CHAPTER 2 Review Exercises

Exercise numbers with a gray background indicate problems that the authors have designed to be solved *without a calculator*.

The collection of exercises marked in red could be used as a chapter test.

In Exercises 1 and 2, write an equation for the linear function f satisfying the given conditions. Graph $y = f(x)$.

1. $f(-3) = -2$ and $f(4) = -9$

2. $f(-3) = 6$ and $f(1) = -2$

In Exercises 3 and 4, describe how to transform the graph of $f(x) = x^2$ into the graph of the given function. Sketch the graph by hand and support your answer with a grapher.

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

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

In Exercises 5–8, find the vertex and axis of the graph of the function. Support your answer graphically.

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

6. $g(x) = 4(x - 5)^2 - 7$

7. $f(x) = -2x^2 - 16x - 31$

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

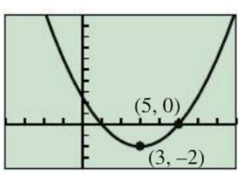
In Exercises 9 and 10, write an equation for the quadratic function whose graph contains the given vertex and point.

9. Vertex $(-2, -3)$, point $(1, 2)$

10. Vertex $(-1, 1)$, point $(3, -2)$

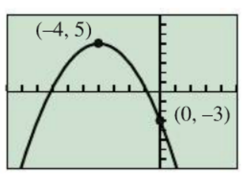
In Exercises 11 and 12, write an equation for the quadratic function with graph shown, given one of the labeled points is the vertex of the parabola.

11.



[–4, 8] by [–4, 10]

12.



[–10, 5] by [–8, 8]

In Exercises 13–16, graph the function in a viewing window that shows all of its extrema and x-intercepts.

13. $f(x) = x^2 + 3x - 40$

14. $f(x) = -8x^2 + 16x - 19$

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

16. $f(x) = x^3 - x^2 - 20x - 2$

In Exercises 17 and 18, write the statement as a power function equation. Let k be the constant of variation.

17. The surface area S of a sphere varies directly as the square of the radius r.

18. The force of gravity F acting on an object is inversely proportional to the square of the distance d from the object to the center of the earth.

In Exercises 19 and 20, write a sentence that expresses the relationship in the formula, using the language of variation or proportion.

19. $F = kx$, where F is the force it takes to stretch a spring x units from its unstressed length and k is the spring's force constant.

20. $A = \pi \cdot r^2$, where A and r are the area and radius of a circle and π is the usual mathematical constant.

In Exercises 21–24, state the values of the constants k and a for the function $f(x) = k \cdot x^a$. Describe the portion of the curve that lies in Quadrant I or IV. Determine whether f is even, odd, or undefined for $x < 0$. Describe the rest of the curve if any. Graph the function to see whether it matches the description.

21. $f(x) = 4x^{1/3}$

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

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

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

In Exercises 25–28, divide $f(x)$ by $d(x)$, and write a summary statement in polynomial form.

25. $f(x) = 2x^3 - 7x^2 + 4x - 5$; $d(x) = x - 3$

26. $f(x) = x^4 + 3x^3 + x^2 - 3x + 3$; $d(x) = x + 2$

27. $f(x) = 2x^4 - 3x^3 + 9x^2 - 14x + 7$; $d(x) = x^2 + 4$

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

In Exercises 29 and 30, use the Remainder Theorem to find the remainder when $f(x)$ is divided by $x - k$. Check by using synthetic division.

29. $f(x) = 3x^3 - 2x^2 + x - 5$; $k = -2$

30. $f(x) = -x^2 + 4x - 5$; $k = 3$

In Exercises 31 and 32, use the Factor Theorem to determine whether the first polynomial is a factor of the second polynomial.

31. $x - 2$; $x^3 - 4x^2 + 8x - 8$

32. $x + 3$; $x^3 + 2x^2 - 4x - 2$

In Exercises 33 and 34, use synthetic division to prove that the number k is an upper bound for the real zeros of the function f.

33. $k = 5$; $f(x) = x^3 - 5x^2 + 3x + 4$

34. $k = 4$; $f(x) = 4x^4 - 16x^3 + 8x^2 + 16x - 12$

In Exercises 35 and 36, use synthetic division to prove that the number k is a lower bound for the real zeros of the function f.

35. $k = -3$; $f(x) = 4x^4 + 4x^3 - 15x^2 - 17x - 2$

36. $k = -3$; $f(x) = 2x^3 + 6x^2 + x - 6$

In Exercises 37 and 38, use the Rational Zeros Theorem to write a list of all potential rational zeros. Then determine which ones, if any, are zeros.

37. $f(x) = 2x^4 - x^3 - 4x^2 - x - 6$

38. $f(x) = 6x^3 - 20x^2 + 11x + 7$

In Exercises 39–42, perform the indicated operation, and write the result in the form $a + bi$.

39. $(1 + i)^3$ **40.** $(1 + 2i)^2(1 - 2i)^2$

41. i^{29} **42.** $\sqrt{-16}$

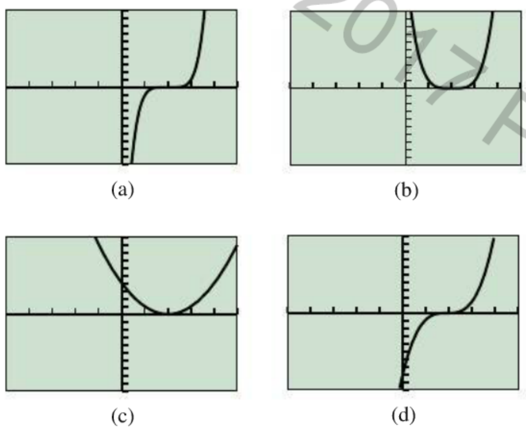
In Exercises 43 and 44, solve the equation.

43. $x^2 - 6x + 13 = 0$ **44.** $x^2 - 2x + 4 = 0$

In Exercises 45–48, match the polynomial function with its graph. Explain your choice.

45. $f(x) = (x - 2)^2$ **46.** $f(x) = (x - 2)^3$

47. $f(x) = (x - 2)^4$ **48.** $f(x) = (x - 2)^5$



In Exercises 49–52, find all of the real zeros of the function, finding exact values whenever possible. Identify each zero as rational or irrational. State the number of nonreal complex zeros.

49. $f(x) = x^4 - 10x^3 + 23x^2$

50. $k(t) = t^4 - 7t^2 + 12$

51. $h(x) = x^3 - 2x^2 - 8x + 5$

52. $k(x) = x^4 - x^3 - 14x^2 + 24x + 5$

In Exercises 53–56, find all of the zeros and write a linear factorization of the function.

53. $f(x) = 2x^3 - 9x^2 + 2x + 30$

54. $f(x) = 5x^3 - 24x^2 + x + 12$

55. $f(x) = 6x^4 + 11x^3 - 16x^2 - 11x + 10$

56. $f(x) = x^4 - 8x^3 + 27x^2 - 50x + 50$, given that $1 + 2i$ is a zero.

In Exercises 57–60, write the function as a product of linear and irreducible quadratic factors all with real coefficients.

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

58. $f(x) = 9x^3 - 3x^2 - 13x - 1$

59. $f(x) = 2x^4 - 9x^3 + 23x^2 - 31x + 15$

60. $f(x) = 3x^4 - 7x^3 - 3x^2 + 17x + 10$

In Exercises 61–66, write a polynomial function with real coefficients whose zeros and their multiplicities include those listed.

61. Degree 3; zeros: $\sqrt{5}, -\sqrt{5}, 3$

62. Degree 2; -3 only real zero

63. Degree 4; zeros: $3, -2, 1/3, -1/2$

64. Degree 3; zeros: $1 + i, 2$

65. Degree 4; zeros: -2(multiplicity 2), 4(multiplicity 2)

66. Degree 3; zeros: $2 - i, -1$, and $f(2) = 6$

In Exercises 67 and 68, describe how the graph of the given function can be obtained by transforming the graph of the reciprocal function $f(x) = 1/x$. Identify the horizontal and vertical asymptotes.

67. $f(x) = \dfrac{-x + 7}{x - 5}$

68. $f(x) = \dfrac{3x + 5}{x + 2}$

In Exercises 69–72, find the asymptotes and intercepts of the function, and graph it.

69. $f(x) = \dfrac{x^2 + x + 1}{x^2 - 1}$ **70.** $f(x) = \dfrac{2x^2 + 7}{x^2 + x - 6}$

71. $f(x) = \dfrac{x^2 - 4x + 5}{x + 3}$ **72.** $g(x) = \dfrac{x^2 - 3x - 7}{x + 3}$

In Exercises 73–74, find the intercepts, analyze, and graph the given rational function.

73. $f(x) = \dfrac{x^3 + x^2 - 2x + 5}{x + 2}$

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

In Exercises 75–82, solve the equation or inequality algebraically, and support graphically.

75. $2x + \dfrac{12}{x} = 11$

76. $\dfrac{x}{x + 2} + \dfrac{5}{x - 3} = \dfrac{25}{x^2 - x - 6}$

77. $2x^3 + 3x^2 - 17x - 30 < 0$

78. $3x^4 + x^3 - 36x^2 + 36x + 16 \geq 0$

79. $\dfrac{x + 3}{x^2 - 4} \geq 0$

80. $\dfrac{x^2 - 7}{x^2 - x - 6} < 1$

81. $(2x - 1)^2|x + 3| \leq 0$

82. $\dfrac{(x - 1)|x - 4|}{\sqrt{x + 3}} > 0$