2.3 Assess Your Understanding 1, 4, 10, 11, 13, 15, 17, 19, 21, 27, 29, 33, 45, 53, 61

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

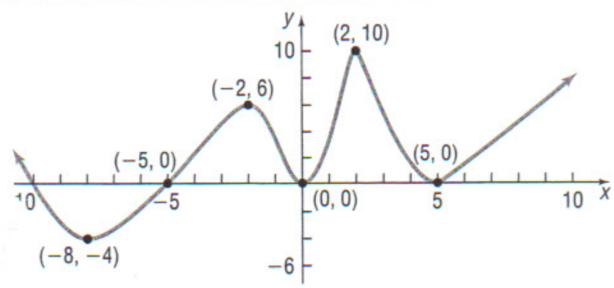
1. The interval (2, 5) can be written as the inequality $2 < x < 5$. (pp. A73–A74)
2. The slope of the line containing the points $(-2, 3)$ and $(3, 8)$ is 1. (pp. 29–30)
3. Test the equation $y = 5x^2 - 1$ for symmetry with respect to the x-axis, the y-axis, and the origin. (pp. 19–20) y-axis
4. Write the point–slope form of the line with slope 5 containing the point $(3, -2)$. (p. 33) $y + 2 = 5(x - 3)$
5. The intercepts of the equation $y = x^2 - 9$ are $(-3, 0), (3, 0), (0, -9)$. (pp. 18–19)

Concepts and Vocabulary

6. A function f is ________ on an open interval I if, for any choice of x_1 and x_2 in I, with $x_1 < x_2$, we have $f(x_1) < f(x_2)$.
7. A(n) ________ function f is one for which $f(-x) = f(x)$ for every x in the domain of f; a(n) ________ function f is one for which $f(-x) = -f(x)$ for every x in the domain of f.
8. ***True or False*** A function f is decreasing on an open interval I if, for any choice of x_1 and x_2 in I, with $x_1 < x_2$, we have $f(x_1) > f(x_2)$.
9. ***True or False*** A function f has a local maximum at c if there is an open interval I containing c so that for all x in I, $f(x) \le f(c)$.
10. ***True or False*** Even functions have graphs that are symmetric with respect to the origin.

Skill Building

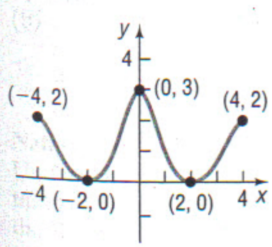
In Problems 11–20, use the graph of the function f given.



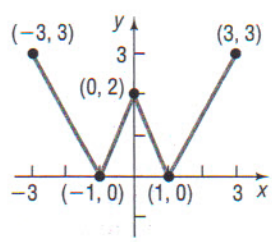
11. Is f increasing on the interval $(-8, -2)$?
12. Is f decreasing on the interval $(-8, -4)$?
13. Is f increasing on the interval $(2, 10)$?
14. Is f decreasing on the interval $(2, 5)$?
15. List the interval(s) on which f is increasing.
16. List the interval(s) on which f is decreasing.
17. Is there a local maximum value at 2? If yes, what is it?
18. Is there a local maximum value at 5? If yes, what is it?
19. List the number(s) at which f has a local maximum. What are the local maximum values?
20. List the number(s) at which f has a local minimum. What are the local minimum values?

In Problems 21–28, the graph of a function is given. Use the graph to find:
(a) The intercepts, if any
(b) The domain and range
(c) The intervals on which it is increasing, decreasing, or constant
(d) Whether it is even, odd, or neither

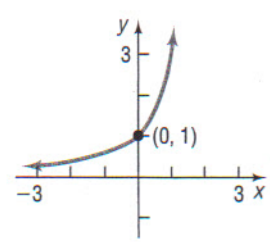
21.



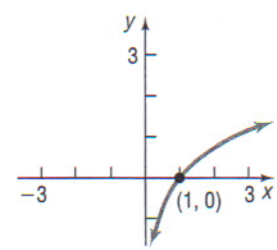
*22.



*23.



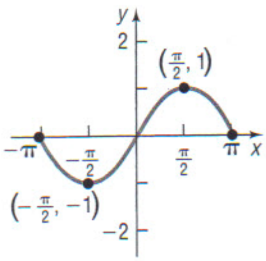
*24.



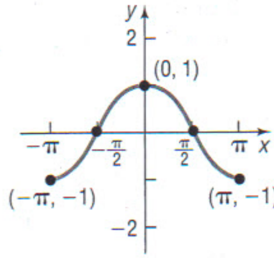
*Due to space restrictions, answers to these exercises may be found in the Answers in the back of the book.

HW - 2.3 - page 2

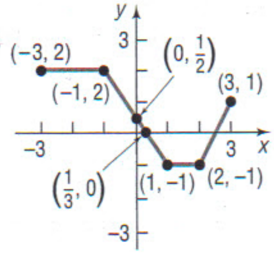
*25.



*26.



*27.



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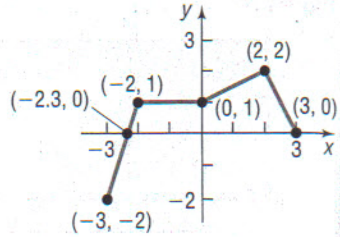
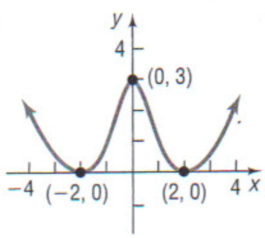
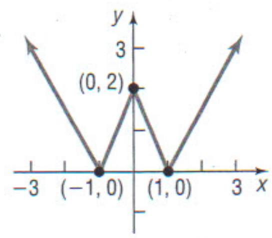


In Problems 29–32, the graph of a function f is given. Use the graph to find:
(a) The numbers, if any, at which f has a local maximum value. What are the local maximum values?
(b) The numbers, if any, at which f has a local minimum value. What are the local minimum values?

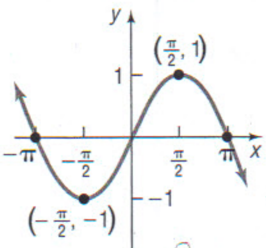
*29.



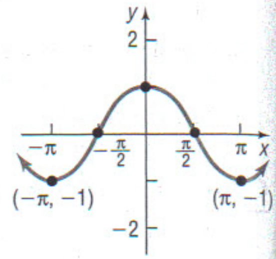
*30.



*31.



*32.



In Problems 33–44, determine algebraically whether each function is even, odd, or neither. 8.

33. $f(x) = 4x^3$

34. $f(x) = 2x^4 - x^2$

35. $g(x) = -3x^2 - 5$

36. $h(x) = 3x^3 + 5$

37. $F(x) = \sqrt[3]{x}$

38. $G(x) = \sqrt{x}$

39. $f(x) = x + |x|$

40. $f(x) = \sqrt[3]{2x^2 + 1}$

41. $g(x) = \dfrac{x^2 + 3}{x^2 - 1}$

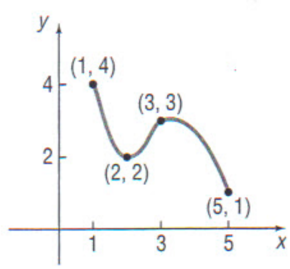
42. $h(x) = \dfrac{x}{x^2 - 1}$

43. $h(x) = \dfrac{-x^3}{3x^2 - 9}$

44. $F(x) = \dfrac{2x}{|x|}$

In Problems 45–52, for each graph of a function $y = f(x)$, find the absolute maximum and the absolute minimum, if they exist.

*45.



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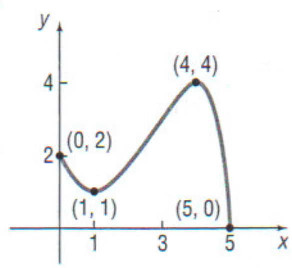
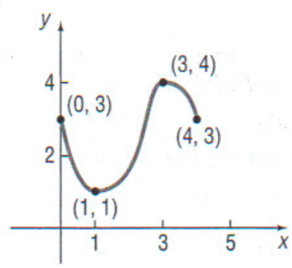
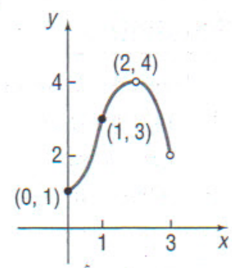


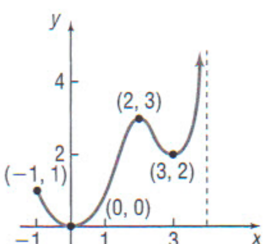
*47.



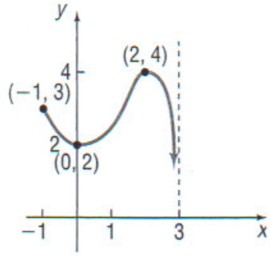
*48.



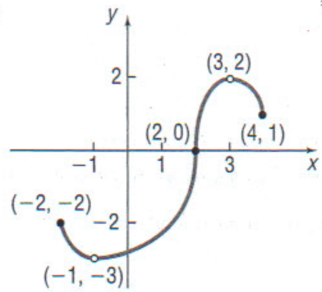
*49.



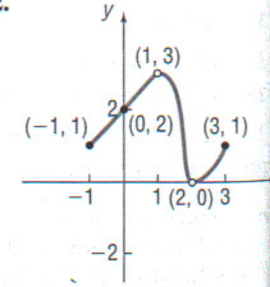
*50.



*51.



*52.



In Problems 53–60, use a graphing utility to graph each function over the indicated interval and approximate any local maximum values and local minimum values. Determine where the function is increasing and where it is decreasing. Round answers to two decimal places.

*53. $f(x) = x^3 - 3x + 2 \quad (-2, 2)$

*54. $f(x) = x^3 - 3x^2 + 5 \quad (-1, 3)$

*55. $f(x) = x^5 - x^3 \quad (-2, 2)$

*56. $f(x) = x^4 - x^2 \quad (-2, 2)$

*57. $f(x) = -0.2x^3 - 0.6x^2 + 4x - 6 \quad (-6, 4)$

*58. $f(x) = -0.4x^3 + 0.6x^2 + 3x - 2 \quad (-4, 5)$

*59. $f(x) = 0.25x^4 + 0.3x^3 - 0.9x^2 + 3 \quad (-3, 2)$

*60. $f(x) = -0.4x^4 - 0.5x^3 + 0.8x^2 - 2 \quad (-3, 2)$

61. Find the average rate of change of $f(x) = -2x^2 + 4$
(a) From 0 to 2 −4
(b) From 1 to 3 −8
(c) From 1 to 4 −10

62. Find the average rate of change of $f(x) = -x^3 + 1$
(a) From 0 to 2 −4
(b) From 1 to 3 −13
(c) From −1 to 1 −1

2.4 Assess Your Understanding 4, 5, 25, 27, 29

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

1. Sketch the graph of $y = \sqrt{x}$. (p. 22)
2. Sketch the graph of $y = \frac{1}{x}$. (pp. 22–23)
3. List the intercepts of the equation $y = x^3 - 8$. (pp. 18–19) $(0, -8), (2, 0)$

Concepts and Vocabulary

4. The function $f(x) = x^2$ is decreasing on the interval (______ .
5. When functions are defined by more than one equation, they are called ______ functions.
6. ***True or False*** The cube function is odd and is increasing on the interval $(-\infty, \infty)$.
7. ***True or False*** The cube root function is odd and is decreasing on the interval $(-\infty, \infty)$.
8. ***True or False*** The domain and the range of the reciprocal function are the set of all real numbers.

Skill Building

In Problems 9–16, match each graph to its function.

A. Constant function *B. Identity function* *C. Square function* *D. Cube function*
E. Square root function *F. Reciprocal function* *G. Absolute value function* *H. Cube root function*

9.  C

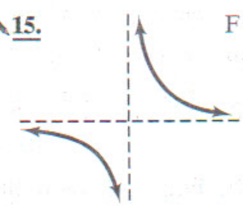
10. A

11.  E

12.  G

13.  B

14.  D

15.  F

16.  H

In Problems 17–24, sketch the graph of each function. Be sure to label three points on the graph.

*17. $f(x) = x$ *18. $f(x) = x^2$ *19. $f(x) = x^3$ *20. $f(x) = \sqrt{x}$
*21. $f(x) = \frac{1}{x}$ *22. $f(x) = |x|$ *23. $f(x) = \sqrt[3]{x}$ *24. $f(x) = 3$

25. If $f(x) = \begin{cases} x^2 & \text{if } x < 0 \\ 2 & \text{if } x = 0 \\ 2x + 1 & \text{if } x > 0 \end{cases}$

find: (a) $f(-2)$ (b) $f(0)$ (c) $f(2)$

26. If $f(x) = \begin{cases} -3x & \text{if } x < -1 \\ 0 & \text{if } x = -1 \\ 2x^2 + 1 & \text{if } x > -1 \end{cases}$

find: (a) $f(-2)$ (b) $f(-1)$ (c) $f(0)$

27. If $f(x) = \begin{cases} 2x - 4 & \text{if } -1 \le x \le 2 \\ x^3 - 2 & \text{if } 2 < x \le 3 \end{cases}$

find: (a) $f(0)$ (b) $f(1)$ (c) $f(2)$ (d) $f(3)$

28. If $f(x) = \begin{cases} x^3 & \text{if } -2 \le x < 1 \\ 3x + 2 & \text{if } 1 \le x \le 4 \end{cases}$

find: (a) $f(-1)$ (b) $f(0)$ (c) $f(1)$ 5 (d) $f(3)$

*Due to space restrictions, answers to these exercises may be found in the Answers in the back of the book.

In Problems 29–40:

(a) *Find the domain of each function.* (b) *Locate any intercepts.* (c) *Graph each function.*
(d) *Based on the graph, find the range.* (e) *Is f continuous on its domain?*

*29. $f(x) = \begin{cases} 2x & \text{if } x \ne 0 \\ 1 & \text{if } x = 0 \end{cases}$

*30. $f(x) = \begin{cases} 3x & \text{if } x \ne 0 \\ 4 & \text{if } x = 0 \end{cases}$

*31. $f(x) = \begin{cases} -2x + 3 & \text{if } x < 1 \\ 3x - 2 & \text{if } x \ge 1 \end{cases}$

*32. $f(x) = \begin{cases} x + 3 & \text{if } x < -2 \\ -2x - 3 & \text{if } x \ge -2 \end{cases}$

*33. $f(x) = \begin{cases} x + 3 & \text{if } -2 \le x < 1 \\ 5 & \text{if } x = 1 \\ -x + 2 & \text{if } x > 1 \end{cases}$

*34. $f(x) = \begin{cases} 2x + 5 & \text{if } -3 \le x < 0 \\ -3 & \text{if } x = 0 \\ -5x & \text{if } x > 0 \end{cases}$

*35. $f(x) = \begin{cases} 1 + x & \text{if } x < 0 \\ x^2 & \text{if } x \ge 0 \end{cases}$

*36. $f(x) = \begin{cases} \frac{1}{x} & \text{if } x < 0 \\ \sqrt[3]{x} & \text{if } x \ge 0 \end{cases}$

*37. $f(x) = \begin{cases} |x| & \text{if } -2 \le x < 0 \\ x^3 & \text{if } x > 0 \end{cases}$

*38. $f(x) = \begin{cases} 2 - x & \text{if } -3 \le x < 1 \\ \sqrt{x} & \text{if } x > 1 \end{cases}$

*39. $f(x) = 2\,\text{int}(x)$

*40. $f(x) = \text{int}(2x)$