

In Exercises 11–32, find the critical numbers of f (if any). Find the open intervals on which the function is increasing or decreasing and locate all relative extrema. Use a graphing utility to confirm your results.

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

12. $f(x) = x^2 + 8x + 10$

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

14. $f(x) = -(x^2 + 8x + 12)$

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

16. $f(x) = x^3 - 6x^2 + 15$

17. $f(x) = x^2(3 - x)$

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

19. $f(x) = \frac{x^5 - 5x}{5}$

20. $f(x) = x^4 - 32x + 4$

21. $f(x) = x^{1/3} + 1$

22. $f(x) = x^{2/3} - 4$

23. $f(x) = (x - 1)^{2/3}$

24. $f(x) = (x - 1)^{1/3}$

25. $f(x) = 5 - |x - 5|$

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

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

28. $f(x) = \frac{x}{x + 1}$

29. $f(x) = \frac{x^2}{x^2 - 9}$

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

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

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

In Exercises 11–26, find the points of inflection and discuss the concavity of the graph of the function.

11. $f(x) = x^3 - 6x^2 + 12x$

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

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

14. $f(x) = 2x^4 - 8x + 3$

15. $f(x) = x(x - 4)^3$

16. $f(x) = x^3(x - 4)$

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

18. $f(x) = x\sqrt{x + 1}$

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

20. $f(x) = \frac{x + 1}{\sqrt{x}}$

21. $f(x) = \sin \frac{x}{2}, [0, 4\pi]$

22. $f(x) = 2 \csc \frac{3x}{2}, (0, 2\pi)$

23. $f(x) = \sec\left(x - \frac{\pi}{2}\right), (0, 4\pi)$

24. $f(x) = \sin x + \cos x, [0, 2\pi]$

25. $f(x) = 2 \sin x + \sin 2x, [0, 2\pi]$

26. $f(x) = x + 2 \cos x, [0, 2\pi]$

In Exercises 27–40, find all relative extrema. Use the Second Derivative Test where applicable.

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

29. $f(x) = (x - 5)^2$

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

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

35. $f(x) = x^{2/3} - 3$

37. $f(x) = x + \frac{4}{x}$

39. $f(x) = \cos x - x$, $[0, 4\pi]$

40. $f(x) = 2 \sin x + \cos 2x$, $[0, 2\pi]$

28. $f(x) = x^2 + 3x - 8$

30. $f(x) = -(x - 5)^2$

32. $f(x) = x^3 - 9x^2 + 27x$

34. $g(x) = -\frac{1}{8}(x + 2)^2(x - 4)^2$

36. $f(x) = \sqrt{x^2 + 1}$

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