

1.2 Assess Your Understanding

'Are You Prepared?' Answers are given at the end of these exercises. If you get a wrong answer, read the pages listed in red.

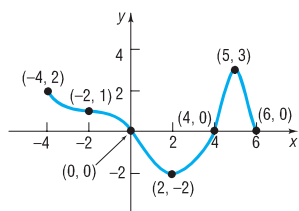
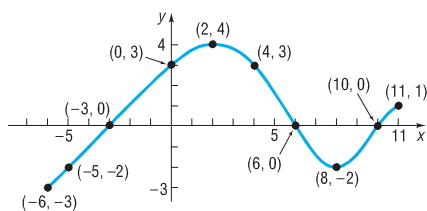
- The intercepts of the equation $x^2 + 4y^2 = 16$ are _____. (p. 12)
- True or False** The point $(-2, -6)$ is on the graph of the equation $x = 2y - 2$. (pp. 9–10)

Concepts and Vocabulary

- A set of points in the xy -plane is the graph of a function if and only if every _____ line intersects the graph in at most one point.
- If the point $(5, -3)$ is a point on the graph of f , then $f(\underline{\quad}) = \underline{\quad}$.
- Find a so that the point $(-1, 2)$ is on the graph of $f(x) = ax^2 + 4$.
- True or False** A function can have more than one y -intercept.
- True or False** The graph of a function $y = f(x)$ always crosses the y -axis.
- True or False** The y -intercept of the graph of the function $y = f(x)$, whose domain is all real numbers, is $f(0)$.

Skill Building

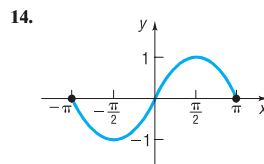
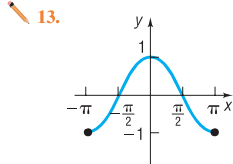
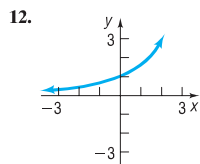
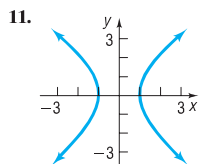
- Use the given graph of the function f to answer parts (a)–(o).
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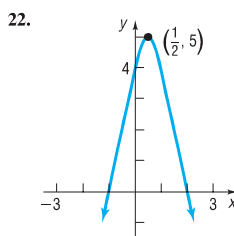
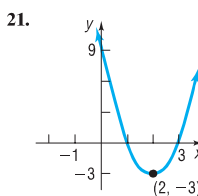
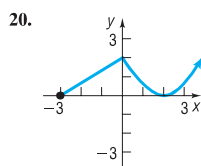
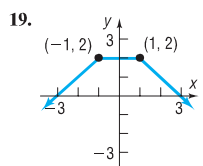
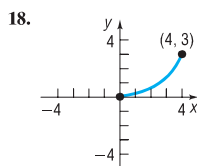
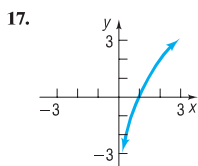
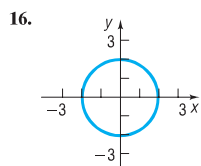
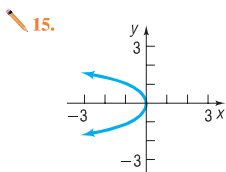


- Find $f(0)$ and $f(-6)$.
 - Find $f(6)$ and $f(11)$.
 - Is $f(3)$ positive or negative?
 - Is $f(-4)$ positive or negative?
 - For what values of x is $f(x) = 0$?
 - For what values of x is $f(x) > 0$?
 - What is the domain of f ?
 - What is the range of f ?
 - What are the x -intercepts?
 - What is the y -intercept?
 - How often does the line $y = \frac{1}{2}$ intersect the graph?
 - How often does the line $x = 5$ intersect the graph?
 - For what values of x does $f(x) = 3$?
 - For what values of x does $f(x) = -2$?
 - What are the zeros of f ?
- Find $f(0)$ and $f(6)$.
 - Find $f(2)$ and $f(-2)$.
 - Is $f(3)$ positive or negative?
 - Is $f(-1)$ positive or negative?
 - For what values of x is $f(x) = 0$?
 - For what values of x is $f(x) < 0$?
 - What is the domain of f ?
 - What is the range of f ?
 - What are the x -intercepts?
 - What is the y -intercept?
 - How often does the line $y = -1$ intersect the graph?
 - How often does the line $x = 1$ intersect the graph?
 - For what value of x does $f(x) = 3$?
 - For what value of x does $f(x) = -2$?
 - What are the zeros of f ?

In Problems 11–22, determine whether the graph is that of a function by using the vertical-line test. If it is, use the graph to find:

- (a) The domain and range (b) The intercepts, if any (c) Any symmetry with respect to the x -axis, the y -axis, or the origin





In Problems 23–28, answer the questions about the given function.

23. $f(x) = 2x^2 - x - 1$

- Is the point $(-1, 2)$ on the graph of f ?
- If $x = -2$, what is $f(x)$? What point is on the graph of f ?
- If $f(x) = -1$, what is x ? What point(s) are on the graph of f ?
- What is the domain of f ?
- List the x -intercepts, if any, of the graph of f .
- List the y -intercept, if there is one, of the graph of f .
- What are the zeros of f ?

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

- Is the point $(-1, 2)$ on the graph of f ?
- If $x = -2$, what is $f(x)$? What point is on the graph of f ?
- If $f(x) = -2$, what is x ? What point(s) are on the graph of f ?
- What is the domain of f ?
- List the x -intercepts, if any, of the graph of f .
- List the y -intercept, if there is one, of the graph of f .
- What are the zeros of f ?

25. $f(x) = \frac{x+2}{x-6}$

- Is the point $(3, 14)$ on the graph of f ?
- If $x = 4$, what is $f(x)$? What point is on the graph of f ?
- If $f(x) = 2$, what is x ? What point(s) are on the graph of f ?
- What is the domain of f ?
- List the x -intercepts, if any, of the graph of f .
- List the y -intercept, if there is one, of the graph of f .
- What are the zeros of f ?

26. $f(x) = \frac{x^2+2}{x+4}$

- Is the point $(1, \frac{3}{5})$ on the graph of f ?

- If $x = 0$, what is $f(x)$? What point is on the graph of f ?
- If $f(x) = \frac{1}{2}$, what is x ? What point(s) are on the graph of f ?
- What is the domain of f ?
- List the x -intercepts, if any, of the graph of f .
- List the y -intercept, if there is one, of the graph of f .
- What are the zeros of f ?

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

- Is the point $(-1, -\frac{1}{2})$ on the graph of f ?
- If $x = -2$, what is $f(x)$? What point is on the graph of f ?
- If $f(x) = \frac{5}{2}$, what is x ? What point(s) are on the graph of f ?
- What is the domain of f ?
- List the x -intercepts, if any, of the graph of f .
- List the y -intercept, if there is one, of the graph of f .
- What are the zeros of f ?

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

- Is the point $(1, 5)$ on the graph of f ?
- If $x = 3$, what is $f(x)$? What point is on the graph of f ?
- If $f(x) = 1$, what is x ? What point(s) are on the graph of f ?
- What is the domain of f ?
- List the x -intercepts, if any, of the graph of f .
- List the y -intercept, if there is one, of the graph of f .
- What are the zeros of f ?

Applications and Extensions

- 29. Free-throw Shots** According to physicist Peter Brancazio, the key to a successful foul shot in basketball lies in the arc of the shot. Brancazio determined the optimal angle of the arc from the free-throw line to be 45 degrees. The arc also depends on the velocity with which the ball is shot. If a player shoots a foul shot, releasing the ball at a 45-degree angle from a position 6 feet above the floor, then the path of the ball can be modeled by the function

$$h(x) = -\frac{44x^2}{v^2} + x + 6$$

where h is the height of the ball above the floor, x is the forward distance of the ball in front of the foul line, and v is the initial velocity with which the ball is shot in feet per second. Suppose a player shoots a ball with an initial velocity of 28 feet per second.

- Determine the height of the ball after it has traveled 8 feet in front of the foul line.
- Determine the height of the ball after it has traveled 12 feet in front of the foul line.
- Find additional points and graph the path of the basketball.
- The center of the hoop is 10 feet above the floor and 15 feet in front of the foul line. Will the ball go through the hoop? Why or why not? If not, with what initial velocity must the ball be shot in order for the ball to go through the hoop?

Source: *The Physics of Foul Shots*, Discover, Vol. 21, No. 10, October 2000

- 30. Granny Shots** The last player in the NBA to use an underhand foul shot (a “granny” shot) was Hall of Fame forward Rick Barry who retired in 1980. Barry believes that current NBA players could increase their free-throw percentage if they were to use an underhand shot. Since underhand shots are released from a lower position, the angle of the shot must be increased. If a player shoots an underhand foul shot, releasing the ball at a 70-degree angle from a position 3.5 feet above the floor, then the path of the ball can be modeled by the function $h(x) = -\frac{136x^2}{v^2} + 2.7x + 3.5$,

where h is the height of the ball above the floor, x is the forward distance of the ball in front of the foul line, and v is the initial velocity with which the ball is shot in feet per second.

- The center of the hoop is 10 feet above the floor and 15 feet in front of the foul line. Determine the initial velocity with which the ball must be shot in order for the ball to go through the hoop.
- Write the function for the path of the ball using the velocity found in part (a).
- Determine the height of the ball after it has traveled 9 feet in front of the foul line.
- Find additional points and graph the path of the basketball.

Source: *The Physics of Foul Shots*, Discover, Vol. 21, No. 10, October 2000

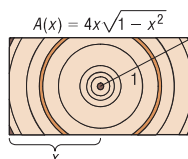
- 31. Cost of Trans-Atlantic Travel** A Boeing 747 crosses the Atlantic Ocean (3000 miles) with an airspeed of 500 miles per hour. The cost C (in dollars) per passenger is given by

$$C(x) = 100 + \frac{x}{10} + \frac{36,000}{x}$$

where x is the ground speed (airspeed \pm wind).

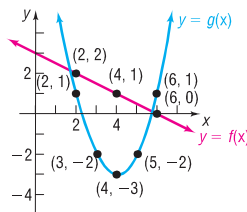
- Determine the cost if the ground speed is 400 miles per hour; 450 miles per hour.
- Find the domain of C .
- Use a graphing utility to graph the function $C = C(x)$.
- Create a TABLE with TblStart = 0 and Δ Tbl = 50.
- To the nearest 50 miles per hour, what ground speed minimizes the cost per passenger?

- 32. Cross-sectional Area** The cross-sectional area of a beam cut from a log with radius 1 foot is given by the function $A(x) = 4x\sqrt{1-x^2}$, where x represents the length, in feet, of half the base of the beam. See the figure.



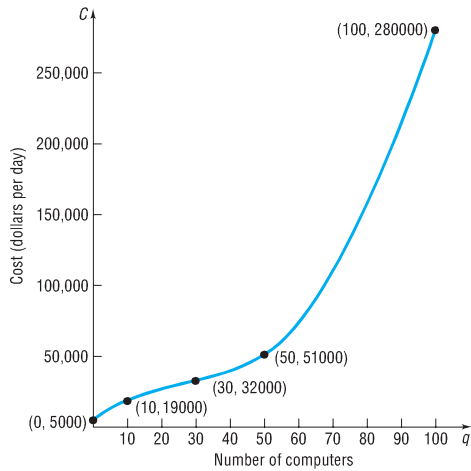
- Find the domain of A .
- Use a graphing utility to graph the function $A = A(x)$.
- Create a TABLE with TblStart = 0 and Δ Tbl = 0.1 for $0 \leq x \leq 1$. Which value of x maximizes the cross-sectional area? What should be the length of the base of the beam to maximize the cross-sectional area?

- 33.** The graphs of two functions, f and g , are illustrated. Use the graphs to answer parts (a)–(f).



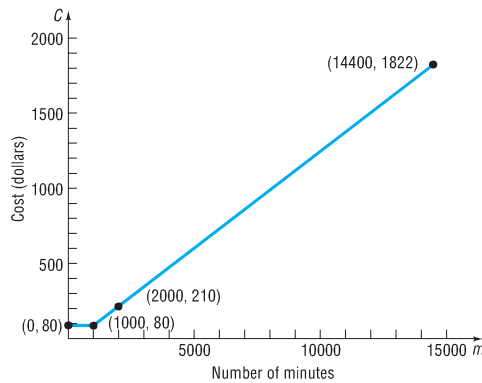
- $(f + g)(2)$
- $(f + g)(4)$
- $(f - g)(6)$
- $(g - f)(6)$
- $(f \cdot g)(2)$
- $\left(\frac{f}{g}\right)(4)$

- 34. Reading and Interpreting Graphs** Let C be the function whose graph is given on the following page. This graph represents the cost C of manufacturing q computers in a day.



- Determine $C(0)$. Interpret this value.
- Determine $C(10)$. Interpret this value.
- Determine $C(50)$. Interpret this value.
- What is the domain of C ? What does this domain imply in terms of daily production?
- Describe the shape of the graph.
- The point $(30, 32000)$ is called an *inflection point*. Describe the behavior of the graph around the inflection point.

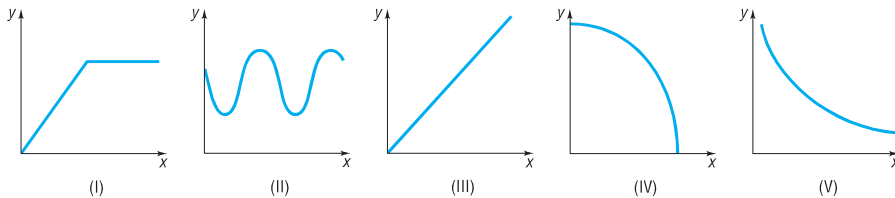
35. Reading and Interpreting Graphs Let C be the function whose graph is given below. This graph represents the cost C of using m anytime cell phone minutes in a month for a five-person family plan.



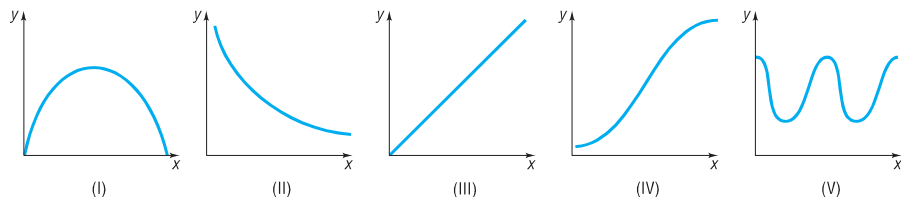
- Determine $C(0)$. Interpret this value.
- Determine $C(1000)$. Interpret this value.
- Determine $C(2000)$. Interpret this value.
- What is the domain of C ? What does this domain imply in terms of the number of anytime minutes?
- Describe the shape of the graph.

Explaining Concepts: Discussion and Writing

- Describe how you would proceed to find the domain and range of a function if you were given its graph. How would your strategy change if you were given the equation defining the function instead of its graph?
- How many x -intercepts can the graph of a function have? How many y -intercepts can the graph of a function have?
- Is a graph that consists of a single point the graph of a function? Can you write the equation of such a function?
- Match each of the following functions with the graph that best describes the situation.
 - The cost of building a house as a function of its square footage
 - The height of an egg dropped from a 300-foot building as a function of time
 - The height of a human as a function of time
 - The demand for Big Macs as a function of price
 - The height of a child on a swing as a function of time



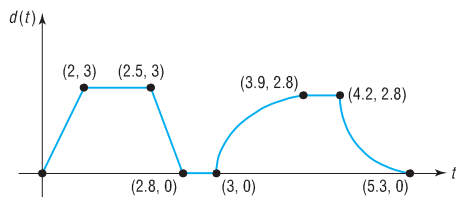
- Match each of the following functions with the graph shown on the following page that best describes the situation.
 - The temperature of a bowl of soup as a function of time
 - The number of hours of daylight per day over a 2-year period
 - The population of Florida as a function of time
 - The distance traveled by a car going at a constant velocity as a function of time
 - The height of a golf ball hit with a 7-iron as a function of time



41. Consider the following scenario: Barbara decides to take a walk. She leaves home, walks 2 blocks in 5 minutes at a constant speed, and realizes that she forgot to lock the door. So Barbara runs home in 1 minute. While at her doorstep, it takes her 1 minute to find her keys and lock the door. Barbara walks 5 blocks in 15 minutes and then decides to jog home. It takes her 7 minutes to get home. Draw a graph of Barbara's distance from home (in blocks) as a function of time.

42. Consider the following scenario: Jayne enjoys riding her bicycle through the woods. At the forest preserve, she gets on her bicycle and rides up a 2000-foot incline in 10 minutes. She then travels down the incline in 3 minutes. The next 5000 feet are level terrain and she covers the distance in 20 minutes. She rests for 15 minutes. Jayne then travels 10,000 feet in 30 minutes. Draw a graph of Jayne's distance traveled (in feet) as a function of time.

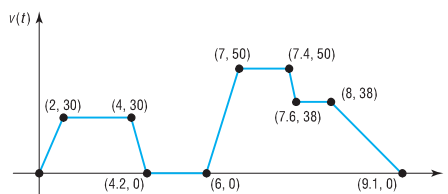
43. The sketch below represents the distance d (in miles) that Kevin is from home as a function of time t (in hours). Answer the questions based on the graph. In parts (a)–(g), how many hours elapsed and how far was Kevin from home during this time?



- From $t = 0$ to $t = 2$
- From $t = 2$ to $t = 2.5$
- From $t = 2.5$ to $t = 2.8$
- From $t = 2.8$ to $t = 3$

- From $t = 3$ to $t = 3.9$
- From $t = 3.9$ to $t = 4.2$
- From $t = 4.2$ to $t = 5.3$
- What is the farthest distance that Kevin is from home?
- How many times did Kevin return home?

44. The following sketch represents the speed v (in miles per hour) of Michael's car as a function of time t (in minutes).



- Over what interval of time is Michael traveling fastest?
 - Over what interval(s) of time is Michael's speed zero?
 - What is Michael's speed between 0 and 2 minutes?
 - What is Michael's speed between 4.2 and 6 minutes?
 - What is Michael's speed between 7 and 7.4 minutes?
 - When is Michael's speed constant?
45. Draw the graph of a function whose domain is $\{x \mid -3 \leq x \leq 8, x \neq 5\}$ and whose range is $\{y \mid -1 \leq y \leq 2, y \neq 0\}$. What point(s) in the rectangle $-3 \leq x \leq 8, -1 \leq y \leq 2$ cannot be on the graph? Compare your graph with those of other students. What differences do you see?
46. Is there a function whose graph is symmetric with respect to the x -axis? Explain.
47. Explain why the vertical-line test works.

'Are You Prepared?' Answers

- $(-4, 0), (4, 0), (0, -2), (0, 2)$
- False