EXTRA PRACTICE

Lesson 1-1 *(Pages 5–11)*

State the domain and range of each relation. Then state whether the relation is a function. Write *yes* or *no*.

1. $\{(1, 4), (-2, 2), (2, 2), (1, -4)\}$
2. $\{(0.5, 3), (-0.5, 3), (3, 0.5), (-3, 0.5)\}$
3. $\{(2, 2), (5, 7), (-1, 1), (0, 3), (7, 5)\}$
4. $\{(3.2, 4), (2.3, -4), (2, 3), (3.2, -1)\}$

Evaluate each function for the given value.

5. $f(4)$ if $f(x) = 4x - 2$
6. $g(-3)$ if $g(x) = 2x^2 - x + 5$
7. $h(1.5)$ if $h(x) = \frac{3}{2x}$
8. $k(5m)$ if $k(x) = |3x^2 - 3|$

Lesson 1-2 *(Pages 13–19)*

1. Given $f(x) = 2x - 1$ and $g(x) = x^2 + 3x - 1$, find $f(x) + g(x)$, $f(x) - g(x)$, $f(x) \cdot g(x)$, and $\left(\frac{f}{g}\right)(x)$.

Find $[f \circ g](x)$ and $[g \circ f](x)$ for each $f(x)$ and $g(x)$.

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

Lesson 1-3 *(Pages 20–25)*

Find the zero of each function. If no zero exists, write *none*. Then graph the function.

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

Lesson 1-4 *(Pages 26–31)*

Write an equation in slope-intercept form for each line described.

1. slope $= 2$, y-intercept $= 1$
2. slope $= -1$, passes through $(1, 2)$
3. slope $= -\frac{1}{4}$, y-intercept $= -3$
4. slope $= 0$, passes through $(-2, -4)$
5. passes through $A(2, 1)$ and $B(-2, 3)$
6. x-intercept $= -1$, y-intercept $= 6$
7. the x-axis
8. slope $= 1.5$, x-intercept $= 10$

Lesson 1-5 *(Pages 32–37)*

1. Are the graphs of $y = 4x - 2$ and $y = -4x + 3$ *parallel, coinciding, perpendicular,* or *none of these*? Explain.

Write the standard form of the equation of the line that is parallel to the graph of the given equation and passes through the point with the given coordinates.

2. $y = x + 1$; $(0, -2)$
3. $y = 2x - 2$; $(1, 3)$
4. $y = -1$; $(-4, 12)$

Write the standard form of the equation of the line that is perpendicular to the graph of the given equation and passes through the point with the given coordinates.

5. $3x - y = 5$; $(-2, 6)$
6. $x = 10$; $(12, -15)$
7. $5x - 2y = 1$; $(3, -7)$

Lesson 1-6 *(Pages 38–44)*

The table shows the number of students enrolled in U.S. public elementary and secondary schools for several school years.

Students Enrolled in U.S. Public Elementary and Secondary Schools								
School Year	1989–1990	1990–1991	1991–1992	1992–1993	1993–1994	1994–1995	1995–1996	2010–2011
Enrollment (thousands)	40.5	41.2	42.0	42.8	43.5	44.1	44.8	?

Source: *The World Almanac,* 1999

1. Graph the data on a scatter plot. Use the last year of the school year for your graph.
2. Use two ordered pairs to write the equation of a best-fit line.
3. Use a graphing calculator to find an equation of the regression line for the data. What is the correlation value?
4. If the equation of the regression line shows a moderate or strong relationship, predict the missing value. Explain whether you think the prediction is reliable.

Lesson 1-7 *(Pages 45–51)*

Graph each function.

1. $f(x) = \begin{cases} x + 2 \text{ if } x \le -1 \\ 2x \text{ if } x > -1 \end{cases}$
2. $g(x) = |x + 2|$
3. $h(x) = [\![x]\!] - 1$
4. $f(x) = \begin{cases} -2 \text{ if } -2 \le x \le -1 \\ x \text{ if } -1 < x \le 2 \\ 3x \text{ if } x > 2 \end{cases}$
5. $g(x) = |5 - 2x|$
6. $k(x) = 2[\![x]\!]$

Lesson 1-8 *(Pages 52–56)*

Graph each inequality.

1. $y > 2$
2. $x + y \le 3$
3. $-y > x + 1$
4. $4x + 2y \le 6$
5. $-1 \le x + y \le 4$
6. $y \le |x|$

Lesson 2-1 *(Pages 67–72)*

Solve each system of equations by graphing. Then state whether the system is *consistent and independent, consistent and dependent,* or *inconsistent.*

1. $2x - y - 1 = 0$
   $3y = 6x - 3$
2. $y - 3x = 8$
   $x + y = 4$
3. $3x - y = -1$
   $2y - 6x = -4$

Solve each system of equations algebraically.

4. $5x + 2y = 1$
   $x + 2y = 5$
5. $2x + 4y = 8$
   $2x + 3y = 8$
6. $8x + 2y = 2$
   $3x - 4y = -23$

Lesson 2-2 *(Pages 73–77)*

Solve each system of equations.

1. $x + y = 6$
   $x + z = -2$
   $y + z = 2$
2. $x + 2y - z = -7$
   $2x - 2y - z = 6$
   $x + y - 2z = -6$
3. $2x - 3y + z = 1$
   $x + y - z = -4$
   $3x - 2y + 2z = 3$

Lesson 2-3 *(Pages 78–86)*

Find the values of x and y for which each of the following equations is true.

1. $\begin{bmatrix} 2x + y \\ x + 2y \end{bmatrix} = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$
2. $\begin{bmatrix} x + 2y \\ 2x - 2y \end{bmatrix} = \begin{bmatrix} 5 \\ -2 \end{bmatrix}$
3. $\begin{bmatrix} 3x \\ 4y \end{bmatrix} = \begin{bmatrix} y - 7 \\ 5x \end{bmatrix}$

Use matrices A, B, C, D, and E to find each of the following. If the matrix does not exist, write *impossible.*

$$A = \begin{bmatrix} 4 & -1 \\ 1 & 5 \\ 2 & 6 \end{bmatrix} \quad B = \begin{bmatrix} 2 & 0 & -3 \\ 4 & -3 & 2 \end{bmatrix} \quad C = \begin{bmatrix} 7 & -5 \\ 0 & 1 \\ 8 & 4 \end{bmatrix} \quad D = \begin{bmatrix} -4 & 1 \\ 2 & 3 \end{bmatrix} \quad E = \begin{bmatrix} 1 & -5 \\ -3 & 2 \end{bmatrix}$$

4. $A + C$
5. $D - E$
6. $4B$
7. $D + B$
8. $2C + 3A$
9. AC
10. ED
11. $BC - D$

Lesson 2-4 *(Pages 88–96)*

Use matrices to perform each transformation. Then graph the pre-image and image on the same coordinate grid.

1. Triangle ABC has vertices $A(5, -3)$, $B(2, 4)$, and $C(-2, -6)$. Use scalar multiplication to find the coordinates of the triangle after a dilation of scale factor 0.5.
2. Quadrilateral $JKLM$ has vertices $J(6, -2)$, $K(-3, -5)$, $L(-4, 7)$, and $M(1, 5)$. Find the coordinates of the quadrilateral after a translation of 2 units left and 3 units down.
3. Triangle NPQ is represented by the matrix $\begin{bmatrix} -5 & 3 & 0 \\ 2 & 8 & -4 \end{bmatrix}$. Find the coordinates of the image of the triangle after a reflection over the y-axis.
4. Square $WXYZ$ has vertices $W(-3, 3)$, $X(-6, 2)$, $Y(-5, -1)$, and $Z(-2, 0)$. Find the coordinates of the image of the square after a rotation of 180° counterclockwise about the origin.
5. Triangle FGH has vertices $F(-4, 2)$, $G(2, -3)$, and $H(-6, -7)$. Find the coordinates of the image of $\triangle FGH$ after $Rot_{90} \circ R_{y=x}$.

Lesson 2-5 *(Pages 98–105)*

Find the value of each determinant.

1. $\begin{vmatrix} 3 & 7 \\ -11 & 2 \end{vmatrix}$
2. $\begin{vmatrix} -3 & -5 \\ -7 & -2 \end{vmatrix}$
3. $\begin{vmatrix} -5 & 0 \\ -\frac{1}{2} & -6 \end{vmatrix}$
4. $\begin{vmatrix} -1 & 0 & 2 \\ -3 & 1 & -2 \\ 5 & -1 & -3 \end{vmatrix}$
5. $\begin{vmatrix} -1 & 3 & 2 \\ 4 & -2 & 1 \\ 3 & -3 & -4 \end{vmatrix}$
6. $\begin{vmatrix} 4 & 0 & -1 \\ 5 & 3 & 6 \\ -2 & -5 & 2 \end{vmatrix}$

Find the multiplicative inverse of each matrix, if it exists.

7. $\begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix}$
8. $\begin{bmatrix} 10 & 0 \\ 5 & 4 \end{bmatrix}$
9. $\begin{bmatrix} 5 & -6 \\ -3 & 4 \end{bmatrix}$
10. $\begin{bmatrix} 3 & -5 \\ 6 & 1 \end{bmatrix}$

Solve each system by using a matrix equation.

11. $3x + 2y = 22$
    $x - 2y = -6$
12. $4x - 2y = -6$
    $3x + y = -7$
13. $2x + y = 4$
    $4x - 3y = 13$

Lesson 2-6 *(Pages 107–111)*

Solve each system of inequalities by graphing. Name the vertices of each polygonal convex set. Then, find the maximum and minimum values of each function for the set.

1. $x \leq 3$
   $y \geq 1$
   $y \leq 2x + 1$
   $f(x, y) = 4x + 3y$
2. $y \geq 2$
   $0 \leq x \leq 4$
   $y \leq x + 3$
   $f(x, y) = 2x - y$
3. $y \leq -x$
   $y \geq 2x - 4$
   $|x| \leq 1$
   $f(x, y) = -x - y$

Lesson 2-7 *(Pages 112–118)*

Solve each problem, if possible. If not possible, state whether the problem is *infeasible,* has *alternate optimal solutions,* or is *unbounded.*

1. **Business** The area of a parking lot is 600 square meters. A car requires 6 square meters of space and a bus requires 30 square meters. The attendant can handle only 60 vehicles. If a car is charged \$3.00 and a bus is charged \$8.00, find how many of each type of vehicle should be accepted to maximize income.
2. **Manufacturing** Based on survey results, Yummy Ice Cream concluded that it should make at least twice as many gallons of black walnut flavor as chocolate mint flavor. One distributor wants to order at least 20,000 gallons of the chocolate mint flavor. The company has all of the ingredients to produce both flavors, but it has only 45,000 gallon size containers available. If each gallon of ice cream sells for \$2.95, how many gallons of each type flavor should the company produce?
3. **Business** Cathy places greeting cards from two different companies on a display rack that can hold 90 cards. She has agreed to display at least 40 of company A's cards on the rack and at least 25 of company B's cards. Cathy makes a profit of \$0.30 on each card she sells from company A and \$0.32 on each card she sells from company B. How many cards should Cathy display from each company to maximize her profit?
4. **Personal Finance** Kristin makes \$5 an hour at a video store and \$7 an hour at a landscaping company. She must work at least 4 hours per week at the video store, and the total number of hours she works at both jobs in a week cannot be greater than 15. What is the maximum amount Kristin could earn (before deductions) in a week?

Lesson 3-1 *(Pages 127–136)*

Determine whether the graph of each function is symmetric with respect to the origin.

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

Determine whether the graph of each equation is symmetric with respect to the x-axis, y-axis, the line $y = x$, the line $y = -x$, or none of these.

4. $xy = 2$
5. $y + x^2 = 3$
6. $y^2 = \frac{2x^2}{7} + 1$
7. $|x| = 4y$
8. $y = 3x$
9. $y = \pm\sqrt{x^2 - 1}$

Lesson 3-2 *(Pages 137–145)*

Describe how the graphs of $f(x)$ and $g(x)$ are related.

1. $f(x) = \frac{1}{x}$ and $g(x) = \frac{1}{x} + 2$
2. $f(x) = x^2$ and $g(x) = 3x^2$
3. $f(x) = |x|$ and $g(x) = |x + 4| - 3$
4. $f(x) = x^3$ and $g(x) = \frac{1}{2}(x - 1)^3$
5. Write the equation of the graph obtained when the graph of $y = [\![x]\!]$ is expanded horizontally by a factor of 2 reflected over the x-axis, and then translated 5 units down.

Lesson 3-3 *(Pages 146–151)*

Graph each inequality.

1. $y \leq x^2 + 1$
2. $y > |x + 4|$
3. $y \leq -\sqrt{x - 2}$
4. $y < 2|x - 1|$
5. $y \leq |x| + 2$
6. $y > (x + 2)^2 - 1$

Solve each inequality.

7. $|x - 2| \leq 3$
8. $|4x - 2| \geq 18$
9. $|5 - 2x| < 9$
10. $|x + 1| - 3 > 1$
11. $|2x + 3| < 27$
12. $|3x + 4| - 3x \geq 0$

Lesson 3-4 *(Pages 152–158)*

Graph each function and its inverse.

1. $f(x) = |x| - 2$
2. $f(x) = x^2 + 1$
3. $f(x) = -1$

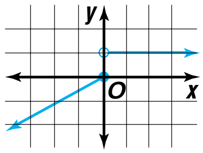
Find $f^{-1}(x)$. Then state whether $f^{-1}(x)$ is a function.

4. $f(x) = 4x - 5$
5. $f(x) = -2x + 2$
6. $f(x) = x^2 + 6$
7. $f(x) = (x - 2)^2$
8. $f(x) = -\frac{x}{2}$
9. $f(x) = \frac{1}{x - 4}$
10. $f(x) = x^2 + 8x - 2$
11. $f(x) = x^3 + 4$
12. $f(x) = -\frac{3}{(x + 1)^2}$

Lesson 3-5 *(Pages 159–168)*

Determine whether each function is continuous at the given x-value. Justify your response using the continuity test.

1. $y = x^2 - 3$; $x = 2$
2. $y = \dfrac{x}{x+3}$; $x = -3$
3. $f(x) = \dfrac{x-2}{(x-1)^2}$; $x = 1$
4. $f(x) = \begin{cases} x - 2 \text{ if } x \geq 3 \\ 2x - 5 \text{ if } x < 3 \end{cases}$; $x = 3$
5. Determine whether the graph at the right has infinite discontinuity, jump discontinuity, or point discontinuity, or is continuous.

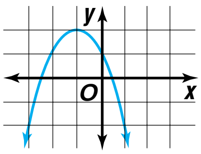


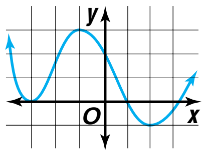
Describe the end behavior of each function.

6. $y = x^3 + 3x^2 + x - 2$
7. $y = 5 - x^4$
8. $f(x) = \dfrac{3}{x^2}$

Lesson 3-6 *(Pages 171–179)*

Locate the extrema for the graph of $y = f(x)$. Name and classify the extrema of the function.

1. 

2. 

Lesson 3-7 *(Pages 180–188)*

Determine the equations of the vertical and horizontal asymptotes, if any, of each function.

1. $f(x) = \dfrac{3x}{x-2}$
2. $g(x) = \dfrac{2x^2}{x+3}$
3. $h(x) = \dfrac{x-5}{x^2+6x+5}$
4. Does the function $f(x) = \dfrac{x^2+2x+1}{x-3}$ have a slant asymptote? If so, find an equation of the slant asymptote. If not, explain.

Lesson 3-8 *(Pages 189–196)*

Find the constant of variation for each relation and use it to write an equation for each statement. Then solve the equation.

1. If y varies directly as x, and $y = 8$ when $x = 2$, find y when $x = 9$.
2. If g varies directly as w, and $g = 10$ when $w = -3$, find w when $g = 4$.
3. If t varies inversely as r, and $r = 14$ when $t = -6$, find r when $t = -7$.
4. If y varies jointly as x and z, and $y = 60$ when $x = 5$, and $z = 4$, find y when $x = 5$ and $z = 10$.
5. Suppose y varies inversely as the square of x and $x = 3$ when $y = 27$. Find y when $x = 5$.
6. Suppose a varies jointly as b and the cube of c and $a = -36$ when $b = 3$ and $c = 2$. Find a when $b = 5$ and $c = 3$.

Lesson 4-1 *(Pages 205–212)*

Determine whether each number is a root of $x^3 - 7x^2 + 2x + 40 = 0$. Explain.

1. -2
2. 1
3. 2
4. 5

Write the polynomial equation of least degree for each set of roots. Does the equation have an odd or even degree? How many times does the graph of the related function cross the x-axis?

5. $3, 4$
6. $-2, -1, 2$
7. $-1.5, -1, 1$
8. $-2, -i, i$
9. $-3i, -i, i, 3i$
10. $-1, 1, 2, 3$

Lesson 4-2 *(Pages 213–221)*

Solve each equation by completing the square.

1. $x^2 - 4x - 5 = 0$
2. $x^2 + 6x + 8 = 0$
3. $m^2 + 3m - 2 = 0$
4. $2a^2 - 8a - 6 = 0$
5. $h^2 - 12h = 4$
6. $x^2 - 9x + 1 = 0$

Find the discriminant of each equation and describe the nature of the roots of the equation. Then solve the equation by using the Quadratic Formula.

7. $4x^2 - 3x - 7 = 0$
8. $w^2 + 2w - 10 = 0$
9. $12t^2 - 5t + 6 = 0$
10. $x^2 + 6x - 13 = 0$
11. $4n^2 - 4n + 1 = 0$
12. $4x^2 + 6x = 15$

Lesson 4-3 *(Pages 222–228)*

Divide using synthetic division.

1. $(x^2 + 10x + 8) \div (x + 2)$
2. $(x^3 - 3x^2 + 4x - 1) \div (x - 1)$
3. $(x^3 - 3x - 5) \div (x + 1)$
4. $(x^4 - 2x^3 - 7x^2 - 3x - 4) \div (x - 4)$

Use the Remainder Theorem to find the remainder for each division. State whether the binomial is a factor of the polynomial.

5. $(x^2 + 2x - 8) \div (x + 4)$
6. $(x^3 + 12) \div (x - 1)$
7. $(4x^3 + 2x^2 + 6x + 1) \div (x + 1)$
8. $(x^4 - 4x^2 + 16) \div (x - 4)$

Lesson 4-4 *(Pages 229–235)*

List the possible rational roots of each equation. Then determine the rational roots.

1. $x^3 + 2x^2 - 5x - 6 = 0$
2. $2x^4 - x^3 + 2x^2 - 3x + 1 = 0$
3. $x^3 + x^2 - 2 = 0$
4. $6x^4 + x^3 + 22x^2 + 4x - 8 = 0$

Find the number of possible positive real zeros and the number of possible negative real zeros for each function. Then determine the rational zeros.

5. $f(x) = x^3 - 4x^2 - x + 4$
6. $f(x) = x^4 + x^3 + 3x^2 - 5x + 10$
7. $f(x) = 4x^3 - 7x + 3$
8. $f(x) = x^4 - x^3 + 4x - 4$

Lesson 4-5 *(Pages 236–242)*

Determine between which consecutive integers the real zeros of each function are located.

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

Approximate the real zeros of each function to the nearest tenth.

4. $f(x) = 4x^4 - 6x^2 - 2x + 1$
5. $f(x) = 2x^5 + 3x^4 - 12x + 4$
6. $f(x) = -2x^4 + 5$

Lesson 4-6 *(Pages 243–250)*

Solve each equation or inequality.

1. $\frac{6}{x} + x = 5$
2. $\frac{7}{y-1} - \frac{4}{y} = \frac{y}{y-1}$
3. $\frac{5}{r+1} - \frac{4}{r-1} = \frac{1}{r^2-1}$
4. $2 = \frac{1}{2-t} + \frac{4}{t-2}$
5. $\frac{1}{3w} + \frac{4}{5w} \leq \frac{1}{15}$
6. $\frac{x-2}{x} < \frac{x-4}{x-6}$

Lesson 4-7 *(Pages 251–257)*

Solve each equation or inequality.

1. $\sqrt{2 + 3t} = 4$
2. $4 - \sqrt{x - 2} = 1$
3. $\sqrt[3]{y - 7} + 10 = 2$
4. $\sqrt{a + 1} - 5 = \sqrt{a - 6}$
5. $\sqrt{2x + 3} \leq 2$
6. $\sqrt[4]{6a - 2} > 4$

Lesson 4-8 *(Pages 258–264)*

Use a graphing calculator to write a polynomial function to model each set of data.

1.

x	−4	−2	0	2	4	6	8
f(x)	−5	−3.5	−2	−0.5	1	2.5	4

2.

x	−2	−1.5	−1	−0.5	0	0.5	1
f(x)	0	2.375	3	2.625	2	1.875	3

3.

x	−3	−1.5	−1	0	0.5	2	2.5
f(x)	3.81	0.44	−0.56	−0.7	−0.56	1.31	2.44

4. **Families** The average numbers of households in the United States from 1991 to 1997 are listed below.

Year	1991	1992	1993	1994	1995	1996	1997
Number of Households (in thousands)	94.3	95.7	96.4	97.1	98.9	99.6	100.0

Source: *The 1999 World Almanac and Book of Facts*

a. Write a model that relates the number of households as a function of the number of years since 1991.

b. Use the model to predict the number of U.S. households in the year 2006.

EXTRA PRACTICE

Lesson 5-1 *(Pages 277–283)*

Change each measure to degrees, minutes, and seconds.

1. $13.75°$
2. $75.72°$
3. $-29.44°$
4. $87.81°$

Write each measure as a decimal to the nearest thousandth.

5. $144° \ 12' \ 30''$
6. $-38° \ 15' \ 10''$
7. $-107° \ 12' \ 45''$
8. $51° \ 14' \ 32''$

If each angle is in standard position, determine a coterminal angle that is between 0° and 360°. State the quadrant in which the terminal side lies.

9. $850°$
10. $-65°$
11. $1012°$
12. $578°$

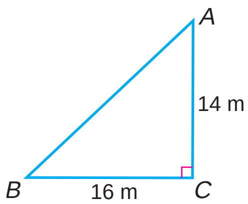
Find the measure of the reference angle for each angle.

13. $126°$
14. $-480°$
15. $642°$
16. $1154°$

Lesson 5-2 *(Pages 284–290)*

1. If $\tan\theta = \frac{5}{6}$, find $\cot\theta$.
2. If $\csc\theta = 2.5$, find $\sin\theta$.

Find the values of the six trigonometric functions for each $\angle A$.

3.


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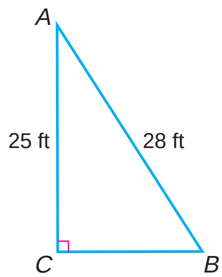

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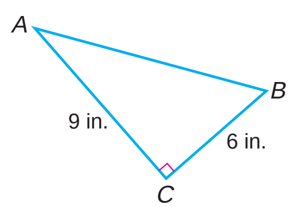


Lesson 5-3 *(Pages 291–298)*

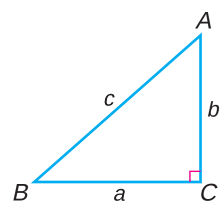
1. If $\tan\theta = 0$, what is $\cot\theta$?
2. Find two values of θ for which $\cos\theta = 0$.

Find the values of the six trigonometric functions for angle θ in standard position if a point with the given coordinates lies on its terminal side.

3. $(-1, -2)$
4. $(-2, 2)$
5. $(5, 2)$
6. $(-4, 3)$

Lesson 5-4 *(Pages 299–304)*

Solve each problem. Round to the nearest tenth.



1. If $A = 38°$ and $b = 15$, find a.
2. If $c = 19$ and $B = 87°$, find a.
3. If $a = 16.5$ and $B = 65.4°$, find c.
4. If $B = 42° \ 30'$ and $b = 12$, find a.
5. If $B = 75°$ and $c = 5.8$, find b.
6. A statue 20 feet high stands on top of a base. From a point in front of the statue, the angle of elevation to the top of the statue is 48°, and the angle of elevation to the bottom of the statue is 42°. How tall is the base?

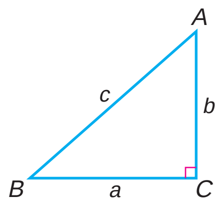
CONTENTS

Lesson 5-5 *(Pages 305–312)*

Evaluate each expression. Assume that all angles are in Quadrant I.

1. $\sin\left(\arcsin \frac{3}{4}\right)$
2. $\sec\left(\cos^{-1} \frac{1}{2}\right)$
3. $\cot\,(\tan^{-1} 1)$

Solve each problem. Round to the nearest tenth.



4. If $a = 38$ and $b = 25$, find A.
5. If $c = 19$ and $b = 17$, find B.
6. If $a = 24$ and $c = 30$, find B.
7. If $c = 12.6$ and $a = 9.2$, find B.
8. If $b = 36.5$ and $a = 28.4$, find A.

Lesson 5-6 *(Pages 313–318)*

Solve each triangle. Round to the nearest tenth.

1. $A = 75°, B = 50°, a = 7$
2. $A = 97°, C = 42°, c = 12$
3. $B = 49°, C = 32°, a = 10$
4. $A = 22°, C = 41°, b = 25$

Find the area of each triangle. Round to the nearest tenth.

5. $A = 34°, b = 12, c = 6$
6. $B = 56.8°, A = 87°, c = 6.8$
7. $a = 8, B = 60°, C = 75°$
8. $A = 43°, b = 16, c = 12$

Lesson 5-7 *(Pages 320–326)*

Find all solutions for each triangle. If no solution exists, write *none*. Round to the nearest tenth.

1. $a = 5, b = 10, A = 145°$
2. $A = 25°, a = 6, b = 10$
3. $B = 56°, b = 34, c = 50$
4. $A = 45°, B = 85°, c = 15$

Lesson 5-8 *(Pages 327–332)*

Solve each triangle. Round to the nearest tenth.

1. $b = 6, c = 8, A = 62°$
2. $a = 9, b = 7, c = 12$
3. $B = 48°, c = 18, a = 14$
4. $a = 14.2, b = 24.5, C = 85.3°$

Find the area of each triangle. Round to the nearest tenth.

5. $a = 4, b = 7, c = 10$
6. $a = 4, b = 6, c = 5$
7. $a = 12.4, b = 8.6, c = 14.2$
8. $a = 150, b = 124, c = 190$

9. **Geometry** The lengths of two sides of a parallelogram are 35 inches and 28 inches. One angle measures 110°.
   a. Find the length of the longest diagonal.
   b. Find the area of the parallelogram.

EXTRA PRACTICE

Lesson 6-1 (Pages 343–351)

Change each degree measure to radian measure in terms of π.

1. $120°$
2. $280°$
3. $-440°$
4. $-150°$

Change each radian measure to degree measure. Round to the nearest tenth.

5. $\frac{8\pi}{3}$
6. $\frac{5\pi}{12}$
7. -2
8. 10.5

Evaluate each expression.

9. $\sin \frac{5\pi}{6}$
10. $\sin \frac{4\pi}{3}$
11. $\cos \frac{9\pi}{4}$
12. $\cos\left(-\frac{3\pi}{2}\right)$

13. The diameter of a circle is 10 inches. If a central angle measures 80°, find the length of the intercepted arc.

Lesson 6-2 (Pages 352–358)

Determine each angular displacement in radians. Round to the nearest tenth.

1. 5 revolutions
2. 3.8 revolutions
3. 14.2 revolutions

Determine each angular velocity. Round to the nearest tenth.

4. 2.1 revolutions in 5 seconds
5. 1.5 revolutions in 2 minutes
6. 15.8 revolutions in 18 seconds
7. 140 revolutions in 20 minutes

8. A children's Ferris wheel rotates one revolution every 30 seconds. What is its angular velocity in radians per second?

Lesson 6-3 (Pages 359–366)

Find each value by referring to the graph of the sine or cosine function.

1. $\cos 4\pi$
2. $\sin 8\pi$
3. $\sin \frac{3\pi}{2}$

Graph each function for the given interval.

4. $y = \sin x,\ -4\pi \le x \le -2\pi$
5. $y = \cos x,\ -\frac{9\pi}{2} \le x \le -\frac{5\pi}{2}$

Lesson 6-4 (Pages 368–377)

State the amplitude and period for each function. Then graph each function.

1. $y = 2 \cos \theta$
2. $y = -3 \sin 0.5\theta$
3. $y = \frac{1}{2} \cos \frac{\theta}{4}$

Write an equation of the sine function with each amplitude and period.

4. amplitude $= 0.5$, period $= 6\pi$
5. amplitude $= 2$, period $= \frac{\pi}{3}$

Write an equation of the cosine function with each amplitude and period.

6. amplitude $= \frac{3}{5}$, period $= 4\pi$
7. amplitude $= 0.25$, period $= 8$

Lesson 6-5 *(Pages 378–386)*

State the phase shift for each function. Then graph each function.

1. $y = \sin(2\theta - \pi)$
2. $y = 2\cos(\theta + 2\pi)$
3. $y = \sin\left(\frac{\theta}{2} + \frac{\pi}{2}\right)$

Write an equation of the sine function with each amplitude, period, phase shift, and vertical shift.

4. amplitude $= 2$, period $= 2\pi$, phase shift $= \pi$, vertical shift $= -1$
5. amplitude $= 0.5$, period $= \frac{\pi}{4}$, phase shift $= 0$, vertical shift $= 3$

Write an equation of the cosine function with each amplitude, period, phase shift, and vertical shift.

6. amplitude $= 20$, period $= \frac{\pi}{2}$, phase shift $= 2\pi$, vertical shift $= 4$
7. amplitude $= \frac{3}{4}$, period $= 10$, phase shift $= 0$, vertical shift $= \frac{1}{2}$

Lesson 6-6 *(Pages 387–394)*

1. **Meteorology** The equation $d = 2.7 \sin(0.5m - 1.4) + 12.1$ models the amount of daylight in Cincinnati, Ohio, for any given day. In this equation $m = 1$ represents the middle of January, $m = 2$ represents the middle of February, etc.
   a. What is the least amount of daylight in Cincinnati?
   b. What is the greatest amount of daylight in Cincinnati?
   c. Find the number of hours of daylight in the middle of October.
2. **Waves** A buoy floats on the water bobbing up and down. The distance between its highest and lowest point is 6 centimeters. It moves from its highest point down to its lowest point and back to its highest point every 14 seconds. Write a cosine function that models the movement to the equilibrium point.

Lesson 6-7 *(Pages 395–403)*

Graph each function.

1. $y = \cot\left(\theta - \frac{\pi}{4}\right)$
2. $y = \sec\theta + 2$
3. $y = \csc(2\theta + 2\pi)$

Lesson 6-8 *(Pages 405–412)*

Find each value.

1. $\mathrm{Cos}^{-1}\, 0$
2. Arcsin 0
3. $\cos(\mathrm{Tan}^{-1}\, 1)$
4. $\mathrm{Cos}^{-1}\left(\tan\frac{3\pi}{4}\right)$
5. $\sin\left(\mathrm{Cos}^{-1}\frac{1}{2} + \mathrm{Sin}^{-1}\, 0\right)$
6. $\cos\left(2\,\mathrm{Sin}^{-1}\frac{\sqrt{3}}{2}\right)$

EXTRA PRACTICE

Lesson 7-1 *(Pages 421–430)*

Use the given information to determine the exact trigonometric value.

1. $\cos\theta = \frac{1}{4}$, $0° < \theta < 90°$; $\csc\theta$
2. $\cot\theta = -\frac{\sqrt{6}}{3}$, $\frac{\pi}{2} < \theta < \pi$; $\tan\theta$

Express each value as a trigonometric function of an angle in Quadrant I.

3. $\cos\frac{13\pi}{6}$
4. $\tan(-315°)$
5. $\csc(-930°)$

Simplify each expression.

6. $\frac{\tan\theta}{\sin\theta}$
7. $\cot\theta\tan\theta + \sin\theta\sec\theta$
8. $(1 + \sin x)(1 - \sin x)$
9. $\frac{\cot x \sin x}{\csc x \cos x}$

Lesson 7-2 *(Pages 431–436)*

Verify that each equation is an identity.

1. $\csc^2\theta = \cot^2\theta + \sin\theta\csc\theta$
2. $\frac{\sec\theta - \csc\theta}{\csc\theta\sec\theta} = \sin\theta - \cos\theta$
3. $\sin^2 x + \cos^2 x = \sec^2 x - \tan^2 x$
4. $\sec A - \cos A = \tan A \sin A$

Find a numerical value of one trigonometric function of x.

5. $\frac{\cot x}{\csc x} = 1$
6. $2\tan x\sin x + 2\cos x = \csc x$

Lesson 7-3 *(Pages 437–445)*

Use sum or difference identities to find the exact value of each trigonometric function.

1. $\cos 75°$
2. $\sin 105°$
3. $\tan\frac{\pi}{12}$
4. $\tan\frac{7\pi}{12}$
5. $\sec\frac{29\pi}{12}$
6. $\cot 375°$

Find each exact value if $0 < x < \frac{\pi}{2}$ and $0 < y < \frac{\pi}{2}$.

7. $\sin(x + y)$ if $\cos x = \frac{2}{5}$ and $\sin y = \frac{3}{4}$
8. $\cos(x - y)$ if $\cos x = \frac{5}{12}$ and $\cos y = \frac{11}{12}$
9. $\tan(x + y)$ if $\cot x = \frac{4}{3}$ and $\sec y = \frac{5}{4}$
10. $\sec(x - y)$ if $\tan x = \frac{7}{6}$ and $\csc y = \frac{8}{5}$

Lesson 7-4 *(Pages 448–455)*

Use a half-angle identity to find the exact value of each function.

1. $\sin 15°$
2. $\cos 75°$
3. $\tan \frac{\pi}{12}$
4. $\cos 22.5°$
5. $\sin \frac{5\pi}{12}$
6. $\tan 112.5°$

Use the given information to find $\sin 2\theta$, $\cos 2\theta$, and $\tan 2\theta$.

7. $\cos \theta = \frac{2}{7}, 0° < \theta < 90°$
8. $\sin \theta = \frac{2}{3}, 0 < \theta < \frac{\pi}{2}$
9. $\tan \theta = -3, 90° < \theta < 180°$
10. $\csc \theta = -\frac{3}{2}, \frac{3\pi}{2} < \theta < 2\pi$

Lesson 7-5 *(Pages 456–461)*

Solve each equation for $0° \leq x < 360°$.

1. $4 \cos^2 x - 2 = 0$
2. $\sin^2 x \csc x - 1 = 0$
3. $\sqrt{3} \cot x = 2 \cos x$
4. $3 \cos^2 x = 6 \cos x - 3$

Lesson 7-6 *(Pages 463–469)*

Write the standard form of the equation of each line given p, the length of the normal segment, and ϕ, the angle the normal segment makes with the positive x-axis.

1. $p = 12, \phi = 30°$
2. $p = 2, \phi = \frac{\pi}{3}$
3. $p = \frac{1}{2}, \phi = 150°$

Write each equation in normal form. Then find the length of the normal and the angle it makes with the positive x-axis.

4. $4x + 10y + 10 = 0$
5. $x - y = 2$
6. $2x + 3y = 12$

Lesson 7-7 *(Pages 470–476)*

Find the distance between the point with the given coordinates and the line with the given equation.

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

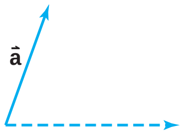
Find the distance between the parallel lines with the given equations.

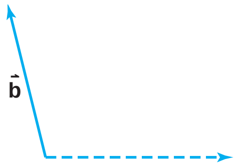
5. $x + 2y = -2$
   $x + 2y = 4$
6. $y = \frac{2}{3}x + 3$
   $3y - 2x = 7$

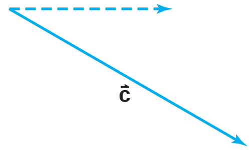
7. **Geometry** Find the height to the nearest tenth of a unit of a trapezoid with parallel bases that lie on lines with equations $2x + 5y = -1$ and $2x + 5y = 4$.

Lesson 8-1 *(Pages 485–492)*

Use a ruler and a protractor to determine the magnitude (in centimeters) and direction of each vector.

1. 

2. 

3. 

Use $\vec{a}$, $\vec{b}$, and $\vec{c}$ above to find the magnitude and direction of each resultant.

4. $\vec{a} + \vec{b}$
5. $\vec{b} + \vec{c}$
6. $\vec{a} + \vec{c}$
7. $\vec{a} - \vec{b}$
8. $2\vec{c}$
9. $2\vec{c} - \vec{b}$

Find the magnitude of the horizontal and vertical components of each vector shown for Exercises 1–3.

10. $\vec{a}$
11. $\vec{b}$
12. $\vec{c}$

Lesson 8-2 *(Pages 493–499)*

Find the ordered pair that represents $\overrightarrow{AB}$. Then find the magnitude of $\overrightarrow{AB}$.

1. $A(3, 6), B(4, 1)$
2. $A(-1, 3), B(-2, 2)$
3. $A(0, -4), B(-1, -8)$
4. $A(1, 10), B(3, -9)$
5. $A(-6, 0), B(-3, -6)$
6. $A(4, -5), B(0, 7)$

Find the magnitude of each vector and write each vector as the sum of unit vectors.

7. $\langle 5, 6\rangle$
8. $\langle -2, 4\rangle$
9. $\langle -10, -5\rangle$
10. $\langle 2.5, 6\rangle$
11. $\langle 2, -6\rangle$
12. $\langle -15, -12\rangle$

Lesson 8-3 *(Pages 500–504)*

Find an ordered triple to represent $\vec{p}$ in each equation if $\vec{q} = \langle 1, 2, -1\rangle$, $\vec{r} = \langle -2, 2, 4\rangle$, and $\vec{s} = \langle -4, -3, 0\rangle$.

1. $\vec{p} = 2\vec{q} + 3\vec{s}$
2. $\vec{p} = \vec{q} - \frac{1}{2}\vec{r} + \vec{s}$
3. $\vec{p} = -2\vec{r} + \vec{s}$
4. $\vec{p} = \frac{3}{4}\vec{s} + 2\vec{q}$

5. **Physics** If vectors working on an object are in equilibrium, then their resultant is zero. Two forces on an object are represented by $\langle 2, -4, 1\rangle$ and $\langle 5, 4, 3\rangle$. Find a third vector that will place the object in equilibrium.

Lesson 8-4 *(Pages 505–511)*

Find each inner product and state whether the vectors are perpendicular. Write *yes* or *no*.

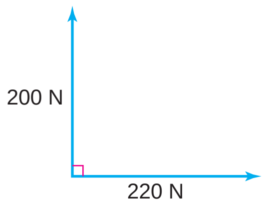
1. $\langle 3, 4\rangle \cdot \langle 2, 5\rangle$
2. $\langle -3, 2\rangle \cdot \langle 4, 6\rangle$
3. $\langle -5, 3\rangle \cdot \langle 2, -3\rangle$
4. $\langle 8, 6\rangle \cdot \langle -2, -3\rangle$
5. $\langle 3, 4, 0\rangle \cdot \langle 4, -3, 6\rangle$
6. $\langle 4, 5, 1\rangle \cdot \langle -1, -2, 3\rangle$

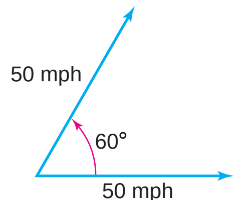
Find each cross product. Then verify that the resulting vector is perpendicular to the given vectors.

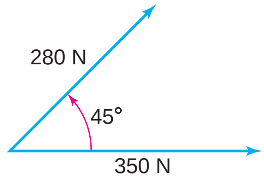
7. $\langle 1, 0, 3\rangle \times \langle 1, 1, 2\rangle$
8. $\langle 3, 0, 4\rangle \times \langle -1, 5, 2\rangle$
9. $\langle -1, 1, 0\rangle \times \langle 2, 1, 3\rangle$
10. $\langle -1, -3, 2\rangle \times \langle 6, -1, -2\rangle$

Lesson 8-5 *(Pages 513–519)*

Find the magnitude and direction of the resultant vector for each diagram.

1. 

2. 

3. 

4. A 90 Newton force and a 110 Newton force act on the same object. The angle between the forces measures 90°. Find the magnitude of the resulting force.

Lesson 8-6 *(Pages 520–525)*

Write a vector equation of the line that passes through point P and is parallel to $\vec{\mathbf{a}}$. Then write parametric equations of the line.

1. $P(2, 3)$, $\vec{\mathbf{a}} = \langle 1, 0\rangle$
2. $P(-1, -4)$, $\vec{\mathbf{a}} = \langle 5, 2\rangle$
3. $P(-3, 6)$, $\vec{\mathbf{a}} = \langle -2, 4\rangle$
4. $P(3, 0)$, $\vec{\mathbf{a}} = \langle 0, -1\rangle$

Write an equation in slope-intercept form of the line with the given parametric equations.

5. $x = 3t$
$y = 2 + t$
6. $x = -1 + 2t$
$y = 4t$
7. $x = 3t - 10$
$y = t - 1$

Lesson 8-7 *(Pages 527–533)*

1. **Sports** A golf ball is hit with an initial velocity of 70 yards per second at 34° with the horizontal. Find the initial vertical and horizontal velocity for the ball.
2. **Sports** An outfielder catches a fly ball and then throws it to third base to tag the runner. The outfielder releases the ball at an initial velocity of 75 feet per second at an angle of 25° with the horizontal. Assume the ball is released 5 feet above the ground.
   a. Write two parametric equations that represent the path of the ball.
   b. How far will the ball travel horizontally before hitting the ground?
   c. What is the maximum height of the trajectory?

Lesson 8-8 *(Pages 535–542)*

Describe the result of the product of a vertex matrix and each matrix.

1. $\begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & -4 \end{bmatrix}$
2. $\begin{bmatrix} 0.5 & 0 & 0 \\ 0 & 0.5 & 0 \\ 0 & 0 & 0.5 \end{bmatrix}$
3. $\begin{bmatrix} -1.5 & 0 & 0 \\ 0 & 1.5 & 0 \\ 0 & 0 & 1.5 \end{bmatrix}$

Lesson 9-1 *(Pages 553–560)*

Graph each point.

1. $K(4, 45°)$
2. $M\left(2, \frac{\pi}{6}\right)$
3. $N\left(\frac{3}{2}, -240°\right)$
4. $P\left(-1.5, \frac{5\pi}{6}\right)$

Graph each polar equation.

5. $r = 2$
6. $\theta = 60°$
7. $r = -2.5$
8. $\theta = \frac{7\pi}{6}$
9. Write a polar equation for the circle centered at the origin with radius $\sqrt{5}$.

Lesson 9-2 *(Pages 561–567)*

Graph each polar equation. Identify the type of curve each represents.

1. $r = -2 \sin \theta$
2. $r = 4\theta$
3. $r = 2 + 2 \cos \theta$
4. Write an equation for a rose with 5 petals.

Lesson 9-3 *(Pages 568–573)*

Find the polar coordinates of each point with the given rectangular coordinates. Use $0 \leq \theta < 2\pi$ and $r \geq 0$.

1. $(1, -1)$
2. $(3, 0)$
3. $(2, \sqrt{2})$

Find the rectangular coordinates of each point with the given polar coordinates.

4. $\left(2, \frac{\pi}{4}\right)$
5. $\left(\frac{1}{4}, \frac{\pi}{2}\right)$
6. $(5, 240°)$

Write each rectangular equation in polar form.

7. $x = -2$
8. $y = 6$
9. $x^2 + y^2 = 36$
10. $x^2 + y^2 = 3y$

Write each polar equation in rectangular form.

11. $r = 4$
12. $r = 4 \cos \theta$

Lesson 9-4 *(Pages 574–579)*

Write each equation in polar form. Round ϕ to the nearest degree.

1. $6x - 5y + 6 = 0$
2. $3x + 9y = 90$

Write each equation in rectangular form.

3. $8 = r \cos (\theta - 30°)$
4. $1 = r \cos (\theta + \pi)$
5. Graph the polar equation $3 = r \cos (\theta - 30°)$.

Lesson 9-5 *(Pages 580–585)*

Simplify.

1. i^{-10}
2. i^{17}
3. i^{1000}
4. $i^{12} + i^{-4}$
5. $(4 - i) + (-3 + 5i)$
6. $(6 + 6i) - (2 + 4i)$
7. $(3 + i)(5 - 3i)$
8. $(2 + 5i)^2$
9. $(1 - \sqrt{2}i)(-3 - \sqrt{8}i)$
10. $\frac{4 + i}{1 - i}$
11. $\frac{6 + 2i}{-2 + i}$
12. $\frac{(i - 2)^2}{4 + 2i}$

Lesson 9-6 *(Pages 586–591)*

1. Solve $4x - 6yi = 14 + 12i$ for x and y, where x and y are real numbers.

Graph each number in the complex plane and find its absolute value.

2. $4 + i$
3. $-5i$
4. $2 - \sqrt{3}i$

Express each complex number in polar form.

5. $4 + 4i$
6. $-2 + i$
7. $4 - \sqrt{2}i$

8. **Electricity** The impedance in one part of a series circuit is $5(\cos 0.9 + j \sin 0.9)$ ohms and in the second part of the circuit it is $8(\cos 0.4 + j \sin 0.4)$ ohms.
   a. Convert these complex numbers to rectangular form.
   b. Add your answers from part **a** to find the total impedance in the circuit.
   c. Convert the total impedance back to polar form.

Lesson 9-7 *(Pages 593–598)*

Find each product or quotient. Express the result in rectangular form.

1. $6\left(\cos \frac{\pi}{2} + i \sin \frac{\pi}{2}\right) \cdot 4\left(\cos \frac{\pi}{4} + i \sin \frac{\pi}{4}\right)$
2. $3\left(\cos \frac{3\pi}{4} + i \sin \frac{3\pi}{4}\right) \div \frac{1}{2}(\cos \pi + i \sin \pi)$
3. $5(\cos 135° + i \sin 135°) \cdot 2(\cos 45° + i \sin 45°)$

Lesson 9-8 *(Pages 599–606)*

Find each power. Express the result in rectangular form.

1. $\left[4\left(\cos \frac{\pi}{2} + i \sin \frac{\pi}{2}\right)\right]^4$
2. $(12i - 5)^3$

Find each principal root. Express the result in the form $a + bi$ with a and b rounded to the nearest hundredth.

3. $(1 + i)^{\frac{1}{3}}$
4. $(-1)^{\frac{1}{5}}$

Lesson 10-1 *(Pages 615–622)*

Find the distance between each pair of points with the given coordinates. Then, find the coordinates of the midpoint of the segment that has endpoints at the given coordinates.

1. $(-2, 2), (4, 5)$
2. $(-3, 6), (8, -1)$
3. $(r, 6), (r, -2)$
4. If $M(-5, 8)$ is the midpoint of $\overline{AB}$ and B has coordinates $(6, 2)$, find the coordinates of A.
5. Determine whether the quadrilateral having vertices at $(5, 10)$, $(5, 2)$, $(2, 8)$, and $(2, 5)$ is a parallelogram.
6. Andrea's garden is 50 feet long and 40 feet wide. Andrea makes a path from one corner of the garden to a water fountain at the center. Suppose the corner of the garden is the origin and the garden is in the first quadrant.
   a. Find the ordered pair that represents the location of the water fountain.
   b. Find the length of the path.

Lesson 10-2 *(Pages 623–630)*

Write the standard form of the equation of each circle described. Then graph the equation.

1. center at $(-2, 2)$, radius $\sqrt{2}$
2. center at $(0, -4)$, tangent to the x-axis

Write the standard form of each equation. Then graph the equation.

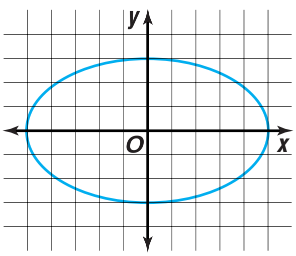
3. $x^2 = 49 - y^2$
4. $x^2 + y^2 + 6x - 8y + 18 = 0$

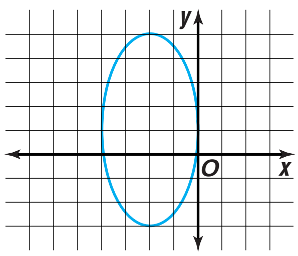
Write the standard form of the equation of the circle that passes through the points with the given coordinates. Then identify the center and the radius.

5. $(2, -2), (0, -4), (-2, -2)$
6. $(-1, 3), (-4, 6), (-7, 3)$
7. Write the equation of the circle that passes through the point $(2, -5)$ and has its center at $(4, 0)$.

Lesson 10-3 *(Pages 631–641)*

Write the equation of each ellipse in standard form. Then find the coordinates of its foci.

1. 

2. 

3. For the equation of the ellipse $\frac{(x-4)^2}{64} + \frac{(y-1)^2}{16} = 1$, find the coordinates of the center, foci, and vertices. Then graph the equation.

Lesson 10-4 *(Pages 642–652)*

1. Graph the equation $\frac{(y-2)^2}{49} - \frac{(x-1)^2}{9} = 1$. Label the center, foci, and the equations of the asymptotes.
2. Graph the equation $xy = 16$.

Write an equation of the hyperbola that meets each set of conditions.

3. The center is at $(-4, 3)$, $a = 3$, $b = 2$, and it has a horizontal transverse axis.
4. The foci are at $(2, -3)$, and $(2, 7)$ and the vertices are at $(2, -1)$ and $(2, 5)$.

Lesson 10-5 *(Pages 653–661)*

For the equation of each parabola, find the coordinates of the vertex and focus, and the equations of the directrix and axis of symmetry. Then graph the equation.

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

Write the equation of the parabola that meets each set of conditions.

3. The vertex is at $(-2, 3)$ and the focus is at $(0, 3)$.
4. The focus is at $(0, -2)$ and the equation of the directrix is $y = -3$.

Lesson 10-6 *(Pages 662–669)*

Identify the conic section represented by each equation. Then write the equation in standard form.

1. $x^2 + y^2 - 8x + 2y + 13 = 0$
2. $x^2 - 4y^2 + 10x - 16y = -5$
3. $y^2 - 5x - 6y + 9 = 0$
4. $x^2 + 2y^2 + 2x + 8y = 15$

Lesson 10-7 *(Pages 670–677)*

Identify the graph of each equation. Write an equation of the translated or rotated graph in general form.

1. $x^2 + y^2 = 9$ for $T_{(1, -1)}$
2. $4x^2 + y^2 = 16$ for $T_{(-3, -2)}$
3. $49x^2 - 16y^2 = 784$; $\theta = \frac{\pi}{4}$
4. $4x^2 - 25y^2 = 64$; $\theta = 90°$

Identify the graph of each equation. Then find θ to the nearest degree.

5. $2y^2 + 3y - 2\sqrt{2}xy + x^2 - 1 = 0$
6. $15x^2 + 5xy + 5y^2 + 9 = 0$

Lesson 10-8 *(Pages 678–684)*

Solve each system of equations algebraically. Round to the nearest tenth. Check the solutions by graphing each system.

1. $xy = 3$
   $x^2 - y^2 = 8$
2. $x - y = 4$
   $x^2 = 10y^2 + 10$

Lesson 11-1 *(Pages 695–703)*

Evaluate each expression.

1. $(-12)^{-2}$
2. -12^{-2}
3. $(4 \cdot 6)^3$
4. $\left(\frac{2}{3}\right)^4$
5. $\frac{16}{16^{\frac{1}{2}}}$
6. $27^{\frac{1}{2}} \cdot 20^{\frac{1}{2}}$
7. $\left(\sqrt[4]{625}\right)^2$
8. $\frac{1}{\sqrt[3]{(15)^6}}$

Simplify each expression.

9. $(2a^4)^2$
10. $(x^4)^3 \cdot x^5$
11. $((3f)^{-2})^3$
12. $\left(\frac{c^{-3a}}{c^{4a}}\right)^2$
13. $\left(2n^{\frac{1}{3}} \cdot 3n^{\frac{1}{3}}\right)^6$
14. $\left(\frac{h^6}{216h^{-3}}\right)^{-\frac{1}{3}}$
15. $\sqrt[3]{z^4(z^4)^{\frac{1}{2}}}$
16. $(4r^2t^5)(16r^4t^8)^{\frac{1}{4}}$

Express using rational exponents.

17. $\sqrt{a^3b^5}$
18. $\sqrt[3]{64m^9n^6}$
19. $15\sqrt[3]{r^{12}t^2}$
20. $\sqrt[8]{256x^2y^{16}}$

Lesson 11-2 *(Pages 704–711)*

Graph each exponential function.

1. $y = 3^x$
2. $y = 3^{-x}$
3. $y = -3^{x+1}$

Lesson 11-3 *(Pages 712–717)*

1. **Psychology** The Ebbinghaus Model for human memory gives the percent p of acquired knowledge that a person retains after an amount of time. The formula is $p = (100 - a)e^{-bt} + a$, where t is the time in weeks, and a and b vary from one person to another. If $a = 18$ and $b = 0.6$ for a certain student, how much information will the student retain two weeks after learning a new topic?
2. **Physics** Newton's Law of Cooling expresses the relationship between the temperature in degrees Fahrenheit of a cooling object y and the time elapsed since cooling began t in minutes. This relationship is given by $y = ae^{-kt} + c$, where c is the temperature surrounding the medium. Suppose vegetable soup is heated to 210°F in the microwave. If the room temperature is 70°F, what will the temperature of the soup be after 10 minutes? Assume that $a = 140$ and $k = 0.01$.
3. **Forestry** The yield y in millions of cubic feet of trees per acre for a forest stand that is t years old is given by $y = 6.7\,e^{\frac{-48.1}{t}}$.
   a. Find the yield after 15 years.
   b. Find the yield after 50 years.
4. **Banking** Compare the balance after 20 years of a \$5000 investment earning 5.8% compounded continuously to the same investment compounded semiannually.

Lesson 11-4 *(Pages 718–725)*

Write each equation in exponential form.

1. $\log_{16} 2 = \frac{1}{4}$
2. $\log_{\frac{1}{2}} 8 = -3$
3. $\log_4 \frac{1}{4} = -1$

Write each equation in logarithmic form.

4. $8^{-2} = x$
5. $x^5 = 32$
6. $\left(\frac{1}{4}\right)^{-2} = 16$

Evaluate each expression.

7. $\log_5 \frac{1}{5}$
8. $\log_3 27$
9. $\log_{36} 6$

Solve each equation.

10. $\log_3 y = 4$
11. $\log_5 r = \log_5 8$
12. $\log_5 35 - \log_5 d = \log_5 5$
13. $\log_4 \sqrt{4} = x$
14. $\log_4 (2x + 3) = \log_4 15$
15. $4 \log_8 2 + \frac{1}{3}\log_8 27 = \log_8 a$

Lesson 11-5 *(Pages 726–732)*

Given that log 5 = 0.6990, log 8 = 0.9031, and log 14 = 1.1461, evaluate each logarithm.

1. log 5000
2. log 0.0008
3. log 0.14

Find the value of each logarithm using the change of base formula.

4. $\log_3 81$
5. $\log_6 12$
6. $\log_5 29$

Solve each equation.

7. $3^x = 45$
8. $6^x = 2^{x-1}$
9. $5 \log y = \log 32$

Lesson 11-6 *(Pages 733–737)*

Evaluate each expression.

1. ln 35
2. ln 0.562
3. antiln 1.2354

Convert each logarithm to a natural logarithm and evaluate.

4. $\log_{15} 10$
5. $\log_3 14$
6. $\log_8 350$

Use natural logarithms to solve each equation or inequality.

7. $5^x = 90$
8. $7^{x+2} = 5.25$
9. $4^x = 4\sqrt{3}$
10. $6e^x = 48$
11. $50.2 < e^{0.2x}$
12. $16 = 10(1 + e^x)$

Lesson 11-7 *(Pages 740–748)*

Find the amount of time required for an amount to double at the given rate if the interest is compounded continuously.

1. 4.5%
2. 6%
3. 8.125%
4. **Biology** The data below give the number of bacteria found in a certain culture.

Time (hours)	0	1	2	3	4
Bacteria	6	7	12	20	32

a. Find an exponential model for the data.
b. Write the equation from part **a** in terms of base e.
c. Use the model to estimate the doubling time for the culture.

EXTRA PRACTICE

Lesson 12-1 *(Pages 759–765)*

Find the next four terms in each arithmetic sequence.

1. $7, 3, -1, \ldots$
2. $0.5, -1, -2.5, \ldots$
3. $-14, -8, -2, \ldots$
4. $3, 2.8, 2.6, \ldots$
5. $4x, -x, -6x, \ldots$
6. $2y - 4, 2y - 2, 2y, \ldots$

For Exercises 7–13, assume that each sequence or series is arithmetic.

7. Find the 16th term in the sequence for which $a_1 = 2$ and $d = 5$.
8. Find n for the sequence for which $a_n = -20$, $a_1 = 6$ and $d = -2$.
9. What is the first term in the sequence for which $d = 4$ and $a_{12} = 42$?
10. Find d for the sequence in which $a_1 = 7$ and $a_{13} = 30$.
11. What is the 24th term in the sequence 10.5, 10, 9.5, …?
12. Find the sum of the first 12 terms in the series $2 + 2.8 + 3.6 + \cdots$.
13. Find n for the series for which $a_1 = -4$, $d = 4$, and $S_n = 80$.

Lesson 12-2 *(Pages 766–773)*

Determine the common ratio and find the next three terms of each geometric sequence.

1. $14, 7, 3.5, \ldots$
2. $-2, 4, -8, \ldots$
3. $\frac{2}{3}, \frac{1}{2}, \frac{3}{8}, \ldots$
4. $10, -5, 2.5, \ldots$
5. $8, 8\sqrt{2}, 16, \ldots$
6. $a^{10}, a^8, a^6, \ldots$

For Exercises 7–11, assume that each sequence or series is geometric.

7. Find the sixth term of a sequence whose first term is 9 and common ratio is 2.
8. If $r = 4$ and $a_8 = 100$, what is the first term of the sequence?
9. Find the first three terms of the sequence for which $a_5 = 10$ and $r = -\frac{1}{2}$.
10. Write a sequence that has two geometric means between 4 and 256.
11. What is the sum of the first six terms of the series $3 + 9 + 27 + \cdots$?

12. **Biology** A certain bacteria divides every 15 minutes to produce two complete bacteria.
    - a. If an initial colony contains a population of b_0 bacteria, write an equation that will determine the number of bacteria b_t present after t hours.
    - b. Suppose a petri dish contains 12 bacteria. Use the equation found in part **a** to determine the number of bacteria present 4 hours later.

Lesson 12-3 (Pages 774–783)

Find each limit, or state that the limit does not exist and explain your reasoning.

1. $\lim_{n\to\infty} \frac{4 + 2n}{3n}$
2. $\lim_{n\to\infty} \frac{n^4 - 3n}{n^3}$
3. $\lim_{n\to\infty} \frac{8n^2 + 6n - 2}{4n^2}$
4. $\lim_{n\to\infty} \frac{4n^2 - 2n + 1}{n^2 + 2}$
5. $\lim_{n\to\infty} \frac{n^3 - n^2 + 4}{5 + 2n^3}$
6. $\lim_{n\to\infty} \frac{2^n n}{2 + n}$

Write each repeating decimal as a fraction.

7. $0.\overline{09}$
8. $0.1\overline{3}$
9. $7.\overline{407}$

Find the sum of the series, or state that the sum does not exist and explain your reasoning.

10. $\frac{1}{20} + \frac{1}{40} + \frac{1}{80} + \cdots$
11. $\frac{2}{7} + \frac{4}{7} + \frac{8}{7} + \cdots$

Lesson 12-4 (Pages 786–793)

Use the ratio test to determine whether each series is *convergent* or *divergent*.

1. $1^2 + 2^2 + 4^2 + 8^2 + \cdots$
2. $\frac{1}{3} + \frac{2}{3} + 1 + \frac{4}{3} \cdots$
3. $1 + \frac{1}{3 \cdot 8} + \frac{1}{9 \cdot 27} + \frac{1}{27 \cdot 64} + \cdots$
4. $4 + 2 + 1 + \frac{1}{2} + \cdots$

Use the comparison test to determine whether each series is *convergent* or *divergent*.

5. $\frac{7}{7} + \frac{7}{13} + \frac{7}{19} + \frac{7}{25} + \cdots$
6. $\frac{1}{2^2} + \frac{1}{4^2} + \frac{1}{6^2} + \frac{1}{8^2} + \cdots$

Determine whether each series is *convergent* or *divergent*.

7. $1 + \frac{1}{2^0 + 1} + \frac{1}{2^1 + 1} + \frac{1}{2^2 + 1} + \frac{1}{2^3 + 1} + \cdots$
8. $\frac{2}{3} + \frac{4}{4} + \frac{8}{5} + \frac{16}{6} + \cdots$

Lesson 12-5 (Pages 794–800)

Write each expression in expanded form and then find the sum.

1. $\sum_{n=1}^{5} (3n - 1)$
2. $\sum_{a=3}^{6} 4a$
3. $\sum_{k=3}^{7} (k^2 - 2)$
4. $\sum_{j=4}^{8} \frac{j}{j + 3}$
5. $\sum_{p=0}^{4} 3^p$
6. $\sum_{n=1}^{\infty} 2 \cdot \left(\frac{3}{4}\right)^n$

Express each series using sigma notation.

7. $5 + 8 + 11 + 14$
8. $-8 - 12 - 16 - \cdots - 40$
9. $\frac{1}{4} + 0 + 4 + \cdots + 65{,}536$
10. $1 + 2 + 6 + 24 + \cdots$

Lesson 12-6 *(Pages 801–805)*

Use Pascal's triangle to expand each binomial.

1. $(2 + x)^4$
2. $(n + m)^5$
3. $(4a - b)^3$

Use the Binomial Theorem to expand each binomial.

4. $(m - 3)^6$
5. $(2r + s)^4$
6. $(5x - 4y)^3$

Find the designated term of each binomial expression.

7. 6th term of $(x + y)^8$
8. 5th term of $\left(b + \sqrt{3}\right)^7$
9. 3rd term of $(4z - w)^{10}$
10. 8th term of $(2h - k)^{12}$

Lesson 12-7 *(Pages 806–814)*

Find each value to four decimal places.

1. $\ln(-3)$
2. $\ln(-4.6)$
3. $\ln(-0.75)$

Use the first five terms of the exponential series and a calculator to approximate each value to the nearest hundredth.

4. $e^{1.2}$
5. $e^{-0.7}$
6. $e^{3.65}$

Use the first five terms of the trigonometric series to approximate the value of each function to four decimal places. Then, compare the approximation to the actual value.

7. $\cos \frac{\pi}{4}$
8. $\sin \frac{\pi}{6}$
9. $\cos \frac{\pi}{3}$

Lesson 12-8 *(Pages 815–821)*

Find the first four iterates of each function using the given initial value. If necessary, round your answers to the nearest hundredth.

1. $f(x) = 2x; x_0 = -2$
2. $f(x) = x^2; x_0 = 4$

Find the first three iterates of the function $f(z) = 0.5z + i$ for each initial value.

3. $z_0 = 2i$
4. $z_0 = 4 + 4i$

5. **Banking** Mendella has a savings account that has an annual yield of 5.4%. Find the balance of the account after each of the first five years if her initial balance is $4000.

Lesson 12-9 *(Pages 822–828)*

Use mathematical induction to prove that each proposition is valid for all positive integral values of *n*.

1. $2 + 4 + 6 + \cdots + 2n = n(n + 1)$
2. $1 + 3 + 6 + \cdots + \frac{n(n+1)}{2} = \frac{n(n+1)(n+2)}{6}$

3. Prove that $5^n - 1$ is even for all positive integers n.

Lesson 13-1 *(Pages 837–845)*

1. If you roll two 6-sided number cubes and then spin a 6-colored spinner with equal sections, how many outcomes are possible?
2. How many ways can 8 books be arranged on a shelf?

State whether the events are *independent* or *dependent*.

3. tossing three coins, then rolling a die
4. selecting members for a committee
5. deciding the order in which to answer your e-mail messages

Find each value.

6. $P(5, 5)$
7. $P(8, 3)$
8. $P(4, 1)$
9. $P(10, 9)$
10. $P(9, 6)$
11. $P(7, 3)$
12. $\dfrac{P(5, 2)}{P(2, 1)}$
13. $\dfrac{P(8, 6)}{P(7, 4)}$
14. $\dfrac{P(5, 2) \cdot P(8, 4)}{P(10, 1)}$
15. $C(4, 2)$
16. $C(10, 7)$
17. $C(6, 5)$
18. $C(4, 3) \cdot C(7, 3)$
19. $C(3, 1) \cdot C(8, 7)$
20. $C(9, 5) \cdot C(4, 3)$

Lesson 13-2 *(Pages 846–851)*

How many different ways can the letters of each word be arranged?

1. *mailbox*
2. *textbook*
3. *almanac*
4. *dictionary*

5. How many different 4-digit access codes can have the digits 5, 7, 2, and 7?

Determine whether each arrangement of objects is a *linear* or *circular* permutation. Then determine the number of arrangements for each situation.

6. 4 friends seated around a square table
7. 9 charms on a charm bracelet with no clasp
8. a stack of 5 books on a table

Lesson 13-3 *(Pages 852–859)*

Using a standard deck of 52 cards, find each probability.

1. P(ace)
2. P(a card of 5 or less)
3. P(a red face card)
4. P(not a queen)

One pencil is randomly taken from a box containing 8 red pencils, 4 green pencils, and 2 blue pencils. Find each probability.

5. P(blue)
6. P(green)
7. P(not red)
8. P(red or green)

A bag contains 2 white, 4 yellow, and 10 red markers. Two markers are drawn at random without replacement. What are the odds of each event occurring?

9. drawing 2 yellow markers
10. not drawing red markers
11. drawing 1 white and 1 yellow
12. drawing two different colors

Lesson 13-4 (Pages 860–867)

Determine if each event is *independent* or *dependent*. Then determine the probability.

1. the probability of selecting a red marble, not replacing it, then a green marble from a box of 6 red marbles and 2 green marbles
2. the probability of randomly selecting two dimes from a bag containing 10 dimes and 8 pennies, if the first selection is replaced
3. There are two traffic lights along the route that Laura drives from home to work. One traffic light is red 50% of the time. The next traffic light is red 60% of the time. The lights operate on separate timers. Find the probability that these lights will both be red on Laura's way from home to work.

Determine if each event is *mutually exclusive* or *mutually inclusive*. Then determine each probability.

4. the probability of tossing two number cubes and either one shows a 5
5. the probability of selecting a card from a standard deck of cards and the card is a 10 or an ace

Lesson 13-5 (Pages 868–874)

A jar contains 4 blue paper clips and 8 red paper clips. One paper clip is randomly drawn and discarded. Then a second paper clip is drawn. Find each probability.

1. the second paper clip is blue, given that the first paper clip was red
2. the second paper clip is blue, given that the first paper clip was blue
3. A pair of number cubes is thrown. Find the probability that the numbers of the dice match given that their sum is greater than 7.
4. A pair of number cubes is thrown. Find the probability that their sum is greater than 7 given that the numbers match.
5. One box contains 3 red balls and 4 white balls. A second box contains 5 red balls and 3 white balls. A box is selected at random and one ball is withdrawn. If the ball is white, what is the probability that it was taken from the second box?

Lesson 13-6 (Pages 875–882)

Find each probability if a coin is tossed three times.

1. P(all heads)
2. P(exactly 2 tails)
3. P(at least 2 heads)

Jojo MacMahon plays for the Worthington Wolves softball team. She is now batting 0.200 (meaning 200 hits in 1000 times at bat). Find the probability for the next five times at bat.

4. P(exactly 1 hit)
5. P(exactly 3 hits)
6. P(at least 4 hits)

Lesson 14-1 *(Pages 889–896)*

The daily grams of fat consumed by 30 adults who participated in a random survey are listed below.

45, 22, 36, 30, 59, 29, 28, 45, 55, 38, 36, 40, 35, 62, 69,
28, 45, 38, 39, 45, 40, 42, 62, 51, 42, 60, 29, 26, 60, 70

1. What is the range of the data?
2. Determine an appropriate class interval.
3. Name the class limits.
4. What are the class marks?
5. Construct a frequency distribution of the data.
6. Draw a histogram of the data.
7. Name the interval or intervals that describe the grams of fat consumed by most adults who participated in the survey.

Lesson 14-2 *(Pages 897–907)*

Find the mean, median, and mode of each set of data.

1. {130, 190, 180, 150}
2. {18, 19, 18, 16, 17, 15}
3. {25, 38, 36, 42, 30, 28}
4. {2, 5, 9, 10, 3, 4, 6, 9, 5, 1}
5. {2.5, 5.6, 6, 7, 2.3, 6.4, 6.5, 7, 8, 10, 4, 5.6}

Find the mean, median, and mode of the data represented by each stem-and-leaf plot.

6.

stem	leaf
1	4 5 5 6
2	0 1 4 7 8
3	6 9 9

1|4 = 14

7.

stem	leaf
3	0 4 6
5	2 4 4 6 6 7
6	2 3 6 8
7	0 1 6 7
8	2

3|0 = 3.0

8.

stem	leaf
8	0 2 3 9
9	6 7 8
10	4 5 5 8
11	1 7 8

8|0 = 800

9. Make a stem-and-leaf plot of the following number of hours worked by employees at a restaurant.

36, 17, 24, 39, 44, 37, 28, 29, 40, 55,
35, 34, 42, 29, 26, 24, 12, 19, 34, 23

10. Find the value of x so that the mean of {4, 5, 6, 9, 10, x} is 8.
11. Find the value of x so that the median of {4, 3, 19, 16, 4, 7, 12, x} is 7.5.

Lesson 14-3 *(Pages 908–917)*

Find the interquartile range and semi-interquartile range of each set of data. Then draw a box-and-whisker plot.

1. {45, 39, 44, 39, 51, 38, 59, 35, 58, 79, 40}
2. {2, 6, 4.5, 4, 3, 8, 3, 8, 10, 4, 2.5, 7.3, 4, 8, 1, 2.2}

Find the mean deviation and the standard deviation of each set of data.

3. {150, 220, 180, 200, 175, 180, 250, 212, 195}
4. {3.5, 4.2, 3.7, 5.5, 2.9, 1.4, 2.4, 2, 3, 5.3, 4.6}

5. **Sports** The numbers of hours per week members of the North High School basketball team spent practicing, either as a team or individually, are listed below.

   15, 18, 16, 20, 22, 18, 19, 20, 24, 18, 16, 18

   a. Find the median number of practice hours.
   b. Name the first quartile point and the third quartile point.
   c. Find the interquartile range.
   d. What is the semi-interquartile range?
   e. Are there any outliers? If so, name them.
   f. Make a box-and-whisker plot of the data.

Lesson 14-4 *(Pages 918–925)*

1. The mean of a set of normally distributed data is 10 and the standard deviation is 2.
   a. Find the interval about the mean that includes 25% of the data.
   b. What percent of the data is between 8 and 14?
   c. What percent of the data is between 7 and 10?
   d. Find the interval about the mean that includes 80% of the data.
2. Suppose 400 values in a set of data are normally distributed.
   a. How many values are within one standard deviation of the mean?
   b. How many values are within two standard deviations of the mean?
   c. How many values fall in the interval between the mean and one standard deviation above the mean?

Lesson 14-5 *(Pages 927–932)*

Find the standard error of the mean for each sample.

1. $\sigma = 1.2, N = 90$
2. $\sigma = 3.4, N = 100$
3. $\sigma = 12.4, N = 240$

For each sample, find the interval about the sample mean that has a 1% level of confidence.

4. $\sigma = 4.2, N = 40, \overline{X} = 150$
5. $\sigma = 10, N = 78, \overline{X} = 320$

Lesson 15-1 *(Pages 941–948)*

Evaluate each limit.

1. $\lim_{x \to 4} (x^2 + 2x - 2)$
2. $\lim_{x \to -1} (-x^4 + x^3 - 2x + 1)$
3. $\lim_{x \to 0} (x + \sin x)$
4. $\lim_{x \to -4} \frac{x^2 - 16}{x + 4}$
5. $\lim_{x \to -2} \frac{x^2 + 5x + 6}{x^2 + x - 2}$
6. $\lim_{x \to 2} \frac{3x + 9}{x^2 - 5x - 24}$

Lesson 15-2 *(Pages 951–960)*

Use the definition of derivative to find the derivative of each function.

1. $f(x) = 5x$
2. $f(x) = 9x - 2$

Use the derivative rules to find the derivative of each function.

3. $f(x) = \frac{1}{2}x + \frac{2}{3}$
4. $f(x) = x^2 + 4x + 8$

Find the antiderivative of each function.

5. $f(x) = x^5$
6. $f(x) = 2x^2 - 8x + 2$
7. $f(x) = \frac{1}{5}x^3 - \frac{3}{4}x - 1$
8. $f(x) = \frac{x^3 - 2x^2 + x}{x}$

Lesson 15-3 *(Pages 961–968)*

Use limits to evaluate each integral.

1. $\int_0^3 5x\,dx$
2. $\int_1^5 (x + 1)\,dx$
3. $\int_0^2 (x^2 + 4x + 4)\,dx$

4. **Business** A T-shirt company determines that the marginal cost function for one of their T-shirts is $f(x) = 6 - 0.002x$, where x is the number of T-shirts manufactured and $f(x)$ is in dollars. If the company is already producing 1500 of this type of T-shirt per day, how much more would it cost them to increase production to 2000 T-shirts per day?

Lesson 15-4 *(Pages 970–976)*

Evaluate each indefinite integral.

1. $\int x^6\,dx$
2. $\int 5x^4\,dx$
3. $\int (x^2 - x + 5)\,dx$
4. $\int (-4x^4 + x^2 - 6)\,dx$

Evaluate each definite integral.

5. $\int_{-2}^{2} 14x^6\,dx$
6. $\int_0^6 (x + 2)\,dx$
7. $\int_2^4 (x^2 - 4)\,dx$
8. $\int_4^5 (x - 4)(x + 2)\,dx$

EXTRA PRACTICE