 & (y + 4)^2 &= 10y^2 + 10 \\
 & & y^2 + 8y + 16 &= 10y^2 + 10 \\
 & & 9y^2 - 8y - 6 &= 0
 \end{aligned}$$

$$y = \frac{-(-8) \pm \sqrt{(-8)^2 - 4(9)(-6)}}{2(9)}$$

$$y = \frac{8 \pm 2\sqrt{70}}{18}$$

$$y = \frac{4 \pm \sqrt{70}}{9}$$

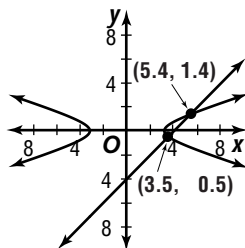
$$y = \frac{4 \pm \sqrt{70}}{9} \text{ or } y = \frac{4 - \sqrt{70}}{9}$$

$$y \approx 1.4 \quad y \approx -0.5$$

If $y = 1.4$, then $x = (1.4) + 4$ or 5.4 .

If $y = -0.5$, then $x = (-0.5) + 4$ or 3.5 .

$(5.4, 1.4)$, $(3.5, -0.5)$



Lesson 11-1

Page A46

$$1. \quad (-12)^{-2} = \frac{1}{(-12)^2} = \frac{1}{144}$$

$$2. \quad -12^{-2} = -\frac{1}{12^2} = -\frac{1}{144}$$

$$3. \quad (4 \cdot 6)^3 = 4^3 \cdot 6^3 = 64 \cdot 216 = 13,824$$

$$4. \quad \left(\frac{2}{3}\right)^4 = \frac{2^4}{3^4} = \frac{16}{81}$$

$$5. \quad \frac{16}{16^{\frac{1}{2}}} = \frac{16}{(4^2)^{\frac{1}{2}}} = \frac{16}{4} \text{ or } 4$$

$$6. \quad 27^{\frac{1}{2}} \cdot 20^{\frac{1}{2}} = (3^2 \cdot 3)^{\frac{1}{2}} \cdot (2^2 \cdot 5)^{\frac{1}{2}} = (3^2)^{\frac{1}{2}} \cdot 3^{\frac{1}{2}} \cdot (2^2)^{\frac{1}{2}} \cdot 5^{\frac{1}{2}} = 3 \cdot 2 \cdot 15^{\frac{1}{2}} = 6\sqrt{15}$$

$$7. \quad (\sqrt[4]{625})^2 = 625^{\frac{2}{4}} = 625^{\frac{1}{2}} = \sqrt{625} \text{ or } 25$$

$$8. \quad \frac{1}{\sqrt[3]{(15)^6}} = \frac{1}{15^{\frac{6}{3}}} = \frac{1}{15^2} = \frac{1}{225}$$

$$9. \quad (2a^4)^2 = 2^2 \cdot (a^4)^2 = 4a^8$$

$$10. \quad (x^4)^3 \cdot x^5 = x^{12} \cdot x^5 = x^{17}$$

$$11. \quad ((3f)^{-2})^3 = (3f)^{-6} = \frac{1}{(3f)^6} = \frac{1}{3^6 \cdot f^6} = \frac{1}{729f^6}$$

$$12. \quad \left(\frac{c^{-3a}}{c^{4a}}\right)^2 = \frac{c^{-6a}}{c^{8a}} = c^{-14a} = \frac{1}{c^{14a}}$$

$$13. \quad (2n^{\frac{1}{3}} \cdot 3n^{\frac{1}{2}})^6 = 2^6 n^{\frac{6}{3}} \cdot 3^6 n^{\frac{6}{2}} = 64n^2 \cdot 729n^3 = 46,656n^5$$

$$14. \quad \left(\frac{h^6}{216h^{-3}}\right)^{-\frac{1}{3}} = \left(\frac{h^9}{216}\right)^{-\frac{1}{3}} = \frac{h^{-\frac{9}{3}}}{216^{-\frac{1}{3}}} = \frac{216^{\frac{1}{3}}}{h^3} = \frac{\sqrt[3]{216}}{h^3} = \frac{6}{h^3}$$

$$15. \quad \sqrt[3]{z^4(z^4)^{\frac{1}{2}}} = \sqrt[3]{z^4 \cdot z^2} = \sqrt[3]{z^6} = z^{\frac{6}{3}} = z^2$$

$$16. \quad (4r^2t^5)(16r^4t^8)^{\frac{1}{4}} = (4r^2t^5)(16^{\frac{1}{4}}r^{\frac{4}{4}}t^{\frac{8}{4}}) = (4r^2t^5)(2rt^2) = 8r^3t^7$$

$$17. \quad \sqrt{a^3b^5} = a^{\frac{3}{2}}b^{\frac{5}{2}}$$

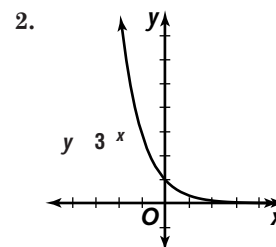
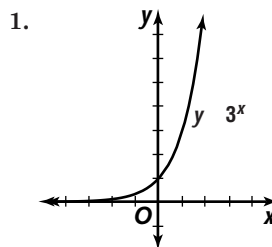
$$18. \quad \sqrt[3]{64m^9n^6} = 64^{\frac{1}{3}}m^{\frac{9}{3}}n^{\frac{6}{3}} = (4^3)^{\frac{1}{3}}m^3n^2 = 4m^3n^2$$

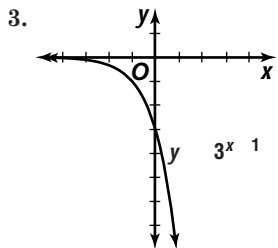
$$19. \quad 15\sqrt[3]{r^{12}t^2} = 15r^{\frac{12}{3}}t^{\frac{2}{3}} = 15r^4t^{\frac{2}{3}}$$

$$20. \quad \sqrt[8]{256x^2y^{16}} = 256^{\frac{1}{8}}x^{\frac{2}{8}}y^{\frac{16}{8}} = (2^8)^{\frac{1}{8}}x^{\frac{1}{4}}y^2 = 2x^{\frac{1}{4}}y^2$$

Lesson 11-2

Page A46





Lesson 11-3

Page A46

1. $p = (100 - a)e^{-bt} + a$
 $p = (100 - 18)e^{-0.6(2)} + 18$
 $\approx 42.7\%$

2. $y = ae^{-kt} + c$
 $y = 140e^{-0.01(10)} + 70$
 $\approx 197^\circ \text{F}$

3a. $y = 6.7e^{\frac{-48.1}{t}}$
 $y = 6.7e^{\frac{-48.1}{15}}$
 $y \approx 0.271292$ millions of cubic feet
 $y \approx 271,292 \text{ ft}^3$

3b. $y = 6.7e^{\frac{-48.1}{t}}$
 $y = 6.7e^{\frac{-48.1}{50}}$
 $y \approx 2.560257$ millions of cubic feet
 $y \approx 2,560,257 \text{ ft}^3$

4. Continuously Semiannually
 $A = Pe^{rt}$ $A = P\left(1 + \frac{r}{n}\right)^{nt}$
 $A = 5000e^{0.058(20)}$ $A = 5000\left(1 + \frac{0.058}{2}\right)^{2(20)}$
 $A = \$15,949.67$ $A = \$15,688.63$

The account that compounds continuously would earn \$261.04 more than the account compounded semiannually.

Lesson 11-4

Page A47

1. $16^{\frac{1}{4}} = 2$

2. $\left(\frac{1}{2}\right)^{-3} = 8$

3. $4^{-1} = \frac{1}{4}$

4. $\log_8 x = -2$

5. $\log_x 32 = 5$

6. $\log_{\frac{1}{4}} 16 = -2$

7. $\log_5 \frac{1}{5} = x$
 $5^x = \frac{1}{5}$
 $5^x = 5^{-1}$
 $x = -1$

8. $\log_3 27 = x$
 $3^x = 27$
 $3^x = 3^3$
 $x = 3$

9. $\log_{36} 6 = x$
 $36^x = 6$
 $(6^2)^x = 6$
 $6^{2x} = 6^1$
 $2x = 1$
 $x = \frac{1}{2}$

10. $\log_3 y = 4$
 $3^4 = y$
 $81 = y$

11. $\log_5 r = \log_5 8$
 $r = 8$

12. $\log_5 35 - \log_5 d = \log_5 5$
 $\log_5 \frac{35}{d} = \log_5 5$
 $\frac{35}{d} = 5$
 $7 = d$

13. $\log_4 \sqrt{4} = x$
 $\log_4 4^{\frac{1}{2}} = x$
 $\frac{1}{2} \log_4 4 = x$
 $\frac{1}{2} = x$

14. $\log_4 (2x + 3) = \log_4 15$
 $2x + 3 = 15$
 $2x = 12$
 $x = 6$

15. $4 \log_8 2 + \frac{1}{3} \log_8 27 = \log_8 a$
 $\log_8 2^4 + \log_8 27^{\frac{1}{3}} = \log_8 a$
 $\log_8 16 + \log_8 3 = \log_8 a$
 $\log_8 48 = \log_8 a$
 $48 = a$

Lesson 11-5

Page A47

1. $\log 5000 = \log (5 \cdot 1000)$
 $= \log 5 + \log 10^3$
 $= \log 5 + 3 \log 10$
 $= 0.6990 + 3$
 $= 3.6990$

2. $\log 0.0008 = \log (0.0001 \cdot 8)$
 $= \log 10^{-4} + \log 8$
 $= -4 \log 10 + \log 8$
 $= -4 + 0.9031$
 $= -3.0969$

3. $\log 0.14 = \log (0.01 \cdot 14)$
 $= \log 10^{-2} + \log 14$
 $= -2 \log 10 + \log 14$
 $= -2 + 1.1461$
 $= -0.8539$

4. $\log_3 81 = \frac{\log 81}{\log 3}$
 $= 4$

5. $\log_6 12 = \frac{\log 12}{\log 6}$
 ≈ 1.3869

6. $\log_5 29 = \frac{\log 29}{\log 5}$
 ≈ 2.0922

$$7. \quad 3^x = 45$$

$$x \log 3 = \log 45$$

$$x = \frac{\log 45}{\log 3}$$

$$x \approx 3.4650$$

$$8. \quad 6^x = 2^{x-1}$$

$$x \log 6 = (x-1) \log 2$$

$$x \log 6 = x \log 2 - \log 2$$

$$x \log 6 - x \log 2 = -\log 2$$

$$x (\log 6 - \log 2) = -\log 2$$

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

$$x \approx -0.6309$$

$$9. \quad 5 \log y = \log 32$$

$$\log y^5 = \log 32$$

$$y^5 = 32$$

$$y^5 = 2^5$$

$$y = 2$$

Lesson 11-6

Page A47

$$1. \quad 3.5553$$

$$2. \quad -0.5763$$

$$3. \quad 3.4398$$

$$4. \quad \log_{15} 10 = \frac{\ln 10}{\ln 15}$$

$$\approx 0.8503$$

$$5. \quad \log_3 14 = \frac{\ln 14}{\ln 3}$$

$$\approx 2.4022$$

$$6. \quad \log_8 350 = \frac{\ln 350}{\ln 8}$$

$$\approx 2.8171$$

$$7. \quad 5^x = 90$$

$$x \ln 5 = \ln 90$$

$$x = \frac{\ln 90}{\ln 5}$$

$$x \approx 2.7959$$

$$8. \quad 7^{x+2} = 5.25$$

$$(x+2) \ln 7 = \ln 5.25$$

$$x \ln 7 + 2 \ln 7 = \ln 5.25$$

$$x \ln 7 = \ln 5.25 - 2 \ln 7$$

$$x = \frac{\ln 5.25 - 2 \ln 7}{\ln 7}$$

$$x \approx -1.1478$$

$$9. \quad 4^x = 4\sqrt{3}$$

$$x \ln 4 = \ln 4\sqrt{3}$$

$$x = \frac{\ln 4\sqrt{3}}{\ln 4}$$

$$x \approx 1.3962$$

$$10. \quad 6e^x = 48$$

$$e^x = 8$$

$$x \ln e = \ln 8$$

$$x \approx 2.0794$$

$$11. \quad 50.2 < e^{0.2x}$$

$$\ln 50.2 < 0.2x \ln e$$

$$\frac{\ln 50.2}{0.2} < x$$

$$x > 19.5801$$

$$12. \quad 16 = 10(1 + e^x)$$

$$1.6 = 1 + e^x$$

$$0.6 = e^x$$

$$\ln 0.6 = x \ln e$$

$$-0.5108 \approx x$$

Lesson 11-7

Page A47

$$1. \quad t = \frac{\ln 2}{0.045}$$

$$\approx 15.40 \text{ yr}$$

$$2. \quad t = \frac{\ln 2}{0.06}$$

$$\approx 11.55 \text{ yr}$$

$$3. \quad t = \frac{\ln 2}{0.08125}$$

$$\approx 8.53 \text{ yr}$$

$$4a. \quad y = 5.2449(1.5524)^x$$

$$4b. \quad y = 5.2449(e^{\ln 1.5524})^x$$

$$y \approx 5.2449e^{0.4398x}$$

$$4c. \quad \text{Use } t = \frac{\ln 2}{k}; k = 0.4398$$

$$t = \frac{\ln 2}{0.4398}$$

$$\approx 1.58 \text{ hr}$$

Lesson 12-1

Page A48

$$1. \quad d = 3 - 7 \text{ or } -4$$

$$-1 + (-4) = -5, -5 + (-4) = -9,$$

$$-9 + (-4) = -13, -13 + (-4) = -17$$

$$-5, -9, -13, -17$$

$$2. \quad d = -1 - 0.5 \text{ or } -1.5$$

$$-2.5 + (-1.5) = -4, -4 + (-1.5) = -5.5,$$

$$-5.5 + (-1.5) = -7, -7 + (-1.5) = -8.5$$

$$-4, -5.5, -7, -8.5$$

$$3. \quad d = -8 - (-14) \text{ or } 6$$

$$-2 + 6 = 4, 4 + 6 = 10,$$

$$10 + 6 = 16, 16 + 6 = 22$$

$$4, 10, 16, 22$$

$$4. \quad d = 2.8 - 3 \text{ or } -0.2$$

$$2.6 + (-0.2) = 2.4, 2.4 + (-0.2) = 2.2,$$

$$2.2 + (-0.2) = 2, 2 + (-0.2) = 1.8$$

$$2.4, 2.2, 2, 1.8$$

$$5. \quad d = -x - 4x \text{ or } -5x$$

$$-6x + (-5x) = -11x, -11x + (-5x) = -16x,$$

$$-16x + (-5x) = -21x, -21x + (-5x) = -26x$$

$$-11x, -16x, -21x, -26x$$

$$6. \quad d = (2y - 2) - (2y - 4)$$

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

$$= 2$$

$$2y + 2, 2y + 2 + 2 = 2y + 4,$$

$$2y + 4 + 2 = 2y + 6, 2y + 6 + 2 = 2y + 8$$

$$2y + 2, 2y + 4, 2y + 6, 2y + 8$$