Chapter 1 Practice Exercises (*Optional)

1-01 The Cartesian Plane

1. (a) If a point lies on the x-axis, what is its y-coordinate? (b) If a point lies on the y-axis, what is its x-coordinate?

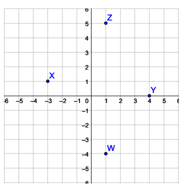
2. Which quadrant contains only negative coordinates?

Plot the given points.

3. A(3, 0), B(−2, −4), C(−1, 3)

4. $D\left(\frac{1}{2}, \frac{3}{2}\right)$, $E\left(4, -\frac{1}{2}\right)$, F(0, −2)

5. Find the coordinates of the points in the graph.



Find the exact distance between the two points. Use radical form.

6. A(3, 0), B(−9, −5)

7. M(1, −2), N(2, −5)

8. C(4, −2), D(−1, 3)

Find the missing coordinate given the distance between the points.

9. E(2, 4), F(x, 7); d = 5

10. G(−2, 5), H(2, y); d = $2\sqrt{5}$

11. I(3, 0), J(x, 4); d = $4\sqrt{2}$

Find the midpoint between the two points.

12. A(3, 0), B(−9, −5)

13. M(1, −2), N(2, −5)

14. C(4, −2), D(−1, 3)

Find the missing endpoint given one endpoint and the midpoint.

15. endpoint (2, 4), midpoint (6, 2)

16. endpoint (3, −1), midpoint (2, 0)

17. endpoint (−2, 5), midpoint $\left(\frac{1}{2}, -\frac{5}{2}\right)$

Problem Solving

18. Jeanne and Francois were doing an experiment and obtained the following data points. Graph the points and describe the pattern. (1, 1.5), (3, 5.5), (4, 7.5), (6, 11.5), (7, 13.5)

19. A person on a boat in Lake Michigan starts to sink. If its location is (−20, 15), a Sheriff's Department boat is at (−5, 0), and a Coast Guard boat is at (−10, 33), which boat is closer to come to the rescue?

20. A manufacturer wants its warehouse halfway between Chicago and Detroit. Where should the warehouse be located if Chicago is located at 41.8781° N, 87.6298° W and Detroit is located at 42.3314° N, 83.0458° W? What major town on I-94 is that closest to? (You will probably need to put your coordinates on a map app to find out.)

1-02 Graphs

1. What is the y-intercept?

2. How do you find the x- and y-intercepts?

Find the x-intercept and the y-intercept without graphing. Write the coordinates of each intercept.

3. $y = -2x + 2$

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

5. $2x + y = -5$

6. $y = x^2 - 1$

Graph the equation by making a table.

7. $y = -2x + 2$

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

9. $2x + y = -5$

10. $y = x^2 - 1$

Use your graphing calculator to find the y-intercept. On the TI-84 do this by 1) entering the equation in the [y=] menu, 2) pressing the [graph] button, and 3) using the [2nd] [calc] button and choosing *1:value* from the menu. At the lower part of the screen you will see "x=" and a blinking cursor. You may enter any number for x and it will display the y value for any x value you input. Use this and plug in $x = 0$ to find the y-intercept. On a NumWorks, 1) select *Grapher* from the home screen. 2) Enter the equation in the *expressions* tab. 3) Select the *Graph* tab to see the graph. Pressing any number followed by (EXE) will move the cursor to that x-value. The y-value can be read off the bottom of the screen.

11. $y = -x + 3$

12. $y = x - 4$

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

Use your graphing calculator to find the x-intercept. On the TI-84 do this by 1) entering the equation in the [y=] menu, 2) pressing the [graph] button, and 3) using the [2nd] [calc] button and choosing *2:zero* from the menu. At the lower part of the screen you will see "*Left Bound?*" and a blinking cursor on the graph of the line. Move this cursor to the left of the x-intercept, hit [enter]. Now it says "*Right Bound?*" Move the cursor to the right of the x-intercept, hit [enter]. Now it says "*Guess?*" Move your cursor to the left somewhere in between the left and right bound near the x-intercept. Hit [enter]. At the bottom of your screen it will display the coordinates of the x-intercept or the "zero". On the NumWorks, 1) select *Grapher* from the home screen. 2) Enter the equation in the *expressions* tab. 3) Select the *Graph* tab to see the graph. 4) Use the arrow pad to select *Calculate* at the top of the graph. 5) Select *Find* and then 6) select *Zeros*. The zeros can be read of the bottom of the graph. If there are multiple zeros, the left and right arrows will alternate between them.

14. $y = -x + 3$

15. $y = x - 4$

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

For the following exercises, (a) find the center and (b) radius and (c) graph the circle.

17. $x^2 + y^2 = 9$

18. $(x + 2)^2 + (y - 1)^2 = 4$

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

20. $(x + 3)^2 + (y - 2)^2 = 36$

Mixed Review

21. (1-01) Find the distance between (1, 2) and (4, −9)

22. (1-01) Find the midpoint between (1, 2) and (4, −9)

Solve the following equations for y:

23. $x + 2y = 4$

24. $3x - y = 10$

25. $\frac{x+y}{2} = 12$

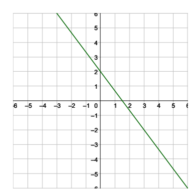
1-03 Linear Equations in Two Variables

1. What is the relationship between the (a) slopes and (b) y-intercepts of two parallel lines?

2. If a vertical line has the equation $x = 3$ and a horizontal line has the equation $y = 1$, what is the point of intersection? Why?

3. Explain how to find a line perpendicular to a linear function that passes through a given point.

4. Find the slope from the graph.



5. Find the slope of the line passing through (2, −3) and (−1, 4).

Write the equation of the line with the following characteristics.

6. Slope of 2 and y-intercept of −14

7. Passing through (3, 8) and (−2, −4)

8. Passing through (−2, 1) and (1, −5)

9. Parallel to $y = \frac{2}{3}x + 4$ and passing through (2, 1)

10. Perpendicular to $y = -\frac{4}{3}x - \frac{1}{3}$ and passing through (4, −2)

Graph the equations.

11. $x = 3$

12. $y = -2.5$

13. $y = -x + 1$

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

15. $2x + 4y = 6$

Problem Solving

16. An airplane is coming in for a landing. Its altitude, A in feet, after t minutes can be modeled by $A = 35{,}000 - 3{,}000t$. Write a complete sentence describing the airplane's starting altitude and how it changes over time.

17. Francine is driving to her grandmother's house. After 10 minutes she is 70 miles away from grandmother's house. Later, 30 minutes after leaving, she is 50 miles away from grandmother's house. What is her rate in miles per hour?

18. Jamal wants to start a small business selling homemade jams. If the cost of the equipment is \$250 and the cost of the ingredients and jar is \$3.25 per jar, write an equation modeling Jamal's costs C as a function of jars of jam x.

19. Omar spent last summer selling cookbooks door to door. His costs of travel and lodging are \$1500, but he makes a profit of \$5 per book. Write an equation for Omar's profits.

20. *Sally has a rain gauge in her yard. It is now raining and the gauge is filling up at 0.25 inches per hour. If there was 1 inch in the rain gauge before it starting raining, write an equation for the level of water in Sally's rain gauge as a function of time.

21. *Todd is scuba diving in Mexico. He is a little low on air and needs to come back to the surface. He is 50 ft down and rises at about 0.5 ft/s. How long will it take Todd to get to the surface? (Alex A.)

22. The Canada Goose is a successful conservation story. After being hunted almost to extinction, the population is now very large. In 1970, about 9,000 Canada geese were counted in Michigan. In 2020, that number increased to over 300,000. What is the average rate of change of the goose population and what does it mean? (data: Michigan DNR)

Mixed Review

23. (1-02) Find the (a) center and (b) radius and (c) graph the circle $(x + 2)^2 + (y - 1)^2 = 16$

24. (1-02) Graph $y = x^2$ by first making a table.

25. (1-02) Find the x- and y-intercepts of $2x + 3y = 12$

26. (1-01) Find the distance between (1, 2) and (−3, −1)

27. (1-01) Find the midpoint between (4, 9) and (0, 3)

1-04 Functions and Functional Notation

1. How are relations and functions related?

Determine whether the relation represents y as a function of x.

2. {(1, 2), (4, 5), (−2, 2), (1, 4)}

3. $y = 2x^2$

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

Evaluate function f for (a) $f(2)$, (b) $f(-1)$, (c) $f(a)$, (d) $f(a + h)$

5. $f(x) = 2x + 3$

6. $f(x) = x^2 - 2x$

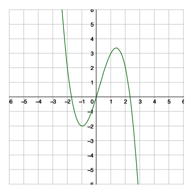
7. For $f(x) = x^2 - 2x$, evaluate $\frac{f(a+h)-f(a)}{h}$.

For the function (a) evaluate $f(-1)$ and (b) solve $f(x) = 2$.

8. *$f(x) = 5x - 14$

9. $f(x) = \sqrt{-x+2}$

10. $f(x)$ as is in the graph.



Find the domain of the function. Write the answer in interval form.

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

12. $f(x) = -3\sqrt{x-4}$

13. $f(x) = -x^3 - x$

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

Evaluate the piecewise function for (a)$f(-3)$, (b)$f(0)$, (c)$f(2)$, (d)$f(5)$

15. $f(x) = \begin{cases} -2x, \text{if } x \le 0 \\ \frac{1}{2}x^2 + 1, \text{if } x > 0 \end{cases}$

16. $f(x) = \begin{cases} x + 1, \text{if } x \le -1 \\ 0, \text{if } -1 < x \le 2 \\ -x + 2, \text{if } x > 2 \end{cases}$

17. $f(x) = \begin{cases} (x+2)^2, \text{if } x < 1 \\ \sqrt{10-x}, \text{if } x \ge 1 \end{cases}$

Mixed Review

18. (1-03) Find a linear equation that passes through (3, 4) and (0, −2).

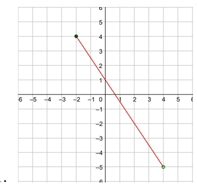
19. (1-03) Graph $2x - 4y = 0$.

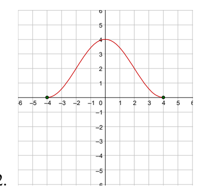
20. (1-02) Graph $(x - 1)^2 + y^2 = 9$.

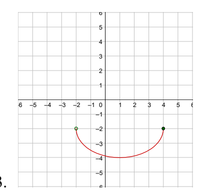
21. (1-01) Find the distance (4, −6) is from the origin.

1-05 Graphs of Functions

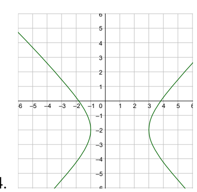
Write the domain and range of each function using interval notation.

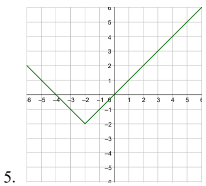
1. 

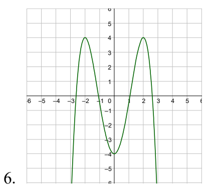
2. 

3. 

Use the vertical line test to determine if the graph represents a function.

4. 

5. 

6. 

Find the zeros of the following functions.

7. $f(x) = 5x - 8$

8. $g(x) = x^2 + 3x + 2$

9. $h(x) = \sqrt{x+1}$

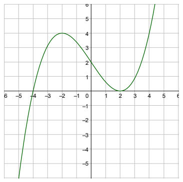
Find the average rate of change of each function on the interval.

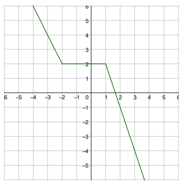
10. $j(x) = x^2 + 4$ on $[2, a]$

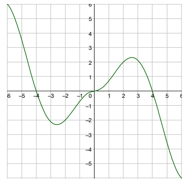
11. $k(x) = -2x + 1$ on $[1, 1 + h]$

12. $m(x) = 2x^2 - 3$ on $[x, x + h]$

Use the graph of each function to estimate the (a) intervals on which the function is increasing or decreasing and (b) the extrema.

13. 

14. 

15. 

16. An odometer in a car gives the distance the car has been driven. At the start of a trip, the odometer reads 124,231 miles. At the end of the trip, 7.25 hours later, the odometer reads 124,739 miles. What is the average speed of the car during this trip?

Mixed Review

17. (1-04) Evaluate the function for (a) $f(-2)$, (b) $f(0)$, $f(2)$: $\begin{cases} 2x, \text{ if } x < 0 \\ x+1, \text{ if } x \geq 0 \end{cases}$

18. (1-04) Find the domain of the function: $r(t) = \frac{t}{t-3}$

19. (1-03) Find the linear equation that passes through (1, 0) and is parallel to $y = 3x - 1$

20. (1-02) Find the x- and y-intercepts of $2x - y = 4$

1-06 Graphs of Parent Functions

Identify the parent function and then use a graphing utility to graph the function. Be sure to choose an appropriate viewing window.

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

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

3. $h(x) = 2\sqrt{x}$

4. $j(x) = \frac{1}{x+1}$

5. $k(x) = -|x| + 4$

Sketch a graph of the piecewise function.

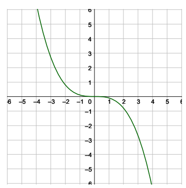
6. $f(x) = \begin{cases} -3x - 2, \text{ if } x < 1 \\ \dfrac{1}{2}x - \dfrac{3}{2}, \text{ if } x \geq 1 \end{cases}$

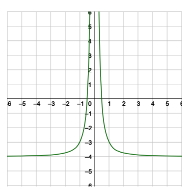
7. $f(x) = \begin{cases} \dfrac{1}{x}, \text{ if } x < -1 \\ \sqrt{x+1} - 1, \text{ if } x \geq -1 \end{cases}$

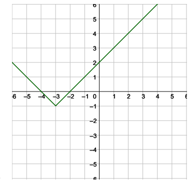
8. $f(x) = \begin{cases} -x^3, \text{ if } x < 0 \\ x^2, \text{ if } x \geq 0 \end{cases}$

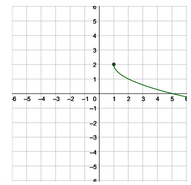
9. $f(x) = \begin{cases} |x+4| + 1, \text{ if } x \leq 0 \\ x, \text{ if } x > 0 \end{cases}$

Identify the parent function.

10. 

11. 

12. 

13. 

Problem Solving

14. A secretary is paid \$14 per hour for regular time and time-and-a-half for overtime. The weekly wage function is

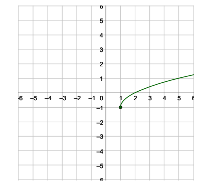
$$W(h) = \begin{cases} 14h, \text{ if } 0 < h \leq 40 \\ 21(h-40) + 560, \text{ if } h > 40 \end{cases}$$

where h is the number of hours worked in a week.

a. Find $W(30)$, $W(40)$, $W(50)$, $W(60)$.
b. The company decreased the regular work week to 35 hours. What is the new weekly wage function?

Mixed Review

15. (1-05) Use the graph of the function to estimate the intervals on which the function is increasing or decreasing.



16. (1-05) Find zeros of $f(x) = x^2 - 4$.

17. (1-05) Find the average rate of change from $[x, x + h]$ for $f(x) = 2x^2$.

18. (1-04) Evaluate the function $g(x) = 2x + 3$ at the indicated values $g(-1)$, $g(2)$, $g(a)$, $g(a + h)$

19. (1-04) Find the domain of the function using interval notation: $h(x) = 3\sqrt{x-2}$

20. (1-02) Find the (a) radius and (b) equation of the circle with center (2, 3) and point on the circle (4, 5). Then (c) graph the circle.

1-07 Transformations of Functions

1. Write an equation for the function obtained when the graph of $f(x) = |x|$ is translated left 3 units and up 1 unit.

2. Write an equation for the function obtained when the graph of $f(x) = \frac{1}{x^2}$ is translated right 2 units and down 4 units.

Describe how the graph of the function is a transformation of the graph of the original function *f*.

3. $y = f(x - 15)$

4. $y = f(x + 1)$

5. $y = f(x) + 17$

6. $y = f(x) - 20$

7. $y = f(x + 2) + 4$

Use the graph of $f(x) = 2^x$ shown in figure 26 to sketch a graph of each transformation of $f(x)$.

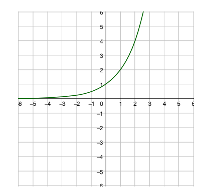


Figure 1: $f(x) = 2^x$

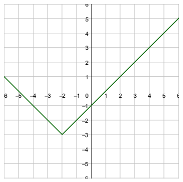
8. $h(x) = 2^{x-1} - 3$

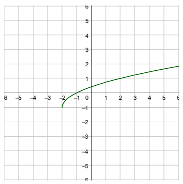
Sketch a graph of the function as a transformation of the graph of one of the parent functions.

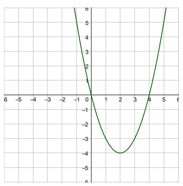
9. $f(t) = (t - 1)^2 - 2$

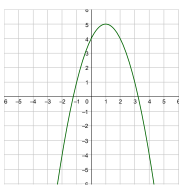
10. $k(x) = (x + 2)^3 - 2$

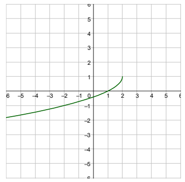
Write an equation for each graphed function by using transformations of the graphs of one of the parent functions.

11. 

12. 

13. 

14. 

15. 

Write a formula for the function g that results when the graph of a given parent function is transformed as described.

16. The graph of $f(x) = \sqrt{x}$ is reflected over the x-axis and horizontally shrunk by a factor of $\frac{1}{3}$.

17. The graph of $f(x) = x^2$ is vertically shrunk by a factor of $\frac{1}{2}$, then shifted to the right 2 units and down 3 units.

Describe how the given function is a transformation of a parent function. Then sketch a graph of the transformation.

18. $g(x) = 3(x - 1)^2 - 6$

19. $h(x) = -|2x - 4| + 3$

20. $a(x) = -\sqrt{-x + 2}$

Mixed Review

21. (1-06) Graph $f(x) = \begin{cases} 2x + 1, & \text{if } x \leq -1 \\ x^2, & \text{if } x > -1 \end{cases}$

22. (1-05) Find the domain and range for the function, $f(x) = 2^x$, in figure 26.

23. (1-04) Find the domain of $g(x) = \frac{1}{2}x^2 + 5$.

24. (1-03) Graph $y = \frac{2}{3}x - 1$.

25. (1-01) Find the distance and midpoint between $(-1, -2)$ and $(5, 6)$

1-08 Combinations of Functions

1. If the order is reversed when composing two functions, can the result ever be the same as the answer in the original order of the composition? If yes, give an example. If no, explain why not.

2. If $f(x) = 2x + 3$ and $g(x) = x^2 + x$, find $f + g$, $f - g$, fg, and $\frac{f}{g}$.

3. If $f(x) = x + 3$ and $g(x) = x^2 + 6x + 9$, find $f + g$, $f - g$, fg, and $\frac{f}{g}$.

4. If $f(x) = -x^2$ and $g(x) = \sqrt{3x}$, find $f + g$, $f - g$, fg, and $\frac{f}{g}$.

Use each pair of functions to find $f(g(x))$ and $g(f(x))$. Simplify your answers.

5. $f(x) = 2x^2$ and $g(x) = \sqrt{3x}$

6. $f(x) = x^2 - 2x$ and $g(x) = \frac{1}{2}x + 1$

7. $f(x) = 2 - \sqrt{x}$ and $g(x) = (2 - x)^2$

Use graphs of parent functions $f(x)$, $g(x)$, and $h(x)$, shown in figure 2, to evaluate the expressions.

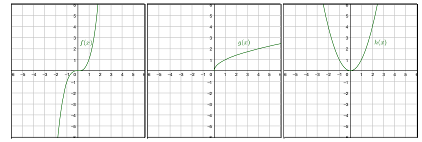


Figure 2: f(x), g(x), and h(x)

8. $g(h(2))$

9. $f(g(1))$

Use the functions $f(x) = x^2 + 1$ and $g(x) = -3x + 2$ to evaluate or find the composite function as indicated.

10. $f(g(x))$

11. $(g \circ g)(x)$

Find functions $g(x)$ and $h(x)$ so the given function can be expressed as $f(x) = g(h(x))$.

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

13. $f(x) = \frac{2}{3x^2}$

14. $f(x) = 2\sqrt{5x^2}$

Problem Solving

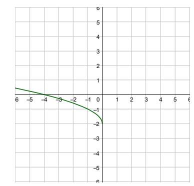
15. The speed of sound in air is a function of the temperature $v(T) = 331\sqrt{\frac{T}{273}}$, but that temperature must be in Kelvin. Kelvin is a function of degrees Celsius ($K(C) = C + 273$) and degrees Celsius is a function of degrees Fahrenheit ($C(F) = \frac{5}{9}(F - 32)$).
    a. Find the composition $T(F) = (K \circ C)(F)$ to create a formula to convert degrees Fahrenheit to Kelvin.
    b. Find the composition from part *a* with the speed of sound. In other words, find $(v \circ T)(F)$.
    c. What is the meaning of the function in part *b*.
    d. Find the speed of sound in air when the temperature is 65°F.

16. The number of birds, B, in the backyard is a function of the number of eggs, N that they lay, $B(N)$. The number of eggs laid, E, is a function of time, t, $E(t)$. Which of the following would you do in order to find when the number of birds in the backyard is 25?
    a. Evaluate $B(E(25))$.
    b. Evaluate $E(B(25))$.
    c. Solve $B(E(t)) = 25$.
    d. Solve $E(B(N)) = 25$.

Mixed Review

17. (1-07) Describe how the following function is transformed from the original parent function: $h(x) = -|x + 3| - 4$.

18. (1-07) Write a function for the following graph:



19. (1-05) Find the zeros of $f(x) = (x + 2)^2$

20. (1-05) Find the average rate of change on the interval $[x, x + h]$ for $k(x) = x^3 + 2$

1-09 Inverse Functions

1. How do you find the inverse of a function algebraically?

Use function composition to verify that $f(x)$ and $g(x)$ are inverse functions.

2. $f(x) = \sqrt[5]{x + 1}$ and $g(x) = x^5 - 1$

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

4. $f(x) = (x + 1)^2$ and $g(x) = \sqrt{x} - 1$

5. $f(x) = 3 - x$ and $g(x) = -x + 3$

6. $f(x) = \frac{2x+3}{5x+4}$ and $g(x) = \frac{3-4x}{5x-2}$

Find $f^{-1}(x)$ algebraically for each function.

7. $f(x) = 2x - 3$

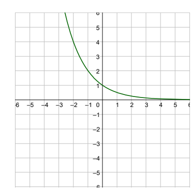
8. $f(x) = 2 - \sqrt[3]{x}$

9. $f(x) = \frac{x}{x-4}$

10. $f(x) = 2x^2, x \geq 0$

11. $f(x) = (x + 3)^2, x \leq -3$

12. Use the graph of $f(x)$ to graph the inverse.



Problem Solving

13. The kinetic energy of a 70 kg person is $K(v) = 35v^2$ where v is the speed of the object. Find the inverse of the function and explain its meaning. (Note: Speed is always greater than or equal to zero.)

14. A function $F(t)$ gives the number of flowers, F, a bee has visited in time, t. What would be a good name of the inverse of this function, and what is its meaning?

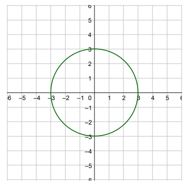
Mixed Review

15. (1-08) Given $f(x) = 2x$ and $g(x) = x^2 + 3$, find $f + g$, $f - g$, fg, and $\frac{f}{g}$.

16. (1-07) Describe how the formula is a transformation of a parent function: $m(t) = 4(2 - t)^3$

17. (1-06) Sketch a graph of the piecewise function: $p(x) = \begin{cases} |x+2|, \text{ if } x \le 1 \\ -(x-1)^2 + 3, \text{ if } x > 1 \end{cases}$

18. (1-05) Write the domain and range of the function shown in the graph using interval notation.



19. (1-04) Evaluate $f(2)$, $f(-1)$, and $f(t + 2)$ for $f(x) = -2(x + 1)^2$.

20. (1-03) Write an equation for a line perpendicular to $y = 2x + 3$ and passing through the point (0, 1).

1-10 Mathematical Modeling

1. What is extrapolation when using a linear model?

2. A scientist collected data about the diameter of a tree and the age of the tree. She performed a regression to determine whether there is a relationship between the diameter of a tree (x, in inches) and the tree's age (y, in years). The results of the regression are given below. Use this to predict the age of a tree with diameter 10 inches.
   $y = ax + b$
   $a = 0.715$
   $b = -0.414$
   $r = 0.965$

Draw a scatter plot for the data provided. Does the data appear to be linearly related? If yes, find the equation of the best fitting line.

3.

1	2	3	4	5	6
46	50	55	58	63	68

4.

1	3	5	7	9	11
1	9	25	49	81	121

5. A spring stretches when a mass is hung from it. The table shows the data from a certain spring. Draw a scatter plot and estimate the equation of the best-fitting line. How far would 2.5 kg stretch this spring?

Mass (kg)	1.0	1.2	1.4	1.6	1.8	2.0
Length (cm)	21.4	25.6	29.8	34.5	38.7	43.0

6. The U.S. Census tracks the percentage of persons 25 years or older who are college graduates. That data for women for several years is given in Table 2. Determine whether the trend appears linear. If so, and assuming the trend continues, in what year will the percentage exceed 50%?

Table 2

Year	1984	1989	1994	1999	2004	2009	2014	2019
Percent Graduates	15.7	18.1	19.6	23.1	26.1	29.1	32.0	36.6

7. Use the data set to calculate the regression line using a graphing utility, and determine the correlation coefficient to 3 decimal places of accuracy.

x	2	15	26	30	55
y	0	19	36	42	79

The population of Berrien Springs, Michigan decreased from 1980 to 2019. Table 3 shows the population data.

Table 3

Year	1980	1990	2000	2010	2019
Population	2042	1927	1862	1800	1727

8. Use a linear regression to determine a function P, where the population depends on the year, t. Let $t = 0$ represent 1980. Round to three decimal places of accuracy.

9. Predict when the population will hit 1500.

Write an equation describing the relationship of the given variables. Then solve for the unknown variable.

10. y varies directly as x. When $x = 4$, then $y = 16$. Find y when $x = 8$.

11. y varies directly as the square root of x. When $x = 16$, then $y = 8$. Find y when $x = 25$.

12. y varies inversely with x. When $x = 3$, then $y = 6$. Find y when $x = 9$.

13. y varies inversely with the square of x. When $x = 2$, then $y = 1$. Find y when $x = 3$.

14. y varies jointly as x, z, and w. When $x = 4$, $z = 2$, and $w = 7$, then $y = 168$. Find y when $x = 1$, $z = 2$, and $w = 3$.

15. y varies jointly as the square of x and the square root of z. When $x = 2$ and $z = 9$, then $y = 48$. Find y when $x = 5$ and $z = 4$.

16. The current in a circuit varies inversely with its resistance measured in ohms. When the current in a circuit is 2 amperes, the resistance is 100 ohms. Find the current if the resistance is 120 ohms.

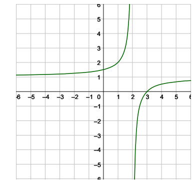
17. The rate of vibration of a string under constant tension varies inversely with the length of the string. If a string is 36 inches long and vibrates 120 times per second, what is the length of a string that vibrates 60 times per second?

Mixed Review

18. (1-09) Use function composition to verify that $f(x)$ and $g(x)$ are inverse functions. $f(x) = 2x^3$; $g(x) = \sqrt[3]{\frac{x}{2}}$

19. (1-09) Find the inverse function of $f(x) = \frac{3}{x+2}$

20. (1-07) Write a function for the following graph.



1-Review

Take this test as you would take a test in class. When you are finished, check your work against the answers.

1. Plot the points (−5, 1) and (2, 6). Find the coordinates of the midpoint of the line segment joining the points and the distance between the points.

2. Graph $f(x) = \sqrt{x+3}$.

3. Graph $f(x) = -|2x|$.

4. Graph $(x + 1)^2 + (y - 2)^2 = 16$.

5. Graph $f(x) = \begin{cases} \frac{1}{2}x^2, \text{ if } x \le 0 \\ -|x|, \text{ if } x > 0 \end{cases}$.

6. Find the equation of the line passing through (15, 20) and (17, −10).

7. Find the equation of the line parallel to $y = -2x - 1$ and passing through (1, 3).

8. If $f(x) = 3x^3 + |x|$, find $f(-2)$.

9. If $f(x) = \frac{x}{x-1}$, find $f(x + 2)$.

10. Find the domain of $f(x) = \sqrt{2x-4}$.

11. Find the zeros of $f(x) = x^2 - 4$.

12. Determine the intervals that $f(x) = -|x + 4|$ is increasing and decreasing.

13. Identify the parent function of $f(x) = \frac{2}{(x+2)^2}$.

14. Describe how the formula is a transformation of a parent function: $g(x) = -|2x| + 3$.

15. Find the inverse of $f(x) = (x - 2)^2$, $x < 2$.

16. If y varies directly with x, and $y = 4$ when $x = 3$, find y when $x = \frac{3}{5}$.

Use $f(x) = 2x - 1$ and $g(x) = 4x^2$ to solve the following problems.

17. Find $(gf)(x)$.

18. Find $(f \circ g)(x)$.

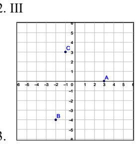
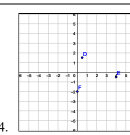
19. Find $(g \circ f)(x)$.

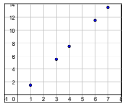
20. For the following data set, draw a scatter plot and then use technology to find the equation of the best fitting line.

2	4	6	8	10
10	13	15	19	22

Answers

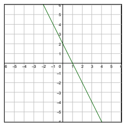
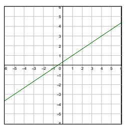
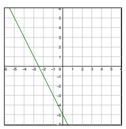
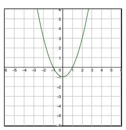
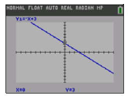
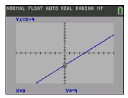
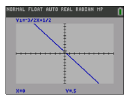
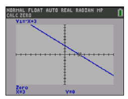
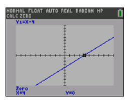
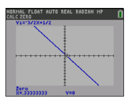
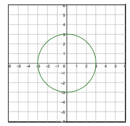
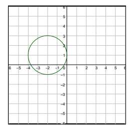
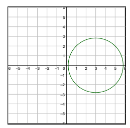
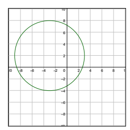
1-01

1. 0; 0
2. III
3. 
4. 
5. W(1, −4), X(−3, 1), Y(4, 0), Z(1, 5)
6. 13
7. $\sqrt{10}$
8. $5\sqrt{2}$
9. $x = -2, 6$
10. $y = 3, 7$
11. $x = -1, 7$
12. $\left(-3, -\frac{5}{2}\right)$
13. $\left(\frac{3}{2}, -\frac{7}{2}\right)$
14. $\left(\frac{3}{2}, \frac{1}{2}\right)$
15. (10, 0)
16. (1, 1)
17. (3, −10)

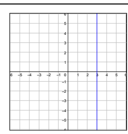
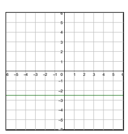
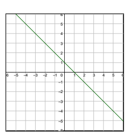
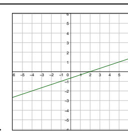
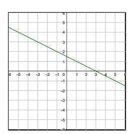
18.  ; a line

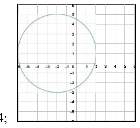
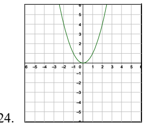
19. The Coast Guard boat
20. 42.1048° N, 85.3378° W; Battle Creek, MI

1-02

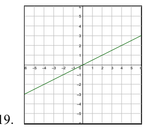
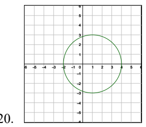
1. The point where the graph intersects the y-axis.
2. Let the other variable = 0 and solve
3. (1, 0); (0, 2)
4. $\left(-\frac{1}{2}, 0\right)$; $\left(0, \frac{1}{3}\right)$
5. $\left(-\frac{5}{2}, 0\right)$; (0, −5)
6. (−1, 0), (1, 0); (0, −1)
7. 
8. 
9. 
10. 
11.  ; (0, 3)
12.  ; (0, −4)
13.  ; (0, .5)
14.  ; (3, 0)
15.  ; (4, 0)
16.  ; (0.333, 0)
17. (0, 0); 3; 
18. (−2, 1); 2; 
19. (3, 0); $2\sqrt{2}$; 
20. (−3, 2); 6; 
21. $\sqrt{130}$
22. $\left(\frac{5}{2}, -\frac{7}{2}\right)$
23. $y = -\frac{1}{2}x + 2$
24. $y = 3x - 10$
25. $y = -x + 24$

1-03

1. The slopes are equal; y-intercepts are not equal.
2. The point of intersection is (3, 1). This is because for the horizontal line, all of the y coordinates are 1 and for the vertical line, all of the x coordinates are 3. The point of intersection will have these two characteristics.
3. First, find the slope of the given line. The slope of the perpendicular line is the negative reciprocal. Substitute the slope m of the perpendicular line and the coordinate of the given point into the equation $y - y_1 = m(x - x_1)$ and solve for y.
4. $-\frac{4}{3}$
5. $-\frac{7}{3}$
6. $y = 2x - 14$
7. $y = \frac{12}{5}x + \frac{4}{5}$
8. $y = -2x - 3$
9. $y = \frac{2}{3}x - \frac{1}{3}$
10. $y = \frac{3}{4}x - 5$
11. 
12. 
13. 
14. 
15. 
16. The airplane's initial altitude is 35,000 feet and decreases by 3,000 feet per minute.
17. −60 miles per hour (She is getting closer to grandmother's house by 60 miles per hour.)
18. $C = 3.25x + 250$
19. $P = 5x - 1500$
20. $d = 0.25t + 1$
21. 100 seconds

22. 5820 geese per year. On average, the geese population increased by 5820 geese every year.
23. (−2, 1); 4; 
24. 
25. (6, 0); (0, 4)
26. 5
27. (2, 6)

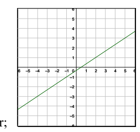
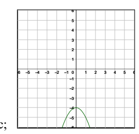
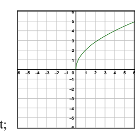
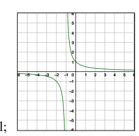
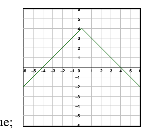
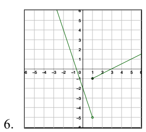
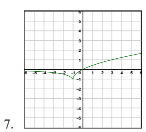
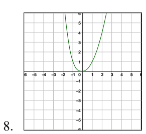
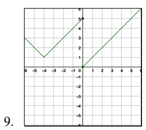
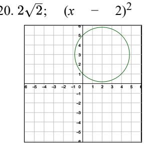
1-04

1. Functions are relations where each input gives exactly one output.
2. Not a function
3. Function
4. Not a function
5. 7; 1; $2a + 3$; $2a + 2h + 3$
6. 0; 3; $a^2 - 2a$; $a^2 + 2ah + h^2 - 2a - 2h$
7. $2a + h - 2$
8. $f(-1) = -19$; $x = \frac{16}{5}$
9. $f(-1) = \sqrt{3}$; $x = -2$
10. $f(-1) = -2$; $x = -2, 0.6, 2$
11. $(-\infty, -3) \cup (-3, \infty)$
12. $[4, \infty)$
13. $(-\infty, \infty)$
14. $(-\infty, -3) \cup (-3, 3) \cup (3, \infty)$
15. 6; 0; 3; $\frac{27}{2}$
16. −2; 0; 0; −3
17. 1; 4; $2\sqrt{2}$; $\sqrt{5}$
18. $y = 2x - 2$
19. 
20. 
21. $2\sqrt{13}$

1-05

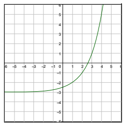
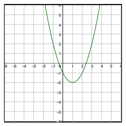
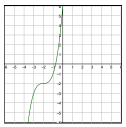
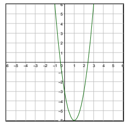
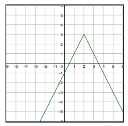
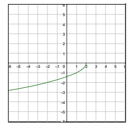
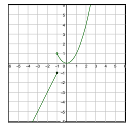
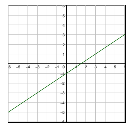
1. [−2, 4); (−5, 4]
2. [−4, 4]; [0, 4]
3. (−2, 4]; [−4, −2]
4. Not a function
5. Function
6. Function
7. $\frac{8}{5}$
8. −2, −1
9. −1
10. $a + 2$
11. −2
12. $4x + 2h$
13. Increasing: $(-\infty, -2) \cup (2, \infty)$; Decreasing: $(-2, 2)$; Maximum: (−2, 4); Minimum: (2, 0)
14. Increasing: never; Decreasing: $(-\infty, -2) \cup (1, \infty)$; Constant: (−2, 1); No local maximum or minimum
15. Increasing: (−2.6, 2.6); Decreasing: $(-\infty, -2.6) \cup (2.6, \infty)$; Maximum: (2.6, 2.3); Minimum: (−2.6, −2.3)
16. about 70.0 mph
17. −4; 1, 3
18. $(-\infty, 3) \cup (3, \infty)$
19. $y = 3x - 3$
20. (2, 0); (0, −4)

1-06

1. Linear; 
2. Quadratic; 
3. Square root; 
4. Reciprocal; 
5. Absolute value; 
6. 
7. 
8. 
9. 
10. Cubic
11. Reciprocal squared
12. Absolute Value
13. Square Root
14. 420, 560, 770, 980; $W(h) = \begin{cases} 14h, & \text{if } 0 < h \le 35 \\ 21(h - 35) + 490, & \text{if } h > 35 \end{cases}$
15. Increasing: $[1, \infty)$, never decreases
16. −2, 2
17. $4x + 2h$
18. 1, 7, $2a + 3$, $2a + 2h + 3$
19. $[2, \infty)$
20. $2\sqrt{2}$; $(x - 2)^2 + (y - 3)^2 = 8$; 

1-07

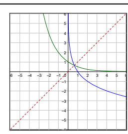
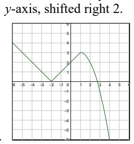
1. $y = |x + 3| + 1$
2. $y = \frac{1}{(x-2)^2} - 4$
3. Translated right 15
4. Translated left 1
5. Translated up 17
6. Translated down 20
7. Translated left 2 and up 4

8. 
9. 
10. 
11. $y = |x + 2| - 3$
12. $y = \sqrt{x+2} - 1$
13. $y = (x - 2)^2 - 4$
14. $y = -(x - 1)^2 + 5$
15. $y = -\sqrt{-x+2} + 1$
16. $y = -\sqrt{3x}$
17. $y = \frac{1}{2}(x-2)^2 - 3$
18. Stretched vertically by factor of 3, translated right 1 and down 6; 
19. Reflected over x-axis, horizontally shrunk by factor of 1/2, translated right 2 and up 3; 
20. Reflected over the y-axis, reflected over the x-axis, shifted right 2; 
21. 
22. Domain: $(-\infty, \infty)$; Range: $(0, \infty)$
23. $(-\infty, \infty)$
24. 
25. 10, (2, 2)

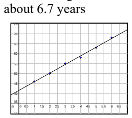
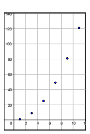
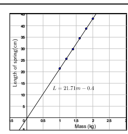
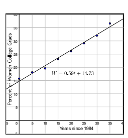
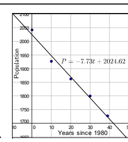
1-08

1. Yes, $f(x) = 2x$ and $g(x) = \frac{1}{2}x$
2. $x^2 + 3x + 3$; $-x^2 + x + 3$; $2x^3 + 5x^2 + 3x$; $\frac{2x+3}{x^2+x}$
3. $x^2 + 7x + 12$; $-x^2 - 5x - 6$; $x^3 + 9x^2 + 27x + 27$; $\frac{1}{x+3}$
4. $\sqrt{3x} - x^2$; $-x^2 - \sqrt{3x}$; $-x^2\sqrt{3x}$; $-\frac{x^2}{\sqrt{3x}}$
5. $f(g(x)) = 6x$; $g(f(x)) = x\sqrt{6}$
6. $f(g(x)) = \frac{1}{4}x^2 - 1$; $g(f(x)) = \frac{1}{2}x^2 - x + 1$
7. $f(g(x)) = x$; $g(f(x)) = x$
8. 2
9. 1
10. $9x^2 - 12x + 5$
11. $9x - 4$
12. $g(x) = x^2$; $h(x) = x + 3$
13. $g(x) = \frac{2}{x}$; $h(x) = 3x^2$
14. $g(x) = 2\sqrt{x}$; $h(x) = 5x^2$
15. $T(F) = \frac{5}{9}F + \frac{2297}{9}$; $(v \circ T)(F) = 331\sqrt{\frac{5F+2297}{2457}}$; speed of sound in air based on temperature in degrees Fahrenheit; 341.9 m/s
16. c
17. Reflected over the x-axis, shifted left 3 and down 4
18. $f(x) = \sqrt{-x} - 2$
19. −2
20. $3x^2 + 3xh + h^2$

1-09

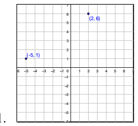
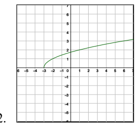
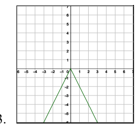
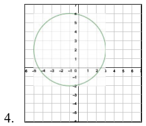
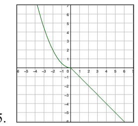
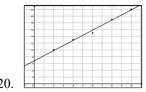
1. 1. Make sure f is a one-to-one function. 2. Rewrite the $f(x)$ as y. 3. Interchange the x's and the y's. 4. Solve for y. 5. Rewrite the y as $f^{-1}(x)$.
2. $f(g(x)) = x$
3. $f(g(x)) = x$
4. $f(g(x)) = x$
5. $f(g(x)) = x$
6. $f(g(x)) = x$
7. $f^{-1}(x) = \frac{x+3}{2}$
8. $f^{-1}(x) = (2 - x)^3$
9. $f^{-1}(x) = \frac{4x}{x-1}$
10. $f^{-1}(x) = \sqrt{\frac{x}{2}}$
11. $f^{-1}(x) = -\sqrt{x} - 3$
12. 
13. $v(K) = \sqrt{\frac{K}{35}}$; The inverse gives the speed of a given kinetic energy
14. $t(F)$; the time it takes the bee to visit F flowers
15. $x^2 + 2x + 3$; $-x^2 + 2x - 3$; $2x^3 + 6x$; $\frac{2x}{x^2+3}$
16. Vertical stretch by a factor of 4, reflected over the y-axis, shifted right 2.
17. 
18. Domain: $[-3, 3]$; Range: $[-3, 3]$
19. −18, 0, $-2t^2 - 12t - 18$
20. $y = -\frac{1}{2}x + 1$

1-10

1. Making predictions based on a model outside of the data range.
2. about 6.7 years
3.  ; $y = 4.343x + 41.467$
4.  ; not linear
5.  ; extrapolation; 53.7 cm
6.  ; 2043
7. $y = 1.494x - 3.045$; $r = 1.000$
8.  ; $P = -7.73t + 2024.62$
9. 2047
10. $y = 4x$; 32
11. $y = 2\sqrt{x}$; 10
12. $y = \frac{18}{x}$; 2
13. $y = \frac{4}{x^2}$; $\frac{4}{9}$
14. $y = 3xzw$; 18
15. $y = 4x^2\sqrt{z}$; 200
16. 1.67 amperes
17. 72 inches

18. $f(g(x)) = x$
19. $f^{-1}(x) = \frac{3}{x} - 2$
20. $f(x) = -\frac{1}{x-2} + 1$

1-Review

1.  $\left(-\frac{3}{2}, \frac{7}{2}\right)$; $\sqrt{74}$
2. 
3. 
4. 
5. 
6. $y = -15x + 245$
7. $y = -2x + 5$
8. −22
9. $\frac{x+2}{x+1}$
10. $[2, \infty)$
11. −2, 2
12. Increasing: $(-\infty, -4)$; Decreasing: $(-4, \infty)$
13. Reciprocal squared function
14. Reflected over the x-axis, Horizontal contraction by a factor of $\frac{1}{2}$, Vertical shift of 3
15. $f^{-1}(x) = -\sqrt{x} + 2$
16. $y = \frac{4}{5}$
17. $8x^3 - 4x^2$
18. $8x^2 - 1$
19. $16x^2 - 16x + 4$
20.  ; $y = 1.5x + 6.8$